Internet Journal of Criminology© 2017

ISSN 2045 6743 (Online)

Is it Strange or is it Scary? Examining Salience and Arousal Explanations of the "Weapons Focus Effect".

Dominic Willmott[1]

University of Huddersfield, Huddersfield, UK

Accepted for publication in *Internet Journal of Criminology*

[1] **Publication based upon the research conducted and submitted in partial fulfilment for the Bachelor of Science Degree (BSc) in Psychology with Criminology at the University of Huddersfield (April 2011).**

Abstract

There is a mass of research literature providing evidence for the 'Weapon Focus' effect which although traditionally accounted for in terms of an Arousal explanation, underpinned by Easterbrook's (1959) Cue-Utilisation Hypothesis, recently research has favoured causation of such an effect in terms of a Salience explanation, understood in terms of Schematic memory structures. However, neither explanation as of yet has been able to conclusively disprove the other. In a study measuring the physiology and memory of participants, in conditions specifically designed to improve on past literatures methodological shortfalls, the effects of both explanations were meticulously separated out in an attempt to clearly investigate differences between them. Findings displayed that although differences emerged between memory scores and levels of physiological arousal between salience and arousal conditions, such were not to a significant extent. Methodological shortfalls within the current experiment and past research studies are thought to account for the failure to produce a weapons focus effect or further significant differences, however critical evaluation and deeper consideration of the current theoretical accounts identifies the inadequacy of these explanations, as well as future suggestions on how such might be improved.

Key terms; Weapons Focus Effect, Object Salience, Arousal, Emotional Responsiveness

Acknowledgements

There are many people to whom thanks is owed for the helping me produce this undergraduate thesis. To the Psychology technicians whom helped me in the setting up of the experimental procedures for this project, especially the chief technician Sarah Pearson and senior technician Adam Robson. I would also like to thank all the lecturers within the psychology department whom have supported me throughout. Thanks is owed mostly however to my project supervisor Dr. David Tyfa whom has not only supported me through tough times when the project wasn't running so smoothly, but both encouraged and inspired me throughout the duration of my degree, allowing me to progress above and beyond my own expectations. Finally I would like to thank my whole family and my partner, for supporting me throughout my studies.

Introduction

Within the criminal justice system Eyewitness Testimony (EWT) plays a large and integral part in the identification and conviction of many offenders, which over time has often been suggested as exerting too powerful an influence upon court case verdicts (Gudjonsson, 1996). Throughout the United Kingdom and America the introduction of DNA in the 1990's brought about proving many innocent people to have been wrongly convicted and imprisoned largely on the basis of inaccurate EWT (Wells et al, 1998). The Devlin Report conducted in the UK some years earlier provided evidence that such miscarriages of justice that led to wrongful convictions and incarceration of innocent suspects, were not simply isolated occurrences (Devlin, 1976). Similarly Scheck et al (2000) and Well's et al (2006) independently examining sentencing exonerations in New York, found in over 75% of cases inaccurate EWT was the key component in wrongful convictions. Such research undoubtedly highlight the degree of credibility ascribed to EWT despite evidence demonstrating how seemingly vulnerable such memory of events may be.

Research into the 'Weapon Focus' Effect

Over time much research has been conducted examining a variety of perceptual and memory fallibilities associated with EWT, one area of which has acquired considerable attention is that known as the 'Weapons focus' effect (WFE).The WFE described by Wells and Olson (2003) as amongst the best known but least understood memory phenomenon's, refers to a common adverse effect upon certain memories when a weapon is present in a crime scene. Loftus et al (1987:55) defined WFE as "the concentration of a witness's attention on a weapon and the resultant reduction in ability to remember details of the crime thereafter". Such an effect seemingly has great implications for criminal proceedings as it would suggest that in some of the most serious of crimes where weapons are present, EWT is potentially unreliable. This is a claim not lacking empirical support.

In an early study by Johnson & Scott (1976), participants in field settings overheard either an innocuous or argumentative conversation, followed by observing an individual fleeing the scene whilst holding either a greased pen or blood stained knife. Findings displayed significantly greater recollection of the knife in comparison to the pen, alongside significantly decreased identification of the target individual. Despite some researchers contesting that the presence of blood and the argument itself may have confounded with the presence of a weapon (Shaw and Skolnick, 1994), subsequent research implementing greater methodological controls, obtained consistent findings.

Loftus et al (1987) for example, studied participants eye fixations whilst observing video clip scenarios depicting an individual directing either a gun or cheque towards a restaurant cashier and

found that participants focused more frequently and for longer on the weapon object. Findings also displayed participants recalled significantly fewer correct details regarding the target individual in the weapon present condition than the non-weapon present condition, thereby suggesting the increase in attention paid to a weapon inhibited accurate memory of the perpetrator and other such peripheral details. Similarly Maass & Kohnken (1989) whom in response to criticism's regarding the passive nature and inactive role of witnesses in the previous research designed a new experimental paradigm. Participants whilst secured into a chair were approached by an experimenter holding either a syringe or pen, thereby directly involved in the scenario and found that exposure to the syringe (weapon object) significantly decreased line-up recognition of the experimenter in comparison to that of the pen. In a meta-analysis of weapons focus research Steblay (1992) reported finding overall a reduction in the accuracy of line-up identifications and details recalled about the event and perpetrator when a weapon was present. This difference was only small but nonetheless significant.

A small number of studies however, based upon real police witness data considered to be high in ecological validity in comparison to laboratory simulations, failed to obtain support of a WFE (e.g. Shaw and Skolnick, 1994; Wright and McDaid, 1996; Valentine et al, 2003). Having said this, Wells et al (2006) provided a plausible explanation of such findings suggesting that real crime data can be considered unavoidably entangled with confounding variables between crimes and therefore may have obscured the presence of a WFE. One such likely factor is the variation in the duration of time that 'Perpetrators' were observed between crimes, which in itself has been shown to alter memory recall abilities (Bornstein et al, 1998).

Overall though, consistent with findings from Kassin et al's (2001) survey of Forensic psychology experts, whereby 87% stated the WFE was reliable enough for psychologists to testify about in court, 97% of whom propose such an opinion to be grounded in reliable research findings, laboratory experiments and field study simulations have repeatedly demonstrated the deleterious effects that the presence of a weapon has upon witness memory (Maass and Kohnken, 1989; Kramer et al, 1990; Mitchell et al, 1998; Pickel, 1998,1999; Hope and Wright, 2007; Davies et al, 2008). Having said this, causes of the WFE are less clear and are accounted for predominantly in terms of two main explanations each of which opposes the other within the aforementioned research.

Arousal Explanation of the 'Weapon Focus' effect

One hypothesis put forward for such a narrowing of attention focus effect is the Arousal explanation. Understood in terms of Easterbrook's (1959) Cue-Utilisation hypothesis, as an organism experiences heightened emotional arousal (i.e. in response to threatening or fearful stimuli such as a weapon), perceptual range is suggested to narrow and attention becomes focused upon the source of such

arousal (e.g. a weapon) whilst less arousing aspects or 'cues' in the context of the crime, either fail to be attended to or to a lesser extent (e.g. perpetrators description). As a result, the assumption is that central 'cues' are processed and well remembered but peripheral aspects fail to be encoded, consequently causing memory for such to be poor.

Despite its intuitively appealing simplicity in regards to explaining causation of the WFE, an opinion seemingly shared by researchers in the field whom have largely adopted the explanation even with the availability of other Arousal perspectives, offering slightly alternative and arguably more detailed explanations (e.g. Deffenbacher et al, 1994; 2004), the arousal explanation in line with Easterbrook's (1959) hypothesis fails to explicitly account for how such emotionally-arousing objects are thought to cause such a narrowing of attention focus. One seemingly likely explanation in line with evolutionary based 'fight or flight' responses is that, in fearful events weapons are focused upon in order to assess the best course of action required in order to survive, ultimately leading to greater processing and encoding of such details whilst less immediately informative aspects are neglected and therefore are unlikely to be recalled as well. Nonetheless, Easterbrook's (1959) interpretation has been the most favoured explanation adopted by researchers in the field, a great deal of whom have claimed to have obtained supportive and corresponding findings of such.

Maass and Kohnken's (1989) study as was outlined above, found participants exposed to 'threatening' stimuli not only recalled significantly less details regarding the experimenter but provided significantly better recall of the weapon and experimenters hand with which it was held, when compared to non-threatening stimuli. Similarly Kramer et al (1990) upon exposing participants to video clips whereby the visibility of 'threatening' objects was manipulated between samples, found the greater the visibility of a weapons presence, the greater the level of reported arousal and the poorer the recall of witnessed events.

