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The basis of the weapon focus effect: evaluating the unusual item and arousal/threat hypotheses

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Abstract

This study attempted to investigate how well two leading explanations of the Weapon Focus Effect, A drop in memory performance as a result of the presence of a weapon, could account for its occurrence. The arousal/threat hypothesis attributes the WFE to an attentional narrowing induced by physiological arousal, whereas the unusual item hypothesis claims the memory deficit comes from difficulty processing objects schematically incongruent for their context, which causes them to draw more attention at memory encoding, at the expense of memory for other details. A sample of 72 participants aged between 17 and 66 watched one of four 1 minute long videos, manipulating weapon presence and level of threat shown, and assessed their recall on a 13 point multiple choice questionnaire. This study failed to replicate the Weapon Focus effect, as no significant differences were found when comparing participant memory performance in participants assigned to conditions featuring threat and weapon presence, and those in control conditions. Participants showed significantly higher self-reported stress as a result of threat presence and weapon presence, and rated the target item as more unusual in the weapon condition, indicating the manipulation of these variables was successful, though no association was found between these factors and recall accuracy. This study's inability to replicate the WFE is attributed to limitations in the questionnaire used to assess recall accuracy.

Traditionally, there are few events more dramatic in the proceedings of a criminal case than the moment an eyewitness identifies the defendant as the culprit of a crime they witnessed with their own eyes. Considering DNA evidence is a relatively recent development in criminal investigation, the testimony of an eyewitness is often the deciding factor for juries in voting for the conviction of a defendant (Wells & Olson, 2003). However, eyewitness identification and recall is far from infallible. Since the beginning of the use of DNA testing in post-conviction appeals, over 320 people have been exonerated in the United States, with 72% of these convictions being based on the testimony of an eyewitness (Wilson, Bernstein, & Hugenberg, 2016). In the UK, concerns over the reliability of eyewitness testimony have been raised to the home office as early as 1976, with the Devlin report recommending that no individual be convicted on the sole basis of an eyewitness identification (Devlin, 1976). Advances in cognitive psychology have highlighted issues in human memory that have implications for the levels of trust a jury should place in an eyewitness, such as decline in memory for events with age, difficulties in cross-racial perpetrator identification, and reduced identification accuracy as a result of limited exposure time to the perpetrator (Bornstein, Deffenbacher, Penrod & Mcgorty, 2012., Yarmey, 1985).

One of the most replicated findings in the investigation of eyewitness recall is a decrease in participant recall ability as a result of the presence of a weapon in a scene, which has a strong basis in research (Steblay, 1992., Fawcett, Russel, Peace, & Christie, 2011., Kocab & Sporer, 2016). Broadly defined, the Weapon Focus Effect (or WFE) is an object-related decrease in memory performance (normally assessed through feature recall or person identification) for elements of a visual scene presented simultaneously with a weapon (Fawcett et al, 2011). In one of the first studies investigating the WFE, Johnson & Scott (1976) saw participants sat in a

waiting room expecting to partake in a standard laboratory experiment, which served as a pretense for a staged crime. Participants assigned to the control condition overheard a benign conversation in an adjacent room regarding an equipment failure, before the target individual emerged from the room, with grease on his hands and holding a pen, and left. Participants in the experimental condition overheard a loud argument and the sound of furniture crashing coming from the same room, before the same target left the room carrying a bloodied letter opener, before once again exiting the room. Participants in the control group could identify the target out of a series of 50 photographs with 49% accuracy, while participants in the experimental group performed at around 33% accuracy in the same task, suggesting a memory related decrease as a result of seeing a more violent scene featuring a weapon. However, weapon presence was not the only difference between the two conditions, as they heard different conversations, different levels of implied violence, and differed on the presence of blood, and so it is difficult to attribute their results solely to the weapon focus effect.

One of the interesting findings of the Johnson and Scott study is that participants in the experimental condition could provide longer and more detailed descriptions of the target object. This provides early evidence for the leading theorised mechanism of how the WFE operates, namely by dividing attention at the memory encoding phase (Christianson, Loftus, Hoffman, & Loftus, 1991., Hope & Wright, 2007., Kocab & Sporer, 2016., Loftus, 1987., Pickel, 2015). This conceives of the WFE as an example of the Von Restorff effect, the phenomenon where people show greater ability to remember items that appear distinctive, due to their attention grabbing nature, compared to objects more mundane for their context, which are more likely to be overlooked at memory encoding (Von Restorff, 1933). This definition has been applied to weapons, with Loftus characterising weapons as objects which “appear to capture a good deal of…attention, resulting in, among other things, a reduced ability to recall other details from the

environment” (Loftus, 1979, p 35). This explanation was investigated by Loftus (1987). In this experiment, participants observed a series of slides depicting a man approaching a cashier at a fast food restaurant, and presenting them with either a cheque (control condition) or pointing a handgun at them (experimental condition). Using a multiple choice questionnaire investigating details about the scene and the perpetrator, as well as a lineup identification task, they replicated the WFE. Using eye tracking data, they found that the amount of fixations made on the target item was negatively correlated with accuracy in perpetrator description and identification, and participants made a greater number of fixations on the gun than the cheque, providing support for the notion that the WFE is rooted in attentional focus at memory encoding. Hope and Wright (2007) followed a similar paradigm, though participants were presented with a secondary task. Simultaneous to the slideshow, participants saw a small box on the screen showing a changing series of even numbers, and had to press a button to indicate when they had seen an odd number. Once again, the WFE was replicated in a questionnaire concerning details of the scene. They also found participants response time in the secondary task was significantly reduced in the weapon condition, which they concluded was a result of attentional fixation on the target item at the expense of the number display, and further suggesting attention is the basis of the weapon focus effect.

