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# Temporal Shifts in Weapon Focus: Comparing Retrograde and Anterograde Effects

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TEMPORAL SHIFTS IN WEAPON FOCUS: COMPARING RETROGRADE AND  
ANTEROGRADE EFFECTS

TEMPORAL SHIFTS IN WEAPON FOCUS: COMPARING RETROGRADE AND  
ANTEROGRADE EFFECTS

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
Master of Arts in Psychology

By

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## ABSTRACT

When an eyewitness suffers an impairment of memory for a criminal's face because the criminal used a weapon during the commission of the crime, this impairment is called the weapon focus effect. Literature provides two explanations for how this effect arises: some implicate the narrowing of attentional cues to the weapon during the commission of a crime because arousal of the victim increases, while others claim that the weapon is merely a novel object in most everyday contexts, and novel objects demand more attention than contextually appropriate ones. The current study employed a simulated crime paradigm taking place in a bar where a criminal brandished either a drinking glass (normal object), a rubber chicken (novel object), or a gun (weapon). Timing of the object's presentation was also manipulated such that it was visible before, after, or during the time when the culprit's face was visible. Target-present and target-absent lineups, cued-recall questions, and retrospective identification confidence questions were administered. The weapon focus effect was found on diagnosticity ratios of lineup selections when objects were presented after the face such that the glass was more diagnostic of suspect guilt than the gun or the chicken. When objects were presented in tandem with the face, the glass was only more diagnostic of guilt than the gun. Eyewitness confidence suffered most when the chicken was seen. Implications for current theories of weapon focus and public policy are discussed.

This thesis is approved for recommendation  
to the Graduate Council.

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## ACKNOWLEDGMENTS

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Also, special thanks go out to the members of my thesis committee, Denise Beike and Mathew Feldner, for their diverse and unique perspectives on stress and cognitive functioning.



## DEDICATION

This master's thesis is dedicated to all people who have been wrongfully convicted of crimes based on faulty eyewitness evidence. It is my sincere hope that the research presented herein will help prevent this kind of failure in the criminal justice system.

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## **Temporal Shifts in Weapon Focus: Comparing Retrograde and Anterograde Effects**

The “weapon focus effect” refers to the tendency for the presence of a weapon in any setting to cause a decrement in memory for the appearance of the individual holding the weapon and for other details of the event where it was presented. The consensus is that the weapon draws the attention of the witness, distracting attention away from the perpetrator. The earliest antecedents of this paradigm in the field of experimental psychology originated from Hugo Münsterberg in the early 20<sup>th</sup> century (Hothersall, 2004), but the effect was not systematically studied until the wave of eyewitness testimony research came in the 1970s (Memon, Mastroberardino, & Fraser, 2008).

Before describing the current study, a brief overview of the major concepts in eyewitness research that are pertinent to studying the weapon focus effect will be provided. Following this will be a review of the seminal literature in weapon focus that will present the standard research paradigm and several experiments that have explored the roles of arousal, object unusualness, and timing of the object’s presentation in eyewitness memory. Finally, the current research will be outlined, and results will be discussed.

### **Key Concepts in Eyewitness Research**

The aim of experiments using eyewitness paradigms is to empirically test facets of cognition such as memory and attention in scenarios that replicate crimes and judicial procedures. This relationship also runs in the opposite direction: criminal investigations involving eyewitnesses depend on the basic cognitive functioning of the eyewitness. To outline how psychological phenomena in the legal realm should be studied, Wells (1978) proposed that two distinct subsets of variables exist in applied eyewitness research: system variables, which are practices used by law enforcement officials including method of suspect lineup administration,

interrogation tactics, and other procedures, and estimator variables, which are variables uncontrollable by law enforcement such as distance between the suspect and the witness, whether the suspect was wearing a disguise, and, of theoretical interest to the current proposal, the presence of a weapon during the commission of the crime. Wells concluded that, due to their volatility and unpredictability, estimator variables research is less helpful than system variables research because refining practices of law enforcement officials is a more utilitarian venture that can lead to reforms in the criminal justice system.

Lineup type and method of administration are two of the system variables Wells described. In eyewitness research, the two major types of lineups presented to witnesses for identification are target-present and target-absent lineups. They provide researchers with unique dependent measures in their research: Target-present lineups have a correct individual to select, and therefore give researchers a hit-rate to measure, but target-absent lineups have no correct answers, so rejection of the lineup is the only correct decision. It's worth noting that in the real world, criminal investigators do not know whether their lineup is target-present or target-absent, so unbiased witness instructions ("The perpetrator may or may not be among the photographs you see...") lead to more correct rejections of target-absent lineups and higher correlations between identification accuracy and confidence than biased instructions (Cutler, Penrod, & Martens, 1987; Lindsay & Wells, 1985).

The decision-making processes of witnesses when presented with a lineup tend to be governed by either relative or absolute judgments about the similarity of the individuals in them to the target whom the eyewitness remembers (Lindsay & Wells, 1985; Wells, 1984). Relative judgments are made when an eyewitness examines all of the individuals in the lineup, comparing each to the others. Relative judgments are more common in simultaneous lineups (i.e., the target

and the foil individuals are all visible at once), and involve the witness choosing the member of the lineup who most closely resembles his or her memory of the culprit. In a target present lineup, this strategy may be acceptable, since the suspect really is guilty. But in a target absent lineup it is problematic, because even in a target absent lineup *someone* will be closer to the witness's memory than all the other choices. Absolute judgments, however, are made when the eyewitness is forced to choose an individual who most closely matches their memory for the suspect without seeing other individuals at the same time. Sequential lineups tend to produce the most absolute judgments because witnesses view each photo individually, rejecting those that do not match the target, until a match is found (Carson & Gronlund, 2011). As such, these judgments produce far fewer false alarms than relative judgments because the decision criterion is more conservative.

The final important components of eyewitness research are the diagnosticity and fairness of lineups. Diagnosticity is rooted in Bayesian statistical analysis and refers to the ratio of correct identifications of suspects in target present lineups to mistaken identifications of suspects in target absent lineups (Wells & Lindsay, 1980). Lineup diagnosticity calculations provide an indication of how likely it is that someone is guilty given that they were identified in a lineup. More specifically, if the diagnosticity of a lineup is  $K$ , then, if a suspect is chosen from a lineup, there are  $K$ -to-1 odds that the suspect is guilty.

A lineup is fair if an eyewitness selecting an image from a target-absent lineup has no better chance of selecting the suspect than one of the foil individuals (bear in mind that, since not every suspect is guilty, the suspect is not always the target). To accomplish this, a fair lineup should include the suspect and foils chosen based on their correspondence not to the suspect but the verbal description provided by the eyewitness (Luus & Wells, 1990). Although diagnosticity

and fairness are related, diagnosticity is not necessarily a direct measure of fairness. For example, if one member of a set of identical sextuplets is suspected of a crime, a lineup containing the suspect and the five siblings would be fair (i.e., each would have an equal chance of getting chosen), but this lineup would have very low diagnosticity. However, a very unfair lineup featuring an African American suspect and five Caucasian foils would also have low diagnosticity.

The sections that follow will cover several topics related to the weapon-focus effect specifically. After early experiments employing the typical weapon-focus paradigm have been described, seminal research on the independent roles of threat and object unusualness on the effect will be outlined in detail. Research dealing with timing of the weapon presentation will also be included as grounds for the current study's principal investigation. Finally, an overview of the current study will be given.

### **Early Investigations of the Weapon-Focus Effect**

Johnson (1977) conducted the first major eyewitness study to compare the impact of threatening or non-threatening live scenarios on eyewitness performance. The key to generating threat in this study was that one condition featured an object that appeared to have been recently used as a weapon and the other condition used a similar object that did not appear to have been used as such. Participants were recruited for what was ostensibly an experiment in learning. While in the waiting area, they overheard a conversation between two confederates posing as an experimenter and participant. In half of the conditions, the conversation was hostile and followed by crashing sounds, culminating in the exit of the participant confederate holding a bloody letter opener. In the other half, the conversation was neutral and followed by crashing sounds after which the participant confederate exiting with grease on his hand, which was

holding a pen. To enhance realism and arousal further, the high arousal condition's confederate experimenter was dressed as a police officer while in the non-threatening condition the experimenter wore a white lab coat. In each condition participants were then informed that the participant who just left committed a crime in the lab room and that they must help identify the suspect. Each was first administered the Byrne Effectance Arousal Scale to measure arousal levels. A further manipulation involved timing of the eyewitness interrogation and presentation of the mug-shot book: half of the participants were interviewed immediately and the others were interviewed one week later. The interview questions consisted of open-response and cued-recall items pertaining to the event and target individual. A main effect of arousal condition on scores from the arousal scale was found, with males reporting the greatest positive arousal and females reporting greater negative arousal. A main effect of arousal condition on free recall was also found such that the low arousal condition produced the greatest number of correct details freely recalled. The author also found a significant main effect of timing on recall of the event such that immediate interrogation produced more details than the delayed interrogation. Also of interest was a significant arousal by sex interaction demonstrating that male witnesses gave more accurate descriptions of the target in the high arousal condition and women gave more accurate descriptions of the target in the low arousal condition.

This study is the earliest to demonstrate the weapon-focus effect, even though the author did not label it as such at the time. It is also one of the earliest to attempt simulation of police procedure in collecting data; namely, a realistic mug-shot book was used for lineup administration and an experimenter was dressed as a police officer in the threatening condition (although this latter feature has rarely been used since). Because participants in the threatening condition actually believed that they were participating in a criminal investigation of a violent

assault at the time of data collection, modern ethical standards would prevent use of the levels of deception used in this study today. Thus, the strong effects uncovered in this study are a glimpse at a kind of forbidden fruit that researchers of weapon-focus cannot truly replicate today.

However, the basic paradigm comparing weapons to other objects has remained unchanged.

A meta-analysis by Steblay (1992) of 12 weapon focus studies using the basic paradigm establishes a medium effect size of weapon-focus on accurate recall for perpetrator features (.55) and a small effect size on lineup identification accuracy (.13) when weapon-present and weapon-absent conditions were compared. Modes of presentation also produce different effect sizes, such that videos of simulated crimes had the lowest effect size, followed by slide presentations, and the greatest effects came from live, staged events. These live events also produced the greatest arousal effects, while slide and video presentations produced moderate effects. The lowest arousal levels were generated by studies using weapons but where no crime was committed (i.e., the weapon was not used as such). Among studies using a lineup identification task, the greatest effect size was found in target-absent lineups ( $h = .43$ ) while a small effect size was generated by studies employing a target-present lineup ( $h = .12$ ). However, it's worth noting that only four studies utilizing a target-absent lineup were included in the meta-analysis, with only one of these being a published study (Maas & Köhnken, 1989); therefore, more research into the different effects on target-absent lineups and target-present lineups should be performed. Finally, the wide range of age groups used in every weapon-focus study reveals that the effect is generalizable among all age groups and different sample populations.

Steblay (1992) admitted that the weapon focus effect is moderate, but qualifies this by stating its significance given that weapon presence is one of many variables that can influence eyewitness memory. Also, although many more articles on the weapon focus effect have been



published since the year her meta-analysis was carried out, the author was able to show unequivocally in even a small sample of the 12 studies available at the time that the effect is consistent. Some of these classic studies and more recent ones investigating further aspects of the effect will be reviewed in the following sections.

### **The Roles of Threat and Arousal**

An early component thought to contribute to the weapon focus effect is increased arousal. Easterbrook (1959) proposed that behavior is governed by the myriad of environmental cues an individual encounters in a given setting. These cues work by first attracting attention, demanding some response, and then conditioning an association between the cue and the response. Arousal and stress work by narrowing the range of potential cues that an organism will attend to – or, utilize – in a given situation down to the most central details of that context so that the organism might behave in the most adaptive way possible. All remaining cues are considered peripheral and are not attended. No great intuitive leap is required to apply this to the classic weapon focus scenario: when a robber points a gun at a stranger in an alley, the gun and the hand holding it become the most central cues of the situation, and the face is peripheral. In other words, when just surviving becomes the most important outcome of the situation, making note of the robber's face for future reference becomes less important.

Much research in eyewitness memory has concentrated on studying the degrees to which heightened arousal enhances and degrades memory. Deffenbacher et al. (2004) explored this by conducting a meta-analysis on 27 studies of eyewitness memory involving stress. Inclusion criteria required that studies have both a facial recognition task (i.e., a lineup selection task) and a free recall task for the witnessed individual. The meta-analysis revealed that heightened stress has a very deleterious effect on lineup selection accuracy. When broken down between target-

absent and target-present lineups, the greatest effect seemed to stem from accurate selection from target-present lineups while correct rejection of target-absent lineups remained unaffected. Heightened stress also impacted eyewitness recall, and further analysis showed the effect was greater on cued-recall questions than on free-recall questions.

Perhaps producing more helpful insights than Easterbrook's (1959) cue-utilization hypothesis, this analysis of several studies provides confirmatory evidence that stress causes reduced attention given to peripheral visual stimuli. Importantly to the applied eyewitness memory researcher, the effects are stronger on recognition than on recall. This replicates in the broader domain of eyewitness research the finding Steblay (1992) found specifically within the weapon focus effect. It also shows that situational stress does affect memory performance.

Johnson (1977) makes a strong case for the role of arousal in the weapon-focus effect. Although he discovered that men and women performed differently when arousal levels were manipulated, whether arousal impacts witnesses of the two genders differently is still a point of contention in eyewitness testimony research. However, his predictions based on the cue-utilization hypothesis were confirmed. One interesting avenue unexplored by the study would have been to have a neutral conversation followed by the bloody hand with letter-opener and a hostile conversation followed by the greasy hand with fountain pen condition. This may have primed individuals for a threatening situation that would have amounted to nothing and vice-versa. This object-unusualness as a function of context will be discussed later.

Respectfully disagreeing with Wells' (1978) contention that system variables deserve more attention by researchers than estimator variables, Cutler, Penrod, and Martens (1987) empirically tested several system and estimator variables. Their belief was that studying estimator variables would help shed light on their effect on eyewitness reliability, and this

knowledge would lead to “more informed decisions” (p. 235) in the jury room. The researchers conducted a large between-subjects design in which participants viewed videos of staged crimes and later undergo witness questioning and lineup identification procedures. In all, 15 different system and estimator variables were manipulated, including weapon visibility and arousal level. No main effect of arousal level on lineup identification accuracy was found, but a main effect of weapon visibility was found such that the high visibility condition produced lower identification accuracy than the low visibility condition. Neither variable had an impact on selection confidence or choosing rate (i.e., whether a photo from the lineup was actually chosen by the witness). The other pertinent effect was of arousal level on perceived viewing time, where participants who viewed the highly arousing video perceived that the video was shorter than the video in the low-arousal condition. In reality, both videos were approximately 30s each. This study provided more support that arousal levels and weapon presence impact eyewitness performance. Unfortunately, rather than using a true weapon-absent condition, the authors opted to have the weapon outlined in the pocket of the suspect in the low-visibility condition. Effects of weapon on arousal and memory performance may have been greater if a condition with no weapon and a condition with a highly visible weapon were compared.

A live event involving confederates is perhaps the most ecologically valid procedure, given that some later studies have found that witnesses to these sorts of stimuli have reduced memory performance and provide proportionately fewer details and correct details than their counterparts who watch video presentations (Ihlebaek et al., 2003). Maass and Köhnken (1989) also manipulated real-life interactions with a confederate holding a weapon-type object. They first measured arousal on a standardized scale and employed a questionnaire asking the degree to which participants were afraid of the experimental object (in this case, a syringe filled with a

yellow liquid). The authors told participants they would be participating in a study investigating physical activities and mental health. Participants first filled out Janke and Debus's EWL mood scale and a filler questionnaire that contained only one question of experimental interest: whether or not the participant was afraid of injections. The participant was then strapped to a chair and left waiting for several minutes until a female confederate entered the room holding either a pen or a syringe with fluid inside. The second manipulation involved the confederate either telling the participant that she was just in the room to get supplies for another study or telling the participant that s/he would be receiving an injection (i.e., a verbal threat). In all conditions, the confederate remained in the room for 20s. After one minute, the first experimenter returned and administered the mood scale again, followed by a seven-person target-absent lineup and a questionnaire with several cued-recall questions asking about the confederate's appearance. The authors found a main effect of presence of the syringe on mood but no significant effect of the verbal threat on mood. Participants who saw the syringe also generated more false alarms on the target-absent lineup than did participants who saw the pen. Of specific interest to supporters of the cue-utilization hypothesis is the finding that cued-recall questions about the "hand area" (p. 404) were more accurate if the syringe was present versus not present, and post-hoc tests revealed that individuals who were told they would be injected and saw the syringe had the greatest recall for hand cues. Also of interest is the finding that individuals who self-reported being more afraid of injections recalled fewer details than those who reported being less afraid, especially in the cell containing both presence and the verbal threat.