More recently Davies et al (2008) studying the WFE upon children when exposed to an array of objects rated in terms of the nature of threat and unusualness they represented, found conditions containing an object deemed 'threatening', elicited significantly lower levels of accurate recall regarding the appearance of the experimenter, than control and unusual object conditions. Alternatively Hope and Wright (2007) had participants view a slideshow sequence of an event varying only in the objects held by a perpetrator between conditions, whilst attending to a secondary task. By categorising objects as representing either threat or unusualness as well as representing neither (e.g. Control object), the authors reported that although both threatening and unusual objects were found to command attention, the threat associated with the weapon ultimately resulted in poorer perpetrator recognition ability than the other non-threatening conditions. Although such findings seemingly provide support for the Arousal explanation, methodological shortfalls within the research literature may suggest findings should be interpreted with care.

Firstly, most if not all studies to date directly measuring the effect of a weapons presence upon memory, have failed to actually measure the physiological arousal levels of participants. Despite this, studies such as Kramer et al (1990) have nonetheless reported the presence of a weapon to have increased arousal on the basis of questionable measures, whereby participants simply reporting how 'Aroused' they felt during exposure to stimuli in experimental conditions. As was noted by Coolican (2009) such self-rating scores rely upon subjective human judgements and therefore are unable to reliably ensure such ratings between participants equally represent the same extent of arousal experienced. An explanation for a lack of such measures within past research may be in part due to the lack of detailed explanation of exactly why such heightening of arousal is thought to cause a narrowing of perceptual focus as well as the suggestion that laboratory simulations are unlikely to produce the same increases in arousal as would be expected upon exposure to a real life crime (Loftus et al, 1987). Nonetheless, if only to the hypothesised lesser extent, it seems likely that measuring arousal may in some way aid the understanding of processors underlying of the arousal explanation.

Secondly, much past research failed to conduct any initial corroboration that objects thought to be, 'fearful' or 'threatening' were actually perceived as such by the experimental participants or any independent samples. Additionally, the few studies that did address this issue, did so poorly. Maass and Kohnken (1989) and Hope and Wright (2007) simply presumed weapon objects selected were perceptibly threatening and fearful failing to account for how salient weapons may be perceived as when unexpectedly observed in a given scenario. Similarly Davies et al (2008) assigned a syringe as representing arousing stimuli despite being only marginally perceived as the most threatening from an array of objects and more than a quarter of the preliminary sample rating such to be the most salient object within the array. The use of such poorly established and uncorroborated object representations may have great implications for the findings and conclusions drawn within past research. For example Steblay's (1992) aforementioned Meta-analysis, along with other aforementioned research, all of which has reported greatest effect sizes to have been obtained when stimuli objects were deemed highly Arousing and threatening, may in fact be equally attributable, if not more indicative of an objects unusual, unexpected presence in the context in which they are observed. The concept of such is in fitting and in fact the basis of the opposing main explanation of the WFE namely, the Salience explanation.

Salience Explanation of the 'Weapon Focus' effect

Within the Salience explanation, 'weapon focus' is thought to occur as a result of certain objects whether a weapon or otherwise being perceived as unusual, novel or unexpected within a given context and thereby being inconsistent within past schematic memory structures. Moreover, it is proposed that when the presence of an object within particular context (e.g. a 'Gun' or 'Chicken' in

the bank), fails to conform with previous expectations held within such a context based upon past experiences of similar scenarios, such objects 'capture' attention focus in order to account for its presence. As a result, attention capacity elsewhere narrows to the point that more congruent or expected aspects of a scene fail to be processed and encoded, reducing subsequent recall abilities for such information (Kramer et al, 1990; Pickel, 1998; Pickel, 2009). This more recent explanation for the WFE based upon object saliency, has yielded some seemingly strong contradictory findings.

Pickel's (1999) findings suggested accurate memory recall of an event involving the presence of a weapon was only impaired in settings whereby the presence of a weapon was deemed incongruent. Moreover, when a male in a video clip was observed approaching a female and obtaining money whilst in possession of a firearm, findings displayed in the context of a shooting range (where the presence of a gun was not considered unusual), participants provided more accurate descriptions of the male as opposed to when the same scenario was observed in the context of a baseball ground (where such an objects presence was considered unusual), whereby accurate descriptions were significantly poorer.

In an earlier study, Pickel (1998) improving on poorly defined object representation's identified in past research, showed participants a video clip scenario of a robbery in a hairdressing salon whereby a 'perpetrator' was observed holding varying objects, rated beforehand in terms of perceived 'threat' and 'unusualness'. Findings displayed, when the objects were highly unusual but low in threat within the given context (e.g. a whole raw chicken), witnesses recalled significantly less accurate descriptions regarding the perpetrator's appearance, than objects rated more threatening but were congruent within the scenario (e.g. scissors). Correspondingly in a similar study independently conducted around the same time, Mitchell et al (1998) drew consistent findings, also concluding that object salience alone was sufficient in obtaining a WFE. Such findings led the researchers to suggest that contrary to the Arousal hypothesis, the WFE occurred not because of the threat or fear associated with a weapon, needing not even be a weapon object but from any unusual object in a context where its presence is considered unexpected.

The Salience explanation gains further credibility when considering research investigating the role of cognition in visual processing. Loftus and Mackworth (1978), Henderson, et al (1999) and Gordon (2004) measuring eye fixations upon objects consistent or incongruent within varying contexts (e.g. octopus / tractor in a farm scene), obtained findings suggesting unexpected object's in given situation's achieved longer and more frequent eye fixations than more context consistent objects. The authors perceived such findings quite plausibly, as seeming to display a relationship between the nature of information observed and subsequent memory recall ability.

Overall, despite the Salience explanation being a relatively recent hypothesis for the WFE and only limited numbers of research literature having been conducted on such principles, all findings obtained as of yet have been supportive of object unusualness and novelty causing such an effect. Such findings have led the Salience camp to propose that, although witnesses may indeed feel frightened in response to a weapons presence, in line with the arousal explanation, such increased anxiety or arousal levels are not thought to be an adequate enough factor to cause the WFE (Pickel et al, 2006). Although not detailing explicitly why such an effect is deemed an unlikely cause, the aforementioned findings by Pickel, (1998) and Mitchell et al, (1998) thought to provide support of such a claim, displaying that objects need not even be threatening (e.g. chicken, stethoscope), in order to produce a WFE. The 'Weapon Focus' effect is therefore suggested to be, too narrow an explanation of such an effect, instead thought to be better described as a more general, 'attention focus' effect.

Current study Rationale

Within past research certain methodological shortfalls have allowed for findings derived to be brought into question. Moreover, research conducted around the Arousal explanation has been shown for the most part to have failed to conduct any preliminary research to ensure stimuli objects accurately represented the arousal and salient conditions to which they were assigned. Similarly, although research into the Salience explanation has generally conducted preliminary studies, in line with the Arousal literature, research has largely failed to conduct any post study corroboration of participant interpretations of experimental objects. Due to the problems identified regarding the possible inaccurate perception of such object conditions, this may have to some extent prevented clearer inferences being drawn in regards to Salient or Arousal object effect's upon memory recall. Such improvements on such limitations within future research, may therefore allow for any differences found between Arousal and Salient conditions, to be more confidently attributed as evidence for such an explanation of the WFE.

Additionally, lacking within all of the aforementioned research directly investigating object Salience and Arousal explanations of the WFE, is any conclusive measures of physiological arousal, despite such being the underlying premise from which the Arousal explanation is based and the Salience explanation refuting such a concept to be the driving force behind memory fallibility. Although Loftus et al, (1987) provide a likely explanation for the lack of measurement of arousal within past research, suggesting the passive nature of laboratory simulations are unlikely to induce arousal or stress levels similar to those experienced by real crimes witnesses, the authors also found even when events which participants were exposed to were not particularly stressful or arousing, attention narrowing onto weapons did still occur.

Consideration has also been paid to psycho-physiologists Klorman et al's (1977) research which suggested that when exposed to threatening or fearful situations such as, a violent crime where a weapon is present, the response of an eyewitness is almost always to generate an automatic stress response' or defensive response to such 'stressors'. This defensive response to fearful objects is something current day anatomists Tortora and Derrikson (2008) have suggested is characterised by an automatic heightening in physiological arousal such as acceleration in heart rate and sweat responses, thought to occur as a result of the body seeking to prepare for a state of 'readiness' in response to encountering such stressors, known as the 'fight or flight' response.

If there is something special about emotionally arousing events beyond an objects 'unusualness', then objects rated as highly arousing but low in salience, would still be expected to produce poorer memory recall of peripheral details than neutral control objects, alongside greater increases physiological arousal than highly salient and neutral control object conditions.