There are different explanations for why this attentional focus occurs, and what makes a weapon “distinctive” in regards to the Von Restorff effect. The first explanation attributes the attentional focus to physiological arousal induced by seeing a weapon, which causes participants to fixate on the object that induced that arousal (Loftus, 1987). This is based on Easterbrook’s (1959) Cue Utilisation hypothesis, which claims that as an individual experiences higher levels of stress, they experience an “attentional tunneling”, causing a decrease in the amount of environmental cues they can attend to, and leading them to place greater attention

on fewer details in the scene, such as a weapon, at the expense of other details, such as details of the perpetrator's appearance. A wealth of literature on the relationship between stress and eyewitness recall has shown every possible relationship between stress and memory, from damaging memory performance, to promoting it, to no observable effect (Deffenbacher et al, 2004). These complicated findings are typically explained through the Yerkes-Dodson curve, which claims the relationship between stress and memory is shaped in an inverted U, with participants showing low cognitive performance at rest, until mild arousal induces a state of alertness, which improves performance until arousal reaches levels high enough to put participants in a state of stress, at which point their performance suffers, and individuals begin to show results consistent with Easterbrook's cue utilisation hypothesis (Yerkes & Dodson, 1908). Christianson (1991) refined this explanation, noting the effect of arousal on the cues an individual can attend to are not uniform, and in fact individuals experiencing high levels of arousal show greater memory for the central details of a scene (e.g. in the context of WFE research, the weapon itself) at the expense of more peripheral details (such as the appearance of the perpetrator). Much research has investigated arousal as a potential cause of the weapon focus effect. Kramer, Buckhout, & Eugenio (1990) showed participants a slideshow featuring a group of men playing a card game, which erupted into an argument between the target individual and a second actor. In one condition, the target entered the room concealing from the viewer a glass bottle behind his back, cursed at his victim, and struck him with it. Another condition saw the situation proceed the same, except the target entered the room brandishing the weapon more obviously. They found memory for details about the perpetrator's appearance was greater in the condition with the concealed weapon, supporting the existence of the WFE. Results also indicated memory for details about the perpetrators appearance was negatively correlated with self-reported anxiety, providing evidence for arousal as the cause of the WFE. Studies such as Tooley (1987) attempted to investigate the role of arousal in the WFE through directly manipulating it outside of the method used to expose participants to a scene featuring a

weapon. In this study, participants viewed 21 slides featuring full body shots of men standing in a convenience store, holding either a weapon or a more neutral item (e.g. a can of soup), and their attention was manipulated through instructions to focus on either the participants face, their hands, the background, or to focus freely. Participants in conditions manipulating arousal were told they would be met with an electric shock while viewing the slides, or were exposed to bursts of white noise. The study supported the existence of the WFE in regards to person identifications, as well as attention as the mediating factor in this effect. There was found to be no interaction between induced arousal and attentional focus, a finding replicated by other studies attempting to directly manipulate arousal (Maass & Kohnken, 1989., Pickel, 1998). Though this theory proposes a promising explanation of the WFE, it suffers from definitional issues, such as what specifically distinguishes a “central” detail from a “peripheral” one, and how these details can be consistently classified (Kocab & Sporer, 2016., Heuer & Reisberg, 1990). Similar objections can be made to the use of the term “arousal” in the context of investigating how a witness’s emotion may impact their recollection of an event. Fear, anxiety, alertness, and stress all fall under the blanket term of “arousal”, with little regard for any qualitative differences between them, so it remains unknown if these different emotional states show differential effects on an individual’s memory (Deffenbacher et al, 2004., Fawcett et al, 2011, Brown, 2003). Investigations into the arousal explanation of the weapon focus effect have also been met with methodological limitations, particularly their reliance on self-report measures for arousal/anxiety, which are less reliable than empirical measures of physiological arousal, such as heart rate or galvanic skin response (Steblay, 1992., Fawcett, 2011). There is also doubt as to how well arousal induced in a laboratory setting can be reflective of the levels of stress experienced by someone experiencing a real violent crime. Even in experiments manipulating arousal through measures such as threatening electric shock, participants can be reasonably certain they stand no risk of death or serious bodily injury, unlike witnesses of crimes involving deadly weapons, and therefore it is unclear to what extent studies investigating

arousal show ecological validity. Weapon focus has also been elicited in studies featuring contexts designed to produce minimal arousal. In a second series of experiments, Kramer et al (1990) found that the weapon effect occurred in a blank, stark hallway. Their attempt at making the environment non-arousing was successful, as participants reported low levels of stress. This suggests there may be more in causing the weapon focus effect than merely high levels of arousal in the participant.

Rather than focusing on physiological arousal, some researchers have attributed the attentional basis for the weapon focus effect to the weapon's incongruence with its context, arguing that in most situations investigated, a weapon can be considered an unusual item (Pickel, 1998., Mitchell, Livosky, & Mather, 1998., Carlson & Carlson, 2012). This approach is based on a wealth of literature on attention, which notes that people fixate for longer and more frequently on items of greater informational value, and novel items may be more telling of the nature of a scene than items more congruent with it (Antes, 1974). In the context of weapon focus research, a gun will have more informational value than any other item in a convenience store, as it is the key item indicating the scene is showing a robbery. Much of the theoretical explanation for the unusual item hypothesis is based on Loftus and Mackworth's (1978) model of early visual scene processing. This model conceives of visual processing as a stepwise process, starting with attending to the general qualities of the scene. The individual objects of the scene are then attended to, and examined with reference to their consistency with existing schemas. Objects deemed inconsistent are then processed, and existing schemas are modified, or the object is re-assessed. Loftus and Mackworth claim this last step takes greater attention and therefore greater fixation to process, which they demonstrated through showing participants visual scenes with an obviously inconsistent aspect to them, such as an octopus in a farm scene (Loftus & Mackworth, 1978). This finding has been often replicated in regard to the processing and eye

tracking of participants viewing objects schematically incongruent with the scene they appear in (De Graef, Christiaens, & d'Ydewalle, 1990., Henderson, Week, & Hollingworth, 1999) Given that in most weapon focus literature, weapons such as firearms are unusual for their contexts (e.g. convenience stores, fast food restaurants, offices), the unusual item hypothesis argues that they are schematically incongruent with their context, which requires extra attentional resources to process, which comes at the cost for memory of items more congruent with the scene, and details Christianson would deem more "peripheral" (Christianson, 1992., Pickel, 1999). The unusual item hypothesis benefits from strong definitions in terms of what is considered "unusual", and how these items disrupt visual processing, which gives the hypothesis explanatory strength.