This study is notable for being one of the few where a live event served as the stimulus. Also important is the brief exploration into individual differences they made; specifically, exploring the differences between participants who are afraid of injections and those who are

not. This renders a challenge to proponents of the hypothesis that the weapon focus effect is due to the unusualness of the object because the experimental object in this study is not unusual at all in the setting. After all, if a person is strapped to a chair in a lab room where a medical experiment is about to take place, someone walking in the room wearing a white coat and holding a syringe should not be surprising. This study nonetheless generated the effect and manipulated threat as well, and thus showed that heightened arousal has an effect in the absence of unusualness.

Unhappy with what they described as a lack of a “sophisticated methodology” (p. 56) in weapon focus research, Loftus, Loftus, and Messo (1987) constructed and carried out a weapon focus study using violent and nonviolent simulations as stimulus material and eyetracking data, event description, and lineup identification as dependent measures. In the first study, participants watched one of two series of slide presentations portraying a sequence of events occurring at a restaurant called Taco Time. In the normal-object slideshow, an individual walked up to the cashier, hands her a check, and receives money in return. In the weapon slideshow, the individual walked up to the cashier, points a gun at her, and receives money from her. While watching the slideshow, eye movements were tracked and videotaped. After its completion, and following a 15-minute retention interval, participants completed a 20-item multiple-choice questionnaire probing recognition memory for details about the event and also selected a photograph from a 12-person target-present lineup. No main effects for descriptions or lineup selections were found between the two violence condition groups, but there were significant main effects for number of eye fixations on the object as well as average duration of fixations such that the gun in the violent condition garnered more and longer fixations than the check in the comparable slides from the non-violent condition. Believing that the lack of memory effects

were due to low statistical power caused by the first experiment's small sample size ( $n = 36$ ), it was replicated with 80 participants and excluded the eye-tracking portion. With more power, main effects were found on correct responses to items on the questionnaire and lineup selection such that details were more accurately recalled and the perpetrator was more often identified in the nonviolent condition. However, both violent and non-violent conditions selected the correct individual above a chance level of 8.5%.

To adequately measure the impact of arousal and threat on participants, a weapon-focus researcher must somehow control for arousal induced by violence and weapon presence. Hulse and Memon (2006) attempted this by measuring the differing levels of emotional arousal in police officers when viewing a crime with a weapon present versus not present. The reasoning was that, because they encounter weapons regularly in their line of work, officers' arousal levels would not be affected by mere weapon presence and they should be able to describe details of the witnessed event better. All participants were Scottish police officers authorized to use firearms. Officers' anxiety levels were measured pre- and post-test with Spielberger's State Anxiety Inventory, and heart rate was also measured. Officers witnessed a video simulation of a domestic dispute, where a man and woman were approached by another woman who incites an altercation that culminates in her drawing a gun. In one version of the video, the woman shoots the gun at both the man and the other woman, while in another the gun is not shot. Each video was about one minute long, and the perpetrator was onscreen in each version for about 30 seconds, and in the shoot condition, the gun was visible for five seconds. A structured interview was then given where the officers described what they saw to the best of their abilities, beginning with open-ended recall of the event followed by more probing questions about details from the videos. After a ten minute set of filler tasks, a target-absent lineup was presented where correct

rejection was the only possible correct response. Correct details and incorrect details were primary dependent variables. State anxiety between video conditions was significantly different; heart rates, however, were not. There was also a significant effect for video on event recall completeness such that the no-shoot video generated more complete recalled details than the shoot video. However, there was also a main effect for video condition on event recall accuracy, such that recall was more accurate in the shoot condition. This is in line with the cue-utilization hypothesis (Easterbrook, 1959), because although fewer details were recalled in the shoot condition, a greater percentage of accurate details was provided because the shoot condition drew attention to more central details. Participants in the “shoot” condition also had more accurate descriptions of the weapon but less accurate descriptions of the shooter, generating the classic weapon-focus effect. As is normally the case with weapon-focus studies, correct lineup rejection was not significant between conditions.

This study is important because the one population trained to witness and most likely to witness violent crimes – law enforcement officials – have been left out of most weapon focus and stress research. Most interesting is their finding that details not recalled from the ‘shoot’ condition appeared prior to the perpetrator producing a weapon, a result the authors attribute to increased arousal level. However, the authors also cite a purely cognitive explanation: the officers may have instinctively honed in on the weapon because its presence and the act committed with it determined what course of action they would take in a real-life situation. More bluntly put: The moment the weapon was presented, they were authorized to shoot the perpetrator.

Believing that increased level of arousal is a major factor influencing the weapon focus effect, Kramer et al. (1990) showed participants slideshow presentations across several studies

manipulating the timing of the weapon's presentation with respect to the target's face and the object carried by the target in an attempt to alter arousal levels. Participants in the first experiment watched a highly-detailed slideshow of four men playing cards for money in a room. To enhance the realism of the slides, a soundtrack was produced with dialog. After one of the individuals won, the others argued with him and accused him of cheating before leaving the room. Another individual then entered the room holding a bottle with which he repeatedly struck the winner. In the second version of the slideshow, the perpetrator held the bottle behind his back until he struck the victim with it. The experimenters then administered questionnaires asking cued-recall questions about the perpetrator and the weapon as well as Likert questions regarding arousal levels where 1 indicated bored and 7 indicated anxious. To score the cued-recall questions, a +1 was assigned to all correct details and a -1 was assigned to all incorrect responses, with a maximum score of 17 possible. Main effects for weapon visibility on accuracy were found such that accuracy scores were higher when the weapon was visible only after the face. A  $\chi^2$  analysis on the weapon identification question revealed that correct identification of the weapon was significantly higher in the high visibility condition than in the low visibility condition. In keeping with several studies on weapon-focus, lineup identification was non-significant between visibility conditions. The important finding for proponents of the arousal hypothesis of weapon focus was that arousal ratings negatively correlated with accuracy scores in both conditions. To provide more diagnostically useful data on this, arousal scores were collapsed into three groups: low arousal, medium arousal, and high arousal. ANOVAs were carried out in each arousal group to determine main effects of weapon visibility on accuracy. In keeping with the rest of the data discovered, non-significant differences were found among



participants with low arousal ratings, and significant differences occurred in the medium and high arousal groups.

Admitting to shortcomings of the first experiment – specifically, that weapons were present in all conditions and that the slides contained several potentially distracting details – a series of four small experiments was carried out featuring slide presentations of a target walking down a bare hallway holding either a newspaper or a meat cleaver. The first study's slides were merely of the male target walking down the hallway with one of the two objects. The second featured the same man with a stocking cap obscuring his face in the first slide, which he took off, progressively rendering his face more visible until it was completely visible. The third study had the man carrying no object for the first half of the slides, only for the object to suddenly appear in his hand for the second half. The final experiment showed the man walking down the hallway, with the object only appearing in the third of the six slides. Participants were given questionnaires measuring memory and arousal as in the first experiment. Across the first three experiments, main effects of object on accuracy were the only effects such that the newspaper produced greater accuracy scores than the meat cleaver. In the fourth study, which included only a single slide with the face and object visible, there was no significant difference between conditions. In all four studies, arousal levels remained unaffected by object conditions.

These two experiments demonstrate weapon focus effects in both highly arousing situations and non-arousing situations. Their findings indicate that, while the arousing nature of violent situations where a weapon is present does induce the effect, the effect can also occur when a weapon is presented in a mundane situation that does not elevate self-reported arousal. This means that something other than the weapon's propensity to increase arousal impacts

eyewitness memory. The authors suggest that the meat cleaver looked unusual in the hallway but the newspaper did not, and this in turn drew attention to it over the target's face.

There is clearly support for Easterbrook's (1959) cue utilization hypothesis in the typical weapon-focus paradigm. In their general discussion, Loftus, Loftus, and Messo (1987) apply the hypothesis to their results, explaining that the range of cues narrow to the weapon in the otherwise mundane and non-threatening event. They, like Kramer et al. (1990), also point out that the attention drawn by the weapon might be due to its being an unusual object in that context.

### **The Role of Unusualness**

Much classic research in cognitive psychology has shown that unusual or informative objects tend to draw more attention than normal objects. For example, Antes (1974) used eyetracking methods to explore the extent to which participants fixated their gaze on the informative aspects of nine complex images from the Thematic Apperception Test. Informative aspects had to meet the criteria that they somehow broke the redundancy of the image. For example, a plain white wall in an image is not as informative as the bowl of fruit sitting on a table in front of the wall. The author found significant correlation between the informativeness of regions on the images and number of fixations given to those regions. Student's *t*-tests revealed that fixations were more often focused on informative parts of the images than on non-informative parts. Informative parts also had greater fixation primacy (i.e., gazes drifted to those regions first) than non-informative parts. An interesting finding was that fixations on informative objects did not appear to be due to "scanning" the image with the pupil before a fixation. Rather, the data seemed to indicate that a "peripheral editing process" (p. 69) was taking place that governed the unconscious decision to make the first fixation.

Unlike a later study by Loftus and Mackworth (1978), this study did not manipulate the unusual nature of certain visual stimuli. Perhaps more impressively, it demonstrated that the finer details of visual stimuli have the highest fixation density compared to redundant portions of the stimuli. This means that these features of visual stimuli receive more attention because, in the context of the entire image, they are different.

Loftus and Mackworth (1978) attempted to lend even more support to the notion that informative or novel objects draw more attention than non-informative or normal objects. Their participants viewed 78 pictures of different settings including an informative object which was novel to the setting, or a non-informative object that seemed to belong in the setting. For example, one pair of images included a scene of a farm with a tractor in front of a barn, and its counterpart image substituted the tractor with an octopus. Eyetracking was used, and as with Antes (1974) fixation primacy, duration, and total fixations on the experimental objects were the dependent variables. Sign tests revealed that informative objects were viewed earlier than their non-informative counterparts and drew more total fixations. An ANOVA revealed that the informative objects drew fixations for longer durations. A significant interaction between object type and fixation duration was also demonstrated such that subsequent fixations on informative objects tended to increase in length over non-informative controls.

This study demonstrates that individuals tend to look upon novel objects in a scene first, more often, and for longer durations than normal objects. That novel objects automatically draw so much attention in this way lends support to the idea that a weapon's novelty or unusualness in a given situation is a contributing factor to the weapon-focus effect. The authors did not administer memory questionnaires for the participants to fill out concerning recalled details from the images, but later studies would do just that.

The thrust of Pickel's (1998) research serves to dethrone arousal and threat as chief causes (or causes at all) of the weapon focus effect. In the author's first rigorous investigation into the role of unusualness as a primary cause for the weapon focus effect, four combinations of unusual and/or threatening objects were used to elicit the effect. In the first experiment, participants viewed one of five videos representing a different object condition. In each, a male target approached a female receptionist working the register at a hair salon, received money, and left. A "no object" condition served as a control scenario. The remaining conditions portrayed the man presenting a pair of scissors (the low unusualness/high threat object), a man's wallet (the low unusualness/low threat object), a raw rotisserie chicken (the high unusualness/low threat object) and a handgun (the high unusualness/high threat object). After watching the video, participants engaged in filler tasks for ten minutes before completing a questionnaire with items pertaining to the appearance of the two individuals. Finally, participants viewed a five-person target-present lineup for the perpetrator and selected who they believed appeared opposite the cashier. To ensure that other nonverbal cues would not influence interpretation of the scenario, the cashier maintained a mild expression across all conditions and the perpetrator did not engage in any obviously threatening movements. In accordance with the hypotheses, no main effect of object conditions on description responses for the cashier was found. Of the four object conditions, the largest amount of correct descriptive information was found in either of the two non-unusual objects over the two unusual objects. An ANOVA comparing the no object condition to the combined object conditions revealed that no object yielded the largest number of remembered details of all five conditions. No main effect was found for the type of object on lineup selection; however, witnesses who made correct selections were significantly more confident than those who made incorrect selections. Also, while most individuals correctly

recalled the object being held by the perpetrator, participants in the wallet condition more often than not forgot the object. Finally, interpretation of the nature of the scenario varied by condition such that participants in the handgun condition believed that they were witnessing a robbery more often than the other object conditions. Therefore, witnesses to events involving weapons interpret those events as crimes, while other objects generate non-threatening or ambiguous interpretations. In other words, the mere presence of a weapon has the power to dramatically shift the meaning of an entire scenario.

To generalize to different settings with different objects, a second study was carried out, this time including a manipulation check to ensure that participants actually felt threatened by the object and believed it unusual to some degree. The findings of the first experiment were replicated. Newman-Keuls tests revealed that the two high threat items were rated as more threatening than the two low threat objects, and the two unusual objects were rated as more unusual than the two non-unusual objects. Finally, interpretation as a robbery (a high-threat situation) did not significantly impair lineup accuracy or details remembered.

One aspect of this study that might require further study is the timing of the interpretation question. Interpretation for what was transpiring, threat level, and unusualness rating of the object could have been more accurately measured immediately following the video, not at the end of other questions, a lineup, and a filler task. This problem could be explored by simply testing these variables at these two points in the sequence. If a difference is found, then these questions would be system variables that could change in actual police investigations. Also, in each study the unusualness affected the dependent measures while the level of threat did not.

To provide further support for the unusualness hypothesis, Pickel (1999) explored a new paradigm manipulating weapon presence in different contexts; specifically, in what settings and

by whom was the weapon brandished. Threat was controlled for in two studies respectively by portraying the weapon either on a shooting range or in the hand of a police officer. Participants in the first experiment viewed videos featuring a man approaching a woman and producing a handgun. The setting was either a baseball stadium or a shooting range, and in half of the videos the man pointed the gun at the woman (the high threat condition) and in the other half he held it nonchalantly without pointing it at her (the low threat condition). After a ten-minute retention interval, participants were given a memory questionnaire featuring recognition and cued-recall questions about the woman (who served as the control individual) and the man. As a manipulation check, the author also included questions about the setting and what object the man was holding. The final measure was a five-person target-present lineup. No main effects were found for memory of the control individual. However, the predicted main effect of setting on the target individual was found such that memory for the target's appearance when he appeared on the shooting range was better than at the baseball stadium. Very pertinent to Pickel's hypothesis is that threat level – whether the gun was pointed at the woman – had no impact on memories for either individual. No interaction between threat level and setting were found, and no main effects or interaction were found on the lineup. Finally, setting had no impact on interpretation of the event; but a main effect of threat level on interpretation was found such that 96% of participants reported thinking that a robbery was taking place when the gun was pointed at the woman and 3% reported not thinking that a robbery was taking place when the gun was not pointed at the woman.

A second experiment was carried out to investigate the effect that holding a weapon has on memories for individuals whose professions are made clear by their attire. Once again, participants watched videos, but in this experiment either a Catholic priest or a police officer was

seen holding either a cellular phone or a handgun while speaking to a woman. A similar memory questionnaire was administered as in the first experiment, but in this study items relating to the unusualness of the object held by the target individual were also included. A significant interaction of target individual and object was found on unusualness such that the gun and phone were not particularly unusual in the hand of the police officer, but the phone was less unusual than the gun when held by the priest. When the analysis included both individuals, a main effect for object unusualness was found such that the gun was rated more unusual than the phone. A main effect of object on accuracy for the target individual descriptions was found such that the gun produced less accurate descriptions than the phone, and an interaction was found where the priest generated more accurate scores with the phone than the gun but the police officer was unaffected by object. Finally, no main effects or interactions were found for lineup choices.

This study demonstrates unusualness as a factor that generates at least some type of weapon focus effect. On a shooting range or in the hands of a police officer, a handgun not only fails to generate the effect, but when threatening overtures were made in either setting of the first experiment no differences were found in memory for the target. It might be prudent to note that in all videos no sound was recorded, rendering the subject matter of the discussions ambiguous and preventing participants from hearing any changes in inflection or lexical decisions that might be taken as threatening. Finally, the author again failed to produce an effect of condition on lineup selection. This may not be too surprising, however, given the low correlation between description accuracy and lineup choice (Wells, 1985) and the low effect size that the weapon focus effect has on lineup accuracy (Stebly, 1992).