Contrastingly, in accordance with the Salience explanation, if a physiologically arousing (threatening / fearful) object that produces a WFE is simply a by-product of its unexpected and unusual presence in a given scenario, rather than any fear induced arousal effects, then object's specifically rated as, high in arousal and low in salience, should display very little, if any, deleterious effects upon memory recall of peripheral details. Similarly objects rated as, high in salience and low in arousal, should display a traditional WFE for such objects, producing poorer recall of peripheral details than all other objects. Furthermore in line with Salience explanation's position, these effects would be expected to occur irrespective of any increase in physiological arousal levels experienced in response to highly arousing object conditions.

In the past researchers have seemed to adopt one perspective over the other however, the present review seems to suggest that both explanations may in fact be valid. Having said that, recent research has favoured the view that object Salience may be a more significant factor in causing the greatest deleterious memory effect. On the basis of this reasoning the current study will aim to clearly separate the effects of object salience and arousal by use of pre and post questionnaires to identify object salience or arousal and show which produces the strongest WFE. In addition, physiological measures will also be included to show that the threatening object does cause arousal. This logic leads us to the following hypotheses.

Hypothesis 1 – Both Salience and Arousing object conditions will produce significantly poorer recall accuracy of the video clip target individual than a neutral control condition. However, the salience object condition will produce significantly poorer memory recall than the arousing object condition.
Hypothesis 2- The Arousal object condition will produce significantly greater increases in Physiological Arousal than Salience object conditions.

Method

Preliminary Study

Within the Preliminary study, opportunity sample participants (N=20) recruited from the general population, completed a questionnaire. Participants rated an array of objects (selected on the basis of usage in past research e.g. Pickel, (1998); Davies et al, (2008)) on a 9 point scale, in terms of how Salient (Novel, Interesting or Unusual) and Arousing (Frightening or Threatening) they perceived objects to be in the context of a building site. The item rated most Arousing (High Arousal / Low Salience) was assigned as representing the stimuli object in the Arousal condition and most Salient (High Salience, Low Arousal) was assigned as representing the stimuli object in the Salience condition, within the current experiment. The object that was most commonly rated as both low on Arousal and Salience was used in the control condition.

Experimental Study

Participants. Twenty eight British university students (14 Male, 14 Female) aged 20 – 42 years old, from an opportunity sample were allocated to one of the three experimental conditions; Arousing condition, Salient condition and a control condition, upon arriving on the day. Each condition had a roughly equal split of, participants and males / females. No individuals or particular groups of people were excluded from participating, only taking note of participant's experiencing heart problems, high blood pressure or known memory defects to ensure such factors did not impact experimental results. However, no such conditions were known to be present within any of those who took part. The participant's who took part in the video clip experimentation study, also took part in the post study questionnaire (see Appendix 1.B) however, were independent from those who participated in the preliminary study (see Appendix 1.A).

Design. The study adopted an independent measures design. The Independent variable (IV) was the variation of film clips observed. The Dependent variable's (DV) were changes in physiology (Change in Galvanic Skin Response – GSR, measured in Micro MHO's and Change in Heart Rate measured by ECG in beats per minute) and Memory scores measuring correct answers out of ten. Based on preliminary study findings, objects were assigned to conditions which they were found to accurately represent (see Procedure below). The Arousing Condition (High Arousal / Low Salience) was assigned the Screwdriver object and the Salience Condition (High Salience, Low Arousal) was assigned the Raw Chicken object. A Control Condition used a letter object rated as low in both Arousal and Salience. Controls were meticulously undertaken in an attempt to ensure any difference

in results could be attributed to differences between the experimental conditions. For example, ensuring all aspects of the video clip, conditions and environment where the clips were observed and memory scores undertaken were identical between conditions, with the only difference being the variation in the object presented in the clip.

Apparatus. Three video clips were recorded using a digital camera near the grounds of a building site which was visible in the background, involving one of three objects (Whole Raw Chicken, Screwdriver and Letter) that represented the condition therein. A BIOPAC MP150 system and acquisition software along with desktop computers and electrode conductance gel (applied to finger tips to monitor pulse), were used to record physiological responses.

Procedure. Participants were briefed that they were required to watch a short video clip which they would later be asked to answer a series of questions about whilst having physiological responses (GSR and Heart Rate) measured. Participant's in each condition observed a 60 second video clip whereby in the context of a building site where a female is seen to be pursued by a male in workman's clothing, who after gaining her attention and exchanging dialogue (which participants could not hear), presents her with one of the aforementioned objects from his bag. The face and appearance of the actor holding the object was visible for the same amount of time in each condition. In each of the conditions participants were connected up to the physiological recording BIOPAC equipment. Participants were given time to relax after which baseline measurements were recorded (60 seconds) before experimentation began and were then recorded continuously whilst watching the sixty second long clip. To encourage concentration on the clip a blank screen was shown at the start of the video stating, "The clip will Begin in 5 Seconds'.

Participants were then disconnected from the BIOPAC apparatus and then without conferring (in order to obtain a level of ecological validity to that of real police interview questioning) completed the memory questionnaire. The memory questionnaire consisted of ten multiple choice questions regarding the appearance of the actor holding the object (see Appendix 1.C), comprising of the correct answer, two incorrect answers and 'Cannot remember' which participants were encouraged to select rather than guess, if the answer was unknown. Finally participants were asked to complete a post study questionnaire identical to that used in the preliminary study in order to determine if experimental objects were equally interpreted as Arousing and Salient, thereby corroborating experimental condition's representation.

Ethics. All BPS ethical guidelines and procedures were adhered to throughout the duration of the research. Partially informed consent was obtained and participants were fully debriefed about the

purpose of the experiment after taking part, as well as being provided with contact details in the event that any future enquires or issues emerged, including access to counselling services and data withdrawal information (see Appendix 1D – 1E). However after the study no participants chose to do so. The design of the video clip scenarios also excluded the use of any extremely violent or threatening content in an attempt to ensure participants were not harmed or adversely affected by anything encountered throughout the course of the experiment.

Results

Preliminary Study Questionnaire [1]

The preliminary study data in Table 1.1 below shows mean differences between Arousal and Salience ratings. *(Difference / Polarisation score = Arousal score – Salience score, therefore high arousal / low salience = a positive (+) score and low arousal / high salience = a negative (-) score).*

The Screwdriver and Whole Raw Chicken objects obtained the greatest mean polarisation scores i.e. the bigger the polarisation score, the more arousing and less salient and more salient and less arousing the objects were respectively rated as. Both objects also display small standard deviations showing most ratings clustered tightly around the mean values. The letter and piece of paper objects can be seen to display the smallest mean difference ratings alongside the lowest mean salience and arousal ratings.

Table 1.1 –Mean Salience, Arousal and Difference scores for Preliminary study objects.

Stimuli objects	**N**	**Arousal scores** Mean	(SD)	**Salience scores** Mean	(SD)	**Mean Difference scores**
Brick	20	9.1	(1.0)	2.4	(0.9)	6.7
Screw-driver	20	**9.0**	**(0.8)**	**2.0**	**(0.7)**	**7.0**
Piece of paper	20	**1.4**	**(0.5)**	**1.6**	**(0.9)**	**-0.2**
Knife	20	8.8	(1.0)	9.1	(0.9)	-0.4
Letter	20	**1.3**	**(0.5)**	**1.7**	**(0.9)**	**-0.4**
Small parcel	20	1.8	(0.8)	1.6	(0.6)	-0.2
Raw Chicken	20	**1.1**	**(0.2)**	**9.3**	**(0.8)**	**-8.3**
Toy octopus	20	2.3	(1.1)	9.0	(1.0)	-6.7
Hammer	20	8.1	(1.6)	2.7	(1.6)	5.5
Banana	20	1.1	(0.3)	3.3	(1.8)	-2.2
Box of Chocolates	20	1.2	(0.7)	5.1	(2.0)	-3.9
Handgun	20	9.6	(0.9)	9.4	(1.0)	0.2

Figure 1.2 below shows how the objects with the greatest and smallest mean polarisation scores were rated in terms of representing salience and arousal in the context of a building site, in the preliminary study questionnaire.

[1]Although likert scales were used, data was assumed to approximate Interval level (Coolican, 2009).