The unusual item hypothesis has varying levels of evidence from a variety of different experiments. In one of the first experiments to directly investigate unusualness and its role in the weapon focus effect, Mitchell et al (1998) showed participants one of four videos depicting an interaction between two businessmen, in which one reaches into his briefcase and produces a different item. In the control condition, he pulls out a hand, and greets the other with a handshake. In the unusual item condition, he produces a stick of celery. This study also manipulated threat in the weapon condition, and featured a handgun presented threateningly (pointed at the other businessman), and non-threateningly, where it was simply presented to the other. They found that participants assigned to the weapon and unusual item conditions showed a deficit in their memory for details about the scene and the target actor when measured on a multiple choice questionnaire. Interestingly, though there was no significant differences between participants in the weapon-threat condition and the novel item condition, the weapon-non-threat condition barely reached significance in performance compared to the controls, despite no changes to the target item, which suggests there is more to causing the WFE than simply just

unusualness (Mitchell et al, 1998). The finding of a novel item producing a memory deficit analogous to the WFE has been replicated by a number of studies featuring a variety of different items, including a feather duster, a child's stuffed toy, and a whole raw chicken (Pickel, 1998., Carlson & Carlson, 2012., Hope and Wright, 2007). Rather than manipulate the target item itself, Pickel provided evidence for the unusual item hypothesis through a series of experiments manipulating other details about the situation a weapon can appear in. In one experiment, participants observed a 2 minute video featuring a woman observing sports being played, before a man holding a handgun approached her (Pickel, 1999). She then gave him a handful of dollars, and he walked off. Threat was manipulated through altering how the target individual approached the victim, either pointing the weapon at her and threatening her, or greeting her neutrally. In one condition, this sequence took place at a sports event, and in another, at a shooting range. When assessed on a multiple choice questionnaire, they found participant's recall for details about the event and the perpetrator were significantly worse in the condition featuring a sporting event rather than the gun range, though there was no effect of context on lineup identification accuracy. Since a handgun is congruent with a shooting range, no weapon focus effect occurred, supporting the unusual item hypothesis. Similar results were found by studies manipulating the individual holding the weapon, finding reduced or eliminated weapon effects from individuals more expected to hold threatening objects, compared to those where a weapon is more expected, such as police officers compared to priests, African American men dressed in stereotypical clothing compared to white men, and men in general compared with women (Pickel, 1999., Pickel, 2009., Pickel & Sneyd, 2018., Kim, Park, & Lee, 2014).

While the unusualness hypothesis seems to be a promising explanation for the WFE, evidence from meta-analyses and experiments have often shown that while unusual items can produce results similar to weapons, they often produce lower effect sizes in comparison to them,

suggesting there is more involved in causing the weapon effect than simply the incongruence of the target item with its context (Hope & Wright, 2007., Fawcett, 2011., Erickson, Lampinen, & Leding, 2014., Carlson, Weatherford, Carlson, & Bednarz, 2016). When defining a “negative emotional event” which crimes can usually be considered to fall under, Christianson (1992) claimed the definition included being unusual and unexpected, as well as distressing. When manipulating both contextual unusualness and threat level in a scene presented in virtual reality, Kim, Park, and Lee (2014) posited that the unusualness and arousal explanations are not necessarily mutually exclusive, a hypothesis supported by their findings, as they found recall for details of the scene and perpetrator were weakest in the conditions that maximised threat and unusualness. This could explain the studies finding higher effect sizes for weapons, as they are both unusual and potentially arousing. Few studies have entertained the possibility of an interaction played by threat and unusualness, which suggests further research is needed in investigating this explanation.

Interestingly, Christianson’s definition doesn’t limit unusualness to simply the target, and highlights the possibility of situational unusualness contributing to the weapon effect. This highlights the possibility of an effect similar to the weapon effect being produced by unusual actions, rather than just unusual items. Studies investigating schematically incongruent objects being repurposed as weapons (e.g. glass bottles, staplers) have yielded mixed results (Kramer et al, 1990., Carlson & Carlson, 2012., Carlson et al, 2016). Kramer et al (1990) managed to produce the weapon effect using a glass bottle as the target item, despite this being a congruent object for the context of a group of adult men playing a card game. Some research has failed to find similar effects while investigating scene congruent items being used as weapons (Carlson & Carlson, 2012., Carlson et al, 2016). However, these studies only measured eyewitness recall through lineup identification, a measure that has been found to have a much weaker

relationship with weapon presence than more descriptive measures, such as questionnaires relating to the perpetrator's appearance, with many experiments and meta-analyses finding non-significant relationships, and effect sizes smaller than for perpetrator descriptions (Kocab & Sporer, 2016., Fawcett et al, 2011., Carlson et al, 2016., Pickel, 1999., Hope & Wright). Therefore, the possibility remains that the weapon effect can also be produced by actions unusual for their context, as well as items, which warrants further investigation, considering the likelihood that violent crimes occur with otherwise everyday items being used as weapons.

This study will attempt to investigate the weapon effect through manipulating weapon presence and the level of threat shown in a scene. It is anticipated that conditions featuring a weapon will show a reduced ability to recall details of a scene compared to a control group featuring a more contextually appropriate item, consistent with previous research demonstrating the WFE. Secondly, it is anticipated that conditions with a more obvious level of threat will show reduced recall ability. This should be the case for conditions featuring a weapon and a non-weapon, consistent with the arousal explanation, as higher levels of threat should push participants deeper into the yerkes-dodson curve, and research suggesting everyday items used unusually could produce the WFE. Finally, it is predicted that both arousal and unusualness play an additive role in producing the WFE, and so conditions featuring a weapon and the highest levels of threat should show the most reduced result compared to the controls.

Participants

72 participants took part in this study. Participants did not have to meet any specific requirements, as the study aimed to gather a wide range of participants from across the population. This sample was sufficient, as a one-tailed G*Power calculation was used to

produce a minimum sample size of 70 when the alpha was set at .05, and power set at .80, with a medium effect size. Of these participants, 21 were male, and 52 were female. The mean age of these participants was 28.63, with a minimum age of 17 and a maximum age of 66. The standard deviation of ages was 14.74.