Pickel et al. (2008) conducted a weapon focus study on children because they do not have fully developed schemas of different adult occupations. This special population allows for a good

opportunity to determine whether the weapon focus effect is a product of heightened arousal or unusualness of the object. The authors used three age groups: preschool children aged 4 and 5 years, older children aged 7 and 8 years, and adults. Each participant was shown one of four 1 minute 45 second videos manipulating person schema (the robber was either a mail carrier or a chef) and object type (either a water bottle or a knife). Pilot tests revealed that the children identified the knife with the chef. After watching the video, each participant was given a modified structural interview asking for details about the thief and the situation afterward, and accuracy scores served as dependent measures. Main effects for object type, schema role, and age group were found such that more details were remembered in the water bottle condition, chef condition, and adult group. They also found a schema role X object type interaction revealing that in the chef condition there were no significant differences between object conditions on recalled details but the mail carrier condition did produce the effect. No three-way interaction was uncovered. Aside from accuracy, total number of details reported was also used as a dependent measure, for which a main effect of age was found mirroring the previous age group effect.

Although this study certainly showed that context and schema roles are important factors in determining the effect of unusualness on weapon focus, the absence of a stress measure – even a self-reported one – renders its finding and the authors’ assertion that Easterbrook (1959) was mistaken rather dubious. One might interpret that the only new evidence here is that young children recall fewer accurate details about an event than older children, who in turn recall fewer accurate details than adults. However, the weapon focus effect found in the youngest groups could have resulted from the young children having very strict schemas for mail carriers and chefs, not that the weapon focus effect results from the unusualness of the object carried by



either. This marks an intuitive leap on the part of the authors for which they do not account. The idea of using a special population with a genuine *tabula rasa* regarding weapons was intriguing, however.

An opposing conclusion that children do experience heightened arousal at the same time as the weapon-focus effect was taken by Davies, Smith, and Blincoe (2008). Opposing the unusualness hypothesis, the authors constructed a study with children to generate an arousal-based weapon-focus effect. Three-year-olds, 4-year-olds, and 5-year-olds participated in a cross-sectional design. Children looked at an array of 14 pilot-tested “normal” childhood objects on a table. A 15th item was a red pen (normal object), syringe filled with red fluid (weapon), or a mobile phone which, for the age group, was considered unusual. After 40 seconds of examination by the children, the experimenter covered the items and asked the children to immediately recall what they saw on the table. Three hours later, the children filled out a multiple-choice questionnaire to describe the experimenter who showed them the objects. No main effects for age or child gender were found, but main effects for array type on number of items recalled, recall priority (i.e., its placement in the list of recalled items) of the main object, and recognition of descriptors of the experimenter were found such that the syringe group recalled the fewest items, gave the syringe higher priority in free recall, and answered the fewest experimenter description questions correctly. The mobile phone and pen groups did not differ from each other. Priority in recall significantly predicted experimenter description accuracy in the syringe group but not the other two, and within the different age groups number of items recalled was also a significant predictor of experimenter description accuracy. However, when split among the different array types, the pen group was the only one with a correlation between

recall of objects in the array and appearance descriptors, which led the authors to think that the syringe's effect was arousal-based and not unusualness-based. This means that the

This study provides more evidence that threat narrows the range of cues that attract attention even at an early age, and the authors made shrewd use of a syringe, which children at these age groups likely only appreciate for its ability to inflict harm. One possible criticism, however, arises in the choice of the novel object. Children at this age might not have their own mobile phones yet but they surely see them on a regular basis. Although it rarely appears in the context of the classroom setting, the younger children especially might even consider the phone merely one of a myriad of entertaining objects used for play in their mothers' purses. However, the effects of threat remain clear.

When considering the unusualness of an object, one must also consider the gender of the individual holding the object because some objects are gender-specific. Shaw and Skolnick (1994) explored the different levels of attention paid to targets of both genders by gender-matched and mismatched participants in an attempt to investigate the own-sex bias component of weapon focus and the role it may play on perceived unusualness. Participants watched a short series of slides where a male or female perpetrator exited a phone booth carrying one of six objects: a handgun, a magazine, a conch shell, a stethoscope, an orange traffic pylon, or a wooden snake. An important thing to note about this study is that the situation itself is not arousing or threatening, but left intentionally ambiguous. After watching the slide show, participants engaged in filler activities for 15 to 20 minutes and then answered cued-recall questions probing for details about the target's appearance and viewed a six person target-present lineup from which to select an image. Self-reported confidence was measured before and after the questionnaire and lineup. The predicted own-sex bias was found such that men correctly

answered recall questions about male targets more often than females, while females correctly answered recall questions about female targets more often than males. A marginal subject gender effect was found, indicating that women were slightly more accurate witnesses than men. An object X subject sex interaction was found, and a Duncan multiple range test showed that women appeared most distracted by the conch shell and least distracted by the handgun, while men appeared most distracted by the traffic pylons and least distracted by the shell. Furthermore, women were less distracted by the handgun than men. There were no effects on lineup accuracy; however, men were significantly more confident than women before recall and recognition measures. Also, confidence was highly correlated with accuracy of selection.

Unlike most articles reviewed thus far, this study seemed less concerned with the induction of a weapon focus effect and more concerned with the cross-categorization effect, making use of the weapon-focus paradigm as a milieu to study the latter. That said, it is still surprising that the researchers actually failed to produce an actual weapon-focus effect. The authors concede this fact, attributing it to the rather un-arousing stimulus. The cross-categorization effect found, however, warrants more investigation in the weapon-focus arena.

To replicate and expand upon their results, Shaw and Skolnick (1999) performed another study manipulating perpetrator gender. The authors employed what they believed to be much more ecologically valid and richly detailed stimulus materials. To accomplish this, participants (who were university students) watched videos of a male professor giving a lecture, and after some time either a male or female perpetrator abruptly entered the classroom holding either nothing, a book (the normal object), a handgun (the weapon), a pair of traffic pylons, or a stethoscope (both of which were unusual in the situation). The intruder engaged the professor in a tense dialog and left the room. Participants then engaged in a filler task for around 15 minutes

before filling out a questionnaire with cued-recall items asking about the appearance of the intruder and the object. Items were then scored in the same manner as Kramer et al., (1990), with self-report questions employed to measure arousal levels. Of note is the lack of a significant main effect of arousal on intruder description accuracy scores. However, a main effect of participant gender on accuracy scores was obtained, revealing that women scored higher than men. This runs contrary to Johnson's (1977) finding over two decades prior. When breaking analyses down to gender-matched and gender-mismatched pairs of witnesses/intruders, the traditional weapon focus effect was found such that the weapon and unusual objects both produced the effect. However, other than this result, no other own-sex bias was revealed, contradicting their earlier finding (Shaw & Skolnick, 1994). Pearson correlations revealed positive correlations between object description accuracy and intruder description accuracy across all object condition, which contradicts the cue-utilization hypothesis.

Further pursuant to her unusualness hypothesis of the weapon focus effect, Pickel (2009) explored the manipulation of comparing female and male object holders. Her reasoning was that women holding weapons are more unusual than men holding weapons; thus, female perpetrators will generate a more pronounced weapon-focus effect than male perpetrators. In the first of three studies, she showed a 90s video of either a male or female perpetrator who is seen in a car holding either a handgun or a compact disc (CD). The individual then jumped out of the car and robs a man and woman walking by. Participants in groups of up to six watched one of the four versions of the video and afterward completed a questionnaire. The first contained a modified cognitive interview with questions asking about the perpetrator's appearance. The second asked if the perpetrator was carrying a weapon, what kind it was, and on a 9-point scale how unusual it seemed in the hands of the perpetrator. Response descriptions were measured by blind coders,

who quantified total correct and incorrect details. A main effect of object type on correct details was found such that more correct details about the perpetrator were found if the object was the CD, and a main effect for perpetrator gender was found such that more correct details for the male perpetrator were recalled. An interaction between object and perpetrator gender was also found, and a simple effects test showed a greater effect of object on correct details when the perpetrator was female. A main effect of object type on incorrect details was also found such that the handgun produced more incorrect details than the CD, but no main effects for perpetrator gender on incorrect details were found. Another significant interaction was found, with the female target producing the larger simple effect. All participants correctly identified the objects, and a main effect for object type on unusualness was found so that the gun was more unusual than the CD, and a main effect for gender was also found such that the object was more unusual if it was carried by the female. The pertinent result to the study was the significant interaction, which revealed that the gun was found more unusual if held by a female. Unusualness was correlated with fewer recalled correct details and more incorrect details. Threat ratings were not significant, nor did they correlate with correct details (i.e., arousal did not lead to weapon focus because threat was not self-reported).

A second experiment was carried out using a similar video where a male or female perpetrator is seen holding a pocket knife (masculine typical), a knitting needle (feminine typical), or a CD, and then robs a man and woman walking by while holding the object to them. Responses were coded similarly to Experiment 1, and main effects regarding correct and incorrect details given were replicated. An object type by perpetrator gender interaction was also found such that correct details were highest for each gender if the perpetrator held the CD, but lowest if the opposite-gender stereotyped object was held. A second analysis excluding the CD

repeated the pattern with stronger effects, and the inverse pattern was found for incorrect details. Unusualness was also in line with hypotheses, showing that objects were rated as more unusual if held by the gender opposite their stereotypes, and each significantly correlated with correct and incorrect details provided. However, main effects for threat ratings were not significant nor did they correlate with details.

A final study was carried out to observe whether the unusualness of the female holding a weapon could be attenuated if subjects were primed to her aggressive nature. To show generalizability, a video was used featuring different perpetrators and objects. Participants watched videos with either a male or female perpetrator holding either a switchblade knife or a highlighting pen, which were pilot-tested as seeming masculine or unisex, respectively. Participants were further divided into groups primed for the individual's prior violent history or mundane biographical information. Results from the prior experiments were replicated with an addition of an interaction between object type and information on number of correct and incorrect details, indicating that unusual and threatening objects both . An interaction between perpetrator gender and object was also found. The control information condition mirrored this first experiment in that more correct details were reported when the perpetrator held the pen instead of the knife. The most important finding was that the weapon focus effect was non-significant when the participants were primed with dangerous information. Finally, because being primed with dangerous information should mean that the knife is consistent with expectations, an object x information interaction was found on unusualness ratings.

The author demonstrates with this study that the cue utilization hypothesis does not entirely account for the effects found because self-reported threat levels are constant among experiments and conditions. The differing weapon focus effect is attributed to the presence of the

weapon violating the person schema for women. It is interesting that she failed to replicate the own-sex bias found by Shaw and Skolnick (1994). A limitation shared with other research in weapon focus is that the participants did not witness a real crime, and the video was not taken from the point of view of the person being robbed.

Unsatisfied with explanations by Pickel (1998, 1999) regarding unusualness as the primary generator of the weapon focus effect, Hope and Wright (2007) devised a modified experimental paradigm whereby unusualness was measured in conjunction with reduced attention capacity. Each participant was shown a slideshow portraying a male target entering a grocery store and shopping, and at the critical slide producing a handgun, a feather duster, or a wallet before leaving the store. What makes their design new is that in addition to viewing the slideshow, participants simultaneously attended to a set of two digit numbers that changed every 400 milliseconds. Every time an odd number appeared, the participant was told to press the "O" key. After a twenty minute filler task, participants completed a 22-item forced-choice task asking for details about the slideshow and retrospective confidence. These items were followed by free recall questions regarding the weapon and its appearance. Correct responses to these questions as well as reaction time to pressing the "O" key served as dependent measures. For the slide portraying the perpetrator producing the critical object, a main effect was found on reaction time such that the control condition produced shorter reaction times than the weapon or unusual object conditions, which did not differ significantly from one another. A main effect for object type on these scores was found, and post-hoc tests revealed that the effect was due to the weapon and unusual conditions producing fewer accurate responses than the other control conditions. Interestingly, the weapon condition produced lower confidence ratings than the other two object conditions. The same pattern emerged when questions pertaining only to the appearance of the

perpetrator were analyzed. Ninety-three percent of participants in the weapon condition correctly identified the object compared to 67% in the unusual object condition and 60% in the control condition. Moreover, participants in the weapon condition freely recalled more details about the weapon than the other two objects, which were not significantly different from one another. The findings suggest that, when attention span is reduced with another demanding task, the role of unusualness is abated because the brief assessment of the object as simply unusual competes with the task for fewer resources than the assessment that the object is threatening.

The idea that unusualness arises as a cause of the weapon focus effect only when attention capacity is reduced makes this study unique. In a way, it hints at a larger, as-yet unconstructed theoretical model of the weapon focus effect where both unusualness and arousal level play a role in the reduction of cues as a function of the attention span of the eyewitness, which determines the extents of the contributions made by unusualness and threat. However, the finding that the weapon produced lower confidence in recall accuracy, greater accuracy in details for the perpetrator, and greater object identification means that weapons impact cognition uniquely. The authors themselves allude to this in their discussion, describing a “further conceptual dimension” (p. 958) that renders the weapon uniquely attention-grabbing over unusual objects and normal objects. The mix of results throughout the literature on whether unusualness or threat level takes precedence in processing weapons leads me to believe that unusualness may attract initial attention so that the object in question might be assessed for level of threat. When the object is indeed threatening, increased arousal then further narrows attention to that object and other salient environmental cues, which would then increase the weapon focus effect over purely unusual objects. This is also hinted at by what Shaw and Skolnick (1999)



described as the “reduced-overall-processing explanation” (p. 2338) of the weapon focus effect, which implicates unusualness and heightened arousal as possible explanations for the effect.

### **Temporal Manipulations**

The question of interest investigated in the current study is something never explicitly explored in the weapon focus canon: that is, does the timing of the weapon’s visibility impact the weapon focus effect? However three studies have explored related ideas. Loftus and Burns (1982) had participants view either a violent or nonviolent version of a graphic video depicting a bank robbery. The violent version contained scenes from inside a bank followed by an armed robbery of the bank by two individuals, and ended in the parking lot outside where a child was shot by one of the robbers. The nonviolent portion did not contain the shooting of the child, but instead showed another scene from inside the bank that nevertheless clearly portrays the post-robbery tension. The researchers constructed a 25 item questionnaire probing for recalled details of the video, with the most important question coming at the end, concerning a number on the back of the child’s jersey. A significant effect for type of video was found on recall of the number on the child’s jersey, where about 4% of the participants recalled the number in the violent condition and about 25% of the participants recalled in the nonviolent condition. In the second experiment in this study, the researchers modified the final question about the number on the child’s jersey so that it was a multiple-choice recognition question rather than a recall question. They attained inflated but still significantly different percentages of accuracy, with 28% of the subjects responding correctly in the violent condition and 55% responding correctly in the non-violent condition. In the final experiment of this study, the researchers included a third film with an unexpected ending where, instead of a child being shot by one of the robbers, the film cuts to an ending with two individuals walking along a beach. Once again employing a

recognition question for the pivotal detail, the violent ending generated less accuracy for the number on the child's jersey while the two non-violent conditions did not differ significantly from one another in number of correct responses.

Although not strictly a weapon-focus study, this study does have several hallmarks that make it relevant to the proposed research. Specifically, Loftus and Burns compared two different videos where an event detail present before the violent or nonviolent event (i.e., the number on the child's jersey) was not remembered as easily when it was followed by a violent event. Also, the authors' attempt at manipulating unusualness in the manner later refined by Pickel (1998) produced early evidence that unusualness and threat level produce unique effects on eyewitness memory. Finally, what sets this study apart from modern weapon focus research is that the authors were not looking at correct vs. incorrect recalled details of the perpetrator of the bank robbery and event details given in an open-ended question. Instead, all questions were cued-recall with the exception of the important detail question about the jersey number.

Citing Loftus and Burns (1982), Bornstein, Liebel, and Scarberry (1998) examined the effect of the level of violence in a middle segment in a film scene on memory for details that occurred in the preceding and following segments. They used a re-edited version of the scene with a non-violent middle segment with the same actors as a nonviolent control condition in case enhanced memories for the other two segments were due to their respective primacy and recency. The numbers of details in each of the segments were quantified, and percentage of these remembered were dependent variables. They found the predicted main effect of film segment with more correct details of the violent segment being recalled than the other two segments, which themselves were not significantly different from one another. However, they failed to find a main effect for film condition (violent vs. nonviolent), thereby violating the usual

weapon focus pattern. They did find an interaction between film segment and film conditions where significantly more correct details were remembered in the middle segment of the violent film than its non-violent counterpart. While this might seem counterintuitive to Easterbrook's (1959) cue-utilization hypothesis, the authors actually interpret their finding as supportive because, when the scene is considered as a whole, the most salient and arousing details of it appear during the violent segment, so more attention is paid to it. Once again, this is not strictly a weapon focus study, and like Loftus et al. (1982), the authors limited their dependent variable to correct details viewable throughout the scenes themselves.