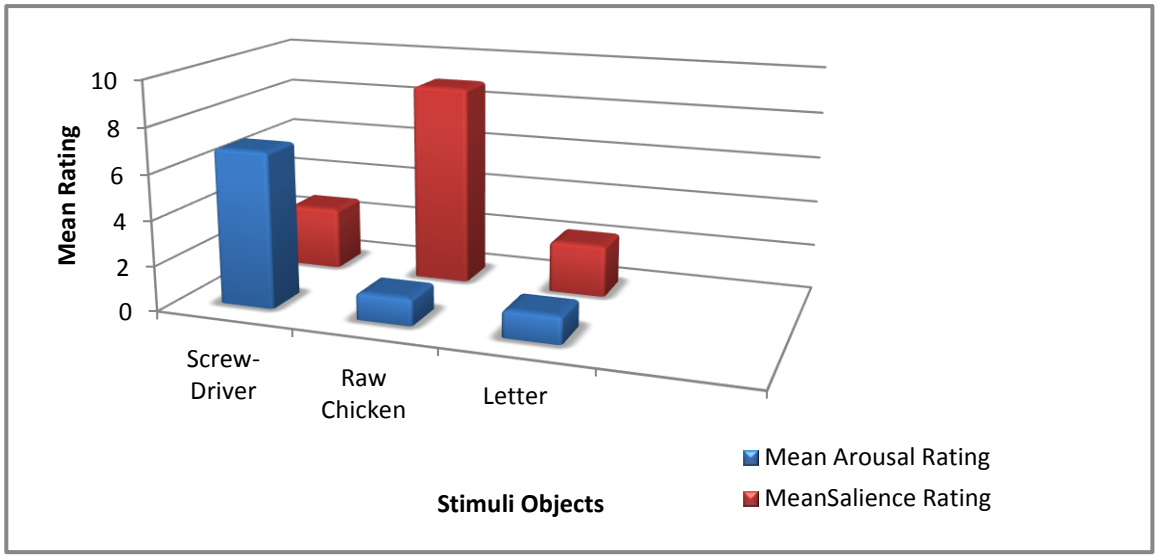

Figure 1.2 – Bar chart of Greatest and Smallest mean Polarisation scores

Positively ranked High Arousal / Low Salience Objects

Shapiro-Wilk normality tests were conducted on the mean positive difference scores (high Arousal, low Salience) and mean negative differences scores (high Salience, low Arousal) for both the Preliminary and Post study questionnaire comparisons, due to the test being considered to be the most reliable normality measure, yielding exact significance values rather than the 0.2 approximation occasionally provided by Kolmogorov-Smirnov tests (Field, 2009).

Results displayed the majority of scores in all Arousal/ Salience comparisons displayed similar significant p-values and therefore all differed significantly from a normal distribution (see Appendix) and consequently the same non-parametric tests were also adopted. Despite parametric tests being robust enough to withstand moderate violations, when several violations occur in order to confidently infer the existence of any effect found the safer option is to conduct a non-parametric equivalent (Coolican, 2009).

A Freidman's ANOVA was therefore conducted on the High arousal, low salience object polarisation scores comparing the mean ranks (see appendix 1.4), displaying a significant difference between objects (Chi-Square = 61.71; df = 4; $p < 0.001$) (see Appendix 1.5).

A Wilcoxon signed ranks test was conducted in order to compare the differences between arousing object polarisation scores, making a "Bonferroni" correction of the significance level in order to account for multiple comparisons. The level was set at $p = 0.01$ in order that comparisons not be too stringent as to commit type 2 errors however is conservative enough not to commit type 1 errors either (Field, 2009).

Results showed the screwdriver polarisation score was significantly different from the handgun ($Z = -3.96$; $N = 20$; $p < 0.001$) and parcel ($Z = -3.96$; $N = 20$; $p < 0.001$) object polarisation scores however despite approaching significance there was no significant difference between the screwdriver and the hammer ($Z = -2.31$; $N = 20$; $p = 0.02$) and more evidently the screwdriver and the Brick ($Z = -0.70$; $N = 20$; $p = 0.48$) polarisation scores (see Appendix 1.6).

The screwdriver object was found to have the greatest mean polarisation between arousal and salience ratings (high arousal / low salience) as well as displaying a significantly greater polarisation score than half of the other objects.

Negatively ranked Low Arousal / Highly Salient Objects

A Freidman's ANOVA comparing the mean ranks (see Appendix 1.8) of object polarisation scores found significant differences occurred between objects (Chi-Square = 99.20; df = 6; $p < 0.001$) (see Appendix 1.9).

A Wilcoxon signed ranks test found the 'Chicken' object to be significantly different from the 'Octopus' ($Z = -3.13$; $N = 20$; $p < 0.001$), 'Banana' ($Z = -3.95$; $N = 20$; $p < 0.001$) and 'Chocolates' ($Z = -3.84$; $N = 2$; $p < 0.001$) polarisation scores (see Appendix 2.0) and therefore feasibly than all other lower ranked objects as well.

The chicken object therefore had the greatest mean polarisation between arousal and salience ratings (low arousal / high salience) as well as displaying a significantly greater polarisation score, than all other objects. The Raw chicken object therefore best represented the high salience / low arousal condition, along with the aforementioned screwdriver object that best represented the high arousal / low salience object. The letter object was assigned as the control object due to displaying one of the lowest mean polarisation scores and lowest overall ratings in salience and arousal.

Post Study Questionnaire

The Post study questionnaire data in Table 2.1 below shows mean differences between Arousal and Salience ratings. As with the preliminary study, the Screw-driver and Raw Chicken objects displayed the greatest mean polarisation scores. Both objects also display reasonably large standard deviations especially the screwdriver object which compared to the preliminary study results, exhibits fairly substantial variation around the mean values. The letter object again displayed one the smallest mean polarisation scores, alongside low mean salience and arousal ratings of which standard deviations are tightly clustered around the mean.

Table 2.1 –Mean Salience, Arousal and Difference scores for Post study objects.

Stimuli objects	N	Arousal scores Mean	(SD)	Salience scores Mean	(SD)	Mean Difference scores
Brick	30	5.8	(3.1)	3.6	(2.7)	2.2
Screw-driver	30	**6.9**	**(2.7)**	**2.8**	**(1.9)**	**4.0**
Piece of paper	30	1.2	(0.4)	2.5	(2.5)	-1.3
Knife	30	8.8	(1.2)	7.9	(2.5)	0.9
Letter	30	**1.2**	**(0.4)**	**2.3**	**(2.0)**	**-1.1**
Small parcel	30	2.6	(1.7)	3.0	(2.5)	-0.4
Raw Chicken	30	**1.2**	**(0.6)**	**8.9**	**(1.7)**	**-7.8**
Toy octopus	30	1.5	(0.8)	8.0	(2.1)	-6.4
Hammer	30	6.3	(2.8)	2.7	(1.9)	3.7
Banana	30	1.2	(0.4)	4.9	(2.6)	-3.7
Box of Chocolates	30	1.4	(1.0)	5.3	(2.2)	-3.9
Handgun	30	9.6	(0.8)	9.2	(1.3)	0.4

Figure 2.2 below shows the objects with the greatest and smallest mean difference scores ratings in terms of representing salience and arousal in the context of a building site scenario, in the post experimental questionnaire.

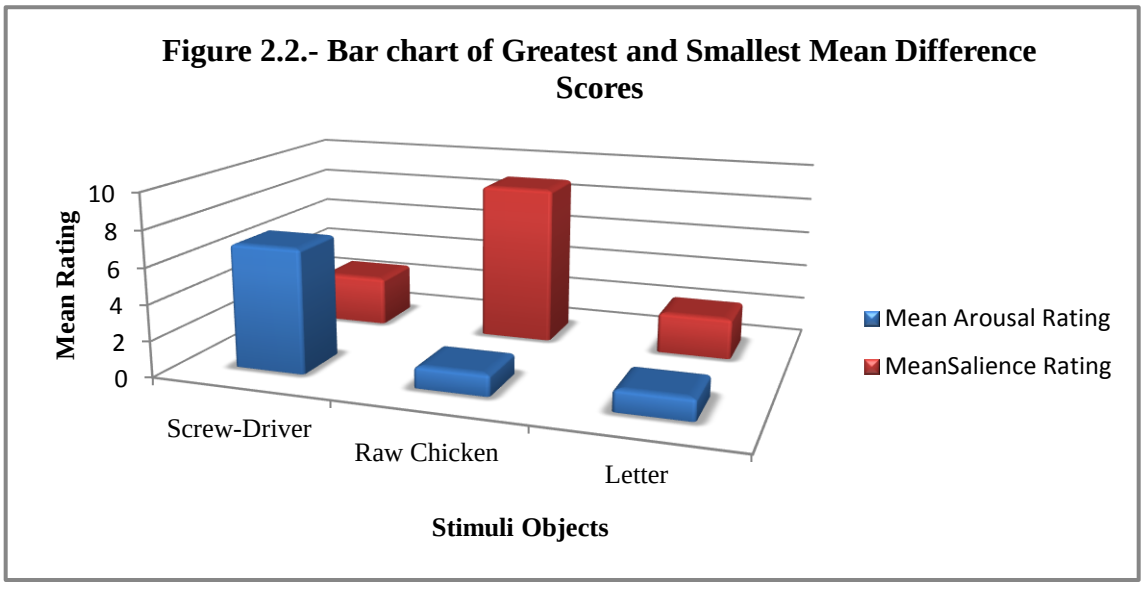

Figure 2.2 – Bar chart of Greatest and Smallest mean Polarisation scores

Positively ranked High Arousal / Low Salience Objects

A Freidman's ANOVA comparing mean ranks (see Appendix 2.4) of object polarisation scores found significant differences occurred between objects (Chi-Square = 35.14; df = 4; $p < 0.001$) (see Appendix 2.5).