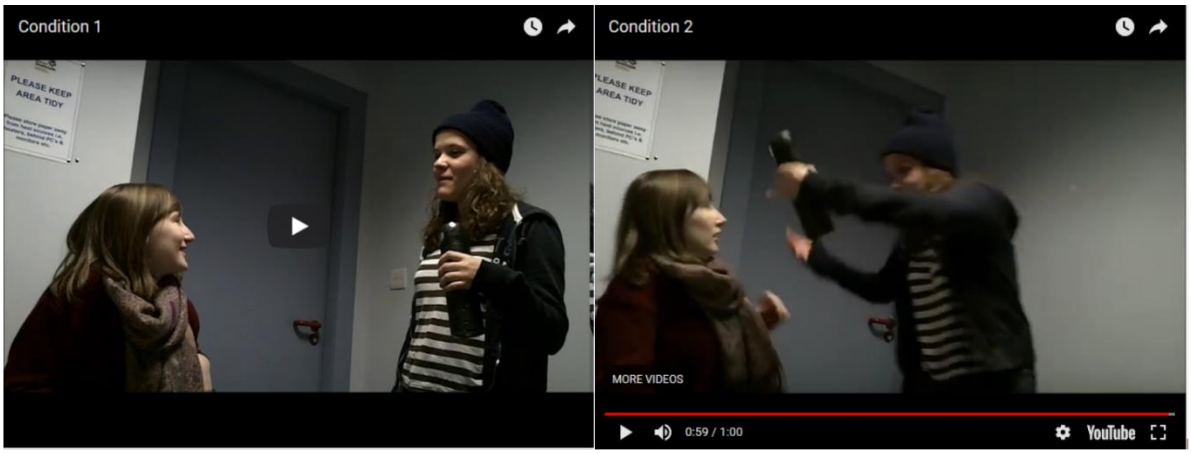
Design

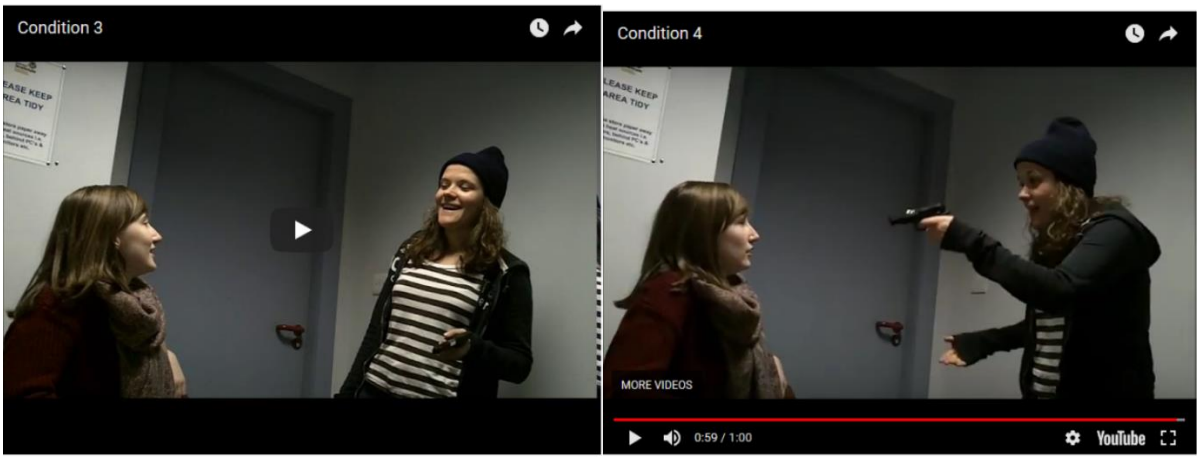
This study used a 2x2 independent measures design. The first independent variable manipulated was the presence of a weapon in the video, and the second was the level of aggression employed by the actors in the video. The experiment monitored two dependent variables, one being the amount of details the participant correctly recalled, and the second being the amount of misremembered details participants recalled. These measures were computed into an accuracy score, =number of correct details/[number of correct plus incorrect details]; in order to provide a measurement of recall accuracy that works independently of the total amount of recalled details, which was used to allow for comparison between studies (Kocab & Sporer, 2016).

Materials

4 videos were recorded in order to manipulate the variables of weapon and threat presence. In the 2 threat absent conditions, the video showed an actor (designated as “the victim”) sitting at a desk working on a laptop for around 15 seconds, before a second actor (designated “the perpetrator”) came in holding the target item. The two

actors had a conversation for about 1 minute, before the second actor waved goodbye and left the room. The threat present conditions followed the same format and timeline, with an argument erupting towards the end of the video, with the second actor making aggressive expressions and gestures, culminating in this actor appearing to swing the target item at the first actor's face, at which point the video ended. In the weapon present condition, the target item being carried by the perpetrator was a replica pistol, whereas in the weapon absent condition, this item was replaced by a coffee flask. The scene contained details such as clothing, characteristics of the actors' appearance, as well as details about the background, that served to test the participant's memory. A still from each condition is shown below (figure 1).





(**Figure 1**) Still images from each condition. Conditions featuring weapon presence are shown on the bottom row, with the control conditions on the top. Conditions featuring threat are shown on the right, while the non-threat controls are shown on the left.

The amount of details a participant could recall was assessed on a 13 point questionnaire, with questions concerning details about the perpetrator. Some of these questions were answered through multiple choice, and others followed an open response format, in order to maximise the amount of details participants could report. In the free recall section, participant's responses were scored as one correct detail for every part of a details they could recall (e.g. "Black jumper" was scored as 2 details, 1 for "black" and one for "jumper"). However, Cronbach's alpha was calculated to be -.632, suggesting this scale to be unreliable. After answering questions regarding the video they had witnessed, participants were asked if they had noticed the target item, and indicated on a 5 point Likert scale how threatened they felt by what they saw, as

well as how unusual they found the target item to be for its context. These questions were included to serve as manipulation checks.

Procedure

Participants who displayed interest in the study responded to adverts placed around the university campus and various social media platforms through email, and were assigned to an experimental condition. After being assigned to a condition, participants were sent a link via email to take part in the experiment online. Participants read an information sheet outlining the details and purpose of the experiment, and gave their consent for participation. Participants were instructed to observe the video clip corresponding to their condition, and complete the corresponding questionnaire, as well as the manipulation check questions. Participants were then presented with a short debrief giving further detail on the nature of the experiment, and thanked for their contribution.