These two studies measured the differences in recall for events that occurred outside of the actual violent event, but since neither employed a standard lineup selection procedure or probed for specific details about the perpetrators using a form of post-event interview like those used by real criminal investigators, the light they have shed on possible temporal effects in an applied setting remains dim. Moreover, neither study was specifically concerned with the weapon focus effect, with the researchers instead referring to their principal phenomena of interest as "mental shock" (Loftus & Burns, 1982, p. 318) and a "negative emotional event" (Bornstein, Liebel, & Scarberry, 1998, p. 119). However, both of these teams of researchers applied the cue-utilization hypothesis (Easterbrook, 1959) to their results in a general sense; namely, instead of salient features of a three-dimensional stimulus narrowing cues, the salient event of an entire four-dimensional temporal sequence narrows cues to that relevant event, obscuring memory for details occurring before and after the event. For example, if an individual's face is briefly visible and then he points a gun at a victim before turning around again, the victim's encoding of the face would be disrupted by the gun, which thereby impedes later recognition memory. The question remains whether a similar anterograde effect might be

produced when a weapon is presented before the face. Given early research using word lists containing high-priority words among common words (Tulving, 1969), an inference could be made that events occurring after a shocking event such as the presentation of a weapon might not suffer from a decrement in memory. However, given the added role that heightened arousal has been shown to play in the weapon-focus effect, it's possible that the encoding of events immediately following the presentation of a weapon might suffer from a memory decrement because presence of the weapon creates heightened arousal that disrupts encoding for events following it (e.g., Thompson et al., 2001). So, since a threatening object has the potential to induce retrograde amnesia for events preceding it and also disrupt encoding for events following its presentation, a model of the weapon-focus effect is necessary that would implicate heightened arousal as a cause for retrograde and anterograde effects while unusualness alone would only cause retrograde effects. Therefore, a weapon focus study should be carried out manipulating unusualness, threat level, timing of the salient object's presentation, and utilize recall and recognition questions including target-present and target-absent lineups.

### **The Current Study**

In all studies in the weapon-focus canon reviewed thus far, the face of the perpetrator was always clearly visible before the weapon was presented for several seconds, with the exception of Kramer et al.'s (1990) study which teased apart the impact of the timing of the weapon's presentation such that it either showed simultaneously with the face or after the face appeared. The pattern they found over several experiments was that the weapon's deleterious effect on memory remained the same whether the face was visible first or simultaneously. However, they did not include a manipulation where the face was only visible after the weapon, nor did they include a novel object condition to compare to the weapon and normal object. Loftus and Burns

(1982) found a similar retrograde effect that a violent portion of a film had on memory for a baseball jersey number visible before the violent portion occurred. Bornstein et al. (1998) replicated this finding. None of these studies explored a possible anterograde effect that presentation of the weapon before the face might have on memory for the face or recall. If proactive or retroactive interference occur in the different timing scenarios, I could expect that consolidation of the face's encoding would be disrupted and yield poorer lineup identification and lower scores on other memory measures for context than a simultaneous timing condition. However, another possibility would be that retrieval for the face is blocked by a weapon and novel object because more elaboration is given for objects that were presented after the face. This would lead to more difficulty in retrieving the face if these objects were presented after the face.

Although several investigations of weapon focus utilize videos as stimulus materials, I opted to use a series of slides presenting still images. This is because, although films have been shown to elicit emotions such as increased arousal (Gross & Levenson, 1995; Philippot, 1993) and have been used as stimulus materials in several weapon focus studies (e.g., Loftus & Burns, 1982), Steblay's (1992) meta-analysis indicates that a more robust effect size of weapon focus is generated by slide presentations compared to videos. Granted, the greatest effect sizes are found in live staged simulations, but time and human constraints restrict this option from the current study.

In addition to these issues, the vast majority of weapon focus studies have relied entirely on target-present lineups, and rarely have both target present lineups and target absent lineups been used. This is clearly problematic because Bayesian likelihood analyses of lineups require knowing both the probability of an accurate identification in a target present lineup and mistaken

identification in a target absent lineup (Brewer & Wells, 2011). It is also well known that factors that impact target present and target absent lineups are dissociable (Cutler, Penrod, & Martens, 1987; Steblay, 1992). For this reason, the present research includes both target present and target absent lineup. The weapon focus pattern should be found such that the likelihood ratios indicate lineup selections are more diagnostic of guilt when normal objects are presented and less diagnostic when novel objects and weapons are presented.

Another major gap in weapon focus research is that all studies known to the current researchers have their participants view videos or slideshows of a perpetrator and a victim such that the participants are only bystanders to the crime. A more robust effect will likely be found when the participant is role-playing the victim, seeing slides or footage from a first-person point of view. So, one feature of my stimulus material that sets it apart from most studies in the weapon focus literature is that my photographs are taken from the first-person point of view. I believe that this creates a more ecologically valid presentation than studies that utilize photographs taken from a third-person point of view that renders the participant a mere “fly on the wall”, since victims are witnesses, too.

## **Method**

### **Participants**

One thousand, two hundred sixty-three undergraduates at two southern universities participated in this 3 (Object: Neutral, Novel, Weapon) X 3 (Timing: Before, During, After) X 2 (Lineup: Target Absent, Target Present) between-subjects design. Although 1298 individuals participated initially, 35 were removed for not answering any of the questions. Participants signed up for and took this study online, and were informed that the nature of the study involved stress's impact on memory.

## Materials

**Photographs and Slide Presentation.** Taking a cue from previous seminal weapon-focus studies (e.g., Kramer et al., 1990; Loftus, Loftus, & Messo 1987), a slide sequence was used. Nine volunteers (males = 5) were photographed in a lab room decorated to have the appearance of a bar. The photographs were taken from a first-person perspective, and seven volunteers looked and gestured toward the camera as though they are ordering drinks from the participant. The remaining two individuals were fillers who sat at a table in the background conversing with each other. Each photograph was then added to a series of slides for the participants to view. One of the individuals held an object out to the camera. In the normal-object condition, the object was an empty glass, in the novel-object condition it was a rubber chicken, and in the weapon condition it was a realistic airsoft gun. The three temporal conditions varied in the timing of the object's presentation: one manipulation showed the object before the face, the second showed the object after the face, and the third showed the face and object simultaneously. In each condition, the target's face was the same size onscreen (approximately two cm in height every time she is visible).

**Photo Lineups.** For the target individual, two types of simultaneous lineups were constructed. The target-absent lineup was composed of six foils who have been previously rated by 20 research assistants as looking similar to the target ( $M = 4.27$ ,  $SD = 1.22$ ) on a seven-point Likert scale where 1 represents not similar and 7 represents extremely similar. Six separate target-present lineups were used, each with the target replacing one of the foils and consequently appearing equally often in each of the six positions in the lineup. Images in the lineups were presented as three columns of two photographs each (see Figures 1 and 2).

**Post-Identification Questions.** A set of free-recall, cued-recall, and recognition questions were used immediately preceding the lineup presentation to measure remembered details of the individual, weapon, and event. All questions are shown in the Appendices. Detailed cued-recall questions asking about the target's appearance, attire, the object being held were asked. Of particular theoretical interest to the present study is the question asking, "Did you see the object before or after you saw the person's face?" In addition, questions probing for details about the weapon were also asked, including, "What object was the person holding?" as well as manipulation check questions assessing participants' perceptions of threat and unusualness of the object.

Cutler, Penrod, and Dexter (1990) have demonstrated that the self-professed confidence of an eyewitness weighs heavily on a jury's decision-making process, so questioning ended by measuring retrospective confidence and memory for viewing conditions. Participants answered 15 Likert-type questions similar to those used by Wells and Bradfield (1998) measuring post-identification confidence ("At the time you made your lineup decision, how certain were you that your choice was right?") and others asking about perceived difficulty with the lineup selection process.

## **Procedure**

**Bartender Training.** This study was taken online using a web-based survey interface. Participants first received instructions that they would be trained as a bartender and that their memory for the cost of four different drinks would be tested. So that the task would not be too difficult, the price of each drink was a whole dollar amount. After spending as much time as necessary looking at the drink menu and prices, the participants clicked a button onscreen to advance to a slide listing each drink along with text-entry boxes where the participant entered the



price of the drink as part of a testing phase. Although I am not using memory for drink prices as a dependent measure, this part of the experiment serves as an attention check to ensure that participants are attending to and are engaged in the study. Outliers in the dataset were checked against their responses at this slide to see if the drink prices were correct. If they were all incorrect, this was grounds for removing that participant's data from final analyses.

**Bartending.** After being trained on the drink prices, the participants viewed a series of slides with a filler individual standing at the bar looking at the camera. A photo loaded identical to this one but with a dialog bubble displaying a drink order (e.g., "I'll take an imported beer") superimposed to the right of the filler's face. The images were followed with the whole dollar amount given to the participant, (e.g., "He gives you \$10. How much change do you give him back?") and below was a text-entry box for the participant to enter a whole dollar amount of change to be given.

**Experimental Slides.** After six filler individuals ordered drinks, a young female target appeared in three slides automated to appear for 2s each. Nine unique sets of slides appeared depending on condition. Each set showed either an empty glass (Normal Object), rubber chicken (Novel Object), or a realistic airsoft gun (Weapon). Each was sequenced so that the object was either presented first, the target's face is presented first, or the object and face were presented simultaneously. The final photo of each set (which was the third photo in the object-before and object-after conditions and the second photo in the object-simultaneous condition) showed the target's back to the camera as she walked toward the door of the bar.

**Follow-Up Questioning.** A notification onscreen told the participant that the last individual who appeared at the bar committed a crime. Either a target-absent or a target-present lineup was administered after the final slide image was displayed, with instructions asking the

participant to press the numeric key corresponding to the number below the individual who last appeared in the bar. The instructions were unbiased and informed participants that the individual might not actually appear in the lineup. After the lineup administration, participants answered cued-recall questions about the target as well as the contextual details of the bar. Multiple-choice questions were also administered to gauge recognition memory. The participants answered 5 Likert-type questions asking how much attention was paid to the object, as well as how surprising or threatening the object was in the context of the bar. Finally 11 Likert-type questions were administered probing for retrospective memory for lineup selection confidence and viewing conditions. The participants were then asked to provide demographic information, were debriefed and assigned research credit. Each experimental session took no more than 30 minutes.

## **Results**

The thrust of this experiment was threefold. First, I wanted to replicate the classic weapon focus pattern where recognition memory for target and event details are worse in crime scenarios where a weapon is presented than in scenarios where a normal object is presented. A novel object (i.e., the rubber chicken) was included to further test the effect of attentional processes paid to novel objects on encoding. In particular, since most weapon focus studies have used only a target present lineup, an important goal was to determine if a weapon focus effect occurred in the context of a target absent lineup. The second goal of this study was to determine if timing of weapon presentation influenced the pattern of results. The literature on interference effects indicates that this would likely be the case. The third goal was to compare inferentially, for the first time in eyewitness memory research, diagnosticity ratios among each of our nine Object X Timing combinations. This last goal would employ a methodology to determine, in a

concrete applied setting, the likelihood of a suspect's guilt or innocence based on their selection from a lineup or the lineup's rejection when a combination of factors precedes lineup administration. Site comparisons between the two participating colleges found no significant differences in dependent variables,  $p$ 's > .5.

### **Threat/Surprise Manipulation Check**

When conducting an experiment manipulating threat and novelty of various objects, it is important to first ensure that threat and surprise were generated by the objects. The following five analyses were conducted on post-event questions about the object, and serve as manipulation checks designed to measure attention paid to the objects compared to perpetrator's face, threat generated by the object, and surprise generated by the object. Questions are displayed in Appendix C. Each analysis was a 3 (Object Type: Normal, Chicken, Gun) X 3 (Timing: After, Before, During) factorial analysis of variance.

A significant main effect of Object Type on reported attention paid to the object was found,  $F(2, 1254) = 35.13$ ,  $MSE = 9.35$ ,  $p < .001$ ,  $\eta^2_p = .053$ . LSD post-hoc tests revealed that the effect was driven by the Normal Object receiving significantly less attention than the Chicken or the Gun, both  $p$ 's < .001. The Chicken and the Gun were not significantly different from one another,  $p > .30$ . A significant effect of Timing on attention was also found,  $F(2, 1254) = 7.52$ ,  $MSE = 9.35$ ,  $p = .001$ ,  $\eta^2_p = .012$ . LSD post-hoc tests revealed that the effect was driven by the Object After Face condition generating less attention than the Before or During conditions, both  $p$ 's = .001, neither of which were significantly different from one another,  $p > .90$ . No significant Object X Timing interaction was found,  $F(4, 1254) = 1.79$ ,  $MSE = 9.35$ ,  $p = .13$ ,  $\eta^2_p = .006$ .

A significant main effect of Object Type on reported surprise felt for the object was found,  $F(2, 1252) = 35.13$ ,  $MSE = 6.01$ ,  $p < .001$ ,  $\eta^2_p = .416$ . LSD post-hoc tests revealed that the effect was driven by the Normal Object being considered significantly less surprising than the Chicken or the Gun, both  $p$ 's  $< .001$ . The Chicken and the Gun were not significantly different from one another,  $p > .35$ . No significant effect of Timing on surprise was found,  $F(2, 1252) = 1.68$ ,  $MSE = 9.35$ ,  $p = .19$ ,  $\eta^2_p = .003$ , nor was there a significant Object X Timing interaction found,  $F(4, 1252) = 1.10$ ,  $MSE = 9.35$ ,  $p = .36$ ,  $\eta^2_p = .003$ .

A significant main effect of Object Type on reported threat felt for the object was found,  $F(2, 1251) = 375.57$ ,  $MSE = 5.01$ ,  $p < .001$ ,  $\eta^2_p = .375$ . LSD post-hoc tests revealed that the effect was driven by the Gun being considered significantly more threatening than the Chicken or the Normal Object, both  $p$ 's  $< .001$ . The Chicken and the Normal Object were not significantly different from one another,  $p > .13$ . No significant effect of Timing on surprise was found,  $F(2, 1251) = .80$ ,  $MSE = 5.01$ ,  $p = .49$ ,  $\eta^2_p = .001$ , nor was there a significant Object X Timing interaction found,  $F(4, 1251) = 1.10$ ,  $MSE = 5.01$ ,  $p = .15$ ,  $\eta^2_p = .005$ .

A significant main effect of Object Type was found on reported surprise that would be felt for the object if it was encountered in real life,  $F(2, 1252) = 225.62$ ,  $MSE = 8.37$ ,  $p < .001$ ,  $\eta^2_p = .265$ . LSD post-hoc tests revealed that the effect was driven by the Normal Object being considered significantly less surprising than the Chicken or the Gun, both  $p$ 's  $< .001$ . The Chicken and the Gun were not significantly different from one another,  $p > .80$ . No significant effect of Timing on forecast surprise was found,  $F(2, 1252) = .91$ ,  $MSE = 8.37$ ,  $p > .40$ ,  $\eta^2_p = .001$ . There was also a significant Object X Timing interaction,  $F(4, 1252) = 2.56$ ,  $MSE = 8.37$ ,  $p = .037$ ,  $\eta^2_p = .008$ . Simple univariate tests of Timing condition at each level of Object Type revealed a significant simple effect of Timing within the Normal Object condition,  $F(2, 1252) =$

4.88,  $MSE = 8.37$ ,  $p = .008$ ,  $\eta^2_p = .008$ . No simple effects of Timing were found within the Chicken condition,  $F(2, 1252) = 1.14$ ,  $MSE = 8.37$ ,  $p > .30$ ,  $\eta^2_p = .002$ , and no significant simple effect of Timing was found within the Gun condition,  $F(2, 1252) = .02$ ,  $MSE = 8.37$ ,  $p > .95$ ,  $\eta^2_p < .001$ .

