VICTIMISATION AND EYEWITNESS MEMORY: EXPLORING THE EFFECTS OF PHYSIOLOGICAL AND PSYCHOLOGICAL FACTORS

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Victimisation and Eyewitness Memory: Exploring the effects of physiological and psychological factors

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Submitted to the University of St. Andrews for the Degree of Ph.D.

September 1999

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Abstract

This thesis presents research designed to explore the role of physiological and psychological factors in mediating the effects of victimisation upon eyewitness memory. A tripartite model of arousal and memory is proposed encompassing physiological, psychological and motivational mechanisms.

In order to investigate the potential role of these mechanisms, three laboratory based studies and one archival study are presented.

The results of the laboratory studies suggest that physiological arousal may not influence eyewitness memory. In contrast, whilst direct support for an influence of psychological arousal is not provided, the possibility that psychological arousal may be an important factor cannot readily be dismissed.

From a methodological perspective, contrary to existing laboratory-based research concerning visually-induced arousal, the results of the laboratory studies suggest that personal involvement may be an important factor influencing memory. Furthermore, the third laboratory study found that, differences in memory for emotional and neutral material may be a function of inherent differences between the material rather than an influence of arousal.

Finally, in order to compare and contrast laboratory based research with the performance of real witnesses, a field based study utilising closed-circuit television to assess eyewitness accuracy for action details was conducted. In line with Studies One and Two, victims and bystanders were not found to differ in their memory performance. This study provides direct support for existing field and archival research suggesting that real victims and bystanders tend to be highly accurate in their eyewitness accounts.

Taken together, the results of the research presented in this thesis suggest that whilst physiological arousal may not be an important factor influencing eyewitness memory, psychological and motivational influences may be important when witnesses are personally involved with the target incident.

Chapter 1

Introduction

This thesis presents research conducted to investigate the effects of victimisation, specifically perceived threat and physiological arousal, upon eyewitness performance. The aim of this chapter, which is divided into two sections, is to place the current research in a wider context. The first section provides an overview of the field of eyewitness research by examining:

- Whether there is a need for eyewitness research;
- How eyewitness research may be utilised in practice; and,
- What eyewitness research has contributed to practice so far.

The second section is more specific, providing a background to victimisation and eyewitness testimony by describing:

- The importance of the victim's role within the judicial process;
- The uniqueness of the victimisation experience; and,
- How victimisation may influence eyewitness performance.

1.1 Overview of Eyewitness Research

1.1.1 Is there a need for eyewitness research?

There are three fundamental reasons why research concerning eyewitness testimony is of importance: moral issues; the reliance upon eyewitness testimony as evidence within the judicial process; and economic issues.

From a moral perspective, members of society relinquish their own right to retaliate to harm done to them in exchange for the protection that the criminal law offers. As a result, this places a fundamental moral requirement upon the judicial system to punish criminals, just as it places a moral requirement upon it's members to refrain from breaking the law (Allen, 1995). In order for society to meet these requirements, it is essential that measures are taken to prevent the occurrence of miscarriages of justice, thereby ensuring that society is (i) protected from those actually violating the criminal law, and (ii) to ensure they are protected from the possibility of being wrongly convicted and imprisoned themselves. In doing this, the criminal justice system can maintain a societal perception of being fair and trustworthy. If these virtues are not maintained, however, individuals may become less likely to report crimes or give evidence and the moral basis of society may be significantly weakened.

Across all areas of law and stages of the legal process there is great reliance upon eyewitness evidence. At the beginning of the process, witness reports to the police play a major role in directing the path of investigations. At the trial stage eyewitnesses may be called to give evidence in a wide variety of cases. Whilst criminal trials in particular rely heavily on eyewitness testimony, eyewitnesses may be called to give evidence in cases involving many other aspects of law. For example, an eyewitness may be called in a case based upon tort law concerning the details of a motor vehicle accident. Similarly, an eyewitness might be called to testify regarding the signatory of a challenged will in a probate case. Legal and psychological questions concerning the veracity of eyewitness evidence are often raised in such cases. This is not surprising when one considers it has been estimated that since 1900, 52.3% of miscarriages of justice that have come to light in the United States are primarily the result of erroneous eyewitness identification (Huff, Rattner & Sagarin, 1996). Similarly, eyewitness identification was also found to be the most prevalent cause of wrongful imprisonment in an earlier British study (Brandon & Davies, 1973). Although we have no unequivocal way of knowing how frequently

miscarriages of justice actually occur, it is evident they do. Psychological research concerning the veracity of eyewitness evidence may contribute to minimising their frequency.

In economic terms, an erroneous conviction is extremely expensive. Not withstanding the cost of the investigation, the pre-trial period and the trial itself, simply to keep an adult male in prison for one year costs the UK Government between approximately £15,000 in an open prison and £35,000 in a high security prison (Wilson & Ashton, 1998). The total financial cost of a number of years of wrongful imprisonment, therefore, could be quite considerable. In addition, for many cases there are subsequent judicial reviews and/or appeals which further increase the costs. Furthermore, the cost of compensation for wrongful conviction may also be considerable.

The principle applied aim of eyewitness research, therefore, can be conceptualised in terms of assisting the judicial system to effectively and efficiently (i) identify those who have committed crimes, and (ii) contribute to preventing mistaken convictions of innocent people.

1.1.2 How may eyewitness research be used in practice?

Fundamentally, there are three ways in which eyewitness research can be implemented in a practical sense to assist the judicial system. Firstly, psychologists can help to draw up guidelines, or make recommendations, for those involved with the judicial process to follow. These recommendations are often directed towards police procedures or court procedures. In terms of police procedures, recommendations have been made, for example, concerning the conduction of lineups (Wells, Seelau, Rydell & Luus, 1994), and concerning effective interviewing procedures (Kebbell & Wagstaff, 1999). Similarly, recommendations have also been made concerning children's testimony (Davies & Westcott, 1999).

Secondly, psychologists may appear in court as expert witnesses, on behalf of prosecution or defence counsel, in order to inform or educate the judge and/or jury concerning the psychological factors that influence eyewitness memory (Gudjonsson & Haward, 1998). Psychologists have been giving expert evidence in court on issues of eyewitness testimony for at least one hundred years, the first recorded instance being in Munich in 1896 (see Blackburn, 1996). Consequently, both the British Psychological Society and the American Psychological Association publish registers of practicing, qualified expert witnesses.

Although recommendations, such as those mentioned above are often made on a discretionary basis, as research findings, practical evidence and case law accumulates, recommendations and guidelines may ultimately become enshrined in statutory legislation such that they are no longer discretionary. For example, the Police and Criminal Evidence Act (1984) contains codes of practice for police officers conducting identification parades.

1.1.3 What has eyewitness research contributed to practice so far?

Over the last century, particularly the last 20 years, a great deal of eyewitness research has been conducted (see e.g., Kebbell & Wagstaff, 1999; Loftus, 1979; Ross, Read & Toglia, 1994; Sporer, Malpass & Koehnken, 1996; Wells & Loftus, 1984; for comprehensive reviews). This research has been conducted in a number of areas across all stages of the judicial process.

1.1.3.1 The incident stage

The majority of eyewitness research has tended to focus on this stage of the judicial process, exploring a wide variety of factors that appear to influence how individual witnesses experience incidents. These factors have been termed estimator variables as they are not under the control of the legal system and can only be estimated after the occurrence of the event (Wells, 1978). In terms of expert testimony, it is generally on these factors that expert psychological witnesses can be requested to inform, or

educate, the judiciary. Consequently, a great deal of research has investigated the effects of these variables upon eyewitness memory. For example, witness factors researched include: the expectations, gender, age, race, intelligence, face recognition skills, confidence, and personality characteristics of witnesses; whilst situation factors researched include: perceptual salience, exposure duration, number of perpetrators, weapon presence, crime seriousness, and post-event information effects (see Kebbell & Wagstaff, 1999, and Narby, Cutler & Penrod, 1996, for reviews).

1.1.3.2 The investigatory stage

In addition to the large body of research concerning identification procedures (see Sporer, Malpass & Koehnken, 1996, for a review), a similarly large area of research centres around the study of interview techniques for improving the accuracy and amount of information witnesses recall. The realisation that individuals, ranging from parents and social workers to police officers, may use flawed questioning or interviewing techniques (i.e., use suggestive or leading questions) inspired research that led to the development of investigative interviewing techniques. In particular, a technique known as the Cognitive Interview has been developed which uses a variety of means to help witnesses recall as much accurate information as possible without increasing the chances of recalling inaccurate information (see Fisher, McCauley & Geiselman, 1994, for an account of the development, revision, testing, and applications of the Cognitive Interview). This technique has undergone considerable reliability and validity testing (Fisher et al., 1994) as well as comparisons to other similar memory enhancing techniques (Clifford & George, 1996). Although a national curriculum does not currently exist, many police forces within the UK train Investigating Officers in how to conduct effective investigative interviews, including using cognitive interviews (Davies, Marshall & Robertson, 1998).

1.1.3.3 The courtroom stage

Although for some eyewitnesses the end point of their involvement with the criminal justice system may be an interview with the police, for many the judicial process may

ultimately result in an appearance in court at which they have been called to give evidence. A great deal of eyewitness research has looked at factors affecting witnesses' ability to give evidence during cross-examination. In particular, research has investigated the effects of factors including the intimidating environment of the courtroom and the nature of cross-examination for vulnerable witnesses such as children (Westcott & Page, 1998) or those with learning disabilities (Kebbell & Hatton, in press). Following research in this area there have been significant advances in understanding and consequent changes in legislation. In particular, under the Criminal Justice Act 1991, in cases of child sexual and physical abuse video-taped evidence may be submitted in place of the child's live cross-examination. Although children are still required to give evidence, they do not have to do so in what is often a particularly frightening and intimidating environment. Similarly, in the United States, although some states have maintained the right for defendants to confront their accusers (e.g., Iowa), many states (e.g. Maryland) have legislation that allows for the use of video-links (Davies, 1996).

Despite the wide variety of factors investigated at each stage of the judicial process, some factors that may be fundamental to witnesses' experience and behaviour during and after the actual incident have received little direct research attention. These factors concern the effects of victimisation, in particular arousal and perceived threat, upon eyewitness memory. Fundamentally, there is a large gap in the research literature concerning the effects of these variables upon eyewitness memory despite their prevalence during most criminal incidents. For example, although the term 'weapon focus', which refers to a witness's focus of attention onto a weapon to the detriment of other aspects of the incident, has been relatively well-documented in laboratory research, the principles and mechanisms underlying this effect are little understood (see Steblay, 1992, for a review and meta-analysis of the weapon focus effect). Addressing this gap in our knowledgemight provide a much needed insight into the factors that can affect the encoding of information and subsequent eyewitness memory.

1.2 Victims and eyewitness testimony

1.2.1 The importance of the victim's role within the judicial process

As mentioned above, eyewitness reports are heavily relied upon at all stages in the judicial process with victims in particular playing a central and important role throughout. Although the precise nature of victimisation varies depending upon the crime type, in all criminal incidents, excluding victimless drug-related offences, there is at least one victim, whether the crime is directed against an individual (e.g., a sexual offence), a group (e.g., a bank robbery with multiple perpetrators) or against a company (e.g., fraud). Furthermore, in terms of investigation, victims are often the first individuals to report the incident to the police. Hence, they are the police's first point of investigatory contact and therefore may affect the initial investigation decisions. A Scottish Office report found that 61% of a sample of 255 victims reported the incident to the police themselves. Only 8% of the 255 cases were reported by unknown bystanders, the remaining 31% of cases were reported by individuals known to the victim i.e., family members, neighbours, or work colleagues (see MacLeod, Carson & Prescott, 1996). Not only are victims most likely to report the crime in the first instance, but the likelihood of reporting increases when the victim has been physically or emotionally affected, and for cases of violent crime the police depend almost entirely on victim reports to direct whole investigations (Petersilia, 1994).

Finally, in terms of evidence, victims are central witnesses in court, and in many cases they may be the only witness. Both the judge and the jury will be extremely interested in the victim's testimony and may, therefore, place a great deal of credibility on the content of the testimony. Although it is clear that victims have a crucial role to play at all stages, it is particularly important to point out that the role of bystanders should not, as a consequence, be minimised. In particular, some non-victim witnesses may be extremely involved with the incident, for example, in terms

of proximity and/or relationship to the victim, even though they are not themselves being directly victimised. They could, therefore, also be crucial witnesses and may represent a proportion of the 31% of cases mentioned above (MacLeod et al., 1996) where the incident is initially reported by an individual known to the victim.

1.2.2 Uniqueness of the victimisation experience

Whilst the precise nature of the effects of victimisation will vary depending upon the type of incident and the victim involved, there is no doubt that many of the effects will be unpleasant or negative.

1.2.2.1 During the incident

Excluding victims of fraud, almost all victims will experience some form of arousal or emotion during the victimisation experience itself. Specifically, the level and perseverance of the arousal will be dependent upon the type of incident experienced. Crimes involving weapons, or physical threat, for example, are likely to be more arousing than crimes involving no threat of physical harm, although the latter crimes may still be very arousing. In addition, it is likely that the level of arousal experienced by victims will be higher than that experienced by bystanders present, although bystander witnesses may also be significantly aroused by the incident.

Although the effects of victimisation can be unique and varied depending upon the nature of the incident, as expected there is a clear trend in terms of more emotional effects experienced by victims of more violent crimes. For example, MacLeod et al. (1996) found that:

- Two-thirds of the victims in the research sample said that they had been emotionally affected by the victimisation episode;
- 11% of victims reported feelings of fear and helplessness;
- A greater variety of feelings were expressed by victims of violent/threatening incidents;

- Feelings of anxiety were high across threatening/violent incidents;
- 25% of victims of violent or threatening incidents said that they felt afraid or helpless after the incident;

In particular, it is not surprising that victims for whom the target incident had been their first experience of victimisation were more likely to feel shocked or surprised (23%), and worried, scared or helpless (17%) in comparison to those who had experienced a previous victimisation episode. This should not, however, minimise perceptions of the effects of repeat victimisation which can be extremely traumatic. Similar results were found in an earlier study by Haward (1981). When questioned, 92% of 119 victims of personal direct assaultive crimes questioned reported feeling extremely distressed by the experience of victimisation and 11% felt they would never fully recover from the experience.

Although it is clear that the effects of violent crimes are significant, less violent crimes may also have a significant emotional effect upon victims. For example, a study reporting victim's first reactions to the effects of residential burglary showed that 30% of the 322 victims questioned felt anger/annoyance, and 19% shock. Only 17% reported feeling no strong reaction (Maguire, 1981). Similar results were presented by Norris, Kaniasty & Thompson (1997) who, although they found that victims of violence were the most severely distressed group of victims, also found property crime victims showed considerable distress, thus highlighting the importance for how a crime is perceived.

The relationship between victim and offender will also most likely have an effect upon the nature of the victim's experience. In cases where the offender is known to the victim (e.g., in most cases of sexual assault), the victim will already have attitudes towards the offender which may affect the experience. Eighteen percent of the victims surveyed by MacLeod et al., reported knowing the identity of the offender, and 41% of these said that they had a negative attitude towards the offender before

the incident. Similarly, the relationship between bystander witnesses and victim(s) may also have a role in mediating the effects of victimisation. Witnesses other than the victim were present in a third of all the cases surveyed by MacLeod et al., and were known to the victim in 71% of the incidents.

As well as the psychological effects associated with victimisation, many victims are also physically injured. A detailed analysis of injuries from violent crime committed in the United States (rape, robbery or assault) by Harlow (1989) revealed that of the sample studied approximately 28% of the victims of violent crime were injured, 13% requiring medical attention and 7% requiring hospital care. The injuries included bruises (85%), broken bones or teeth (6%), knife injuries (3%), and gunshot wounds (1%).

1.2.2.2 After the incident

In addition to the emotional upset experienced during the crime, the effects of victimisation may persist long after the incident. For example, indirect post-event physical effects may appear for victims. Victims may experience an intensity of symptoms more commonly associated with post-traumatic stress disorder. Indeed, a decline in physical health was reported by just over 25% of the victims surveyed by MacLeod et al., 1996. Some of the emotional effects appeared in the period immediately after the incident e.g., anger, shock and surprise, whilst other reported effects (e.g., anger, annoyance, tension, anxiety, feeling upset, vulnerable, frightened, suspicious, distrustful, depressed, withdrawn, persecuted, and violated) were evident long after the actual episode. In addition, in terms of preoccupation, 41% of victims said they spent 'a lot of time' thinking about why the incident had happened to them after the incident. Of the victims interviewed by Maguire (1981) 65% reported that the residential burglary was still having some effect upon them 4-10 weeks after the incident. Similarly, Norris et al. (1997) found that criminal victimisation was associated with: depression, anxiety, hostility, somatic symptoms, fear of crime,

avoidance, lower self-esteem, increased alienation, and the need for both formal and informal support.

In recognition of these clear psychological and physical effects of victimisation, victim assistance programs have been established in many countries in order to assist victims in dealing with the consequences of crime (Erez, 1989). To supplement this, police personnel are increasingly being trained in the special needs of victims with a particular emphasis on identifying and referring victims to appropriate support schemes.

1.2.3 How might victimisation influence eyewitness performance?

In summary, then, as a result of their unique role in the incident victims have a central involvement within the judicial process. The effects of victimisation may, however, be extremely traumatic, involving physical and psychological arousal and may exert particular influence on certain aspects of a victim's memory. Critically, there is a wide range of existing psychological research that suggests arousal and perceived threat may have a significant role to play in directing attention towards and subsequent memory for information. In light of the existing research it is suggested that the experience of victimisation, characterised by increased physiological arousal and perceived threat, may have an effect upon the type, amount and accuracy of information reported.

In light of the key role played by victims in the judicial process, therefore, it is argued that it is essential that the potential effects of victimisation upon eyewitness memory are investigated. In particular, research in this area may help us to identify those factors that may influence victim's eyewitness memory, both during and after the victimisation experience, and how these may affect the memorial ability of victims in comparison to that of bystanders. The research presented in this thesis was specifically conducted to investigate this.

Chapter 2

Key Issues

As discussed in Chapter One, experiencing any crime against the person (be it assault, theft, or other threatening behaviour) is likely to result in fear for one's personal safety and a heightening of emotional arousal both during and after the incident. Despite the potential importance of such factors for eyewitness reliability, however, psychological research has largely failed to address this issue. The principal reasons for this revolve around a set of complex methodological and ethical issues which, in practice, have proved difficult to surmount. Furthermore, research concerning arousal and eyewitness memory has been characterised by a relative lack of consistency and clarity in the use of terminology. Consequently, in order to place the research presented within this thesis in context, in this chapter the key methodological and ethical issues which impinge upon work in this field are discussed and the terminology commonly used in this area are briefly described.

2.1 Methodological and ethical dilemmas

Chapter One set out how eyewitness research can be used in practical settings. Although such clear examples of practical applications exist, it is not a foregone conclusion that such applications are unanimously accepted or encouraged. Indeed, many legal practitioners and academics argue that eyewitness research is of limited practical use in its current form because the majority of this research has been conducted within the laboratory where external validity has been compromised (Berkerian, 1993; Egeth, 1993; Yuille, 1993). In particular, there has been considerable debate surrounding the extent to which psychological mechanisms concerning eyewitness memory are sufficiently understood to be presented in court as expert evidence (Elliott, 1993; Goodman-Delahunty, 1997;

Gudjonsson, 1993; Kassin, Ellsworth & Smith, 1994; Konechi & Ebbesen, 1986; Leippe, 1995; Loftus, 1983; McCloskey & Egeth, 1983b; Seelau & Wells, 1995; Sheldon & MacLeod, 1991). Fundamentally, these arguments revolve around an internal versus external validity debate.

2.1.1 The internal versus external validity debate

Firstly, it is important to clarify what is meant by internal and external validity. Internal validity specifically refers to the extent to which the tests of a study actually measure the variables of interest. External validity, on the other hand, refers to the extent to which a study is able to measure the variables of the population to which the study is generalised, in this case real victims and witnesses. The rationale for this particular debate concerns the fact that whilst laboratory based studies may have high internal control and validity, they are low in external validity. That is, they lack the realism and consequentiality of real life incidents. In contrast, although field and archival studies investigate memory for real-life incidents, they lack the internal control available with laboratory based studies. Consideration of the methodology employed in studies of eyewitness performance is important when trying to compare and understand the apparent discrepancies in their findings. In particular, a fundamental question arises: are the memories studied in these two settings qualitatively different or does the source of discrepancy lie within the methodological diversity of these studies, i.e., type of stimulus material, time of memory test, or type of memory test? In the following section the particular methodological strengths and weaknesses of field, archival and laboratory based research are critically discussed.

2.1.1.1 Field and archival research

Many have argued that human memory should be studied in natural everyday environments, i.e., studying real victims and witnesses to actual criminal incidents (e.g., Yuille, 1993). Initially, this would seem like a sensible argument as the aim of such research is to inform policy and practice. Indeed, field and archival based research has been conducted where the incidents studied are serious, directly involve and are consequential for the victims and witnesses present (e.g.,

Christianson & Hubinette, 1993; MacLeod & Shepherd, 1986). Hence, there are also high levels of witness cooperation with police and other judicial personnel as a result of witnesses' motivation to see 'justice done'.

Despite such obvious high external validity, however, field and archival research is characterised by an associated trade-off in terms of internal validity. Most importantly, no studies conducted to date have been able to measure the accuracy of real witness statements because there has been no way of knowing what actually happened. As a result, studies have generally only been able to look at the amount or consistency of information reported by witnesses over time (e.g., MacLeod & Shepherd, 1986; Yuille & Cutshall, 1986). Despite such attempts to circumvent the issue of eyewitness accuracy, the problem remains as information concerning accuracy is of paramount importance if we are to be able to say anything concrete about actual eyewitness performance.

Another fundamental trade-off concerns the extent to which real witnesses are physiologically and psychologically affected by the incidents with which they are involved. Although it is not possible retrospectively to measure physiological arousal experienced at the time of the incident, self-report measures can be used retrospectively to assess the extent to which the witnesses were emotionally aroused by the event. While the reliability of such reports is questionable (Wright, 1997), they may provide an insight into the degree of affect experienced.

A further problem, often encountered when conducting field research, concerns witness self-selection. For example, in studies measuring the consistency of witness reports between an original report given to the police and a later research interview, there is often a high attrition rate when witnesses are contacted and invited to participate in a research interview (e.g., Christianson & Hubinette, 1993; Yuille & Cutshall, 1986). This raises the possibility that only witnesses who feel confident about the reliability of their memories for the event may be prepared to come forward and participate, thereby inflating reliability estimates.

Additionally, comparison across real witnesses is complicated as the roles of individual witnesses may vary depending on the type of incident witnessed and their relationship with other witnesses (MacLeod, 1989). The content and style of police interviews may also vary, contributing to problems of comparison: i) across real witnesses, ii) with research interviews conducted in studies concerned with consistency of reporting, and iii) with laboratory based witnesses where memory measures may be more detailed or involve recognition rather than recall. This is an important distinction to make as it has long been argued that recall and recognition may involve different memory processes. For example, Anderson & Bower (1972) proposed that recall involves two successive stages: i) a retrieval stage and ii) a recognition stage. On this basis, whilst recall involves search and retrieval as well as recognition, recognition tests only involve the second stage and therefore may facilitate the remembrance of more information than when only recall memory is measured (Koriat & Goldsmith, 1994). Although not all researchers agree with the details of Anderson & Bower's proposal (e.g., Tulving & Thomson, 1973), there is a general consensus that retrieval is a more important component of recall memory than it is of recognition memory (Morris & Gruneberg, 1994). In addition, laboratory based memory measures can tap into additional information such as the confidence of the witness by asking them explicitly to rate their confidence, or, using a technique from pure memory research, by asking participants whether they consciously remember or simply have a 'feeling of knowing' or seeing the information before (Donaldson, 1996; Tulving, 1983).

In summary, then, field and archival research is characterised by a number of fundamental methodological problems serving to reduce internal validity.

2.1.1.2 Laboratory based research

In light of the problems associated with field and archival research, the majority of research in this area has been conducted within the laboratory where the variables of interest can be more readily manipulated and controlled. However, as Chapter Three highlights, in addition to the discrepancy between the findings of

laboratory and field or archival based research, there is a lack of consistency across the findings of laboratory based research which is most likely due to the wide variation in paradigms used.

Nevertheless, in contrast to field and archival based research, laboratory research is characterised by two fundamental advantages: i) the opportunity to measure the degree of affect associated with stimuli; and ii) precise knowledge of the stimulus material against which witness memorial accuracy may be assessed. With regards to affect, it is possible to measure physiological effects of stimuli during presentation as well as employing self-report measures of psychological effects. Unlike field and archival research, such methods are generally employed during and immediately after the incident rather than weeks or months afterwards. Additionally, there is less influence from the biases associated with witness self-selection encountered in field studies. In line with this, instead of relying on police interviews or research interviews, often conducted many months after the original event, laboratory based studies have control over not only the type of memory measures employed, i.e., recall versus recognition, but over the interval between stimulus experience and memory testing.

Despite such high internal validity, however, laboratory research is plagued by an associated trade-off in terms of external validity. Fundamentally, the majority of laboratory research has been conducted with stimuli which are relatively innocuous. There are two main reasons for this. Firstly, the majority have presented their stimulus using unrealistic methods such as slides (Christianson & Mjorndal, 1985; Christianson & Nilsson, 1984; Christianson et al., 1984; Kramer, Buckhout & Eugenio, 1990) or video-tapes (Clifford & Hollin, 1981; Clifford & Scott, 1978; Loftus & Burns, 1982). Only a very small number have attempted to maximise external validity by using live staged-events or simulations to compare victims and bystanders (Hosch & Bothwell, 1990; Hosch, Leippe, Marchioni & Cooper, 1984; Hosch & Platz, 1984). Secondly, although the content of the stimuli are generally forensically relevant, i.e., depicting bank robberies (Loftus & Burns, 1982; Loftus, Schooler, Boone & Kline, 1987) or assaults and muggings

(Clifford & Hollin, 1981; Kramer, Buckhout & Eugenio, 1990) some have shown non-forensically relevant stimuli such as disfigured faces (Christianson & Nilsson, 1984) or hospital operations (Heuer & Reisberg, 1990).

In combination, an unrealistic presentation method and content results in relatively innocuous stimuli. Indeed, despite having the opportunity, many studies have not measured the effect of their manipulations on witness physiology in order to ascertain whether their emotional stimuli are indeed arousing. Where manipulation checks have been employed and successful creation of differential arousal levels between treatment groups demonstrated, ethical constraints mean that the physiological reactions experienced may remain quite different from those experienced by actual victims of crime. It should be acknowledged, however, that a level of innocuousness in laboratory studies is insurmountable because of ethical constraints. For obvious reasons there are limitations as to the level of arousal or victimisation that can be created within the laboratory without participants' prior consent. In particular, such research should always comply with ethical guidelines published by societies such as the British Psychological Society and the American Psychological Association.

Another effect of ethical constraints concerns the debriefing of participants, which in laboratory studies occurs immediately following stimulus presentation and prior to memory testing. As a result, participants' motivation may be diminished and is unlikely to be equatable with the motivation of a real witness trying to remember as many details as possible when aiding the police 'catch the criminal' and 'see justice done' (cf. Foster, Libkuman, Schooler & Loftus, 1994; Leippe, Wells & Östrom, 1978).

Finally, it is often argued that the sample population is not representative of the population to which the results are being generalised (O'Rourke, Penrod, Cutler & Stuve, 1989). For example, the majority of laboratory based studies employ young undergraduates. Clearly, real witnesses to crime are not all undergraduate students.

In summary, although laboratory studies provide the opportunity to use a controlled environment in which to explore a wide range of factors that may influence eyewitness memory, they are ethically constrained often to the extent of having little or no involvement or consequence for the participant witnesses.

2.1.2 The way forward - a combined approach

As discussed, field, archival and laboratory based research are each characterised by a number of advantages and disadvantages over one another. Unfortunately, combination of all the advantageous aspects is not an option. Hence, it is argued that for research in this area to be of use a combined approach should be adopted where ideas and hypotheses are investigated both in a controlled laboratory environment and in a real-eyewitnessing situation. In order to maximise the potential of future research it is argued that, in line with ethical guidelines, laboratory based studies should maximise their external validity by using forensically relevant paradigms and utilising manipulation checks to assess the extent of physiological and psychological arousal. Overcoming the internal validity problems associated with field studies, although harder, is not insurmountable. In particular, Chapter Seven presents an exploratory study specifically designed to overcome the problems of assessing eyewitness accuracy in field and archival studies.

Fundamentally, as Endel Tulving has pointed out, there is no reason to believe that there is only one correct way in which memory should be studied (Tulving, 1991). Similarly, Yuille (1993) also advocated that in addition to the plethora of laboratory based studies in this area we must study actual forensic eyewitnesses. In line with these views, the research presented in this thesis utilises a variety of methods.

2.2 Defining and clarifying terminology

Within the eyewitnessing literature, the terms stress, arousal, emotion, mood, and anxiety are widely used and everyone understands what is generally meant by the

terms. Despite such a general level of understanding, however, the lack of a precise and agreed definition, in conjunction with the interchangeable use of the terms, has heightened the lack of clarity in the use of any one of them. A brief description of the common terms used in the eyewitness literature is provided. Whilst these definitions are by no means definitive, they do provide a basis for understanding their general meaning and use.

2.2.1 Stress

Broadly, stress is a set of responses elicited by the perception of a stressor. A stressor may be defined as an uncontrollable event that is perceived as threatening physical or psychological harm. Consequently stress responses are negative (unpleasant) in affect and can be physiological (i.e., activation of the sympathetico-andrenal system to produce and circulate adrenalin preparing the body for fight or flight), or psychological (i.e., feelings of anxiety).

2.2.2 Arousal

Arousal is a fundamental part of the stressor-stress relationship in that it is the physiological state elicited by an organism in response to its perceptions of the environment. In addition to producing states of extreme anxiety (generally termed the stress response), arousal can also be used to define states at the opposite end of the continuum, such as states of deep sleep. Therefore, unlike stress, arousal may be used to define states of positive affect as well as negative affect. As with stress, however, arousal may be physiological, (i.e., resulting from activation of the sympathetico-adrenal system), or psychological (i.e., perceived threat).

2.2.3 Emotion

Emotion, on the other hand, is much harder to define but may include the psychological and physiological state elicited in response to an organism's perceptions of its environment. A working definition is provided by Oatley and Jenkins:

"1. An emotion is usually caused by a person consciously or unconsciously evaluating an event as relevant to a concern (a goal) that is important; the emotion is felt as positive when a concern is advanced and negative when a concern is impeded. 2. The core of an emotion is readiness to act and the prompting of plans; an emotion gives priority for one of a few kinds of action to which it gives a sense of urgency - so it can interrupt, or compete with, alternative mental processes or actions. Different types of readiness create different outline relationships with others. 3. An emotion is usually experienced as a distinctive type of mental state, sometimes accompanied or followed by bodily changes, expressions, actions" (Oatley & Jenkins, 1996, p.96).

2.2.4 Mood

The term mood refers to a relatively permanent emotional state that may last for hours, days or weeks, often at low intensity.

2.2.5 Anxiety

Anxiety, often viewed as objectless in its causality, is generally used to refer to a vague unpleasant emotional state with qualities of apprehension, dread or distress.

Although a few studies of events positive in affect have been conducted, i.e., events which are pleasant or enjoyable such as the sight of a man holding a baby or a beach at sunset (e.g., Bradley et al., 1992), the majority of research on arousal or emotion and memory has studied the effects of events negative in affect upon memory. Such events are associated with the evocation of some form of unpleasant or negative response and tend to include events which if experienced personally would be violent, shocking or traumatic to a certain degree, such as car accidents or surgical operations (e.g., Heuer & Reisberg, 1990; Christianson and Loftus, 1987). As the experience of victimisation is an unpleasant or negative experience, the research presented within this thesis also focuses on events which are negative in affect and memory for those events.

Chapter 3

Research Review

This chapter is concerned with critically discussing and evaluating existing research in order to consider fully *whether* memory for negative emotional events and neutral events may differ and if so, *how* they differ. Following this, Chapter Four specifically reviews the theoretical mechanisms which have been put forward to explain *why* negatively arousing or emotional information may affect memory.

As a result of the existing research interest and activity in this area, a number of literature reviews and books concerning the effects of arousal and emotion upon eyewitness memory have already been published (e.g., Christianson, 1992a, 1992b; Deffenbacher, 1983; Deffenbacher, 1991; Egeth, 1994). On the basis of these existing reviews, rather than simply regurgitating or being repetitive, this research review presents the central literature in this area along with new research which has been published since the existing reviews themselves were published. Furthermore, rather than consider laboratory, field and archival studies as distinct entities, as many existing reviews have done, in this review the distinction is made between memory for personally meaningful arousing events, whether manipulated within the laboratory or studied in real life, and memory for events and information associated with visually-induced arousal, which traditionally have tended to be studied within the laboratory. As will be seen, on the basis of research conducted since Christianson's important review paper (Christianson, 1992a), it is argued that this is an appropriate alternative manner in which to present and critically evaluate the research conducted in this area.

3.1 Eyewitness memory for personally meaningful arousing events

Memory for personally meaningful arousing events refers specifically to an arousing or emotional event that has some form of personal significance, whether it is a crime or other emotional event. Specifically, this section reviews: autobiographical memory; archival and field research that has looked at memory for real crimes; and laboratory based simulation studies which have attempted to induce victimisation and, therefore, personal involvement.

3.1.1 Autobiographical memory

As the term itself suggests, autobiographical memory refers to an individual's recollection of events in their own life. Principally investigated as a means of understanding normal human memory, this was one of the first aspects of memory to stimulate research (i.e., Galton, 1883). Since then, a great deal of interesting work has investigated the role of emotional affect in autobiographical memory (see Rubin, 1996; Thompson, Skowronski, Larsen & Betz, 1996; Winograd & Neisser, 1992, for comprehensive reviews). In particular, no account of autobiographical memory research is complete without reference to the seminal paper in this area published by Brown & Kulik (Brown & Kulik, 1977).

Brown & Kulik investigated participant's memories for a number of national news events, such as the assassination of President John F. Kennedy, by asking them to describe the circumstances in which they first heard of these events and by asking them to rate the consequentiality of the event for themselves. Even after an intervening period of over 10 years, they found participants' memories for these events to be very vivid. Interestingly, the vividness extended beyond details for the event itself to include circumstantial details, such as where the individual was when they heard the news or how they heard the news, especially if they rated the event as consequential for themselves. As a result, Brown and Kulik coined the term 'flashbulb memory' suggesting that this type of memory has two principle determinants, a high degree of surprise or emotion, and a high level of consequentiality. They concluded that if these determinants are present in a given situation then a flashbulb memory occurs. Since the publication of Brown and

Kulik's paper, many studies have demonstrated similar flashbulb type memory effects (Bohannon, 1988; Christianson, 1989; Pillemer, 1984; Rubin & Kozin, 1984; Wright, 1993).

As well as studying memory for national news events, several studies have looked at participants' memories for personal events which are emotional, such as the death of a relative or a traffic accident, and found these also appear to exhibit flashbulb type memory effects similar to those described by Brown & Kulik (1977). For example, Christianson & Loftus (1990) asked participants to describe their individual most traumatic memory and rate the affect associated with both the original incident and the memory itself. They found that participants' rated emotion was significantly correlated with the number of central details the participants rated themselves to remember. Similar results, suggesting that affect strength is related to rated memory vividness, have been found in a number of other studies (Rubin & Kozin, 1984; Reisberg, Heuer, McLean, & O'Shaughnessy, 1988; Strongman & Kemp, 1991; Wagenaar & Groeneweg, 1990)

Despite the concordance in findings between the studies of memory for national news events and those for personally arousing events, the potential mechanisms behind the flashbulb memory phenomena are less clear. It has been suggested that biological or neurobiological mechanisms promote the formation of memories for emotional or important information (Gold, 1992; Livingston, 1967). For example, Brown & Kulik (1977), drew heavily on the work of Livingston (1967) to explain their findings. Using Livingston's theory, they argued that when an individual experiences an emotional event there is an associated biochemical change in the brain activating what Livingston termed a 'Now print!' mechanism which captures the details for the event rather like a photographic image. Similar mechanisms have been proposed by others (e.g., Gold, 1986; 1992). These theories are discussed in more detail in Chapter Four. Hence, Brown & Kulik (1977) suggested that flashbulb memories were different to normal everyday memories in

that increased intensity or affect associated with the event results in a more vivid subsequent memory due to the enhanced biochemical activation.

In direct contrast, however, it has also been argued that flashbulb memories are not special or different from normal memories and that their apparent permanence, detail and vividness is due to psychological mechanisms rather than biological mechanisms (Christianson, 1989; McCloskey, Wible & Cohen, 1988; Weaver, 1993; Wright, 1993). Prominent amongst the psychological arguments is the suggestion that the reported vividness of such memories is not a function of the incident itself, but rather a function of extensive or continuous rehearsal which results in their persistence (Bohannon, 1988; Christianson, 1989). Using a similar paradigm to Brown & Kulik (1977), Bohannon (1988) tested participant's memories for the Challenger Space Shuttle disaster and asked participants to rate their emotional reaction (calm versus upset) upon hearing of the disaster, and whether they recounted the story of hearing the news to others on only a few occasions or on many occasions. Frequency of rehearsal was found to be sufficient to produce a flashbulb memory type effect, although at a longer retention interval the effect appeared to be enhanced when greater rehearsal was reported in conjunction with higher emotional affect.

In line with this, it has also been suggested that these vivid memories are reconstructions after the event. In a comparison of memories measured shortly after the murder of Olaf Palme, the Swedish Prime Minister, with reports obtained one year later (double assessment technique), Christianson (1989) found that there was a loss of consistent information over the intervening time contradicting the idea that flashbulb memories are formed at the time of the incident, but rather are reconstructed afterwards. In support of this, Wright (1993) also found systematic biases in participants' recollections of the Hillsborough football disaster over time.

From a slightly different perspective, it has also been argued that the recollection of events after several years is not a function of their vividness and consequentiality, but a function of the fact that an explicit retrieval aid is provided

which facilitates the recall of the event itself and concomitant circumstances. Critically, if similar prompts were given for non-emotional information or events, then detailed and vivid memories might also be reported (Christianson, 1998, personal correspondence).

Furthermore, the role of surprise in the formation of these memories has also been questioned. Neisser (1982) suggests that events which have been expected for a long time can also produce persistent vivid memories, i.e., the awaited news of the death of an ill friend or relative can produce persistent memories of where and how one heard the news of the death.

One of the only studies to have a baseline record of events, against which to compare memory accuracy, was carried out by Larsen (1992) who kept a diary collecting news events and everyday personal experiences over a period of 9 months. In contrast to existing studies, Larsen found that as surprise and importance of the news increased, memory of the reception context (where and how the news was heard) deteriorated, whilst memory for the news itself improved. As will be seen later, this pattern of results is similar to the central and peripheral detail distinction found in many laboratory studies of arousal and eyewitness memory.

It is clear, then, that the existence of the flashbulb memory phenomena is not universally accepted. Indeed, whether flashbulb memories are in fact different from other everyday memories is a continuing debate. Furthermore, the study of flashbulb memories is complicated by the same methodological problems as field and archival eyewitness memory studies in that for most cases there is no accurate record of what actually happened and therefore the accuracy of these memories cannot reliably be assessed. Even where studies have tried to overcome this and used a measure of memory consistency over time, issues of rehearsal effects become paramount.

3.1.2 Archival and field research

Those studies which have examined actual eyewitness performance have utilized two main methodologies. One group of studies (archival studies) have looked specifically for patterns in the amount and type of information typically reported to the police by examining actual eyewitness reports held in police records (e.g., Kuehn, 1974; MacLeod & Shepherd, 1986; MacLeod, 1989; Sporer, 1992). Other studies (field studies) have measured the consistency of information between that which was reported to the police at the time of the incident with that reported during subsequent interviews conducted by researchers (e.g., Yuille & Cutshall, 1986; Cutshall & Yuille, 1989).

3.1.2.1 Archival studies

In the earliest study of actual eyewitness reports, Kuehn (1974) assessed the effects of crime type and victim characteristics on the ability of 100 victims of violent crimes (rapes, assaults, robberies and homicide) to provide complete descriptions of their assailants to the police. Completeness of descriptions was assessed on the basis of 9 pre-determined physical characteristics. Whilst 85% of all victims reported 6 or more characteristics, Kuehn noted that victims of robberies provided more complete accounts than did victims of rape or assault, and that uninjured victims provided more complete accounts than did injured victims, suggesting that crimes higher in personal violence or threat to one's safety are likely to be associated with less complete accounts of assailants by their victims.

An archival study by Sporer (1992) of 139 person descriptions from cases of robbery and rape, however, failed to support Kuehn's conclusion. Specifically, Sporer found an almost linear increase in the number of descriptive details as a function of the level of stress experienced by a witness. Level of stress had been evaluated by classifying incidents on the basis of witnesses' self-reported anxiety in conjunction with weapon presence and injury occurrence. In this study, however, only half of the witnesses actually witnessed the incident. The remainder had not witnessed the incident per se but had interacted with the perpetrator either

just before or after the incident occurred. Consequently, it is possible that those witnesses who interacted with the perpetrator but did not actually witness the incident may have experienced lower levels of stress and attended to the perpetrator to a lesser extent than did those who had actually witnessed the incident.

In a similar vein, MacLeod and Shepherd (1986) examined action and description details reported by victims and bystanders. From a sample of 379 witness statements concerning 135 cases of assault, they found that male witnesses reported significantly more information than did female witnesses in cases where the victim had been injured, whereas no difference was found between males and females where the victim had been uninjured. They argued for the possibility that females may produce less complete accounts in more arousing incidents (i.e., those where the victim had sustained physical injuries). A subsequent analysis of the same data set by MacLeod (1989) revealed that victims reported significantly more action and description details about the perpetrator than did any other witness type. The reasons for these differences may lie in the fact that i) the information available to passive observers is likely to differ from the information available to those who are actively involved; ii) for bystanders, the victim is a competing stimulus which may serve to limit the processing of information about other persons and objects; and iii) differential demands may be made on witnesses by police officers as a means of providing investigative leads or judicial proof (MacLeod, 1985).

Whilst these studies reveal the information typically reported to the police by particular witness types (e.g., victim, friend of victim, associate of perpetrator, uninvolved bystander) and highlight the need to consider the role of individual witnesses when assessing eyewitness testimony, they fail to provide little more than educated guesses as to the relationship between arousal and eyewitness performance as they include neither a measure of arousal nor of memorial accuracy.

3.1.2.2 Field studies

An important first step in this regard was taken by Yuille and Cutshall (1986) who measured the consistency of 13 witnesses' memories by comparing statements given to the police immediately following a gun store robbery and shooting incident, with statements given in interviews conducted by researchers 4 to 5 months after the event. The incident involved a single male robbing a gun store, after which he ran out to his car, closely followed by the gun store owner who was armed with a loaded revolver. The robber fired 2 shots wounding the store owner, who subsequently fired six shots killing the robber. The research interviews elicited a higher mean number of details than did the police interviews (81.27 and 49.96 respectively), with over 50% of the details being action based. There was, however, considerable inter-witness variability in the number of details reported (between 17 and 95.5 details). Consequently, witnesses were grouped according to whether they had been centrally or peripherally located whilst witnessing the shooting. For both sets of interviews, witnesses who were located centrally reported approximately twice the number of details reported by those who were on the periphery.

Importantly, Yuille and Cutshall attempted to assess the accuracy of the details reported by combining forensic evidence, the reports of all witnesses, police, and support personnel, and by 'employing the constraints of logic.....to reconstruct the events' (p.105). Whilst this provides an account of what most likely occurred, it does not provide an unequivocal assessment of what actually happened. Thus, as Yuille and Cutshall readily acknowledge, this method permits only an estimate to be made rather than an accurate assessment of eyewitness accuracy. Using this method they found no difference in overall accuracy between central and peripheral witnesses for either interview, and little change in accuracy across all witnesses between the police (82.14%) and research (80.66%) interviews. Although unable to compare victim with bystander performance (as the only victim did not wish to take part), they attempted to explore the impact of stress by asking the witnesses to rate retrospectively the level of stress experienced at the time of the incident. Those rating themselves as highly stressed were significantly

more accurate in the police interview than those who only rated themselves as having been mildly stressed. However, viewing proximity and level of stress were confounded as those witnesses who rated themselves as having been the most stressed were those who were most centrally located and, therefore, presumably most at risk. There is the additional problem of asking witnesses to judge how stressed they had been at the time of the incident after a lapse of up to two years.

Despite the inevitable messiness of such data, Yuille and Cutshall's study represents an important milestone in eyewitness research, not only in terms of what it tells us about the reliability of eyewitness testimony but also in the way in which it provides contradictory findings to those laboratory studies which traditionally emphasize the inherent unreliability of witness memory. Using actual witnesses to a violent crime, Yuille and Cutshall found that people's memories were, in fact, surprisingly reliable. Detractors from this position, however, would point out that only 13 of the 20 witnesses contactable were prepared to participate in their study and therefore it may be that only those who felt confident about the reliability of their memories for the event were prepared to come forward and participate, thereby inflating reliability estimates. In addition, there is the problem that the single incident examined may have been particularly memorable. There is little doubt that it was unusual given that the robber's accomplice (who was waiting for him in the getaway car outside the store) locked the doors of the car, preventing the robber making his getaway and allowing the store owner to catch up with him and shoot the robber dead. Cutshall and Yuille (1989), however, subsequently extended their analysis to include two further shooting incidents plus a series of bank robberies. In each case, they confirmed their initial findings that eyewitness memory was remarkably reliable and that it remained so over relatively long periods of time (approximately two years).

A later study by Christianson & Hubinette (1993) also confirmed Yuille and Cutshall's conclusion. They examined a number of bank robberies in which they surveyed victims (i.e., those held under gun point) and bystanders (i.e., non-victim bank employees and customers) four to fifteen months after the original robberies

using multiple-choice questionnaires rather than interviews. Witnesses' responses were verified by comparison with available forensic evidence, including police reports, reports from all witnesses to each specific robbery and photographs/films of the scene of the crime. The results showed that victims provided the more accurate information regarding the robbery and the events which led up to it. In contrast to other studies in the field, however, they found no effect of rated level of original emotional arousal upon memory for robbery details (e.g., number of robbers, robber's weapon, and who collected the money), although it was related to memory for circumstances surrounding the robberies (e.g., time of day, number of customers, and day of the week). It is worth noting, however, that 44 per cent of the questionnaires were not returned which raises the possibility that estimates of accuracy may have been truly reflective.

More recently, Tollestrup, Turtle & Yuille (1994) compared witnesses to fraud with witnesses to robbery for perpetrator descriptions. The fraud cases mainly involved passing bad cheques at various locations and in most cases the witnesses were unaware that a crime had actually occurred, which makes this more like a study of memory for everyday encounters. This is highlighted by the finding that the majority of fraud victims were unable to recall many details regarding the appearance of the perpetrator. Victims of robbery provided more detailed descriptions than did bystander witnesses to robberies, although once again this is possibly because they had a better view, especially of the perpetrator's face. As a measure of accuracy, Tollestrup et al., compared witness statements with details of suspects who had confessed their guilt (but who may not necessarily have been guilty). Whilst too few fraud victims offered sufficient descriptions to provide a reliable score for accuracy, victims and bystanders to robberies were not found to have differed in their accuracy for descriptions regarding hair, age and weight, although bystanders were more accurate for height. Had they been able to consider the accuracy of all details reported, however, a different pattern of results may have emerged, especially with regards to memory for action details. Also, the fact that there was little homogeneity in the robberies examined (ranging from purse snatches to armed robbery) casts doubt on whether aggregation of such diverse

cases is warranted. Indeed, Yuille and Cutshall (1986) had earlier made the point that while nomological summaries are useful in describing patterns in eyewitness recall, we need to take into account the role of ideographic factors if we are to gain an improved understanding of eyewitness performance.

In summary, these studies have a number of common features. All provide valuable information on actual eyewitness performance which permits much needed comparisons with findings derived from laboratory studies. They also, however, have a number of common problems: First, there is the problem of self-selection in that those individuals who decline to participate may do so because they feel they have poor memories for the incident which, in turn, inflates estimates of eyewitness accuracy. Second, although each incident was witnessed by a large number of witnesses, between-witness comparisons are problematic due to the considerable variations in witnessing circumstances. Third, the measures of accuracy are largely estimates based on police records and what was remembered by other witnesses, police, and support personnel, and consistency of information between interviews. Given that Loftus (1997) has amply illustrated how easy it is to incorporate false information into a witness's memory, measures of consistency between interviews cannot be taken as an indication of accuracy. Fourth, all of these studies have focused on descriptive aspects of the event (e.g., offender's appearance) rather than action details because the latter is difficult to verify. Yet, the accuracy of action details (i.e., who did what and to whom) is central to the judicial process. Other than determining what was said, once identification has been established, the remainder of court business often focuses on the actions and intent of individuals involved in the incident.

3.1.3 Laboratory studies of victims and bystanders

Despite the importance of victim eyewitness performance in the judicial process and the novelty of the victimisation experience, eyewitness testimony research has virtually neglected victim eyewitnesses in favour of bystander eyewitnesses. In particular, to date only five published studies have attempted to compare victim

and bystander memory for personally meaningful events under controlled laboratory conditions.

The first of these was a laboratory study carried out by Hosch & Cooper (1982). In their study pairs of participants witnessed a staged event involving either no theft (control), the theft of a calculator belonging to the experimenter (bystander condition) or the theft of a watch belonging to one of the participant pair (victim condition). Consequently, the victims and bystanders were not actually witnesses to the same theft. Memorial accuracy, measured using a six-picture identification test, was poorest in the no-theft control condition with no significant difference in identification accuracy between witnesses to the calculator theft or the watch theft. Hosch and Cooper suggested that although care was taken to minimise overall stress levels the victims might have been more aroused and upset than the bystanders, thus mitigating any effects of attention. As there were no measures of physiological or self report arousal, however, there is no way of knowing whether the witnesses were differentially aroused. Similarly, the failure to find any differences between the participant groups and conditions may have occurred as identification accuracy was the only form of memory measure taken. More extensive memory measures, such as recall or recognition tests, would have provided a more detailed assessment of the witnesses' memories.

A further study (Hosch, Leippe, Marchioni & Cooper, 1984) employed the same calculator and watch theft conditions as the earlier Hosch & Cooper (1982) study. Interestingly, in this study rather than debriefing participants before test, police detectives took witness statements in order to suggest that a real crime had occurred until after testing. Unfortunately the witness statements were only taken as part of the deception of the experiment and were therefore not analysed. Consequently, as with Hosch and Cooper (1982), memory was only assessed using a photographic lineup. In contrast to the Hosch and Cooper study, however, the results indicated that victim witnesses were least likely to be accurate in their identification especially when given biased lineup instructions suggesting that the suspect was in the lineup.

Using a similar personal theft paradigm involving the theft of game money from one of a pair of participants, Kassin (1984) measured memorial accuracy via a physical description form, requesting specific information about the culprit's physical appearance and clothing, and a photographic lineup. Although Kassin attempted to measure the affect of the manipulation, this was done using only a single question about participants' self-reported nervousness during the theft which failed to reveal a difference between the victims and bystanders. Nevertheless, in line with Hosch et al. (1984) victims were found to be poorer at identifying the perpetrator than were bystanders. No significant differences were found for the physical descriptions.

Finally, Hosch & Bothwell (1990) conducted two experiments in which they attempted to overcome some of the problems of the earlier studies by measuring the physiological effect of their manipulation. In their first experiment, however, they failed to produce a differential effect of arousal between victims and bystanders (measured by skin impedance). This was most probably due to the fact that the victims and bystanders had not actually been witness to the same incident, specifically, the bystander witnessed a calculator theft whilst the victim witnessed the theft of her own purse. Despite failing to find a difference in arousal levels between the witness groups, when they correlated arousal with identification performance they found that the more aroused witnesses were less likely to misidentify the perpetrator. This finding is in contrast with Hosch et al. (1984) and Kassin (1984) who found that victims were poorer in accuracy although as there were no physiological measures of arousal in these latter studies it is questionable whether the experiments are comparable.

In order to overcome problems encountered in the previous study, in the second experiment victims and bystanders were run in pairs witnessing the same incident. Unfortunately, this time the physiological data (skin impedance) was lost on 7 of the 10 victim participants thus making it impossible to say anything conclusive about whether the manipulation had actually caused a differential effect of arousal between victims and bystanders. In addition to a photographic lineup, in this

experiment participants were asked to give written descriptions of the participant's appearance. Although there was no significant difference between victims and bystanders in terms of identification accuracy, the written descriptions given by victims were significantly more accurate than those given by bystanders.

The lack of adequate manipulation checks in all apart from one of these studies prevents anything conclusive being said regarding the findings. In addition, the memory measures are far from comprehensive and do not provide a detailed picture of a victim or bystander's memory for a personally experienced event. As a result, from all of these five studies it is not possible to tell whether differential arousal levels occur between victims and bystanders and whether there is a subsequent difference in memory.

In addition, two further studies have attempted to study a form of personal threat. Peters (1988) involved witnesses personally using an inoculation paradigm. Specifically, participants were asked to provide physical descriptions and make identifications concerning a nurse who had recently inoculated them and a second person they met shortly after inoculation. It was found that when the subjects were aroused (measured via heart rate) memory for the nurse was significantly reduced in comparison to memory for the second confederate with whom the participants interacted. Whilst participants were obviously personally involved with the manipulation, it is argued that it differs significantly from the nature of the experience of real witnesses. Specifically, it is argued that participants in Peter's study would have been preoccupied with the incident which they knew was about to happen. Whilst real witnesses may speculate regarding what is about to happen they cannot be sure and may pay more attention to the event in order to monitor exactly what is happening.