A Wilcoxon signed ranks test found the 'Screwdriver' object to be significantly different from the 'Brick' object polarisation score ($Z = -2.68$; $N = 30$; $p = 0.01$) and therefore feasibly all other lower ranked objects as well (Knife and Handgun). There was no significant difference between the screwdriver and the hammer polarisation scores ($Z = -0.82$; $N = 30$; $p = 0.41$) (see Appendix 2.6).

The screwdriver object was found to have the greatest mean polarisation between arousal and salience ratings (high arousal / low salience) as well as displaying a significantly greater polarisation score than all but one of the other objects. The screwdriver object best represented the high arousal, low salience condition and therefore corresponds with findings from the preliminary studies sample ratings.

Negatively ranked Low Arousal / Highly Salient Objects

A Freidman's ANOVA comparing mean ranks (see Appendix 2.8) of object polarisation scores found significant differences occurred between objects (Chi-Square = 114.53; df = 6; $p < 0.001$) (see Appendix 2.9).

A Wilcoxon signed ranks test found the 'Chicken' object to be significantly different from the 'Octopus' ($Z = -3.24$; $N = 30$; $p < 0.001$) and 'Banana' ($Z = -4.50$; $N = 30$; $p < 0.001$) polarisation scores (see Appendix 3.0) and therefore feasibly than all other lower ranked objects as well.

The chicken object therefore had the greatest mean polarisation between arousal and salience ratings (low arousal / high salience) as well as displaying a significantly greater polarisation score, than all other objects. The Raw chicken object was therefore found to best represent the high salience / low arousal condition and again the letter object was found to display amongst the lowest mean polarisation scores and lowest overall ratings in salience and arousal.

Therefore results from the preliminary study and post study correspond, both displaying the same objects as having the greatest polarisation indicative of high arousal / low salience (screwdriver) and high salience /low arousal (Raw Chicken).

Physiological responsiveness and Memory scores of experimental procedure

The statistics in Table 3.1 below show the lowest mean memory scores occurred in the salience condition (high salience / low arousal rating) however this was only marginally lower that the arousal condition (high arousal / low salience rating). Changes in Physiology displayed mean increases occurred in the arousal condition for heart rate however was only marginally greater than that of the salience condition. For GSR, mean increases were shown to be greatest in the control condition with only slight increases occurring in the arousal condition and decreases occurring in the salient condition.

(*Changes in Physiology = difference between three second average of GSR / Heart rate score whilst the condition object was presented during each condition and Average Baseline GSR / Heart rate measurements during each condition*).

Table 3.1- Mean Memory scores and Change in Physiology within conditions

	N	Mean	SD
Memory Score	**28**		
Control	10	8.3	0.8
Salience	9	7.1	1.6
Arousal	9	7.4	1.3
Change in GSR	**28**		
Control	10	0.6	0.9
Salience	9	-0.4	1.3
Arousal	9	0.02	0.6
Change in Heart Rate	**28**		
Control	10	-6.6	13.2
Salience	9	2.1	18.7
Arousal	9	3.1	8.5

Figure 3.2 below shows both experimental conditions exhibited poorer memory recall than control object condition; with the salient object producing the poorest memory recall (NB: X axis is not from zero).

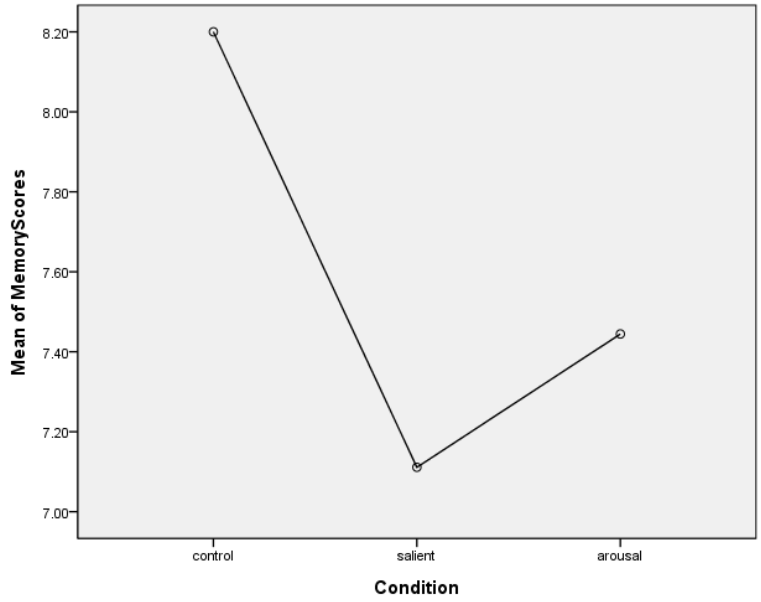

Figure 3.2 - Line Graph displaying mean memory scores for each condition

Figure 3.3 below displays slight increases in heart rate between baseline and object presentation in both experimental conditions with the arousal condition attaining a marginally higher increase than the salient condition. Heart rate in the control condition decreased when compared to baseline.

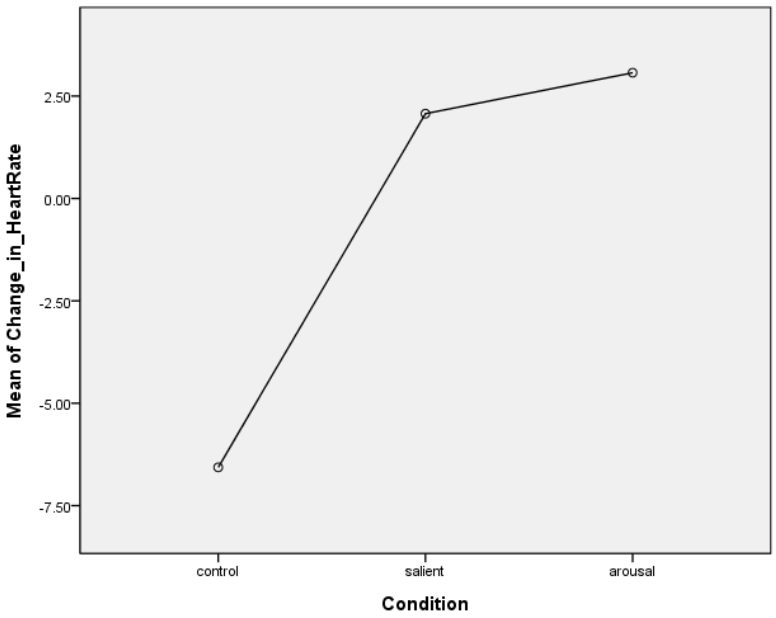

Figure 3.3 - Line Graph displaying mean changes in heart rate for each condition

Figure 3.4 below displays the arousal condition elicited a marginal increase in GSR in comparison to baseline means and the salient condition elicited no increase in GSR instead eliciting a mean decrease in sweat response. Unexpectedly the control condition displayed the greatest mean increase.

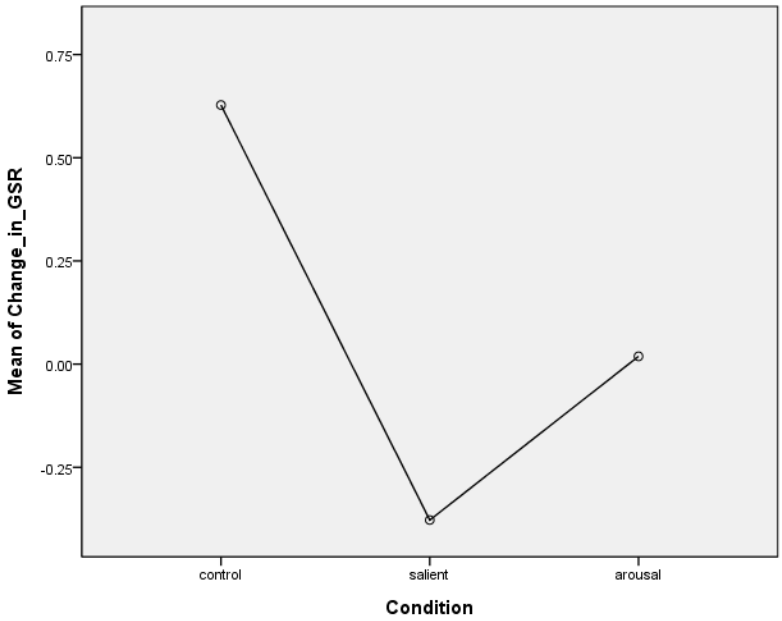

Figure 3.4 - Line Graph displaying mean changes in GSR for each condition

A Shapiro-Wilk normality test was conducted on the mean change in GSR and mean change in Heart rate values within each condition, displaying all conditions had non-significant p-values (see Appendix 3.5) and therefore data did not differ significantly from a normal distribution. Within the data one slight extreme score was identified however the skew was not considerably large i.e not equating twice its standard error therefore was considered to be at an acceptable level (Coolican, 2010) and was included along with all other data.