A significant main effect of Object Type was found on reported forecast threat that would be felt for the object if it was encountered in real life,  $F(2, 1252) = 1057.78$ ,  $MSE = 4.72$ ,  $p < .001$ ,  $\eta^2_p = .628$ . LSD post-hoc tests revealed that the effect was driven by the Gun being considered significantly more threatening than the Chicken or the Normal Object, both  $p$ 's  $< .001$ . The Chicken and the Normal Object were not significantly different from one another,  $p > .10$ . A significant effect of Timing on forecast threat was also found,  $F(2, 1252) = 10.75$ ,  $MSE = 4.72$ ,  $p < .001$ ,  $\eta^2_p = .017$ . LSD post-hoc tests revealed that the effect was driven by the During condition generating significantly more forecast threat than the After or Before conditions, both  $p$ 's  $< .001$ . The After and Before conditions were not significantly different from one another,  $p > .95$ . There was also a significant Object X Timing interaction,  $F(4, 1252) = 2.44$ ,  $MSE = 4.72$ ,  $p = .045$ ,  $\eta^2_p = .008$ . Simple univariate tests of Timing condition at each level of Object Type revealed a significant simple effect of Timing within the Gun condition,  $F(2, 1252) = 12.74$ ,  $MSE = 4.72$ ,  $p < .001$ ,  $\eta^2_p = .020$ . A marginal simple effect of Timing was found within the Normal Object condition,  $F(2, 1252) = 2.45$ ,  $MSE = 4.72$ ,  $p = .09$ ,  $\eta^2_p = .004$ , and no significant simple effect of Timing was found within the Chicken condition,  $F(2, 1252) = .45$ ,  $MSE = 4.72$ ,  $p > .60$ ,  $\eta^2_p = .001$ .

In sum, the results of the manipulation check revealed that, while the chicken and gun were both more surprising than the glass, the glass and chicken were both less threatening than

the gun. Furthermore, the gun and chicken attracted more attention than the glass. This fit right in line with my hypothesis, so I proceeded to analyze my other dependent measures.

### **Target-Present Lineup Analyses**

The proportion of correct suspect identifications, mistaken foil identifications, and mistaken rejections in target present lineups are shown in Table 1. Two separate 3 (Object Type: Glass, Chicken, Gun) X 3 (Timing: Object Before, Object After, During) analyses of variance were conducted on suspect selections and foil selections.

A main effect of Timing was found on target selections in the TP lineups,  $F(2, 621) = 3.73$ ,  $MSE = .210$ ,  $p = .025$ ,  $\eta^2_p = .012$ . LSD post-hoc tests revealed the Timing effect was driven by the During condition resulting in significantly fewer suspect identifications than the Object Before condition,  $p = .045$ , and marginally fewer identifications than the Object After condition,  $p = .09$ . Object After and Object before conditions were not significantly different from one another,  $p > .9$ . No significant effect of Object Type were found,  $F(2, 621) = 1.07$ ,  $MSE = .210$ ,  $p = .35$ ,  $\eta^2_p = .003$ , nor was there a significant Object Type X Timing interaction,  $F(4, 621) = 1.40$ ,  $MSE = .210$ ,  $p > .2$ ,  $\eta^2_p = .009$ .

A main effect of Object Type was found on foil selections in the TP lineups,  $F(2, 621) = 4.12$ ,  $MSE = .121$ ,  $p = .017$ ,  $\eta^2_p = .013$ . LSD post-hoc tests revealed the Object Type effect was driven by the Chicken producing significantly more foil selections than the Glass,  $p = .015$ , and marginally more foil selections than the Gun,  $p = .083$ . The Glass and the Gun were not significantly different from one another,  $p > .79$ . No significant effect of Timing was found,  $F(2, 621) = .11$ ,  $MSE = .121$ ,  $p = .90$ ,  $\eta^2_p < .000$ , nor was there a significant Object Type X Timing interaction,  $F(4, 621) = 1.63$ ,  $MSE = .121$ ,  $p = .16$ ,  $\eta^2_p = .010$ .

### **Target-Absent Lineup Analysis**

Mean proportions of foil selections and lineup rejections in target absent lineups are shown in Table 1. A main effect of Object Type was found on rejections in the TA lineups,  $F(2, 624) = 5.55$ ,  $MSE = .245$ ,  $p = .004$ ,  $\eta^2_p = .017$ . LSD post-hoc tests revealed the Object Type effect was driven by the Glass yielding significantly more lineup rejections than the Chicken,  $p = .05$ , and the Gun,  $p = .002$ . The Chicken and the Gun were not significantly different from one another,  $p > .6$ . No significant effect of Timing was found,  $F(2, 624) = 1.82$ ,  $MSE = .121$ ,  $p = .163$ ,  $\eta^2_p = .006$ , nor was there a significant Object Type X Timing interaction,  $F(4, 624) = 1.21$ ,  $MSE = .121$ ,  $p = .31$ ,  $\eta^2_p = .008$ .

### **Diagnosticity of Timing and Object Conditions**

When jurors are presented with identification evidence in court they need to evaluate the probability that the suspect is guilty, given that he or she has been identified. The most common index of this probability is the diagnosticity of the lineup. Lineup diagnosticity is the probability that a suspect is selected in a target present lineup, divided by the probability that a suspect is identified in a target absent lineup. Because the target absent lineups used in experiments often do not identify any particular person as the suspect, the common convention is to estimate the proportion of suspect identifications in target absent lineups by dividing the proportion of foil identifications in TA lineups by the nominal size (in the present case, 6) of the lineup (Lampinen, Neuschatz, & Cling, 2012 for a discussion).

$$Diagnosticity_{suspect\ choice} = \frac{p(\text{Suspect Chosen} | TP\ Lineup)}{p(\text{Foil Chosen} | TA\ Lineup)/6} \quad (1)$$

For each of the nine conditions in the experiment I calculated the diagnosticity using the above equation. The greatest diagnosticity was 17.20 and found in the Normal/After condition, indicating a 17.20 to 1 chance that the suspect was guilty given that she was chosen from the

lineup. The smallest diagnosticity was 5.58 and found in the Gun/During condition. Remaining diagnosticities for lineup selections are found in Table 2. The general pattern suggests lower diagnosticities in the weapon and novel object conditions when compared to the common object condition.

Diagnosticity can also be calculated for lineup rejections (Wells & Lindsay, 1980). For lineup rejections the diagnosticities indicate the odds that a suspect is innocent, given that the lineup was rejected.

$$Diagnosticity_{lineup\ rejection} = \frac{P(\text{Lineup Rejection} | \text{TA Lineup})}{P(\text{Lineup Rejection} | \text{TP Lineup})} \quad (2)$$

The largest diagnosticity ratio found was in the Chicken/After condition, 5.83, indicating that, when a novel object is presented after the perpetrator's face, there is a 5.83 to 1 likelihood that the suspect is innocent given that the lineup has been rejected. The lowest diagnosticity ratio is in the Gun/During condition, 1.25, which is close to floor.

Most of the times when diagnosticities are presented in published work, only descriptive statistics are presented. This is because no established methods are in existence to provide inferential comparisons among lineup diagnosticities. Recently, Lampinen and Erickson (in prep) developed a bootstrapping approach that can be used to make inferential comparisons between diagnosticities in different conditions. Monte Carlo simulations have shown that this approach adequately controls for Type I Error.

This particular bootstrapping approach involves randomly resampling with replacement from the original samples. This process is used to create 10,000 new samples of the same size for each condition. For each simulated experiment, the proportion of suspect IDs in the target present lineup and foil IDs in target absent lineups was used to generate a diagnosticity ratio.



These 10,000 simulated diagnosticity ratios were then used to determine the 95% confidence interval for each of the diagnosticities in each of the 9 cells. See Table 3 for each diagnosticity and its bootstrapped 95% confidence interval.

To compare conditions, I took each of the 10,000 simulated diagnosticities from one condition and randomly paired it with one of the 10,000 simulated diagnosticities of the condition it was being compared to, allowing me to compute the difference between the two diagnosticities for each of the 10,000 simulated experiments. I then calculated the 95% confidence interval of the difference between the diagnosticities. If the 95% confidence interval of this difference did not include zero, then the null hypothesis could be rejected. Monte Carlo simulations show that this procedure provides reasonable protection against Type I error (Lampinen & Erickson, in prep).

To avoid alpha inflation, only preplanned comparisons between the Glass and the other two objects were carried out within each timing condition. So, six comparisons were carried out: Glass/Before vs. Chicken/Before, Glass/Before vs. Gun/Before, Glass/After vs. Chicken/After, Glass/After vs. Gun/After, Glass/During vs. Chicken/During, and Glass/During vs. Gun/During. The significant differences in suspect selection diagnosticity ratios were Glass/After vs. Gun/After, 95% CI [3.48, 19.74], Glass/After vs. Chicken/After, 95% CI [2.68, 19.15], and Glass/During vs. Gun/During, 95% CI [.84, 7.71]. In other words, a suspect who was selected from a lineup has a higher probability of being the perpetrator if the perpetrator held a contextually appropriate object during the commission of the crime after his/her face was visible than if the perpetrator held a weapon or novel object. However, if the object was held while the perpetrator's face was visible, only the gun was able to significantly reduce the probability that the suspect was the perpetrator.

A similar approach was used to compare diagnosticities of lineup rejections. The only significant difference in lineup rejection diagnosticity ratios was Glass/During vs. Gun/During, 95% CI [-4.98, -.08]. In other words, if a lineup is rejected, and the perpetrator was holding a contextually appropriate object during the commission of the crime, then there is a significantly lower probability that the suspect was the perpetrator than if the perpetrator held a gun. This was only the case if the object was brandished while the face was visible. The implications of this distinction between the gun and the novel object on lineup rejections are further expounded upon in the discussion.

### **Retrospective Questions**

After lineup administration, I included retrospective questions similar to those used by Wells and Bradfield (1998). The questions included a probe for confidence in lineup selection on a sliding scale of 0 to 100 and 11 Likert-type questions on a scale from 1 to 10 for memory of viewing conditions in the crime scenario. See Appendix C for a full list of retrospective questions. Because confidence is very influential to judges and juries, the confidence measure was analyzed individually, and the remaining 11 questions were converted to standardized scores and averaged together for analysis. Each analysis was a 3 (Object Type) X 3 (Objecting Timing) X 2 (Lineup Type: Target Present, Target Absent) factorial analysis of variance. The analysis was restricted to individuals who selected the suspect from the target present lineups or who selected one of the foils from the target absent lineups. This is because the dependent variables in these analyses are factors that are typically used in court when evaluating a witness's identification. This procedure of restricting analysis of confidence and other retrospective measures to choosers is a common practice in the eyewitness literature for that reason (Brigham, 1988).

A significant main effect of Object on retrospective confidence was found,  $F(2, 806) = 3.04$ ,  $MSE = 592.90$ ,  $p = .048$ ,  $\eta^2_p = .007$ . LSD post-hoc tests revealed the effect was driven by marginally greater confidence in the Gun condition than the Chicken condition,  $p = .087$ . Other comparisons were non-significant,  $p$ 's  $> .25$ . A significant main effect of Lineup Type on retrospective confidence was also found,  $F(1, 806) = 60.15$ ,  $MSE = 592.90$ ,  $p < .001$ ,  $\eta^2_p = .069$ , such that TP lineups yielded more confident choosers ( $M = 71.70$ ,  $SD = 24.74$ ) than did TA lineups ( $M = 57.50$ ,  $SD = 23.92$ ). Object Timing produced only a marginal effect on retrospective confidence,  $F(2, 806) = 2.50$ ,  $MSE = 592.90$ ,  $p = .08$ ,  $\eta^2_p = .006$ . Although the main effect was marginal, LSD post-hoc tests revealed that the During condition produced significantly lower confidence than After,  $p = .043$ , and Before,  $p = .026$ , which were not significantly different from one another,  $p > .95$ . None of the four interactions were found to be significant: Object Type X Timing,  $F(4, 806) = .958$ ,  $MSE = 592.90$ ,  $p = .43$ ,  $\eta^2_p = .005$ , Object Type X Lineup,  $F(2, 806) = .429$ ,  $MSE = 592.90$ ,  $p = .65$ ,  $\eta^2_p = .001$ , Timing X Lineup,  $F(2, 806) = .619$ ,  $MSE = 592.90$ ,  $p = .54$ ,  $\eta^2_p = .002$ , and Object Type X Timing X Lineup,  $F(4, 806) = .837$ ,  $MSE = 592.90$ ,  $p = .50$ ,  $\eta^2_p = .004$ . Means and standard deviations for each cell can be found in Table 7.

A significant main effect of Object Type on viewing condition responses was found,  $F(2, 782) = 8.30$ ,  $MSE = .240$ ,  $p < .001$ ,  $\eta^2_p = .021$ . LSD post-hoc tests revealed that viewing conditions were rated by participants who saw the Gun as being better than participants who saw the Chicken,  $p < .001$ , and by participants who saw the Glass as higher than participants who saw the Chicken,  $p = .016$ . The Gun was only marginally higher than the Glass,  $p = .09$ . A significant main effect of Timing on viewing condition responses was also found,  $F(2, 782) = 7.85$ ,  $MSE = .240$ ,  $p < .001$ ,  $\eta^2_p = .020$ . LSD post-hoc tests revealed that viewing conditions for

the During condition were rated lower than After,  $p < .001$ , or Before,  $p = .01$ , and that Before viewing conditions were rated lower than After,  $p = .042$ . A significant main effect of Lineup Type on viewing condition responses was also found,  $F(1, 782) = 53.91$ ,  $MSE = .240$ ,  $p < .001$ ,  $\eta^2_p = .064$ , such that viewing conditions were reported as better by participants who viewed the TP Lineup ( $M = .16$ ,  $SD = .52$ ) than by participants who viewed the TA Lineup ( $M = -.12$ ,  $SD = .47$ ). None of the four interactions were found to be significant. None of the four interactions were found to be significant: Object Type X Timing,  $F(4, 782) = 2.01$ ,  $MSE = .240$ ,  $p = .091$ ,  $\eta^2_p = .010$ , Object Type X Lineup,  $F(2, 782) = .42$ ,  $MSE = .240$ ,  $p = .66$ ,  $\eta^2_p = .001$ , Timing X Lineup,  $F(2, 782) = .22$ ,  $MSE = .240$ ,  $p = .80$ ,  $\eta^2_p = .001$ , and Object Type X Timing X Lineup,  $F(4, 782) = 1.55$ ,  $MSE = .240$ ,  $p = .19$ ,  $\eta^2_p = .008$ . Means and standard deviations for each cell can be found in Table 8.

### **Cued Recall Questions**

Total cued recall scores were summed, as well separate totals for the target-related questions and the context-related questions. Separate 3 (Timing) X 3 (Object Type) ANOVAs were conducted on all three totals.

A significant main effect for Object Type was found on cued recall scores for questions about the target,  $F(2, 1275) = 3.06$ ,  $MSE = 1.78$ ,  $p = .047$ ,  $\eta^2_p = .005$ . LSD post-hoc tests revealed that the effect was driven by the Gun yielding significantly higher recall scores than the Normal object,  $p = .028$ , and Chicken,  $p = .037$ , while the Chicken and the Normal Object were not significantly different from one another. A main effect of Timing was also found on combined total cued recall scores,  $F(2, 1275) = 66.08$ ,  $MSE = 1.78$ ,  $p < .001$ ,  $\eta^2_p = .094$ . LSD post-hoc tests revealed that the Timing effect was driven by the During condition yielding lower recall scores than either the After or Before conditions, both  $p$ 's  $< .001$ . The Object X Timing

interaction was non-significant,  $F(4, 1275) = 1.79$ ,  $MSE = 1.78$ ,  $p > .10$ ,  $\eta^2_p = .006$ . See Table 4 for means and standard deviations for each cell.

Next to be analyzed were cued recall total scores for questions regarding the setting in which the crime occurred. No significant main effect for Object Type was found,  $F(2, 1275) = .13$ ,  $MSE = .948$ ,  $p > .85$ ,  $\eta^2_p < .001$ . No main effect of Timing was found,  $F(2, 1275) = 1.96$ ,  $MSE = .948$ ,  $p > .10$ ,  $\eta^2_p = .003$ . Also, the Object Type X Timing interaction was not significant,  $F(4, 1275) = 1.13$ ,  $MSE = .948$ ,  $p > .30$ ,  $\eta^2_p = .004$ . For means and standard deviations for these scores, see Table 4.