Using a similar paradigm, Toglia, Payne, Nightingale & Ceci (1989), involved participants by informing them either that an inoculation was about to take place (high arousal condition) or that one would not take place (low arousal condition). When participants were tested for details of an incidental scripted interaction

between the experimenter and a confederate, however, there were no differences in performance, irrespective of whether participants believed they were about to be inoculated or not. Furthermore, measures of galvanic skin response revealed no significant differences between the two groups, thus questioning the effectiveness of the manipulation itself.

3.2 Eyewitness memory and visually-induced arousal

Memory for events and information associated with visually-induced arousal specifically refers to visual stimuli that are arousing, such as films of operations, but that do not have any immediate and direct personal significance for the viewer. Specifically, this section reviews laboratory research in this area including work which has made a distinction between memory for details central to an event and those peripheral to an event, and the phenomena closely linked to this referred to as the weapon focus effect. In addition, this section also discusses positive emotional events in order to give a more wholistic view of arousal and memory, thus providing an insight into whether the effects of emotion upon memory may be confined to negative emotion or whether they may be more generic.

The lack of baseline measures involved in the study of autobiographical memory and the study of real eyewitnesses, such as the lack of an account of what actually happened, has meant that virtually all eyewitness research has been conducted in the laboratory, where internal validity is higher as the eyewitness variables of interest can be more accurately controlled and manipulated as required. The typical paradigm involves the presentation of material (generally slides or videos) to two groups of participants. Using such a design, the experimental group are shown negatively-valenced emotional information whilst a control group are shown neutrally-valenced information. Consequently, much of what we have come to understand about the relationship between arousal and the reliability of victim testimony has been derived indirectly from laboratory studies in which memory performance for visually-arousing stimuli is compared against memory performance for visually-neutral stimuli (e.g., Christianson, 1984; Christianson & Loftus, 1987; Burke, Heuer & Reisberg, 1992). Whilst such studies have

successfully created differences in arousal levels between treatment groups, as will be discussed, the physiological reactions experienced remain quite different from those experienced by actual victims of crime.

3.2.1 Laboratory based work

The traditional view, supported by early research conducted in this area, suggested that arousal has a negative effect upon memory, reducing the amount of information remembered. For example, an early study by Clifford & Scott (1978) found that recall was much more accurate for the details of a non-violent film than for a violent film. They employed a popular paradigm, where the details of the two films were identical apart from a middle section which either involved two policemen assaulting a bystander (violent film) or the bystander helping the policemen look for a criminal (non-violent film). Although this enabled the content of the films to be equated as far as possible, a measure of film affect (rated on a single 2-point scale) was only taken from participants viewing the violent film. Hence, it was not possible to directly compare whether viewing the violent film was indeed more emotional than viewing the non-violent film and thus whether it may have influenced memory performance.

Similar detrimental memory effects were demonstrated by Clifford & Hollin (1981), who found that witnesses shown a videotaped violent mugging remembered the film less accurately than did witnesses who saw a non-violent videotape involving direction seeking. In particular, as the number of perpetrators in the violent condition increased participants' memorial accuracy decreased. From this study, however, it is not possible to tell whether the observed decrease in accuracy was a function of the arousal itself or whether it was simply a function of the increase in the number of perpetrators present, and therefore the increased information competing for attention. In addition, this explanation holds when one considers that the accurate photographic identification of a single perpetrator was not found to differ between the violent and non-violent film conditions. Furthermore, as with the Clifford & Scott (1978) study, the lack of adequate manipulation checks prevents us from knowing whether viewing the violent film

induced a higher level of negative emotional arousal than viewing the non-violent film.

A further series of three experiments which are also commonly cited as showing arousal to have a detrimental effect upon memory were conducted by Loftus & Burns (1982). They found that when participants where shown a film of a bank robbery, in which a young boy is violently shot in the face, they showed poorer memory (recall and recognition) for details of the film than when a non-violent version was viewed. In addition, they argue that participants failure in the violent film condition to recall the number 17, seen on the back of the top worn by the young boy, exemplifies a retrograde amnesia effect occurring as a result of the following violence. As discussed below, however, such a piece of information is particularly peripheral in terms of the whole event and the importance of other information. Nevertheless, the authors suggest that this retrograde amnesia, or inability to recall the critical detail immediately preceding the violent shooting, is due to the emotional nature of the event disrupting memory such that information is not fully stored. Whilst this remains a possibility, once again there were no physiological manipulation checks to confirm that the two versions of the incident were in fact differentially arousing.

Furthermore, in contrast to the retrograde amnesia effect demonstrated by Loftus & Burns (1982), Christianson & Nilsson (1984) found evidence for an anterograde amnesia effect associated with viewing negatively arousing visual stimuli. As the violent aspect of the Loftus & Burns (1982) study occurred at the end of the stimulus presentation, however, it is not possible to tell whether they may also have observed an anterograde amnesia affect in addition to the retrograde amnesia effect. In a series of four experiments, Christianson & Nilsson (1984) presented participants with a series of slides in which each slide was accompanied by four verbal descriptors. Whilst control groups were shown three phases of slides depicting all neutral looking faces, the experimental groups were shown a phase of 'horribly disfigured' faces in between two phases of neutral faces. Unlike the studies discussed above, however, physiological measurements of skin

conductance and cardiac activity confirmed that participants viewing the disfigured faces were more physiologically aroused. In tests of recall and recognition memory for the verbal descriptors attached to each face, however, poorer memory was found for the items associated with the traumatic faces themselves as well as for the descriptors associated with the neutral items following the traumatic faces (anterograde amnesia). It is important to recognise, however, that the poorer memory for the descriptors associated with the traumatic faces may indicate that the participants devoted more attention to looking at the faces themselves. As a result, had they been tested for the faces rather than the descriptors they may in fact have shown superior performance. Unfortunately, as this was not tested it is not possible to tell whether this was the case.

A similar anterograde amnesia effect was also demonstrated in a study by Kramer, Buckhout, Fox, Widman & Tusche (1991). In their study, however, the target portion of the slide series was only a single slide, depicting either a scene labeled NYPD (emotional condition) or an M.G.M. Studios labeled slide (neutral condition). Although they found that participants showed amnesia for the slides following the target slide in the emotional condition but not in the neutral condition, no mention is made in terms of recall accuracy for the critical slides themselves. Using the same type of paradigm, a recent study by Bornstein, Liebel & Scarberry (1998) found participants to demonstrate both retrograde and anterograde amnesia effects. Participants viewed either a violent film, depicting a shooting incident, or a non-violent control version of the same film where the violent portion was changed. Following the film, participants made three successive attempts to recall details of the event. Although those viewing the violent film were better at recalling the details of the event itself, they were poorer at recalling the details that preceded or followed the violence. As might be expected, both groups recalled significantly more information over successive recall attempts.

Although these studies demonstrate retrograde and anterograde amnesia effects, little consideration is given to memory performance for the emotional information

itself, which most likely would be the critical information of interest in an applied or practical situation. Despite the variation in methodology and results from these laboratory studies, however, as more research has been conducted a theme has emerged suggesting that relative to those viewing neutral stimuli, participants viewing negatively valenced emotional stimuli show enhanced memory for central detail information (Burke et al., 1992; Christianson & Loftus, 1987; Christianson & Loftus, 1991; Heuer & Reisberg, 1990; Safer, Christianson, Autry, & Österlund, 1998). There is, however, discrepancy in the results with regards to whether memory for central information is to the detriment of memory for peripheral details (Safer et al., 1998) or not (Heuer & Reisberg, 1990).

3.2.2 Central versus peripheral details

Before discussing research in this area, it is necessary to define clearly the terms central and peripheral details. Central details are those which are essential in order to make sense of the situation, thus including details related to the source and degree of danger or threat, such as the presence or absence of a weapon, or number of perpetrators. In contrast, peripheral details are not essential for making sense of the situation, including details such as the colour of the perpetrator's clothing and other background details irrelevant to witness safety (see Christianson, 1992a, for a discussion). As mentioned above, using these definitions the number 17, on the back of the top worn by the young boy in the violent film condition of the study conducted by Loftus & Burns (1982), would be classified as peripheral as it would not have been essential in order to understand what was going on in the film.

Typical of the studies investigating memory for central and peripherally related details, Christianson and Loftus (1987) conducted two studies in which they presented participants with either a slide sequence consisting of a three phase neutral story, or a sequence where the middle phase of the story was altered to be an arousal-inducing car accident. From earlier work (Christianson, 1984) it was known that those who viewed the car accident version were differentially aroused, exhibiting a drop in heart rate during the emotional phase. In the first study,

Christianson & Loftus (1987) instructed participants to write down what they felt was the most distinguishing detail of each slide. Participants were then tested for their recall of the central details they had written down as well as the contents of the pictures themselves. Participants viewing the traumatic slides were better able to recall the details they had written down than did those who viewed the neutral slides, but were not better able to recognise the specific slides they saw. This pattern of results was obtained at long (2 weeks) and short (20 minutes) retention intervals. Similarly, they conducted a follow-on experiment which showed that participants viewing a videotape of a traumatic bank robbery, involving a young boy being shot in the face, were better able to recall the central aspects of the event than did those who viewed a non-traumatic version of the robbery even after a retention interval of 6 months. The authors interpreted this to suggest that the essence or theme of a traumatic event is well retained in memory in contrast to other more peripheral details for which memory is impaired. In support of this, similar effects were found by Burke, Heuer and Reisberg (1992) who showed that recognition memory for gist, basic-level visual information and plot-irrelevant (or peripheral) details associated with the central characters of the slides were improved in an emotional condition whilst details not associated with the event's centre were poorer. Physiological measures also confirmed that the emotional condition were significantly differentially aroused, demonstrating a drop in heart rate over the three phases of the slide presentation, in contrast to the neutral story group.

In contrast to this, however, Kebeck & Lohaus (1986) found that whilst participants shown a neutral or traumatic version of a story were equal in their recall of central information, those shown the traumatic version were less able to free recall peripheral information at immediate recall or following a 2 week delay. The arousing film used in this study, however, was relatively innocuous as it only depicted an argument and there were no manipulation checks to see whether it was in fact more arousing than the neutral film.

In a further series of five experiments, Christianson & Loftus (1991) presented participants with a slide sequence in which a critical slide varied according to each experimental condition. In the emotional condition the critical slide showed a woman injured near a bicycle, in the non-emotional condition the critical slide showed a woman riding a bicycle. Christianson and Loftus also included an unusual condition in order to investigate whether emotion affects memory for reasons that go beyond the unusualness or the distinctiveness of an emotional situation. This particular aspect of the study, which specifically concerns the theoretical mechanisms underlying arousal and memory, is discussed in detail in Chapter Four. Results showed that in comparison to the non-emotional condition, when the critical slide was emotional the participants were better able to recall or recognise a central detail from the critical slide than a peripheral detail. However, the only manipulation checks were self-report measures across all slides without specific reference to the critical slides. In addition, the designated central and peripheral details were the colour of the woman's coat (central information) and the colour of the car (peripheral information). On the basis of the earlier definition of central information, it is argued that the colour of the woman's coat would not have been central to understanding what was happening.

A study by Heuer & Reisberg (1990) found memory for information central to an event and peripheral detail to be enhanced by emotion after a two week interval. Using an incidental-learning paradigm participants were shown slides depicting either an emotional or a neutral version of a story, in which only the central phase was altered, accompanied by audio-taped sentences. Measurements of heart rate taken throughout showed that in contrast to the neutral group, those in the emotional condition demonstrated a drop in heart rate across the slide phases. The aroused group showed superior recall and recognition accuracy compared to the neutral group suggesting that arousal promotes memory for the event's gist at the expense of detail.

A recent series of studies conducted by Safer et al. (1998) similarly suggests that participants may extend or narrow scene boundaries depending on the emotional

nature of the stimulus information. Participants in the studies viewed either a visually neutral or emotional series of slides and subsequently completed a recognition test for the slides they had seen. After viewing an emotionally arousing scene, participants selected slides that tended to narrow the scene's boundaries as well as demonstrating enhanced memory for the critical arousal inducing aspects of the scene. Those viewing neutral slides, on the other hand, tended to extend the scene's boundaries and showed no selective memory advantage for particular details. Safer et al. (1998) argue that the 'tunnel' memory phenomenon displayed by the participants was achieved via the more elaborative processing of critical details.

3.2.2.1 Weapon focus effect

Pivotal to the issue of memory for central and peripheral information is the weapon focus effect (Kramer, Buckhout & Eugenio, 1990; Loftus, Loftus & Mezzo, 1987; Maass & Kohnken, 1989). Although discussed in detail in Chapter Four, it is pertinent to mention this phenomena here as a weapon would be classified as a central piece of information if present in a stimulus array. The weapon focus effect itself is a well-documented phenomena within the eyewitness literature referring to a witness's propensity to focus attention on a weapon to the extent that other more peripheral details, especially characteristics of the perpetrator's face, are attentionally excluded resulting in poorer memory for them. A meta-analysis of the weapon focus effect (Steblay, 1992) revealed its existence as a well documented effect within the research literature.

In summary, from these studies it would appear it is possible that where negative emotional arousal is shown to reduce identification accuracy it is because of the presence of a weapon or some other attention 'catching' aspect of the stimulus array. Possible attentional and elaborative mechanisms, which may account for the existence of these findings, are discussed in detail in Chapter Four.

3.2.3 Positive visually-induced arousal

In order to understand fully the effects of emotional arousal it is important to consider whether the effects observed with negative emotional arousal are also observed with positive emotional arousal. For example, an event that is positive in affect may also be unusual or incongruous and consequently result in differential attention/processing. Although research on memory for positive emotional events has received much less attention than research on memory for negative emotional events, previous studies have shown that, similarly to negative emotional arousal, the critical aspects of positive emotional events are typically well remembered whilst memory for surrounding peripheral items is poorer (e.g., Detterman & Ellis, 1972; Ellis, Detterman, Runcie, McCarver & Craig, 1971; Runcie & O'Bannon 1977).

Christianson (1986) conducted two experiments where, instead of being presented with emotional slides negative in affect, participants were presented with slides positive in affect depicting erotic scenes. Measurement of heart rate and self-reported arousal confirmed that the erotic slides induced a higher state of positive emotional arousal (characterised by a higher level of heart rate) than did a series of neutral slides. In terms of memory, those presented with the erotic slides showed poorer memory for verbal descriptors accompanying the slides than those presented with neutral slides. This suggests that when presented with erotic scenes the participants spent more time looking at or processing the slides than the accompanying verbal descriptors. As discussed above with regards to the study by Christianson & Nilsson (1984), however, had the participants been tested for details of the slides themselves it is possible that those shown the erotic slides would have demonstrated superior performance.

In line with this idea, the findings of a study by Bradley, Greenwald, Petry & Lang (1992) found that pictures rated as highly arousing were remembered better than those rated as less arousing. Participants were presented with photographic slides depicting various contents along the arousal continuum, ranging from an aimed pistol to a man holding a baby. Participants rated each slide on the

dimensions of valence and arousal followed by either an immediate or delayed (one year) free-recall test in which participants were asked to write down, in any order, a word or phrase that described each experimental slide that they could remember. Immediate recall results showed that memory for both pleasantly and unpleasantly rated slides was greater than for neutral rated slides. The delayed recall results showed that, whilst the unpleasantly rated slides were still recalled better 1 year later, the superior recall effect of the pleasantly rated slides had disappeared, suggesting that high negative arousal may facilitate short and long-term memory performance, whilst positive emotional arousal may facilitate short-term memory only.

Together, these studies add further support to the suggestion that it may not be something inherent in only negative emotional stimuli that results in differential memory performance.

3.2.4 Thematic versus visually-induced arousal

It has been argued that the discrepancy in the results found between laboratory and field studies centres around the fact that the majority of laboratory based studies have actually looked at visually induced arousal rather than thematically induced arousal (Heuer, Reisberg & Rios, 1997). Visually induced arousal, as mentioned earlier, is created solely by the visual component of a stimulus array, such as the image of a car accident. In contrast, Heuer et al. (1997) argue that thematically induced arousal is created by a personal empathy with the event.

Heuer et al. (1997) conducted a laboratory study designed specifically to compare the effects of thematically induced arousal with visually induced arousal. Participants were presented with a series of slides depicting a male and female on their first date within the female's apartment. A neutral group were shown only the slides, whilst a thematically aroused group were played an accompanying arousal inducing narrative suggesting that the date had culminated in rape. The slide sequences shown to both groups were identical apart from a single slide, thus trying to ensure that any arousal induced was a function of the thematic narrative

rather than the visual content of the slides themselves. The date rape theme was chosen specifically because it was a topical issue amongst the students on the campus at the time and therefore likely to induce empathy. Heart rate measured during stimulus presentation revealed that the two groups were differentially aroused, although similar to studies of visually-induced arousal, participants in the arousal condition demonstrated a drop in heart rate across the slide presentation which only rose at the point of the assault. Results indicated that the thematically aroused group was superior in their memory for the central gist of the event in comparison to the neutral group but were poorer for more peripheral details. Consequently, despite the thematic nature of the manipulation employed, the results of this study are in line with previous studies of visually-induced arousal (cf. Christianson & Loftus, 1991 - who also employed a single slide difference methodology; Burke et al., 1992).

Cahill & McGaugh (1995) found similar results in an earlier experiment where they presented participants with identical slides but altered the emotional nature of them by presenting different accompanying narratives. Although those viewing the emotional story showed enhanced memory for the story, level of emotional arousal was measured by emotionality ratings rather than physiological measures.

Critically, then, it is argued that whilst the use of narratives may provide an additional sensory dimension to these laboratory studies, as they do not involve the witnesses personally, the extent to which these studies, rather than studies of visually-induced arousal, reflect the performance of real personally involved or threatened witnesses is questionable.

3.3 Conclusions: The role of personal involvement

Whilst laboratory studies of thematically-induced arousal purport to be different to other laboratory studies, the extent to which they are different remains questionable. Traditional laboratory studies strongly suggest that attentional and elaborative mechanisms contribute to the selective remembering of central details over peripheral details, although the extent to which elaboration plays a part in

these studies remains questionable. Whilst participants in these studies may have experienced a relative degree of empathy or understanding, there is no personal involvement when viewing the slides in the sense that the 'witnesses' fail to feel personally threatened. It is posited that there is an enormous discrepancy between the kind of elaborative processing engaged in by uninvolved participants when simply viewing 'emotional' slides, compared with the kind of elaborative processing engaged in by witnesses who find themselves to be personally involved. In the latter case, an important feature of processing emotional information is whether it has personal relevance or significance. Personally involved witnesses may engage in ongoing thoughts concerning aspects of the incident and associated short- and long-term consequences for themselves. Should this be the case, we need to exercise caution in generalizing results from studies of visually-induced arousal to witnesses involved in actual crimes as the physiological reactions and psychological experiences may be qualitatively different.

In particular, the experience of witnessing a real crime almost certainly results in an elevated heart rate which is characteristic of a defensive or aversive physiological response. Despite this, many of the studies have failed to take measures of the actual level of arousal experienced by those presented with the purported emotionally-valenced information relative to those viewing the purported neutral information. In particular, an analysis of 50 experiments in this area revealed: only 10 took both physiological measures of autonomic arousal (i.e., heart rate or galvanic skin response) and a self-report measure (e.g., Heuer & Reisberg, 1990); 7 took only a physiological measure (e.g., Hosch & Bothwell, 1990); 19 used only self-report measures (e.g., Christianson & Loftus, 1987), of which 8 used only a single self-report question (e.g., Kassin, 1984); and 14 experiments failed to take any measure of arousal whatsoever (e.g., Hosch et al., 1984). Consequently, in many of the studies the researchers could not be sure that their emotional condition stimulus was indeed more arousing than their neutral condition stimulus, and therefore could not validly infer a relationship between arousal and any subsequent memory effects. In the few studies of eyewitness

testimony that have attempted to measure physiological responses during the witnessing of an event, however, the physiological effects displayed by participants are often orienting responses. In other words, instead of experiencing an increase in heart rate whilst viewing a visually traumatic episode, participant witnesses typically exhibit a decrease in heart rate. Clearly, while such studies purport to say something about the effects of arousal on eyewitness performance, they can only tell us part of the story. In fact, they reveal little about the effects of victimization on memory performance and, in particular, how defensive physiological reactions might affect eyewitness reliability (cf. Christianson, 1984; Heuer & Reisberg, 1990). It is argued that existing research has neglected to consider the role of personal involvement and perceived threat despite the fact that such factors are central to the victimization experience. In doing so, the possible mediating effects of arousal upon eyewitness memory have yet to be fully explored. Specifically, visually-induced arousal, which tends to result in an orienting response, may have different effects upon memory than arousal induced through personal involvement with a threatening stimulus.

In addition, the stimulus material viewed by witness groups within the same laboratory studies is often considerably different in content. For example, in a study conducted by Heuer and Reisberg (1990) witnesses in an emotional condition were shown slides depicting a story in which a mother takes her son to visit his father at his workplace where he is a surgeon and they see him operating on a victim of an accident shown in an earlier slide. Witnesses in the neutral condition, however, were shown slides depicting the mother and son visiting the father who this time works as a car mechanic and is shown fixing a car. This study and many others have tried to equate the material viewed by the groups in some way, such as by equating the length of time that the perpetrator or central individual is in view, or by changing only the central portion of the slide series rather than the whole series (Christianson & Loftus 1987; Clifford & Scott, 1978; Heuer & Reisberg, 1990). Whilst this enables an insight into the role of physiological arousal and how eyewitness memory may work, no account seems to be taken of the fact that, rather than being an effect of physiological arousal,

any differences in memory performance could simply be due to the fact that the witness groups watched stimulus incidents that were different. In particular, it could simply be that the emotional stimulus is inherently more interesting than the neutral stimulus. For example, slides or a video of a simulated crime or operation are likely to be far more interesting than watching a series of slides or a video depicting someone mending a car. Indeed, many of the laboratory based studies have not employed physiological manipulation checks and so are unable to unequivocally say that one group of witnesses were more aroused than another group.

To re-cap, participants in laboratory studies typically display orienting physiological responses to visually-induced arousal whereas witnesses who experience direct personal involvement with actual threatening events will most likely display defensive physiological responses characteristic of the 'fight or flight' response. In order to advance our understanding of the effects of arousal on eyewitness memory, therefore, we need to be aware that these two distinct physiological responses may affect memory performance in different ways or, at least, indicate the possibility that different cognitive processes may have been engaged. Should this be found to be the case, this distinction may help to explain some of the disparity that currently exists in the eyewitnessing literature concerning the effects of arousal on memory. While field research has tended to find that arousal leads to an improvement in memory performance, the findings from laboratory studies remain quite mixed. This diversity in methodology and results makes the area very complex to categorise and assimilate.

This chapter highlights the potential importance of the role of personal involvement in eyewitness memory, including the possibility that mechanisms associated with the psychological response, and the defensive nature of the physiological response, may be central to subsequent memory effects. The following chapter discusses theoretical mechanisms that have been proposed to explain the effects of these factors upon eyewitness memory, along with specific research which has attempted to investigate these mechanisms.

Chapter 4

Theoretical Mechanisms

4.1 Introduction

Whilst Chapter Three was concerned with whether and how negatively arousing or emotional information may affect memory, this chapter is specifically concerned with reviewing and discussing existing mechanisms and explanations concerning *why* effects may occur. On account of the enormity of the cognitive and physiologically based literature concerned with arousal and performance, however, it would be inappropriate to review and discuss the whole area here. As a result, this review specifically focuses on those theoretical mechanisms which have been used to explain aspects of eyewitness memory performance.

Whilst some suggest the physiological element of a witness's response is critical, i.e., biological-evolutionary mechanisms are central (e.g., Brown & Kulik, 1977; Gold, 1992; Livingston, 1967), others suggest that the psychological element of a witness's response is critical, i.e., cognitive mechanisms are central (e.g., Christianson & Loftus, 1991; Christianson, Loftus, Hoffman & Loftus, 1991; Craik & Lockhart, 1972; Easterbrook 1959). Consequently, the first half of this chapter is divided into two sections: i) the role of *physiological* mechanisms and ii) the role of *psychological* mechanisms. In each section, the major theoretical mechanisms used to explain aspects of eyewitness performance are outlined along with a discussion of research which has explored the usefulness and robustness of these mechanisms. Following this, the final half of the chapter is dedicated to proposing a new theoretical approach

which takes account of issues arising from the existing theoretical explanations and associated research.

4.2 The role of physiological mechanisms

As outlined in Chapter One, most victims and witnesses will experience some form of physiological arousal during the experience of an incident itself. This will most likely be dependent upon the level of involvement of the witness and the type of incident experienced. For example, it is likely that the level of physiological arousal experienced by victims will be higher than that experienced by bystanders present, although bystander witnesses may also exhibit significant elevation in physiological arousal. Similarly, crimes involving weapons or physical threat are likely to be more physiologically arousing than crimes involving no threat of physical harm, although the latter crimes may still be very arousing (MacLeod et al., 1996).

The nature of the physiological response exhibited by real eyewitnesses facing a personally threatening situation is almost certainly an elevation in heart rate characteristic of the 'fight or flight' response. Specifically, the 'fight or flight' response is a preparation for action, e.g., as the name suggests, fighting or fleeing, which results from increased activation of the sympathetico-adrenal system that controls readiness for action. Simplistically, the response is characterised by an increase in the level of adrenalin released into the blood stream which quickens the speed at which the heart pumps. In conjunction with vasoconstriction, this ensures blood is transferred around the body quicker, increasing oxygen provision to the muscles and, hence, ensuring readiness for action.

4.2.1 Biological-evolutionary theories

The biochemical change associated with the 'fight or flight' response has been viewed by many as a central factor affecting subsequent memory for the source of the threat or danger itself (Brown & Kulik, 1977; Gold, 1992; Livingston, 1967). The impetus

behind such a view comes from evolutionary ideas that in order to survive we have an innate predisposition not only to respond to (e.g., the fight or flight response), but also to process and store information from the event for potential future reference (Christianson, 1997; Christianson & Engelberg, 1997). Fundamentally, biological-evolutionary theories propose that increased intensity or affect associated with an event results in a more vivid subsequent memory due to enhanced biochemical activation and assimilation. Two main theories based upon this viewpoint have been used in the eyewitness literature (Livingston, 1967; Gold, 1992).

4.2.1.1 Now print! Theory (Livingston, 1967)

Livingston's theory proposes that when an individual experiences an emotional event the associated biochemical change in the brain activates a 'Now print!' mechanism, capturing all the details for the event rather like a photographic image. Livingston described the processes leading up to the formation of a 'photo' as commencing with recognition of novelty or unusualness in the environment. This recognition is made by a system known as the reticular activating system (RAS) which has been viewed by others as a unifying and modulating system of arousal (e.g., Luria, 1981). Following recognition, the limbic system, generally thought to be involved in emotional and motivational behaviours, becomes involved, discriminating biologically meaningful (e.g., associated with pain) and personally significant aspects of the stimuli for that particular individual at that particular moment. Livingston proposed that this results in limbic discharge into the reticular formation, causing a diffusely projecting reticular formation discharge to be distributed throughout both hemispheres. This discharge he conceived to be a "Now print!" order for memory, resulting in all recent brain events and all recent conduction activities being "printed" to facilitate repetition of similar conduction patterns in the future. It is an interesting aspect of this theory that, unlike many cognitive based theories (e.g., Easterbrook, 1959), it is not capacity driven, suggesting that all details can be captured.

4.2.1.2 Neurobiological Mechanism (Gold, 1992)

The neurobiologically based mechanism which Gold proposes is based upon adrenalin and glucose modulation of memory storage. In particular, it suggests that adrenalin released into the blood stream promotes the storage of recent information. Studies using rats demonstrated that injection with adrenalin produced memory enhancement for a wide range of behavioural tasks, e.g., appetitive learned responses (McGaugh, 1989; McGaugh & Gold, 1989). Specific support for memory storage modulation by adrenalin came from the fact that the effects appeared to be both dose and time dependent. In particular, dosage enhanced memory in an inverted-U function and was most effective when administered close to training.

Although convincing, there were still gaps in the proposed mechanism because adrenalin itself does not cross the blood-brain barrier. Identification of an associated increase in circulating blood glucose levels following adrenalin injection, however, suggested that glucose may act as an intermediate mechanism (Ellis, Kennedy, Eusebi & Vincent, 1967). Subsequently, glucose injection was also found to enhance memory storage in rats (Gold, 1986; Messier & Destrade, 1988; Messier & White, 1984; White & Messier, 1988). The safety of glucose for humans enabled the effects observed in rats to be studied in humans. The findings of several experiments indicated that glucose significantly enhanced human memory performance when measured using a variety of tests (e.g., logical memory tests involving single presentations of taped narrative passages followed by 15 minute delayed recall measures; Gold, 1986; Hall, Gonder-Frederick, Chewning, Silveira & Gold, 1989; Manning, Hall & Gold, 1990). On the basis of these findings, Gold (1992) proposed that flashbulb memories represent a special case of neuroendocrine regulation of the biological processes responsible for storing information and that the storage of information at the time of an emotional event reflects an instance of physiological enhancement of memory.

4.2.2 Empirical investigations of physiological mechanisms

The biological-evolutionary theories outlined above suggest that it is primarily as a result of physiological arousal that differences in memory occur. Although specific research has contributed to the development of the ideas outlined above, unfortunately little research has empirically investigated their direct application to memory for more complex information.

Heavily based upon complex neurobiology, Livingston described his theory as a visualisation of how these systems may work rather than a prescriptive mechanism (Livingston, 1967). As such, there is no direct and conclusive empirical support for the whole theory. Indeed, there are a number of aspects which are not fully understood, such as how novelty is recognised in the first instance. Nevertheless, as discussed in Chapter Two, this mechanism has been cited as a potential explanation for the existence of flashbulb memories (Brown & Kulik, 1977). In particular, the idea of a flashbulb or Now print! mechanism has been used to explain the fact that in addition to remembering the central elements of incidents, individuals also remember the concomitant circumstances as if a photograph had been taken of the event. Whilst many studies in autobiographical memory have advocated such a biologically-based mechanism to account for detailed and vivid memories, they provide little empirical support for such mechanisms as little is known about the actual physiological or biological effects of the original events for which such vivid and detailed memories are reported.

Nevertheless, laboratory research has attempted to investigate separately the effects of physiological and psychological arousal upon human memory by studying the influence of physiological arousal when it is un-associated with the to-be-remembered event. Indeed, there is a large cognitive based literature which has used such methods to investigate the effects of arousal. However, such work has generally looked at arousal's effects upon performance on a variety of information processing tasks rather than memory per se (e.g., Anderson, 1990; Broadbent, 1954; Eysenck,

1976; Näätänen, 1973; Neiss, 1988; Neiss, 1990; Poulton, 1978; Van Gemmert & Van Galen, 1997).

One study that did measure memory (Brigham et al., 1983), presented participants with facial slides whilst either stimulating them with electric shocks (physiological arousal group) or not stimulating them (control group). However, in addition to finding no differences between the treatment groups in terms of heart rate, skin conductance or finger pulse volume, none of the physiological measures were correlated with slide recognition accuracy. A similar study presented subjects with a non-violent film (Hollin, 1984). During a small portion of the film, half the participants were presented with loud white noise via headphones. Although subsequent memory was poorer in the noise group, no physiological measures were taken to show whether the manipulation had successfully created differential physiological arousal. Hence, both of these studies are of limited use. In particular, although such studies allow memory to be investigated when the source of arousal is un-associated with the stimulus, the extent to which loud white noise elicits a response similar to a fight or flight defensive response is questionable.

However, in line with the increase in blood adrenalin levels associated with a fight or flight response, two studies have utilised adrenalin in order to manipulate physiological arousal un-associated with the to-be-remembered event (Christianson & Mjorndal, 1985; Christianson, Nilsson, Mjorndal, Perris and Tjellden, 1986). Christianson & Mjorndal (1985) injected their participants with either adrenalin or saline and then presented them with pairs of slides depicting neutral faces, each accompanied by 4 verbal descriptors (name, occupation, hobby and a personality trait). Participants were asked to recall (exp 1.) or recognise (exp 2.) as many of the descriptors they had read aloud during the presentation period as possible. In both experiments, although participants injected with adrenalin showed a significantly higher heart rate and skin conductance level than those injected with saline, there were no differences in memory performance. Although this suggests that increased

physiological arousal did not serve to enhance memory performance, it would have been interesting to consider whether the same results emerged when participants memory performance was assessed on the slide contents rather than just the descriptors accompanying the slides.

In a further study, Christianson et al. (1986) conducted a slight variation of their earlier work. This time, one group of participants were injected with adrenalin and shown neutral slides with accompanying verbal descriptors (physiological arousal only, as in the earlier study), whilst a second group were injected with saline and shown emotional slides (depicting facial injuries) accompanied with verbal descriptors (and, therefore, producing the possibility for both physiological and psychological arousal in this group). Physiological and self-report data showed that those injected with adrenalin and those shown the facial injury slides were aroused to equivalent levels. Obvious ethical constraints limit the amount of adrenalin that can be administered, however, and the subsequent heart rates exhibited by the participants were relatively low, a maximum of 91 beats per minute in those given adrenalin compared to a maximum of 80 beats per minute in those given saline and presented with emotional slides. In addition, heart rates were calculated as the highest value reached in each period rather than an average value across each period. Taking this into account, when recall memory for verbal descriptors was tested, those shown the facial injury slides performed below those injected with adrenalin and shown neutral slides. Hence, there was a difference between the two groups even though they were not differentially physiologically aroused.

Whilst it appears that memory is poorer for the facial injury slides, however, it is in fact poorer for the accompanying verbal descriptors. It is not known whether differences would have emerged if memory for the slides had been tested. Furthermore, it is quite possible that the poorer performance for those shown the facial injury slides was because they spent more time looking at the facial injuries, which were probably more interesting, than the descriptors on which they were to be

tested. Those shown neutral slides, in contrast, would not necessarily have been more interested in the slides than the accompanying descriptors.

In conclusion, then, although the biochemically based studies by Gold (1986, 1992) and others provide support for physiological mechanisms mediating the effects of arousal upon memory, much more research is required in order to firmly establish the role of such a mechanism, especially in terms of memory for more complex information.

4.3 The role of psychological mechanisms

In addition to the experience of physiological arousal, victims and witnesses to crimes with direct personal relevance will experience psychologically related arousal, such as fear for one's personal safety (Carson & MacLeod, 1997; MacLeod et al., 1996). The cognitive interpretation involved in producing such arousal, may be central to guiding attentional and elaborative resources. Before discussing research which has investigated this possibility, the main theories of attention and elaboration used in the eyewitness literature are briefly described.

4.3.1 Attentional theories

The explanations most widely cited to explain attentional aspects of arousal's effect upon eyewitness memory are the Yerkes-Dodson Inverted-U Hypothesis (Yerkes & Dodson, 1908) and the Cue-Utilization Hypothesis (Easterbrook, 1959).

4.3.1.1 Inverted-U Hypothesis (Yerkes & Dodson, 1908)

Yerkes & Dodson (1908) proposed an inverted-U function to account for the effects of arousal upon performance. They suggested that as level of arousal increases performance also increases, but only up to an optimal task dependent level. Once the level of arousal goes beyond the optimal level performance starts to decrease. Indeed, many eyewitness memory reports have suggested that the effects of emotional arousal

upon eyewitness memory follow the Yerkes-Dodson function (see Deffenbacher, 1983; Loftus, 1979). Nevertheless, despite being widely cited in the eyewitness literature, the Yerkes-Dodson law may not be the most appropriate explanation of the effects of arousal upon memory. Indeed, its universal nature enables us to use it as an explanation at any stage. Hence, it is often used post-hoc to describe almost any effects.

4.3.1.2 Cue-Utilization Hypothesis (Easterbrook, 1959)

Easterbrook (1959) proposed in his Cue-Utilization Hypothesis that as arousal changes, the range of cues which an individual may utilise also changes. At low levels of arousal attention is unfocussed and the range of cues an individual may utilise is wide. As arousal increases, however, the range of attentional cues is more narrowly focused onto specific task dependent cues. As arousal increases further, the attentional focus may be sufficiently reduced resulting in the exclusion of some task dependent cues. Hence, in contrast to the biologically based Now print! theory (Livingston, 1967), this hypothesis is capacity driven in that it suggests that not all details can be captured because of a finite amount of processing resources. This hypothesis is frequently used to explain the relationship between arousal and performance proposed by Yerkes and Dodson.

4.3.2 Elaborative theories

The most widely cited theoretical work relating to elaboration, both within the cognitive and eyewitness literature, centres around the seminal paper by Craik & Lockhart (1972).

4.3.2.1 Levels of Processing (Craik & Lockhart, 1972)

Craik & Lockhart (1972) presented a conceptual framework in which they argue that the depth, or number of levels, to which stimulus material is processed is a direct determinant of how well it is subsequently remembered. Their Levels of Processing Theory proposes that stimulus information is processed through a series of stages at

which different kinds of information are successively extracted from the stimulus. They propose that physical or sensory information is extracted first and later stages are concerned with matching the input with stored information from previous experience, i.e., pattern recognition and the attachment of meaning. Further, the level or depth of processing received by a stimulus has a substantial effect upon its memorability. In addition, they argue that one of the results of this hierarchy of processing stages is the memory trace, arising as a result of the perceptual processing. Specifically, they suggest that trace persistence is a function of the depth of analysis, with deeper levels of analysis being associated with more elaborate, longer lasting and stronger traces.

Later work, however, identified that their original approach was over-simplified (Craik & Tulving, 1975). Research showed that in addition to the depth of processing, elaboration (the amount of processing of a particular kind) is also important (Craik & Tulving, 1975). At the time of Craik & Lockhart's original work (Craik & Lockhart, 1972), similar theoretical frameworks, based on stages of processing, also existed (e.g., Bower, 1967; Cermak, 1972; Norman & Rumelhart, 1970; Posner, 1967). Despite these, Craik & Lockhart's framework has become the most widely cited theory in this area. Several studies within the cognitive literature have shown support for this framework. For example, Bower & Karlin (1974) demonstrated that memory for pictures of faces was superior when participants processed the faces in terms of likeableness or honesty than when they processed them for gender.

Despite such support, however, there are a number of criticisms of Levels of Processing Theory. From the needs of a pure memory perspective, it is difficult to be sure exactly what the level of processing actually engaged in is, not least because of the methodological lack of an independent measure of processing depth. In addition, levels of processing theory ignores the role of the retrieval environment and the demands of memory tests. Similarly, as with many other theories from the cognitive psychology literature, it seems to describe the process without providing a real

explanation for what happens. Nevertheless, from an applied perspective, it provides a basis for understanding observations concerning the effects of negative emotional arousal upon memory and appears to be the most applicable account currently available from the cognitive literature.

4.3.3 Empirical investigations of psychological mechanisms

Throughout the eyewitness literature, many studies have been conducted to investigate attentional and elaborative elements of eyewitness memory.

4.3.3.1 The weapon focus effect

As mentioned in Chapter Three, the weapon focus effect is a well-documented phenomena within the eyewitness literature (see, Kramer et al., 1990; Loftus, Loftus & Mezzo, 1987; Maass & Kohnken, 1989). Weapon focus occurs when a weapon "appears to capture a good deal of...attention, resulting in, among other things, a reduced ability to recall other details from the environment" (Loftus, 1979). Specifically, a witness's attention is concentrated on the barrel of a gun or the blade of a knife during a crime, leaving less attention available for viewing other items such as the perpetrator's face. A meta-analysis of the weapon focus effect (Steblay, 1992) revealed its significant existence as a documented effect within the research literature.

The first study providing direct empirical support for this was carried out by Loftus, Loftus & Mezzo (1987). Participants were shown a series of slides depicting an event in a fast-food restaurant. Half of the participants saw a customer point a gun at the cashier (arousing condition) whilst the other half saw the same customer hand the cashier a cheque (neutral condition). After a short retention interval the participants completed a recognition questionnaire and attempted to identify the target customer from a 12 person photo-graphic lineup. There was no significant difference between participants in the arousing or neutral conditions on the recognition questionnaire (which concerned event information such as "what item did the person buy?"). However, the participants in the neutral condition were more

accurate in their identification of the target customer. Hence, participants in the arousing condition may have attended to the weapon more than the target customer's face. This study suggests, therefore, that for violent crimes where a weapon is present, participants may process less peripheral information than when no weapon is present.

In a slight variation, Maass and Koehnken (1989) also found that participants who feared injections demonstrated reduced accuracy for the facial details of an individual holding a syringe, suggesting that their fear of injections may have resulted in the syringe being a salient object for them relative to those participants who reported not fearing injections. Similar results were found in a live-event study by Peters (1988), who measured the accuracy of witnesses' identification of a nurse who had recently administered an inoculation to them and a confederate researcher whom participants had interacted with shortly after the inoculation. Pulse rate measures showed that witnesses were more aroused during the inoculation than afterwards and witnesses subsequently accurately identified the researcher significantly more often than they did the nurse.

4.3.3.2 Eye fixation research

Taking the weapon focus effect further, it has been shown that eye-fixations are made more frequently and for longer durations on a gun than on a neutral item (Loftus et al., 1987). In a follow-up experiment to their main weapon focus study, Loftus et al. (1987) found that participants made eye fixations more often and for longer durations on a gun pointed at a cashier than a cheque handed to the cashier. On this basis, if physiological arousal is not as important as cognitive mechanisms, it was predicted that if an unusual item (unaccompanied by physiological arousal) had been pointed at the cashier instead of the gun, such as a banana, similar eye fixation patterns would have been observed. In support of this, research has demonstrated that objects which are incongruous result in earlier, more frequent, and longer eye fixations than more probable or congruous objects do. For example, Loftus & Mackworth (1978)

demonstrated that participants fixated more often and for a longer duration on an octopus in a farm scene than they did usual farm animals.

Although it has been shown that people fixate more often and for a longer duration on emotional and novel information, further support for cognitive based mechanisms is provided by research which suggests that increased attention alone may not be sufficient to produce memory effects. Research suggests that the level/extent of information processing may be equally as important. Christianson, Loftus, Hoffman and Loftus (1991) discovered that when they equated the number of eye fixations made upon aspects of a stimulus, memory was still superior for the emotional rather than neutral aspects suggesting that the extent to which processing occurs may also be important. In line with this, Christianson and Loftus (1991) found that participant's retrospective reports suggested that differential elaboration occurred when people viewed emotional, unusual and neutral events. In support of this, a comparison of normal participants with psychopaths revealed that normal participants recalled the central details of emotional slides far better than did psychopaths. The rationale for this finding is that as psychopaths are unable to experience or appreciate the emotional information presented to them, they do not experience the same narrowing of attention that tends to be demonstrated by normal participants (Christianson, Forth, Hare, Strachan, Lidberg & Thorell, 1996).

4.3.3.3 Unusualness/novelty research

A small number of studies have specifically set out to explore the effects of the unusualness or novelty of information on memory. Central amongst these, Christianson and Loftus (1991) conducted a series of studies where participants were presented with a slide sequence in which the middle slide varied according to three different conditions; a neutral condition, in which the middle slide depicted a woman riding a bicycle; an emotional condition, in which the middle slide depicted an injured woman lying on the ground beside a bicycle, or an unusual condition, in which the middle slide depicted a woman carrying a bicycle upside down on her

shoulder. In terms of the affective quality of the slides, although self-report measures revealed that the emotional series of slides were rated as the most unpleasant, no objective physiological measures were taken to support this. Nevertheless, in terms of recalling the central details of the slides, participant witnesses performed equally well in all three conditions, although this was associated with reduced recall of peripheral details in both the emotional and unusual conditions. When participant witnesses' memories were tested for only the different middle slide in each sequence, however, the unusual group performed poorer on both central and peripheral information in comparison to the emotional group who still performed better on central information with an associated reduction in recall for the peripheral information.

Christianson and Loftus interpreted these results to suggest that, in contrast to the neutral condition, in both the emotional and unusual conditions attention was drawn away from the peripheral or background information in the slides to the central information. They suggest that for the critical slide, participants in the unusual condition were poorer on central details as well as peripheral details because they may have spent more time elaborating on the event itself, such as why someone would be carrying a bicycle on their shoulder, whereas the emotional group may have elaborated more about the actual woman lying injured on the ground rather than the event per se. In support of this, reports provided by participants suggested that differential elaboration occurred depending on whether they viewed the emotional, unusual or neutral slide sequence. In particular, those viewing the unusual condition slides indicated that, although they were as concerned about the central action of the critical slide as the emotional group were, they were less specific concerning elaboration about the woman in the slides.

The memory measures utilised in this study were, however, only focused on recall for the colour of coat the woman was wearing (classified as a central detail) and the colour of a car in the background (classified as a peripheral detail). Hence, this did not enable a detailed measure of memory to be made. In addition, it suggests that the

colour of the woman's coat was central detail information. Based upon definitions used in other studies this would have been termed peripheral information not central to the basic story line (e.g., Heuer & Reisberg, 1990).

Furthermore, support for unusual information attracting attention in a similar manner to emotional information was also found by Mitchell, Livorsky and Mather (1998). In line with a weapon focus style phenomena, they found that participants who watched a videotaped scene in which a stick of celery was brandished were actually poorer at remembering details of the perpetrator's appearance than when participants saw a gun brandished, thus showing that it is possible to produce a similar 'weapon focus effect' by using unusual or novel but non-threatening objects.

4.4 Conclusions

Research conducted to date provides some support for the role of physiologically driven mechanisms mediating the effects of arousal upon eyewitness memory. However, the amount of research conducted in this area is small, and more research needs to be conducted in order to firmly establish the existence of such a mechanism within the literature, especially in terms of memory for more complex information.

In contrast, there is currently a great deal of support for psychologically driven mechanisms mediating the effects of arousal upon memory. The increased support for psychological mechanisms could, however, simply be a function of the fact that much more research has been conducted in this particular area. Nevertheless, the research does suggest that psychological or cognitive processes influence not only the focus or direction of attention resources but also the degree of elaborative processing of emotional stimuli.

Fundamentally, whilst research findings support both the influence of physiological arousal upon human memory and the influence of psychological arousal upon human

memory, their relative influence or, indeed, whether one influences memory to the mutual exclusion of the other has not yet been demonstrated. In reflection of this, existing theoretical explanations have selectively concentrated on either physiological mechanisms or psychological mechanisms without cognisance to a potential relationship between the two. Furthermore, the potential role for other mediating factors have been ignored.

4.5 A new theoretical approach to understanding eyewitness performance

In light of the discussions above, it is argued that there is a need for a new theoretical approach to provide a fresh direction for eyewitness research. For too long the Yerkes-Dodson Inverted-U Hypothesis (Yerkes & Dodson, 1908) and Easterbrook's Cue-Utilisation Hypothesis (Easterbrook, 1959) have been relied upon to account retrospectively for memory performance under conditions of stress or arousal (see also McCloskey & Egeth, 1983b; Naatanen, 1973; Neiss, 1988, 1990). The continued use of these explanations offers little advance on our current understanding of the relationship between arousal and memory performance.

Based on the existing theoretical mechanisms and associated research discussed in the first half of this chapter, it is argued that there are two key components to an advance on the current theoretical approach to understanding eyewitness performance. Firstly, instead of treating physiological and psychological arousal as distinct entities, it is suggested that they should be viewed as more dynamic or interactive factors, with the potential for both to influence memory and perhaps in a joint manner. Second, it is suggested that in understanding eyewitness performance account needs to be taken of compensatory mechanisms such as motivation in mediating the effects of arousal upon memory.

4.5.1 An integrated approach to physiological andpsychological arousal

As set out in the first half of this chapter, existing theories utilised within the eyewitness literature have tended to be either physiological or psychological in their approach to the influence of arousal upon memory. Furthermore,whilst research findings support the influence of physiological or biological arousal upon human memory (e.g., Hall et al., 1989; Manning et al., 1990), a large amount of research also supports the influence of psychological arousal upon human memory (e.g, Christianson et al., 1991; Loftus et al., 1987). However, whether one influences memory to the mutual exclusion of the other has not yet been demonstrated. Logically, it is posited that rather than being mutually exclusive, their influences might be inextricably linked and that any theory of the effects of arousal upon eyewitness memory should reflect this possibility. Specifically, it is suggested that any comprehensive theory of the influence of arousal upon eyewitness performance needs to take a multi-factor dynamic approach rather than a uni-dimensional approach.

A similar attempt has been made by Clark & Watson (1991), who proposed a Tripartite Model of Anxiety and Depression in an attempt to overcome diagnostic nomenclature which represented the two as conceptually and empirically separate. Not unlike the influence of physiological and psychological arousal upon memory, the relationship between anxiety and depression has been viewed in varying ways, including: differing points along the same continuum, alternative manifestations of a common underlying diathesis, and as conceptually and empirically distinct phenomena (Clark, 1989). As with existing theories attempting to explain the effects of arousal upon eyewitness memory, each of these views is supported by some research. However, despite the support for theories postulating anxiety and depression as conceptually and empirically distinct phenomena, Clark and Watson identified increasing support for a more mixed approach to anxiety-depression diagnoses. They reviewed existing psychometric data relevant to this issue in order to investigate the extent to which empirical research findings support the existence

of one or more mixed mood disorders. Gradually, it became clear that rather than being conceptually and empirically distinct phenomena, the data were best captured by a tripartite structure of a general distress factor and specific factors for anxiety and depression, respectively. Their tripartite model implies that a complete description of the affective domain requires assessing both the unique and common elements of the syndromes: (1) general distress (non-specific component), (2) the physiological tension and hyper-arousal of anxiety, and (3) the pervasive anhedonia of depression. They argued that jointly these factors provide a more satisfactory diagnostic scheme for the anxiety and depressive disorders and suggested the need for a diagnosis of anxiety-depression as mixed. Furthermore, they also argued that the tripartite approach helps to explain why the various views of anxiety and depression have developed and represents a framework for their integration.

Although this approach is clinical with a particular emphasis on nosology, it is suggested that bringing together the elements of physiological arousal, psychological arousal and, as will be discussed below, motivation (compensatory mechanisms) in a similar tripartite arrangement, offers reasonable theoretical development on the existing uni-dimensional explanations of the effects of arousal upon eyewitness memory. On this basis, a more complete understanding of the effects of arousal upon eyewitness performance requires understanding the following three elements: (1) physiological arousal, (2) psychological arousal, and (3) motivation (compensatory mechanisms). As with the anxiety-depression model, jointly these factors may provide a more satisfactory explanatory scheme for understanding eyewitness performance. This proposed tripartite arrangement is not, however, presented as an answer to the theoretical problems associated with understanding eyewitness performance, but as a potential step forward in this complex area.

4.5.2 The role of motivation - a 'cognitive-energetical' approach

To date, the majority of eyewitness studies have neglected to manipulate personal involvement and have failed, therefore, to consider the role of motivation in

mediating the effects of arousal upon memory (e.g., Christianson & Loftus, 1991; Heuer & Reisberg, 1990). As a result, theoretical explanations of eyewitness performance have tended not to take account of this factor. Of the small number of studies that have manipulated personal involvement (e.g., Christianson & Hubinette, 1993; Hosch et al., 1984; Hosch & Cooper, 1982; Yuille & Cutshall, 1986), explanations underpinning the findings have relied upon existing theories used to account for the findings of the laboratory based studies where witnesses were not personally involved. Hence, it is argued that there is a fundamental gap in existing theoretical explanations of the effects of arousal upon eyewitness memory. It is suggested that this gap may be bridged by the 'cognitive-energetical' approach put forward by Hockey (1997) combining energetical processes with information processing models.

Hockey's framework attempts to explain and predict human performance under conditions of stress and high workload. Although his framework is grounded in ergonomics, taking a longer-term approach to the effects of stress on performance at work, it is believed that the underlying elements of this model have direct implications for our understanding of the relationship between arousal and eyewitness performance. In particular, this model takes account of cognitive control and regulatory processes which may serve to protect or maintain performance under conditions of stress or arousal.

Until now, theoretical explanations of how arousal affects eyewitness performance have tended to be encompassed within capacity models that suggest perceptual narrowing occurs because of the allocation of limited cognitive resources to the essential aspects of the stimulus array (e.g., Easterbrook's Cue-Utilization Hypothesis). This, in turn, leaves less of the finite resources for more peripheral aspects of the stimulus array, resulting in poorer performance for peripheral information relative to central details. This explanation has been heavily relied upon as it provides a logical explanation for much of the laboratory-based eyewitness

research, where participants viewing emotional material have tended to demonstrate poorer memory for peripheral details in comparison to those viewing non-emotional material (e.g., Burke et al., 1992; Christianson & Loftus, 1991; Heuer et al., 1997; Kebeck & Lohaus, 1986).

In his 'cognitive-energetical' framework, however, Hockey states that through an active process of cognitive resource management, via mental effort, individuals may choose to protect their performance, although this may occur at the expense of increased subjective effort, and behavioural and physiological costs. Alternatively, performance stability can be achieved by reducing performance goals without an increase in costs (or effort).

Underpinning his framework, is the assumption that behaviour is goal-directed. On this basis, behaviour is modified by reference to internal standards or goal achievement requirements (through negative feedback) so that currently active goals can be maintained and purposive behaviour promoted. Any costs associated with goal maintenance may be mental effort and high levels of subjective strain, and physiological increased levels of sympathetic dominance - further suggesting that in order to understand eyewitness performance, physiological and psychological elements should not be viewed as having distinct influences. Control is achieved by comparing target output values with current activity (Hockey argues that this occurs via an action monitor), and changing the output until the discrepancy is removed (or kept within acceptable limits).

On the basis of this approach, then, when the goal of personal safety is threatened, it is suggested that continuous environmental sensory scanning and elaborative processing would enable individuals to compare current target output values (readiness to maintain personal safety) with current activity (protective, withdrawing, or defensive readiness). In other words, make continuous mental assessments of whether and to what extent personal safety is still threatened by changing external

demands, and thus change their behaviour or response until the discrepancy is removed (or kept within acceptable limits; Derryberry & Tucker, 1994). Indeed, from an evolutionary perspective it is essential to recognise and remember negative emotional events in order to ensure appropriate responses in maintaining protective, withdrawing, or defensive behaviour in future situations (Christianson & Engelberg, 1997).