Along with meeting the assumptions that physiological data be interval level and normally distributed, an independent sample design requires the homogeneity of variance between the independent groups to be equally distributed i.e. non significantly different (Coolican, 2010). A Levene's equality of variance test conducted upon 'Change in GSR' and 'Change in Heart rate' displayed non-significant differences between distributions occurred ($p = 0.3$ and 0.23) respectively (see Appendix 3.6) and so a One way independent groups ANOVA was conducted.

Results displayed no significant differences between Salience, Arousal or Control conditions were obtained within Change in GSR ($F = 2.532$; $df = 2, 25$; $p = 0.10$), Change in Heart Rate ($F = 1.364$; $df = 2, 25$; $p = 0.27$) or mean Memory scores ($F = 2.03$; $df = 2,25$; $p = 0.15$) (see Appendix 3.7).

Discussion

Study Findings

The aim of the present study was to investigate the effects of object salience and arousal upon memory recall and physiological arousal, in an attempt to identify causation of the weapon focus effect (WFE), whilst methodologically improving on the experimental procedures adopted within past research.

The results displayed *hypothesis 1,* that both Salient and Arousing object conditions would produce significantly poorer recall accuracy of the video clip target individual than a neutral control condition and that the salience object condition would produce significantly poorer memory recall than the arousing object condition, was unsupported. Similarly *hypothesis 2*, that the Arousal object condition would produce significantly greater increases in physiological Arousal than Salience object conditions, was also unsupported.

Memory score findings suggested that although both Arousal and Salience object conditions displayed poorer memory recall that the neutral control object, with the Salience condition displaying the greatest deleterious effect upon recall of the target individual's appearance, as was hypothesised, such differences were not found to be significantly different between conditions. Both Salient and Arousal conditions thereby failed to produce a significant weapon focus effect upon memory recall.

Findings also indicated that the Arousal object condition failed to obtain significantly greater changes in either heart rate or galvanic skin responses (GSR) than Salient or control conditions, barely even obtaining an increase in 'change in GSR' whereby the control condition unexpectedly, although only moderately to a non-significant level, displayed the greatest such change. Findings from both the preliminary and post study questionnaires did however display that ratings of objects assigned to represent, high salient / low arousal and high arousal / low salient conditions in the current experiment, corresponded between the preliminary and experimental participants. This thereby suggests that objects were accurately perceived by the experimental participants as representing the conditions to which they had been assigned. Overall despite differences occurring in how participants responded to salient and arousing objects, the predicted significant differences between conditions were not obtained.

The current study findings may be interpreted in different ways. One interpretation may be that in direct comparison to past research findings that obtained support consistent with the arousal explanation (Maass and Kohnken, 1989; Hope and Wright, 2007; Davies et al, 2008) and salience explanation (Mitchell et al, 1998; Pickel, 1998; 1999; 2009), when objects were accurately perceived by participants as being Salient or Arousing, neither explanation causes a WFE. Alternatively, a

seemingly more likely conclusion based upon the consistency with which the WFE has been displayed within the past research reviewed, is that the absence of such an effect may have been the result of methodological limitations present within the current study.

Methodological Explanations

One methodological limitation that may have resulted in failure to obtain a significant object effects is the small sample size adopted. As was noted by Coolican (2009) failing to obtain significant differences between conditions may not necessarily be indicative of no real effect occurring, but rather the result of using too few participants which are likely to be unrepresentative of the population and allow for sample bias's to skew data, making any differences between conditions difficult to detect. It seems likely then that as only a small number of participants were tested, a type II error may have been committed, in that analysis may have failed to accurately demonstrate the genuine effects that Salience and Arousal objects had upon memory recall abilities and physiological responses.

Another such shortfall may have been the passive, detached nature by which participants 'witnessed' memory, was assessed. Within the current research, to ensure that any effects which occurred in salient object or arousing object conditions did not confound with other aspects of the scene, the video clip was purposefully kept from looking explicitly like a robbery event (i.e. so that any effects would be the result of the arousal or salient objects rather than the threatening nature of the event itself causing increased arousal or activation of a robbery schema). Having said this, in doing so as was recognised by Loftus et al (1987) and Maass and Kohnken (1989), the level of realism and personal involvement experienced from video clip observations may have failed to resemble even modestly, that experienced in real crime exposure and therefore as was found in a similar study by Shaw and Skolnick (1994), such experiments may not have been immersive enough to allow any arousal or salience based weapon focus effects to occur.

Additionally, the short interval in-between participants observing one of the varying video clips before answering the memory questionnaire, may have allowed for remembered events to have been still 'fresh' in their minds and therefore failed to actually account for any deleterious effects *per-se*. Moreover, despite previous research reviewed generally adopting such an immediate memory assessment and resultantly obtaining findings consistent with salient or arousing objects producing a WFE (e.g. Maass and Kohnken, 1989; Pickel, 1998; Hope and Wright, 2007; Davies et al, 2008), some research has quite logically shown that the longer the duration between witnessed events and subsequent recall, even as little as one week, results in poorer the recall ability (Tucky and Brewer, 2003).

Theoretically, drawing on Atkinson and Shiffrons (1968) Multi-Store model of memory, recent events can be held and remembered in what is known as the 'short-term' memory store for short time periods without actually drawing on memories that have been encoded and retained in the 'long-term' memory store. As such, the immediacy of the memory recall testing may have reduced or even prevented any memory effects associated with object salience or arousal from being accurately measured and displayed.

Methodological limitations identified in the present study may therefore account for the failure to obtain differences between the effects that Salience and Arousal have upon memory, from being clearly identified. Aside from such, also evident is the need for clearer detailed distinction between the two major explanations of the WFE, with it seeming fair to assume that such may allow for their effects upon memory to be examined in more depth within future research.

Further Theoretical Discussion

Research reviewed has shown both Arousal and Salience explanations have obtained supportive findings consistent with their conceptual underpinnings. Traditionally research supported the Arousal perspective, displaying threatening objects to be afforded longer and more frequent eye fixations (Loftus et al, 1987) and achieve a greater drain on attention capacity than non-threatening objects (Hope and Wright, 2007). However, more recently researchers in the area have tended to favour the view that object salience may in fact best account for the WFE, proposing that research findings offering support for the Arousal explanation may actually be more indicative of the salient nature that such emotionally arousing objects possess. This claim is not without reasoning and is seemingly well supported within the recent decade of literature, with research displaying the presence of a weapon to impair memory only when objects were deemed, unusual or unexpected in the context that they were encountered in (Pickel, 1999) or where such object's were not in fitting with the beholder's appearance (Pickel, 2009).

Such findings supporting the salience explanation have led some researchers to refute the premise that an increase in arousal brings about the WFE at all, despite acknowledging that exposure to a weapon is likely to induce fear and increase physiological arousal (Pickel, 1998; 1999; Mitchell et al, 1998; Pickel et al, 2006). However, drawing such a conclusion seems to be a highly speculative claim to make simply on the basis of obtaining support for the object salience effect and without detailing why such heightened arousal is not considered viable enough to effect memory recall. Although in part this may be due to Easterbrook's (1959) Cue-Utilisation hypothesis and the proponents of the Arousal explanation themselves failing to detail exactly why, rather than how, fearful stimuli are thought to cause heightened arousal and why such a heightening in arousal levels then causes a weapon object to

be focused upon. Nonetheless before such potentially overly simplified conclusions of the WFE can be drawn, causation behind the Arousal explanation undoubtedly needs to be examined in more depth, something that researchers from both camps have seeming deemed unimportant in the past, simply conducting addition research aiming to support or refute the explanation without actually investigating why such an effect occurs (e.g. Maass and Kohnken, 1989; Kramer et al, 1990; Mitchell et al, 1998; Pickel, 1998, 1999, 2009; Davies et al, 2008).