The analysis on total scores calculated by summing target and context questions. No significant main effect for Object Type was found on total cued recall scores,  $F(2, 1275) = 2.06$ ,  $MSE = 3.20$ ,  $p = .116$ ,  $\eta^2_p = .003$ . A main effect of Timing was found, however, on combined total cued recall scores,  $F(2, 1275) = 46.43$ ,  $MSE = 3.20$ ,  $p < .001$ ,  $\eta^2_p = .068$ . LSD post-hoc tests revealed that the Timing effect was driven by the During condition yielding lower recall scores than either the After or Before conditions, both  $p$ 's  $< .001$ . These latter two conditions were not significantly different from one-another,  $p > .75$ . The Object X Timing interaction was non-significant,  $F(4, 1275) = 1.99$ ,  $MSE = 3.20$ ,  $p = .09$ ,  $\eta^2_p = .006$ .

Of interest to a weapon focus study investigating the roles of threat and novelty on eyewitness memory is the question of whether participants can correctly identify the object being brandished by the criminal. If attention is narrowed to the threatening and novel objects, one would expect their identification to come with ease compared to normal objects. A significant main effect for Object Type was found on cued recall scores for the question asking what object the culprit was holding,  $F(2, 1275) = 3.96$ ,  $MSE = .072$ ,  $p = .019$ ,  $\eta^2_p = .006$ . LSD post-hot tests revealed that the effect was driven by the Chicken yielding significantly lower correct responses

than the Normal object,  $p = .005$ , and marginally lower correct responses than the Gun,  $p = .079$ , while the Gun and the Normal Object were not significantly different from one another,  $p > .30$ . A main effect of Timing was also found on cued recall scores for the question asking what object the culprit was holding,  $F(2, 1275) = 3.186$ ,  $MSE = .072$ ,  $p = .04$ ,  $\eta^2_p = .005$ . LSD post-hoc tests revealed that the Timing effect was driven by the During condition yielding lower correct responses than the After condition,  $p = .012$ , while During was not significantly different from Before,  $p > .2$ , nor was After significantly different from Before,  $p > .2$ . The Object X Timing interaction was non-significant,  $F(4, 1275) = 2.05$ ,  $MSE = .072$ ,  $p > .80$ ,  $\eta^2_p = .006$ . See Table 5 for means and standard deviations for each cell.

### Multiple Choice Questions

The multiple choice questions were each graded such that correct answers were scored as a “1” and incorrect answers were scored as “0”. Each participant was then given a total score, and these total scores were loaded as dependent variables in a univariate ANOVA with Object Type and Timing as factors. A main effect for Timing on correct responses was found,  $F(2, 1215) = 18.13$ ,  $MSE = .946$ ,  $p < .001$ ,  $\eta^2_p = .029$ . LSD tests of Timing revealed that multiple choice question scores were higher in the Object After condition than in the During condition,  $p < .001$ , and Object Before was also higher than the During condition,  $p < .001$ . Object After and Object Before were not significantly different from one another,  $p > .3$ . See Table 6 for means and standard deviations of each cell.

No main effect for Object Type was found, however,  $F(2, 1215) = .14$ ,  $MSE = .946$ ,  $p = .87$ ,  $\eta^2_p < .001$  and no Object Type X Timing interaction was found,  $F(4, 1215) = .61$ ,  $MSE = .946$ ,  $p = .65$ ,  $\eta^2_p = .002$ . However, simple effects tests within the Object Type condition revealed significant effects of Timing on multiple choice question scores within each Object

Type condition: Normal,  $F(1, 1215) = 3.21$ ,  $MSE = .946$ ,  $p = .04$ ,  $\eta^2_p = .005$ ; Chicken,  $F(1, 1215) = 9.27$ ,  $MSE = .946$ ,  $p < .001$ ,  $\eta^2_p = .015$ ; and Gun,  $F(1, 1215) = 6.86$ ,  $p = .001$ ,  $MSE = .946$ ,  $\eta^2_p = .011$ .

## Discussion

The current experiment was designed to shed light on the weapon focus effect by experimentally manipulating timing of the weapon's presentation. Weapon focus could be explained in terms of interference effects in addition to the narrowing of attentional cues associated with heightened arousal. In other words, a weapon appearing before the perpetrator's face could affect witnesses' memories differently from when it appears after or during the time when the face is visible, and this effect could behave differently from novel objects or normal objects because weapons are more likely to increase arousal. Of secondary interest was a direct comparison between target-absent and target-present lineups, which has been rarely examined in weapon focus research. The third major goal for the present research was to determine the diagnosticity of various combinations of timing and object types and inferentially compare them using a new methodology. First the results of the individual dependent measures will be discussed, and then a general discussion of the implications of the findings will be given.

### Lineup Analyses

**Target Present Lineups.** The lineup analyses revealed no classic weapon focus pattern for suspect selections from target-present lineups. Note that the lack of a significant weapon focus effect for lineup identifications is not an unusual outcome. As noted in the introduction, prior research has often failed to find a significant weapon focus effect with regards to lineup accuracy and the Steblay (1992) meta-analysis indicated the effect size for weapon presence was relatively small.

The timing manipulation did yield an effect where objects presented alongside the face in the During condition produced significantly fewer target selections than the After or Before conditions. This indicates that the presence of any object, including a weapon, while the target's face was visible was more disruptive of facial encoding than presence before or after the face was visible. This, however, does not exclude the possibility that proactive and retroactive interference played a role in the After or Before conditions. On the contrary: Both Before and After produced non-target selections, but the During condition produced more relative to the other two timing conditions. A problem I face in interpreting these data is the fact that, prior to the target's appearance, no other patron in the bar scenario presented an object alongside their face. It is therefore possible that the timing effect was due to participants seeing something different, rather than genuinely dividing their attention. Likewise, all timing effects on the other dependent measures that were driven by the During condition producing lower memory than the Before or After conditions could be explained in this way. To resolve this question, I could re-run the experiment using photographs of the fillers depicting them with contextually appropriate objects such as beer bottles and empty glasses while ordering their drinks.

The interesting Object effect on target-present lineups appeared for foil selections. Here, instead of a Timing effect, an Object effect was found such that the chicken produced more foil selections than the gun or the normal object. This fits in line with the idea that the novelty of the object is not just in the context of the bar but in most participants' daily experiences. I believe that the increase in foil selections was due to participants focusing more attention on the object in an attempt to identify it, and this drew attention away from the target in the situation. The gun, although threatening and attention-grabbing, is easily identifiable by most people and so did not draw the extra attention required for object identification. Therefore, one possibility is that



uncommon objects disrupt face encoding because discerning the object's identity is unknown. The object identity question within the cued-recall section revealed that most participants were actually able to accurately identify it, so this opens the field for another explanation: The rubber chicken was not just novel but truly bizarre in the setting. A recent example of a weaponless, bizarre crime is a bank robbery in New Hampshire where a man dressed as a tree (Attewell, 2007). Although he was later apprehended, future research on bizarreness's effect on eyewitness memory could reveal a robust version of the weapon focus effect in the absence of a weapon.

The challenge now is to account for why the chicken's drawing of attention came at the expense of lineup rejections rather than target selections. Perhaps this is because the chicken was sufficient to shake the confidence participants had in their lineup selections, while the gun was not. Confidence and accuracy have a tenuous relationship, but only in situations where information processing sufficiently suffers (Deffenbacher, 1980; Bothwell, Deffenbacher, & Brigham, 1987). As expected, the manipulation checks revealed that the chicken was merely unusual while the gun was both unusual and threatening. However, post-identification confidence ratings from witnesses in the chicken condition were lowest compared to the other two objects across nearly every timing and lineup combination (see Table 7). Unusualness could indeed be the key component to disrupting this relationship in a way that arousal does not; after all, threatening objects would increase orienting responses and narrow attentional cues. Unusual objects engender a "What on Earth is that?" reaction that overtakes attentional processing.

**Target Absent Lineups.** In the target-absent lineups, the gun and chicken conditions produced significantly more false identifications than the glass condition. This result is especially important, because it reveals that mistaken convictions of innocent suspects are more likely when a weapon or unusual object is brandished in the course of a crime than if an expected

object is brandished. The present study is one of only three to specifically examine false identifications in the context of a target absent lineup, one of only two to include both target present and target absent lineups, and the only study to include a novel but non-threatening object as well a weapon in this context of target absent lineups. The findings indicate a robust weapon focus effect indicating that the presence of a weapon or novel object increases selection of innocent individuals from lineups, which should be troubling to members of law enforcement concerned with reducing the number of innocent people convicted of crimes chiefly because of faulty eyewitness memory.

**Lineup Diagnosticity.** Likelihood of a suspect's guilt when the suspect is chosen from a police lineup is influenced by a number of factors, including other evidence against the individual and the influence of estimator variables during the crime. The base rate of guilt is the *a priori* probability of guilt before the identification procedure takes place, and identification then provides more information to investigators that then increases likelihood of guilt. Likewise, as the probability of guilt increases, so too increases the likelihood of the suspect being chosen from the lineup. The current study manipulated two estimator variables to determine their combined influence on base rate probabilities. Diagnosticity ratios calculated from suspect selections when target-absent and target-present lineups were administered then provided the information gained from a suspect's having been selected from a lineup.

All previous reports of lineup diagnosticity have simply presented the diagnosticities for each cell and briefly interpreted their implications. Never before have diagnosticities been inferentially compared using null-hypothesis statistical testing, and this has left a large hole in the literature. Therefore, this element of my study breaks new ground for eyewitness memory research. Of particular interest was the finding that lineup selections were more diagnostic of

suspect guilt if a glass was held after the perpetrator's face than if the gun or chicken were held after the face. This reveals that a weapon and novel object proactively interfere with target lineup selection more than a normal object, and that retroactive interference plays a minimal role in lineup selection diagnosticity. When the objects are presented simultaneously with the face, only the weapon significantly reduces diagnosticity compared to the normal object. These two latter conditions were also the only two to produce a significant difference in lineup rejection diagnosticities, where lineup rejection when a glass was held was significantly more diagnostic of suspect innocence than when a gun was held. This suggests that the weapon does have a unique impact on eyewitness memory separate from novelty, and this effect is more pronounced when it is visible simultaneously with the face of the perpetrator. This pattern fits well with Easterbrook's (1959) cue-utilization hypothesis, and suggests that in the two seconds that object and face were visible that arousal, not novelty, was sufficient to disrupt facial encoding enough to impact lineup diagnosticity.

The value of diagnosticity ratios is the inference one can make about how they affect base rate probabilities. As previously stated, base rates provide *a priori* probabilities of guilt to criminal investigators. To provide a concrete example, imagine a base rate of guilt at 100%. In this scenario, every suspect chosen from a lineup is guilty. For criminal investigators, this would be a fantastic world in which to work, because they would need to look no further than eyewitness identification for every crime they investigated. Of course, this is not the case in actual criminal cases. However, predetermining factors can increase the base rate of guilt. Results of the current study reveal that contextually appropriate objects provide a greater conditional probability of suspect selection given their guilt than do other objects. This effect is most pronounced when objects were presented after the suspect's face (see Figure 3), but

remains higher than the other two sets of guilt in both the Before (see Figure 4) and During (see Figure 5) conditions. To put this in context of criminal investigation, imagine a police department that wants to be 95% certain that a suspect is guilty before prosecuting her. If a contextually appropriate object was brandished after the individual's face during the robbery, this criterion is reached when there is a 50% base rate probability of the suspect's guilt. In other words, an eyewitness's selection of the individual increases the probability that the suspect was guilty sufficiently for the hypothetical precinct to prosecute. However, if a novel object or weapon were brandished after the suspect's face, the investigators have to wait until there is enough evidence to provide a 70% base rate probability of suspect guilt in order for the lineup selection to push the probability of guilt upward to the prosecution criterion. Timing also influences this decision-making process, because suspect selection similarly boosts the probability of guilt from 70% to 95% when objects are presented before faces. When objects are presented before faces, novel objects and weapons require an 80% base rate of guilt before they can push lineup selection up to 95%, whereas a normal object only requires a 70% base rate.

### **Cued Recall Questions**

The cued recall questions revealed non-significant differences between object conditions for memory questions about contextual details of the bar itself. A possible explanation for this is that the target with an object drew more attention than the rest of the bar or the fillers because the participants grew accustomed to attending to whoever next stood at the bar. Also, the contextual information was simply not salient to the task; this is apparent because the average context scores are much lower across cells than the target scores.

An especially interesting finding of cued recall responses is that the traditional weapon focus pattern did not emerge: that is, target cued recall scores were worst in the normal object

and novel object conditions, while the gun yielded the highest scores. While at first this might seem counterintuitive, a feasible interpretation for this effect is that the gun drew more attention to the slideshow than did the glass, which was contextually appropriate, and also drew more attention than the chicken, which was simply unusual. Once participants paid more attention to the slideshow after seeing the attention-drawing object, they were then more receptive to further details about the target, who remained visible even after the object was presented because all timing conditions featured a final “exit” slide allowing several target details to remain visible to participants for another two seconds. Another explanation is that, because object identification was lowest in the novel object condition, this may have driven recall scores down in the novel object condition. This is especially feasible because object identification was grouped with target identification questions. Also, confusion over the nature of the novel object and what it was could have distracted participants from other details present in the slideshow.

Once again, I found a main effect of timing driven by higher scores in the during condition than in the before and after conditions. The lack of an Object X Timing interaction indicates that this is likely due to the object suddenly appearing alongside the face in the Object during condition sufficiently distracting attention of the participant away from the face, disrupting its encoding. To implicate the weapon focus effect for the Timing effect, an interaction would need to emerge where only the chicken and the gun yielded a decrement in memory for the target’s face, while the normal object did not disrupt encoding.

### **Multiple Choice Questions**

Dearth of a weapon focus effect on multiple choice questions could be due to the fact that these questions were administered after the lineups. Therefore, responses to questions pertaining to the target’s appearance were likely influenced by the commonalities among the members of

the lineup as much as to the participant's person memory for the target. However, these results are of a lesser interest to the current study because previous research that has counterbalanced the lineup and follow-up questioning administrations has found that interview questions influence lineup selections similarly to how lineup selections influencing interview responses (Cutler et al., 1986). In other words, witness's determination to remain internally consistent can potentially confound responses to whatever recognition memory measure is administered second.

The curious finding, then, is that a timing effect on multiple choice scores was nonetheless found, and it revealed the same pattern as the other timing effects, where the During timing yielded lower memory scores than the Before or After conditions. This, therefore, presents more evidence that the lack of a weapon focus pattern between object conditions is due to a weak effect on multiple choice questions probing recognition memory. So, the presentation of the lineup before these questions might not have been detrimental to the Object effect because none was going to be found in the first place. However, given the large number of participants in the study, immense amounts of statistical power may explain the finding of a weak, albeit significant effect.

### **Implications for Theoretical Accounts of the Weapon Focus Effect**

**Temporal Manipulations of Weapon Focus.** One interesting finding of the current study is that its manipulation of timing revealed a pattern of effects different from that found by Kramer et al. (1990). In their first experiment, they found that memory for the perpetrator and context was better when the weapon (in their case, a bottle) was brandished after the face. This differs from my result showing that the simultaneous condition had an advantage over the other two timing conditions. In my study, it is possible that being personally involved in the slide presentation influences attention paid to the presentation: Kramer et al. (1990) had participants

watch slideshows as passive viewers to scripted depictions of events occurring to other people, whereas my participants were actively involved in the slide presentation in a simulated exercise in bartending. Therefore, it is possible that a different level of processing (Craik & Lockhart, 1972) of the task may have influenced the timing effect in a way that shifts victim-witnesses' attention to more central details than third-party witnesses, whose attention is free to roam. Emotional arousal could also be implicated in this regard as well, because being personally victimized like my participants has been shown to enhance eyewitness accuracy over third-party witnesses who were not victims of crimes (Hosch & Cooper, 1982; Hosch et al., 1984).