Research has shown that motivation processes may exert considerable influence over information processing (Blaney, 1986). In line with this, under circumstances of personal threat, not only may witnesses' attentional breadth be expanded (Eriksen & Yeh, 1985), but the degree of elaboration engaged in is likely to be enhanced (Christianson et al., 1991; Craik & Lockhart, 1972; 1975) in order to ensure accurate and efficient interpretation, monitoring and response (Derryberry & Tucker, 1994). Hence, it is suggested that continuous environmental scanning and elaborative processing may result in a compensated memory performance and that it is this which reflects the discrepancy between the memory performance of witnesses who are not personally involved in the target incident and those who are personally involved. In line with this, Hockey argues that in real life settings, people are more likely to show high levels of motivational control than is typically shown by participants who are asked to perform tasks that have no relevance beyond the laboratory (cf. Yuille, 1993). Hence, any decrement in performance is more likely to occur under laboratory conditions than in naturalistic settings.

Hence, in real eyewitness situations when a witness is aware that an incident is taking place or that they are or might become the victim of crime, they may be more motivated to try to understand what is going on and, as a result, may better remember details of the incident thereby compensating for any detrimental effects of arousal on eyewitness performance. Indeed, research with real witnesses suggests that their memory is good, even over long periods of time (e.g.,Christianson & Hubinette, 1993; Yuille & Cutshall, 1986, 1989; Fisher, Geiselman & Amador, 1989).

In contrast to studies of real witnesses, in laboratory based eyewitness studies where participants are not personally involved and there are, therefore, no threats to personal goals, there is no actual personal cost associated with reducing performance goals. Hence, although participants may be aroused and goals (i.e., memory performance) may be threatened, these goals may not be sufficiently personal to motivate goal maintenance via increased effort. That is, participants may not be motivated to scan, monitor and increase elaborative processing of the target stimulus. This may, explain why un-involved participants in laboratory based eyewitness studies, who are presented with arousing stimuli have, relative to those shown neutral stimuli, tended to demonstrate a trade-off for peripherally related details whilst protecting performance for centrally related details (Burke et al., 1992; Christianson, 1984; Christianson & Loftus, 1987; Christianson & Loftus, 1991; Heuer et al., 1997; Kebeck & Lohaus, 1986). It is possible that the trade-off in memory for peripheral details may reflect a reduction in performance goals as there is no motivation or energising of additional cognitive resources to maintain performance for them.

It is important to clarify, however, that it is not suggested that whenever witnesses are personally involved their memory performance will be enhanced or maintained. Indeed, Christianson & Engelberg (1997) describe several case studies where traumatic memories are inaccessible. Under such conditions of extremely high personal threat (e.g., rape or serious assault), it is possible that, from a biological-evolutionary perspective, memory for the incident could be detrimental to *future* goal maintenance (i.e., future happiness and ability to cope with normal everyday activities). In such circumstances a cost associated with goal maintenance could be repression, at least initially, of memory for the critical incident.

Furthermore, where real witnesses remain unaware that an incident is taking place or that it only becomes apparent to them after the incident has finished, it might be expected that their performance would be more like that of a laboratory witness as

they are not physiologically or psychologically aroused and do not know their personal goals are threatened. Indeed, Tollestrup et al., (1994) found that in comparison to robbery witnesses, fraud victims were less able to recall details regarding the appearance of the perpetrator.

4.5.3 Performance effectiveness versus performance efficiency

Critically, when participants are personally involved with the to-be-remembered event, especially if it threatens personal goals, performance effectiveness may not be reduced. However, this is not to say that performance efficiency is unaffected. Hence, Hockey states that performance measurement needs to be concerned not only with effectiveness but with the efficiency of behaviour (Hockey, 1996).

The importance of this approach is closely linked to Eysenck & Calvo (1992) in their Processing Efficiency Theory which centres around the distinction between performance effectiveness and performance efficiency and was designed to provide an explanation of the effects of state anxiety on performance. Within this theory, it is assumed that it is the level of state anxiety, rather than trait anxiety, which is generally crucial in determining individual differences in internal processing and performance. Further, worry, (e.g. self-pre-occupation, concern of performance) is regarded as forming the cognitive component of state anxiety. According to processing efficiency theory, worry has two main effects: (1) a reduction in the storage and processing capacity of the working memory system available for a concurrent task, and (2) an increment in on-task effort and activities designed to improve performance. Hence, in line with Hockey's cognitive-energetical framework, processing efficiency theory argues that worry serves a motivational function leading to the allocation of additional processing resources (i.e., effort) and the initiation of processing activities (e.g., strategies) designed to improve performance. This control or self-regulatory system, which is involved in mediating the effects of anxiety on performance, is a central element of the processing efficiency theory. As a result, the theory specifies a critical difference between performance effectiveness and

performance efficiency. Whilst performance effectiveness equals the quality of performance, performance efficiency is the quality of performance divided by effort (additional resources allocated). Hence, in line with Hockey, anxiety or worry characteristically impairs efficiency more than effectiveness.

In terms of eyewitness memory, then, it is suggested that when participants are personally involved with the to-be-remembered event, especially if it threatens personal safety goals, performance effectiveness may not be reduced. Performance efficiency, on the other hand, would be more likely to show a decrement due to the increased effort utilised to maintain performance effectiveness (or in Hockey's terms, protect personal goals). Hence, if the performance efficiency of witnesses could be accurately measured, it is posited that it is here that differences might lie. That is, there would be no difference in the performance effectiveness of aroused versus non-aroused participants, but what may well differ is their performance efficiency as the aroused participants may exert more effort in order to maintain personal goals.

Perhaps then, a real life victim witness, who uses effort to maintain memory performance could be said to have a lower processing efficiency than a non-victim witness who does not utilise as much effort to maintain memory performance. Hence, although their performance effectiveness does not differ, their performance efficiency may. However, from a practical or applied perspective this is not a problem as it is an eyewitness's performance effectiveness which is critical to the judicial process rather than their performance efficiency.

4.5.4 A tripartite model of arousal and eyewitness memory

In summary, reliance upon uni-dimensional theories to account for the influence of arousal upon eyewitness memory offers little advance on current understanding. Instead, it is proposed that a more multi-factor dynamic approach needs to be taken which encompasses both physiological and psychological effects, as well as

acknowledging the potential role of compensatory mechanisms associated with motivation to protect personal goals.

On this basis, it is suggested that a better understanding of the effects of arousal upon eyewitness performance requires understanding the following three elements: (1) physiological arousal, (2) psychological arousal, and (3) motivation (compensatory mechanisms). It is posited that jointly these factors may provide a more satisfactory explanatory scheme for understanding eyewitness performance. As stated earlier, however, this proposed tripartite arrangement is not presented as an answer to the theoretical problems associated with understanding eyewitness performance, but as a potential step forward in this complex area.

4.6 Research aims

Based upon existing research and the theoretical mechanisms discussed and proposed in this chapter, the aims of the research presented within this thesis were:

1. **To investigate the effects of personal involvement and perceived threat upon eyewitness memory within the laboratory.**

   As highlighted, research to date has neglected to examine the role of personal involvement and perceived threat, in mediating the effects of arousal on eyewitness performance. Importantly, investigation of these factors may also provide an insight into the potential role of motivation or compensatory mechanisms. Furthermore, there is a need for carefully controlled work in which evaluating the success of arousal manipulations should no longer have to rely upon indirect or retrospective inferences based on whether a differential eyewitness performance has been obtained or not. The results of two studies, which sought to address these issues, are reported within Chapter Five.

2. **To investigate the influence of physiological arousal and differential interest upon eyewitness memory within the laboratory.**

   Within this chapter it has been highlighted that only a very small amount of research has directly investigated the influence of physiological arousal upon eyewitness memory. Furthermore, there is a need for research in which memory for the target stimulus is assessed rather than associated verbal descriptors. Hence, the study presented within Chapter Six was conducted to investigate whether physiological arousal has an effect upon eyewitness memory for complex information on its own or whether its effects might be mediated by other factors. In addition, as laboratory studies investigating memory for emotional information have tended to make comparisons between groups experiencing different stimuli (emotional and neutral), it is timely to assess whether memory differences observed between such groups are actually a function of arousal, as has generally been interpreted, or whether they may in fact be a function of an inherent difference between the two stimuli.

3. **To investigate the accuracy of information reported by real victims and witnesses.**

   As revealed in Chapter Three, the few studies that have examined actual eyewitness memory, have been only partially successful in achieving a necessary balance between external and internal validity. Fundamentally, they have been unable to assess eyewitness accuracy, having instead relied upon measures of the amount of details or the consistency of reporting as indicators of eyewitness performance. In order for further progress to be made in this field, information concerning the accuracy of real eyewitnesses is required. The study presented within Chapter Seven attempts to address this issue.

Chapter 5

The Role of Personal Involvement and Perceived Threat: Laboratory Investigations

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5.1 Introduction

The research presented in this chapter, was conducted in order to investigate the effects of personal involvement and perceived threat upon eyewitness memory within the laboratory. As discussed within Chapter Three, the majority of eyewitness research conducted to date has been laboratory based, where visually-induced arousal has been studied rather than arousal induced through personal involvement (e.g., Christianson & Loftus, 1987; Christianson & Loftus, 1991). Whilst such studies suggest that arousal affects attentional and elaborative mechanisms resulting in the selective remembering of central details over peripheral details (e.g., Christianson & Loftus, 1991; Loftus et al., 1987), the extent to which this is the case remains questionable. Although the participants in such studies may have experienced a relative degree of empathy or understanding, there is no personal involvement when viewing visually-arousing slides or films in the sense that the 'witnesses' fail to feel personally threatened. This is particularly highlighted by the fact that witnesses experiencing visually-induced arousal have tended to demonstrate orienting physiological responses (e.g., Christianson, 1984; Christianson & Loftus, 1987; Burke et al., 1992) rather than defensive physiological responses which are characteristic of emotional incidents having some form of personal involvement.

As a result, it is suggested that there may be a marked discrepancy between the attentional and elaborative processing engaged in by uninvolved participants when simply viewing 'emotional' slides, compared with the attentional and elaborative

processing engaged in by witnesses who find themselves to be personally involved. Should this be found to be the case, such a distinction may help to explain some of the disparity that currently exists in the eyewitnessing literature concerning the effects of arousal on memory.

Consequently, this research examines the effects of defensive physiological responses, induced through personal involvement and perceived threat, on eyewitness performance under conditions in which both objective and subjective measures of arousal have been taken to ensure the effectiveness of manipulations. In doing so, it is predicted that there will be not only differences in eyewitness performance between the threatening and control conditions, but also between victims and bystanders within the threatening condition because of the nature of the threat manipulation. In particular, it is predicted that relative to bystanders within the threatening condition, threatened victims will be concerned with their personal safety. As a result, they may be more motivated to try to understand what is going on and may, therefore, scan or monitor the situation such that they demonstrate enhanced memory for centrally-related details (e.g., the source of the personal threat, such as physical actions or verbalisations related to the chances of attack), without the associated trade-off for more peripherally-related details (e.g., appearance-related details or verbalisations unrelated to the chances of attack) typically found within laboratory studies of visually-induced arousal (e.g., Burke et al., 1992; Christianson & Loftus, 1987; Christianson & Loftus, 1991).

Fundamentally, in this area of research there is a need for carefully controlled work in which evaluating the success of arousal manipulations should no longer have to rely upon indirect or retrospective inferences based on whether a differential eyewitness performance has been obtained or not. It is hoped that the novel methodology presented here will prove an important step in this direction. The results of two studies are reported which have sought to address these complex issues.

5.2 Laboratory Study One

5.2.1 Method

5.2.1.1 Participants

A total of 40 male undergraduate students (aged 18 - 26 years) from the University of St. Andrews participated in pairs (20 victim witnesses and 20 bystander witnesses). Each participant was remunerated by entry into a prize raffle (1st prize, £30.00). All subjects were naive to the true purpose of the study believing it to involve only the completion of 'questionnaires about yourself' and 'abstract thinking tasks'. Informed consent, for the disclosed aspects of the study, was obtained from each participant prior to the study. Although participants were also informed at this point of their ability to terminate the study at any time, whilst still being entered for the prize raffle, none did so.

5.2.1.2 Design

A 2 (threatening or control condition) x 2 (victim or bystander witness) between participants design was employed.

5.2.1.3 Apparatus

Measurements of heart rate (HR) were recorded continuously during the study as a physiological correlate of the emotional arousal experienced by the participants in each condition. Measurements were taken using RM-10 ambulatory recording units (Parametric Recorders Ltd.). Three Beckman bipolar thoracic skin electrodes, containing a 0.05 molar NaCl electrode jelly, were attached (two on the anterolateral portion of the ribcage and one on the upper thorax to serve as a ground). The recording module used a 2 microamp continuous alternating current to measure resistance with recordings taken at a sample rate of 5Hz. The resulting raw heart rate data were checked for recording artefacts and averaged over 5 second periods to produce the final heart rate figures for analysis.

5.2.1.4 Procedure

The design of this study was submitted to the University of St Andrews School of Psychology Ethics Committee for ethical approval prior to its execution. The committee ensured that it met with the ethical guidelines laid down by both the British Psychological Society and the American Psychological Association. Using a deception paradigm, the participants were led to believe that the purpose of the study was to investigate the effects of different tests, 'questionnaires about yourself' and 'abstract thinking tasks', upon heart rate. Participants, who were all unfamiliar with one another, were run in pairs. Upon arrival in the laboratory they were randomly seated at separate desks situated approximately 1 metre apart. Hence, both participants could easily view the whole interaction including both of the intruders. The victim's desk was located immediately in view of the laboratory entrance with the bystanders desk (see Figure 1).

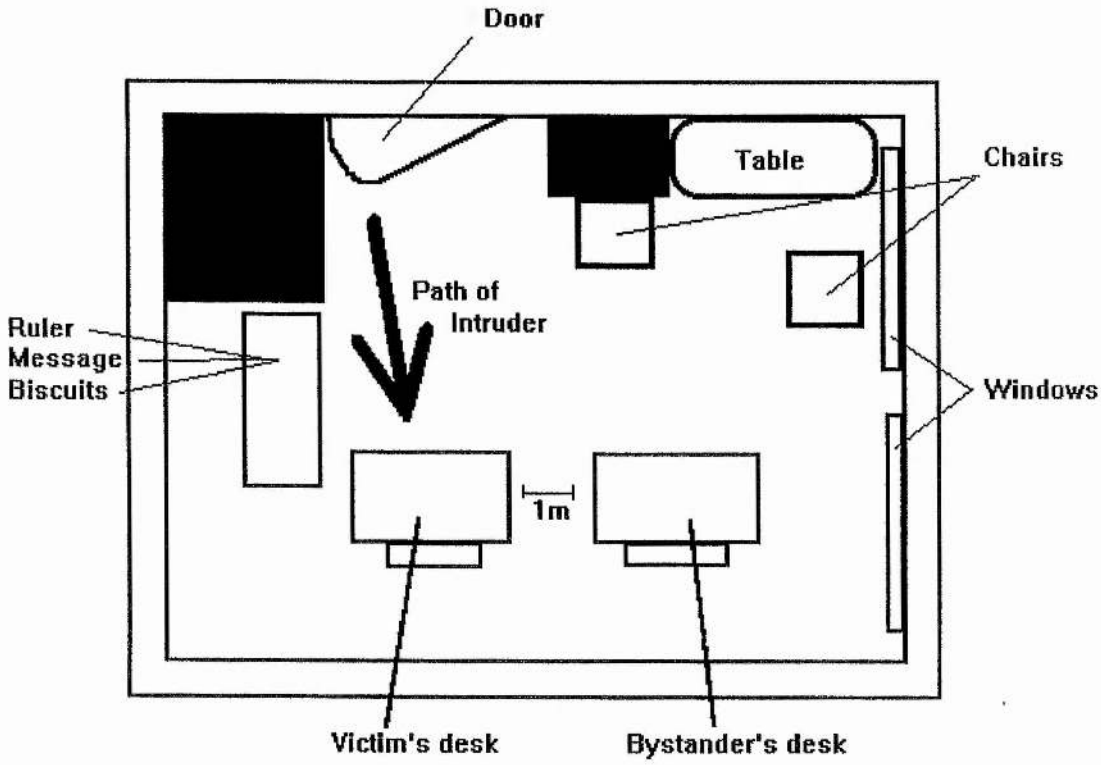

Figure 1: Layout of the laboratory during Study One.

From the moment HR recording commenced, the experimenter independently timed the study in order to correspond the incident occurrence with the heart rate recording. Immediately following the commencement of heart rate recording, participants were asked to complete what they believed were the questionnaires about themselves. The first test, the Spielberger State-Trait Anxiety Inventory (form Y-1), was administered to measure state-arousal (Spielberger, 1983). Next, participants were given Raven's Progressive Matrices as a distracter task during which the stimulus interaction occurred. Participants were led to believe that this test was the first of the 'abstract thinking tasks'. Once this test had been administered, the experimenter left the room to collect a forgotten test. Approximately 5 minutes after the experimenter had left the laboratory the stimulus interaction occurred.

The threatening condition interaction commenced with a male confederate bursting into the laboratory (see Appendix 1 for full details of the threatening condition). As soon as he saw the strategically positioned 'victim' he immediately accused him of having been seen with his girlfriend. Moments later a second male confederate ran into the laboratory and tried to calm down his irate friend. The second confederate then grabbed hold of the irate confederate who, resisting his friends grip, picked up a wooden ruler from a side table and waved it threateningly at the victim. The second confederate increased his attempt to remove his irate friend and managed to convince him that they should leave the laboratory. The irate confederate was uncooperatively forced out of the laboratory by his friend, who subsequently uttered a warning to the victim as they both left and slammed the laboratory door shut. In the Control Condition, the first confederate entered the laboratory and realized that the experimenter was not there (see Appendix 2 for full details of the control condition). The first confederate asked the 'victim' if he could leave a message. Moments later the second confederate hurried into the laboratory to see if his friend had found the experimenter. Upon realising that he hadn't, he urged the first intruder to hurry as they were late. The first intruder wrote a message down, picking up a wooden ruler from the side as he did so. He left the message and dropped the ruler on a side table, asking the victim to point it

out when the experimenter returned. Both intruders thanked the victim for his help and left the laboratory, closing the door quietly behind them.

Each interaction lasted approximately 30 seconds and both conditions were matched for detail, especially in terms of actions such as the ruler being picked up. In addition, during each interaction both confederates directed all their attention solely towards the victim. Consequently, the bystander's presence was ignored in order to minimise any threat he might feel. In both conditions the experimenter returned to the laboratory approximately two minutes after the confederates had left. In line with ethical appropriateness and to enable further memory and affect intensity measurement, participants were immediately informed that the interaction was staged, physiological recording was stopped, and the heart rate belts were removed. Participants were then informed they were required to complete four further tests about themselves and the interaction. This testing stage commenced with participants completing the Mackay Mood Adjective Checklist (Mackay, Cox, Burrows & Lazzerini, 1978) as a retrospective measure of their self-reported arousal during the incident. Following this, participants were taken individually, one after the other, to separate interview rooms where they verbally answered a single free recall question, asking exactly what had happened during the incident, followed by a verbal cued recall test consisting of three questions prompting for recall of information on; the physical appearance of the intruders, verbal aspects of the incident, and the actions of the intruders (see Appendix 3 for full details of the recall measure). Participants responses were audio recorded for later transcription. Next, participants completed a questionnaire consisting of 34 forced-choice recognition questions, and 7 further ratings of how they felt during the interaction. The forced-choice recognition test was used to assess memory in a more fine grained way, less influenced by the patterns of report bias which can occur with recall tests (see Appendices 4 and 5 for full details of the recognition questionnaires).

Finally, participants were shown two 6-person, simultaneous, photographic lineups, one for each intruder. Both target-present and target-absent lineups were

used and the position of the intruders within the target-present lineups was randomised throughout. Each lineup was constructed following the recommendations for properly conducted sequential lineups (Koehnken, Malpass and Wogalter, 1996; Lindsay, Lea and Fulford, 1991; Wells, Seelau, Rydell and Luss, 1994; Wells, Small, Penrod, Malpass, Fulero, Brimacombe, 1998). On the basis of these recommendations, head and shoulder photographs of both intruders were shown simultaneously for a 30-second period to five pilot participants. To prevent the pilot participants consciously trying to remember the individuals shown, they were instructed to "consider what type of person you think each individual appears to be, for example do they look friendly, approachable etc.?" After the viewing period, the pilot participants were instructed to spend approximately 3 minutes writing down what type of person they considered each individual to be before finally being asked to recall what the individuals looked like and give a written description. From the descriptions given an overall composite description was made for each intruder and a lineup constructed based upon that composite. On this basis, each member of the lineup matched the overall description given by the five pilot participants for the target intruder for that lineup. To ensure the fairness of the lineup, each was shown to a further five pilot participants to whom the overall composite description was read. These participants were instructed to pick the individual from the lineup that matched the composite description. Unfortunately, although a Chi-square test would have been an appropriate test to analyse this data, the sample size used to pilot the lineups was in fact too small to be reliable. In particular, more than twenty percent of the cells within the contingency table have an expected frequency of less than five (Dowdy & Wearden, 1991; Howell, 1992). Despite this, for the five pilot participants the real intruder was picked no more frequently than the other males pictured.

After completion of all experimental tests, participants were thoroughly debriefed and informed about the importance of not divulging to anyone what they had been asked to do as it could compromise the purpose of the study. Participants were also informed that if they wished to come back at any point to discuss any aspect of the

study that worried them they were free to do so. None of the participants complained about treatment received during or after the study and no-one returned after the study.

5.2.1.5 Recall scoring procedure

The method of scoring employed for the cued and free recall statements is based upon the widely used Statement Analysis Procedure described by Yuille & Cutshall (1986). This method was utilised because it enables statements to be analysed in a precise and consistent manner. In particular, once a coder has had sufficient training in the procedures the process proves highly reliable. Rigorous testing and assessment of this method revealed that separate coders demonstrate less than 5% variance in coding (Yuille & Cutshall, 1986; Yuille & Cutshall, 1988; Yuille & McEwan, 1985). Each recall interview was audio-taped, transcribed and edited. Editing involved the removal of hesitancies and repetitions from each statement. In particular, any details reported during the cued recall which had already been reported during the free recall were removed leaving only additional new details in the cued recall. Hence, the free and cued recall together represented a witness's total recall absent of any repetition. Following editing, each free and cued recall statement was parsed into separate sentences and scored according to the statement analysis procedure described by Yuille & Cutshall (1986). This method assigns 1 point to every specific item of information. For example, the statement "he picked up the ruler and threw it" contains three separate items of information; "picked up", "the ruler" and "threw it". Similarly, the statement "he shouted something about seeing me with his girlfriend down Market Street yesterday" would score 5 points - one point for describing 'seeing me with', and one point each for 'girlfriend', 'Market', 'Street' and 'yesterday'. Although one whole point was assigned for each item reported, in terms of the accuracy of details, if an item was vague only half a point was assigned. Using this method, each witness statement was classified into one of four categories: (i) accurate, (ii) inaccurate, (iii) confabulated, and (iv) unclassifiable (i.e., any unknown details, such as a witness's reply to an intruder) and by grouping all four categories together it was possible to calculate a witness's total recall performance.

Unclassifiable details were not included in any analyses. In addition, each statement was scored in this manner according to four types of information: (a) action descriptions, (b) appearance descriptions and, (c) verbal descriptions. In line with Yuille & Cutshall (1986), estimates of confidence, i.e., "I think" or "he might have" were not weighted. In addition, each incident was classified in terms of the number of details that it contained, thus enabling analysis concerning the percentage of the available details recalled rather than the actual number. This was calculated on the basis that for intruder one there were a larger number of available details that could potentially be reported as he was the primary figure within the incident, hence there would be a higher probability of recalling a greater number of details for intruder 1 than intruder 2. Calculating the percentage of available details recalled allows a more valid investigation concerning whether intruder 1 may have been more memorable, salient or attention catching than intruder 2. In addition, it allows the existence of possible floor or ceiling effects to be observed. Similarly, although the incidents were matched as far as possible, there were slightly more details relating to the control incident than the threatening incident. Consequently, this method of analysis also ensures valid comparison across the incidents.

5.2.1.6 Manipulation checks

Figure 2 shows the mean baseline heart rate (averaged over 2 minutes immediately preceding the incident) and the progression of mean heart rates during and immediately following the incident (both 30 second periods). Unfortunately, heart rate data was lost for both victims and bystanders in 3 of the 10 threatening sessions, leaving data available for 7 of the sessions. All physiological data for the control sessions was available.

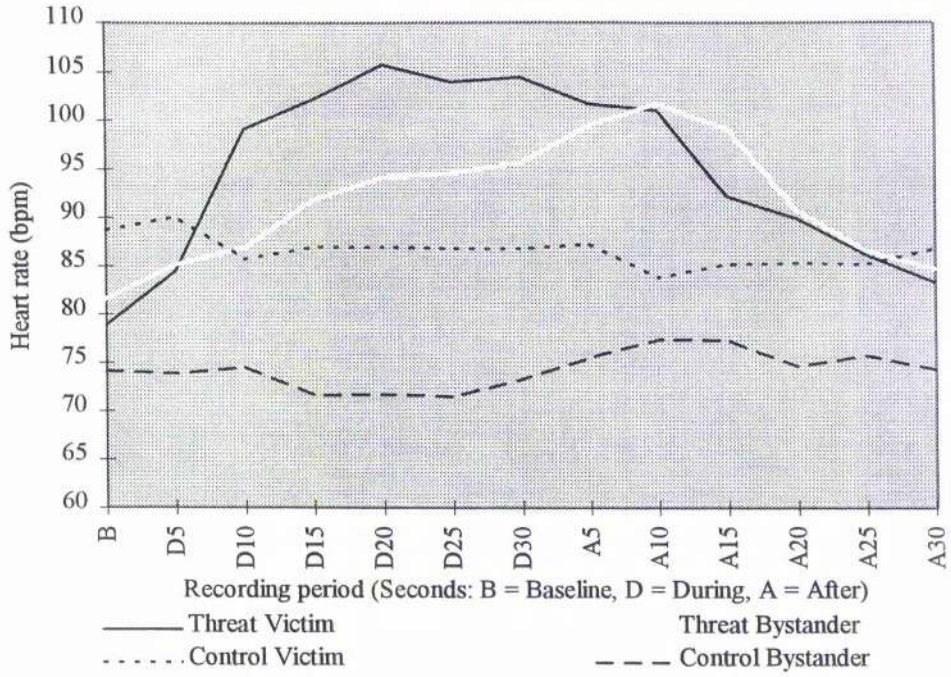

Figure 2: Mean heart rate progression during and after the incident.

Analysis of covariance, with baseline as the covariate, revealed that witnesses in the threatening condition were significantly more aroused than those in the control condition both during the incident ($F(1,29) = 19.67$, $p < 0.001$), and after the incident ($F(1,29) = 14.77$, $p < 0.005$; all statistical output for this study is shown in Appendix 9). Victims in the threatening condition, however, were not significantly more aroused, during or after the incident, than bystanders in the same condition. Similarly, there were no significant differences between victims and bystanders within the control condition.

In terms of self-reported arousal, an ANOVA revealed, as expected, no differences in state arousal (STAI, form Y-1) between any of the witness groups before the incident occurred (see Table 1). Further, in line with the physiological results threatened witnesses' ratings on the MacKay Mood Adjective Checklist revealed that they rated themselves as being more stressed ($F(1,36) = 39.28$, $p < 0.001$) and more aroused ($F(1,36) = 8.36$, $p < 0.01$) than control witnesses during the incident. Again, there were no differences between victims and bystanders within the

threatening condition or between victims and bystanders within the control condition (see Table 1).

	State Arousal (STAI, Y-1)	Arousal During (Mackay Arousal Scale)	Stress During (Mackay Stress Scale)
Threat Victims	37.20 (7.27)	4.90 (1.10)	4.80 (1.93)
Threat Bystanders	38.30 (10.78)	5.20 (1.14)	5.10 (1.60)
Threat Total	37.75 (8.97)	5.05 (1.10)	4.95 (1.73)
Control Victims	35.90 (3.48)	2.80 (2.25)	2.10 (2.38)
Control Bystanders	38.20 (8.66)	4.40 (1.58)	0.70 (0.95)
Control Total	37.05 (6.53)	3.60 (2.06)	1.40 (1.90)

Table 1: Mean (SD) STAI and Mackay Mood Adjective Checklist scores.

Mean ratings of participant's emotional responses, from the seven 6-point self-rating scales at the end of the recognition questionnaire, are summarised in Table 2. ANOVAs carried out on these rating data revealed that, in line with the physiological results, threatened witnesses rated themselves as: more threatened during the incident ($F(1,36) = 38.00$, $p < 0.001$); more threatened immediately following the incident ($F(1,36) = 17.15$, $p < 0.001$); more likely to be attacked during the incident ($F(1,36) = 25.33$, $p < 0.001$); more angry during the incident ($F(1,36) = 7.05$, $p < 0.05$); more afraid during the incident ($F(1,36) = 34.65$, $p < 0.001$); and more afraid immediately following the incident ($F(1,36) = 9.88$, $p < 0.005$) than were witnesses in the control condition. The only scale on which the threatened witnesses did not rate themselves more highly was the extent to which they felt angry immediately following.

Despite no difference between threatened victims and bystanders in terms of physiological arousal, one interaction was evident ($F(1,36) = 5.10$, $p < 0.05$, see Figure 3). A post-hoc Tukey test revealed that threatened victims rated themselves as feeling more threatened immediately following the incident than were bystanders in the same condition ($p < 0.05$).

	Threat during	Threat following	Chance of attack during	Angry during	Angry following	Afraid during	Afraid following
Threat Victims	3.70 (1.06)	2.70 (1.42)	2.70 (1.25)	2.40 (1.35)	1.80 (1.14)	2.50 (1.18)	2.00 (1.25)
Threat Bystanders	2.80 (1.40)	1.60 (0.84)	2.10 (1.10)	2.20 (1.14)	1.90 (1.29)	2.70 (1.25)	1.50 (0.85)
Threat Total	3.25 (1.29)	2.15 (1.27)	2.40 (1.19)	2.30 (1.22)	1.85 (1.18)	2.60 (1.19)	1.75 (1.07)
Control Victims	1.30 (0.67)	1.00 (0.00)	1.10 (0.32)	1.90 (0.99)	1.50 (0.71)	1.00 (0.00)	1.00 (0.00)
Control Bystanders	1.40 (0.52)	1.10 (0.32)	1.00 (0.00)	1.00 (0.00)	1.10 (0.32)	1.00 (0.00)	1.00 (0.00)
Control Total	1.35 (0.59)	1.05 (0.22)	1.05 (0.22)	1.45 (0.83)	1.30 (0.57)	1.00 (0.00)	1.00 (0.00)

Table 2: Mean (SD) ratings of emotional responses (6-point scale: 1 = not at all / 6 = extremely).

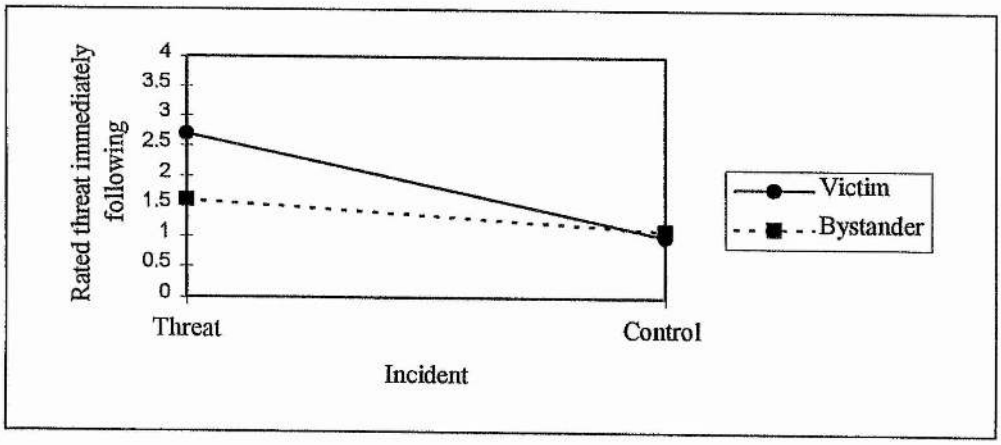

Figure 3: Mean rated threat immediately following the incident as a function of incident and witness type.

It is important to recognise, however, that individual differences may have played a significant part in the effect the manipulation had upon the participants. Therefore, in addition to making comparisons across the treatment groups, within the threat group (n = 14) the way in which physiological and psychological arousal interacted was investigated by correlating physiological arousal with perceived threat during the incident and also with the extent to which participants perceived they would be attacked during the incident. Thus, enabling consideration of arousal on a continuum rather than in discrete groups. Standardized residual values of the heart rate data were used for the correlations in order to account for baseline variation of participants' resting heart rate levels. These Spearman correlations were not, however, significant.

5.2.2 Results

5.2.2.1 Percentage of available details recalled

From Table 3 it can be seen that there were no differences between the witness groups in terms of the percentage of available details recalled for free recall, cued recall or, therefore, recall in total.

	Free Recall	Cued Recall	Total Recall
Threat Victims	12.45 (4.33)	10.32 (3.84)	22.77 (6.46)
Threat Bystanders	11.22 (6.57)	8.72 (3.39)	19.95 (8.19)
Threat Total	11.83 (5.45)	9.52 (3.62)	21.36 (7.32)
Control Victims	10.89 (3.48)	6.39 (3.87)	17.28 (6.10)
Control Bystanders	11.31 (5.08)	8.12 (3.68)	19.42 (6.89)
Control Total	11.10 (4.24)	7.25 (3.78)	18.35 (6.43)

Table 3: Mean (SD) percentage of available details recalled.

In order to investigate whether threatened witnesses might recall a greater percentage of available details relating to the threatening or arousing aspects of the incident, however, the details were classified according to whether they were centrally or peripherally related. This classification was made in line with

definitions employed in existing studies (Burke et al., 1992; Christianson & Loftus, 1991; Heuer & Reisberg, 1990). On this basis, central details comprised information required to make sense of the situation (i.e., threatening actions) whereas peripheral information was irrelevant to making sense of the situation (i.e., clothing colour). ANOVAs conducted on the data classified in this manner, however, revealed no differences between the witness groups.

Further, as the incidents in this study involved two intruders, it was chosen to consider whether a higher percentage of available details were reported for intruder 1 in comparison to intruder 2, particularly as intruder 1 was the main aggressor in the threatening condition. For both free recall and total recall ANOVA's revealed an interaction of incident by information type (whether the information pertained to intruder 1 or to intruder 2) ($F(1,36) = 4.85$, $p < 0.05$, and $F(1,36) = 4.48$, $p < 0.05$, respectively), see Figures 4 and 5. However, post-hoc tests revealed no significant differences between the threat and control groups for either interaction (see Table 4).

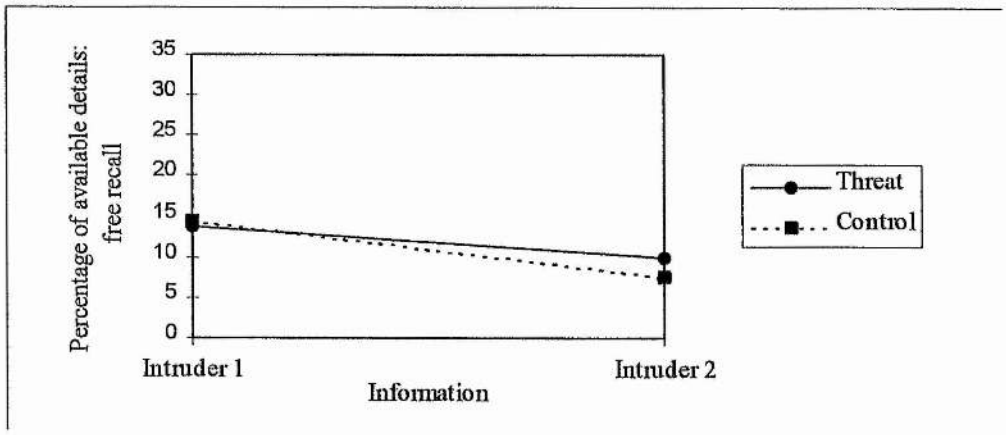

Figure 4: Mean percentage of available details free recalled as a function of information and incident type.

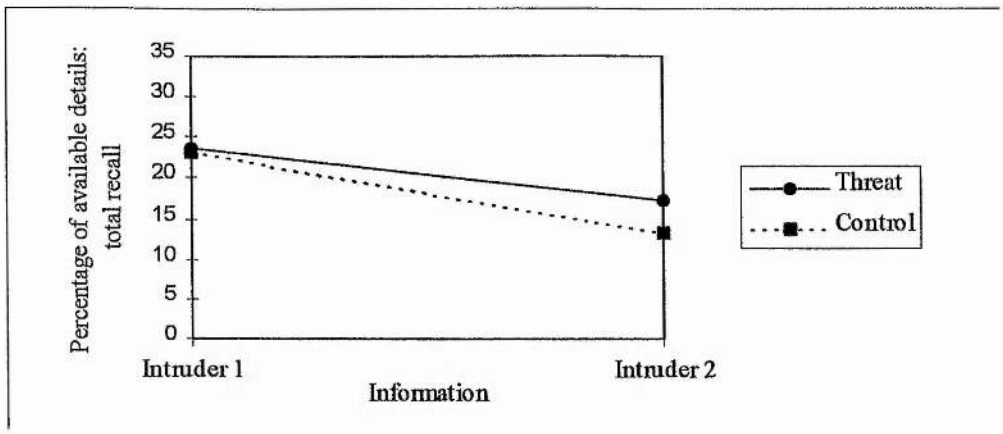

Figure 5: Mean percentage of available details recalled in total as a function of information and incident type.

	Free Recall		Total Recall	
	Intruder 1	Intruder 2	Intruder 1	Intruder 2
Threat	13.79 (7.00)	10.00 (4.85)	23.57 (9.39)	17.17 (6.95)
Control	14.54 (5.28)	7.47 (4.45)	23.16 (7.71)	13.28 (6.00)

Table 4: Mean (SD) percentage of available intruder1 and intruder 2 details recalled.

A third classification method was employed specifically to investigate whether threatened witnesses may recall more action, verbal or appearance related details in comparison to control witnesses. ANOVAs revealed an interaction of incident by information type (action, verbal or appearance detail) for free recall ($F(2,72) = 4.07$, $p < 0.05$; see Figure 6) and total recall ($F(2,72) = 9.07$, $p < 0.001$; see Figure 7). Post-hoc Tukeys tests revealed that in terms of total recall witnesses within the threat group reported a significantly higher percentage of available action details than did witnesses within the control group, $p < 0.005$ (see Table 5). For free recall, however, no differences between the incidents emerged.

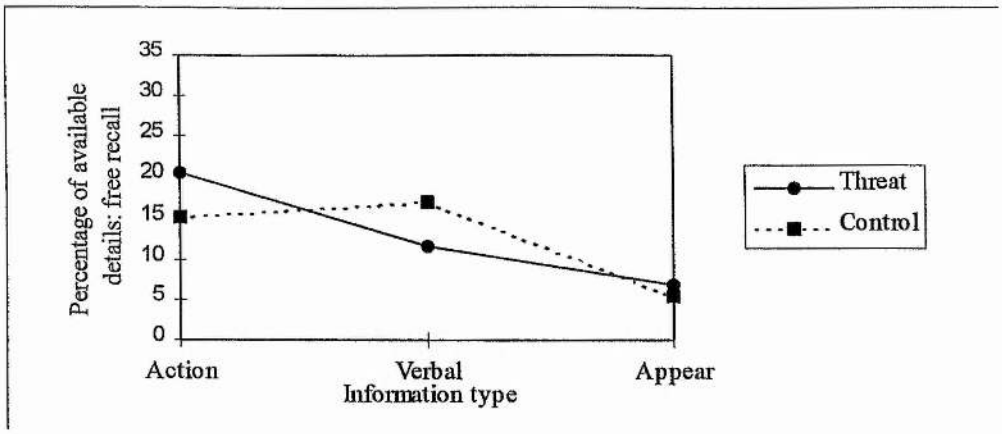

Figure 6: Mean percentage of available details free recalled as a function of information and incident type.

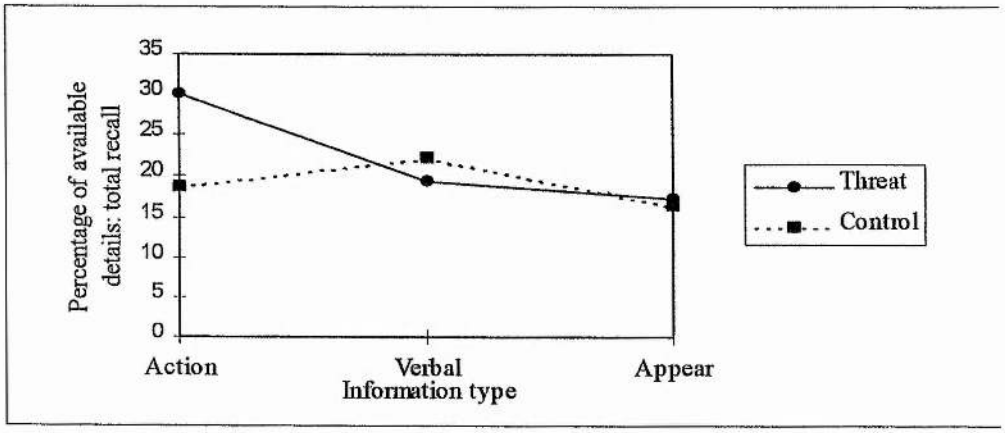

Figure 7: Mean percentage of available details recalled in total as a function of information and incident type.

		Action	Verbal	Appearance
Free Recall	Threat	20.48 (11.51)	11.67 (6.25)	6.82 (7.99)
	Control	15.16 (5.69)	16.95 (10.54)	5.51 (7.24)
Total Recall	Threat	30.10 (13.03)	19.38 (6.20)	17.27 (8.93)
	Control	18.71 (5.67)	22.20 (11.30)	16.31 (8.69)

Table 5: Mean (SD) percentage of available action, verbal and appearance details recalled.

To further analyse whether physiological arousal may have had an impact on the percentage of available details reported, Pearson Product-Moment correlations were conducted across the 14 threat group witnesses for whom physiological data was available. Once again, to take account of baseline heart rate levels standardized residual values were used. The results suggest that as physiological arousal during the incident rose so did: free recall overall ($r = .620$, $p < 0.05$); free recall pertaining to intruder 1 ($r = .670$, $p < 0.05$); free recall pertaining to intruder 2 ($r = .582$, $p < 0.05$); total recall overall ($r = .700$, $p < 0.01$); total recall pertaining to central details ($r = .579$, $p < 0.05$); total recall pertaining to peripheral details ($r = .701$, $p < 0.01$); total recall pertaining to intruder 1 ($r = .649$, $p < 0.05$); total recall pertaining to intruder 2 ($r = .655$, $p < 0.05$); total recall pertaining to action details ($r = .572$, $p < 0.05$); and total recall pertaining to appearance details ($r = .642$, $p < 0.05$). However, inspection of the scatterplots for these correlations (see Appendix 9), suggests that virtually all of them may not be terribly robust. Application of Anscombe's (Anscombe, 1973) useful rule for deciding whether there really is a robust relationship between two variables (i.e., if removal of a few observations at random does not alter the shape of the scatterplot then there is probably a real relationship), suggests that with the exception of the positive correlation between heart rate during the incident and the percentage of available peripheral details recalled, the other correlations may be misleading.

Pearson correlations of the percentage of available details reported with residual values of heart rate after the incident were not significant. Similarly, Spearman correlations (across all 20 threat group witnesses) of perceived threat and perceived likelihood of attack during the incident with percentage of available details recalled were also not significant.

5.2.2.2 Accuracy of recall

Accuracy scores were calculated as the percentage of details recalled that were correct. Table 6 shows the overall accuracy scores for free recall, cued recall and total recall. ANOVA on this data revealed no significant differences.

	Free Recall	Cued Recall	Total Recall
Threat Victims	89.21 (8.65)	75.84 (12.16)	82.92 (5.64)
Threat Bystanders	88.00 (13.48)	74.59 (14.84)	80.11 (9.99)
Threat Total	88.60 (11.04)	75.22 (13.22)	81.52 (8.03)
Control Victims	91.31 (9.00)	70.34 (19.68)	82.87 (6.50)
Control Bystanders	88.15 (6.09)	69.15 (21.19)	78.12 (9.98)
Control Total	89.73 (7.65)	69.74 (19.92)	80.50 (8.55)

Table 6: Mean (SD) percentage free, cued and total recall accuracy.

As with the amount of information recalled, the details reported were classified according to three criteria. Firstly, when the data were classified as central or peripheral an interaction of incident with information type ($F(1,24) = 5.16$, $p < 0.05$) was obtained for free recall accuracy (see Figure 8). Post-hoc Tukey tests revealed that threatened witnesses just missed being significantly lower in accuracy for peripheral details than were control witnesses ($p = 0.051$; see Table 7).

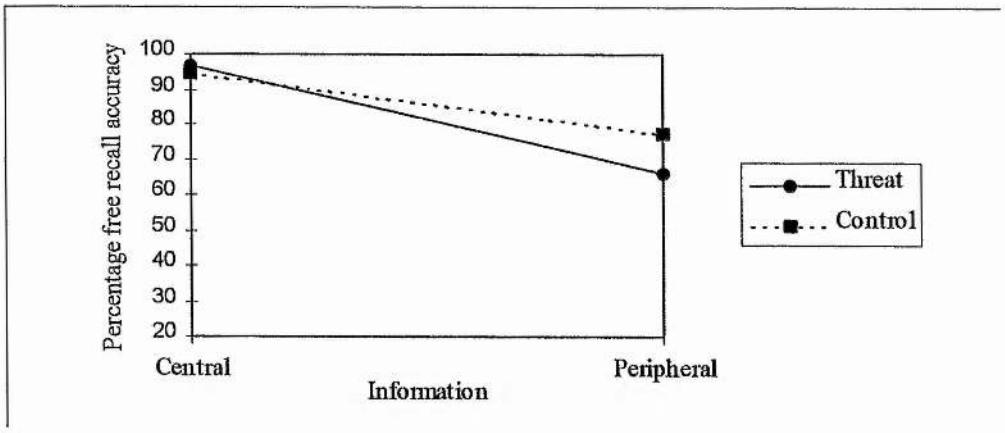

Figure 8: Mean percentage free recall accuracy as a function of information and incident type.

When the details were classified according to which intruder they referred to (see Table 8), interactions between incident and information type were present for cued recall accuracy ($F(1,34) = 6.22$, $p < 0.05$; see Figure 9) and total recall accuracy ($F(1,36) = 7.28$, $p < 0.05$; see Figure 10). Despite these interactions, however,

post-hoc Tukey tests did not reveal any significant differences between incidents or witnesses for either interaction.

	Central	Peripheral
Threat	96.65 (5.51)	65.91 (16.54)
Control	94.55 (6.45)	77.44 (16.75)

Table 7: Mean (SD) percentage free recall accuracy for central and peripheral details.

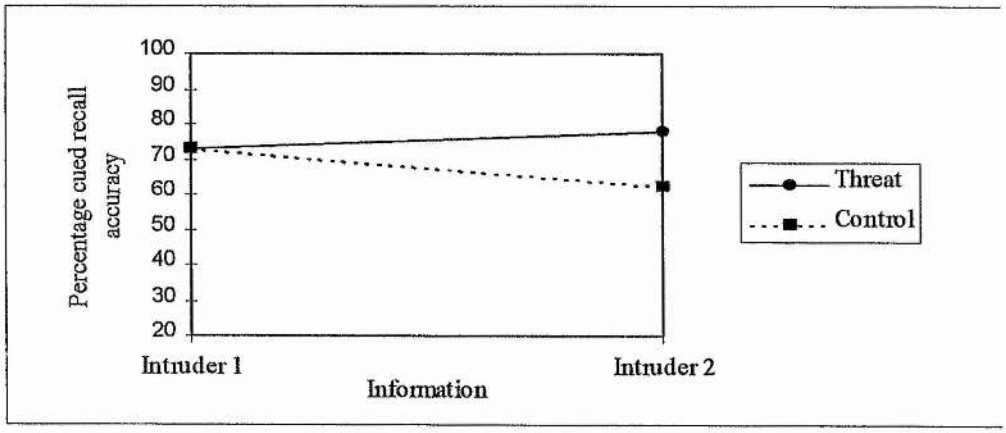

Figure 9: Mean percentage cued recall accuracy as a function of information and incident type.

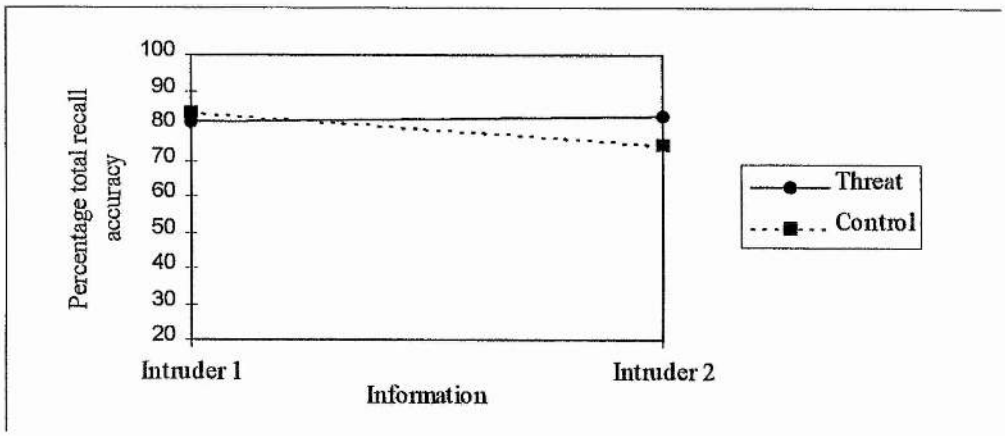

Figure 10: Mean percentage total recall accuracy as a function of information and incident type.

	Cued Recall		Total Recall	
	Intruder 1	Intruder 2	Intruder 1	Intruder 2
Threat	72.82 (15.39)	77.72 (16.10)	80.92 (7.49)	82.87 (11.92)
Control	73.18 (19.02)	62.19 (29.97)	83.87 (8.64)	74.77 (14.84)

Table 8: Mean (SD) percentage cued and total recall accuracy for intruder 1 and intruder 2 details.

Finally, when the data were classified according to whether they related to action, verbal or appearance details, an interaction between incident and information type was obtained for free recall accuracy ($F(2,38) = 3.72$, $p < 0.05$; see Figure 11). Once again, however, post-hoc Tukey tests revealed no significant differences between the incidents (see Table 9).

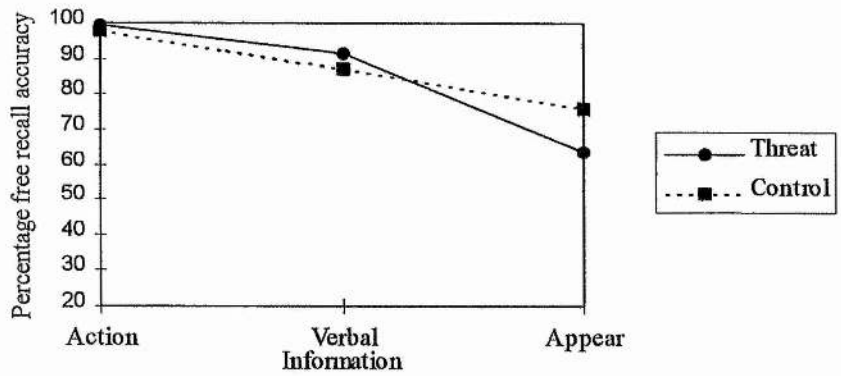

Figure 11: Mean percentage free recall accuracy as a function of information and incident type.

	Action	Verbal	Appearance
Threat	99.20 (3.58)	91.24 (13.01)	63.50 (17.88)
Control	97.83 (5.44)	87.07 (12.79)	75.80 (16.27)

Table 9: Mean (SD) percentage free recall accuracy for action, verbal and appearance details.

Similarly, although a three-way interaction of incident by witness by information type was also obtained for total recall accuracy ($F(2,70) = 3.46$, $p < 0.05$; see Figure 12), post-hoc tests did not reveal any significant differences between the witness groups (see Table 10).

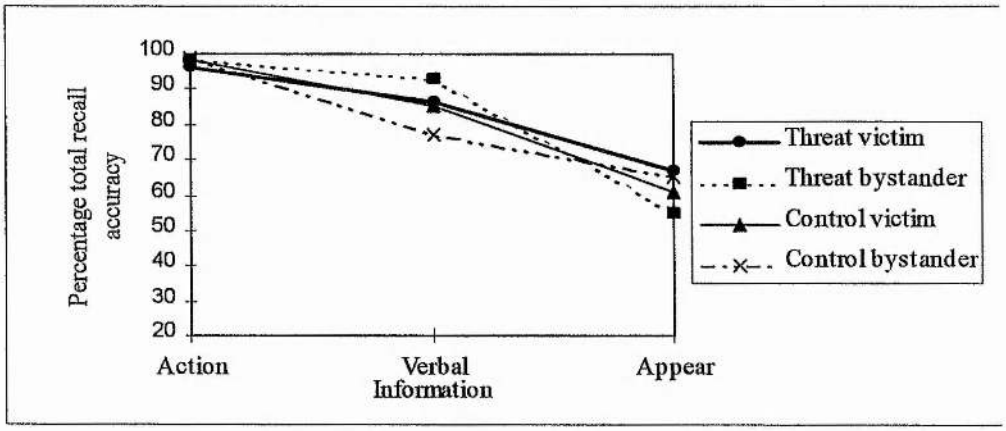

Figure 12: Mean percentage total recall accuracy as a function of information, incident and witness type.