Results

The means and standard deviations for the details of the perpetrator recalled are shown below (Table 1). The largest mean amount of correct details was remembered in the control condition, though the overall accuracy of recall in this condition is around the second highest level. While slightly less details were recalled in the no weapon-threat condition, they tended to be more accurate. The weapon-no threat group showed similar recall to the No-weapon-threat group, though less accuracy. The Weapon-Threat

group showed the lowest amount of details recalled, with the least amount of accuracy. These findings are broadly consistent with the first hypothesis, as less details were recalled (and less accurately) in conditions featuring weapons, compared to the control group. Support for the second hypothesis is mixed, as conditions featuring threat showed lower recall of correct details, though in the no-weapon-threat condition, accuracy for recalled details was higher than the control group. The third hypothesis was supported, as the largest deficit in memory recall and accuracy was seen in the weapon-threat group.

Table 1. Means (and standard deviations) of details remembered by participants in each condition.

	Details recalled correctly	**Incorrect details**	**Accuracy Score**
No Weapon-No Threat (control)	14.37(2.85)	1.47 (1.43)	0.91(0.87)
No Weapon-Threat	13.83 (2.18)	1.17 (1.04)	0.93 (0.66)
Weapon-No Threat	13.89 (3.05)	1.72 (1.67)	0.91 (0.82)
Weapon-Threat	13.35 (2.78)	1.88 (1.45	0.89 (0.89)

The results were analysed with a 2x 2 between subjects multiple analysis of variance, in order to investigate the effects of both the manipulated variables on the dependent variables of correct details and incorrect details, as well as on accuracy score. This analysis found no significant difference between groups assigned to conditions with a weapon presence and those assigned to the control, in both correct and incorrect details recorded, as well as in recall accuracy, $F(3, 65)=.370$, $p=.775$; Wilk's $\Lambda=0.983$, partial $\eta 2=0.017$, meaning no support for the first hypothesis was found. Similarly, no significant difference was found between participants assigned to high threat conditions and those assigned to the control, $F(3, 65)=.495$, $p=.687$; Wilk's $\Lambda=.978$, partial $\eta 2=.022$, meaning there was also no support for the second hypothesis. Finally, no significant interaction effect was detected between these manipulated variables, $F(3, 65)=.561$, $p>.643$; Wilk's $\Lambda=.975$, partial $\eta 2=.025$, and so there was no support for the third hypothesis.

This study included two 5 point Likert scale questions at the end of the questionnaire, asking participants to indicate how unusual they found the target item to be for its context, and to rate how stressed they felt by what they had witnessed. A 2x2 between subjects analysis of variance was conducted in order to see the effects of both weapon presence and threat presence on the dependent variable of self-reported stress. There was a significant effect of threat on self-reported stress, $F(1,67)=7.33$, $p=.009$, suggesting the variable of threat was successfully manipulated. There was also a significant effect of weapon presence on self-reported stress, $F(1,67)=4.48$, $p=038$. An

interaction effect was also found, F(1,67), p=.038, suggesting these factors interact to produce higher self-reported stress. A second 2x2 between subjects ANOVA found that ratings of unusualness of the target item was significantly associated with weapon presence, F(1,67)=30.87, p=.000, while no such relationship was found between threat and item unusualness, F(1,67)=.248, p=.620.

A non-significant positive correlation was found when investigating the relationship between self-reported stress and recall accuracy with a Pearson's correlation, r=.037, N=71, p=.759, suggesting no relationship between these variables. Similarly, no correlation was found between how unusual the participants found the target item to be and how accurately they recalled details of the scene, r=-.008, N=71, p=.945.

Discussion

This study failed to find any decrease in memory performance as a result of the presence of a weapon, meaning no support was found for the first hypothesis. There was also no deficit in memory performance as a result of the presence of threat, and so there was no support for the study's second hypothesis. Since there was no observable influence of weapon presence or threat on memory recall performance, the third hypothesis of an additive effect between these two factors also remains unsupported.

The findings of this study are surprising in regards to previous research and theory. Most notably, this study failed to replicate the weapon focus effect, a phenomena that has shown to be consistently reliable since it's discovery (Fawcett et al, 2011., Kocab &

Sporer, 2016., Steblay, 1992). Some previous research has found weak or non-significant relationships between weapon presence and accuracy of perpetrator descriptions (Loftus, 1987-experiment 1., Shaw & Skolnick, 1999). However, meta-analyses have previously found stronger instances of the weapon focus effect when measured through a memory recall questionnaire, as opposed to a line-up identification task (Fawcett et al, 2011., Kocab & Sporer, 2016). It is possible no effect was detected due to limitations in the questionnaire, as reliability tests deemed the scale to be unreliable. While the questionnaire is strengthened through its use of a mixture of cued recall questions and multiple choice, it has a comparably fewer number of items compared to studies making use of similar questionnaires, with only 13 items, which may have reduced this study's chances of detecting any differences between the conditions (Kim, Park, & Lee, 2014., Loftus et al, 1987., Pickel, 1999., Pickel & Sneyd, 2018). Previous research has attempted to maximise their chances of finding an effect through ensuring the content of their stimuli were rich in detail. Though the stimuli used in the current study were comparable to those used in previous studies in terms of run time, number of actors, and the actions depicted, the videos used by this study took place in a moderately stark environment (a small, mostly empty office room), and there were few details about the target individual for the participant to recall outside of their basic appearance (e.g no jewellery, no accessories, no emphasised mannerisms or distinctive features such as tattoos or piercings) in comparison to stimuli used by some previous research (Kim, Park, & Lee, 2014., Loftus et al, 1987., Pickel, 1999., Pickel & Sneyd, 2018).

This study was also possibly hindered in its attempt at replicating the weapon focus effect through its lack of a distinctive retention interval and filler task. According to prevailing models of forgetting, memory is suggested to decay in quality over time, uniformly affecting different aspects of a scene at encoding, such as memory for faces, words, and animals (Kassin, 1989., Wixted & Ebbesen, 1997). These findings have been applied to eyewitness testimony research, with some studies finding a decrease in total memory recall for person attributes when asked to provide details of the perpetrator in a crime they witnessed (Ebbesen & Rienick, 1998). Retention interval is often considered an important mediating variable in the weapon focus effect, with analysis of archival data by Tollestrup, Turtle, & Yuille, (1994) finding the effects of weapon presence on memory only reached significance after witness's retention interval was included in their analysis. In order to maximise their chances of finding an effect, and attempting to bear at least some similarity to how real life criminal cases proceed, most studies include lengthy filler tasks between when the target scene is initially presented and when participants are tested on their recall of that scene, employing tasks such as 20 minutes of solving mathematical problems, or 15 minutes of watching slides and writing descriptions of them (Hope & Wright, 2007., Loftus et al, 1987). While this study included a brief period between stimulus presentation and memory assessment where participants were asked to complete demographic information, this took no more than 1 minute, a relatively small retention interval, as previous research has designated even up to 10 minutes as a "immediate" in the context of weapon focus research, in comparison to research opting for "short" intervals, of anywhere between 10 minutes and 24 hours, or "long" intervals of over 24 hours (Fawcett et al, 2011).