**Lack of Weapon Focus Effect on Cued Recall.** Also in Kramer et al. (1990), no weapon focus effect was found in the condition where the object was presented on a single slide in the middle of the slide presentation. Here, the target was empty-handed for the entire presentation except for the third slide, where either a newspaper or meat cleaver was shown in the individual's hand. The absence of the effect may have been due to the fact that, regardless of the object condition, the sudden presence of the object was sufficiently distracting and drew attention to the slide presentation. A brief glance at their cell means shows that memory scores for the newspaper condition were lower than the other newspaper conditions in their other experiments, while memory scores in the meat cleaver condition were higher than the other scores but still contained more incorrect recollections than correct recollections. This would exclude the possibility, at least in their study, that the sudden presence of an object resulted in generally higher cued recall memory scores because more attention was suddenly drawn to the slide presentation itself. The meat cleaver's sudden appearance and disappearance were not enough to engender any emotional arousal, so arousal did not reduce the encoding of the images in the presentation. However, the meat cleaver and the newspaper were surprising, maybe even

puzzling, enough to the participants to equalize memory scores for both objects. This would explain why the weapon focus effect is diminished if the object suddenly appears, because any object would influence memory.

**Target-Present and Target-Absent Lineups.** Loftus, Loftus, and Messo (1987) called for future investigations of the weapon focus effect to include unusual objects and compare target-absent lineups to target-present lineups. The former call has been answered here as well as elsewhere (Hope & Wright, 2007; Pickel, 1998; 1999; 2009), but this study is one of only a very few to do examine the latter. The speculation by Loftus, Loftus, and Messo (1987) that weapon presence would result in more lineup rejections was not found; on the contrary, presence of unusual objects as well as weapons resulted in more target-absent identifications than the normal object. An influential factor in this result could be the manner in which the eyewitnesses made their lineup decisions. This study employed only simultaneous lineups, which encourage witnesses to use more relative judgments than sequential lineups (Carson & Gronlund, 2011; Lindsay & Wells, 1985; Wells, 1984). Perhaps unusual and threatening objects render witnesses especially susceptible to making relativistic judgments, whereas absolute judgments would not suffer as much because sequential lineups force witnesses to carefully elaborate on each lineup member before committing to reject. The general trend for sequential lineups is that they greatly reduce false alarms while they only moderately diminish hits. Therefore, this could be the answer to lowering foil selection rates in target-absent lineups when a weapon is employed.

### **Applied Implications**

In recent decades, law enforcement has begun to accept many empirical findings related to eyewitness memory. It is now commonly accepted by attorneys and trial judges that when a weapon is brandished during the course of a crime, an eyewitness's memory for the perpetrator's



face is diminished (Desmarais & Read, 2011). The current study replicated this finding specifically in regards to lineup selections. However, the new finding unique to this study is that unusual objects increase the likelihood of selecting a foil from a lineup from which the target is actually present. Crimes committed where unusual objects are brandished instead of weapons, then, produce their own decrement to eyewitness memory, and since this line of research is relatively young and sparsely investigated, its findings supply more information that criminal investigators should consider when discerning the probative value of an eyewitness's testimony. Although investigators and members of the general public might buy the idea that a weapon would reduce eyewitness accuracy, they might be harder sold the idea that a peculiar object can also disrupt memory; after all, people might more easily relate to the frightening feeling of being robbed with a weapon but less likely to believe that unusualness does anything other than make a witness briefly think, "Gosh, that's weird".

Desmarais and Read (2011) found in a survey that members of the general public are less acquainted with the concept of weapon focus than investigators and attorneys. Because ordinary citizens are also potential jurors in criminal trials, this could result in wrongful convictions based on eyewitness accounts of events where a weapon or unusual objects were involved. At the heart of this problem is the philosophical debate among scholars of law regarding whether preventing innocents from being imprisoned should take precedence over maximizing the number of guilty suspects imprisoned (Laufer, 1995). The traditional threshold for level of certainty of guilt used in the legal community is deemed the "Blackstone ratio" (Laufer, 1995, p. 333), and draws its inspiration from Blackstone's (1765) maxim that ten guilty people going free is preferable to a single innocent person being wrongfully punished. Both unusual and threatening objects significantly increase the likelihood of selecting such an innocent person from a target-absent

lineup, and my results also show that foil selections are increased with unusual objects. This should be troubling to officials attempting to optimize the number of correct convictions compared to wrongful convictions. The more members of law enforcement and the general public understand the fallibility of human memory, the fewer wrongful convictions will occur.

### **Future Research**

As mentioned earlier, the results of the current study have opened the door for future avenues of research within the same program. To resolve the timing effects that conflict with the findings of Kramer et al. (1990), another study could be carried out where bar patrons are depicted holding contextually appropriate objects, and in the critical slides the target would be seen holding either a glass, chicken, or gun. Another question I have raised is whether victim-witnesses who view events from a first-person point of view would suffer different memory decrements from third-person witnesses who are not as personally involved in the ongoing crime. This could be accomplished rather simply by producing first- and third-person stimulus materials and comparing them in the same model to measure different degrees of the weapon focus effect. A final interesting avenue, which has yet to be considered in eyewitness research, involves attempting to arm people against the weapon focus effect in a crime scenario. If the dual influence of arousal and unusualness is so strong, it may prove difficult to overcome with merely a verbal warning about the effect.

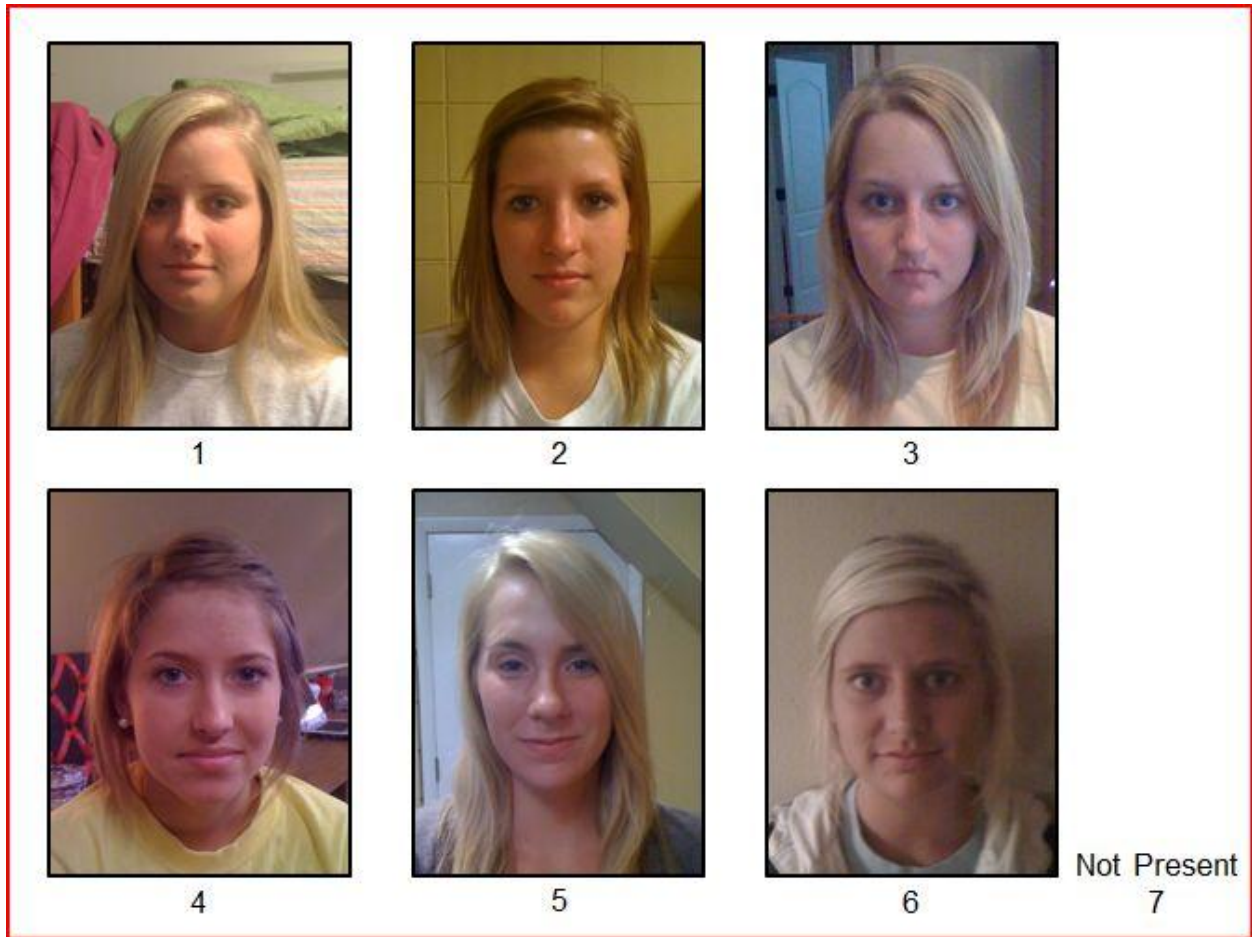
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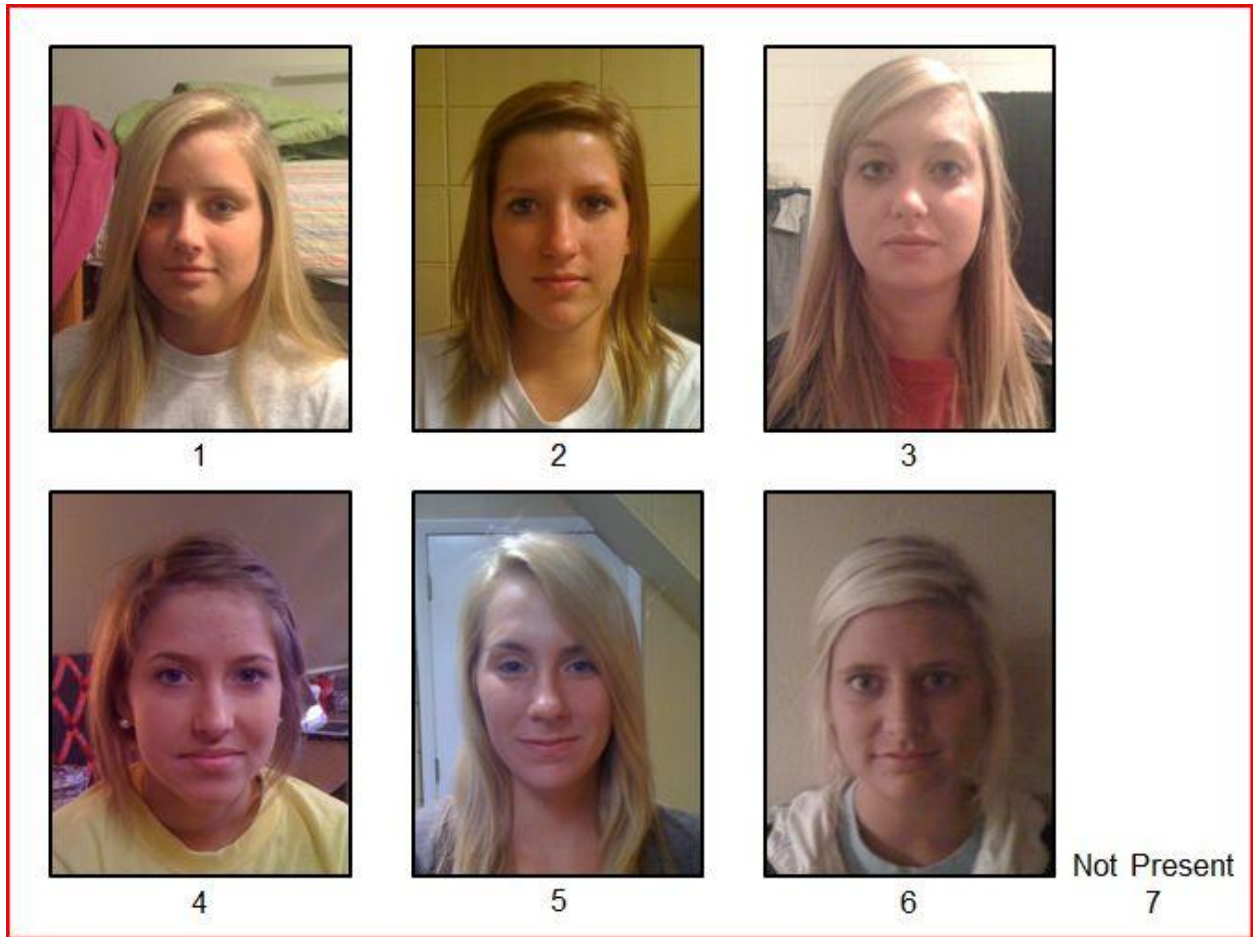
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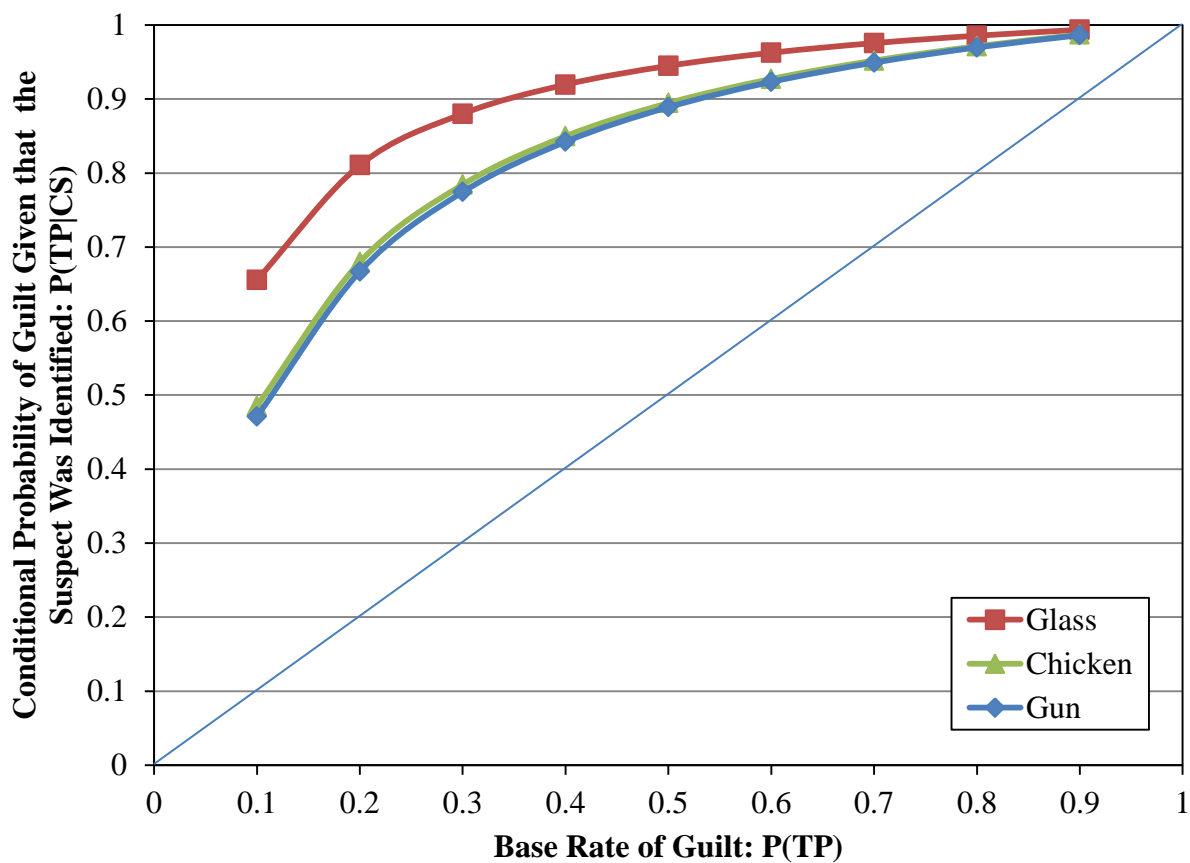


*Figure 1.* The target-present lineup, with the target in the “3” position. The five other target-present lineups featured the target in the other positions.