	Action	Verbal	Appearance
Threat Victims	96.03 (6.53)	86.44 (13.70)	67.02 (8.36)
Threat Bystanders	98.22 (3.21)	92.71 (11.25)	54.69 (16.99)
Total	97.12 (5.13)	89.58 (12.62)	61.18 (14.25)
Control Victims	98.09 (4.03)	85.50 (9.39)	60.84 (16.54)
Control Bystanders	99.00 (3.16)	77.34 (12.95)	64.99 (26.71)
Total	98.55 (3.56)	81.42 (11.78)	62.91 (21.72)

Table 10: Mean (SD) percentage total recall accuracy for action, verbal and appearance details.

To further analyse whether physiological arousal may have had an impact on recall accuracy, Pearson Product-Moment correlations were conducted across the 14 threat group witnesses. Once again, to take account of baseline heart rate levels standardized residual values of the heart rate data were used in the correlations. Although the results suggest that as physiological arousal during the incident rose

the accuracy of action details free recalled drops ($r = -.539$, $p < 0.05$), inspection of the associated scatterplot (see, Appendix 9) suggests that this is not the case. Specifically, only 1 of the 14 threat group witnesses for whom physiological data were available was less than 100% accurate for the action details they free recalled. Pearson correlations of recall accuracy with residual values of heart rate after the incident were also not significant.

Spearman correlations (again across the threat group witnesses) of perceived threat and perceived likelihood of attack during the incident with recall accuracy suggested that as rated threat during the incident rose so too did the accuracy of appearance details cue recalled ($n = 18$; $r = .540$, $p < 0.05$). In addition, as rated perceived chance of attack during the incident rose the accuracy of verbal details recalled in total decreased ($n = 20$; $r = -.475$, $p < 0.05$). Once again, however, inspection of the scatterplots for these relationships (see Appendix 9) suggests that they are not representative of real relationships.

5.2.2.3 Recognition accuracy

The recognition questionnaires for both the threatening and control conditions consisted of two-alternative (2AFC) and four-alternative (4AFC) forced choice questions. For obvious reasons regarding differences in the probability of guessing correctly for these two sets of questions, they were analysed separately. In addition, recognition accuracy was calculated as a percentage due to differing numbers of question types set between the questionnaires for the threatening condition and the control condition. The threatening condition questionnaire contained a total of 34 questions (eleven 2AFC and twenty-three 4AFC), whilst the control condition questionnaire contained a total of 32 questions (eleven 2AFC and twenty-one 4AFC).

Firstly, ANOVA revealed that witnesses within the threatening condition were significantly more accurate for 2AFC questions in total than were witnesses within the control condition, $F(1,36) = 7.07$, $p < 0.05$ (see Table 11). There were,

however, no significant differences between the groups in terms of accuracy for 4AFC questions overall.

Using the same criteria as for the recall data, the questions were grouped according to whether they concerned central or peripheral detail information (see Table 11). In terms of 2AFC questions, an interaction of incident with information type was obtained ($F(1,36) = 9.19$, $p < 0.005$; see Figure 13). Post-hoc Tukey tests revealed that the threat group were higher in accuracy for central detail questions than were the control group, $p < 0.001$. For 4AFC questions a three-way interaction of incident by witness by information type just reached significance ($F(1,36) = 4.12$, $p = 0.05$; see Figure 14). However, post-hoc Tukeys tests revealed no significant differences between the witness groups.

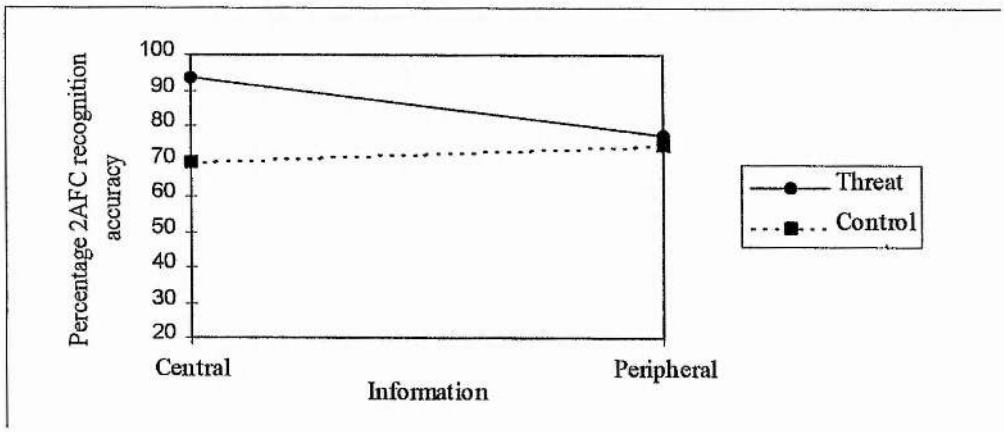

Figure 13: Mean percentage 2AFC recognition accuracy as a function of information and incident type.

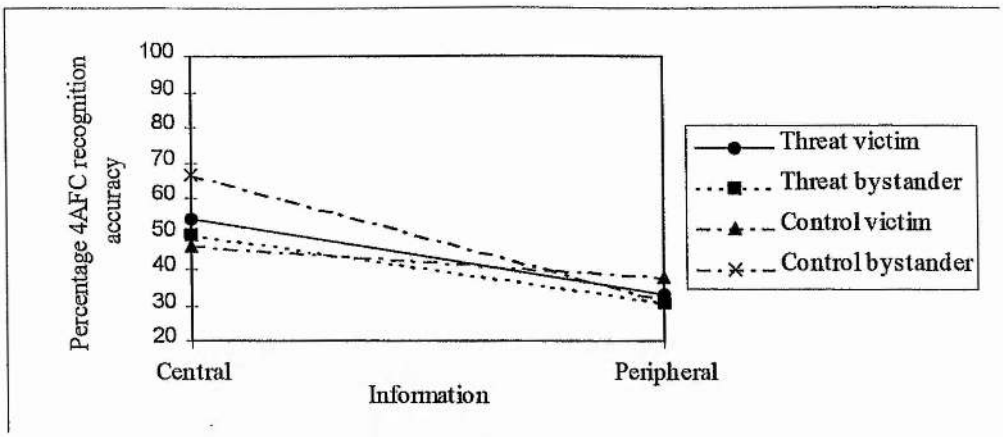

Figure 14: Mean percentage 4AFC recognition accuracy as a function of information, incident and witness type.

	2AFC			4AFC		
	Central	Peripheral	Total	Central	Peripheral	Total
Threat Victim	96.67 (10.54)	80.00 (8.74)	84.55 (6.14)	54.00 (23.19)	32.77 (6.65)	37.39 (7.16)
Threat Bystander	90.00 (16.10)	75.00 (8.33)	79.09 (8.62)	50.00 (17.00)	30.56 (14.64)	34.78 (12.47)
Threat Total	93.33 (13.68)	77.50 (8.70)	81.82 (7.80)	52.00 (19.89)	31.67 (11.13)	36.09 (9.98)
Control Victim	63.33 (24.60)	73.75 (17.13)	70.91 (14.08)	46.67 (23.31)	37.78 (14.54)	39.05 (15.02)
Control Bystander	76.67 (22.50)	75.00 (8.33)	75.46 (10.54)	66.67 (22.22)	31.11 (7.03)	36.19 (5.60)
Control Total	70.00 (23.94)	74.38 (13.13)	73.18 (12.32)	56.67 (24.43)	34.45 (11.63)	37.62 (11.13)

Table 11: Mean (SD) percentage recognition accuracy for central detail, peripheral detail and total questions.

Classification of the questions according to which intruder they referred was also made but again revealed no significant differences between the witness groups. Finally, analysis of data classified according to action, verbal or appearance questions was not conducted on 2AFC questions because the absence of verbally

related 2AFC questions meant that the resulting groups were identical to those of the central and peripheral classification. Specifically, all of the action questions pertained to central aspects of the incidents and all of the appearance questions pertained to peripheral details. Hence, the results of analysis on the data classified in this manner would be identical to that shown above for the central and peripheral detail classification. Thus, the threat group would be higher in accuracy for action details than the control group ($p < 0.001$). For 4AFC questions, however, the classification was made and revealed a three-way interaction of incident by witness by information types (action, verbal or appearance details), $F(2,72) = 3.29$, $p < 0.05$; see Figure 15. Post-hoc Tukey tests, however, revealed no significant differences between the witness groups (see Table 12).

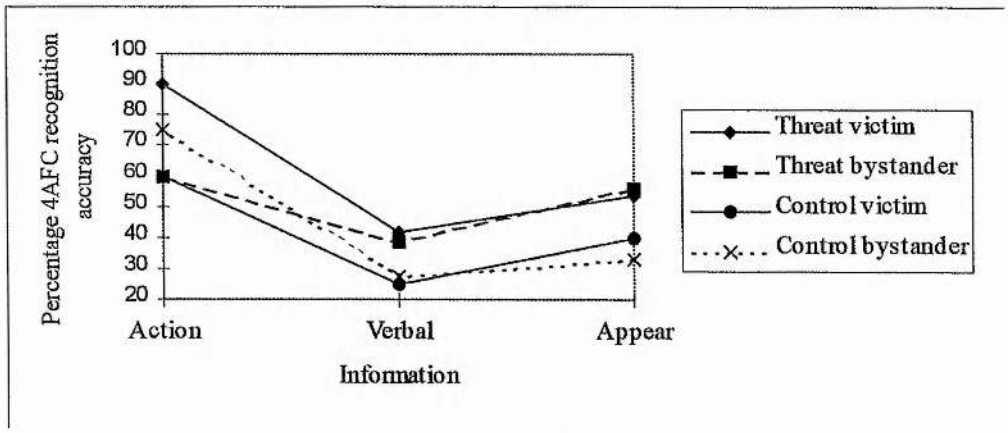

Figure 15: Mean percentage 4AFC recognition accuracy as a function of information, incident and witness type.

As with recall performance, to further analyse whether physiological arousal during or after the incident may have had an impact on recognition accuracy, Pearson Product-Moment correlations were conducted across the 14 threatening condition witnesses for whom physiological data was available. Once again, to take account of baseline heart rate levels standardized residual values of the heart rate data were used in the correlations. Pearson correlations of accuracy for 2AFC questions and the residual values of heart rate both during and after the incident were not significant. Interestingly, however, for 4AFC questions significant correlation co-efficients were obtained suggesting that as physiological arousal

during the incident rose, accuracy declined for 4AFC questions: overall ($r = -.588$, $p < 0.05$); pertaining to peripheral details ($r = -.783$, $p < 0.005$), pertaining to intruder 2 ($r = -.855$, $p < 0.001$), and pertaining to appearance related details ($r = -.562$, $p < 0.05$). In direct contrast, however, as physiological arousal after the incident rose accuracy for 4AFC questions pertaining to central details also rose ($r = .563$, $p < 0.05$). Once again, however, inspection of the scatterplots for all of these correlations (see, Appendix 9) suggests that they do not represent real relationships. Further, Spearman correlations (across all 20 threat group witnesses) of perceived threat and perceived likelihood of attack during the incident with recognition accuracy for both 2AFC and 4AFC questions were not significant.

	2AFC		4AFC		
	Action	Appearance	Action	Verbal	Appearance
Threat Victims	96.67 (10.54)	80.00 (8.74)	90.00 (21.08)	41.67 (21.15)	53.75 (11.86)
Threat Bystanders	90.00 (16.10)	75.00 (8.33)	60.00 (45.95)	38.33 (15.81)	56.25 (23.75)
Threat Total	93.33 (13.68)	77.50 (8.70)	75.00 (38.04)	40.00 (18.26)	55.00 (18.32)
Control Victims	63.33 (24.60)	73.75 (17.13)	60.00 (31.62)	25.00 (20.41)	40.00 (15.07)
Control Bystanders	76.67 (22.50)	75.00 (8.33)	75.00 (35.36)	27.50 (24.86)	33.33 (8.89)
Control Total	70.00 (23.94)	74.38 (13.13)	67.50 (33.54)	26.25 (22.18)	36.67 (12.52)

Table 12: Mean (SD) percentage recognition accuracy for action, verbal and appearance detail questions.

5.2.2.4 Identification

Witnesses' identification decisions for the lineups were classified as being either correct or incorrect (see Table 13). A correct decision was either an accurate identification from a target present lineup or a correct rejection from a target

absent lineup. Consequently, an incorrect decision was a false alarm from either a target present or absent lineup, or an incorrect rejection from a target present lineup.

In terms of lineup 1 (Intruder 1), the contingency table for incident by witness by decision type analysis contains more than 20% of cells with expected cell frequencies of less than 5 and is, therefore, too small for reliable analysis to be carried out (see Appendix 9). When the data are collapsed across witness type, however, it is acceptable to make comparisons. A two-way χ^2 test of association was conducted but did not reveal a significant relationship between incident type and decision type.

For lineup 2 (Intruder 2), cell sizes were also too small to conduct further reliable analysis across incident, witness and decision types. As can be seen from Table 13, when the data are collapsed across witness type it is revealed that across both incidents equal numbers of correct and incorrect decision types were made.

	Lineup 1		Lineup 2	
	Correct	Incorrect	Correct	Incorrect
Threat Victims	7	3	4	6
Threat Bystanders	3	7	5	5
Threat Total	10	10	9	11
Control Victims	5	5	5	5
Control Bystanders	7	3	4	6
Control Total	12	8	9	11

Table 13: Number of correct and incorrect identification decisions.

Finally, Point-biserial correlations were conducted across the threatening condition witnesses. However, no significant correlation coefficients were revealed when heart rate during and after the incident (standardized residual values of the heart rate data in order to take account of baseline heart rate values), as well as

perceived threat or perceived chance of attack were correlated with identification decision.

5.2.3 Discussion Study One

Firstly, despite setting up a successful threatening manipulation in this study (i.e., a significant difference in physiological arousal between the threatening and control conditions both during and after the incident), the use of objective manipulation checks showed that a difference in physiological arousal between threatened victims and bystanders within the same condition was not successfully manipulated during or immediately after the incident. Fundamentally, however, unlike all of the previous studies that have attempted to set up similar paradigms (e.g., Hosch & Cooper, 1982; Hosch et al., 1984), the use of objective manipulation checks enabled clear recognition that this difference was not achieved.

As the manipulated threat was clearly directed towards the victim rather than the bystander of each pair, it is interesting to consider why the expected difference in physiological arousal did not occur. A possible explanation concerns the room in which the incidents took place. The laboratory was particularly small and consequently bystanders were very close to the incident and may have perceived themselves as being in the way. For example, if some form of physical action had occurred they would at least have had to move out of the way to avoid physical contact and the possibility of being hurt. In addition, the bystander was the only other 'neutral' individual in the room at the time of the incident. Consequently, there may have been an implicit obligation upon them to intervene and try to placate the situation if necessary. Indeed, during the debriefing sessions many of the bystanders within the threatening condition reported feeling in the midst of it all and thinking that they might have to get involved if things escalated out of hand. The obligation to intervene in combination with the possibility of being hurt, may have caused the bystanders' arousal to be elevated to a level similar to the victims'. Thus, it would seem that, as with the threatened victims, bystanders in

the same condition may also have experienced a form of personal involvement and associated perceived threat during the incident, albeit for different reasons. In line with this, there were no differences between the threatened victims and bystanders in terms of both rated threat and perceived chance of attack during the incident.

Interestingly, although there were no differences in physiological arousal, threatened victims did report being significantly more threatened immediately following the incident than did bystanders in the same condition. Furthermore, physiological arousal and the various measures of self-reported psychological arousal were not correlated. This is not necessarily as expected as one might predict that witnesses perceiving themselves as more threatened, or more likely to be attacked, would also be higher in physiological arousal as a result of the associated innate fight or flight response. However, whilst this suggests that physiological and psychological arousal differ (i.e., as rated threat or perceived chance of attack increased it was not associated with an increase in physiological arousal), self-ratings based on Likert-type scales are not necessarily as reliable or valid as they are often interpreted to be, especially when used with small sample sizes (Wright, Gaskell & O'Muircheartaigh 1997). Unfortunately, measurement of psychological affect is reliant upon such introspective self-reports and it is possible that the sample size utilised within this study ($n = 14$, as physiological data was only available from 14 threat group witnesses) was not large enough to allow such relationships to manifest themselves. Brigham et al., (1983), which appears to be the only other eyewitness study which attempted to correlate physiological and psychological arousal measures, also failed to find a relationship between three different measures of physiological and self-reported arousal with a sample size of twenty.

Unfortunately, the extent of this potential measurement issue within the eyewitness literature is largely unknown as the majority of studies which have employed both physiological and psychological arousal measures have not reported whether they found them to be correlated (e.g., Christianson, 1984; Christianson, 1986; Christianson & Mjorndal, 1985; Christianson & Nilsson, 1984). The question also

arises as to which is more appropriate to use. Although physiological measures may be more objective, self-report measures have, arguably, greater external validity than do physiological measures because the judicial system relies upon retrospective self-reports in estimating the affect associated with a crime (Brigham et al., 1983). Fundamentally, this issue highlights the importance of using both objective and self-report measures in the experimental environment in order to more fully understand the effects of the experimental manipulation.

5.2.3.1 Memory performance of victims versus bystanders

In terms of memory performance, it was predicted that relative to bystanders within the same condition, threatened victims would be concerned with their personal safety. As a result, they would be more motivated to try to understand what was going on and, therefore, scan or monitor the situation such that they demonstrate enhanced memory for centrally-related details (e.g., the source of the personal threat, such as physical actions or verbalisations related to the chances of attack), but without the associated trade-off for more peripherally-related details (e.g., appearance-related details or verbalisations unrelated to the chances of attack) typically found within laboratory studies of visually-induced arousal (e.g., Burke et al., 1992; Christianson & Loftus, 1987; Christianson & Loftus, 1991).

However, as a difference in arousal level between threatened victims and bystanders was not successfully manipulated, it is perhaps not surprising that no significant differences in memory performance between the two groups were observed. In terms of motivation and the potential role of compensatory mechanisms, as threatened victims and bystanders rated themselves as equally threatened and likely to be attacked during the incident, it is possible that they were equally motivated to protect their personal goals and, in so doing, understand what was going. As a result, both may have employed compensatory mechanisms, thus demonstrating similar memory performance.

Fundamentally, this highlights the importance of manipulation checks and calls into question the study by Hosch & Cooper (1982) who also found no differences

in memory performance (identification accuracy) between victims and bystanders, but failed to assess whether they had successfully manipulated differentially aroused (physiological or psychological) witnesses.

There were, however, two interesting non-significant differences within this study which are worthy of discussion. Firstly, threatened victims were slightly higher in overall recall accuracy, although not recognition accuracy, for appearance related details than were bystanders within the same condition. Although it was anticipated that threatened victims would not demonstrate poorer memory for appearance related details relative to threatened bystanders, it was not expected that they might demonstrate a superior memory for such details. In retrospect, however, this might reflect the possibility that the threatened victims in this study may have spent more time specifically processing the appearance, and perhaps faces in particular, of the intruders in order to work out whether they actually knew them. They were, after all, being accused of seeing the first intruder's girlfriend and it is not, therefore, unlikely that they would have spent time trying to work out if they had seen the intruder before. The bystanders, however, would have had no reason to think about whether they actually knew the intruder or had seen him before. This interpretation is supported if we look at the mean recall accuracy rates for appearance details pertaining to intruder 1 and intruder 2 separately. Threatened victim's accuracy for intruder 1 appearance details was 69% in comparison to bystanders 52%, a difference of 17 percent. For intruder 2 appearance details, however, threatened victims' accuracy was 62% and bystanders 56%, a difference of only 6 percent. In addition, threatened victims were correct in their lineup decision concerning intruder 1 40% more often than threatened bystanders. It is interesting, however, that control bystanders correctly identified intruder 1 as frequently as did threatened victims, thus suggesting no effect of physiological arousal or perceived threat upon identification accuracy. However, as the nature of the incidents experienced by these two witness groups were different, it remains possible that other factors may have exerted an additional influence on the performance of one group relative to the other.

Although not statistically significant, these results tenuously suggest that relative to threatened bystanders, threatened victims may have spent more time attending to, or processing, appearance details for intruder 1. Although such a suggestion is in line with Hosch & Bothwell (1990), who found laboratory victims to be more accurate than bystanders in terms of written descriptions of a perpetrator, in terms of identification accuracy it contrasts with the laboratory studies of Hosch et al. (1984) and Kassin (1984) who found victims to be poorer at identifying the perpetrator of a theft than bystanders. Furthermore, this tentative pattern appears to contrast with the work of Tollestrup et al., (1994) who found that real victims and bystanders to robberies did not differ in their accuracy for descriptions regarding hair, age and weight, with bystanders more accurate for height. In the study presented here, however, recall accuracy for appearance details other than simply hair, age, weight and height were assessed (e.g., skin tone, eye colour and details of clothing). In addition, the victims and bystanders in these existing studies would, most likely, not have tried to work out whether they knew the perpetrator(s). However, as the pattern observed in the study presented here is only tentative, too much emphasis must not be placed upon it at this stage.

A second difference of particular interest concerns the finding that threatened victims were considerably higher in 4AFC recognition accuracy for action details than were threatened bystanders. Standard deviations were large, however, and this difference did not emerge as statistically significant. Nevertheless, this tentatively suggests that when prompted the victims were better able to remember action details, possibly because these aspects of the incident were most central to the source of personal threat. As the victims and bystanders were not differentially aroused, at first glance it would seem unlikely that this indicates a significant effect of access or retrieval of information concerning arousing events (cf. Christianson & Nilsson, 1984). However, it is possible that this difference did not emerge as significant simply because differential arousal was not evident.

Unfortunately, the small number of existing laboratory studies comparing the performance of victims and bystanders have focused exclusively on witness

descriptions of perpetrator appearance and identification accuracy. Hence, little is known about victim and bystander memory for action details. Although an archival study involving the analysis of statements provided by real victims and bystanders showed victims to report significantly more action details concerning the perpetrator than any other witness type (MacLeod, 1989), little is known about the accuracy of such descriptions due to an inability to assess what actually happened after the event. This highlights the gap in knowledge concerning real witnesses memory for action details. Indeed, this is an important issue highlighted by Yuille and Cutshall's finding that over 50% of details reported during research interviews with real witnesses were action based details (Yuille & Cutshall, 1986).Furthermore, the accuracy of action details (i.e., who did what and to whom) is central to the judicial process. Other than determining what was said, once identification has been established, the remainder of court business often focuses on the actions and intent of individuals involved in the incident. The results of a study which attempts to bridge this research gap are presented within Chapter Seven.

Whilst acknowledging that the differences discussed above are not statistically significant, it is, nevertheless, interesting to consider possible mechanisms underlying them as such little is known about the relative performance of victims and bystanders. Firstly, of course, the failure for the differences to reach statistical significance may simply be a reflection of meaninglessness. It is possible, however, that if arousal is an important factor influencing eyewitness memory, then the failure for these differences to reach statistical significance may have been because threatened victims arousal levels were not sufficiently higher than threatened bystanders to allow such memorial differences to emerge as statistically significant. Alternatively, it is possible that rather than reflecting an influence of arousal, these differences instead reflect something inherent in the differing nature of the roles or positions of the threatened victims and bystanders relative to one another (e.g., that the intruders were instructed to direct all attention to the victim in each pair). In this regard, patterns of memory performance between control victims and bystanders are particularly important. As they were not witness to an

arousing or threatening incident we would not expect to observe differences between the two unless factors directly relating to the different roles of the witnesses or instructions to the perpetrators exert an influence. Fundamentally, there were no significant differences in memory between the two. Initially, this suggests that the tentative differences observed between threatened victims and bystanders may have been due to reasons other than something inherent in their differing roles or positions. However, although not significant (standard deviations were again large), it is interesting that bystanders within the control condition appear to be higher in 4AFC recognition accuracy for central details than were control victims. Hence, the potential for the different roles of the witnesses or experimental instructions to perpetrators to exert an influence upon the witnesses' memory cannot, at this stage, be ruled out.

Alternatively, it is possible that for bystanders within the threatening condition the victim could, to a certain extent, be a competing stimulus, serving to limit the bystander's processing of information about other aspects of the stimulus incident. For example, it is possible that the bystanders may have attended to the victim in an attempt to observe his response to the accusations of the initial intruder, and thereby monitor or assess whether they should intervene. In line with this, in the control condition victims and bystanders appear to perform at a more similar level, suggesting that bystanders may not have attended to the victim to the detriment of other details or information. This might also have contributed to threatened victims tentative superior performance for appearance related details relative to threatened bystanders.

Fundamentally, all of the explanations given above are purely speculative as the differences discussed did not emerge as statistically significant. The number of threatened victims and bystanders in each sample where quite small and it is possible that, as a result, these differences were not able to emerge as significant.

5.2.3.2 Correlation of arousal and memory

Although a difference in arousal level between threatened victims and bystanders was not successfully manipulated and there were no significant differences in memory performance between the two, it is possible that individual differences may have played a significant part in the effect the manipulation had upon the participants. Therefore, in addition to considering the group based performance of threatened victims and bystanders, the way in which arousal and memory performance interacted was investigated by correlating physiological arousal, both during and after the incident, as well as perceived threat and perceived chance of attack during the incident, with the various measures of memory performance. Such consideration is important as it may throw much needed light on the relationship between arousal and eyewitness memory.

Although it was hypothesised that threatened witnesses would be concerned with their personal safety and, as result be more motivated to try to understand what was going on, the finding of no significant relationships between rated threat or perceived chance of attack and the various measures of memory performance suggests that psychological arousal is not directly related to memory performance. This finding contrasts with existing studies of personally involved witnesses. An autobiographical memory study, in which participants were asked to describe their individual most traumatic memory and rate the affect associated with the original incident, found participants' rated emotion to be significantly positively correlated with the number of central details that the participants believed themselves to remember (Christianson & Loftus, 1990). Furthermore, an archival study of victims and bystanders to bank robberies (Christianson & Hubinette, 1993) found a significant positive correlation between rated original emotion and memory for circumstances surrounding the robberies (e.g., time of day, number of customers, and day of the week), although not for specific robbery details (e.g., number of robbers, robber's weapon, and who collected the money). However, their use of retrospective self-report measures to assess original emotion, often experienced several years prior to the actual research, is questionable and may account for the discrepancy between findings (Wright et, al., 1997).

Caution should, however, be exercised in interpreting the finding of the present study to suggest that psychological arousal is not directly related to memory performance as it remains possible that the failure for significant correlations to emerge may relate to the fact that self-ratings based on Likert-type scales are not necessarily as reliable or valid as they are often interpreted to be, especially when used with small sample sizes (Wright et al., 1997). This is, of course, a possible problem already mentioned regarding the absence of correlations between the physiological and psychological arousal measures.

In terms of physiological arousal, however, the finding that as heart rate during the incident increased the percentage of available peripheral details recalled increased, suggests that physiological arousal either directly influences memory in some way or that it may be a parallel indicator of other activity.

Taking the first explanation, if it is the case that physiological arousal facilitates memory (e.g., directly facilitates memory storage; Gold, 1992), then it would be expected that memory for other details, such as central or action related details, would also be found to correlate with physiological arousal. As this was not the case, however, it would seem that physiological arousal may not facilitate memory. Indeed, existing research suggests that physiological arousal does not play a part in mediating the effects of emotion on memory (Christianson et al., 1996; Christianson & Mjorndal, 1985).

Rather than having a direct influence, then, perhaps physiological arousal is a parallel indicator of other activity. Hockey (1997) states that an increase in physiological arousal may be a cost associated with goal maintenance. Hence, if witnesses' personal safety is threatened, in monitoring threat levels and chances of attack their attentional breadth may increase to take in peripheral details, but at the expense of an increase in physiological arousal. Thus, physiological arousal might act as a parallel indicator of such activity. If this were the case, however, the question arises as to why perceived threat and perceived chance of attack (likely

indicators of perceived risk to personal safety) were not found to be correlated with memory in some way. It is possible that the problem of using Likert-type scales to measure psychological processes may underpin this.

The finding that as heart rate during the incident increased so the percentage of available peripheral details increased, is also particularly interesting as it contrasts with existing laboratory based research which suggests that increases in arousal result in a trade-off in terms of memory for peripheral details (e.g., Burke et al., 1992; Christianson, 1984; Christianson & Loftus, 1987; Christianson & Loftus, 1991; Heuer et al., 1997; Kebeck & Lohaus, 1986). Most of these studies have, however, considered group performance across different incidents rather than correlation within the same incident. And, perhaps more importantly, the physiological response demonstrated by participants in existing laboratory studies has been a drop in heart rate, characteristic of an orienting response rather than an elevation in heart rate characteristic of the fight or flight response most likely experienced by real witnesses and demonstrated by the personally involved participants in the study presented here. This supports the suggestion that visually-induced arousal, which tends to result in an orienting response, may have different effects upon memory than arousal induced through personal involvement with a threatening stimulus. How, then, do the results of the study presented here compare with existing studies of participants that have been personally involved with the target incident?

Unfortunately, there appear to be no existing published studies which have manipulated personal involvement and attempted to correlate physiological arousal with memory performance for central or peripheral detail information. The only other study to manipulate personal involvement and investigate the correlation between physiological arousal and memory performance solely considered identification accuracy (Hosch & Bothwell, 1990). They found that as physiological arousal increased, identification accuracy decreased. In contrast, however, the study presented here did not find a relationship between physiological arousal and identification accuracy. However, in Hosch &

Bothwell's study, victims and bystanders were not actually witness to the same incident. Specifically, the bystander witnessed a calculator theft whilst the victim witnessed the theft of her own purse. Hence, it is possible that there may have been something qualitatively different about the two incidents which affected memory rather than differences in arousal per se. For example, witnesses lower in arousal were more likely to be bystanders and there may have been something qualitatively different about the incident they experienced which made it less likely that they would accurately identify the perpetrator.

Furthermore, although unable to consider the relationship between actual physiological arousal and memory performance, Sporer (1992) found an almost linear increase in the number of descriptive details reported as a function of the level of stress experienced by a witness when he conducted an archival analysis of 139 person descriptions from cases of robbery and rape. Level of stress was evaluated by classifying incidents on the basis of witnesses' self-reported anxiety in conjunction with weapon presence and injury occurrence. Only half of the witnesses actually witnessed the incident, however, with the remainder interacting with the perpetrator either just before or after the incident occurred. Consequently, it is possible that those witnesses who interacted with the perpetrator but did not actually witness the incident may have experienced lower levels of stress and attended to the perpetrator to a lesser extent than did those who had actually witnessed the incident.

Fundamentally, however, there is one basic concern regarding the present study which centres around the size of the samples employed. Specifically, it is possible that the sample sizes ($n = 14$ for physiological arousal relationships and $n = 20$ for psychological arousal relationships) were not sufficiently large enough to allow relationships to fully emerge. Indeed, 18 significant correlation coefficients were obtained but the scatterplots were not indicative of real relationships. Had the sample sizes been bigger, it is possible that robust relationships may have emerged.

5.2.3.3 Threat versus control group performance

Although differential arousal between the threat and control groups was demonstrated, the fact that they were viewing different incidents is a confounding variable. Hence, it cannot be ruled out that any differences in memory between these two groups may not be a function of a difference in physiological arousal or perceived threat per se, but may be a function of other factors associated with the differing nature of the incidents exerting an influence on the performance of one group relative to the other (e.g., differential interest or unusualness; the results of a study investigating this possibility are presented within Chapter Six). Nevertheless, at this stage any differences are worthy of note as they may be indicative of the effects of physiological arousal or perceived threat upon memory.

With this in mind, it was predicted that witnesses within the threatening condition would be concerned with their personal safety. As a result, similar to the relative performance of threatened victims and bystanders, they would be more motivated than witnesses within the control condition to try to understand what was going on and, therefore, scan or monitor the situation such that they would demonstrate enhanced memory for centrally-related details (e.g., the source of the personal threat, such as physical actions or verbalisations related to the chances of attack), without the associated trade-off for more peripherally-related details (e.g., appearance-related details or verbalisations unrelated to the chances of attack) typically found within laboratory studies of visually-induced arousal (e.g., Burke et al., 1992; Christianson & Loftus, 1987; Christianson & Loftus, 1991).

In line with this, witnesses within the threatening condition recalled a higher percentage of available action details in total than did witnesses in the control condition, although they did not demonstrate higher recall accuracy for the details. Furthermore, witnesses within the threatening condition were higher in 2AFC, but not 4AFC, recognition accuracy for action detail questions than were control witnesses. This suggests that the aroused witnesses may have attended to and elaborated on action details to a greater extent, most likely as they would have been the primary source of perceived threat. Based on the differing nature of the

two incidents, however, it remains possible that such details may have been more salient within the threatening condition, even though the incidents were matched, as far as possible, for all details.

When central details are considered, however, the only difference to emerge concerned 2AFC questions, with threatened witnesses demonstrating higher recognition accuracy than control witnesses. In this case, however, the central detail grouping happened to be the same as the action detail grouping as there were no 2AFC verbal questions, so this difference is a reflection of memory for action details rather than central details per se.

Hence, there were no central or peripheral detail differences between witnesses within the threatening and control groups. This suggests that, depending on the precise nature of the incident, it may specifically be actions rather than central details as a whole, that witnesses to emotional or arousing material demonstrate superior memory for. Unfortunately, existing research has often used static stimuli which do not demonstrate actions so readily, and has tended not to make the distinction between action details and other information, instead focusing on only a central versus peripheral detail distinction (Christianson & Loftus, 1987; Christianson, & Loftus, 1991; Heuer & Reisberg, 1990; Safer et. al., 1998).

Further possible support for an influence of threat or arousal upon eyewitness memory also comes *a posteriori* from a non-significant difference. In particular, despite a significant interaction between incident and intruder types for cued and total recall accuracy, post hoc tests failed to reveal any differences between or within the groups, possibly because of a lack of statistical power associated with the sample size. However, it appears that the threat group were higher in recall accuracy for details pertaining to intruder 2 for both cued and total recall. This was not necessarily as expected based upon the prediction that the threatened witnesses would attend to the source of the threat, which in this case it was presumed would primarily relate to intruder 1. On reflection, however, it is possible that witnesses within the threatening condition attended to intruder 2 to a greater extent than did

witnesses within the control condition as he was directly related to the threatening nature of the incident. For example, as intruder 2 came into the room to try and remove intruder 1, he may initially have been perceived as an additional aggressor. Subsequently, however, it may have become apparent that he was actually present in order to placate his friend and remove him from the room. Hence, enhanced memory for intruder 2 may have resulted from the fact that his success at persuading his friend to leave the room was inextricably linked to the removal of the immediate source of perceived threat. In line with the proposition that threatened witnesses would make continuous mental assessments of whether and to what extent their personal safety is still threatened, this aspect of the involvement of intruder 2 might well have been monitored. As post hoc tests failed to reveal the location of the significant interaction, however, these possible explanations are purely speculative.

5.2.3.4 Memory for peripheral details

Importantly, although it has been shown that threatened witnesses demonstrated superior memory for action details in comparison to control witnesses, it was predicted that such enhanced performance would not be associated with the typically observed laboratory study trade-off in terms of memory for more peripherally-related details. Indeed, in contrast with laboratory studies of visually-induced arousal (e.g., Christianson & Loftus, 1991; Kebeck & Lohaus, 1986), memory for action details does not appear to have occurred at the expense of more peripherally related details. In particular, although witnesses within the threatening condition recalled a higher percentage of available action details, this superior memory was not associated with a reduced recall accuracy or recall for the percentage of available verbal or appearance details relative to the control witnesses. Interestingly, however, for free recall accuracy threatened witnesses just missed being significantly lower in accuracy for peripheral details than were control witnesses, although for cued and total recall the difference disappears.

In addition, the finding of a significant correlation suggesting that as heart rate during the incident increased so too did the percentage of available peripheral

details recalled, further suggests that the influence of arousal upon memory for peripheral detail information may not be detrimental.

In summary, these results do seem to suggest that, unlike the findings of existing laboratory studies of visually-induced arousal, which have tended to suggest that enhanced memory for central details is associated with a memorial trade-off for more peripheral details (e.g., Burke et al., 1992; Christianson & Loftus, 1987; 1991; Heuer et al., 1997; Safer et al., 1998), when witnesses are personally involved this may not be the case. As mentioned previously, however, it cannot be ruled out that any differences in memory between these two groups may not be a function of the difference in physiological arousal or perceived threat between them, but may be a function of other factors associated with the nature of the incident itself exerting an influence on the performance of one group relative to the other.

5.2.3.5 Conclusions

The failure to manipulate a difference in arousal level between threatened victims and bystanders within the same condition, may account for the lack of significant memory difference between the two. Some interesting non-significant differences suggest that, had the initial manipulation revealed a significant difference in arousal between the threatened victims and bystanders, memory differences may have been observed. In particular, the results tentatively suggest that relative to threatened bystanders, threatened victims may have spent more time attending to, or processing, appearance details for intruder 1 and that, when prompted, they were also better able to remember action details, possibly because these aspects of the incident were most central to the source of personal threat.

In terms of the relationship between arousal and memory, perceived threat and perceived chance of attack were not found to be correlated with any of the memory measures. On this basis, whilst it was predicted that when witnesses are personally involved and their personal goals (e.g., personal safety) are threatened, they may be more motivated to understand what is going on and may therefore

engage in continuous scanning and/or enhanced elaborative processing, the absence of significant correlations suggests that this may not be the case.

As physiological arousal rose, however, so too did the percentage of available peripheral details recalled suggesting that physiological arousal rather than psychological arousal may influence memory. However, this does not explain why other details, such as central or action related details, were not found to correlate with physiological arousal and suggests that rather than directly influencing memory, physiological arousal may instead be a parallel indicator of other activity or a cost associated with goal maintenance (Hockey, 1997).Specifically, whilst Hockey (1997) argues that through an active process of cognitive resource management individuals may choose to protect their performance, he also states that this may occur at the expense of physiological arousal. Hence, in line with Christianson et al., 1996 and Christianson & Mjorndal, 1985, physiological arousal may not play a direct part in mediating the effects of emotion upon memory, but may instead be a cost associated with goal maintenance.

In comparison to witnesses within the control condition, witnesses within the threatening condition demonstrated superior memory for actions and, importantly, they did not demonstrate an associated trade off in terms of memory for more peripheral information. Hence, in line with Hockey's framework (Hockey, 1997), it is argued that the decrement in performance for peripheral details typically identified in laboratory studies of visually-induced arousal may not necessarily be a function of a reduced resource capacity, as previously advocated (Easterbrook, 1959), but a function of the fact that witnesses to visually-arousing stimuli are not personally involved and therefore do not experience changing demands which result in sufficient motivation to re-allocate cognitive resources in order to protect personal goals (Hockey, 1997). It is possible that as the witnesses in the laboratory study presented here were personally involved with the target incident, their motivation to protect personal goals was sufficient to result in memory performance more similar to real witnesses who are also personally involved. Critically, previous laboratory-based research has almost exclusively studied

witnesses detached from the target incident or stimuli and hence, has largely ignored the role of motivation in mediating the effects of emotion upon memory.

Fundamentally, however, based on this study alone we cannot know whether the observed differences between the threatening and control conditions were due to differential arousal levels rather than simply the fact that the two groups experienced incidents of a differing interest level or perceived unusualness (Christianson & Loftus, 1991; Mitchell et al., 1998).

Hence, in light of the findings of this study, a second study was conducted which was specifically designed to take into account the factors that may have led to the bystanders within the threatening condition being as aroused as the threatened victims. Specifically, the aim of the second study was to produce a difference in physiological and psychological arousal levels between threatened victims and bystanders in the same condition and therefore enable direct investigation of memory differences within the same treatment group rather than between different treatment groups.

The design aimed to reduce the bystanders' feelings of being in the way by making them more detached from the incident. Hence, the victims and bystanders within each pair were seated further apart and the laboratory used was much larger than in Study One. In addition, to further maximise the chances that any effects would manifest themselves, especially between threatened victims and bystanders within the same condition, the sample sizes were increased. The content of the incidents themselves, however, did not change.

On the basis of the results of Study One, then, it is predicted that if physiological and psychological arousal are successfully manipulated, and are important factors in mediating the effects of emotion upon memory, we might expect to see the interesting non-significant differences observed between the threatened victims and bystanders in this study emerge as significant. Specifically, enhanced memory for appearance and action details would be manifest without detriment to memory

for more peripherally-related details. In addition, we would expect to see differences between threatened victims and bystanders in a similar manner to those observed between the differentially aroused threatening and control conditions of this study (if the differences were due to arousal rather than an inherent difference between the two incidents). In terms of the threatening and control conditions, it is expected that the pattern of memory performance would be in line with the differences observed between the threatening and control conditions in this study.

5.3 Laboratory Study 2

5.3.1 Method

5.3.1.1 Participants

A total of 64 male undergraduate students (aged 17 - 25 years) from the University of St. Andrews participated in pairs (32 victim witnesses and 32 bystander witnesses). Participants were paid £3.50 each. As with the first study, participants were naive to the true purpose of the study. Informed consent, for the disclosed aspects of the study, was obtained from each participant prior to the study during which they were informed of their ability to terminate their involvement at any point whilst still being paid. None did so.

5.3.1.2 Design

A 2 (threatening or control condition) x 2 (victim or bystander witness) between participants design was employed.

5.3.1.3 Apparatus

Measurements of heart rate were recorded continuously during the study as a physiological correlate of the emotional arousal of the participants in each condition. Measurements were taken using Polar Heart Rate Monitors consisting of an electrode belt, worn around the chest below the pectoral muscles with 0.05

molar NaCl electrode gel, and a recording watch worn around the participant's wrist. Raw recording figures (taken each 5 seconds) were used for analysis.

5.3.1.4 Procedure

The procedure was based upon that employed for Study One. The critical difference, however, was that the victim and bystander witnesses within each participant pair were seated approximately 3 metres apart in order to ensure that the bystander would feel less involved than experienced by those in Study One where they had been seated only 1 metre apart. Once again, the victim's desk was located immediately in view of the laboratory entrance (see Figure 16).

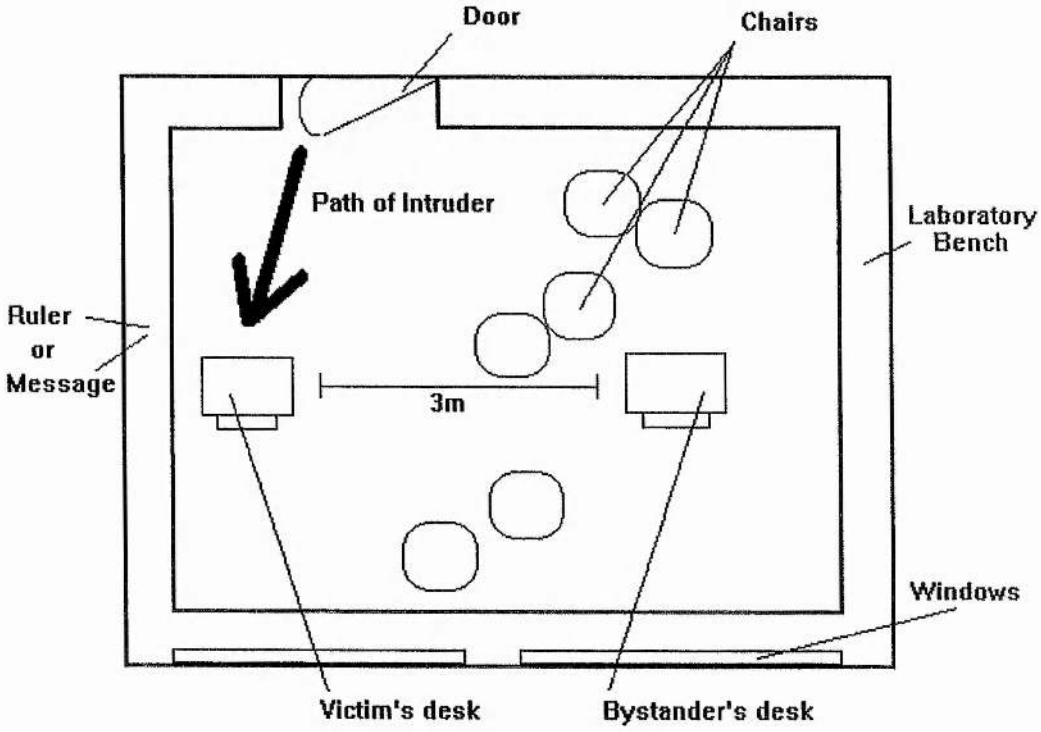

Figure 16: Layout of laboratory during Study Two.

Participants completed the same self-report measures prior to the incident. The content of both the threatening and control conditions was also maintained across studies, with the only change being the use of two new confederate actors. Following the incident and completion of the MacKay Mood Adjective Checklist,

as a retrospective measure of their self-reported arousal during the interaction, participants completed the initial free and cued recall test as detailed in the method for Study One. In terms of the recognition test, however, the questionnaire used for this study contained only four-alternative forced-choice questions. It was decided to drop the 2AFC questions from this study due to the high probability of guessing correctly for these questions in comparison to the 4AFC questions which, therefore, enable the assessment of recognition memory in a manner less influenced by the probability of guessing correctly (see Appendices 6 and 7 for full details of the recognition questionnaires). Finally, participants were shown sequential lineups rather than simultaneous lineups as used in Study One. This decision was made on the basis that sequential presentation of lineups can reduce false identifications by reducing participants' reliance on relative-judgement processes without, importantly, having a detrimental effect upon correct identifications (Cutler & Penrod, 1988; Lindsay et al., 1991; Lindsay & Wells, 1985; Sporer, 1993). As this study was conducted using two new confederate actors, new lineups were constructed following the recommendations for properly conducted sequential lineups (Koehnken et al., 1996; Lindsay et al., 1991; Wells et al., 1994) and the photographs were pilot tested in the same manner as Study One. Once again, although a Chi-square test would have been an appropriate test to analyse this data, the sample size used to pilot the lineups was in fact too small to be reliable. In particular, more than twenty percent of the cells within the contingency table have an expected frequency of less than five (Dowdy & Wearden, 1991; Howell, 1992). Despite this, for the five pilot participants the real intruder was picked no more frequently than the other males pictured. After completion of all tests subjects were thoroughly debriefed and sworn to secrecy. The recall scoring procedure employed was identical to that described in the method section for Study One.

5.3.1.5 Manipulation checks

Figure 17 shows the mean baseline heart rate (averaged over 2 minutes immediately preceding the incident) and the progression of mean heart rates during and immediately following the incident (both 30 second periods). Unlike

Study One, where some data was lost during recording, in this study physiological data was available for all 64 participants. Interestingly, an analysis of covariance (with baseline as the covariate) revealed that during the incident, witnesses in the threatening condition were not significantly more aroused than those in the control condition. This may be explained by considering the progression of heart rates. As can be seen from Figure 17, it appears that during the incident the threatened victims' heart rate is rapidly rising but does not reach its peak elevation until after the incident occurred. In line with this, immediately following the incident, witnesses in the threatening condition were significantly more aroused than were witnesses in the control incident ($F(1, 59) = 20.51$, $p < 0.001$; all statistical output for this study is shown in Appendix 10). More importantly, however, unlike Study One, an interaction of incident by witness was obtained both during ($F(1,59) = 4.17$, $p < 0.05$) and after ($F(1,59) = 15.5$, $p < 0.001$) the incident. Post-hoc Tukeys tests, conducted using standardized residual values of the heart rate data, in order to take account of baseline variation of participants' resting heart rate levels, revealed that both during and after the incident threatened victims were significantly more aroused than were bystanders within the same condition ($p < 0.01$ and $p < 0.001$, respectively). There were no significant differences between control victims and control bystanders.

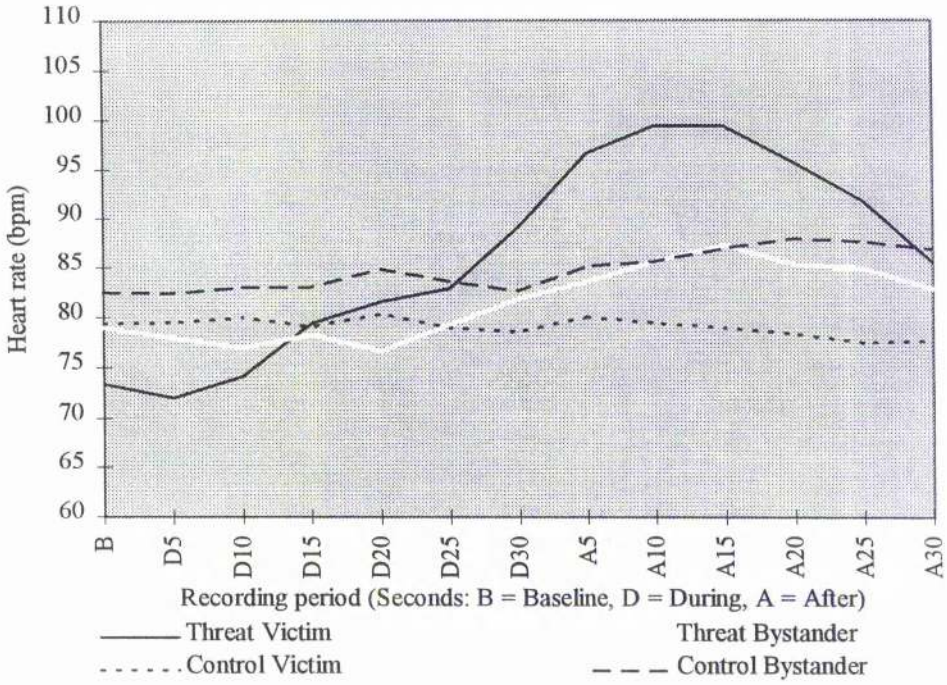

Figure 17: Mean heart rate progression during and after the incident.

As with Study One, an ANOVA conducted on the self-report data revealed, as expected, no differences in state arousal (STAI, form Y-1) between any of the witness groups before the incident occurred. During the incident, in contrast to the physiological results of this study, threatened witnesses rated themselves on the MacKay Mood Adjective Checklist as being significantly more stressed than did control witnesses ($F(1,60) = 67.97$, $p < 0.001$). Whilst on the arousal scale, threatened witnesses just missed rating themselves as more aroused during the incident than did the control group ($p = 0.057$). Interestingly, there were no differences between the victims and bystanders within the threatening condition despite their difference in physiological arousal (see Table 14).

	State Arousal (STAI, Y-1)	Arousal During (Mackay Arousal Scale)	Stress During (Mackay Stress Scale)
Threat Victims	39.44 (10.64)	4.75 (1.24)	5.13 (1.36)
Threat Bystanders	36.50 (7.92)	4.25 (2.35)	4.25 (2.02)
Threat Total	37.97 (9.34)	4.50 (1.87)	4.69 (1.75)
Control Victims	34.75 (8.00)	3.94 (1.81)	1.31 (1.66)
Control Bystanders	35.31 (7.48)	3.25 (1.91)	1.13 (1.63)
Control Total	35.03 (7.62)	3.59 (1.86)	1.21 (1.62)

Table 14: Mean (SD) STAI and Mackay Mood Adjective Checklist scores.

ANOVAs conducted on the data from the seven 6-point self-rating scales regarding specific emotional responses (see Table 15) revealed that, despite no difference in physiological arousal, threatened witnesses rated themselves as: more threatened during the incident ($F(1,60) = 24.15$, $p < 0.001$); more likely to be attacked during the incident ($F(1,60) = 26.90$, $p < 0.001$); and more afraid during the incident ($F(1,60) = 37.53$, $p < 0.001$) than were control witnesses. In line with the physiological results, however, threatened witnesses did not rate themselves as more angry during the incident than did control witnesses. Immediately following the incident, in line with the observed difference in physiological arousal, threatened witnesses rated themselves as more afraid ($F(1,60) = 5.77$, $p < 0.05$), although they did not rate themselves as more threatened or more angry than control witnesses.

Interactions between incident type and witness type were also obtained for perceived threat during the incident ($F(1,60) = 8.36$, $p < 0.01$; see Figure 17) and perceived likelihood of being attacked ($F(1,60) = 11.55$, $p < 0.005$; see Figure 18). In line with the physiological results, post-hoc Tukey tests revealed that threatened victims rated themselves as more threatened during the incident and more likely to be attacked during the incident than were bystanders in the same condition ($p < 0.001$), although they did not rate themselves to be more afraid or more angry during the incident.

	Threat during	Threat following	Chance of attack during	Angry during	Angry following	Afraid during	Afraid following
Threat Victims	3.38 (0.72)	1.88 (1.31)	2.56 (1.03)	1.81 (1.17)	2.13 (1.50)	2.63 (0.81)	1.75 (1.34)
Threat Bystanders	1.88 (0.89)	1.63 (0.89)	1.50 (0.73)	1.56 (0.73)	1.56 (0.89)	2.06 (0.85)	1.44 (0.81)
Threat Total	2.63 (1.10)	1.75 (1.11)	2.03 (1.03)	1.69 (0.97)	1.84 (1.25)	2.34 (0.87)	1.59 (1.10)
Control Victims	1.69 (1.14)	1.19 (0.40)	1.06 (0.25)	1.56 (0.89)	1.38 (0.62)	1.38 (0.62)	1.06 (0.25)
Control Bystanders	1.44 (0.63)	1.50 (0.82)	1.19 (0.54)	1.88 (1.15)	1.69 (0.87)	1.19 (0.40)	1.13 (0.50)
Control Total	1.56 (0.91)	1.34 (0.65)	1.13 (0.42)	1.72 (1.02)	1.53 (0.76)	1.28 (0.52)	1.09 (0.39)

Table 15: Mean (SD) ratings of emotional responses (6-point scale: 1 = not at all/ 6 = extremely)

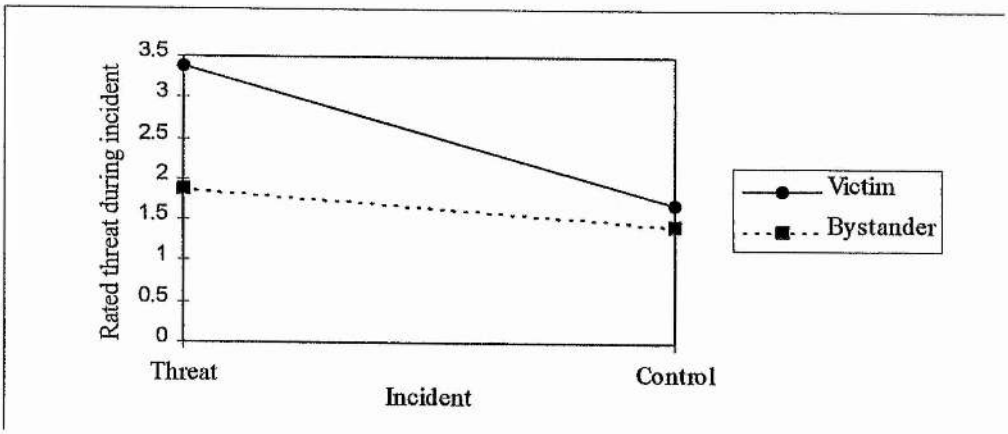

Figure 17: Mean rated perceived threat during the incident as a function of incident and witness type.