Meta-analyses by Fawcett et al (2011) found retention interval could account for a significant amount of variability of results in the 28 studies they investigated. Therefore, it is possible an insufficient retention interval in the current study may explain the incongruence in results with previous research.

The lack of any detection of a relationship between self-reported stress and participant recall performance suggests the results of this study are inconsistent with the arousal explanation of the weapon focus effect. Manipulation check items of the questionnaire found self-report anxiety was higher in conditions with the presence of threat, suggesting this variable was successfully manipulated to some degree by the current study, so the current study's findings casts doubt on theory indicating stress has a negative impact on memory performance (Easterbrook, 1959). However, it is possible the results of this study are explainable through the Yerkes-Dodson curve (Yerkes & Dodson, 1908). Used to explain the diverse range of findings in studies investigating the relationship between stress and memory, this curve claims that stress within an individual facilitates memory performance up to a certain point, after which an individual's capacity to attend to items of a visual scene decreases (Easterbrook, 1959). Given this study found a small, positive non-significant relationship between stress and memory accuracy, it is possible the content of the video was not arousing enough to push participants stress levels to the point where they would start to show an observable decline in memory performance.

This study therefore adds to the inconsistency of results from studies investigating the role of arousal in the weapon focus effect. Pickel's research, though primarily focussed on manipulating unusualness of the target item, seems to have consistently found null results in their attempts to manipulate the level of threat in scenes presented to participants via slideshow or video, consistent with the results of this study (Pickel, 1998, 1999, 2009., Pickel & Sneyd, 2018). Other research has attempted to manipulate arousal through means external to the presented stimuli, such as via white noise. Results of these studies have often shown results consistent with the present study, casting further doubt on the arousal explanation of weapon focus (Tooley et al, 1987). In contrast, other studies investigating the weapon focus effect and arousal have used more extreme methods to elicit arousal. In one such study by Peters (1988), participants were assessed on their recall of a nurse giving them an injection with a sharp syringe, which they found produced a deficit in recall ability compared the controls, who didn't receive any such injection. Meta-analysis by Fawcett et al (2011) distinguished between studies "High" in threat, such as studies featuring the threat of bodily harm to the participant or confederates, and those "low" in threat, such as studies presenting weapons in a less grounded way, such as via slideshow or video, and subsequently found method of displaying threat could account for some of the variation of results in weapon focus research. While the results of the current study oppose the arousal-threat hypothesis, it is possible participants didn't experience stress severe enough to show a notable decrease in memory.

While this study found no observable relationship between reported unusualness of the target item and accuracy of participant recall, participants in the weapon condition were more likely to indicate the item was unusual for its context. While this study failed to replicate the weapon focus effect, participants' rating of the target item is consistent with the unusual item hypothesis, which claims the cause of the weapon focus effect lies in recognition of the target item as incongruent with its context, which consequently draws more attention in order to process this inconsistency (Pickel, 1998). Proponents of this explanation often claim that unusualness is the sole determinant in eliciting the weapon focus effect, and their results are unexplainable by any part of the arousal hypothesis (Pickel, 1998, 1999, 2009). However, this study also found that the presence of a weapon caused participants to report higher levels of stress, even outside of conditions attempting to manipulate threat. From analysis of the two manipulation check questions, participants appear to react to the presence of a weapon with both stress and surprise. Given that the unusualness hypothesis and the arousal hypothesis are not necessarily mutually exclusive, these findings could point towards a more hybrid explanation advocated by some researchers (Christianson, 1992., Kim et al, 2014). However, due to the non-significant findings of this study in regards to the weapon focus effect, these findings cannot yet be linked to this phenomena. It is advised that future research into the causes of the weapon focus effect should employ similar measures of stress and item unusualness in order to more closely tie any observed effects to these theoretical explanations.

It is recommended that future research into the weapon focus effect should adopt a more ecological approach. Previously, research in this area has been dominated by laboratory research, primarily studies presenting stimulus materials through slideshows and short videos (Pickel, 1998, 1999, 2009., Pickel & Sneyd, 2018., Mitchell et al, 1998., Loftus, 1987, Hope & Wright, 2007., Fawcett et al, 2011). In order to create an environment more ecological, research has found promising results when investigating the weapon focus effect through the use of virtual reality, which could serve to provide a more immersive environment for participants in laboratory based experiments. (Kim, Park, & Lee, 2014)

This study intended to investigate the two leading explanations of the Weapon Focus Effect, through manipulating weapon and threat presence, as well as using self-report items to tie any observed effects to current theoretical models. No effect was observed on participant recall as a result of either of these manipulations, though manipulation check items indicate that these manipulations were successful. The lack of observed effects should be attributed to methodological shortcomings, mainly inadequacy of the main measurement used.

Ethical Reflection

In order to investigate the Weapon Focus Effect, this study showed participants videos displaying varying levels of weapon presence and threat. Therefore, the study required exposing participants to potentially stressful material. In order to attempt to keep this presentation ethical, participants were informed prior to the beginning of the video that they may be witnessing a simulation of a threatening crime, and informed they had the right to withdraw if they had doubts about participation. However, in order to avoid priming participants to focus on the weapon in weapon present conditions, participants were not warned of the potential presence of a weapon in the stimulus videos. Given the presence of a weapon could be stressful to participants, this omission was potentially ethically risky. However, the study attempted to warn participants about potential stressors before participation, which could include weapon presence, and they were sufficiently debriefed as to the reasons behind their exposure to these materials after completing the questionnaire. Future research could attempt to reduce any ethical risks by warning participants about stressful items, rather than stressful material in general, in order to ensure properly informed consent.

The distribution of this study through online surveys may present an ethical limitation. Since participants took part in their own time and through their own computers, the researchers were not present to ensure participants well-being. There was also no attempt in the current study to restore participants to positive affect after witnessing a potentially threatening crime, which could have caused a lasting state of stress. Future

research should attempt to ensure participant well-being through monitoring them during and after the presentation of stressful materials, and employ measures to reduce any stress following the study’s conclusion.