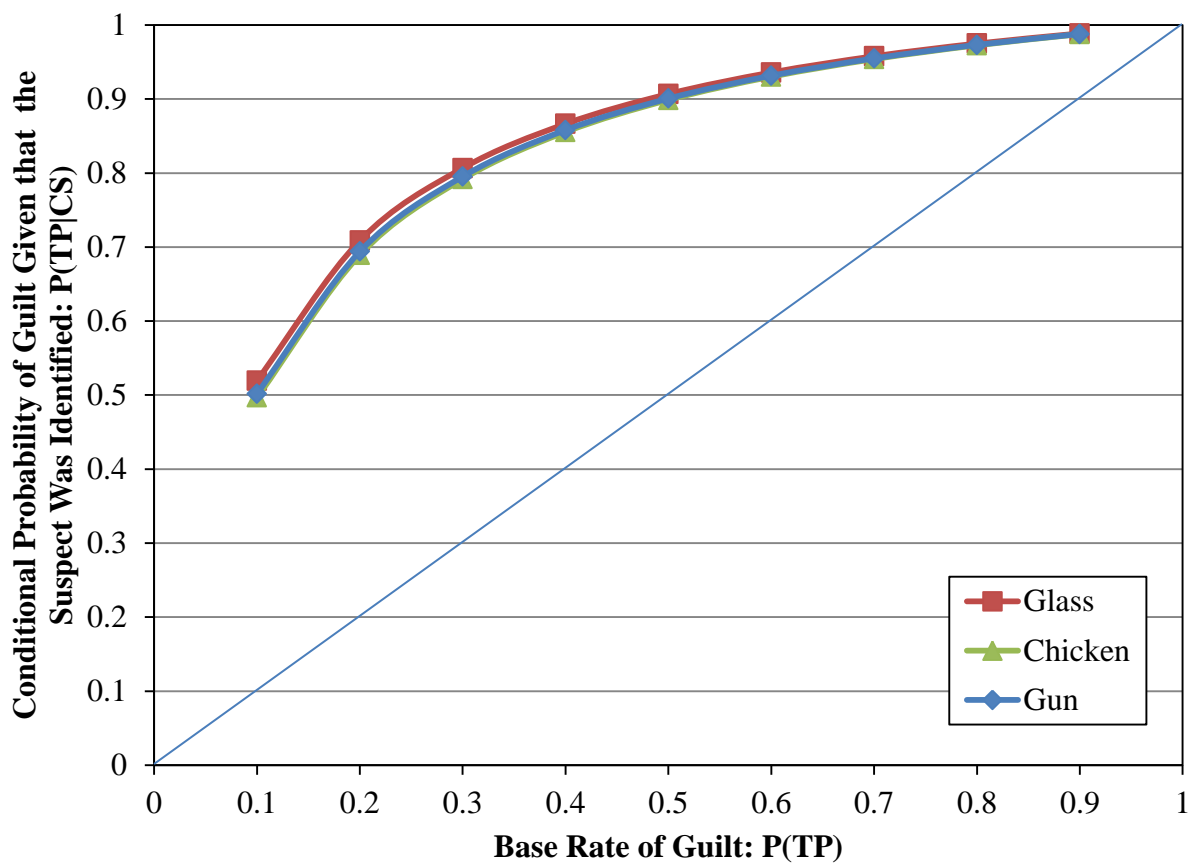


*Figure 2.* The target-absent lineup, with six foils similarity-rated ( $M = 4.27$ ,  $SD = 1.22$ ) on a seven-point Likert scale where 1 represents not similar and 7 represents extremely similar.

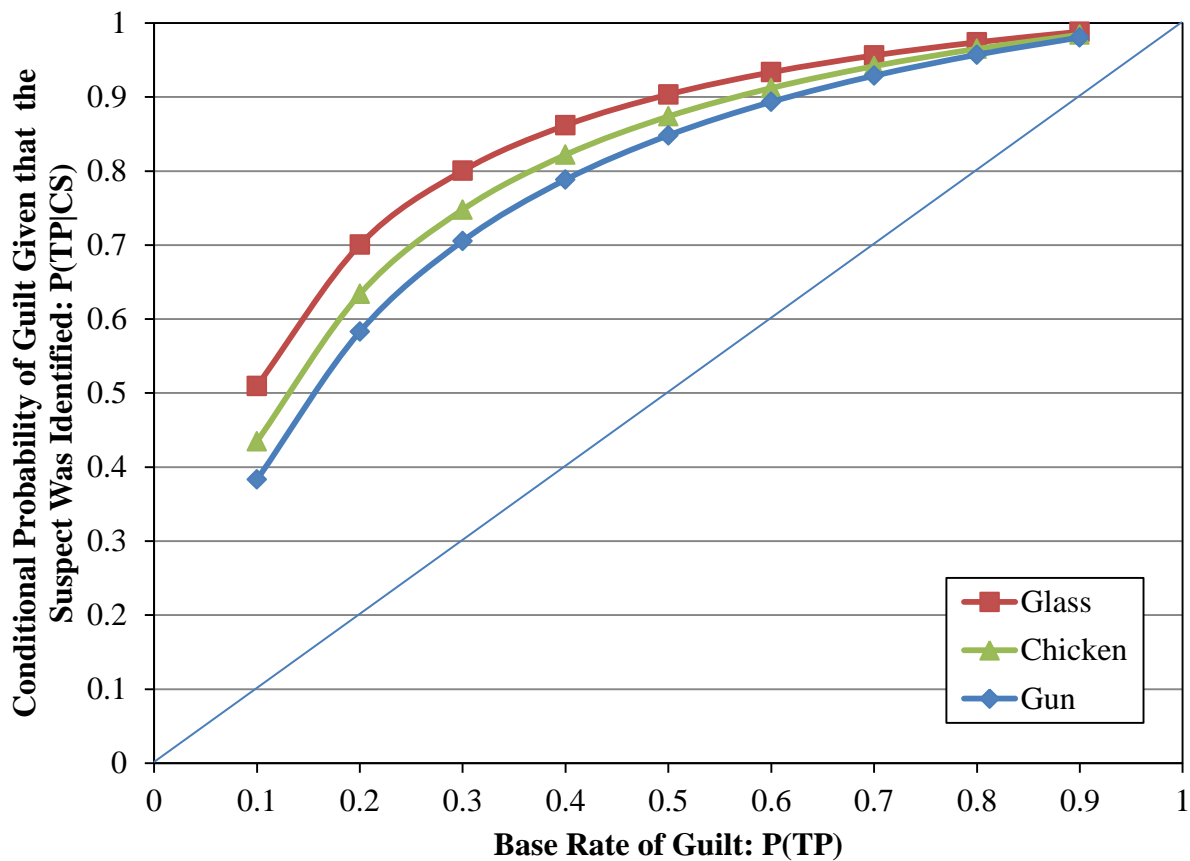




*Figure 3.* Conditional probabilities of guilt as a function of base rate for target selections when objects were presented after the suspect's face was visible. The diagonal represents a pure chance rate. The space below each curve indicates suspect guilt given selection, while the space above indicates probability of false alarms.



*Figure 4.* Conditional probabilities of guilt as a function of base rate for target selections when objects were presented before the suspect's face was visible. The diagonal represents a pure chance rate. The space below each curve indicates suspect guilt given selection, while the space above indicates probability of false alarms.



*Figure 5.* Conditional probabilities of guilt as a function of base rate for target selections when objects were presented simultaneously with the suspect's face. The diagonal represents a pure chance rate. The space below each curve indicates suspect guilt given selection, while the space above indicates probability of false alarms.

*Table 1.* Table presenting means (and standard deviations) for selection rates of targets and foils from target-present lineups and target-absent foil lineups at three levels of Object and three levels of Timing.

		Timing		
		After	Before	During
TP Targets	Normal	.75 (.43)	.73 (.45)	.71 (.46)
	Chicken	.70 (.46)	.68 (.47)	.63 (.49)
	Gun	.72 (.45)	.79 (.41)	.53 (.50)
TP Foils	Normal	.08 (.27)	.17 (.38)	.07 (.25)
	Chicken	.22 (.42)	.16 (.37)	.22 (.42)
	Gun	.16 (.37)	.09 (.29)	.13 (.33)
TA Foils	Normal	.74 (.44)	.55 (.50)	.55 (.50)
	Chicken	.51 (.50)	.54 (.50)	.46 (.50)
	Gun	.46 (.50)	.48 (.50)	.43 (.50)

*Table 2.* Proportions of identifications given suspect guilt, identifications given suspect innocence, diagnosticity ratios, and 95% confidence intervals derived through a bootstrapping procedure for each of the nine combinations of Object and Timing. Because no designated suspect was featured in the target-absent lineup, its proportion was divided by the number of foils in the lineup to produce adjusted diagnosticity ratios.

Combination	p(ID TP)	p(ID TA)	p(ID TA)/6	Diagnosticity	Bootstrapped CI
Normal/After	0.75	0.26	0.04	17.20	[12.14, 27.48]
Normal/Before	0.73	0.45	0.08	9.69	[7.37, 13.33]
Normal/During	0.71	0.46	0.08	9.38	[7.06, 13.03]
Chicken/After	0.70	0.49	0.08	8.47	[6.45, 11.52]
Chicken/Before	0.68	0.46	0.08	8.88	[6.67, 12.49]
Chicken/During	0.63	0.54	0.09	6.95	[5.32, 9.26]
Gun/After	0.72	0.54	0.09	8.00	[6.25, 10.49]
Gun/Before	0.79	0.52	0.09	9.05	[7.11, 12.04]
Gun/During	0.53	0.57	0.10	5.58	[4.10, 7.58]

*Table 3.* Proportions of rejections given suspect guilt, rejections given suspect innocence, diagnosticity ratios, and 95% confidence intervals derived through a bootstrapping procedure for each of the nine combinations of Object and Timing.

Combination	p(REJ TA)	p(REJ TP)	Diagnosticity	Bootstrapped CI
Normal/After	0.74	0.17	4.36	[2.68, 8.90]
Normal/Before	0.55	0.10	5.77	[3.06, 18.12]
Normal/During	0.55	0.22	2.43	[1.59, 4.19]
Chicken/After	0.51	0.09	5.83	[3.00, 18.50]
Chicken/Before	0.54	0.16	3.41	[2.10, 6.82]
Chicken/During	0.46	0.15	3.02	[1.77, 6.44]
Gun/After	0.46	0.12	3.89	[2.14, 9.88]
Gun/Before	0.48	0.12	4.04	[2.26, 9.35]
Gun/During	0.43	0.34	1.25	[.83, 1.97]

*Table 4.* Table presenting means (and standard deviations) of two sets of cued-recall scores at three levels of Object and three levels of Timing. Each correct response received a 1 and each incorrect response received a 0.

		After	Before	During
Cued-Recall Target Scores	Normal	4.75 (1.16)	4.52 (1.69)	3.65 (1.02)
	Chicken	4.65 (1.55)	4.61 (1.27)	3.69 (1.23)
	Gun	4.62 (1.27)	4.92 (1.42)	3.98 (1.27)
Cued-Recall Context Scores	Normal	1.61 (.95)	1.53 (1.04)	1.31 (.92)
	Chicken	1.48 (.91)	1.55 (1.05)	1.50 (.96)
	Gun	1.50 (.92)	1.58 (1.01)	1.48 (.99)

*Table 5.* Table presenting means (and standard deviations) of correct responses to the cued-recall question asking participants to identify the object the target held, at three levels of Object and three levels of Timing. Each correct response received a 1 and each incorrect response received a 0.

	After	Before	During
Glass	.96 (.20)	.91 (.29)	.91 (.29)
Chicken	.92 (.27)	.92 (.27)	.83 (.38)
Gun	.95 (.22)	.93 (.26)	.95 (.22)



*Table 6.* Table presenting means (and standard deviations) of total correct responses to multiple-choice questions regarding the target and the context in which she was viewed, at three levels of Object and three levels of Timing. Each correct response received a 1 and each incorrect response received a 0.

	After	Before	During
Glass	5.75 (1.04)	5.84 (.94)	5.55 (.91)
Chicken	5.82 (.97)	5.82 (.94)	5.38 (1.14)
Gun	5.76 (.99)	5.88 (.93)	5.45 (.89)

*Table 7.* Table presenting means (and standard deviations) for post-identification confidence ratings at two levels of Lineup, three levels of Object, and three levels of Timing. Participants rated confidence on a sliding scale of 0 to 100.

		After	Before	During
Target-Present Lineup	Glass	74.35 (25.26)	70.09 (23.56)	72.39 (24.18)
	Chicken	72.92 (24.20)	71.78 (29.43)	63.66 (22.40)
	Gun	74.49 (26.35)	77.67 (21.97)	65.90 (22.36)
Target-Absent Lineup	Glass	62.30 (21.74)	57.00 (25.29)	54.24 (24.25)
	Chicken	54.15 (25.48)	54.77 (23.76)	52.69 (24.24)
	Gun	57.18 (22.32)	64.32 (23.32)	61.30 (24.11)

*Table 8.* Table presenting means (and standard deviations) for post-identification ratings of viewing conditions at two levels of Lineup, three levels of Object, and three levels of Timing. Participants rated confidence on Likert-type scales from 1 to 10. Scores were standardized and averaged.

		After	Before	During
Target-Present Lineup	Glass	.32 (.50)	.08 (.49)	.14 (.58)
	Chicken	.06 (.56)	.16 (.49)	-.08 (.44)
	Gun	.41 (.44)	.23 (.48)	.10 (.53)
Target-Absent Lineup	Glass	.04 (.47)	-.22 (.44)	-.20 (.43)
	Chicken	-.08 (.51)	-.14 (.54)	-.32 (.42)
	Gun	-.06 (.45)	.00 (.50)	-.03 (.45)

## Appendix A

### **Cued-Recall Questions**

Below are more detailed questions pertaining to the last individual who entered the bar. Answer each to the best of your ability.

1. What ethnic group did the person belong to?
2. Did the individual have a mole, beauty mark, scar, or tattoo that was visible to you (list all that apply)?
3. Describe the shirt being worn by the individual.
4. Describe the pants being worn by the individual.
5. What object was the person holding?
6. Did you see the object the person was holding before or after you saw the person's face?

## Appendix B

### **Multiple-Choice Recognition Questions**

1. What gender was the individual? (Male, Female)
2. How would you describe the person's build? (Thin, Medium, Overweight)
3. What color hair did the individual have? (Blond, Brunette, Red)
4. What color eyes did the person have? (Brown, Blue, Green)
5. Was the individual right or left handed? (Right, Left)
6. Was the individual wearing any jewelry? (Yes, No)
7. Was the individual wearing glasses? (Yes, No)

## Appendix C

### Retrospective Questions

At the time you made your lineup choice, how certain were you that your choice was correct? Use the slider below to indicate your certainty on a scale ranging from 0% certain to 100% certain. A response of 0% indicates that, at the time you made your choice, you believed there was a 0% chance you were correct. A response of 100% indicates that, at the time you made your choice, you thought there was a 100% chance you were correct.

### Weapon Questions

At the very end of the slides, a woman appeared holding an object. That woman was a criminal. The following questions concern your responses to seeing her. Answer each of the questions below, indicating your response on a scale from 1 to 10

1. When the criminal appeared in the bar, did you pay more attention to her face or did you pay more attention to the object she was holding? (1=paid more attention to her face; 10=paid more attention to the object)
2. How surprised were you by the object that the criminal was holding? (1=not at all surprised; 10=very surprised)
3. How frightened were you by the object that the criminal was holding? (1=not at all frightened; 10=very frightened)
4. If you were really working at a bar, and the woman at the end of the slides approached you, how threatening would you find the object that she was holding? (1=not at all threatening; 10=extremely threatening)

5. In the context of working at a bar, how unexpected would it be for someone to approach the bartender holding the object that the woman at the end of the slides was holding?  
(1=not at all unexpected; 10=very unexpected)

### **Target Questions**

The woman at the end of the slides was the criminal. The following questions concern your reactions to the her. Answer each of the questions below, indicating your response on a scale from 1 to 10

1. How good a view did you get of the criminal? (1=very poor view; 10=excellent view)
2. How much attention were you paying to the face of the criminal? (1=none; 10=your total attention)
3. To what extent do you feel you had enough basis (enough information) to make your decision? (1= no basis at all; 10=a very good basis)
4. How easy or difficult was it for you to figure out which response to the lineup was the correct one? (1= extremely easy; 10= extremely difficult)
5. How willing would you be to testify in court that your selection was correct? (1= not at all willing; 10=totally willing)
6. Generally, how good is your recognition memory for the faces of strangers you have encountered on only one prior occasion? (1= very poor; 10=excellent)
7. How clear is the image you have in memory of the criminal who was shown at the end of the slides? (1= not at all clear; 10=very clear)
8. When deciding which response to choose, did you use a process of elimination or did the response you picked just & “popped out” at you? (1= process of elimination; 10=just “popped out” at me)

9. When presented with the lineup, how long did it take you to make your decision (1=not long; 10=very long time)
10. How much time did you have to look at the face of the criminal when she appeared in the bar? (1=not long; 10=very long time)
11. How far away did the criminal appear to be when she entered the bar? (1=very close; 10=very far)