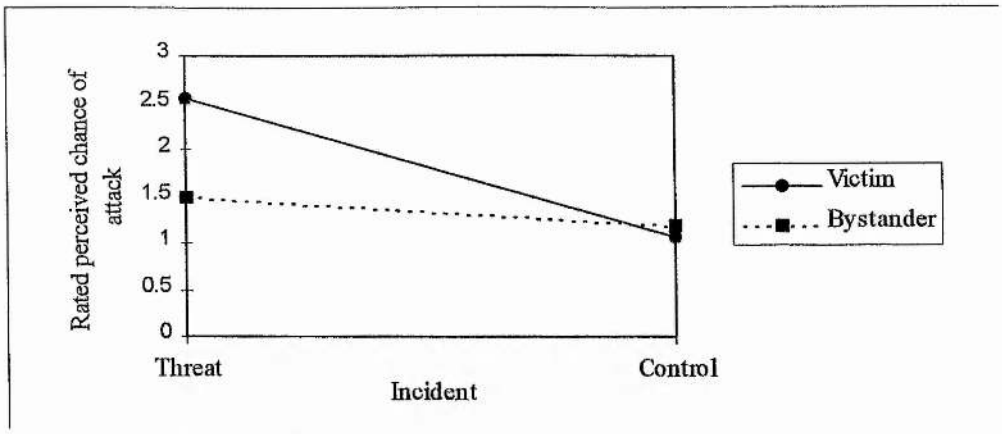

Figure 18: Mean rated perceived chance of attack during the incident as a function of incident and witness type.

Correlations were conducted across the threat group witnesses to see whether physiological arousal was correlated with the measures of perceived threat during the incident and the extent to which witnesses perceived they would be attacked during the incident. Standardized residual values of the heart rate data were used in order to account for baseline variation of participants' resting heart rate levels. Analyses across the witnesses within the threat group ($n = 32$) showed significant positive Spearman correlations between level of physiological arousal during the incident and the extent to which witnesses rated themselves as threatened during the incident ($r = .553$, $p < 0.005$), and their perceived possibility of attack during the incident ($r = .396$, $p < 0.05$). In addition, physiological arousal immediately after the incident was positively correlated with the extent to which witnesses rated themselves threatened during the incident ($r = .578$, $p < 0.005$), and their perceived possibility of attack during the incident ($r = .366$, $p < 0.05$). Inspection of the scatterplots associated with these correlations (see Appendix 10), however, suggests that they cannot be accepted as demonstrative of real relationships.

5.3.2 Results

5.3.2.1 Percentage of available details recalled

Unlike Study One, from Table 16 it can be seen that in terms of free and total recall the threat group reported a higher percentage of available details than the

control group ($F(1,60) = 4.67$, $p < 0.05$, and $F(1,60) = 5.38$, $p < 0.05$, respectively).

As with Study One, more detailed classification and analysis, according to whether the details were centrally or peripherally related were conducted but revealed no significant effects or interactions. Furthermore, no significant differences were revealed when the details were classified according to whether they pertained to intruder 1 or to intruder 2.

	Free Recall	Cued Recall	Total Recall
Threat Victims	12.61 (4.49)	10.79 (2.93)	23.40 (5.16)
Threat Bystanders	10.87 (4.02)	11.37 (4.87)	22.24 (4.95)
Threat Total	11.74 (4.28)	11.08 (3.97)	22.82 (5.01)
Control Victims	11.03 (5.48)	10.99 (4.46)	22.02 (7.19)
Control Bystanders	7.83 (2.60)	9.05 (4.27)	16.88 (5.68)
Control Total	9.43 (4.52)	10.02 (4.41)	19.45 (6.89)

Table 16: Mean (SD) percentage of available details recalled.

However, classification according to whether the details were action, appearance or verbally related, revealed significant interactions of incident by information type for; free recall ($F(2,120) = 3.22$, $p < 0.05$; see Figure 19), cued recall ($F(2,120) = 3.07$, $p = 0.05$; see Figure 20) and, hence, total recall ($F(2,120) = 8.21$, $p < 0.001$; see Figure 21). Post-hoc Tukey tests revealed that the threat group's free and total recall contained a higher percentage of available action details than the control group's ($p < 0.001$ and $p < 0.05$, respectively), see Table 17. For cued recall, however, differences only emerged within the incident groups.

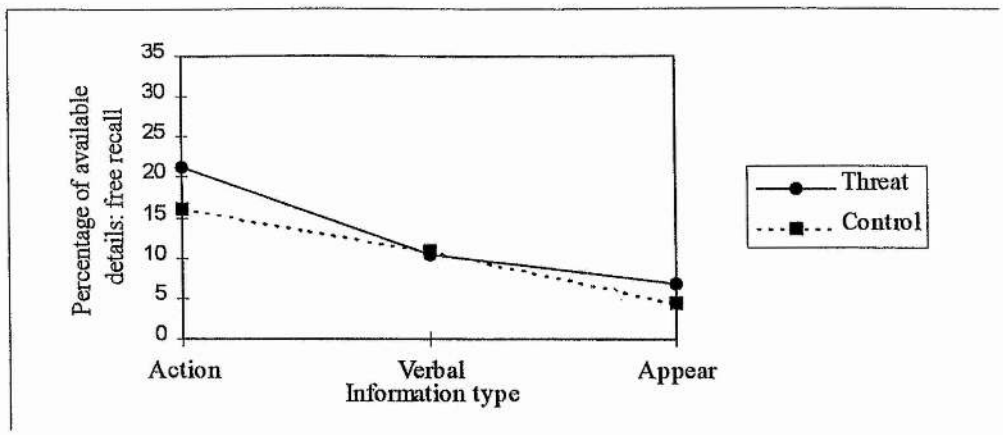

Figure 19: Mean percentage of available details free recalled as a function of information and incident type.

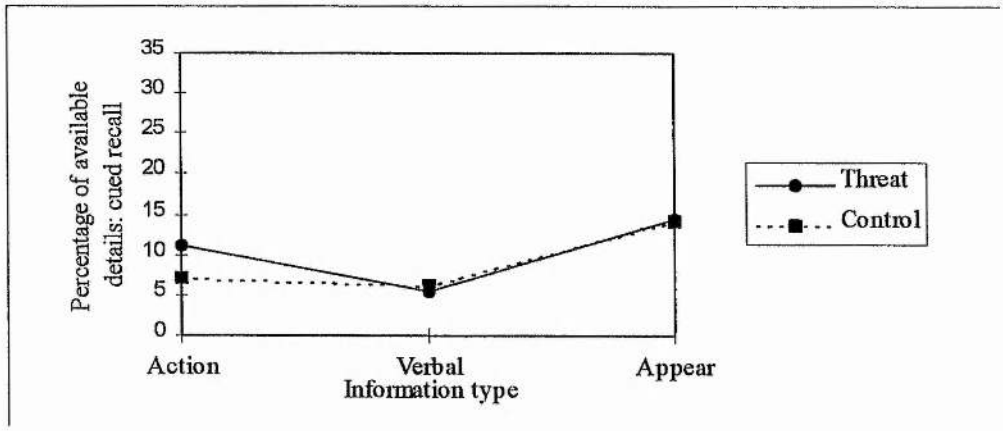

Figure 20: Mean percentage of available details cue recalled as a function of information and incident type.

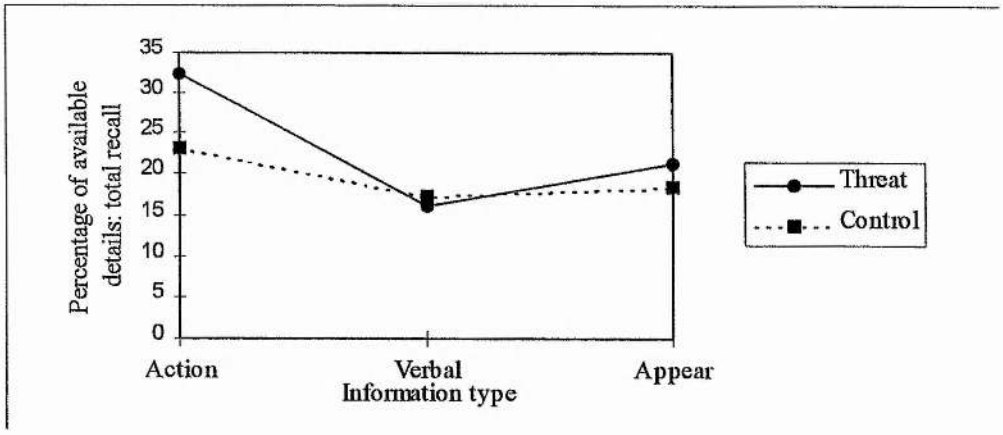

Figure 21: Mean percentage of available details recalled in total as a function of information and incident type.

	Information Type	Free Recall	Cued Recall	Total Recall
Threat	Action	21.20 (8.85)	11.21 (7.83)	32.40 (9.88)
	Verbal	10.48 (4.98)	5.53 (4.48)	16.02 (5.09)
	Appearance	6.93 (6.91)	14.42 (5.99)	21.35 (7.40)
Control	Action	16.08 (7.14)	7.10 (7.19)	23.18 (10.69)
	Verbal	10.94 (4.82)	6.25 (4.67)	17.19 (7.33)
	Appearance	4.41 (6.24)	14.14 (6.80)	18.55 (8.79)

Table 17: Mean (SD) percentage of available action, verbal and appearance details recalled.

To further analyse whether physiological arousal may have had an impact on the percentage of available details reported, Pearson Product-Moment correlations were conducted across the 32 threat group witnesses. Again, to take account of baseline heart rate levels standardized residual values of the heart rate data were used. Although in Study One both the correlation coefficient and the scatterplot were suggestive of a significant positive relationship between heart rate during the incident and the percentage of available peripheral details reported in total, in this study, even with a larger sample size, none of the correlation coefficients proved to be significant.

Spearman correlations of perceived threat and perceived likelihood of attack during the incident with percentage of available details recalled, however, revealed that as rated perceived threat during the incident rose so the percentage of available details free recalled pertaining to intruder 2 also rose ($r = .397$, $p < 0.05$). Furthermore, as the extent to which the threat group witnesses perceived they might be attacked increased so did: free recall overall ($r = .382$, $p < 0.05$); free recall pertaining to peripheral details ($r = .451$, $p < 0.05$); free recall pertaining to intruder 1 ($r = .394$, $p < 0.05$); free recall pertaining to appearance related details ($r = .422$, $p < 0.05$); total recall overall ($r = .356$, $p < 0.05$) and total recall pertaining to intruder 2 ($r = .380$, $p < 0.05$). Inspection of the scatterplots for all of

these correlations (see Appendix 10), however, suggests that they cannot be accepted as representative of real relationships.

5.3.2.2 Accuracy of recall

Accuracy scores were calculated in the same way as for Study One. Table 18 shows the overall accuracy scores for free recall, cued recall and total recall. As with Study One, there were no significant differences between witness groups for free, cued or total recall.

	Free Recall	Cued Recall	Total Recall
Threat Victims	92.02 (6.58)	74.82 (9.11)	83.69 (4.97)
Threat Bystanders	93.16 (6.63)	73.68 (10.76)	83.22 (7.11)
Threat Total	92.59 (6.52)	74.25 (9.83)	83.45 (6.04)
Control Victims	88.57 (9.56)	76.00 (7.47)	82.50 (5.99)
Control Bystanders	89.26 (8.78)	76.99 (15.54)	82.53 (9.65)
Control Total	88.91 (9.03)	76.50 (12.00)	82.51 (7.90)

Table 18: Mean (SD) percentage free, cued and total recall accuracy.

However, when the data were classified according to whether they related to central or peripheral details, an interaction between incident and type of information recalled was obtained for free recall accuracy ($F(1,44) = 16.70$, $p < 0.001$; see Figure 22). Post-hoc Tukey's analysis revealed that whilst there were no differences between the groups in terms of accuracy for centrally-related details, witnesses in the control group were significantly less accurate in their free recall of peripheral details (Mean = 60.64, SD = 31.76) than were witnesses in the threat group (Mean = 86.92, SD = 11.31, $p < 0.001$).

In addition, a three-way interaction of incident type with witness type and type of information was obtained for free recall ($F(1,44) = 4.54$, $p < 0.05$; see Figure 23). Post-hoc Tukeys analysis revealed that control victims were more accurate for peripheral details (Mean = 72.91, SD = 22.41) than were control bystanders (Mean

= 48.37, SD = 35.84), $p < 0.01$. There were no differences between threat victims and threat bystanders.

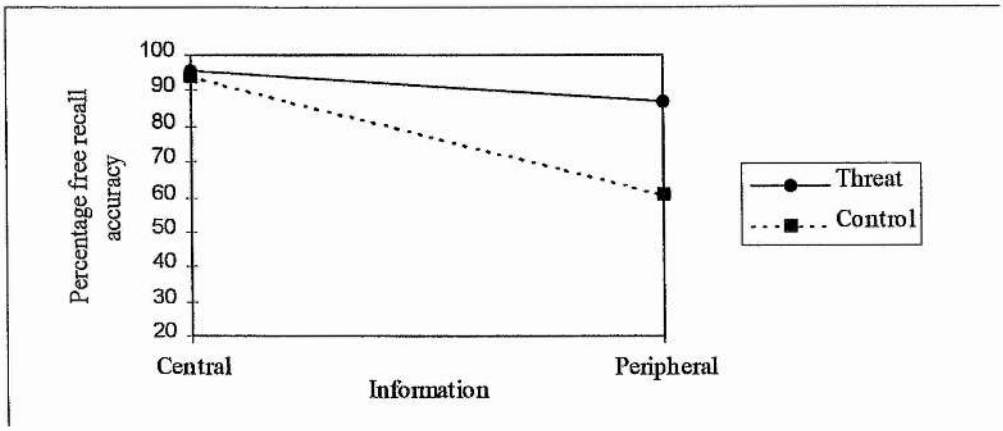

Figure 22: Mean percentage free recall accuracy as a function of information and incident type.

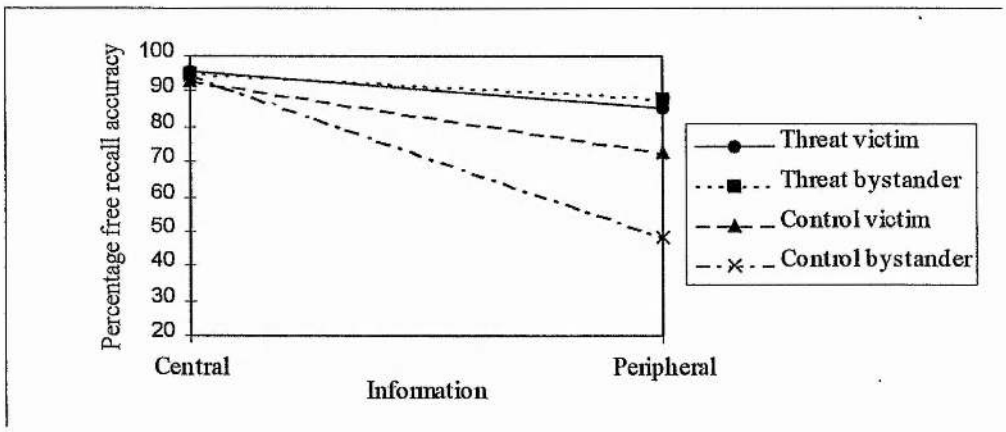

Figure 23: Mean percentage free recall accuracy as a function of information, incident and witness type.

Additional classification and analysis, according to whether the details reported pertained to intruder 1 or 2 revealed no significant differences. Furthermore, classification according to whether the details reported pertained to action, verbal or appearance related details also revealed no significant differences between the witness groups.

Once again, to analyse whether physiological arousal may have had an impact on recall accuracy, Pearson Product-Moment correlations were conducted across the 32 threatening condition witnesses, using standardized residual values of the heart rate data in order to take account of baseline heart rate levels. However, as with Study One, no significant correlations were revealed.

Spearman correlations (again across the 32 threat group witnesses) of perceived threat and perceived likelihood of attack during the incident with recall accuracy, however, suggested that as rated perceived chance of attack during the incident rose so too did: overall free recall accuracy ($r = .436$, $p < 0.05$); free recall accuracy for intruder 2 details ($r = .398$, $p < 0.05$); and cued recall accuracy for intruder 2 details ($r = .368$, $p < 0.05$). Inspection of the associated scatterplots (see Appendix 10), however, suggests that none can be accepted as representative of real relationships.

5.3.2.3 Recognition accuracy

The recognition questionnaires for both conditions consisted of 43 questions, all of which were four-alternative forced choice. As with Study One, recognition accuracy was calculated as the percentage of questions accurately answered. ANOVA revealed that threatened witnesses were more accurate for recognition questions overall (Mean = 56.76, SD = 8.18) than were control witnesses (Mean = 46.29, SD = 7.57), $F(1,60) = 27.74$, $p < 0.001$.

Once again, the data were grouped according to whether the questions concerned central or peripheral detail information (see Table 19). ANOVA conducted on the data classified in this manner revealed an interaction of incident by information type ($F(1,60) = 15.71$, $p < 0.001$; see Figure 24). Post-hoc Tukey tests indicated that threatened witnesses were more accurate than control witnesses on central detail questions ($p < 0.001$).

	Central	Peripheral
Threat Victims	65.63 (14.43)	52.55 (6.38)
Threat Bystanders	59.77 (10.94)	53.94 (13.18)
Threat Total	62.70 (12.94)	53.24 (10.21)
Control Victims	43.33 (14.61)	45.98 (9.92)
Control Bystander	41.25 (11.98)	50.89 (7.43)
Control Total	42.29 (13.18)	48.44 (8.98)

Table 19: Mean (SD) percentage accuracy for central and peripheral recognition questions.

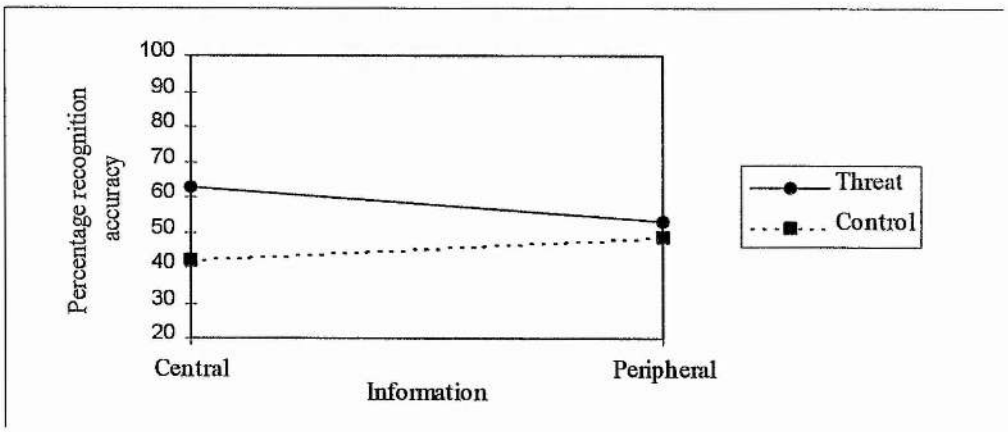

Figure 24: Mean percentage recognition accuracy as a function of information and incident type.

Further classification of the questions, according to whether they pertained to intruder 1 or to intruder 2 (see Table 20), revealed an interaction of incident by information type ($F(1,60) = 4.33$, $p < 0.05$; see Figure 25). Post-hoc analysis revealed that threatened witnesses were more accurate than control witnesses for questions concerning both intruder 1 and intruder 2 ($p < 0.001$ and $p < 0.05$, respectively).

	Intruder 1	Intruder 2
Threat Victims	60.80 (9.22)	53.87 (7.91)
Threat Bystanders	59.37 (12.02)	52.68 (12.35)
Threat Total	60.09 (10.57)	53.27 (10.22)
Control Victims	44.64 (10.56)	45.45 (11.97)
Control Bystanders	47.62 (11.13)	47.44 (7.60)
Control Total	46.13 (10.78)	46.45 (9.91)

Table 20: Mean (SD) percentage accuracy for intruder 1 and intruder 2 recognition questions.

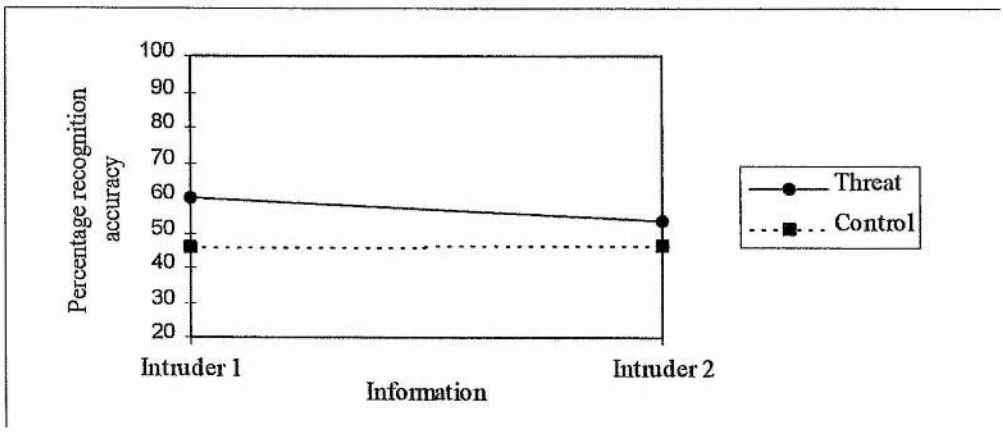

Figure 25: Mean percentage recognition accuracy as a function of information and incident type.

Analysis concerning accuracy for questions concerned with action, verbal or appearance details (see Table 21) revealed an interaction of incident by information type, $F(2,120) = 13.72$, $p < 0.001$, see Figure 26). Post-hoc analysis revealed that threatened witnesses were more accurate for action details than were control witnesses, $p < 0.001$.

	Action	Verbal	Appearance
Threat Victims	78.41 (15.88)	33.13 (13.02)	57.95 (8.22)
Threat Bystanders	67.62 (35.63)	35.63 (14.13)	59.66 (15.56)
Threat Total	73.01 (16.41)	34.38 (13.43)	58.81 (12.27)
Control Victims	47.73 (16.77)	31.25 (16.68)	50.00 (11.74)
Control Bystanders	46.02 (13.88)	30.63 (10.63)	55.97 (7.91)
Control Total	46.87 (15.16)	30.94 (13.76)	52.98 (10.30)

Table 21: Mean (SD) percentage accuracy for action, verbal and appearance recognition questions.

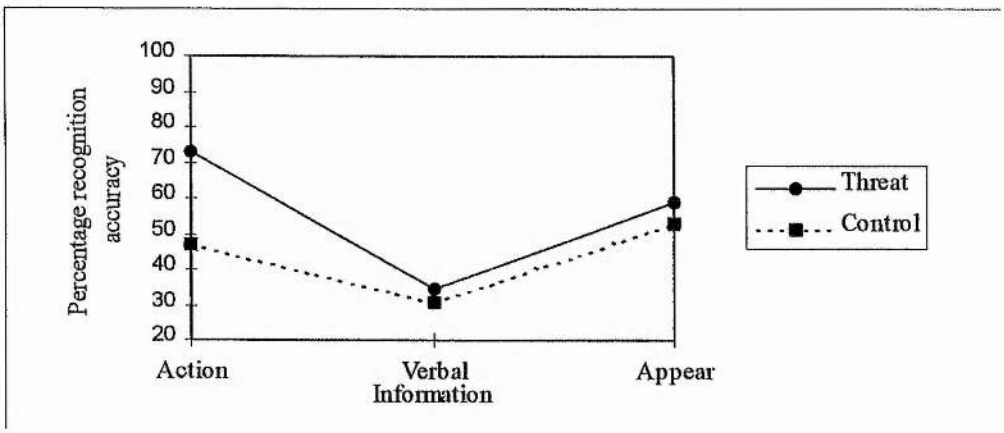

Figure 26: Mean percentage recognition accuracy as a function of information and incident type.

Finally, Pearson Product-Moment correlations were conducted across the 32 threatening condition witnesses, using standardized residual values of the heart rate data in order to take account of baseline heart rate values. However, no significant correlation coefficients were revealed when heart rate during and after the incident were correlated with the various classifications of the percentage of available details recalled.

Spearman correlations of perceived threat and perceived likelihood of attack during the incident with recognition accuracy, however, suggested that as rated threat during the incident rose so too did overall recognition accuracy (r = .391, p

< 0.05) and recognition accuracy for: central detail questions ($r = .374$, $p < 0.05$), intruder 2 detail questions ($r = .359$, $p < 0.05$) and action detail questions ($r = .364$, $p < 0.05$). In addition, as rated perceived likelihood of attack during the incident rose so too did overall recognition accuracy ($r = .387$, $p < 0.05$). Once again, however, inspection of the associated scatterplots suggests that these are not evidence for the existence of real relationships (see Appendix 10).

5.3.2.4 Identification

In line with Study One, witnesses identification decisions for the lineups were classified as correct or incorrect (see Table 22).

In terms of lineup 1 (Intruder 1), whereas cell sizes were too small in Study One to make three-way comparisons, in this study it was possible to perform a three-way log-linear analysis, involving incident, witness, lineup and decision types (see Appendix 10). This revealed a significant relationship between incident type and decision type, $\chi^2_{\text{likelihood ratio}} = 5.14$ (1), $p < 0.05$ (final model: $\chi^2_{\text{goodness-of-fit}} = 3.42$ (4), $p = 0.49$). As can be seen from the contingency table below, participants within the threat condition were correct in their identification decision for lineup 1 (Intruder 1) significantly more often, and therefore incorrect less often, than were participants within the control condition.

	Lineup 1		Lineup 2	
	Correct	Incorrect	Correct	Incorrect
Threat Victims	8	8	5	11
Threat Bystanders	12	4	2	14
Threat Total	20	12	7	25
Control Victims	7	9	4	12
Control Bystanders	4	12	4	12
Control Total	11	21	8	24

Table 22: Number of correct and incorrect lineup decisions.

In terms of lineup 2 (Intruder 2), cell sizes were too small to conduct reliable analysis across incident, witness and decision types. When the data are collapsed across witness type, however, it is acceptable to make comparisons. A two-way χ^2 test of association was conducted but did not reveal a significant relationship between incident type and decision type.

Finally, Point-biserial correlations were conducted across the 32 threatening condition witnesses. However, no significant correlation coefficients were revealed when heart rate during and after the incident (standardized residual values of the heart rate data in order to take account of baseline heart rate values), as well as perceived threat or perceived chance of attack were correlated with identification decision.

5.3.3 Discussion Study Two

Firstly, in terms of the effect of the manipulation, a difference in physiological arousal between threatened victims and bystanders within the same condition was successfully manipulated both during and after the incident. In line with this, threatened victims were also higher in psychological arousal, specifically rating themselves to be more threatened during the incident and more likely to be attacked during the incident, although they did not rate themselves to be more afraid or more angry during the incident. Interestingly, despite the clear difference in physiological arousal, the threatened victims did not rate themselves to be more stressed or aroused during the incident on the Mackay Mood Adjective Checklist (Mackay et al., 1978), once again suggesting physiological and psychological arousal differ. Once the incident was over and the intruders had left the room, the threatened victims were still more physiologically aroused but, as expected, were no longer more psychologically aroused than were bystanders within the same condition.

Essentially, unlike Study One, in this study the desired manipulation was created where victims experiencing direct personal threat were indeed more

physiologically and psychologically aroused than bystanders involved with the same incident but who did not experience direct personal threat. Critically, unlike all of the previous studies that have attempted to set up similar paradigms (Hosch & Bothwell, 1990; Hosch & Cooper, 1982; Hosch et al., 1984; Kassin, 1984), this is the first reported study to successfully demonstrate a significant difference in arousal levels between victims and bystanders within the same condition.

In terms of the different incidents, although the threat condition's elevated physiological arousal was significantly higher than the control condition's immediately after the incident, during the incident the threat condition's physiological arousal did not reach its mean peak elevation until towards the end of the incident, thus preventing the difference between the threatening and control conditions from reaching statistical significance. Despite this, during the incident the manipulation appears to have had greater psychological impact upon the threatened witnesses as they rated themselves to be more threatened, more likely to be attacked and more afraid than did witnesses within the control condition, although they did not rate themselves as more angry during the incident. Similarly, during the incident threatened witnesses rated themselves as being significantly more stressed on the MacKay Mood Adjective Checklist, although they just missed rating themselves to be more aroused than did the control witnesses.

In addition, despite the larger sample size employed within this study, across the threat group physiological arousal was again not shown to be correlated with rated psychological affect, further suggesting that physiological and psychological arousal differ.

5.3.3.1 Memory performance of victims versus bystanders

On the basis of the results of Study One, it was predicted that if physiological and psychological arousal were successfully manipulated, and are important factors in mediating the effects of emotion upon memory, we might expect to see the interesting, although non-significant, differences observed between the threatened victims and bystanders in Study One emerge as significant in this study.

Specifically, enhanced memory for appearance and action details would be manifest without detriment to memory for more peripherally-related details. In addition, we would expect to see differences between threatened victims and bystanders in a similar manner to those observed between the differentially aroused threat and control conditions of Study One (if the differences were due to arousal rather than an inherent difference between the two incidents).

Surprisingly, however, despite setting up a successful manipulation in this study, i.e., differential physiological and psychological arousal between threatened victims and bystanders, these groups did not differ in their memory performance, suggesting that physiological and psychological arousal do not influence memory.

Indeed, the only significant memory difference observed was between victims and bystanders within the control condition, with control bystanders demonstrating poorer performance in terms of free recall accuracy for peripheral details in comparison to control victims. This suggests that the control bystanders may not have been as motivated to accurately recall details during the free recall exercise as the witness groups did not differ in their cued or overall recall accuracy. It is interesting that this effect did not manifest itself in Study One and suggests that either the increase in sample size or the slight change in room layout allowed the difference to reach significance in this study.

Importantly, the interesting, but non-significant, finding within Study One that bystanders within the control condition appeared to be considerably higher in 4AFC recognition accuracy for central details than were control victims was not significant in this study, suggesting that neither the different roles of the witnesses nor experimental instructions to perpetrators exerted an influence upon participants' memories.

As the threatened victims and bystanders within this study were differentially aroused, it is interesting that they did not demonstrate differential memory performance in line with the tentative non-significant differences observed in

Study One. In particular, within Study One, although not significant, threatened victims were slightly higher in overall recall accuracy, although not recognition accuracy, for appearance related details than were bystanders within the same condition, suggesting that they may have spent more time specifically processing the appearance, and perhaps faces in particular, of the intruders in order to work out whether they knew them. However, in this study the pattern disappears completely, with threatened victims actually a few percentage points lower in total recall accuracy for appearance details in comparison to threatened bystanders (Mean = 69.46, SD = 7.89, and Mean = 73.79, SD = 11.58 respectively). Furthermore, for lineup 1, the percentage of correct identification decisions are the opposite way to those observed in Study One, with threat bystanders correctly identifying intruder 1 25% more often than threatened victims. Hence, the use of sequential presentations in this study seems to have increased the number of incorrect decisions made. In short, then, although the results of study one suggested that threatened victims may have spent more time attending to, or processing, appearance details for intruder 1, in this study, despite differential physiological and psychological arousal, this is not the case and suggests no effect of arousal upon memory.

The additional non-significant difference of interest in Study One concerned the finding that threatened victims were considerably higher in 4AFC recognition accuracy for action details than were threatened bystanders. As standard deviations were large, however, this difference did not emerge as statistically significant. In this study, however, although threatened victims recognition accuracy is still higher than threatened bystanders, the difference is smaller and so too are the standard deviations. So, despite a clear difference in arousal, this effect has diminished rather than enhanced. Consequently, it would appear that the interesting but non-significant differences observed in Study One were not tentatively indicative of an influence of arousal upon memory.

In summary, then, despite manipulating a difference in physiological and psychological arousal between threatened victims and bystanders within the same

condition, not only have the interesting non-significant differences found within Study One disappeared, but no other differences in memory performance have manifest themselves.

This is the first time that detailed results, i.e., recall and recognition memory, of this nature have been found, probably not least because it is the first time a manipulation of this nature has been used. Unfortunately, few studies have considered the performance of victims and bystanders as distinct witness types. Indeed, only five published studies have, to date, attempted to compare victim and bystander memory for personally meaningful events under controlled laboratory conditions. These have all utilised simulated thefts paradigms and have produced varying results (see Table 23). In line with the findings of the study presented here, Hosch & Cooper (1982) and Hosch & Bothwell (1990, exp. 2) found no difference between victims and bystanders in terms of identification accuracy. Similarly, Kassin (1984) found no difference in accuracy for physical descriptions. In direct contrast, however, Kassin (1984) also found victims to be poorer than bystanders at correctly identifying the perpetrator of a theft. Similarly, Hosch et al. (1984) found victims less likely to be accurate in their identifications. Furthermore, Hosch & Bothwell (1990) found that as physiological arousal increased identification accuracy decreased (exp. 1), although they also found that victims were better in their written descriptions of the perpetrator than were bystanders.

Although these studies all purport to compare victims and bystanders, one reason for the discrepancy in their findings could be that in 3 of the 5 studies the victim and bystander participants viewed different incidents. Specifically, in the studies by Hosch & Cooper (1982), Hosch et al. (1984) and Hosch & Bothwell (1990, exp.1), participants witnessed a staged event involving either the theft of a calculator belonging to the experimenter (bystander condition) or the theft of a watch or purse belonging to one of the participant pair (victim condition). Consequently, the victims and bystanders were not actually witness to the same theft.

Study	Victim's identification of target perpetrator relative to bystander's
Laboratory studies	
Hosch & Cooper (1982)	↔
Kassin (1984)	↓
Hosch et al., (1984)	↓
Hosch & Bothwell (1990, exp. 1)	↑*
Hosch & Bothwell (1990, exp. 2)	↔
Field/archival studies	
MacLeod (1989)	↑
Tollestrup et al., (1994)	↑

Table 23: Victim's memory for a target perpetrator relative to bystanders: A summary of results (Key: ↑ = enhanced; ↓ = reduced; ↔ = no difference).
*More aroused witnesses were less likely to misidentify the perpetrator.

Hence, the studies employing a methodology most similar to that employed within the study presented here are Kassin (1984), who utilised a personal theft paradigm involving the theft of game money from one of a pair of participants, and Hosch & Bothwell (1990, exp. 2), who utilised a paradigm in which victims and bystanders were run in pairs, both witnessing the victim's purse theft. Although the results of their studies are more in line with the findings of the study presented here, there is still some discrepancy. Specifically, Hosch & Bothwell (1990, exp. 2) found no difference between victims and bystanders in terms of identification accuracy and Kassin (1984) found no difference in accuracy for physical descriptions (based on participants' ability to recall 10 major appearance characteristics), although he did find victims to be poorer than bystanders at correctly identifying the perpetrator of a theft. It is possible, however, that in Kassin's study the bystander had a better

view of the perpetrator during the theft as he was seated across the table from the victim. Hence, the bystander may have been in a better position to view the perpetrator's face, rather than just his major appearance characteristics, which included gender, hair colour and clothing colour.

Unfortunately, as the memory measures used within existing laboratory studies of victims and bystanders are far from comprehensive they do not provide a detailed picture of a victim or bystander's memory for a personally meaningful event against which to compare the results of this study. Indeed, with the exception of Hosch and Bothwell (1990, exp. 2), who looked at the accuracy of written descriptions of the perpetrator, and Kassin (1984) who utilised a physical description form, victim and bystander research has focused exclusively on identification accuracy. Hence, little is known about victim and bystander memory for other information such as action details. It is unfortunate that the witness statements taken by police detectives as part of the deception paradigm utilised by Hosch et al. (1984) were not subsequently analysed as part of their study. Hence, the studies presented in this chapter provide the first detailed assessment (i.e., recall and recognition) of laboratory based victim and bystander memory performance.

Furthermore, as none of the five existing laboratory studies of victims and bystanders have successfully measured arousal, we do not know whether or not their participants were differentially. The failure to successfully manipulate a difference in arousal between threatened victims and bystanders of Study One highlights the importance of manipulation checks. Where existing studies have not measured arousal, they may have mistakenly inferred a relationship between arousal and memory performance.

An inability to objectively assess level of physiological affect is, of course, an unfortunate problem inherent in research with real witnesses. Nevertheless, in contrast to the existing laboratory based studies, research with real victims and

bystanders has considered memory for details other than those pertaining solely to the perpetrator.

Interestingly, although the studies presented here found differentially aroused victims and bystanders not to differ in their memory performance, the majority of archival and field based research with real victims and bystanders have found victim witnesses to demonstrate superior memory in comparison to bystander witnesses. For example, from an archival analysis of 379 witness statements concerning 135 cases of assault, MacLeod (1989) revealed that victims reported significantly more action and description details about the perpetrator than did any other witness type. Similarly, from field work Christianson & Hubinette (1993) found victims provided more accurate information regarding robberies and the events which led up to them (accuracy was assessed by comparison with available forensic evidence, including police reports, reports from all witnesses to each specific robbery and photographs/films of the scene of the crime). Furthermore, Tollestrup et al. (1994) also found victims of robbery provided more detailed descriptions than did bystander witnesses to robberies. However, when they attempted to assess accuracy (by comparing witness statements with details of suspects who had confessed their guilt, but, importantly, who may not necessarily have been guilty), they found victims and bystanders to robberies did not differ in their accuracy for descriptions regarding hair, age and weight, although bystanders were more accurate for height. Unfortunately, they were unable to assess accuracy for other details.

However, although these studies provide valuable information on actual eyewitness performance and permit much needed comparisons with findings derived from laboratory studies, there are number of potential caveats that require consideration when interpreting their findings.

First, there is the problem of self-selection in that those individuals who decline to participate may do so because they feel they have poor memories for the incident which, in turn, inflates estimates of eyewitness accuracy. For example, that 44 per

cent of the multiple-choice questionnaires distributed in the study by Christianson & Hubinette (1993) were not returned, which raises the possibility that their estimates of accuracy may have been inflated. Second, although each incident was witnessed by a large number of witnesses, between-witness comparisons are problematic due to the considerable variations in witnessing circumstances. For example, the information available to some bystander witnesses may differ from the information available to those who are more actively or centrally involved. In addition, where attempts to assess accuracy have been made, these are largely estimates based on police records and what was remembered by other witnesses, police, and support personnel. As differential demands may be made on witnesses by police officers as a means of providing investigative leads or judicial proof (MacLeod, 1985), the use of such methods of assessing accuracy are questionable.

There are, however, possible reasons why memory differences were not observed between the threatened victims and bystanders in the study presented here. First, although the threatened victims and bystanders differed in their rated perceived threat and perceived chance of attack, it is possible that the sample size utilised was not sufficient to allow memory differences to emerge. In particular, at this stage it is possible that the similar memory differences observed in this study and Study One between differentially psychologically aroused threatened and control witnesses could be a function of psychological arousal rather than something inherent in the differing nature of the two incidents. If this is the case, then a larger sample of threat victims and bystanders may have enabled memory differences between them to be observed.

In a similar vein, a further explanation could be that victims may have engaged in or experienced a greater level of intrusive thoughts regarding the incident, serving to reduce their overall attention to a level similar to the bystanders. Hence, any facilitating effects of psychological arousal may have been mitigated.

Of course, neither of these explanations take cognisance of the fact that psychological arousal was not found to correlate with any of the memory measures

in either this study or Study One. Hence, support for psychological arousal exerting an influence on the memories of victims and bystanders appears unlikely, but remains to be confirmed.

5.3.3.2 Correlation of arousal and memory

As individual differences may have played a significant part in the effect the threatening manipulation had upon participants, the way in which arousal and memory performance interacted was investigated by correlating physiological arousal, both during and after the incident, as well as perceived threat and perceived chance of attack during the incident, with the various measures of memory performance. Although several significant correlation coefficients were obtained, even with the larger sample size employed within this study, scatterplots revealed that none could be accepted as representative of robust relationships.

As mentioned above, in line with Study One these results suggest that psychological arousal does not directly influence memory. Hence, although it was hypothesised that threatened witnesses would be concerned with their personal safety and, as result of monitoring the extent of any threat to their personal safety they would demonstrate enhanced memory for more centrally-related details, this does not appear to be the case. This contrasts with the one existing study of real witnesses which reported finding a correlation between rated emotion and memory (e.g., Christianson & Hubinette, 1993), as well as an archival study which found a relationship between rated original emotion and the number of central details that participants reported (Christianson & Loftus, 1990). However, their use of retrospective self-report measures to assess original emotion, often experienced several years prior to the actual research, is questionable and may account for the discrepancy between findings (Wright et, al., 1997).

In terms of physiological arousal, although the results of Study One revealed a significant positive relationship between heart rate during the incident and the percentage of available peripheral details reported in total, in this study, even with a larger sample size, this correlation was not replicated. Hence, whilst the results

of Study One suggest that physiological arousal may either directly influence memory or act as a parallel indicator of other memory related activity, in this Study this appears not to be the case. This is in line with existing laboratory research which found that physiological arousal did not influence memory (Christianson et al., 1996; Christianson & Mjorndal, 1985).

5.3.3.3 Threat versus control group performance

The failure to find a difference in memory between differentially aroused victims and bystanders within the same condition of this study suggests that neither physiological nor psychological arousal directly influences memory. This highlights the possibility that the memory performance of differentially aroused threat and control witnesses is attributable to factors associated with the differing nature of the stimuli they have experienced rather than differential arousal. Specifically, although differential psychological arousal was manipulated between the threat and control groups of this study, the fact that they witnessed different incidents is a confounding variable. Indeed, based on the absence of memory differences between differentially aroused threatened victims and bystanders within this study, it appears likely that any differences between witnesses within the threatening and control conditions is a function of the inherent difference between these two incidents rather than psychological arousal.

This confound is prevalent in much of the existing laboratory based research on emotion or arousal and memory, as it has tended to employ designs where participants view either an emotional or a neutral event which are, at least in the critical or central part, different from each other (e.g., Burke et al., 1992; Christianson, 1986; Christianson & Loftus, 1987; Christianson & Loftus, 1991; Heuer & Reisberg, 1990; Loftus et al., 1987).

Following Study One, it was predicted that the pattern of memory performance between the threat and control conditions would be in line with the differences observed in Study One. However, if the memory differences observed between the threat and control witnesses of Study One are a function of physiological arousal

during the incident, then we would not expect to replicate them in this study where a difference in physiological arousal during the incident was not manipulated. Indeed, all of the memory differences observed between the threatened and control groups of Study One were, replicated within this study, suggesting that, in line with the absence of memory differences between threatened victims and bystanders, the observed differences are not due to an influence of physiological arousal.

Although a few differences emerged in this study which did not manifest themselves in Study One (possibly due to the increase in sample size), the memory performance of witnesses within the threatening and control conditions was directly in line with those observed in Study One. In short, witnesses within the threatening condition recalled a higher percentage of available details overall and were correct on more 4AFC recognition questions than were witnesses in the control group (cf. Study One where threatened victims were higher in 2AFC, but not 4AFC, overall recognition accuracy). With regards to memory for specific information, in line with Study One, participants within the threatening condition recalled a higher percentage of available action details, although again they were not higher in accuracy for these details, and were higher in 4AFC recognition accuracy for action details (cf. Study One where threatened victims were higher in 2AFC, but not 4AFC, recognition accuracy for action details). In this study, threatened witnesses also correctly answered more recognition questions pertaining to intruder 1 and intruder 2 than did control witnesses. In line with this, threatened witnesses also correctly identified intruder 1 significantly more often than did witnesses within the control group.

Finally, with regards to memory for peripheral details, in line with Study One, witnesses within the threatening condition did not demonstrate a trade off in memory (recall or recognition) for peripheral details. Indeed, within this study threatened witnesses demonstrated higher free recall accuracy for peripheral details than did control witnesses. This contrasts with the majority of existing laboratory research which suggests that enhanced memory for certain details tends

to occur at the expense of other more peripheral details (e.g., Christianson & Loftus, 1987; Christianson & Loftus, 1990; Heuer & Reisberg, 1990; Safer et al., 1998).

5.3.3.4 Conclusions

Clearly, then, something is having a facilitating effect upon witnesses' memory in the threat condition relative to those in the control condition. However, the failure to find memorial differences between differentially aroused threatened victims and bystanders of this study, in conjunction with the finding that memory differences observed between the differentially aroused threat and control conditions of Study One were replicated here, where a difference in physiological arousal was not manipulated between threat and control conditions, suggests that this difference is not due to physiological arousal.

Furthermore, although support for an influence of psychological arousal upon memory is also not directly provided by this study, the possibility for an influence of psychological arousal cannot so readily be dismissed on the basis of the results presented here. Alternatively, it is also possible that the memorial differences between the threat and control conditions may be a function of differences in stimulus content, unusualness (Loftus & Mackworth, 1978; Mitchell et al., 1998), or possibly another yet to be identified factor exerting an influence upon memory.

5.4 General discussion

In comparison to bystanders within the threatening condition, it was predicted that threatened victims would be concerned with their personal safety. As a result, they would be more motivated to try to understand what was going on and, therefore, scan or monitor the situation such that they would demonstrate enhanced memory for centrally-related details (e.g., the source of the personal threat, such as physical actions or verbalisations related to the chances of attack), without the associated trade-off for more peripherally-related details (e.g., appearance-related details or

verbalisations un-related to the chances of attack) typically found within laboratory studies of visually-induced arousal (e.g., Burke et al., 1992; Christianson & Loftus, 1987; Christianson & Loftus, 1991).

However, despite manipulating a difference in physiological and psychological arousal between threatened victims and bystanders of Study Two, they did not differ in their memory performance, suggesting that neither physiological nor psychological arousal directly influences memory. In addition, none of the memory measures were found to correlate with physiological arousal in Study Two. Furthermore, support for physiological arousal not exerting an influence upon memory also comes from the finding that memory differences observed between the differentially aroused threat and control conditions of Study One were replicated within Study Two where a difference in physiological arousal was not manipulated between threat and control conditions. Thus, suggesting that the memory differences between the threat and control conditions are not a function of physiological arousal.

Although the studies presented here suggest that psychological arousal does not directly influence memory, the possibility that it may exert an influence upon memory cannot, at this stage, so readily be dismissed. Specifically, similar memory differences observed between differentially psychologically aroused threatened and control witnesses of both Studies One and Two could indicate an influence of psychological arousal. On this basis, the failure to manipulate a difference between the differentially psychologically aroused threatened victims and bystanders of Study Two could either be because the sample size was not sufficient to allow differences to emerge or because victims may have engaged in or experienced a greater level of intrusive thoughts regarding the incident, serving to reduce their overall attention to a level similar to the bystanders. Although neither of these explanations would explain why psychological arousal was not found to be correlated with any of the memory measures in either Study One or Study Two.

However, an equally viable alternative explanation for the differential memory performance of threatened and control witnesses centres around the fact that they witnessed different incidents. Hence, it remains possible that the memory differences observed between the threat and control conditions are instead a function of inherent differences in stimulus content, unusualness (Loftus & Mackworth, 1978; Mitchell et al., 1998), or possibly another yet to be identified factor, exerting an influence upon memory.

5.4.1 Physiological arousal

Despite an emphasis in existing literature on physiological arousal as an explanatory mechanism underpinning the effects of emotion upon memory, little research has attempted to empirically investigate its influence upon memory. Whilst many studies in autobiographical memory have advocated a biologically-based mechanism to account for detailed and vivid memories, they provide little empirical support for such mechanisms as little is known about the actual physiological or biological effects of the original events for which such vivid and detailed memories are reported.

Within the laboratory, a small number of studies have directly attempted to investigate the influence of physiological arousal upon eyewitness memory. Unfortunately, their use in understanding the relationship between physiological arousal and memory is questionable. For example, Brigham et al. (1983), presented participants with facial slides whilst either stimulating them with electric shocks (physiological arousal group) or not stimulating them (control group). However, in addition to finding no physiological differences between the treatment groups, none of the physiological measures were correlated with slide recognition accuracy. Similarly, Hollin (1984) presented subjects with a non-violent film during a small portion of which half the participants were presented with loud white noise via headphones. Although subsequent memory was poorer in the noise group, no physiological measures were taken to show whether the manipulation had successfully created differential physiological arousal. Furthermore, although such a methodology allows memory to be investigated

when the source of arousal is un-associated with the stimulus, the extent to which loud white noise elicits a response similar to a fight or flight defensive response is questionable. Hence, both of these studies are of limited use in understanding whether physiological arousal influences eyewitness memory.

The results of the studies presented within this chapter are, however, largely congruent with the findings of existing studies which have directly sought to investigate the influence of physiological arousal upon memory. In line with an increase in blood adrenalin levels associated with a fight or flight response, Christianson & Mjorndal (1985) and Christianson et al. (1986) utilised adrenalin in order to manipulate physiological arousal un-associated with the to-be-remembered event and isolated from psychological arousal. The first of the studies, Christianson & Mjorndal (1985), injected their participants with either adrenalin or saline and then presented them with pairs of slides depicting neutral faces, each accompanied by 4 verbal descriptors (name, occupation, hobby and a personality trait). Participants were asked to recall (exp 1.) or recognise (exp 2.) as many of the descriptors they had read aloud during the presentation period as possible. In both experiments, although participants injected with adrenalin showed a significantly higher heart rate and skin conductance level than those injected with saline, there were no differences in memory performance. However, while this suggests that increased physiological arousal did not serve to enhance memory performance, it would have been interesting to consider whether the same results emerged when participants memory performance was assessed on the slide contents rather than just the descriptors accompanying the slides.

In a further study, Christianson et al. (1986) conducted a slight variation of their earlier work. This time, one group of participants were injected with adrenalin and shown neutral slides with accompanying verbal descriptors (physiological arousal only, as in the earlier study), whilst a second group were injected with saline and shown emotional slides (depicting facial injuries) accompanied with verbal descriptors (and, therefore, producing the possibility for both physiological and psychological arousal in this group). Physiological and self-report data showed

that those injected with adrenalin and those shown the facial injury slides were aroused to equivalent levels. Obvious ethical constraints limit the amount of adrenalin that can be administered, however, and the subsequent heart rates exhibited by the participants were relatively low, a maximum of 91 beats per minute in those given adrenalin compared to a maximum of 80 beats per minute in those given saline and presented with emotional slides. In addition, heart rates were calculated as the highest value reached in each period rather than an average value across each period. Taking this into account, when recall memory for verbal descriptors was tested, those shown the facial injury slides performed below those injected with adrenalin and shown neutral slides. Hence, there was a difference between the two groups even though they were not differentially physiologically aroused. Whilst it appears that memory is poorer for the facial injury slides, as with the earlier study it is in fact poorer for the accompanying verbal descriptors. It is not known whether differences would have emerged if memory for the slides themselves had been tested.

As a result of these studies, Christianson (1992) concluded that "a general increase in arousal as induced by an external source, like adrenalin, does not affect memory processes in the same way as a source of emotional arousal directly associated with the to-be-remembered event" (p. 300). However, the results of both of the studies presented in this chapter, suggest that association with the to-be-remembered material may not be as important as previously thought.

Furthermore, failure to find support for an influence of physiological arousal upon memory in the studies presented here suggests that the nature of the physiological response (i.e., defensive versus orienting) is unimportant (cf. with the majority of laboratory based studies of visually-induced arousal which have manipulated orienting physiological responses, characterised by a drop in heart rate rather than an elevation; e.g., Christianson, 1984 and Heuer & Reisberg, 1990).

However, if physiological arousal does not influence memory, then it does not explain why research has indicated that glucose significantly enhances human

memory performance when measured using a variety of tests (e.g., logical memory tests involving single presentations of taped narrative passages followed by 15 minute delayed recall measures; Gold, 1986; Hall, Gonder-Frederick, Chewning, Silveira & Gold, 1989; Manning, Hall & Gold, 1990). Gold (1992) proposed that flashbulb memories represent a special case of neuroendocrine regulation of the biological processes responsible for storing information and that the storage of information at the time of an emotional event reflects an instance of physiological enhancement of memory. However, although the biochemically based studies by Gold (1986, 1992) and others provide support for physiological mechanisms mediating the effects of arousal upon memory, much more research is required in order to investigate the possible role of such a mechanism in human memory, especially in terms of complex stimuli.