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Appendices

Descriptives

			Statistic	Std. Error
student	Mean		1.3472	.05650
	95% Confidence Interval for Mean	Lower Bound	1.2346	
		Upper Bound	1.4599	
	5% Trimmed Mean		1.3302	
	Median		1.0000	
	Variance		.230	
	Std. Deviation		.47943	
	Minimum		1.00	
	Maximum		2.00	
	Range		1.00	
	Interquartile Range		1.00	
	Skewness		.656	.283
	Kurtosis		-1.616	.559
sex	Mean		1.7083	.05394
	95% Confidence Interval for Mean	Lower Bound	1.6008	
		Upper Bound	1.8159	
	5% Trimmed Mean		1.7315	
	Median		2.0000	
	Variance		.210	
	Std. Deviation		.45772	
	Minimum		1.00	
	Maximum		2.00	
	Range		1.00	
	Interquartile Range		1.00	
	Skewness		-.936	.283
	Kurtosis		-1.156	.559
age	Mean		28.6389	1.73693
	95% Confidence Interval for Mean	Lower Bound	25.1755	
		Upper Bound	32.1022	
	5% Trimmed Mean		27.2284	
	Median		21.0000	
	Variance		217.220	
	Std. Deviation		14.73838	

	Minimum	17.00	
	Maximum	66.00	
	Range	49.00	
	Interquartile Range	7.25	
	Skewness	1.563	.283
	Kurtosis	.921	.559

sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	21	28.8	29.2	29.2
	female	51	69.9	70.8	100.0
	Total	72	98.6	100.0	
Missing	System	1	1.4		
Total		73	100.0		

student

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	student	47	64.4	65.3	65.3
	non-student	25	34.2	34.7	100.0
	Total	72	98.6	100.0	
Missing	System	1	1.4		
Total		73	100.0		

Reliability Statistics

Cronbach's Alpha[a]	N of Items
-.632	2

Descriptive Statistics

	Threat_presence	weapon_presence	Mean	Std. Deviation	N
details_correct	no_threat	no_weapon	14.3889	2.93336	18
		weapon	14.2941	2.59241	17
		Total	14.3429	2.73262	35
	threat	no_weapon	13.8333	2.17607	18
		weapon	13.4444	2.72725	18
		Total	13.6389	2.43959	36
	Total	no_weapon	14.1111	2.56100	36
		weapon	13.8571	2.65843	35
		Total	13.9859	2.59391	71
details_incorrect	no_threat	no_weapon	1.5000	1.46528	18
		weapon	1.4118	1.37199	17
		Total	1.4571	1.40048	35
	threat	no_weapon	1.1667	1.04319	18
		weapon	1.8889	1.40958	18
		Total	1.5278	1.27584	36
	Total	no_weapon	1.3333	1.26491	36
		weapon	1.6571	1.39205	35
		Total	1.4930	1.32959	71
Accuracy_score	no_threat	no_weapon	.9063	.08703	18
		weapon	.9107	.08291	17
		Total	.9085	.08383	35
	threat	no_weapon	.9250	.06558	18
		weapon	.8794	.08860	18
		Total	.9022	.08022	36
	Total	no_weapon	.9156	.07653	36
		weapon	.8946	.08609	35
		Total	.9053	.08149	71

Box's Test of Equality of Covariance Matrices[a]

Box's M	31.234
F	1.593
df1	18

df2	15776.128
Sig.	.053

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Threat_presence + weapon_presence + Threat_presence * weapon_presence

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	1.000	86383.063[b]	3.000	65.000	.000
	Wilks' Lambda	.000	86383.063[b]	3.000	65.000	.000
	Hotelling's Trace	3986.911	86383.063[b]	3.000	65.000	.000
	Roy's Largest Root	3986.911	86383.063[b]	3.000	65.000	.000
Threat_presence	Pillai's Trace	.022	.495[b]	3.000	65.000	.687
	Wilks' Lambda	.978	.495[b]	3.000	65.000	.687
	Hotelling's Trace	.023	.495[b]	3.000	65.000	.687
	Roy's Largest Root	.023	.495[b]	3.000	65.000	.687
weapon_presence	Pillai's Trace	.017	.370[b]	3.000	65.000	.775
	Wilks' Lambda	.983	.370[b]	3.000	65.000	.775
	Hotelling's Trace	.017	.370[b]	3.000	65.000	.775
	Roy's Largest Root	.017	.370[b]	3.000	65.000	.775
Threat_presence * weapon_presence	Pillai's Trace	.025	.561[b]	3.000	65.000	.643
	Wilks' Lambda	.975	.561[b]	3.000	65.000	.643
	Hotelling's Trace	.026	.561[b]	3.000	65.000	.643
	Roy's Largest Root	.026	.561[b]	3.000	65.000	.643

a. Design: Intercept + Threat_presence + weapon_presence + Threat_presence * weapon_presence

b. Exact statistic

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
details_correct	.705	3	67	.552
details_incorrect	.385	3	67	.764
Accuracy_score	.357	3	67	.784

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Threat_presence + weapon_presence + Threat_presence * weapon_presence

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	details_correct	10.234[a]	3	3.411	.496	.6
	details_incorrect	4.851[b]	3	1.617	.911	.4
	Accuracy_score	.020[c]	3	.007	.981	.4
Intercept	details_correct	13888.007	1	13888.007	2019.519	.0
	details_incorrect	157.918	1	157.918	88.990	.0
	Accuracy_score	58.162	1	58.162	8751.149	.0
Threat_presence	details_correct	8.757	1	8.757	1.273	.2
	details_incorrect	.092	1	.092	.052	.8
	Accuracy_score	.001	1	.001	.106	.7
weapon_presence	details_correct	1.037	1	1.037	.151	.6
	details_incorrect	1.783	1	1.783	1.004	.3
	Accuracy_score	.007	1	.007	1.128	.2
Threat_presence * weapon_presence	details_correct	.384	1	.384	.056	.8
	details_incorrect	2.913	1	2.913	1.642	.2
	Accuracy_score	.011	1	.011	1.670	.2
Error	details_correct	460.752	67	6.877		
	details_incorrect	118.895	67	1.775		
	Accuracy_score	.445	67	.007		
Total	details_correct	14359.000	71			
	details_incorrect	282.000	71			
	Accuracy_score	58.653	71			
Corrected Total	details_correct	470.986	70			
	details_incorrect	123.746	70			
	Accuracy_score	.465	70			

a. R Squared = .022 (Adjusted R Squared = -.022)

b. R Squared = .039 (Adjusted R Squared = -.004)

c. R Squared = .042 (Adjusted R Squared = -.001)