One possibility could be that the increased physiological arousal may itself cause the narrowing of attention focus away from peripheral details in some way, thereby leading to poorer memory recall of particular aspects of an event. However, research examining this concept failed to obtain support, instead finding that when physiological arousal levels were elevated through drug stimulation and physical exertion, such increases alone were not sufficient enough to produce decreased memory abilities consistent with the WFE (Christianson and Mjorndal, 1985; Libkuman et al, 1999).

Another seemingly more likely interpretation of the Arousal hypothesis comes from Evolutionary based Physiological responsiveness. Initially coined by Walter Cannon (1929), emotionally induced bodily changes are thought to have evolved in adaptive ways, allowing the body to function in a manner that aids survival. Furthermore, an emotional response such as fear, thought likely to occur when confronted with threatening stimuli such as a weapon, is said to cause a heightening in physiological arousal as a means of preparing the body for any emergency activity required to aid survival. This is known as the 'fight or flight' response, a largely accepted concept thought to be consistently characterised by heightened levels of physiological arousal e.g. increased heart rate, sweat response and respiration (Klorman et al,1977; Tortora and Derrikson, 2008).

This interpretation therefore allows for the Arousal explanation to be laid out with greater clarity, explaining focus upon a weapon and the corresponding increase in physiological responsiveness, as an adapted method aiding survival, in that central aspects which are the most immediately informative in regards to the level of threat posed, are attended to allowing appropriate responses to be selected in a timely manner. Consequently, peripheral 'cues', less central to aiding the organisms survival, fail to obtain the same degree of processing. This interpretation was supported by Loftus and Burns (1982) and Valentine and Mesout (2009) by displaying that exposure to high levels of violence, thought to induce fear, resulted in poorer memory recall of events, specifically of the 'perpetrators' appearance. Conducting a deeper examination of the mechanisms underlying the arousal explanation has therefore seemingly allowed for support to be provided for the role that arousal has upon the WFE, contrary to the aforementioned salience claim. Therefore alongside previously outlined findings supportive of the salience account, such may seeming display that both explanations albeit in different ways, perquisite the WFE.

Undoubtedly though, exploration of the Arousal explanation seems to suggest that arousal effects upon memory may be more complex than the current Arousal explanation has accounted for. Indications from past research point towards emotionally arousing aspects of an event rather those non-emotionally arousing *per-se*, having a significant impact upon memory recall ability. Crucial to the understanding of such effects upon memory, may therefore be to distinguish between different types of arousal, something which current arousal researchers by enlarge, have failed to consider. Deffenbacher et al (2004) whom offered a variation on the arousal explanation contrasting with Easterbrook's (1959) interpretation, which seemingly provides a more detailed and complex but nonetheless more complete, account of the arousal influence upon memory.

Deffenbacher et al, (2004), suggested two varying forms of arousal, one type involved in non-stressful emotional events but which draw attention towards a stimulus, known as an 'orienting response' and an alternative type involved in stressful events, which elicit a 'defensive response'. The latter response corresponds with Cannon's (1929) aforementioned physiological fight or flight responses to fearful stimuli, proposing such is indicative of heighted physiological arousal, alongside cognitive anxiety such as fear and is thought to be goal-directed (e.g. to survive). In line with such, whilst preparing to respond to imminent threats, memory of peripheral details not being as immediately important and required, are impaired. The alternative type of arousal described as an 'orienting response', differs from the defensive response in that, no actual heightening in physiology within an organism is thought to occur, with arousal instead functioning to support alert wakefulness. This response serves to aid responsiveness to environmentally different occurrences and allows for attention focus to 'orient' towards the most informative or interesting aspects of a scene, rather than details which are motivationally directed. As such this 'arousal' type largely encompasses the conceptual underpinnings of the Salience explanation in that, rather than physiological change *per-se*, the arousal of mental or cognitive functioning is thought to result in the processing of certain informative aspects whilst less engaging, more expected cues, fail to be encoded.

Upon outlining the varying types of arousal, which largely encompass characteristics of both salience and arousal explanations, Deffenbacher et al (2004) identifies a clear distinction between the two explanations of the WFE. Where the current arousal explanation, identical to a 'defensive response' is characterised by physiological activation from emotionally induced cognitive anxiety, the salience explanation, in line with an 'orienting response' is said to effect memory recall when informative aspects of event are perceived as unexpected or unusual within past schematic memory structures, largely if not entirely irrespective of any emotional influence.

Such a concept corresponds with the assumption that both the salience and arousal explanations may independently affect memory recall in a manner consistent with the WFE and clearly distinguishes the role of emotionality, linked to cognitive anxiety. Future research could therefore test such a concept

by separating the effects of salience and arousal (in a manner consistent with the present study) and conducting experimentation in an environment designed to be more physiologically immersive that the previous studies, possibly a cinema whereby fearful content might be expected to elicit greater physiological responsiveness due to their proposed highly engaging nature of such viewing (Griffiths, 2008). Subsequently, by also measuring temporal state anxiety, using a scale such as Speilberger's (1983) State-Trait Anxiety Inventory (SIAI) and validating the results of such alongside changes in physiological responses, if differences in anxiety levels are shown to occur between the two explanations but both nonetheless still obtained reduced memory recall of peripheral details, the WFE would be clearly displayed to be caused by both explanations, in differing ways.

Other means of disentangling the effects of object salience and arousal upon the WFE in future research could be achieved by measuring the activation of various regions of the brain whilst exposed to a fearful or salient stimuli. Research has shown the Amygdala is consistently activated in response to encountering emotionally-arousing events (Canli et al, 2000) and specifically fear (LeBar et al, 1998; Etkin and Egner, 2006). Crucially however, patients with damage to the amygdala, have not been shown to have impaired emotional reactions to arousing stimuli, which seeming suggests the area may not affect how attention focus is distributed or emotional events are perceived, but rather effects how such emotional observations are 'consolidated' within memory (Reisberg, 2006). Furthermore clear distinctions between regions not associated with emotional responses, such as surprise or confusion, in terms of the salience explanation, from that of fear that would allow either defensive or orienting responses in presentation of a weapon object to be identified, as of yet are seemingly unavailable.

Overall what can be obtained from such a theoretical review is that on the basis of the salience explanation alone, which has shown the WFE to occur as a result of inconsistencies within schematic knowledge structures arising, does not imply that the effect cannot occur as a result of emotionally linked physiological arousal as well. In order to contribute further to the understanding of both effects an important factor allowing such may be that future research adopts measures of state anxiety and greater immersive experimental designs as well as brain region activation as developments in neural circuitry occur, to provide greater indications of whether both Salience and Arousal explanations do cause the WFE and if in fact the explanations may even inter-relate.

References

Atkinson, R. & Shiffron, R. (1968) Human memory: a proposed system and its control processes, In: Spence, K & Spence, J. (Ed.) *The psychology of learning and motivation: advances in research and theory*. Vol. 2, New York: Academic Press.

Brigham, J. & Bouthwell, R. (1983) 'The ability of prospective jurors to estimate the accuracy of eyewitness identifications', *Law and Human Behaviour,* 7, pp. 19-30.

Canli, T. & Zhao, Z. & Brewer, J. & Gabrieli, J. & Cahill, L. (2000) 'Event related activation in the human amygdala associates with later memory for individual emotional response', *Journal of Neuroscience,* 20, pp.99-103.

Cannon, W. (1929) *Bodily changes in pain, hunger, fear and rage.* New York. Appleton.

Christianson, S. & Majorndal, T. (1985) 'Adrenaline, emotional arousal and memory', *Scandinavian Journal of Psychology,* 26, pp.237-248.

Coolican, H. (2009) *Research methods and Statistics in Psychology*. 5th Ed. London. Hodder.

Davies, G. M. & Smith, S. & Blincoe, C. (2008) 'A "weapon focus" effect in children', *Psychology, Crime, and Law,* 14, pp.19-28.

Deffenbacher, K. & Bornstein, B. & Penrod, S. & McGorty, E. (2004) 'A meta-analytic Review of the effects of high stress on eyewitness memory', *Law and Human Behaviour*, 28, 687–706.

Devlin, L. (1976) *Report to the Secretary of State for the Home Department of the Departmental Committee on Evidence of Identification in Criminal Cases*. London. Her Majesty's Stationery Office.

Easterbrook, J. (1959) 'The effect of emotion on cue-utilisation and the organisation of behaviour', *Psychological Review,* 66, pp.183-201.

Etkin, A. & Egner, T. (2006) 'Emotional Control circuit of brains fear response discovered', *Science Daily.* [online] Available at: http://www.sciencedaily.com/releases/2006/09/060920193424.htm [Accessed 19th April 2011].