In terms of research with real witnesses, it is an unfortunate fact that it is not possible to objectively assess original physiological arousal. Despite this, Kuehn (1974) found that victims of robberies provided more complete accounts than did victims of rape or assault, and that uninjured victims provided more complete accounts than did injured victims, suggesting that crimes higher in personal violence or threat to one's safety are likely to be associated with less complete accounts of assailants by their victims. In contrast, however, Christianson & Hubinette (1993) found no effect of rated level of original emotional arousal upon memory for robbery details (e.g., number of robbers, robber's weapon, and who collected the money), although it was related to memory for circumstances surrounding the robberies (e.g., time of day, number of customers, and day of the week). Furthermore, Sporer (1992) found an almost linear increase in the number of descriptive details reported as a function of the level of stress experienced by a witness when he conducted an archival analysis of 139 person descriptions from cases of robbery and rape. Level of stress had been evaluated by classifying incidents on the basis of witnesses' self-reported anxiety in conjunction with weapon presence and injury occurrence. In this study, however, only half of the witnesses actually witnessed the incident. The remainder had not witnessed the incident per se but had interacted with the perpetrator either just before or after the

incident occurred. Consequently, it is possible that those witnesses who interacted with the perpetrator but did not actually witness the incident may have experienced lower levels of stress and attended to the perpetrator to a lesser extent than did those who had actually witnessed the incident. However, these studies fail to provide little more than educated guesses as to the relationship between physiological arousal and eyewitness performance as they could not include an objective measure of physiological arousal.

Fundamentally, however, although physiological arousal does not appear to have a facilitating effect upon memory, it is important to note that as a result of the studies presented here, it does not appear to have a debilitating effect.

With regard to physiological arousal's relationship to psychological arousal, as the majority of existing research in the field of eyewitness memory has largely failed to utilise objective manipulation checks (e.g., Christianson & Loftus, 1991; Clifford & Scott, 1978; Hosch & Bothwell, 1990; Hosch & Cooper, 1982; Hosch et al., 1984; Kramer et al., 1991), let alone investigate or report the extent to which they may be correlated, very little is currently known about the relationship between physiological and psychological arousal in terms of eyewitness memory. Initially, it would be expected that in line with the innate 'fight or flight' response, when faced with threat or danger witnesses would experience an elevation in physiological arousal in preparation for action. It does not, of course, necessarily follow that an elevation in physiological arousal has to be associated by perceived threat. It is interesting that within both of the studies presented here, none of the physiological and psychological arousal measures were found to be correlated. It is possible that this may be an indication of the widespread problem associated with the use of introspective self-ratings based on Likert-type scales to assess psychological processes, although the increase in sample size within Study Two did not facilitate the emergence of robust relationships.

5.4.2 Personal involvement

Although the issue of a confound associated with the use of differing incidents is common to much of the research on arousal and memory, there is an interesting difference between the methodology of the studies presented here and the majority of laboratory studies in that the participants in the studies presented here were personally involved with the stimulus incident.

Consequently, although comparison with existing research cannot confirm whether differences between participants experiencing arousing versus neutral stimuli are due to psychological arousal rather than something inherent in the differing nature of the stimuli, such comparison may provide insight into how memory for personally meaningful incidents may differ from incidents which are not personally meaningful.

The results of the studies presented here are in line with existing studies of visually-induced arousal which suggest that arousal may enhance memory for certain information without detriment to other information (Christianson & Loftus, 1987; Christianson & Loftus, 1991). However, in the studies presented here, rather than enhanced memory for central details per se, superior memory for actions was demonstrated (i.e., those key to the threatening aspects of the incident), thus suggesting that, where witnesses are personally involved it may specifically be actions rather than central details as a whole that they demonstrate superior memory for.

In addition, the enhanced memory for actions observed within the studies presented here was not associated with a trade-off in memory for peripheral details. This contrasts with previous research concerning visually-induced arousal which has tended to suggest that there is a trade-off in memory for peripheral details associated with emotional material (Burke et al., 1992; Safer et al., 1998). Indeed, as can be seen from Table 23, of the laboratory based studies which have not manipulated personal involvement only two experiments found that enhanced memory for central details was not to the detriment of peripheral details

(Christianson, 1984; Heuer & Reisberg, 1990). The rest have demonstrated detrimental memory effects for peripherally related details (Burke et al., 1992; Christianson & Loftus, 1991; Heuer et al., 1997; Kebeck & Lohaus, 1986). In particular, with regards to recall memory, 5 out of 6 of the existing experiments found emotion to have detrimental effects upon memory for peripheral details (e.g., Christianson & Loftus, 1991; Kebeck & Lohaus, 1986). Similarly, in terms of recognition memory, 8 out of 10 experiments found detrimental effects of emotion upon memory for peripheral details (e.g., Burke et al., 1992; Heuer et al., 1997). Although the study by Heuer & Reisberg (1990) suggests a memory advantage for peripheral details, the enhanced memory was not directly attributable to the arousal-inducing aspects of the slide presentation employed, but was instead confined to the slides presented after the critical arousal-inducing phase.

Hence, while these studies have not specifically made the distinction between actions and other detail information, they clearly demonstrate a tendency for a trade-off in memory for peripheral details associated with visually-induced arousal.

In contrast, the studies presented within this chapter suggest that when an incident involves a witness personally there may be enhanced memory for action details without an associated trade-off in terms of memory for other details (e.g., verbal or appearance details).

In addition to the studies of visually-induced arousal above, research concerning the weapon focus effect has demonstrated witnesses' propensity to focus attention onto a weapon to the extent that other more peripheral details, especially characteristics of the perpetrator's face, are attentionally excluded resulting in poorer memory for them (see Steblay, 1992). Although this well-documented effect appears to contrast with the findings of the present studies, had they included a specific weapon a different pattern of results may have emerged. Arguably, as no specific weapon was present, the participants in the studies

presented in this chapter may have scanned or monitored the incident in order to assess ongoing threat levels. Clearly, as all crimes do not involve a specific weapon such consideration is important.

Study	Recall Memory		Recognition Memory	
Visually/thematically induced arousal				
Christianson (1984)	C ↑	-	-	P ↔
Kebeck & Lohaus (1986, test 1)	C ↔	P ↓	-	-
Kebeck & Lohaus (1986, test 2)	C ↔	P ↓	-	-
Christianson & Loftus (1987, exp. 1)	C ↑	-	-	P ↓
Christianson & Loftus (1987, exp. 3)	C ↑	-	-	-
Heuer & Reisberg (1990)	C ↑	P ↑	C ↑	P ↑
Christianson & Loftus (1991, exp. 1)	C ↑	P ↓	C ↔	P ↓
Christianson & Loftus (1991, exp. 2)	C ↑	P ↓	C ↔	P ↓
Christianson & Loftus (1991, exp. 3)	C ↑	P ↓	C ↑	P ↓
Christianson & Loftus (1991, exp. 5)	-	-	C ↔	P ↓
Burke et al., (1992, exp. 1)	-	-	C ↑	P ↓
Burke et al., (1992, exp. 2)	-	-	C ↑	P ↓
Heuer et al., (1997)	-	-	C ↑	P ↓
Safer et al., (1998)	-	-	C ↑	-

Table 24: Memory for central and peripheral details associated with negative emotional material in comparison to neutral material: A summary of results (Key: C = central details; P = peripheral details; ↑ = enhanced; ↓ = reduced; ↔ = no effect).

How do findings of the studies presented here compare with research which has specifically manipulated personal involvement? Unfortunately, although little research has manipulated personal involvement, most has been conducted with children. For example, Rudy & Goodman (1991) conducted a study in which pairs of 4 and 7 year olds entered a trailer occupied by an unfamiliar man. One child participated in a set of games with the man, and the other sat and watched. In a subsequent memory test, 10 to 12 days later, they found that participation lowered susceptibility to suggestion and, regardless of age, children evidenced few commission errors to false suggestions about actions relevant to child abuse allegations. Similarly, Ornstein, Gordon & Larus (1992) studied children's (3 and 6 year olds) memory for a personal visit to the doctor for a physical examination. They found that children at both ages remembered most of the features of the check-up and were quite good at giving accurate responses to misleading questions. Although these studies did not make the distinction between central and peripheral details, and centre around issues of children's suggestibility, they both suggest that personal involvement does not have a debilitating effect upon memory.

In terms of adult memory, with the exception of Peters (1988), and the specific studies of victims and bystanders discussed in detail earlier, the role of personal involvement has virtually been ignored. Peters (1988) involved witnesses personally using an inoculation paradigm in which participants were asked to provide physical descriptions and make identifications concerning a nurse who had recently inoculated them and a second person they met shortly after inoculation. It was found that when the subjects were aroused, memory for the nurse was significantly reduced in comparison to memory for the second person. However, this study should be interpreted cautiously due to problems with order effects and other confounding factors. Furthermore, whilst participants were obviously personally involved with the manipulation, it is argued that it differs from the nature of the experience of real witnesses. Specifically, it is argued that participants in Peters' study would most likely have been preoccupied with the incident they knew was about to happen. In contrast, in the studies presented

within this chapter, witnesses would not have known exactly what was going to happen and, therefore, may have monitored the incident to a greater extent than the participants in Peters' study.

Further studies where personal involvement is clearly a central factor, however, are those concerning real witnesses. Unfortunately, as discussed earlier in this chapter, such studies have been plagued by a lack of knowledge concerning accuracy or level of psychological arousal (e.g., MacLeod & Shepherd, 1986; Yuille & Cutshall, 1986). Despite these inherent problems, however, their findings are largely congruent with the suggestion that personal involvement with an incident enhances memory for that incident. Although they have not tended to make such a rigorous distinction between central and peripheral details as have laboratory studies, analysis of data concerning the amount and type of details typically reported by real witnesses supports the idea of enhanced memory associated with personal involvement (MacLeod, 1989; Sporer, 1992). In particular, Sporer (1992) found an almost linear increase in the number of descriptive details as a function of the level of stress experienced (based on self-report ratings, weapon presence and injury occurrence). Similarly, MacLeod (1989) found that victims reported significantly more action and descriptive details about the perpetrator than any other witness, further suggesting a specific role for personal involvement. Yuille & Cutshall (1986) also found those rating themselves as highly stressed to be significantly more accurate in a police interview than those who only rated themselves as having been mildly stressed. It is possible, however, that level of stress and viewing proximity may have been confounded in this study such that those further away may have been not only less stressed but also less able to see the incident clearly.

Hence, it would seem that in comparison to studies of visually-induced arousal, where participants are personally involved their memory for action details may be enhanced without detriment to memory for peripherally related details. However, whether this is a function of psychological arousal associated with personal involvement remains to be confirmed by future research. In particular, despite the

general support from research with real witnesses, it remains to be confirmed that the differences observed between the personally involved threatening and control groups of the studies presented here are due to differences in psychological arousal rather than something inherently different between the two incidents themselves. It is a fundamental confound that the majority of existing research has used different stimuli for emotional and control groups. Specifically, the differences observed between emotion and control groups in laboratory studies which have utilised relatively innocuous stimuli may be because of differential interest between the two group's stimuli rather than arousal per se (Cahill & McGaugh, 1995). Despite such a possibility, the results of these studies have been consistently interpreted to suggest that emotional arousal, experienced whilst viewing negatively-valenced emotional information, results in a focus of attention to the central details of the stimulus and, therefore, enhanced memory for those details.

5.4.3 Theoretical implications

The proposed tripartite model of arousal and memory, put forward within Chapter Four, argued that a more complete understanding of the effects of arousal upon eyewitness performance may require understanding the following three elements: (1) physiological arousal, (2) psychological arousal, and (3) motivation (compensatory mechanisms). Furthermore, it was also argued that jointly these factors may provide a more satisfactory explanatory scheme for understanding eyewitness performance.

Physiological arousal

However, as a result of the studies presented within this chapter, it appears that physiological arousal may not directly influence eyewitness memory. This is interesting as one might think that physiological and psychological arousal would work together in a complementary manner. For example, in line with Gold's Neuro-Biological theory (Gold, 1986; 1992), an enhanced level of physiological arousal and associated adrenergic biochemicals in the blood-stream could result in facilitated consolidation or storage of detailed memories resulting from increased psychologically-guided event processing, especially with regards to threat-related

aspects of an incident. On this basis, where heightened psychological processing does not facilitate enhanced attentional and elaborative processing, increased consolidation or storage of memories may not follow. And in reverse, where psychological processing is directed towards and results in enhanced elaboration for the threatening aspects of the incident, increased physiological arousal may facilitate the consolidation or storage of these memories. On the basis of the studies presented here, however, increased physiological arousal does not appear to have had a direct facilitating effect upon memory.

However, it remains possible that physiological arousal may be a cost associated with goal maintenance. Indeed, whilst Hockey (1997) argues that through an active process of cognitive resource management, via mental effort, individuals may choose to protect their performance, he also states that this may occur at the expense of physiological arousal. Although the finding of only one correlation between physiological arousal and memory is little support for such a mechanism, it is possible that the failure to correlate physiological arousal with the other memory measures is again an issue of the sample sizes employed in the studies presented here.

Psychological arousal

Support for psychological mechanisms influencing memory is also not directly provided, although the potential for an influence remains possible if the differences viewed between participants within the threat and control conditions are due to arousal rather than something inherent in the differing nature of the stimulus incidents. Whilst this would not explain why psychological arousal was not found to correlate with any of the memory measures or why no differences in memory were observed between differentially psychologically aroused threatened victims and bystanders, it is again possible that issues concerning sample sizes may underlie these.

Alternatively, if psychological mechanisms are important, it remains possible that victims may have engaged in or experienced a greater level of intrusive thoughts

regarding the incident, serving to reduce their overall attention to a level similar to the bystanders.

Motivation

In terms of motivation, the failure to observe memory differences between threatened victims and bystanders, despite their difference in perceived threat and perceived chance of attack, suggests that differential motivation was not manifest. For example, victim's monitoring may have occurred in order to provide answers to questions such as: who are these people, do I know them, are they going to physically attack me, who is this second intruder, is he after me too, are they showing any signs of calming down, will they wait outside for me, is it possible I could have been talking to his girlfriend? Bystanders, however, although lower in perceived personal threat and chance of attack, may have been motivated to monitor what was happening in order to answer a different set of questions, such as: who are these people, are they going to attack the victim, what shall I do, who is this second intruder, is he after the victim too, now should I do something, are they showing any signs of calming down, I wonder if he has been seen with his girlfriend? Hence, although the bystander's motivation may have been less related to their own chance of being attacked, they may, nevertheless, have been equally motivated to attend to what was going on.

In keeping with an influence of motivation, whether due to psychological arousal or differential interest, it appears that participants within the threatening condition may have scanned or monitored the incident to a greater extent than the control witnesses, resulting in enhanced memory for actions, without, a trade-off in memory for other more peripheral details. Hence, in line with Hockey's Cognitive-Energetical framework, it would appear that participants in the threatening condition may have been more motivated to understand what was going on than participants in the control condition.

Furthermore, in comparison to studies of visually-induced arousal, although aroused participants in the studies presented here demonstrated enhanced memory

for action details, they did not demonstrate a trade-off in memory for peripheral details. In line with an influence of motivation, this may reflect that where witnesses are personally involved, they are more likely to engage in increased monitoring or scanning of the situation in order to understand what is going on and to ensure that the behavioural response selected is most efficient (Derryberry & Tucker, 1994). Arguably, this adds weight to the idea that participants in traditional laboratory studies do not experience changing demands which result in sufficient motivation to re-allocate cognitive resources in order to protect personal goals (Hockey, 1997).This may go some way towards explaining why memory in the field appears to be good (e.g., Yuille & Cutshall, 1986), but in the laboratory where participants are not personally involved enhanced memory for central details appears to be associated with a trade-off in memory for peripheral details (e.g., Christianson & Loftus, 1991).

At this stage, then, it is not suggested that witnesses can or will remember everything in a stimulus array. Clearly, this is not the case. What is suggested, however, is that whilst laboratory studies have generally argued that emotional arousal reduces performance or restricts attentional and elaborative processing, this may not be the case where witnesses are personally involved. Critically, it is argued that the influence of personal involvement, and therefore motivation, has wrongly been ignored within laboratory research to date (e.g. Burke et al., 1992; Christianson & Loftus, 1987; 1991; Heuer & Reisberg, 1990). Furthermore, what is central and what is peripheral detail will vary from incident to incident and in particular from witness to witness depending upon personal goals which are likely to be linked to the specific nature of the target incident. There is no doubt that selective attention occurs, but at this stage it is argued that to say whether a witness will or will not remember central and or peripheral details may be misleading, especially if such a judgement is heavily based upon laboratory research investigating visually-induced arousal.

In conclusion, since physiological arousal does not appear to exert an influence upon memory a tripartite model of arousal, encompassing physiological arousal,

may not be as useful as previously thought. However, before rejecting physiological arousal from the model, further corroborating studies are required in order to fully understand whether physiological arousal has a role to play in mediating the effects of emotion upon memory.

Similarly, in order to understand the role of psychological arousal and/or motivation, the possibility that differences in memory performance may be due to differential interest or unusualness requires further investigation.

5.4.4 Methodological issues and future research

In considering future research in this area, there are a number of fundamental methodological issues associated which warrant specific mention.

Firstly, the employment of manipulation checks is a critical methodological issue highlighted by the observed failure to manipulate a difference in physiological or psychological arousal between the threatened victims and bystanders within Study One. Although the studies presented here suggest that physiological arousal may not exert an influence upon eyewitness memory, replication of these results are required. If objective manipulation checks had not been used in the studies presented here, as with all of the previous studies of victims and bystanders (e.g., Hosch & Cooper, 1982; Hosch et al., 1984), inferring an incorrect relationship between memory and affect would have been tempting. For example, in the case of Study Two, it could have wrongly been inferred that no difference in arousal had been manipulated as no differences in memory were manifest. Critically, if advances in our understanding of the influence of arousal upon memory are to occur, it is essential that future research employs objective manipulation checks.

As with the majority of existing research, the studies presented here suffer, in part, from an inherent confound associated with comparing participant's memory for differing incidents. Although comparisons across incidents may be interesting, only when we compare participants' memories for the same stimulus information

can we really begin to understand what factors may exert an influence upon memory and in what way.

In a similar vein, consideration needs to be given to the precise nature of the stimulus information presented to participants. Throughout the literature a wide-variety of stimuli have been used ranging from slides of a bicycle accident (Christianson and Loftus, 1991) to a video of a violent mugging (Clifford & Hollin, 1981). Clearly, the nature of these stimuli are quite different, and the extent to which comparison may be made between participants viewing them is questionable. Indeed, as can be seen in Chapter Seven, caution should perhaps be exercised regarding conclusions about eyewitness reliability where these conclusions are based on the aggregated data derived from a number of cases or studies.

Arguably, this is highlighted in the studies presented here. Specifically, as a result of the 'jealous partner' paradigm, threatened victims may have spent time trying to work out whether they knew the intruders. Furthermore, for bystanders the victim may been a prominent competing stimulus as they may have monitored the victim's behaviour in order to assess whether to intervene. Arguably, then, the cognitive processes engaged in by the participants in these studies may have been different from those in the earlier victim and bystander studies utilising live-event theft paradigms (e.g., Hosch & Cooper, 1982; Hosch & Bothwell, 1990).

Retrospectively, it would have been interesting to video-tape each run of the live-event incidents of the studies presented here in order to assess witnesses' memory for what they themselves, including what bystanders remembered about the victim's behaviour and, indeed, whether the victim remembered anything regarding the bystanders' behaviour. Relative to bystanders within the control condition, bystanders within the threatening condition may have demonstrated superior memory for details pertaining to the victim.

In addition, memory measures used within existing laboratory studies of victims and bystanders are far from comprehensive. Hence, future research should consider a more comprehensive assessment of witnesses memory, rather than concentrating solely on identification accuracy. Similarly, future research may wish to consider classifying details into alternative groups in addition to a central and peripheral classification.

Directly related to this, there is a clear need for field based research to make a distinction between memory for central and peripheral details to enable more direct comparison with laboratory based studies. In line with this, investigating real witnesses memory for actions details may be particularly informative, as the studies presented here suggest that it is for these personal-threat related aspects of the incident (i.e. actions) that critical differences may exist.

Finally, measurement of psychological processes is reliant upon introspective self-report measures. As already mentioned, self-report measures are not as valid or reliable as they are often interpreted to be (Wright et al., 1997). Directly related to this, although studies of the nature presented in this chapter are resource intensive, as large a sample size as possible should be utlilised in order to facilitate the emergence of relationships to emerge where they exist.

One of the implicit aims of this research was to stimulate new theoretical and empirical efforts and it is hoped that the interesting findings of the research presented here may contribute to this. Critically, theoretical advancement and understanding in this area is of applied importance. For a criminal investigator, judge or juror a victim may be perceived as the central witness and therefore may be perceived as more or less reliable than a bystander witness depending on the nature of the original incident. If, as the studies presented here suggest, in certain circumstances there may be no difference between the reliability of victim and bystander memories for the same incident, this may have implications in terms of perceptions concerning witness credibility in court as well as initial decisions by investigators with regard to whom they may choose to interview.

Clearly, before anything firm may be advocated, a number of the theoretical aspects of this research require further investigation. Importantly, the studies reported here are the first two controlled laboratory studies to investigate factors which are normally associated with field based studies, i.e., personal involvement and perceived threat. Although specific findings were manifest, from this research it would be foolish, at this stage, to directly advocate whether physiological arousal, psychological arousal, motivation, personal involvement or, indeed, none these, affect attentional or elaborative processes in an eyewitness situation.

Furthermore, although this research suggests that physiological arousal may not exert an influence upon eyewitness memory, the lack of existing research concerning its potential effects makes conclusions concerning this tenuous. In addition, as highlighted by the studies presented here, research is urgently required to investigate the possibility that memorial differences observed between participants viewing different incidents are due to inherent differences in the stimulus information, rather than arousal per se. The implications for the findings of such research are particularly important to interpreting the results of many existing laboratory studies which purport to study emotion and memory. The study presented within Chapter Six was conducted to directly investigate these specific issues.

Chapter 6

The Role of Physiological Arousal and Differential Interest in Eyewitness Memory

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6.1 Introduction

The study presented in this chapter was primarily conducted to directly investigate whether physiological arousal has an effect upon eyewitness memory on its own (e.g., in the absence of psychological arousal and perceived personal threat).

As discussed in Chapters Three and Four, it is well-documented within both cognitive and eyewitness memory literature that emotionally-arousing material is remembered differently than neutral material. As a result, it has increasingly been suggested that physiological and psychological arousal, or both, are key factors mediating the effects of emotion upon memory. However, the precise mechanisms and relationships behind such effects are not at all clear.

The tripartite model of arousal and eyewitness memory put forward in Chapter Four, proposed that in order to more fully understand eyewitness memory a multi-factor dynamic approach should be taken, encompassing both physiological and psychological effects, as well as acknowledging the potential role of compensatory mechanisms associated with motivation to protect personal goals. On this basis, it was suggested that a better understanding of the effects of arousal upon eyewitness performance requires understanding: (1) physiological arousal, (2) psychological arousal, and (3) motivation (compensatory mechanisms).

However, as a direct result of the studies presented within Chapter Five, it now appears that the role of physiological arousal in mediating the effects of emotion upon memory may not be as important as previously thought. Specifically,

physiological arousal does not appear to have a facilitating effect upon memory. Importantly, however, it does not appear to have a debilitating effect either.

Although existing research has directly questioned the influence of physiological arousal on its own upon memory (Brigham et al., 1983; Christianson & Mjorndal, 1985; Christianson et al., 1986; Hollin, 1984), methodological issues associated with these studies makes it impossible for them to tell us whether physiological arousal directly exerts an influence on memory for complex information.

Furthermore, although research suggests that memory effects are not produced by physiological arousal per se, but may be produced by psychological factors triggered by the emotional nature of the material to-be-remembered, little regard has been given to the possibility that rather than being due to psychological arousal, memory differences may be due to the differential nature of the 'emotional' and 'neutral' stimuli presented to participants. This fundamental confound is prevalent in existing research and, in part, the studies presented within Chapter Five. Highlighting this potential problem, existing research has suggested that incidents which are unusual or novel, but are not necessarily emotional or associated with an elevation in physiological arousal, may also be remembered differently than neutral or control incidents (Christianson and Loftus, 1991; Mitchell et al., 1998). Hence, in addition to considering the role of physiological arousal, the study presented in this chapter also addresses the issue of whether memory differences between two groups viewing different stimuli may be due to something inherent in the differing nature of the two stimuli rather than physiological or psychological arousal.

In addition, as a result of this study it is possible to review live-event versus video-tape presentational methodologies. For example, comparison of the findings of Studies One and Two, where participants experienced the threatening incident as a live-event, with the findings of this study, where participants view the threatening incident via video-tape, may provide insight into the potential effects of personal involvement upon memory performance.

This study, then, advances previous research in a number of ways. Firstly, rather than using static stimuli, such as slides of neutral faces (Christianson & Mjorndal, 1985), this study utilised video-tapes of the threatening and neutral incidents employed in the studies presented within Chapter Five, which were shown to be either arousing or un-arousing when experienced first hand as live-events in the laboratory. Secondly, unlike the study conducted by Christianson et al. (1986), where witnesses injected with adrenalin were shown a different series of slides to those not injected with adrenalin, in this study witnesses watched the same films, i.e., physiologically aroused witnesses watched the threatening incident and physiologically un-aroused witnesses watched the same incident. Such a design produced four different witness groups; two groups who watched the video-tape of the threatening incident, one group aroused through exercise (cycling on an exercise bicycle) the other un-aroused, and two groups who watched the video-tape of the control video, one group aroused through exercise the other un-aroused. Thus, the design enables investigation as to whether effects of differential interest or unusualness between the stimuli may influence memory.

As with the studies conducted by Christianson & Mjorndal (1985) and Christianson et al. (1986), in order to separate physiological arousal from psychological factors the source of physiological arousal cannot be associated with the to-be-remembered material itself. Separation in this manner enables specific investigation as to whether something inherent in physiological arousal itself, i.e., not associated with the cognitive aspects of viewing stimuli, has an effect upon memory. There are a number of methods which have been used to induce arousal, including; minor electric shocks (Brigham et al., 1983), white noise (Hollin, 1984), and adrenalin (Christianson & Mjorndal, 1985; Christianson et al., 1986). Although injecting participants with adrenalin may produce a response most similar to the 'fight or flight response', ethical constraints may prevent the injection of sufficient adrenalin to elevate the physiological response to a level akin to that experienced under eyewitnessing conditions. In particular, Christianson et al. (1986) only managed to induce heart rates that reached a

maximum of 91 beats per minute amongst those administered with adrenalin. Hence, in order to overcome ethical constraints but still manipulate arousal to an appropriate level, exercise was chosen as the means of inducing physiological arousal. Indeed, exercise has been successfully used as a method of inducing physiological arousal in previous psychological research (Féry, Ferry, Vom Hope & Rieu, 1997; Kim & Baron, 1988; Tomporowski, Ellis & Stephens, 1987). Kim & Baron (1988), for example, used cycling exercise as a method by which to study whether arousal heightens stereotypic processing. Similarly, Tomporowski et al., (1987) looked at the immediate effects of exercise following a treadmill run on free-recall memory. Finally, unlike the studies conducted by Christianson & Mjorndal (1985) and Christianson et al. (1986), participants' were tested for the content of the film rather than accompanying verbal descriptors, thereby providing a more detailed measure of memory performance for the stimuli itself.

In terms of predicted effects, there should be no difference in rated psychological arousal between the participant groups. It is, of course, expected that those exercising will be higher in physiological arousal than those resting. Consequently, if physiological arousal is a key factor affecting subsequent memory we would expect to observe memorial differences between those groups exercising relative to those resting irrespective of which video-taped incident they watched.

If, on the other hand, inherent differences between the video-tape incidents, such as unusualness or differential interest, exert an influence then we would expect, overall, to see memory differences between the groups watching the different video-tapes irrespective of their level of physiological arousal.

Finally, of course, it is possible that both physiological arousal and differential interest or unusualness may exert an influence. If this is the case, we would expect to see interactions of exercise and video, i.e., those exercising whilst watching a video-taped incident would show differential memory performance compared to those resting whilst watching the same video-taped incident and similar effects

would not be observed between the witnesses viewing the control incident video-tape.

If memory effects are manifest, in line with existing laboratory research it is predicted that whilst there may be enhanced memory for central details, this would most likely be associated with a decrement in performance for peripheral details as the witnesses are not personally involved.

6.2 Method

6.2.1 Participants

A total of 64 male undergraduate students (aged 17 - 25 years) from the University of St Andrews participated. All participants were naive to the true purpose of the experiment, believing it to be a health psychology study to test the widely posited suggestion that exercise improves mental functioning. Informed consent, for the disclosed aspects of the study, was obtained from each participant prior to the experiment, during which they were informed of their ability to terminate the experiment at any point whilst still being paid.

6.2.2 Design

A 2 (threatening or control video-tape condition) x 2 (exercise or rest condition) between participants design was employed.

6.2.3 Apparatus

To achieve the desired level of physiological arousal in the exercise condition, participants cycled on a Monark Ergomedic electronic cycle allowing experimental control of the workload and therefore manipulation of subsequent heart rates. Measurements of heart rate were recorded continuously during the experiment as a physiological correlate of the arousal of the participants in each condition. Measurements were taken using Polar Heart Rate Monitors consisting of an electrode belt worn around the chest below the pectoral muscles with 0.05

molar NaCl electrode gel, and a recording watch worn around each participant's wrist. Raw recording figures, taken at a five second rate, were used for analysis purposes. The incident was displayed on a screen (34cm by 34cm) at a distance of 60cm from the participant pedaling or resting whilst sitting on the bicycle.

6.2.4 Materials

Participants were shown one of two video-taped incidents. These were filmed versions of the incidents used in Studies One and Two. The threatening condition involved a male confederate bursting in through a laboratory doorway to accuse an individual of seeing his girlfriend (the accused individual is not in view and the intruder is in fact talking to the camera as if talking to the viewer of the video-tape). Moments later a second male confederate runs into the laboratory and tries to calm his irate friend who is angrily shouting at the viewer. The second confederate grabs hold of the irate confederate who resists his friend's grip and picks up a wooden ruler from a side table which he waves threateningly at the viewer. The second confederate increases his attempt to remove his irate friend and manages to convince him that they should leave the laboratory. The irate confederate is unwillingly forced out of the laboratory by his friend who utters a warning to the viewer as both confederates leave and slam the laboratory door shut. In the control video-tape condition, the first confederate enters the laboratory, realises that the experimenter is not there and consequently asks where she is and how long she will be (again directed to the viewer of the video-tape). Moments later the second confederate hurries into the laboratory to find his friend has not found the experimenter. He warns him that they will be late for a meeting if they do not hurry. The first confederate asks if they can leave a message for the experimenter. He writes a message down and leaves it on a side table asking the viewer of the videotape to point it out when the experimenter returns. Both intruders thank the viewer for his help and leave the laboratory quietly closing the door. Each video-taped incident lasted approximately 30 seconds and, as for Studies One and Two, both conditions were matched for detail. For example, in terms of actions such as the ruler being picked up. In addition, during each interaction both confederates directed all their attention solely towards the

camera. Furthermore, each incident was filmed from exactly the same angle, to ensure the same viewpoint for both, and from the same distance as would have been viewed by the victims within Studies One and Two.

6.2.5 Procedure

Participants were run individually. Upon arrival in the laboratory participants were seated at a desk where they were attached to the physiological recording apparatus and heart rate recording commenced. At this point the experimenter covertly started recording with a stopwatch so that the time at which the participant watched the video-taped incident could be coordinated with the corresponding point in the recorded heart rate data. After the heart rate monitoring equipment had been attached and initial recording commenced, participants were allowed between 6 and 7 minutes in which to relax before experimental measurements began. Baseline heart rate was calculated as the average heart rate over a two minute period immediately following this initial rest period. Following this they completed the Spielberger State-Trait Anxiety Inventory, Form Y-1 (Spielberger et al., 1970), as a measure of state arousal. Next, the participants in the exercise condition were asked to get onto the exercise cycle and to cycle at an initially allocated low resistance level. Heart rate was monitored and the cycling workload gradually increased over a period of approximately 5 minutes until the workload was at an appropriate level to create the desired heart rate. Although the resistance level required varied from participant to participant, due to differing fitness levels, the resistance level was increased gradually to produce a heart rate of approximately 140 beats per minute in the exercising group. Once the desired heart rate level was reached, participants were requested to continue cycling at that resistance level for five more minutes at which point they would be informed they could stop. It was explained to the resting group that they were a comparison group with those exercising and consequently they were simply asked to sit on the bicycle and relax. Whilst the participant was sitting or cycling at the desired level the experimenter secretly pressed the play button on the video recorder, covertly noted the stopwatch time for later correspondence of incident occurrence and heart rate data, and stated that she had to leave the room to "collect some

forgotten test sheets". She promised to be back in a minute, stressed that the participant should continue pedaling at the desired level and then left the room. Participants in the resting condition were simply informed to remain seated on the bicycle. Whilst the experimenter was out of the room, the video-tape was playing with nothing showing on the screen initially. Suddenly a noise occurred with an accompanying flash of colour from the television screen, to ensure the participant's attention was attracted to it, followed 2 seconds later by the video of the relevant incident for that condition. Following the short incident presentation, the screen went blank again and the participant was given approximately 2 minutes further in which to continue pedaling or sitting on the bicycle before the experimenter returned and informed the participant that a memory test was about to take place. At this point, the participant ceased cycling or sitting on the bicycle and dismounted, the electrode belt and wrist receiver were removed, the participant was seated back at the original desk and allowed a few moments to relax. He was then informed that he was required to complete five further tests about himself and the video-taped incident. This final stage of testing commenced with the participant completing the MacKay Mood Adjective Checklist (MacKay et al., 1978) as a retrospective measure of their self-reported arousal whilst watching the video-taped incident. Following this, participants were asked a single free recall question regarding exactly what had happened during the video-taped incident, followed by a cued recall test consisting of three questions prompting recall for information on: the appearance of the intruders, verbal aspects of the interaction, and the physical behaviour of the intruders. Participants' verbal responses were audio-taped for later transcription. This measure was identical to that used in Studies One and Two. Next, participants completed a questionnaire consisting of forced-choice questions and further manipulation checks (i.e., ratings of how they felt whilst watching the video-taped incident). These questionnaires were based on those used within Study Two. Following this, they were shown two 6-person sequential photographic lineups, one for each intruder. Presence or absence of the intruders within each of the lineups and the position of the intruders within the target-present lineups were completely randomised across all participants. Each lineup was constructed

following recommendations for properly conducted sequential lineups (Koehnken et al., 1996; Lindsay et al., 1991; Wells et al., 1994; Wells et al., 1998). Finally, participants completed a self-report questionnaire concerning their experience of the cycling in terms of emotions experienced as well as perceived exertion and any attentional demands of cycling or sitting on the bicycle whilst watching the video (see Appendix 8 for full details of the questionnaire). After completion of all of the tests, participants were thoroughly debriefed.

6.2.6 Recall scoring methodology

The recall scoring procedure employed was based upon the widely used Statement Analysis Procedure described by Yuille & Cutshall (1986). This procedure was identical to that utilised in Studies One and Two and is described in detail in the methodology of Study One within Chapter Five.

6.2.7 Manipulation checks

Figure 27 shows the mean baseline heart rate and heart rate progression over the periods prior to and during (both 30 second periods) which the participants watched the videos and immediately after watching the videos (60 second period).

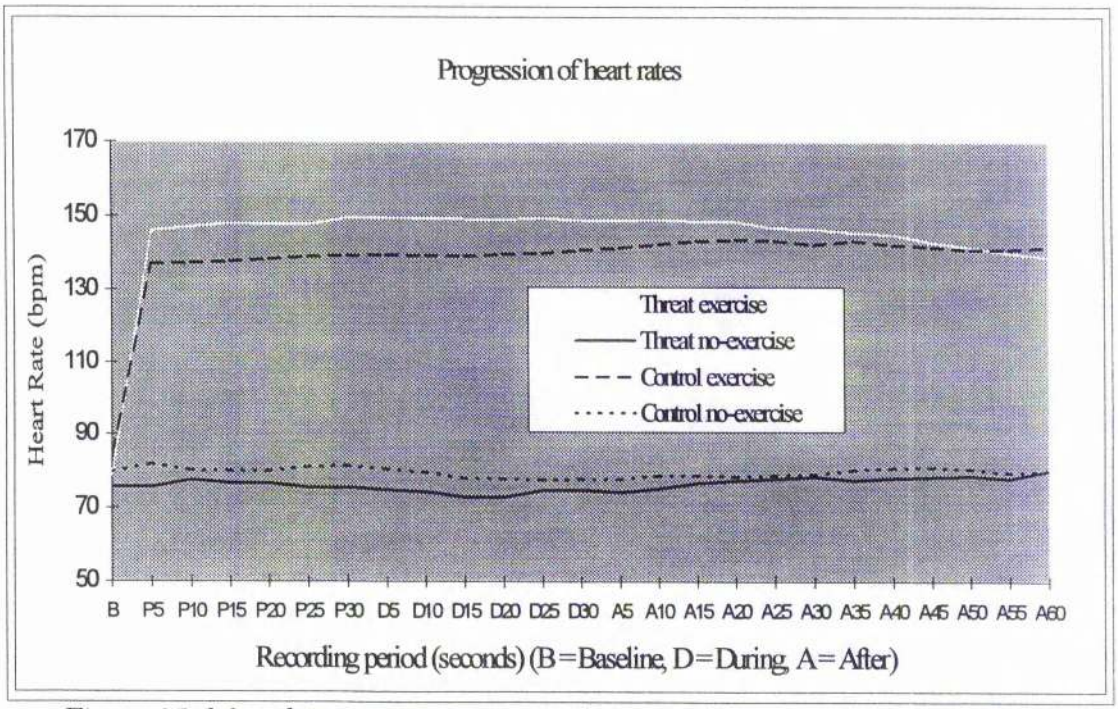

Figure 27: Mean heart rate progression during and after watching the videos.

Across all witness groups, analysis of covariance, with baseline as the covariate, revealed that, as expected, during the videos, and immediately after watching the videos, the participants who exercised were significantly more aroused than those resting ($F(1, 59) = 837.14$, $p < 0.001$, and $F(1, 59) = 879.09$, $p < 0.001$, respectively; all statistical output for this study is shown in Appendix 11). Interestingly, both during and after watching the videos, it was also revealed that those in the threat video group were significantly more aroused than those in the control video group ($F(1, 59) = 7.82$, $p < 0.01$, and $F(1, 59) = 5.81$, $p < 0.05$, respectively).

More importantly, however, during the videos an interaction of video by arousal was obtained ($F(1,59) = 11.49$, $p < 0.005$). Post-hoc Tukeys tests, conducted using standardized residual values of the heart rate data, in order to account for baseline variation of participants' resting heart rate levels, revealed that of the participants watching the threatening video those exercising were more aroused than those resting ($p < 0.001$). Similarly, of the participants watching the control video those exercising were more aroused than those resting ($p < 0.001$).

In line with the finding that participants watching the threat video were more aroused than those watching the control video, participants exercising whilst watching the threat video were more aroused than those exercising whilst watching the control video ($p < 0.001$). There were, however, no differences between participants resting whilst watching the threat video and those resting whilst watching the control video.

Immediately following the incident, however, an interaction of arousal with video just missed significance ($p = 0.057$).

In terms of self-reported arousal, analysis of variance (ANOVA) revealed that participants within the control video group were higher in state arousal (STAI) than participants within the threat video group ($F(1,60) = 7.61$, $p < 0.01$; see

Table 25). There were no differences in state arousal between those exercising and those resting overall or within the video groups.

Despite a difference in physiological arousal, no differences were revealed between the exercising and resting groups during the experiment on the Stress or Arousal Scale of the MacKay Mood Adjective Checklist (see Table 25).

Participants were also required to make retrospective judgments on 6-point rating scales regarding how threatened, angry and afraid they felt both whilst they watched and immediately after watching the videos. As expected, analyses revealed that there were no significant rated differences between any of the witness groups.

	State Arousal (STAI, Y-1)	Arousal During (Mackay Arousal Scale)	Stress During (Mackay Stress Scale)
Threat Exercise	29.00 (7.25)	4.38 (1.45)	2.06 (2.17)
Threat Rest	30.69 (5.55)	3.31 (1.74)	1.13 (1.86)
Threat Total	29.84 (6.41)	3.84 (1.67)	1.59 (2.05)
Control Exercise	33.63 (7.00)	3.88 (1.93)	1.19 (1.76)
Control Rest	36.44 (9.69)	3.31 (1.99)	1.88 (2.33)
Control Total	35.03 (8.44)	3.59 (1.95)	1.53 (2.06)

Table 25: Mean (SD) STAI and Mackay Mood Adjective Checklist scores.

Finally, participants also completed a series of rating questions concerning the experience of either exercising or sitting on the bike, if they were in the rest groups (see Table 26). In support of the physiological results, these revealed that the exercising participants rated the experience of being on the bicycle as; significantly more arousing ($F(1,60) = 23.53$, $p < 0.001$); more difficult cycling/sitting ($F(1,60) = 44.82$, $p < 0.001$); more stressful ($F(1,60) = 25.76$, $p < 0.001$); more enjoyable ($F(1,60) = 11.62$, $p < 0.005$); and more difficult

cycling/sitting while watching the video ($F(1,60) = 17.45$, $p < 0.001$) than the resting participants.

Although the exercising participants also reported devoting more attention to the bicycle ($F(1,60) = 29.92$, $p < 0.001$), importantly they did not consequently rate themselves as having devoted less attention to the video in comparison to the resting participants.

Question	Exercise Group	Rest Group
How arousing sitting / cycling?	2.63 (1.18)	1.38 (0.83)
How difficult sitting / cycling?	2.56 (0.98)	1.19 (0.64)
How stressful sitting / cycling?	2.06 (0.95)	1.13 (0.42)
How enjoyable sitting / cycling?	2.69 (1.12)	1.81 (0.93)
How difficult sitting / cycling & watching?	2.69 (1.64)	1.34 (0.75)
How much attention to sitting / cycling?	3.03 (1.18)	1.68 (0.74)
How much attention to video?	3.03 (1.23)	3.44 (1.39)

Table 26: Mean (SD) ratings concerning experience of cycling or sitting on the bicycle (1 = not at all/none to 6 = extremely/all).

Finally, correlations were conducted across the exercising witnesses to see whether participants' physiological arousal during the videos was correlated with the measures of rated arousal whilst cycling or rated attention devoted to watching the video. Standardized residual values of the heart rate data were used in order to account for baseline variation of participants' resting heart rate levels. However, none of the correlations proved to be significant.

6.3 Results

6.3.1 Percentage of available details recalled

From Table 27 it can be seen that there were no differences between the witness groups in terms of the mean percentage of available details free recalled, cue recalled or, therefore, recalled in total.

In order to investigate whether, in line with the conclusions of earlier studies (Burke et al., 1992; Heuer et al., 1997; Safer et al., 1998), aroused witnesses (i.e., the participants exercising) might recall a greater percentage of the available details relating to the central aspects of the videos, the information recalled was grouped into two categories. On the basis of definitions employed in the studies presented in Chapter Five and existing studies (Burke et al., 1992; Christianson & Loftus, 1991; Heuer & Reisberg, 1990), the details were classified according to whether they were central (i.e., information required to make sense of the situation, such as threatening actions) or peripheral (i.e., irrelevant information not required to make sense of the situation, such as clothing colour). ANOVAs conducted on the data classified in this manner revealed no significant differences between any of the groups.

	Free Recall	Cued Recall	Total Recall
Threat Exercise	10.76 (4.54)	8.79 (4.20)	19.55 (7.56)
Threat Resting	10.57 (3.52)	8.11 (3.09)	18.67 (5.37)
Total	10.66 (4.00)	8.45 (3.64)	19.11 (6.46)
Control Exercise	10.37 (3.94)	8.87 (3.91)	19.24 (5.83)
Control Resting	13.55 (4.87)	7.34 (3.85)	20.88 (6.44)
Total	11.96 (4.65)	8.10 (3.90)	20.06 (6.10)

Table 27: Mean (SD) percentage of available details recalled.

As the incidents portrayed in the videos involved two intruders, in line with Studies One and Two the percentage of available details recalled were classified according to whether they pertained to intruder 1 or intruder 2. This was carried

out on the basis that intruder 1 was the leading/predominant individual in both of the videos and may, therefore, have attracted more of the witnesses attention, especially in the video-taped threatening incident. Intruder 1's greater presence does, of course, mean that there were a greater number of details pertaining to him. By considering the percentage of available details reported, however, this potential bias is counteracted.

For free and total recall interactions of information type (intruder 1 / intruder 2) with video type were obtained $F(1,60) = 18.16$, $p < 0.001$, and $F(1,60) = 12.29$, $p < 0.005$ respectively (see Figures 28 and 29). Post-hoc Tukey tests did not, however, reveal significant differences between the witness groups for either interaction (see Table 28).

	Intruder 1			Intruder 2		
	Free	Cued	Total	Free	Cued	Total
Threat Exercise Threat Rest	12.37 (6.15)	9.24 (4.16)	21.61 (8.40)	8.63 (3.87)	8.19 (5.10)	16.81 (7.60)
	11.50 (3.81)	7.65 (3.28)	19.15 (5.14)	9.33 (3.56)	8.71 (5.05)	18.05 (7.28)
Threat Total	11.94 (5.05)	8.44 (3.77)	20.38 (6.96)	8.98 (3.68)	8.45 (5.00)	17.43 (7.35)
Control Exercise Control Rest	12.68 (4.80)	9.78 (5.17)	22.46 (7.31)	6.82 (3.99)	7.39 (4.14)	14.21 (5.72)
	17.26 (5.60)	6.87 (4.48)	24.13 (6.76)	7.86 (5.02)	8.05 (4.38)	15.91 (6.95)
Control Total	14.97 (5.63)	8.32 (4.98)	23.30 (6.98)	7.34 (4.49)	7.71 (4.20)	15.06 (6.32)

Table 28: Mean (SD) percentage of available details recalled for intruder 1 & 2.

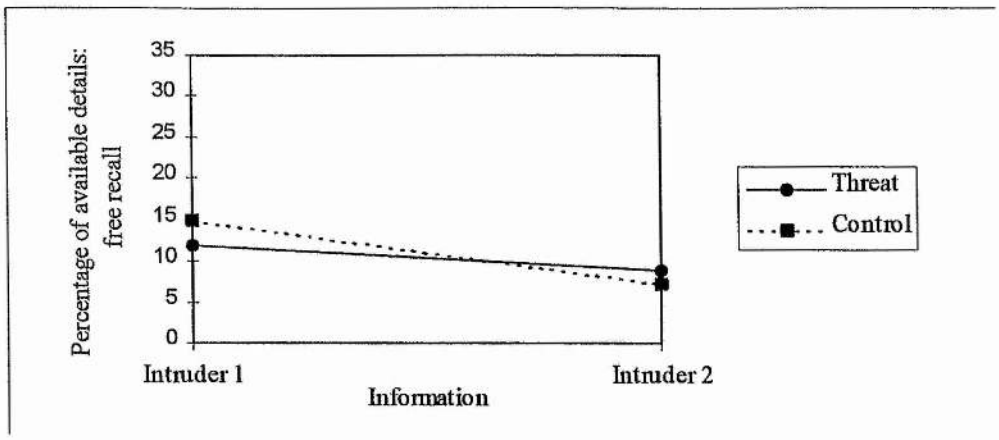

Figure 28: Mean percentage of available details free recalled as a function of information and video type.

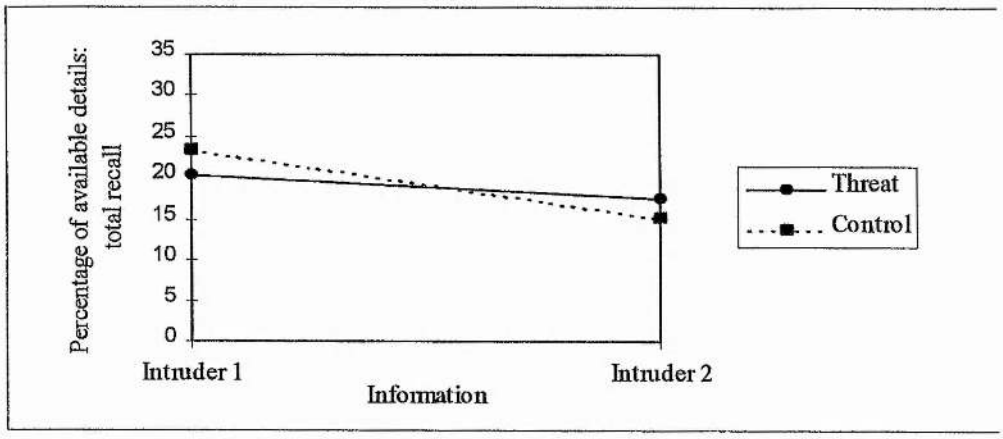

Figure 29: Mean percentage of available details recalled in total as a function of information and video type.

In addition, for free recall a three-way interaction of information, video and arousal type was obtained ($F(1,60) = 5.41$, $p < 0.05$; see Figure 30). Despite this, post-hoc Tukey tests did not reveal a difference between any of the witness groups. Similarly, for cued recall post-hoc tests did not reveal any differences between groups despite an interaction of information type and arousal level ($F(1,60) = 5.38$, $p < 0.05$; see Figure 31).

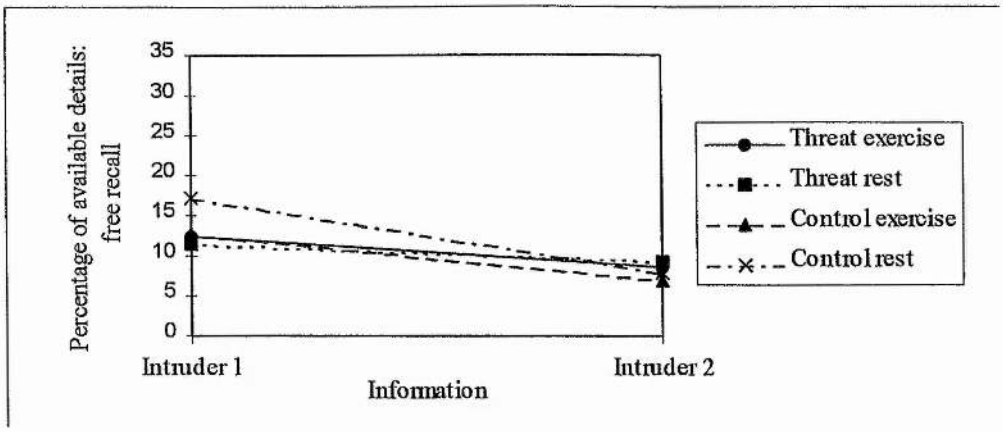

Figure 30: Mean percentage of available details free recalled as a function of information type, arousal level and video type.

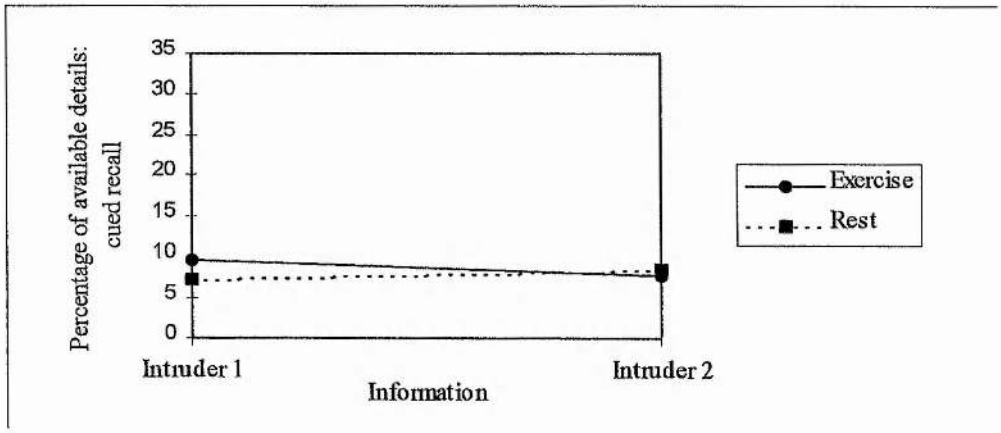

Figure 31: Mean percentage of available details cue recalled as a function of arousal level and information type.

Finally, classification according to the percentage of available action, verbal or appearance related details was made, but revealed no significant main effects or interactions.

To further analyse whether physiological arousal during or after watching the videos may have had an impact on the percentage of available details reported, Pearson Product-Moment correlations were conducted across the witnesses within the exercise group ($N = 32$). These revealed significant correlation coefficients suggesting that as physiological arousal during the video rose so too did: cued recall pertaining to peripheral details ($r = .445$, $p < 0.05$); cued recall pertaining to

intruder 2 ($r = .393$, $p < 0.05$); cued recall pertaining to appearance details ($r = .410$, $p < 0.05$); total recall overall ($r = .350$, $p = 0.05$); total recall pertaining to peripheral details ($r = .411$, $p = 0.05$); and total recall pertaining to appearance details ($r = .384$, $p = 0.05$). Similarly, significant correlation coefficients suggest that as physiological arousal after the video rose so too did: cued recall overall ($r = .359$, $p < 0.05$); cued recall pertaining to peripheral details ($r = .474$, $p < 0.01$); cued recall pertaining to intruder 2 ($r = .439$, $p < 0.05$); cued recall pertaining to appearance details ($r = .429$, $p < 0.05$); total recall overall ($r = .402$, $p = 0.05$); total recall pertaining to peripheral details ($r = .442$, $p = 0.05$); total recall pertaining to intruder 1 ($r = .380$, $p = 0.05$); total recall pertaining to intruder 2 ($r = .358$, $p = 0.05$); and total recall pertaining to appearance details ($r = .430$, $p = 0.05$). However, inspection of the scatterplots for these correlations (see Appendix 11), suggests that none of them can be accepted as demonstrative of real relationships.

Furthermore, Spearman correlations of rated arousal whilst cycling revealed significant positive correlation coefficients suggesting that as rated arousal rose so did: free recall pertaining to action details ($r = .395$, $p < 0.05$); cued recall pertaining to peripheral details ($r = .360$, $p < 0.05$); cued recall pertaining to intruder 2 details ($r = .408$, $p < 0.05$); total recall overall ($r = .397$, $p < 0.05$); and total recall pertaining to intruder 2 ($r = .416$, $p < 0.05$). Once again, however, inspection of the scatterplots for these correlations (see Appendix 11), suggests that none of them can be accepted as demonstrative of real relationships.