Estimates

Dependent Variable	Threat_presence	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
details_correct	no_threat	14.342	.443	13.456	15.227
	threat	13.639	.437	12.767	14.511
details_incorrect	no_threat	1.456	.225	1.006	1.906
	threat	1.528	.222	1.085	1.971
Accuracy_score	no_threat	.909	.014	.881	.936
	threat	.902	.014	.875	.929

Pairwise Comparisons

Dependent Variable	(I) Threat_presence	(J) Threat_presence	Mean Difference (I-J)	Std. Error	Sig.[a]	9 Low
details_correct	no_threat	threat	.703	.623	.263	
	threat	no_threat	-.703	.623	.263	
details_incorrect	no_threat	threat	-.072	.316	.821	
	threat	no_threat	.072	.316	.821	
Accuracy_score	no_threat	threat	.006	.019	.746	
	threat	no_threat	-.006	.019	.746	

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.022	.495[a]	3.000	65.000	.687	.022
Wilks' lambda	.978	.495[a]	3.000	65.000	.687	.022
Hotelling's trace	.023	.495[a]	3.000	65.000	.687	.022
Roy's largest root	.023	.495[a]	3.000	65.000	.687	.022

Each F tests the multivariate effect of Threat_presence. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
details_correct	Contrast	8.757	1	8.757	1.273	.263	.019
	Error	460.752	67	6.877			
details_incorrect	Contrast	.092	1	.092	.052	.821	.001
	Error	118.895	67	1.775			
Accuracy_score	Contrast	.001	1	.001	.106	.746	.002
	Error	.445	67	.007			

The F tests the effect of Threat_presence. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
details_correct	Contrast	8.757	1	8.757	1.273	.263	.019
	Error	460.752	67	6.877			
details_incorrect	Contrast	.092	1	.092	.052	.821	.001
	Error	118.895	67	1.775			
Accuracy_score	Contrast	.001	1	.001	.106	.746	.002
	Error	.445	67	.007			

The F tests the effect of Threat_presence. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Descriptive Statistics

	Threat_presence	weapon_presence	Mean	Std. Deviation	N
threat	no_threat	no_weapon	1.0556	.23570	18
		weapon	2.1765	1.33395	17
		Total	1.6000	1.09006	35
	threat	no_weapon	2.3333	1.13759	18

		weapon	2.3333	1.37199	18
		Total	2.3333	1.24212	36
	Total	no_weapon	1.6944	1.03701	36
		weapon	2.2571	1.33599	35
		Total	1.9718	1.21857	71
unusual	no_threat	no_weapon	2.5000	1.15045	18
		weapon	4.5294	1.12459	17
		Total	3.4857	1.52183	35
	threat	no_weapon	3.0000	.68599	18
		weapon	3.7778	1.21537	18
		Total	3.3889	1.04957	36
	Total	no_weapon	2.7500	.96732	36
		weapon	4.1429	1.21614	35
		Total	3.4366	1.29540	71

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.938	503.090[b]	2.000	66.000	.000
	Wilks' Lambda	.062	503.090[b]	2.000	66.000	.000
	Hotelling's Trace	15.245	503.090[b]	2.000	66.000	.000
	Roy's Largest Root	15.245	503.090[b]	2.000	66.000	.000
Threat_presence	Pillai's Trace	.100	3.667[b]	2.000	66.000	.031
	Wilks' Lambda	.900	3.667[b]	2.000	66.000	.031
	Hotelling's Trace	.111	3.667[b]	2.000	66.000	.031
	Roy's Largest Root	.111	3.667[b]	2.000	66.000	.031
weapon_presence	Pillai's Trace	.355	18.167[b]	2.000	66.000	.000
	Wilks' Lambda	.645	18.167[b]	2.000	66.000	.000
	Hotelling's Trace	.551	18.167[b]	2.000	66.000	.000
	Roy's Largest Root	.551	18.167[b]	2.000	66.000	.000
Threat_presence * weapon_presence	Pillai's Trace	.144	5.556[b]	2.000	66.000	.006
	Wilks' Lambda	.856	5.556[b]	2.000	66.000	.006
	Hotelling's Trace	.168	5.556[b]	2.000	66.000	.006
	Roy's Largest Root	.168	5.556[b]	2.000	66.000	.006

a. Design: Intercept + Threat_presence + weapon_presence + Threat_presence * weapon_presence

b. Exact statistic

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	threat	20.529[a]	3	6.843	5.496	.002
	unusual	41.618[b]	3	13.873	12.255	.000
Intercept	threat	276.683	1	276.683	222.235	.000
	unusual	845.440	1	845.440	746.832	.000
Threat_presence	threat	9.128	1	9.128	7.331	.009
	unusual	.281	1	.281	.248	.620
weapon_presence	threat	5.572	1	5.572	4.476	.038
	unusual	34.947	1	34.947	30.871	.000
Threat_presence * weapon_presence	threat	5.572	1	5.572	4.476	.038
	unusual	6.947	1	6.947	6.137	.016
Error	threat	83.415	67	1.245		
	unusual	75.846	67	1.132		
Total	threat	380.000	71			
	unusual	956.000	71			
Corrected Total	threat	103.944	70			
	unusual	117.465	70			

a. R Squared = .197 (Adjusted R Squared = .162)

b. R Squared = .354 (Adjusted R Squared = .325)

Tests of Between-Subjects Effects

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Correlations

		threat	Accuracy_score
threat	Pearson Correlation	1	.037
	Sig. (2-tailed)		.759
	N	71	71
Accuracy_score	Pearson Correlation	.037	1
	Sig. (2-tailed)	.759	
	N	71	71

Correlations

		Accuracy_score	unusual
Accuracy_score	Pearson Correlation	1	-.008
	Sig. (2-tailed)		.945
	N	71	71
unusual	Pearson Correlation	-.008	1
	Sig. (2-tailed)	.945	
	N	71	71