Field, A. (2009) *Discovering Statistics using SPSS.* 3rd Ed. London. Sage.

Fisher, R, P. & Geiselman, R, E. & Amador, M. (1989) 'Field test of the Cognitive interview: Enhancing the recollection of actual victims and witnesses of crime'. *Journal of Applied Psychology,* 74, pp 722-727.

Geiselman, R, E. & Fisher, R, P. & MacKinnon, D, P. & Holland, H, L. (1985) 'Eyewitness memory Enhancement in the police interview: Cognitive retrieval mnemonics versus hypnosis', *Journal of Applied Psychology,* 70, pp 401-412.

Gordon, R. D. (2004)'Attention allocation during the perception of scenes'. *Journal of Experimental Psychology: Human Perception and Performance,* 30, pp. 760-777.

Griffiths, A. (2008) *Shivers down your spine: Cinema, museums and the immersive view*. New York. Columbia University Press.

Gudjonsson, G. (1996) *The Psychology of Interrogations, Confessions and Testimony.* Chichester. Wiley.

Henderson, J. M. & Weeks, P. A. & Hollingworth, A. (1999) 'The effects of Semantic consistency on eye movements during complex scene viewing', *Journal of Experimental Psychology: Human Perception and Performance,* 25, pp. 210-228.

Hope, L. & Wright, D. (2007) 'Beyond Unusual? Examining the role of attention in the Weapon Focus Effect', *Applied Cognitive Psychology,* 21, pp.951-961.

Johnson, C. & Scott, B. (1976) 'Eyewitness testimony and suspect identification as a function of arousal, sex of witness, and scheduling of interrogation'. *In:* American Psychological Association Annual conference meeting, *1991. Washington, D.C.*

Kassin, S. & Tubb, V. & Hosch, H. & Memon, A. (2001) 'On the 'General acceptance' of eyewitness testimony research – a new survey of the experts', *American Psychologist,* 56, pp. 405-416.

Klorman, R. & Weissberg, R. & Wiesenfield, A. (1977) 'Individual differences in fear and autonomic reactions to affective stimulation', *Psychophysiology,* 14, (1), pp.45-51.

Kohnken, G. & Milne, R. & Memon, A. & Bull, R. (1999) 'The cognitive interview: A Meta Analysis' *Psychology, Crime and Law,* 5, pp.3-28.

Kramer, T. H. & Buckhout, R. & Eugenio, P. (1990) 'Weapon focus, arousal, and eyewitness memory: Attention must be paid', *Law and Human Behavior,* 14, pp.167-184.

LeBar,K. & Gatenby, J. & Gore, J. & LeDoux, J. & Phelps, E. (1998) 'Human Amygdala activation during conditioned fear acquisition and extinction: A mixed-trial fMRI study', *Neuron,* 20, pp.937-945.

Libkuman, T. & Nichols-Whitenead, P. & Griffith, J. & Thomas, R. (1999) 'Source of arousal for memory and detail', *Memory and Cognition,* 27, pp.166-190.

Lindsay, S. & Hagen, L. & Read, J. D. & Wade, K. A. & Garry, M. (2004) 'True photos and False memories', *Psychological Science, 1*5, pp. 149-154.

Loftus, E. (1974) 'Reconstructing Memory: The incredible eyewitness', *Psychology Today,* 8, pp.116-119.

Loftus, E. F. & Burns, T. E. (1982) 'Mental shock can produce retrograde amnesia'. *Memory and Cognition,* 10,(4) pp. 318-323.

Loftus, E. F. & Loftus, G. R. & Messo, J. (1987) 'Some facts about 'weapon focus'. *Law and Human Behavior,* 11, pp. 55-62.

Loftus, G. R. & Mackworth, N. H. (1978) 'Cognitive Determinants of fixation location during picture viewing'. *Journal of Experimental Psychology: Human Perception and Performance,* 4, pp. 565-572.

Loftus, E. F. & Palmer, J. C. (1974) 'Reconstruction of automobile destruction: an example of interaction between language and memory'. *Journal of verbal learning and verbal behaviour,* 13, pp. 585-589.

Loftus, E. F. & Zanni, G. (1975) 'Eyewitness testimony: the influence of the wording of a question'. *Bulletin of Psychonomic society,* 5,(1) pp. 86-88.

Maass, A. & Köhnken, G. (1989) 'Eyewitness identification: Simulating the '*weapon effect*'', *Law and Human Behaviour,* 13, pp.397-408

Milne, R. & Bull, R. (2008) *Investigative Interviewing: Psychology and Practice*. Sussex. Wiley.

Mitchell, K. J. & Livosky, M. & Mather, M. (1998). 'The weapons focus effect revisited: the role of novelty. *Legal and Criminological Psychology,* 3, pp. 287-303.

O'connell, M. & Synnott, J. (2009). 'A position of influence: Variation in offender identification rates by location in a lineup'. *Journal of Investigative Psychology and Offender Profiling,* 6,(2) pp. 139-149.

Pickel, K. L. (1998) 'Unusualness and Threat as possible causes of "Weapon Focus"', *Memory,*6, (3),pp.277-295.

Pickel, K. L. (1999) 'The influence of context on the "weapon focus" effect', *Law & Human Behaviour,* 23, pp.299-311.

Pickel, K. L. (2009). 'The "Weapon Focus" effect on memory for female versus male perpetrators', *Memory,* 17,(6) pp.664-678.

Pickel, K. L. & Ross, S. J & Truelove, R. S. (2006). 'Do weapons automatically capture attention?'. *Applied Cognitive Psychology,* 20, pp.871-893.

Reisberg, D. (2006) Memory for emotional episodes: The strengths and limits of arousal based accounts. *In:* Utti, B. & Nobuo, O. & Siegenthaler, A., eds. *Memory and Emotion: Interdisciplinary perspective.* Oxford: Blackwell, pp.15-36.

Scheck, B. & Neufeld, P. & Dwyer, J. (2000) *Actual Innocence.* New York. Random House.

Shaw, J. I. & Skolnick, P. (1994). 'Sex differences, weapon focus, and eyewitness reliability'. *Journal of Social Psychology,* 134, pp. 413-420.

Shaw, J. I. & Skolnick, P. (1999). 'Weapon focus and Gender differences in Eyewitness accuracy: Arousal vs Salience'. *Journal of Applied Social Psychology,* 29, pp. 2328-2341.

Spielberger, C. (1983) *State-trait anxiety inventory (form y).* PaloAlto. Mind Garden.

Steblay, N. (1992) 'A Meta-analytic review of the weapon focus effect', *Law and Human Behaviour,* 16, pp.413-424.

Tollestrup, P. & Turtle, J. & Yuille, J. (1994) 'Actual victims and witnesses to robbery and fraud: An archival analysis', In: Ross, J. & Read, J. & Toglia, M. (1994) *Adult Eyewitness Testimony: Current trends and developments.* Cambridge. Cambridge University Press.

Tortora, G. & Derrickson, B. (2008) *Principles of Anatomy and Physiology: Maintenance and Continuity of the Human Body*. 12th Ed. Hoboken. Wiley.

Tucky, M. & Brewer, N. (2003) 'The influence of schemas, stimulus ambiguity and interview schedule on eyewitness memory over time', *Journal of Applied Experimental Psychology,* 9, (2), pp.101-118.

Valentine, T. & Mesout, J. (2009). 'Eyewitness identification under stress in the London dungeon', *Applied Cognitive Psychology,* 23, pp.151-161.

Valentine, T. & Pickering, A. & Darling, S. (2003). 'Characteristics of eyewitness identification that predict the outcome of real line ups', *Applied Cognitive Psychology,* 17, pp.969-993.

Wells, G. & Memon, A. & Penrod, S. (2006) 'Eyewitness evidence: Improving its probative value', *Psychological Science in the Public Interest, 7,* (2), pp.45-75.

Wells, G. & Olson, E. (2003) 'Eyewitness identification', *Annual Review of Psychology,* 54, pp.277-295.

Wells, G. & Small, M. & Penrod, S. & Malpass, R. & Fulero, S. & Brimacombe, C. (1998) 'Eyewitness Identification procedures: Recommendations for line-ups and photospreads', *Law and Human Behaviour*,22, pp.603-647.

Willmott, D., & Sherretts, N. (2016) 'Individual Differences in Eyewitness Identification Accuracy between Sequential and Simultaneous Line-ups: Consequences for Police Practice and Jury Decisions', *Current Issues in Personality Psychology*, 4, pp.228-239.

Wright, D. & McDaid, A. (1996) 'Comparing system and estimator variables using data from real lineups', *Applied Cognitive Psychology*, 10, pp.75-84.