However, as can be seen from Tables 27 and 28, the percentage of available details that the participants reported was very low. Hence, they may have been reporting only the details they felt highly confident on, thus not providing such a useful indication of the possible extent of their memories for the event. This is fundamentally why the use of recognition tests in addition to recall tests helps to tease out differences in such circumstances where participants may be selectively reporting recall on the basis of high confidence criterion levels. Although there were no significant differences in terms of the percentage of available details

recalled, it is essential to consider the accuracy of the information recalled in order to assess the extent to which there may be memory differences. For example, although two participant groups may recall the same percentage of available details, one group's accuracy may have been higher, therefore indicating a superior memory for the incident.

6.3.2 Accuracy of recall

Accuracy scores were calculated as the percentage of details recalled that were correct. Table 29 shows the overall accuracy scores for free recall, cued recall and total recall. An ANOVA conducted on this data revealed no significant differences between any of the groups.

	Free Recall	Cued Recall	Total Recall
Threat Exercise	88.88 (9.94)	68.60 (16.71)	79.50 (8.89)
Threat Rest	88.57 (10.31)	67.02 (12.80)	78.75 (9.20)
Threat Total	88.72 (9.96)	67.81 (14.67)	80.79 (8.47)
Control Exercise	90.75 (7.10)	72.03 (16.06)	82.07 (8.11)
Control Rest	90.87 (6.45)	60.33 (16.00)	80.32 (8.56)
Control Total	90.81 (6.67)	66.18 (16.85)	79.54 (8.78)

Table 29: Mean percentage (SD) recall accuracy for free, cued and total recall.

As with the percentage of available details recalled, the details were grouped according to a variety of classification criteria. Firstly, when the data were classified as central or peripheral, there were no significant differences. Classification of the details according to which intruder they related to, however, revealed a three-way interaction for free recall, $F(1,60) = 5.76$, $p < 0.05$ (see Figure 32). However, post-hoc Tukey tests failed to revealed any differences amongst the groups (see Table 30).

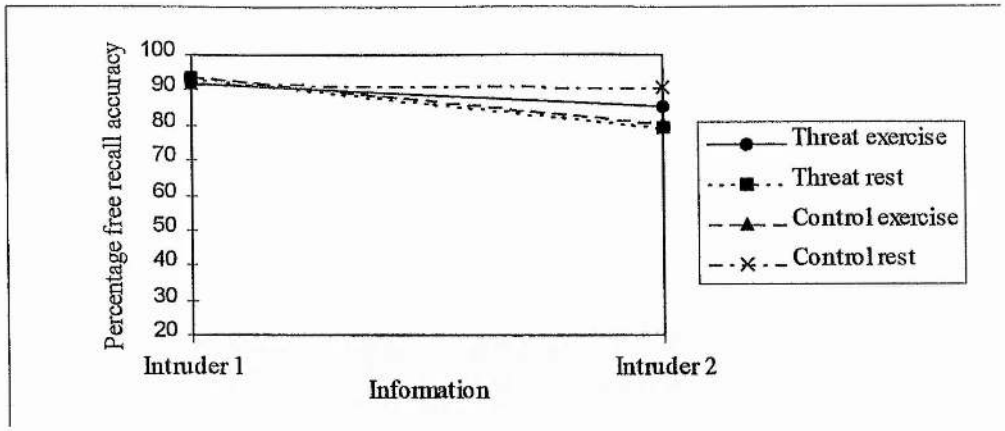

Figure 32: Mean percentage free recall accuracy as a function of information type, arousal level and video type.

	Intruder 1	Intruder 2
Threat Exercise	91.59 (9.73)	85.26 (16.07)
Threat Rest	93.50 (8.12)	79.42 (18.55)
Threat Total	92.54 (8.87)	82.34 (17.33)
Control Exercise	94.22 (7.06)	80.28 (17.56)
Control Rest	91.83 (6.60)	90.54 (13.65)
Control Total	93.02 (6.83)	85.41 (16.32)

Table 30: Mean (SD) free recall accuracy for intruder 1 and intruder 2.

Finally, when the data were classified according to whether they related to action, verbal or appearance details, no significant interactions were revealed.

Once again, to further analyse whether physiological arousal may have an impact on the accuracy of details reported, Pearson Product-Moment correlations were conducted. One significant correlation coefficient was revealed suggesting that as heart rate after the video dropped, so too did recall accuracy for cued recall pertaining to intruder 2. However, inspection of the scatterplot for this correlation indicates that it is not representative of a real relationship (see Appendix 11). Similarly, Spearman correlations of rated arousal whilst cycling with the various measures of recall accuracy were conducted but were not found to be significant.

6.3.3 Recognition accuracy

The recognition questionnaires for both the threatening and control conditions consisted of 43 four-alternative (4AFC) forced choice questions. However, due to differences in the number of questions pertaining to different aspects of the incidents (i.e., action, verbal and appearance related details), recognition accuracy was calculated as a percentage.

In terms of overall accuracy, ANOVA revealed that witnesses watching the threatening video were just significantly higher in accuracy ($M = 53.42$, $SD = 6.83$) than those watching the control video ($M = 49.71$, $SD = 7.81$), $F(1,60) = 4.10$, $p < 0.05$.

Using the same criteria as for the recall data, we grouped the questions according to whether they concerned central or peripheral detail information. The mean recognition accuracy for these groups are shown in Table 31. ANOVA on these data revealed an interaction of video by information ($F(1,60) = 5.62$, $p < 0.05$; see Figure 33) for which post-hoc Tukey tests revealed that, although there was no difference in terms of peripheral details, participants watching the threatening video were more accurate for central detail questions than were those watching the control video ($p < 0.005$).

	Central	Peripheral
Threat Exercise	59.77 (14.25)	49.54 (9.74)
Threat Rest	60.55 (13.25)	49.31 (9.44)
Threat Total	60.16 (13.54)	49.42 (9.44)
Control Exercise	48.33 (15.11)	47.55 (6.35)
Control Rest	52.50 (12.38	51.12 (8.22)
Control Total	50.42 (13.75)	49.33 (7.45)

Table 31: Mean percentage (SD) accuracy of central and peripheral 4AFC recognition questions.

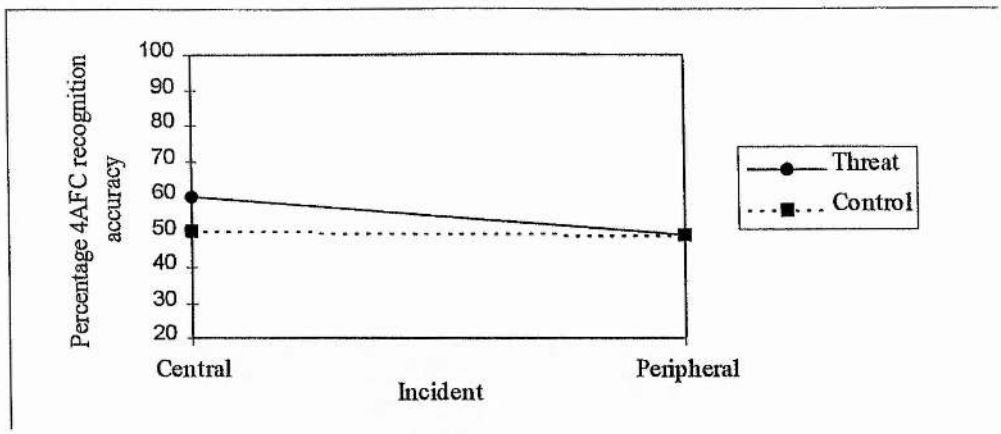

Figure 33: Mean percentage 4AFC recognition accuracy as a function of information and incident type.

Further classification, according to which of the two intruders the questions referred, revealed no significant differences. Finally, the questions were grouped according to whether they related to action, verbal or appearance details (see Table 32). ANOVA conducted on these data revealed an interaction of video by information type ($F(1,60) = 5.78$, $p < 0.005$; see Figure 34). Post-hoc Tukey tests revealed that the participants who watched the threat video were more accurate for action-related questions than were those who watched the control video ($p < 0.001$).

	Action	Verbal	Appearance
Threat Exercise	72.16 (15.02)	36.88 (17.02)	51.42 (11.70)
Threat Rest	72.16 (14.65)	35.63 (10.31)	52.27 (12.08)
Total	72.16 (14.59)	36.25 (13.85)	51.85 (11.71)
Control Exercise	53.98 (18.33)	34.38 (12.63)	50.85 (8.82)
Control Rest	61.93 (17.32)	34.38 (8.92)	54.26 (8.38)
Total	57.96 (18.00)	34.38 (10.76)	52.56 (8.64)

Table 32: Mean percentage (SD) accuracy of action, verbal, and appearance recognition questions

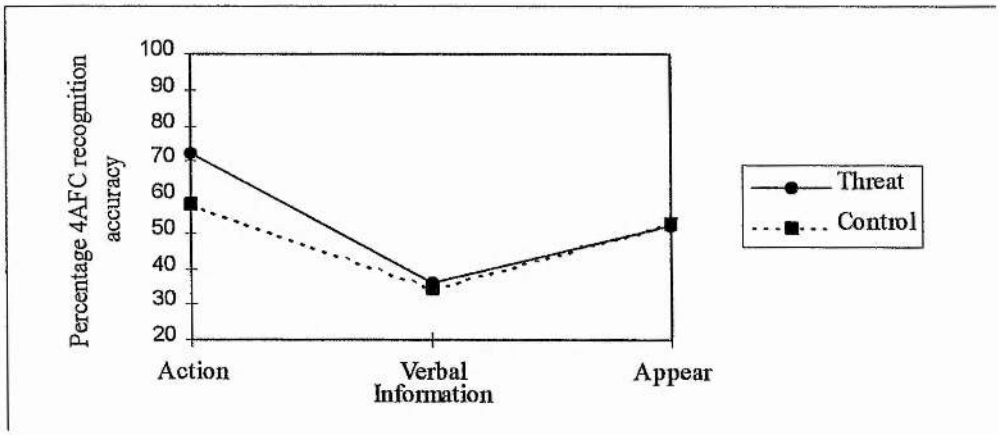

Figure 34: Mean percentage 4AFC recognition accuracy as a function of information and incident type.

Once again, to further analyse whether physiological arousal may have an impact upon recognition accuracy, Pearson Product-Moment correlations were conducted, but revealed no significant correlations. However, Spearman correlations of rated arousal whilst cycling with recognition accuracy revealed two significant correlation coefficients suggesting that the lower participants' rated their arousal whilst cycling to be the lower their 4AFC recognition accuracy was for peripheral details ($r = -.454$, $p < 0.01$) and appearance details ($r = -.368$, $p < 0.05$). Inspection of the scatterplots associated with these correlations, however, reveals that they cannot be accepted as demonstrative or real relationships (see Appendix 11).

6.3.4 Identification

In line with Studies One and Two, witnesses' identification decisions for the lineups were classified as correct or incorrect (see Table 33).

In terms of lineup 1 (Intruder 1), a three-way log-linear analysis involving video, arousal and decision types was conducted but revealed no significant relationships (see Appendix 10).

In terms of lineup 2 (Intruder 2), cell sizes were too small to conduct reliable analysis across incident, witness and decision types. When the data are collapsed across arousal type, however, it is acceptable to make comparisons. Consequently, a two-way χ^2 test of association was conducted across video and decision types, but did not reveal a significant relationship.

	Lineup 1		Lineup 2	
	Correct	Incorrect	Correct	Incorrect
Threat Exercise	6	10	7	9
Threat Rest	7	9	6	10
Threat Total	13	19	13	19
Control Exercise	7	9	2	14
Control Rest	6	10	5	11
Control Total	13	19	7	25

Table 33: Number of correct and incorrect identification decisions.

Finally, Point-biserial correlations were conducted across the exercise witnesses. However, no significant correlation coefficients were revealed when heart rate during and after the incident (standardized residual values of the heart rate data in order to take account of baseline heart rate values), as well as rated arousal whilst cycling were correlated with identification decision.

6.4 Discussion

The finding of no significant interaction between level of arousal and either the type of video-taped incident viewed or the type of information viewed, suggests that level of physiological arousal, as induced via exercise, does not influence

memory. In addition, physiological arousal was not found to be correlated with any of the memory measures, further suggesting that physiological arousal does not influence memory.

Whilst physiological arousal does not appear to have influenced memory, those watching the video-tape of the threatening incident showed significantly enhanced recognition memory for central and action related details in comparison to those watching the video-taped control incident, suggesting that something inherent in the differing nature of the threatening incident relative to the control incident exerted a facilitating effect upon participants' memories.

6.4.1 Influence of physiological arousal

In terms of the success of the manipulation, objective and self-report checks confirmed that exercise was successfully used to create participant groups significantly higher in physiological arousal than resting groups, both during and immediately after the presentation of the video-taped stimuli. By inducing physiological arousal via a source un-associated with the to-be-remembered material, it was possible, therefore, to investigate whether physiological arousal exerts an influence upon memory in the absence of psychological arousal such as perceived threat. On this basis, if physiological arousal may affect memory on its' own, we would have expected to see differences between those exercising and those resting, irrespective of whether they watched the video-tape of the threatening or control incident.

However, the failure to find any effects of exercise, or physiological arousal, across witnesses to both video-taped incidents, suggests that level of physiological arousal, as induced via exercise, does not influence memory. Furthermore, in line with the findings of Studies One and Two, physiological arousal was not found to correlate with any of the memory measures.

A possible counter explanation which could be leveled against this interpretation, however, relates to the fact that as the aroused participants were cycling, they may

have been less able to devote as much attention to the video-taped incidents as were the participants sitting on the bicycle but not cycling. On this basis, it could be argued that any facilitating effects of physiological arousal might have been mitigated, serving to reduce the memory performance of those exercising to a level more like that of the resting participants. Although this is a valid alternative explanation, in this study whilst the participants cycling rated themselves as having devoted more attention to the bicycle, they did not consequently rate themselves as having devoted less attention to the video-taped incident.

The finding of no influence of physiological arousal upon memory is directly in line with the findings of Study Two presented within Chapter Five and with the small amount of existing research investigating this relationship. Specifically, Christianson & Mjorndal (1985) found no subsequent memory differences for a control series of slides when participants were differentially aroused via injection with either adrenalin or saline. Similarly, in a slight variation of their earlier work Christianson et al. (1986) found that, whilst physiological and self-report data showed participants injected with adrenalin and shown a neutral slide series were aroused to an equivalent level as participants injected with saline and shown facial injury slides, those shown the facial injury slides and injected with saline performed below those injected with adrenalin and shown neutral slides when tested using a recall memory test for the verbal descriptors associated with the slide sequences.

In short, the results of this study provide further evidence to suggest that physiological arousal un-associated with the to-be-remembered event has neither a debilitating nor facilitating influence upon memory

6.4.2 Relationship between physiological and psychological arousal

Despite manipulating a difference in physiological arousal between participants exercising and those simply sitting on the bicycle, no differences were revealed on the Stress or Arousal Scale of the MacKay Mood Adjective Checklist, suggesting that psychological arousal and physiological arousal are not the same.

Furthermore, correlations were conducted across the exercising witnesses to see whether participants' physiological arousal during the videos was correlated with the measures of rated arousal whilst cycling or rated attention devoted to watching the video and none of the correlations proved to be significant, further suggesting that they are not related.

These findings are directly in line with both Studies One and Two, where patterns of psychological arousal among the witness groups were not found to mirror patterns of physiological arousal, and measures of the two arousal types were not found to correlate. As discussed in Chapter Five, this is not necessarily as expected, as one might predict that witnesses rating themselves higher in arousal, would also be higher in physiological arousal. Arguably, this highlights the problem of using introspective self-reports to measure cognitive affect. The extent to which one individual rates affect or places a criterion level between feeling aroused or un-aroused, for example, may vary considerably. This highlights the importance of using objective manipulation checks.

Brigham et al. (1983), which appears to be the only other eyewitness study which has made an attempt to correlate physiological and psychological arousal measures, also failed to find a relationship between three different measures of physiological and self-reported arousal.

6.4.3 Differential interest

Importantly, those viewing the video-tapes of the threatening and control incidents did not differ in terms of their self-reported anger or perceived threat experienced whilst viewing the incidents, although they did differ in physiological arousal both during and immediately after viewing the video-taped incidents. Whilst this is an unfortunate confound manifest in this study, based on the finding of no difference between participants exercising and those resting, either within or between incidents, it would appear that the memory differences observed between participants viewing the two different incidents are not a function of physiological arousal.

Participants in the control condition were, however, found to be higher in state arousal than those in the threat condition. Based on the findings that those viewing the threat video-tape demonstrated superior memory to those viewing the control video-tape, this could mean that the control group's higher state arousal had a debilitating effect upon their memory. However, existing research suggests that subjects higher in state anxiety may deploy attention towards threat-related stimuli (MacLeod, Mathews & Tata, 1986; MacLeod & Mathews, 1988). As the control condition incident was not rated as more threatening or stressful in comparison to the threatening condition incident it is argued that in this study state arousal most likely had no influence upon the memories of participants within the control condition.

Fundamentally, it would appear that in the study presented here the threatening video-taped incident may have been inherently more unusual, interesting or attention catching in some way relative to the control video-taped incident. This is an enlightening finding and calls into question the findings of existing research into the effects of emotion upon memory which has presented participant groups with stimuli which are, at least in part, different (e.g., Christianson & Loftus, 1987; Christianson & Loftus, 1991; Clifford & Hollin, 1981; Heuer & Reisberg, 1990; Kebeck & Lohaus, 1986). Where the results of such studies have been interpreted to suggest that differences in memory performance reflect differing emotion or arousal levels, often without supporting evidence from manipulation checks, any differences in memory performance may actually have been due to something inherently more unusual, attention catching or simply more interesting about the emotional stimuli relative to the neutral stimuli.

Indeed, this may explain why Christianson et al. (1986) found that, despite no difference in level of physiological arousal, participants injected with saline and presented with slides of facial injuries performed differently than participants injected with adrenalin and shown a neutral slide series. Arguably, differential interest in the facial injury slides may have accounted for the poorer memory

performance of participants viewing them. Indeed, as memory for verbal descriptors accompanying the slides was tested, the results suggest that participants may have spent more time looking at the facial injury slides to the detriment of the descriptors. Had memory for the facial injury slides been tested, participants may have demonstrated a superior memory performance.

In support of the findings of the study presented here, while it has been shown that people fixate more often and for a longer duration on emotional information (Loftus et al., 1987), research has also demonstrated that objects which are incongruous result in earlier, more frequent, and longer eye fixations than more probable or congruous objects do. For example, Loftus & Mackworth (1978) demonstrated that participants fixated more often and for a longer duration on an octopus in a farm scene than they did usual farm animals.

Furthermore, Mitchell et al. (1998) found that, in line with a weapon focus style phenomena, participants who watched a videotaped scene in which a stick of celery was brandished were actually poorer at remembering details of the perpetrator's appearance than when participants saw a gun brandished, thus showing that it is possible to produce a similar 'weapon focus effect' by using unusual or novel but non-threatening objects.

Christianson & Loftus (1991) specifically set out to explore the effects of the unusualness or novelty of information on memory. They conducted a series of studies where participants were presented with a slide sequence in which the middle slide varied according to three different conditions; a neutral condition, in which the middle slide depicted a woman riding a bicycle; an emotional condition, in which the middle slide depicted an injured woman lying on the ground beside a bicycle, or an unusual condition, in which the middle slide depicted a woman carrying a bicycle upside down on her shoulder. In terms of recalling the central details of the slides, participant witnesses performed equally well in all three conditions, although this was associated with reduced recall of peripheral details in both the emotional and unusual conditions.

When participant witnesses' memories were tested for only the different middle slide in each sequence, however, the unusual group performed poorer on both central and peripheral information in comparison to the emotional group who still performed better on central information with an associated reduction in recall for the peripheral information.

Christianson and Loftus interpreted these results to suggest that, in contrast to the neutral condition, in both the emotional and unusual conditions attention was drawn away from the peripheral or background information in the slides to the central information. They suggest that for the critical slide, participants in the unusual condition were poorer on central details as well as peripheral details because they may have spent more time elaborating on the event itself, such as why someone would be carrying a bicycle on their shoulder, whereas the emotional group may have elaborated more about the actual woman lying injured on the ground rather than the event per se. In support of this, reports provided by participants suggested that differential elaboration occurred depending on whether they viewed the emotional, unusual or neutral slide sequence. In particular, those viewing the unusual condition slides indicated that, although they were as concerned about the central action of the critical slide as the emotional group were, they were less specific concerning elaboration about the woman in the slides.

The memory measures utilised in this study were, however, only focused on recall for the colour of coat the woman was wearing (classified as a central detail) and the colour of a car in the background (classified as a peripheral detail). Hence, this did not enable a detailed measure of memory to be made. In addition, it suggests that the colour of the woman's coat was central detail information. Based upon definitions used in other studies this would have been termed peripheral information not central to the basic story line (e.g., Heuer & Reisberg, 1990).

Critically, however, what is highlighted by the study presented here and the small amount of existing research is that, while emotion may exert an influence upon memory, in order to be able to infer whether differences in memory are in fact due to the emotional or arousing nature of stimuli rather than other confounding factors such as differential interest, future research should take care to ensure that confounds associated with the use of different stimuli are removed and that comparisons are made within experimental conditions rather than between them.

6.4.4 Personal involvement

As set out at the beginning of this chapter, another facet of this study is the possibility to review live-event versus video-tape presentation methodologies. For example, comparison of the findings of Studies One and Two, where participants experienced the threatening incident as a live-event, with the findings of this study, where participants view the threatening incident via video-tape, may provide insight into the potential effects of personal involvement upon memory.

Firstly, it was predicted that if memory differences emerged between participants viewing the threatening and control video-tapes, these would probably be in the form of enhanced memory for central details associated with a decrement in performance for more peripheral detail, in line with existing laboratory research, as the participants were not personally involved with the incident.

In contrast, while there were no differences concerning the percentage of available details recalled or the accuracy of those details, participants viewing the video-tape of the threatening incident showed superior recognition memory overall as well as for central and action details, but without a detriment to their recognition memory for peripheral details.

Interestingly, then, even though the participants in this study were not personally involved, the results differ from existing studies where participants have also not been personally involved (i.e., studies of visually-induced arousal), which have tended to demonstrate that enhanced memory for central details is to the detriment

of memory for peripheral details (Burke et al., 1992; Christianson & Loftus, 1987; Safer et al., 1998).

Enhanced memory for central details without detriment to peripheral details has only been reported in two other laboratory study of visually-induced arousal (Christianson, 1984; Heuer & Reisberg, 1990). However, although Heuer & Reisberg (1990) found a memory advantage for peripheral details, it was not directly attributable to the arousal-inducing aspects of the slide presentation employed, but was instead confined to the slides presented after the critical arousal-inducing phase.

A possible explanation for the threat group's memory maintenance for peripheral details observed in the study presented here, is that the style of the incidents was somewhat novel and may therefore have attracted the participants' attention. Specifically, the video-taped incidents were novel on that they were both in the style of someone speaking to the camera (or to the viewer). As a result, participants may have tried to work out what was going on and whether the individual on the screen was saying anything of particular relevance for them. This may have resulted in facilitated memory maintenance for peripheral details.

In terms of comparison to the personally involved participants in Studies One and Two, there are two main contrasts. First, is the lack of memory differences concerning the percentage of available details recalled. In Studies One and Two witnesses within the threatening condition recalled a higher percentage of available details overall and a higher percentage of available action details.

This most likely reflects that, as the participants in this study were not personally involved with the stimulus incident, their motivation to recall as many details as possible was diminished. However, when 'forced' to make choices during the recognition test, they may have retrieved information they had not been motivated to report during the earlier recall test. This highlights the importance of using recall tests to measure the content and form of participant's spontaneous recall as

well as recognition tests to measure memory in a more detailed form less affected by motivation or report bias.

When recognition memory is considered, then, the second difference of interest is apparent. Whilst the personally involved participants within the threatening condition of Studies One and Two demonstrated superior memory overall and for action details, they did not demonstrate superior memory for central details as did the participants viewing the threatening video-tape in the study presented here. This potentially reinforces the suggestion made in Chapter Five that when witnesses are personally involved, depending on the precise nature of the incident, they may specifically demonstrate superior memory for action details rather than central details as a whole, as these may contain the information most important to the witness (i.e., ongoing level of threat and chance of attack). As participants in the study presented here were not personally involved, they may not have concentrated on actions to the same extent as they would not necessarily have been the most important information to them. Hence, their superior memory for central details as well as action details relative to participants viewing the control incident video-tape.

Interestingly, if this postulation proves to be correct, there would appear to be a role for psychological mechanisms in mediating an influence of emotion upon memory. Specifically, if superior memory for actions, rather than central details as a whole, reflects a witness's attention to the information most important to them, this would suggest that a cognitive interpretation is guiding attention and/or elaboration.

6.4.5 Theoretical implications

In line with Studies One and Two presented within Chapter Five, it appears that physiological arousal may not directly influence eyewitness memory. Further questioning the inclusion of a physiological component within the tripartite model of arousal and memory proposed in Chapter Four.

Furthermore, the findings of the study presented here provides additional evidence to contrast with Gold's Neuro-Biological theory (Gold, 1986; 1992). Critically, the findings of this study do not suggest that an enhanced level of physiological arousal results in the storage of more detailed memories.

However, as concluded within Chapter Five, before rejecting physiological arousal from the model, further corroborating studies are required in order to fully understand whether physiological arousal has a role to play in mediating the effects of emotion upon memory. Indeed, future research concerning the effects of glucose on human memory may serve to clarify the existing discrepancy in research findings concerning the influence of physiological arousal upon memory.

With regards to the roles of psychological arousal and motivation, however, it would appear that personal involvement with an incident may influence memory in a different manner than when participants are not personally involved. Consequently, although this research shows that memory differences may not necessarily be due to psychological arousal, it remains possible that psychological arousal may directly influence memory. Furthermore, the apparent memory difference between participants personally involved with a target stimulus and those not personally involved, suggests that motivation may also be an important factor.

6.4.6 Methodological considerations and future research

A possible criticism of the present study concerns the fact that the video-taped incidents were both in the style of someone speaking to the camera. The rationale behind this was to place the participants in this experiment in the same viewing position as those who experienced the incidents first-hand in the earlier experiments, thus ensuring that we used the same style of stimuli that we knew to be threatening or control in affect when experienced first-hand. However, in this manner it may have taken the participants a few seconds to understand what was happening. While it could be argued that this might have interfered with the participants ability to encode the information initially, all participants were

exposed to the same type of stimulus. Hence, this should not have interfered with the observation of significant effects and interactions.

It is suggested that future research would benefit from greater methodological variation. In particular, on the basis that the study presented here employed video-tapes and previous research by Christianson & Mjorndal (1985) and Christianson et al. (1986) employed slides, it would be interesting to investigate memory for a live-interaction or event where physiological arousal is manipulated via a source un-associated with the to-be-remembered event. Similarly, whilst some research using eye fixations has considered the aspects of the stimulus array witnesses attend to, it is argued that further work using this methodology should be conducted in order to advance understanding concerning the precise attentional and elaborative mechanisms engaged in when experiencing an emotionally arousing incident. For example, inducing physiological arousal through exercise and adrenalin and measuring the nature of attentional activity through eye-fixation methodology.

Critically, if we are to understand the influence of emotion upon memory, more research effort needs to be devoted to trying to understand the particular role of potential influencing factors.

Chapter 7

Eyewitness Memory for Actions using CCTV Recordings of Actual Crimes: An Exploratory Assessment

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7.1 Introduction

As revealed in chapter three, the few studies that have examined actual eyewitness memory, have been only partially successful in achieving a necessary balance between external and internal validity. Fundamentally, they have been unable to assess eyewitness accuracy, having instead relied upon measures of the amount of details or the consistency of reporting as indicators of eyewitness performance. Clearly, in order for further progress to be made in this field information concerning real eyewitness accuracy is required.

It is argued that the present study, which makes use of the latest community policing technology (i.e., closed circuit television or CCTV), uniquely attempts to address this issue and, in doing so, offers a method which could result in advances to our understanding of eyewitness memory. In particular, it is argued that the recent implementation of closed-circuit television (CCTV) into many major towns and cities provides a potential method of overcoming these fundamental problems. CCTV provides visually recorded accounts of real crimes against which witnesses' memories can then be compared, thus enabling eyewitness accuracy to be reliably and objectively assessed. In particular, where existing studies on actual eyewitness memory struggle to assess accuracy for action details, these in particular are preserved on video tape thereby providing an objective record against which to score accuracy. By utilizing CCTV recordings it is possible to obtain a similar level of control enjoyed by experimental studies of eyewitness performance and yet have the external validity traditionally associated only with field studies. In addition, given that incidents are captured on video-tape, they can also be objectively coded for level of violence. While this does not provide us

with a measure of *how* aroused a particular witness was during an incident, it does offer for the first time an alternative to retrospective self-report assessments of the actual level of violence employed which are based upon memory.

In the study presented here a sample of assault cases were selected (with the assistance of Central Scotland Police Force). Each case comprises a set of witness statements and a CCTV recording in which all witnesses (victims and bystanders) were centrally located. Most importantly, perhaps, the data derived from the combined use of actual witness statements and CCTV recordings of actual crimes allows the first objective assessment of eyewitness memory for action details in real crimes.

7.2 Method

7.2.1 Selection of cases

Case selection was influenced by a number of factors. First, from a legal perspective it was required that cases selected were not sub judice, i.e., not pending trial or awaiting further judicial action. Second, in order to allow comparison of victims with bystanders, cases where statements had been made by at least one victim and one bystander were selected as far as possible. In order to maximize the homogeneity and consequent comparability of cases, only assault/and or breach of the peace incidents were selected, i.e., incidents which involved direct witness threat or intimidation. Importantly, this also allowed us to look at witnesses' accounts of perpetrators which the study of other crime types (e.g., property crime) would not have permitted us to do so readily. Searching for appropriate target incidents proved to be very time consuming. Limited police time and resources meant that the final sample size was constrained to 8 incidents of assault and/or breach of the peace as charged by officers of Central Scotland Police. The crime type classification given to a particular incident depends on a range of factors including the level of proof required in order to bring a successful prosecution. Thus, although the 8 target incidents vary in crime classification,

they all have in common the fact that they involved violent behaviour which was directed towards a person or persons.

All the incidents occurred in the town of Stirling during 1996-97. Each comprised a CCTV video-tape of the original incident and accompanying witness statements taken by the police immediately following the incidents. This provided a total of 19 statements (9 victim and 10 bystander witnesses) for detailed analysis. This compares favourably with other similar studies in the field (e.g., Cutshall & Yuille, 1989; Yuille & Cutshall, 1986). All of the witnesses in the present study were Caucasian and comprised 3 females and 16 males ranging in age from 17 to 45 years with a mean age of 26.4 years and only four of the witnesses were older than 28 years. This reflects the fact that most incidents involving assault or breach of the peace tend to involve young males. Information concerning any relationships between witnesses (i.e., familial, friend, or no relationship) was also recorded.

In order to estimate the degree of affect associated with each incident, details of weapon presence (actual or implied) including any details of weapon type were documented. Details concerning the extent of any physical injury to the victim were also documented by utilizing Doctor's reports concerning injuries sustained by victims (available in four of the eight cases), along with any self-reported details about injuries sustained or other psychological or physiological consequences of having been a witness to the incident.

As well as this 'documentary' evidence, seven independent raters (the researcher plus 6 serving police officers, comprising 3 males and 4 females with a mean age 35.9 years) assessed the degree of affect associated with each incident. After viewing each CCTV recording, raters were asked to judge the following: how violent they perceived the incident to have been; the overall extent of any injuries; whether they thought the incident had any emotional effect upon the victims; and whether they thought the incident had any emotional effect upon the non-victim witnesses. Each rating was made on a 6-point scale (1 = not at all to 6 =

extremely). In addition, after viewing and rating each incident separately, the raters were asked to rank all the incidents from most to least serious (see Table 35). The mean level of agreement across raters was high (r = .81).

Case	Rated violence	Rated extent of any injuries	Rated emotional effect upon victims	Rated emotional effect upon bystanders	Ranked seriousness (1 = most, 8 = least)
1	5.86	4.57	4.57	4.93	1
2	3.57	2.71	3.00	3.25	3
3	2.00	1.14	1.57	1.61	8
4	3.71	2.43	3.34	3.07	4
5	2.43	1.29	1.43	1.61	7
6	3.86	3.00	3.00	2.96	2
7	2.86	3.14	2.86	2.61	5
8	2.57	2.00	2.14	2.14	6

Table 35: Mean ratings of incident impact and ranked seriousness.

7.2.2 Scoring procedure

First, any referents (i.e., names identifying actual individuals involved in the cases were removed from the statements). Each statement was then edited (removal of hesitancies, repetitions etc.), parsed into separate sentences and scored according to the statement analysis procedure originally set out by Yuille & Cutshall (1986) and utilised for Studies One and Two within this thesis. To recap, this method assigns 1 point to every specific item of information. For example, the statement "picked up the glass and threw it" contains three separate items of information; "picked up", "the glass" and "threw it". Similarly, the statement "kicked him in the head" contains three separate items; "kicked", "him" and "in the head". Each witness statement was scored in this manner according to four types of information: (a) action descriptions, (b) object descriptions (e.g., weapons), (c) perpetrator descriptions and, (d) verbal descriptions. Each classifiable item of information was scored as being either accurate, inaccurate or confabulated.

Consistent with Yuille & Cutshall (1986), estimates of confidence such as "I think" or "he might have" were not weighted. As only one incident involved any form of weapon (accounting for a total of only 3 reported items), object details were included in the analysis of total recall but not included in the more detailed analysis conducted for each information category.

Clearly, there are probably as many ways of classifying the content of witness statements as there are questions that could be asked of the data. The final choice of categories used in any content analysis, therefore, has to maintain a balance between reliability and utility. High reliability can be achieved by using simple forms of content analysis but this often means that any such coding is essentially mechanical. In contrast, the use of more complex units of analysis is likely to produce more useful but less reliable results. Thus, when conducting any research that involves this level of analysis, one is forced to consider the context of the given research question and to strike a balance between the reliability and quality of answers desired. While it is acknowledged that the information contained in the witness statements could have been coded in a number of different ways, I am confident that the scoring procedure adopted in this research and derived from Yuille & Cutshall's (1986) work provides the best balance between these competing demands. A full breakdown of the details reported for each case is provided in Appendix 12.

7.3 Results

Psychological research in the field of eyewitness testimony is, for the most part, concerned with the production of normative data about the 'average' witness (Sheldon and MacLeod, 1991). The criminal courts, in contrast, are concerned with issues pertaining to specific cases and specific witnesses. Thus, the probative value of much psycholegal research in this field has been questioned by members of the legal profession who consider psychology to be 'ill-equipped for the study of the uniqueness of the witness' (Stone, 1984). In the present study, therefore, two kinds of analyses were undertaken: the first is concerned with data from

individual witnesses to specific incidents while the second takes a more traditional nomological approach.

7.3.1 Case by case analysis

7.3.1.1 Case 1

Background

The videotape clip available for analysis (40 seconds duration) started shortly after the attack commenced. The incident was rated as being the most violent of the 8 cases described in this article and involved an attack by two youths on two other youths at 1.30 am in a street in the town centre. At a street corner, one perpetrator knocked his victim to the ground, stamped upon his head several times and, finally, whilst the victim was still lying on the ground, kicked him sharply in the front of his face. Leaving his victim lying on the ground, the perpetrator joined his friend in punching and kicking the second victim approximately 4 metres further down the street in a shop doorway. A bystander went to the aid of the victim lying on the ground at the street corner, at which point the police arrived. In terms of injury, the individual whose head had been repeatedly kicked and stamped upon suffered bruising on both sides of his head as well as a fractured nose and was detained in hospital overnight for observation. The second victim, attacked in the shop doorway, suffered vomiting and reported not being able to remember events either before or after the attack. From the CCTV footage it could be seen that the incident was watched by 4 male bystanders plus 1 witness who intervened to help the victim lying on the ground. Statements were obtained by the police from the 4 male bystander witnesses immediately after the incident occurred.

Analysis

From Table 36 it can be seen that in all of the witness statements there was a clear emphasis on reporting action details (86.7%). This is most likely because the police arrived and arrested the individuals involved. Consequently, they would not have required detailed descriptions of the assailants' appearance. The small

number of appearance related details that were reported, however, were not always classifiable because of the colour contrast of the CCTV recording for this case. In areas of lower light levels CCTV cameras are monochrome as this provides a clearer image than would a colour camera under the same conditions. As a result, any descriptions of clothing colour could not be classified (total of 3 details). All of the classifiable information reported was 100% accurate. All four witnesses described the "head stamping" aspect of the incident. Whilst this could be attributed to the police specifically probing for information concerning this aspect, two witnesses reported specifically focusing their attention on this due to its particularly violent nature. For example, one witness reported: "I was paying more attention to the fight occurring at the end of the street as it seemed more vicious". A second reported, "I concentrated my attention on the two fighting at the corner of the street". This focus of attention would most likely have been to the detriment of details about the other fight occurring in the shop doorway only a few yards away. Indeed, both of these witnesses also reported feeling confident that they would be able to identify the two fighting at the street corner but not the two fighting in the shop doorway.

Case 1	Witnesses		Action Details	All Details
	1	B	26	31
Total details reported	2	B	37	43
	3	B	27	31
	4	B	27	30
	Mean		29.25	33.75
	1	B	46.15	48.39
Per cent unclassifiable	2	B	40.54	48.84
	3	B	22.22	29.03
	4	B	33.33	33.33
	Mean		35.90	40.74

Table 36: Information reported by witnesses to police for case 1.

7.3.1.2 Case 2

Background

On the way home from a public house at 1.20 am, a family was approached by four youths. Both the father and son were physically attacked by the youths whilst the mother and son's girlfriend tried to dissipate the situation. One aggressor picked up two pint-sized glasses from the pavement and attacked the son. The son moved along the street a few metres and went behind a high wall momentarily out of camera shot. The aggressor threw both pint glasses at the son. The son then ran out from behind the wall back into the view of the camera. At this point the father spotted the CCTV camera and beckoned to it with his arms. Throughout the incident one of the three youths didn't physically attack anyone although a large amount of very explicit arm waving suggested he was heavily involved in the instigation and perpetuation of the situation. At this point the available CCTV footage for this incident ended. According to the witness and police statements, however, at this point the two main aggressors left the scene in a taxi, leaving the non-physical aggressor behind. A few moments later the police arrived and arrested this person. Details of witnesses' statements were obtained by the police from the father, son and mother immediately after the incident occurred. In terms of injury, a doctor's report concerning the son's injuries stated that loose glass was found in his hair as well as evidence of facial grazing, bruising and swelling.

Analysis

In this particular case, the mother reported only approximately half the total number of details reported by either the father or son (see Table 37). Whilst there are a number of reasons for this, it is most likely that the police did not probe for further information from her as they also had detailed statements from the primary witnesses. As with Case 1, monochrome CCTV recording of the incident prevented classification of five appearance details. From the police statements, it was also apparent that prior to the assault actually occurring, there was a period of verbal interaction concerning whether the father knew the principal perpetrator.

This appears to have resulted in a slightly higher amount of verbal details reported for this particular incident. Whilst the verbal details reported by each of the three witnesses corroborated each other, their accuracy could not be assumed on the basis of this and they were consequently scored as unclassifiable. Of those details that were classifiable, they were assessed as being 100% accurate.

Case 2	Witnesses		Action Details	All Details
	1	B	23	24
Total details reported	2	V	41	49
	3	V	57	77
	Mean		40.33	50.00
	1	B	34.78	37.50
Per cent unclassifiable	2	V	56.10	63.27
	3	V	47.37	55.84
	Mean		47.93	55.33

Table 37: Information reported by witnesses to police for case 2.

7.3.1.3 Case 3

Background

This incident occurred within a hospital Accident and Emergency department at 3.30 am. The CCTV footage begun with three individuals sitting in a row in a waiting area facing a reception desk and the CCTV camera. A man and woman came into view at the left hand side of the camera who were clearly arguing, pushing and shoving each other. Two nurses then appeared and attempted to calm everyone down. The man and woman had a firm grip upon one another and a hospital porter arrived to help separate them. The footage then ended. The taping of the incident lasted only 60 seconds and no injuries were sustained. Witness statements were obtained from two nurses who viewed the incident from behind

the reception desk, including the nurse who pushed a panic button specifically set up to alert the police to such incidents.

Analysis

The number of details reported for this particular incident was the lowest for all the incidents studied (see Table 38). This is most likely because it was very short and involved no physical injury. The statements predominantly contained action details, specifically those corroborating the information captured in the CCTV recording. The level of unclassifiable information recalled by witness 2 was particularly high as her statement contained details of pressing the panic button which occurred beyond the view of the camera and consequently could not be reliably verified. Once again, classifiable details were coded as being 100% accurate.

Case 3	Witnesses		Action Details	All Details
Total details reported	1	B	10	13
	2	B	11	16
	Mean		10.50	14.50
Per cent unclassifiable	1	B	20.00	38.46
	2	B	72.73	81.25
	Mean		47.73	62.07

Table 38: Information reported by witnesses to police for Case 3.

7.3.1.4 Case 4

Background

The footage starts with a man and a woman standing on a pavement engaged in an argument. The female was the main aggressor whilst the male was acting in a non-retaliatory manner. The female repeatedly tried to push the male and, having not got any response, took hold of his head and repeatedly tried to head butt and kick him. Eventually, the female left the man alone and turned around. She noticed two young men walking along the pavement towards them. Suddenly the

female, and the male with whom she was originally fighting, attacked the two young men walking along the pavement. They stumbled into the roadway. Victim 1 managed to push the female off relatively easily and moved over to where his friend (victim 2) was rolling around on the ground with the other male. Two male passersby came over to intervene and break up the incident. They managed to separate the individuals and move them over to the pavement where they continued to talk. At this point the videotape ended. The police interviewed the two male victims.

Analysis

Of all 8 cases examined in this study, this is the only one in which all the details reported pertained to actions (see Table 39). This is most likely because the police arrived and arrested both perpetrators. Consequently, when interviewing the victims they would simply have required details of actions to corroborate information on the CCTV recording in order to ensure that there was sufficient evidence to secure a conviction of assault. Once again, accuracy rate for the classifiable material was found to be 100%.

Case 4	Witnesses		Action Details	All Details
Total details reported	1	V	30	30
	2	V	27	27
	Mean		28.50	28.50
Per cent unclassifiable	1	V	50.00	50.00
	2	V	44.44	44.44
	Mean		47.37	47.37

Table 39: Information reported by witnesses to police for case 4.

7.3.1.5 Case 5

Background

The recording commenced with two young male cousins standing at a bank cash machine just before 2.00 am. They were standing with their backs to the machine

facing two other young men, one of whom is described in the witnesses' statements as allegedly having asked for some money. There was some verbal interaction during which one of the young men at the cash machine was punched in the jaw. The victim did not respond in any manner, later reporting that he was aware of the CCTV cameras. In the statements it appears that the victim was also punched at an earlier point in the incident but this could not be verified. The incident recording lasted only 20 seconds.

Analysis

The CCTV recording for this case was the shortest of all eight studied. Whilst all classifiable details were found to be accurate, a high proportion of the details reported were unclassifiable as the recording appeared to have captured only the latter half of the incident (see Table 40).

Case 5	Witnesses		Action Details	All Details
Total details reported	1	V	19	28
	2	B	21	28
	Mean		20.00	28.00
Per cent unclassifiable	1	V	63.16	71.43
	2	B	61.90	71.43
	Mean		62.50	71.43

Table 40: Information reported by witnesses to police for case 5.

As with cases 1 and 2, the CCTV recording was monochrome, against which colour of clothing could not be classified. The seven appearance details are accounted for by descriptions of both the perpetrator's shirt and jacket colours reported as a means of distinguishing between the two perpetrators.

7.3.1.6 Case 6

Background

This incident occurred just after midnight. The CCTV footage started during the middle of a fight between two young men. The young men were seen fighting behind a low wall and emerged into full view from behind some trees. They moved into the centre of what appeared to be a small car park and stumbled to the ground where they continued fighting. One male was lying on the ground whilst another repeatedly punched him in the head and neck region. A third male was present but did not intervene. Whilst the males were on the ground, a male and female police officer ran from around the corner and broke up the incident. They were closely followed by a police van and two further police officers. Several blows to the face and body were sustained by one individual who appeared to be trying to fight the other off. The police arrested and interviewed both individuals involved in the fight.

Case 6	Witnesses		Action Details	All Details
Total details reported	1	V	22	26
	2	V	15	19
	Mean		18.50	22.50
Per cent unclassifiable	1	V	63.64	69.23
	2	V	33.33	47.37
	Mean		51.35	60.00

Table 41: Information reported by witnesses to police for case 6.

Analysis

This incident was novel in that the perpetrators were also the victims of their own actions. Their data was scored as victims for analysis purposes. The high proportion of unclassifiable details for this incident are specifically accounted for by aspects which were occluded by a wall and trees during the fight (see Table 41). Again, all classifiable details were found to be 100% accurate.

7.3.1.7 Case 7

Background

This incident occurred just before midnight. The footage commenced with 3 young men at the side of a street. From police statements it appeared that the aggressor had asked the victim if he had any cigarettes. The victim indicated that he did not have any and the aggressor punched him on the nose, sending him backwards clutching his face as if his nose had been broken. The aggressor turned around and walked off up the street. Meanwhile the third individual lingered for a few moments and then walked off up the street after his friend. The incident lasted 60 seconds. The victim received medical treatment for bruising around his left eye. The police interviewed the victim and the bystander witness.

Analysis

This incident is the only one in the present article where the accuracy rate for classifiable material was not 100% (see Table 42).

Case 7	Witnesses		Action Details	All Details
Total details reported	1	B	21	29
	2	V	17	19
	Mean		19.00	24.00
Per cent unclassifiable	1	B	28.57	48.28
	2	V	29.41	36.84
	Mean		28.95	43.75
Per cent accurate	1	B	66.67	66.67
	2	V	58.33	58.33
	Mean		62.96	62.96

Table 42: Information reported by witnesses to police for case 7.

The accuracy rate fell to 58.3% for the victim and 66.7% for the bystander. This is solely because both the victim and the bystander confabulated aspects of their statements. The bystander, as a friend of the perpetrator, clearly had vested interests in protecting his friend. Consequently, his statement denied seeing his friend punch the victim. The victim, however, embellished the extent of his attack, reporting that he had been kicked to the ground and kicked twice in the ribs. In addition to the CCTV which clearly showed that this had not been the case, a subsequent medical examination indicated no evidence of abdominal bruising despite the victim reporting abdominal pain. This incident highlights the effects of inter-witness relationships and vested interests upon subsequent reporting.

7.3.1.8 Case 8

Background

This incident occurred at 1.30 am. The CCTV footage commenced with a large number of people standing at a taxi rank (a total of 19 individuals including perpetrators, victims and witnesses). One male was lying on the ground with his head hanging over the edge of the pavement. Five people were crouched around him trying to lift his upper body. Behind them there were 13 other individuals standing around. In this group there was an altercation between two males, one male said something to another and turned around as if to walk off. The other man appeared to make a response, and the first male turned around and punched the second male in the face sending him backwards slightly. The aggressor was pulled away and placated by two other males. He made a second attempt to attack the male he had just hit but was pulled further away by his friends. He started to walk away up the street. The footage ends at this point. From the footage it is not known how the male ended up lying on the pavement, although from the statements it appears that he was hit by a different male than the aggressor captured on the CCTV recording. The police interviewed the second individual who was punched and a bystander witness.

Analysis

Classifiable details were found to be 100% accurate, with unclassifiable details primarily referring to the earlier incident which resulted in the first victim falling unconscious on the ground. As can be seen from Table 43, only a small number of the details were actually reported and most of these were action-based.

Case 8	Witnesses		Action Details	All Details
Total details reported	1	B	9	9
	2	V	11	17
	Mean		10.00	13.00
Per cent unclassifiable	1	B	44.44	44.44
	2	V	45.45	41.18
	Mean		45.00	42.31

Table 43: Information reported by witnesses to police for case 8.

7.3.2 Aggregated data analysis

It is apparent from the aggregated data that there are relatively few differences between victims and bystanders both in terms of recall performance (Table 44) and amount of unclassifiable details reported (Table 45). Interestingly, this is directly in line with the findings of Studies One and Two, presented within Chapter Five. It is important to acknowledge, however, that this may be a reflection of standardised police interviewing and report technique than any inherent feature of the witnesses. It was also apparent that, while the CCTV recordings for each incident permitted ratings to be made regarding the violence associated with each incident and rankings computed as to their overall seriousness (Table 35), it proved difficult to interpret how incident violence may have affected recall accuracy. The fact that witnesses were performing at virtually ceiling level across all incidents may simply suggest that there was no effect of incident violence on recall accuracy. On the other hand, the lack of any effect may

be due to the fact that all the incidents in the present study had involved some level of violence and therefore the data may represent some threshold effect. This, however, is an unlikely explanation given that a classification of incidents based on ratings of perceived seriousness of injury to victim (i.e., comparing incidents 1, 2, 6 and 7 with incidents 3, 4, 5 and 8) revealed that significantly more action details were recalled in those incidents which were perceived as involving the most serious injuries (Mean = 28.18; SD = 11.54) compared to those involving the least serious injuries (Mean = 17.25; SD = 8.22), $F(1,18) = 5.21$, $p<.05$.

	Action	Appearance	Object	Verbal	Total
Victims	26.22	1.78	0.33	4.11	32.44
	(13.77)	(3.11)	(0)	(3.69)	(19.22)
Bystanders	21.20	1.20	0.00	3.00	25.40
	(8.95)	(1.48)	(0)	(3.01)	(10.15)
Total	23.58	1.47	0.16	3.53	28.74
	(11.48)	(2.34)	(0)	(3.01)	(15.12)

Table 44: Mean (SD) number of total details reported.

What is certainly clear, is that there is no evidence in the present study (at least, on the basis of the criterion employed here for verifiable information) that incident violence has any detrimental effect on memory performance. In fact, both victims and bystanders performed at very high levels of recall accuracy (96.19% and 96.27% respectively). In order to establish whether there is a graded relationship between level of violence and recall accuracy or whether there is a simple threshold effect, comparisons with witness memory for non-violent incidents would also be required. It is also worth noting, however, that despite the difficulties of interpretation in the present study the procedure set out may prove useful in future research where there is more variation in recall performance and/or where comparisons between recall performance for different crime types is deemed desirable.

	Action	Appearance	Verbal	Total
Victims	48.39	40.74	100.00	53.29
	(11.87)	(35.72)	(0)	(12.40)
Bystanders	40.47	46.67	100.00	48.10
	(16.75)	(50.55)	(0)	(16.48)
Total	44.22	44.45	100.00	50.46
	(14.81)	(42.83)	(0)	(14.54)

Table 45: Unclassifiable details as a percentage of total details reported (SD).

7.4 Discussion

This study represents the first reported attempt to assess the accuracy of actual eyewitness memory using a method whereby the content of witness statements given to the police was compared with target criminal episodes captured on CCTV. Despite the apparent homogeneity of the incidents examined (i.e., all incidents involved violence or threat of violence against a person or persons), the analyses of individual cases indicated considerable variation in both the total number of details (minimum 9 in Case 8 to a maximum 77 in Case 2) and the overall pattern of information reported (e.g., in Case 4, 100% of the details reported concerned actions whereas these made up only 71% of the total number of details recalled in Case 5). This case-by-case approach suggests that greater caution should perhaps be exercised regarding conclusions about eyewitness reliability where these conclusions have been based on the aggregated data derived from a number of cases.

In addition to the obvious dissimilarities between the cases examined, there is also one striking similarity: the fact that for all but one incident there was a 100% accuracy rate for those details that were classifiable (overall mean accuracy was 96.1% for the combined eight cases). This finding contrasts starkly with that indicated by many laboratory studies which illustrate the inherent unreliability of eyewitness memory. However, we should be cautious about placing too much emphasis on the present finding as the percentage of unclassifiable material in witness statements varied from a minimum of 29% up to a maximum of 71.4%

(mean proportion of unclassifiable details was 50.6%). This is an important consideration as the general failure to document the amount of unclassifiable material (e.g., Cutshall & Yuille's restaurant and bread line shooting incidents, 1989) renders it impossible to derive any useful assessment of overall reliability. However, if we were to assume in the present study the unlikely event that all unclassifiable items were totally erroneous, this would take overall accuracy rate down to a mean of 45.5%. This is unlikely, however, given that witnesses were performing at virtually ceiling level for those details that were verifiable and that the verifiability of any item of information was dependent upon the physical and technical limitations of CCTV rather than the witnesses per se. If, however, we make a conservative estimate based on the notion that witnesses were performing at only chance level for the remaining unclassifiable items, this would take overall memory performance to 69.95% which still represents a higher memory performance than many laboratory-based studies of witness memory would suggest. Indeed, the present study bears a remarkable resemblance to that of other field-based studies which report high levels of eyewitness performance, e.g., Yuille & Cutshall (1986) and Cutshall & Yuille (Studies 1-3, 1989) reported mean accuracy rates ranging from 82.1% to 100% for witness reports given to the police immediately after the event (see Table 46).

Clearly, the fact that almost half the details recalled by witnesses in the present study were unclassifiable is less than optimal. However, this is largely a result of the very strict criterion adopted. Although other studies can claim higher proportions of classified details, the verification procedure employed tends to have been based upon reconstructions, interpretations, and/or details of suspects who had confessed (e.g., Cutshall & Yuille, 1989; Christianson & Hubinette, 1993; Tollestrup, Turtle & Yuille, 1994; Yuille & Cutshall, 1986). The strict classification criterion employed in the present study, in contrast, enabled us to provide reliable accuracy rates which could be verified against CCTV recordings. Adopting such a procedure removes any potential confound that may arise through the inclusion of details which can only be classified on the basis of event reconstruction or suspect confession, both of which may be erroneous. Ideally,

however, one would wish to reduce the proportion of unclassifiable material whilst maintaining this strict criterion.

There are also a number of important qualifiers that merit careful consideration. First, it could be argued that the high level of performance was related in some way to the fact that virtually all the verifiable information concerned action details. Actions may simply draw more attention from witnesses than do pallid, non-dynamic descriptor information which, in turn, may lead action details to be better remembered thereby inflating eyewitness performance. Additionally, the fact that CCTV is available as a potential source of evidence may mean that a witness' memory for a perpetrator's appearance is simply not probed. In the present study, for example, only 5% of the total number of details reported to the police concerned appearance details. UK Home Office research reports that "the information provided by the (CCTV) cameras is used by the police to coordinate an appropriate response, and gather evidence that can be used to direct investigations and secure a swift conviction of offenders" (Brown, 1995, p. (v)).

STUDY DETAILS:	ACTION	DESC	OBJECT	VERBAL	TOTAL
Gun store (n=13) (Yuille & Cutshall, 1986)	81.9	75.6	88.5	Not reported	82.1
Restaurant (n=4) (Cutshall & Yuille, 1989)	100.0	--	100.0	Not reported	100.0
Breadline (n=6) (Cutshall & Yuille, 1989)	88.3	97.0	Not reported	Not reported	92.1
Bank robberies (n=17) (Cutshall & Yuille, 1989)	98.9	84.1	Not reported	Not reported	90.2
Current study (n=19)	95.9	100.0	100.0	--	96.21

Table 46: Mean accuracy of classifiable details reported in police interviews.

As a result, it is most likely that for cases such as those reported in this study, officers would concentrate on eliciting action-based details which, in conjunction with the CCTV recording, would provide the necessary evidence to secure a

conviction. Additionally, an examination of the other field-based studies of eyewitness memory indicate that the only occasions when memory for descriptors feature to any great extent is when the perpetrators are unknown (e.g., Studies 2 & 3, Cutshall & Yuille, 1989).

Second, it has to be acknowledged that the police play a large part in determining the kinds of information actually recorded in witness statements both in terms of the questions asked and the information actually recorded. As there is an emphasis on recording those details that are considered central to securing a prosecution, it is argued that the present study potentially represents a more realistic assessment of eyewitness memory than is provided by most laboratory studies which include memory for items that may have little probative or investigative value.

Third, it is important to acknowledge that while CCTV allows us to verify information recorded in witness statements and, as such, provides us with a useful tool for researchers, it also has a number of limitations. Specifically, the target incident may move out of shot, it may fail to allow verification of verbal information, and when conditions for filming are poor, verification of descriptor information may prove impossible. Using CCTV recordings incorporates a number of technological constraints which fundamentally affect the amount of information classifiable. The objectives of CCTV to combat crime require the cameras to move around in order to maximise their effectiveness and efficiency. As one would expect, the CCTV operators may rotate, tilt and zoom the cameras to focus onto the essential aspects of incidents, specifically because the police are interested in the most forensically relevant information. Design constraints, however, prevent most of the cameras from continuous rotation, i.e., once the camera rotates through a clockwise angle of 360° it can only manoeuvre in an anti-clockwise manner. Consequently, a few seconds of action may be lost as the operator moves the camera back around to focus onto specific aspects of an incident. As a result, this can prevent the classification of information occurring beyond the view of the camera as it rotates. In addition, for cases of relatively low light levels, particularly street lit areas, the video tapes are in monochrome as this

provides greater clarity than would a colour camera under the same conditions. However, as a result it also limits the extent to which the accuracy of details can be verified.

As well as the technological constraints inherent in utilising CCTV recordings, there were problems specifically associated with the cases selected. Closed circuit televisions are mainly used to target public disorder problems (Brown, 1995) of which common assaults form a high proportion (Mirlees-Black, Mayhew & Percy, 1996). From a psychological perspective, using assault cases for research is problematic as they often involve some degree of alcohol or drug consumption by perpetrators and witnesses (Yuille & Tollestrup, 1990). This is most likely in the cases reported in the present article as they all occurred around the time at which public bars close, between midnight and 2.00 am. Indeed, one witness reported having consumed alcohol prior to the incident. Highlighting this, during 1997 almost 50% of all detected crimes within the area from which our sample was drawn involved some form of intoxication (Central Scotland Police, 1998). Whilst the effects of alcohol upon eyewitness memory have not been extensively studied, research indicates that alcohol may have a debilitating effect upon memory (O'Toole, Yuille, Patrick & Iacono, 1994; Yuille & Tollestrup, 1990), although this may be mitigated by elevated levels of arousal (Read, Yuille & Tollestrup, 1992). In this study it was not possible to make any objective assessment as to the extent of witness intoxication.

Finally, in comparison to research interviews, statements elicited by the police are often short. For example, Yuille & Cutshall (1986) elicited almost twice as many details in their research interviews as were elicited by the police for the same incident. As already indicated, the existence of CCTV evidence most likely reduces the need for an exhaustive description of the incident in order to secure a conviction. In addition, the existence of a CCTV recording often results in suspects automatically pleading guilty, further reducing the need for the police to elicit a large number of details. From a time and efficiency perspective it is understandable that the police do not try to elicit every possible item of

information that a witness may remember. From a research perspective, however, short statements provided by police interviews may not give a true indication of the full extent of eyewitness memory performance. Thus, future research might benefit from a combination of the methodology used in the present study and that used in the studies conducted by Yuille and Cutshall (1986). In particular, it is argued that, in addition to comparing police interviews with CCTV recordings, an in-depth research interview could also be conducted to provide further comparisons with available CCTV recordings. This would enable more reliable assessments of witness accuracy to be made than is currently provided through event reconstruction, as well as providing a more comprehensive account of witness memory than can be derived from standard police interviews alone.

Closed Circuit Television is increasingly being used in a variety of locations including; banks, shops, schools, car parks and football stadiums, as well as by the police (Brown, 1995; Honess & Charmen, 1992). Consequently, there is immense potential in employing CCTV to study memory for everyday encounters. In addition, it would also be possible in some cases to directly contrast the performance of laboratory witnesses with real witnesses by presenting the original CCTV recording to laboratory witnesses. This would enable a direct comparison between the original witnesses' performance following the direct experience of the event, with the performance of laboratory witnesses experiencing the event indirectly. This might throw much needed light on the continuing debate concerning which aspects, if any, of laboratory witness performance generalise to the performance of real witnesses.

Despite Yuille & Cutshall's (1986) attempt to attract other researchers to conduct archival, in situ research, the obsession with laboratory-based studies of eyewitness performance persists. The present study, however, highlights an initial methodology which is more reliable, internally valid, and less methodologically constrained than previous methodologies and therefore provides some direction for future research in this area. Consequently, in light of the need for further research with real witnesses, it is hoped that the methodology outlined in this

chapter will be developed and extensively used in order that we might advance our understanding of the performance of real eyewitnesses.

Chapter 8

Summary and General Discussion

Based upon existing research and the theoretical mechanisms discussed and proposed within Chapters Three and Four, the aims of the research presented within this thesis were:

1. To investigate the effects of personal involvement and perceived threat upon eyewitness memory within the laboratory.

2. To investigate the influence of physiological arousal and differential interest upon eyewitness memory within the laboratory.

3. To investigate the accuracy of information reported by real victims and witnesses.

8.1 Personal involvement and perceived threat: laboratory live-event studies

As the majority of laboratory-based eyewitness research conducted to date has investigated visually-induced arousal, where participants are not personally involved (e.g., Burke et al., 1992; Christianson & Loftus, 1987, 1991; Heuer & Reisberg, 1990; Heuer et al., 1997; Safer et al., 1998), the two studies presented within Chapter Five examine for the first time the effects of defensive physiological responses, induced through personal involvement and perceived threat, on eyewitness performance under conditions in which both objective and subjective measures of arousal have been taken to ensure the effectiveness of manipulations.

In both experiments, male undergraduates were run in pairs and randomly assigned to be the victim of, or bystander to, either a jealous partner paradigm or a control paradigm. In the jealous partner paradigm, two male targets interacted briefly with the victim accusing him of seeing the girlfriend of one of the target males. The control paradigm involved the same male targets briefly interacting with the 'victim' during they simply wrote a message and left it for the experimenter when she returned.

Unfortunately, the use of objective manipulation checks showed that in Study One a difference in physiological arousal between threatened victims and bystanders within the same condition was not successfully manipulated during or immediately after the incident. This most likely occurred because the laboratory was particularly small and consequently bystanders were very close to the incident and may have perceived themselves as being in the way. Indeed, many of the bystanders within the threatening condition reported feeling in the midst of it all and thinking that they might have to get involved if things escalated out of hand.

Consequently, a second study was conducted in order to try and produce a difference in physiological and psychological arousal levels between threatened victims and bystanders in the same condition and therefore enable direct investigation of memory differences within the same condition rather than between different conditions. Study Two was identical to Study One except for the fact that the victim and bystander within each pair were seated further apart, the laboratory used was much larger than in Study One and the number of subjects was increased from forty to sixty-four. The content of the incidents themselves did not change.

In comparison to bystanders within the threatening condition, it was predicted that threatened victims would be concerned with their personal safety. As a result, they would be more motivated to try to understand what was going on and, therefore, scan or monitor the situation such that they would demonstrate enhanced memory for

centrally-related details (e.g., the source of the personal threat, such as physical actions or verbalisations related to the chances of attack), without the associated trade-off for more peripherally-related details (e.g., appearance-related details or verbalisations un-related to the chances of attack) typically found within laboratory studies of visually-induced arousal (e.g., Burke et al., 1992; Christianson & Loftus, 1987; Christianson & Loftus, 1991).

However, despite manipulating a difference in physiological and psychological arousal between threatened victims and bystanders of Study Two, they did not differ in their memory performance, suggesting that neither physiological nor psychological arousal directly influences memory. In addition, none of the memory measures were found to correlate with physiological arousal in Study Two. Furthermore, support for physiological arousal not exerting an influence upon memory also comes from the finding that memory differences observed between the differentially aroused threat and control conditions of study One were replicated within Study Two where a difference in physiological arousal was not manipulated between threat and control conditions. Thus, suggesting that the memory differences between the threat and control conditions were not a function of physiological arousal.

Importantly, whilst physiological arousal was not found to have a facilitating effect upon memory, it does not appear to have had a debilitating effect either. Furthermore, failure to find support for an influence of physiological arousal upon memory in the studies presented within Chapter Five suggests that the nature of the physiological response (i.e., defensive versus orienting) is unimportant (cf. with the majority of laboratory based studies of visually-induced arousal which have manipulated orienting physiological responses, characterised by a drop in heart rate rather than an elevation; e.g., Christianson, 1984 and Heuer & Reisberg, 1990).

In terms of psychological arousal, although the studies presented within Chapter Five suggest that it does not directly influence memory, the possibility that it may exert an

influence upon memory cannot, at this stage, so readily be dismissed. Specifically, similar memory differences observed between differentially psychologically aroused threatened and control witnesses of both Studies One and Two could indicate an influence of psychological arousal. On this basis, the failure to manipulate a difference between the differentially psychologically aroused threatened victims and bystanders of Study Two could either be because the sample size was not sufficient to allow differences to emerge or because victims may have engaged in or experienced a greater level of intrusive thoughts regarding the incident, serving to reduce their overall attention to a level similar to the bystanders.

Although neither of these explanations explain why psychological arousal was not found to be correlated with any of the memory measures in either Study One or Study Two, it remains possible that the sample size utilised within these studies were not large enough to allow such relationships to manifest themselves. Unfortunately, measurement of psychological affect is reliant upon introspective self-reports and these may not be as reliable or valid as they are often interpreted to be, especially when used with small sample sizes (Wright, et al., 1997).

However, an equally viable alternative explanation for the differential memory performance of threatened and control witnesses centres around the fact that they witnessed different incidents. Hence, it remains possible that the memory differences observed between the threat and control conditions are instead a function of inherent differences in stimulus content, unusualness (Loftus & Mackworth, 1978; Mitchell et al., 1998), or possibly another yet to be identified factor, exerting an influence upon memory.

In terms of comparison with existing research, the results of these studies are in line with existing studies of visually-induced arousal which suggest that arousal may enhance memory for certain information without detriment to other information (Christianson & Loftus, 1987; Christianson & Loftus, 1991). However, rather than

enhanced memory for central details per se, superior memory for actions was demonstrated (i.e., those key to the threatening aspects of the incident), thus suggesting that where witnesses are personally involved it may specifically be actions rather than central details as a whole that they demonstrate superior memory for.

Furthermore, the enhanced memory for action details was not associated with a trade-off in memory for peripheral details. This contrasts with previous research concerning visually-induced arousal, which has tended to suggest that there is a trade-off in memory for peripheral details associated with emotional material (Burke et al., 1992; Safer et al., 1998).

Consequently, the studies presented within Chapter Five suggest that when an incident involves a witness personally there may be enhanced memory for action details without an associated trade-off in terms of memory for other details (e.g., verbal or appearance details). However, whether this is a function of psychological arousal associated with personal involvement remains to be confirmed by future research. In particular, despite the general support from research with real witnesses, it remains to be confirmed that the differences observed between the personally involved threatening and control groups are due to differences in psychological arousal rather than something inherently different between the two incidents themselves. It is a fundamental confound that the majority of existing research has used different stimuli for emotional and control groups. Specifically, the differences observed between emotion and control groups in laboratory studies which have utilised relatively innocuous stimuli may be because of differential interest between the two group's stimuli rather than arousal per se (Cahill & McGaugh, 1995). Despite such a possibility, the results of these studies have consistently been interpreted to suggest that emotional arousal, experienced whilst viewing negatively-valenced emotional information, results in a focus of attention to the central details of the stimulus and, therefore, enhanced memory for those details.

In terms of motivation, the failure to observe memory differences between threatened victims and bystanders, despite their difference in perceived threat and perceived chance of attack, suggests that differential motivation was not manifest. For example, victim's monitoring may have occurred in order to provide answers to questions such as: who are these people, do I know them, are they going to physically attack me, who is this second intruder, is he after me too, are they showing any signs of calming down, will they wait outside for me, is it possible I could have been talking to his girlfriend? Bystanders, however, although lower in perceived personal threat and chance of attack, may have been motivated to monitor what was happening in order to answer a different set of questions, such as: who are these people, are they going to attack the victim, what shall I do, who is this second intruder, is he after the victim too, now should I do something, are they showing any signs of calming down, I wonder if he has been seen with his girlfriend? Hence, although the bystander's motivation may have been less related to their own chance of being attacked, they may, nevertheless, have been equally motivated to attend to what was going on.

In keeping with an influence of motivation, whether due to psychological arousal or differential interest, it appears that participants within the threatening condition may have scanned or monitored the incident to a greater extent than the control witnesses, resulting in enhanced memory for actions, without, a trade-off in memory for other more peripheral details. Hence, in line with Hockey's Cognitive-Energetical framework, it would appear that participants in the threatening condition may have been more motivated to understand what was going on than participants in the control condition. This may reflect that where witnesses are personally involved, they are more likely to engage in increased monitoring or scanning of the situation in order to understand what is going on and to ensure that the behavioural response selected is most efficient (Derryberry & Tucker, 1994). Arguably, this adds weight to the idea that participants in traditional laboratory studies do not experience changing demands which result in sufficient motivation to re-allocate cognitive resources in order to protect personal goals (Hockey, 1997).This may go some way towards explaining

why memory in the field appears to be good (e.g., Yuille & Cutshall, 1986), but in the laboratory, where participants are not personally involved, enhanced memory for central details appears to be associated with a trade-off in memory for peripheral details (e.g., Christianson & Loftus, 1991).

8.2 Physiological arousal and differential interest

Following the studies presented within Chapter Five, the study presented within Chapter Six was conducted to investigate whether physiological arousal has an effect upon eyewitness memory for complex information on its own or whether its effects might be mediated by other factors. In addition, as laboratory studies investigating memory for emotional information have tended to make comparisons between groups experiencing different stimuli (emotional and neutral), this study enabled an assessment as to whether memory differences observed between such groups are actually a function of arousal, as has generally been interpreted, or whether they may in fact be a function of an inherent difference between the two stimuli.

Advancing previous research, which has used static stimuli such as slides of neutral faces (Christianson & Mjorndal, 1985), in this third study participants were presented with video-tapes of the threatening and neutral incidents employed in the studies presented within Chapter Five. Furthermore, unlike existing research (Christianson et al.,1986) in this particular study witnesses watched the same films, i.e., physiologically aroused witnesses watched the real-life threatening or neutral incidents and physiologically un-aroused witnesses watched the same films. Critically, using exercise as the means of inducing physiological arousal, it was possible to isolate physiological arousal from the psychological arousal associated with experiencing such events first hand.

If physiological arousal may affect memory on its' own, we would have expected to see differences between those exercising and those resting, irrespective of whether

they watched the video-tape of the threatening or control incident. However, the finding of no significant interaction between level of arousal and either the type of video-taped incident viewed or the type of information viewed, suggests that level of physiological arousal, as induced via exercise, does not influence memory. In addition, physiological arousal was not found to be correlated with any of the memory measures, further suggesting that physiological arousal does not influence memory. This finding is directly in line with the findings of Study Two presented within Chapter Five and with the small amount of existing eyewitness research investigating this relationship.

Despite manipulating a difference in physiological arousal between participants exercising and those simply sitting on the bicycle, no differences were revealed on the Stress or Arousal Scale of the MacKay Mood Adjective Checklist, suggesting that psychological arousal and physiological arousal are not the same. Furthermore, correlations were conducted across the exercising witnesses to see whether participants' physiological arousal during the videos was correlated with the measures of rated arousal whilst cycling or rated attention devoted to watching the video and none of the correlations proved to be significant, further suggesting that they are not related.

Again, these findings are directly in line with both Studies One and Two, where patterns of psychological arousal among the witness groups were not found to mirror patterns of physiological arousal, and measures of the two arousal types were not found to correlate. As discussed in Chapter Five, this is not necessarily as expected, as one might predict that witnesses rating themselves higher in arousal, would also be higher in physiological arousal. Arguably, this highlights the problem of using introspective self-reports to measure cognitive affect. The extent to which one individual rates affect or places a criterion level between feeling aroused or un-aroused, for example, may vary considerably. This highlights the importance of using objective manipulation checks whenever possible.

Those viewing the video-tapes of the threatening and control incidents did not differ in terms of their self-reported anger or perceived threat experienced whilst viewing the incidents, although they did differ in physiological arousal both during and immediately after viewing the video-taped incidents. Whilst this is an unfortunate confound manifest in this study, based on the finding of no difference between participants exercising and those resting, either within or between incidents, it would appear that the memory differences observed between participants viewing the two different incidents are not a function of physiological arousal.

Specifically, those watching the video-tape of the threatening incident showed significantly enhanced recognition memory for central and action related details in comparison to those watching the video-tape of the control incident, suggesting that something inherent in the differing nature of the threatening incident relative to the control incident exerted a facilitating effect upon participants' memories.

Fundamentally, it would appear that in the study presented here the threatening video-taped incident may have been inherently more unusual, interesting or attention catching in some way relative to the control video-taped incident. This is an enlightening finding in relation to Studies One and Two and calls into question the findings of existing research into the effects of emotion upon memory which has presented participant groups with stimuli which are, at least in part, different (e.g., Christianson & Loftus, 1987; Christianson & Loftus, 1991; Clifford & Hollin, 1981; Heuer & Reisberg, 1990; Kebeck & Lohaus, 1986). Where the results of such studies have been interpreted to suggest that differences in memory performance reflect differing emotion or arousal levels, often without supporting evidence from manipulation checks, any differences in memory performance may actually have been due to something inherently more unusual, attention catching or simply more interesting about the emotional stimuli relative to the neutral stimuli.

Critically, what is highlighted by the study presented within Chapter Six and the small amount of existing research (Christianson & Loftus, 1991; Loftus & Mackworth, 1978; Mitchell et al., 1998) is that, while emotion may exert an influence upon memory, in order to be able to infer whether differences in memory are in fact due to the emotional or arousing nature of stimuli rather than other confounding factors such as differential interest, future research should take care to ensure that confounds associated with the use of different stimuli are removed and that comparisons are made within experimental conditions rather than between them.

In terms of personal involvement, even though the participants in this study were not personally involved, the results differ from existing studies where participants have also not been personally involved (i.e., studies of visually-induced arousal), which have tended to demonstrate that enhanced memory for central details is to the detriment of memory for peripheral details (Burke et al., 1992; Christianson & Loftus, 1987; Safer et al., 1998). Specifically, participants viewing the video-tape of the threatening incident showed superior recognition memory overall as well as for central and action details, but without a detriment to their recognition memory for peripheral details.

A possible explanation for the threat group's memory maintenance for peripheral details observed in the study presented here, however, is that the style of the incidents was somewhat novel and may therefore have attracted the participants' attention. Specifically, the video-taped incidents were both in the style of someone speaking to the camera (or to the viewer). As a result, participants may have tried to work out what was going on and whether the individual on the screen was saying anything of particular relevance for them. This may have resulted in memory maintenance for peripheral details.

In terms of comparison to the personally involved participants in Studies One and Two, there are two main contrasts. First, is the lack of memory differences

concerning the percentage of available details recalled. In Studies One and Two witnesses within the threatening condition recalled a higher percentage of available details overall and a higher percentage of available action details. This most likely reflects that, as the participants in this study were not personally involved with the stimulus incident, their motivation to recall as many details as possible was diminished. However, when 'forced' to make choices during the recognition test, they may have retrieved information they had not been motivated to report during the earlier recall test.

When recognition memory is considered, then, the second difference of interest is apparent. Whilst the personally involved participants within the threatening condition of Studies One and Two demonstrated superior memory overall and for action details, they did not demonstrate superior memory for central details as did the participants viewing the threatening video-tape in the study presented here. This potentially reinforces the suggestion made in Chapter Five that when witnesses are personally involved, depending on the precise nature of the incident, they may specifically demonstrate superior memory for action details, rather than central details as a whole, as these may contain the information most important to the witness (i.e., ongoing level of threat and chance of attack). As participants in the study presented here were not personally involved, they may not have concentrated on actions to the same extent as they would not necessarily have been the most important information to them. Hence, their superior memory for central details as well as action details relative to participants viewing the control incident video-tape.

Interestingly, if this postulation proves to be correct, there would appear to be a role for psychological mechanisms in mediating an influence of emotion upon memory. Specifically, if superior memory for actions, rather than central details as a whole, reflects a witness's attention to the information most important to them, this would suggest that the cognitive interpretation of the incident/stimulus guides attention and/or elaboration.

8.3 Victimisation and eyewitness memory in the field

Investigating real witnesses memory for action details may be particularly informative as Studies One and Two presented in this thesis suggest that it is for these aspects of an incident that critical memory differences may exist. Consequently, in an attempt to address the methodological issues which have constrained this particular area of research, closed-circuit television was identified as a potential methodological tool providing visually recorded accounts of real crimes against which to compare witnesses' memories, thus potentially enabling eyewitness accuracy to be more reliably and objectively assessed. Most importantly, perhaps, the data derived from the combined use of actual witness statements and CCTV recordings of actual crimes allowed the first attempt at objective assessment of eyewitness memory for action details in real crimes.

With regards to the relative eyewitness performance of real victims and bystanders, then, from the aggregated data there were no obvious differences between victims and bystanders both in terms of recall performance and the amount of unclassifiable details reported. Hence, this is directly in line with the findings of Studies One and Two, presented within Chapter Five. It is important to acknowledge, however, that this may be a reflection of standardised police interviewing and report technique than any inherent feature of the witnesses.

Despite the apparent homogeneity of the incidents examined (i.e., all incidents involved violence or threat of violence against a person or persons), however, the analyses of individual cases indicated considerable variation in both the total number of details and the overall pattern of information reported. Specifically, in addition to the obvious dissimilarities between the cases examined, for all but one incident there was a 100% accuracy rate for those details that were classifiable. This finding contrasts starkly with that indicated by many laboratory studies which illustrate the

inherent unreliability of eyewitness memory (Clifford & Hollin, 1981; Clifford & Scott, 1978; Loftus & Burns, 1982). However, due to the large variation in the percentage of unclassifiable material in witness statements we should be cautious about placing too much emphasis on the present finding.

Nevertheless, the present study bears a remarkable resemblance to that of other field-based studies which report high levels of eyewitness performance, e.g., Yuille & Cutshall (1986) and Cutshall & Yuille (Studies 1-3, 1989) reported mean accuracy rates ranging from 82.1% to 100% for witness reports given to the police immediately after the event. Although, the fact that almost half the details recalled by witnesses in the present study were unclassifiable is less than optimal, this is largely a result of the very strict criterion adopted.

8.4 Theoretical issues

Within Chapter Four it was suggested that a reliance upon uni-dimensional theories to account for the influence of arousal upon eyewitness memory offers little advance on current understanding. Instead, it was proposed that a more multi-factor dynamic approach needs to be taken which encompasses both physiological and psychological effects, as well as acknowledging the potential role of compensatory mechanisms associated with motivation to protect personal goals.

On this basis, it was suggested that a better understanding of the effects of arousal upon eyewitness performance requires understanding the following three elements: (1) physiological arousal, (2) psychological arousal, and (3) motivation (compensatory mechanisms). It was posited that, jointly, these factors may provide a more satisfactory explanatory scheme for understanding eyewitness performance.

It was also suggested, however, that this proposed tripartite arrangement is not presented as an answer to the theoretical problems associated with understanding eyewitness performance, but as a potential step forward in this complex area.

8.4.1 Physiological arousal

As a result of the studies presented within this thesis, it appears that physiological arousal may not directly influence eyewitness memory, which questions the inclusion of a physiological component within the proposed tripartite model of arousal and memory.

This is interesting as one might think that physiological and psychological arousal would work together in a complementary manner. For example, in line with Gold's Neuro-Biological theory (Gold, 1986; 1992), an enhanced level of physiological arousal and associated adrenergic biochemicals in the blood-stream could result in facilitated consolidation or storage of detailed memories resulting from increased psychologically-guided event processing, especially with regards to threat-related aspects of an incident. On this basis, where heightened psychological processing does not facilitate enhanced attentional and elaborative processing, increased consolidation or storage of memories may not follow. On contrast, where psychological processing is directed towards and results in enhanced elaboration for the threatening aspects of the incident, increased physiological arousal may facilitate the consolidation or storage of these memories. On the basis of the studies presented here, however, increased physiological arousal does not appear to have had a direct facilitating effect upon memory.

However, before rejecting physiological arousal from the model, further studies are required in order to fully understand whether physiological arousal has a role to play in mediating the effects of emotion upon memory. Indeed, future research concerning the effects of glucose on human memory may serve to clarify the existing

discrepancy in research findings concerning the influence of physiological arousal upon memory.

8.4.2 Psychological arousal

Support for psychological mechanisms influencing memory is also not directly provided, although the potential for an influence remains possible. In particular, although the study presented within Chapter Six demonstrated that the memory differences observed between participants within the threat and control conditions appear to be due to something inherent in the differing nature of the stimulus incidents, this may not mean that psychological arousal has no influence.

Whilst psychological arousal was not found to correlate with any of the memory measures within the laboratory studies, and no differences in memory were observed between differentially psychologically aroused threatened victims and bystanders Study Two, it is again possible that issues concerning sample sizes may underlie these.

Critically, it remains possible that victims within Studies One and Two may have engaged in or experienced a greater level of intrusive thoughts regarding the incident, serving to reduce their overall attention to a level more similar to that of the bystanders. Similar effects may occur with real witnesses, hence the finding of no difference in victim and bystander memories within Chapter Seven. Although it has been mentioned that this pattern may be a reflection of standardised police interviewing and report technique rather than any inherent feature of the witnesses.

Fundamentally, although this research shows that memory differences may not necessarily be due to psychological arousal, it remains possible that psychological arousal may directly influence memory.

8.4.3 Motivation

In terms of motivation, the failure to observe memory differences between threatened victims and bystanders within Study Two, despite their difference in perceived threat and perceived chance of attack, suggests that differential motivation may not have been manifest. For example, victim's monitoring may have occurred in order to provide answers to questions such as: who are these people, do I know them, are they going to physically attack me, who is this second intruder, is he after me too, are they showing any signs of calming down, will they wait outside for me, is it possible I could have been talking to his girlfriend? Bystanders, however, although lower in perceived personal threat and chance of attack, may have been motivated to monitor what was happening in order to answer a different set of questions, such as: who are these people, are they going to attack the victim, what shall I do, who is this second intruder, is he after the victim too, now should I do something, are they showing any signs of calming down, I wonder if he has been seen with his girlfriend? Hence, although the bystander's motivation may have been less related to their own chance of being attacked, they may, nevertheless, have been equally motivated to attend to what was going on.

Furthermore, whether due to psychological arousal or differential interest, it appears that participants within the threatening condition may have scanned or monitored the incident to a greater extent than the control witnesses, resulting in enhanced memory for actions, without, a trade-off in memory for other more peripheral details. Hence, in line with Hockey's Cognitive-Energetical framework, it would appear that participants in the threatening condition may have been more motivated to understand what was going on than participants in the control condition.

In comparison to studies of visually-induced arousal, although aroused participants in Studies One and Two demonstrated enhanced memory for action details, they did not demonstrate a trade-off in memory for peripheral details. This may reflect that where witnesses are personally involved, they are more likely to engage in increased

monitoring or scanning of the situation in order to understand what is going on and to ensure that the behavioural response selected is most efficient (Derryberry & Tucker, 1994). Arguably, this adds weight to the idea that participants in traditional laboratory studies do not experience changing demands which result in sufficient motivation to re-allocate cognitive resources in order to protect personal goals (Hockey, 1997). This may go some way towards explaining why memory in the field appears to be good (e.g., Yuille & Cutshall, 1986), but in the laboratory where participants are not personally involved enhanced memory for central details appears to be associated with a trade-off in memory for peripheral details (e.g., Christianson & Loftus, 1991).

At this stage, it is not suggested that witnesses can or will remember everything in a stimulus array. Clearly, this is not the case. What is suggested, however, is that whilst laboratory studies have generally argued that emotional arousal reduces performance or restricts attentional and elaborative processing, this may not be the case where witnesses are personally involved. Critically, it is argued that the influence of personal involvement, and therefore motivation, has wrongly been ignored within laboratory research to date (e.g. Burke et al., 1992; Christianson & Loftus, 1987; 1991; Heuer & Reisberg, 1990). Furthermore, what is central and what is peripheral detail will vary from incident to incident and in particular from witness to witness depending upon personal goals which are likely to be linked to the specific nature of the target incident. There is no doubt that selective attention occurs, but at this stage it is argued that to say whether a witness will or will not remember central and or peripheral details may be misleading, especially if such a judgement is heavily based upon laboratory research investigating visually-induced arousal.

8.4.4 Is there a future for a tripartite model of arousal and memory?

In conclusion, since physiological arousal does not appear to exert an influence upon memory a tripartite model of arousal, encompassing physiological arousal, may not be as useful as previously thought. However, before rejecting physiological arousal

from the model, further corroborating studies are required in order to fully understand whether physiological arousal has a role to play in mediating the effects of emotion upon memory. Similarly, although support for psychological mechanisms influencing memory is also not directly provided by the studies presented within this thesis, the potential for an influence remains possible. Furthermore, although motivation was not directly manipulated or measured in the studies presented within this thesis, where witnesses are personally involved memory performance appears to be slightly different than when witnesses are not personally involved. Motivational influences may underlie this difference.

As stated earlier, the proposed tripartite arrangement is not presented as an answer to the theoretical problems associated with understanding eyewitness performance, but as a potential step forward in this complex area. Fundamentally, as research evidence accumulates, so theoretical explanations may be refined. Hence, until there is a sufficient body of evidence from which to conclude that physiological arousal, psychological arousal or motivational mechanisms do not influence eyewitness memory, it is argued that a tripartite model of arousal and memory cannot be entirely rejected. Critically, reliance upon uni-dimensional theories to retrospectively account for memory performance under conditions of stress or arousal (see also McCloskey & Egeth, 1983b; Naatanen, 1973; Neiss, 1988, 1990) offers little advance on our understanding. On this basis, it is hoped that future research will endeavour to continuously test and advance theoretical models, such as that proposed within this thesis, in order that we may move forward in terms of our understanding of this complex area.

8.5 Methodological issues

It is argued that the research presented in this thesis identifies two main methodological issues. Firstly, the importance for highly controlled experimentation,

and secondly, the need for a research approach to eyewitness issues which places a greater emphasis upon the use of multiple methodologies.

8.5.1 The importance of controlled experimentation

A fundamental criticism of existing research concerns the lack of manipulation checks incorporated into the design of the studies. A large number of studies concerning arousal and eyewitness memory have failed to measure the effect of their manipulations upon participant arousal levels. Similarly, of the five studies investigating differences between victims and bystanders, not one of the studies successfully measured the physiological effects of the manipulation (e.g., Hosch & Cooper, 1982; Hosch et al., 1984). Despite not knowing the extent to which the participants in these studies were physiologically and psychologically aroused, inferences were made concerning the effects of arousal upon memory to the extent that where differences in memory were observed they were generally attributed to a difference in arousal between those viewing neutral and those viewing emotional stimuli. Furthermore, the nature of the manipulation appears to influence whether an orienting or a defensive response is displayed (Christianson, 1984; Heuer & Reisberg, 1990). Although the research in this thesis suggests that physiological arousal does not influence memory and that, therefore, the nature of the response may be unimportant, if we are to fully understand whether there is a relationship between arousal and memory it is necessary to investigate or at least know the nature of the response exhibited.

Although such research has often conduded the existence of relationships between arousal and memory, the studies presented in this thesis clearly demonstrate that such links should not be drawn without clear empirical support. In particular, the findings of Study Two demonstrated that despite manipulating witness groups who were differentially aroused there were no differences in subsequent memory performance. Similarly, in Study Three although witnesses viewing the different video-taped stimuli remembered the incidents differently they were not differentially aroused. In

these studies manipulation checks were employed and therefore prevent such speculation concerning potential relationships as has occurred with studies which have not utilised manipulation checks. Critically, the evaluation of the success of arousal manipulations should not rely upon indirect or retrospective inferences based on whether a differential eyewitness performance has been obtained.

With regards to memory performance, as with previous research, the research presented within this thesis has highlighted the need to use recall to measure the content and form of participants spontaneous recall as well recognition in order to measure memory in a more detailed form less affected by report bias.

In terms of archival and field based studies, the measurement of memorial accuracy is a continuing problem inherent in the very nature of such studies. It is suggested, however, that the use of CCTV may provide an alternative methodology serving to increase the controllability of such research. Unfortunately, despite Yuille & Cutshall's (1986) attempt to attract other researchers to conduct archival, in situ research, the obsession with laboratory-based studies of eyewitness performance persists. It is hoped that CCTV as an additional methodological tool for studying real witness behaviour may encourage researchers to consider more field and archival based research.

8.5.2 The importance of a multi-methodological approach

As shown by the research presented within this thesis archival and laboratory based research are each characterised by a number of advantages and disadvantages over one another. It is argued that for research in this area to be of use, a combined approach should be adopted where ideas and hypotheses are investigated both in a controlled laboratory environment and in a real-eyewitnessing situation. Fundamentally, there is no reason to believe that there is only one correct way in which memory should be studied (Tulving, 1991). A variety of methods may provide a may 'rounded' picture. Arguably, this is of paramount importance if we are to

investigate the effects of personal involvement, as ethical factors clearly constrain the level of personal threat that may be manipulated within the laboratory. Consequently, in order to fully investigate the potential influence of such factors it is essential researchers look to the field in order to try and replicate laboratory based findings.

8.6 Future applications and research

In terms of future eyewitness research, it is important to bear in mind that the aim of research in this area is to try and understand how real witnesses perform. It is argued, therefore, that generalising the results of laboratory studies to real eyewitness performance is problematic. For example, in terms of cognitive processes there are an enormous number of factors which may have an effect upon the memory of victim or witness of a real crime, such as level of involvement or relationships between witnesses. Each of these may affect what is important to a particular victim or bystander and therefore affect the direction of attention, elaborative processing, and subsequent memory for the incident. Fundamentally, it is argued that the findings of laboratory studies should be quality assured by study in thefield to see whether the effects and findings are up held. Whilst it is acknowledged that there are methodological constraints inherent in the study of real witnesses it is argued that to date not enough use has been made of field studies. Arguably, the field study by Brigham et al. (1982) demonstrated how it is possible to study 'real witness effects' in a more controlled manner than archival studies and a more valid manner than the majority of laboratory based studies.

In addition, more work on the use of retrospective self-report measures as potential indicators of cognitive behaviour and event affect would be useful as, over and above witness memory reports, this is the only information that the judiciary has available to them concerning the psychological effect of the incident upon witnesses. Ultimately, self-report methods could elucidate such things as: the relationships

between witnesses; whether a witness has experienced an incident of this nature previously; personality factors; and in light of the research presented here, the cognitive behaviour engaged in during and after the incident (in retrospect, such information would have been particularly useful in the Studies presented within Chapter Five).

Although we are a long way from being able to compose a 'witness profile', research in this area should, perhaps, endeavour to work towards this. At the very least, in order to advance knowledge in this area it is suggested that future research must explore further the cognitive processes by which eyewitnesses process information.

It is important to remember that the principle applied aim of eyewitness research can be conceptualised in terms of assisting the judicial system to effectively and efficiently (i) identify those who have committed crimes, and (ii) contribute to preventing mistaken convictions of innocent people. In working towards this, a wide variety of factors influencing eyewitness memory have been investigated. Some of the most fundamental variables affecting witnesses during the actual incident have, however, largely been ignored. These factors concern the effects of victimisation, in particular arousal and perceived threat, upon eyewitness memory. There is a large gap in the research literature concerning the effects of these variables upon eyewitness memory despite their prevalence during most criminal incidents. For example, although the term 'weapon focus' has been relatively well-documented in laboratory research, the principles and mechanisms underlying this effect are little understood (see Steblay, 1992, for a review and meta-analysis of the weapon focus effect).

Finally, while field research has tended to find that arousal leads to an improvement in memory performance, the findings from laboratory studies remain quite mixed. Critically, if we are to understand the influence of emotion upon memory, more research effort needs to be devoted to trying to untangle the complex interaction

between biologically based processes and psychologically driven processes. Consequently, it is hoped that future research may take a more cross-disciplinary approach in trying to understand the factors that mediate the effects of emotion upon memory.

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Appendix 1: Threatening Condition Script

THREATENING CONDITION SCRIPT

Throughout the 'act' do not look at B - direct all interaction to V

P1 ascends laboratory stairs very angrily saying;

P1: **"Where is he? I'm sure they came in here."**

He reaches the laboratory and sees V;

P1: **"Ah, there you are - what the hell do you think you've been playing at, hanging around my girlfriend?"**

P2 starts to ascend stairs. It is expected that V will say something here, nevertheless P1 continues;

P1: **"I've seen you several times - I saw you yesterday as I was driving along Market Street."**

P2 reaches the top of the stairs and says;

P2: **"Justin, what the hell are you doing? You should be talking to Rebecca about this instead of throwing your weight around in here."**

P1 turns his head to see P2 and says;

P1: **"Yeh, you'd be angry if it was your girlfriend!"**

P1 continues his ranting and raving, and turns his attention back to V saying;

P1: **"Just bloody stay away from her, right?"**

P2 gives the impression of being aware of how angry P1 is and tries to encourage him to leave by taking hold of his left arm;

P2: **"Justin, come on, we'll be late for Dr Williams."**

P1, however, has clearly not had enough, he wrenches his arm out of P2's hold and continues angrily. He picks up a strategically placed wooden ruler on top of a piece of paper on a table nearby and points it at V;

P1: **"You know what I'm talking about - just stay away from her."**

P1 is now at his peak anger, and 'throws' the wooden ruler onto the table.*

P2 appears worried about what P1 might do next, sensing the urgency of removing P1 from the laboratory, he tries to calm P1;

P2: **"Hey, calm down."**

However, P1 has to have the final word, pointing his finger directly at V he says;

P1: **"You so much as go near her again and I'll kill you!"**

P2 is worried now, he takes hold of P1's arm more firmly than before and pulls him towards the laboratory doorway at the top of the stairs;

P2: **"Come on, we're late ."**

As they leave the laboratory P2 says over his shoulder to V;

P2: **"You'd better leave his girlfriend alone."**

P1 and P2 descend the stairs with P1 still very angry;

P1: **"I'll kill him."**

P2 tries to calm P1:

P2: **"Come on, relax, forget about it."**

P1 and P2 leave the bottom laboratory door, leaving V and B alone in the laboratory, they close the laboratory door noticeably loudly on the way out.

* The ruler throwing needs to be of the same magnitude as the throw in the control condition.

Appendix 2: Control Condition Script

CONTROL CONDITION SCRIPT

Throughout the 'act' do not look at B - direct all interaction to V

I1 walks towards the open laboratory door, as he reaches the door he says (as if he is expecting to see Penny);

I1: **"Penny?"**

Upon seeing subjects in the room, and no Penny, he goes on to say to V and to V only (it is important all interaction is directed to V);

I1: **"Oh, hi there, I was actually looking for Penny Woolnough, is she around?"**

It is expected that V will reply something along the lines of "No, she's just gone out for a few minutes", so P1 can continue;

I1: **"Ah, I really need to see her - do you have any idea how long she will be?"**

Again V is expected to reply but the script simply continues. As V is probably speaking I2 comes in through the door and says;

I2: **"Justin, have you found her?"**

I1 turns his head to see I2 coming in and says;

I1: **"No, she's not here"**

I1 continues to talk to V,

I1: **"Um, I'm in a bit of a hurry, if I write a message down could you make sure she gets it when she comes back?"**

I1 turns to I2 and says;

I1: **Have you got a pen? Cheers.**

I2 hands I1 a pen from his pocket. I1 picks up a strategically placed wooden ruler to expose a scrap of paper on a table next to him (holds the ruler in his non-dominant hand) and quickly scribbles a message..

While I1 is writing the message I2 looks at his watch and says;

I2 **"Justin, you'd better hurry or we'll be late for Dr Williams"**

I1 puts the message onto the side, and picks up a biscuit from the tin placed right next to the paper, as he does this he says;

I1: **"Ah, biscuits, I'm starving!"**

I1 'throws' the wooden ruler back down onto the desk, as he does this I2 says;

I2: **"Oh, give us one"**

I1 hands I2 a biscuit. He then turns to V and says;

I1: **"Um, she'll know who the message is from, if you could point it out to her"**

I2 lightly thumps I1 on the arm and says;

I2: **"Come on, we're late"**

As they leave the laboratory I2 says to V;

I2: **"See yer"**

As they are both leaving I1 asks I2;

I1: **"So where is this office we've got to go to?"**

I2 replies to I1:

I2: **"Somewhere on the third floor I think"**

I1 and I2 leave the laboratory, closing the door behind them, leaving the subjects alone in the laboratory.

Appendix 3: Free Recall Measure

FREE RECALL MEASURE

"I want you to think about the interaction that just occurred. I am going to ask you some questions - please try as hard as possible to recall as much information as you can - if you are not sure about something please still mention it, but make it clear that you are not sure. I emphasise that I want you to tell me as much as you can. If at any point you think of something you wish to add please do so. Most importantly I want you to tell me as much as you can".

---

1. Please describe in as much detail as you can exactly what happened?

---

2. Next I want you to concentrate on the appearance of the aggressors. You may find it easiest to think about and describe one at a time. Please try and recall bodily characteristics, facial characteristics and details of clothing.

---

3. Now I would like you to think about what was said during the interaction. What did the aggressors say to you and to each other? What did you say in return? Did the other subject say anything or get involved?

---

4. Now I would like you to think about the physical behaviour of the actors. Please describe any type of actions or behaviour which occurred during the interaction.

---

5. Finally, is there anything else that you remember or wish to add that you or I haven't mentioned?

Appendix 4: Recognition Questionnaire - Threatening Condition - Study One

QUESTIONNAIRE MEASURE - T

DATE..... SUBJECT NUMBER.....

SUBJECT NAME.....

INTRODUCTION

The purpose of this questionnaire is to assess the sort of information processed from brief interactions such as the one you have just experienced. In this questionnaire you are required to answer forced-choice questions and make judgments regarding various aspects of the interaction.

In order for this questionnaire to be useful I need you to be as honest and truthful as possible in all of your answers. You are assured that all materials from this experiment will remain completely confidential. Your cooperation is greatly appreciated.

Please always write your answer on the dotted lines, or in the appropriate place provided. If you make a mistake cross it out and make your answer in a suitable place on the sheet, carefully indicating where the answer is.

To begin with I would like you to consider the following question and then work your way through the questionnaire at your own pace, being as truthful and honest as possible. If you do not understand anything, please do not hesitate to ask. Thank you for your cooperation.

1) How long do you think the interaction lasted, from the moment the first intruder entered the laboratory to the moment both intruders left?

.....Hours.....Minutes.....Seconds

How confident are you in your estimation? Indicate your confidence by circling the appropriate number below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

The rest of this questionnaire is divided up into sections, please read all instructions carefully.

For the purpose of the rest of this questionnaire *'Intruder One'* refers to the *first* individual entering the laboratory, whilst *'Intruder Two'* refers to the *second* individual entering the laboratory.

SECTION ONE: INTRUDER APPEARANCE

Please take a few moments to recall as much of the appearance of *INTRUDER ONE* as you possibly can, then estimate the following characteristics:

2) Height:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) Weight:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) Build/body shape: Please circle the letter of your choice...

a. Slim-lean b. Stocky-heavy build c. Overweight-fat
d. Athletic-fit e. other (please specify).....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) Age:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

Still concentrating on the appearance of intruder one, please answer the following forced-choice questions by circling the letter next to your chosen answer:

6) What nationality do you think he was?

a. Scottish b. English c. Welsh d. Irish

How confident are you in your answer? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) Did he wear spectacles? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) What colour was his hair?

a. Light brown **b. Dark brown** **c. Blonde** **d. Black**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) Did he have any facial hair? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) What colour were his eyes?

a. Dark brown **b. Light brown** **c. Blue** **d. Grey**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

11) What colour was his T-shirt?

a. White **b. Blue** **c. Green** **d. Yellow**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

12) Was there any writing on his T-shirt? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

13) What colour was his cardigan?

a. Dark Brown **b. Black** **c. Grey** **d. Navy Blue**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

14) What colour trousers was he wearing?

a. Brown b. Blue c. Black d. Green

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

15) What type of footwear was he wearing?

a. Boots b. Shoes c. Training shoes d. Baseball boots

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

16) What colour was his footwear?

a. Black b. Dark brown c. Dark yellow d. Dark red

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

17) Was he wearing any jewellery? a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

---

Please now take a few moments to recall as much of the appearance of INTRUDER TWO as you possibly can, then estimate the following characteristics:

18) Height:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

19) Weight:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

20) <u>Build/body shape</u>: Please circle the letter of your choice...

a. Slim-lean b. Stocky-heavy build c. Overweight-fat

d. Athletic-fit e. other (please specify).....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

21) <u>Age</u>:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

<u>Still concentrating on the appearance of intruder two, please answer the following forced-choice questions by circling the letter next to your chosen answer:</u>

22) <u>What nationality do you think he was?</u>

a. Scottish b. English c. Welsh d. Irish

How confident are you in your answer? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

23) <u>Did he wear spectacles?</u> a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

24) <u>What colour was his baseball cap?</u>

a. Red b. White c. Blue d. Black

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

25) <u>Did he have any facial hair?</u> a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

26) <u>What colour were his eyes?</u>

a. Dark brown b. Light brown c. Blue d. Grey

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

27) <u>What colour was his top?</u>

a. Bottle green b. Navy blue c. Dark Red d. Black

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

28) <u>Was there any writing on his top?</u> a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

29) <u>What colour trousers was he wearing?</u>

a. Brown b. Blue c. Black d. Gray

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

30) <u>What type of footwear was he wearing?</u>

a. Boots b. Shoes c. Training shoes d. Baseball boots

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

31) <u>What colour was his footwear?</u>

a. Black b. Dark brown c. Dark yellow d. Dark red

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

32) <u>Was he wearing any jewellery?</u> a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

SECTION TWO: ACTIONS & OBJECTS

33) Did Intruder One bring anything into the room with him? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

34) What object did Intruder One pick up from beside the laboratory computer?

a. Plastic ruler **b. Plastic letter opener**
c. Wooden ruler **d. Metal letter opener**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

35) Which hand did Intruder One hold the object with?

a. Left Hand **b. Right Hand**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

36) Where did Intruder One throw the object?

a. Onto the floor **b. Onto the accused's desk**
c. Next to the computer **d. At the accused**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

37) Did Intruder Two bring anything into the room with him? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

SECTION THREE: VERBAL INTERACTION

38) What name did Intruder Two call Intruder One?

a. James **b. Justin** **c. Jamie** **d. Johnny**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

39) When did Intruder One say that he had seen you/the other participant with his girlfriend?

a. Last night b. Yesterday c. Saturday d. Today

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

40) Where did Intruder One say that he had seen you/the other participant with his girlfriend?

a. North Street b. Market Street c. South Street d. Bell Street

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

41) What did Intruder One say he was doing when he saw you with his girlfriend?

a. He was driving b. He was in a friend's car
c. He was in a shop d. He was cycling

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

42) What was the name of Intruder One's girlfriend ?

a. Rachel b. Rhona c. Rebecca d. Ruth

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

43) Who did Intruder Two say they would be late for a meeting with?

a. Dr Watson b. Dr Wilson c. Dr Williams d. Dr Wallis

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

SECTION FOUR: GENERAL

44) How threatened did *you* feel *during* the interaction?

1	2	3	4	5	6
Not at all	Very slightly	Mildly	Significantly	Very	Extremely

45) How threatened did *you* feel *immediately following* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

46) During the interaction to what extent did *you* perceive that you might be physically attacked?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

47) How angry did *you* feel *during* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

48) How angry did *you* feel *immediately following* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

49) How afraid did *you* feel *during* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

50) How afraid did *you* feel *immediately following* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

51) Did *you* detect any bodily sensations(i.e. an increase in heart rate, sweating, or shaking) during the interaction, please give details...

.....

.....

.....

52) Was there any particular information asked about in this questionnaire that you feel you are unable to recall because you could not see it during the interaction? Please give details.....

.....

.....

.....

.....

.....

53) <u>Were *you* suspicious of the nature or purpose of the experiment at any point?</u>

a. Yes b. No

54) <u>If you were suspicious of the experiment, please give details of when and why you became suspicious</u>

.....

.....

.....

55) <u>Have you ever been accused of anything like this in this manner before? If 'yes' please give details</u>

.....

.....

.....

56) <u>Which aspect(s) of the interaction do you find most vivid/easiest to recall? Please give details</u>

.....

.....

.....

57) Which aspect(s) of the interaction did you find most attention catching? Please give details

.....

.....

.....

58) How tall are you?.....

59) How much do you weigh?.....

60) What build /body shape would you class yourself as?

a. Slim-lean b. Stocky-heavy build c. Overweight-fat

d. Athletic-fit e. other (please specify).....

Thank you for completing this questionnaire

If there are any other comments you would like to make please do so.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Please make sure that you have answered ALL the questions.

Thank you.

Appendix 5: Recognition Questionnaire - Control Condition - Study One

QUESTIONNAIRE MEASURE - C

DATE..... SUBJECT NUMBER.....

SUBJECT NAME.....

INTRODUCTION

The purpose of this questionnaire is to assess the sort of information processed from brief interactions such as the one you have just experienced. In this questionnaire you are required to answer forced-choice questions and make judgments regarding various aspects of the interaction.

In order for this questionnaire to be useful I need you to be as honest and truthful as possible in all of your answers. You are assured that all materials from this experiment will remain completely confidential. Your cooperation is greatly appreciated.

Please always write your answer on the dotted lines, or in the appropriate place provided. If you make a mistake cross it out and make your answer in a suitable place on the sheet, carefully indicating where the answer is.

To begin with I would like you to consider the following question and then work your way through the questionnaire at your own pace, being as truthful and honest as possible. If you do not understand anything please do not hesitate to ask. Thank you for your cooperation.

1) How long do you think the interaction lasted, from the moment the first intruder entered the laboratory to the moment both intruders left?

.....Hours.....Minutes.....Seconds

How confident are you in your estimation? Indicate your confidence by circling the appropriate number below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

The rest of this questionnaire is divided up into sections, please read all instructions carefully.

For the purpose of the rest of this questionnaire *'Intruder One'* refers to the *first* individual entering the laboratory, whilst *'Intruder Two'* refers to the *second* individual entering the laboratory.

SECTION ONE: INTRUDER APPEARANCE

Please take a few moments to recall as much of the appearance of *INTRUDER ONE* as you possibly can, then estimate the following characteristics:

2) Height:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) Weight:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) Build/body shape: Please circle the letter of your choice...

a. Slim-lean b. Stocky-heavy build c. Overweight-fat
d. Athletic-fit e. other (please specify).....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) Age:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

Still concentrating on the appearance of intruder one, please answer the following forced-choice questions by circling the letter next to your chosen answer:

6) What nationality do you think he was?

a. Scottish b. English c. Welsh d. Irish

How confident are you in your answer? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) Did he wear spectacles? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) What colour was his hair?

a. Light brown **b. Dark brown** **c. Blonde** **d. Black**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) Did he have any facial hair? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) What colour were his eyes?

a. Dark brown **b. Light brown** **c. Blue** **d. Grey**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

11) What colour was his T-shirt?

a. White **b. Blue** **c. Green** **d. Yellow**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

12) Was there any writing on his T-shirt? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

13) What colour was his cardigan?

a. Dark Brown **b. Black** **c. Grey** **d. Navy Blue**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

14) <u>What colour trousers was he wearing?</u>

a. Brown b. Blue c. Black d. Green

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

15) <u>What type of footwear was he wearing?</u>

a. Boots b. Shoes c. Training shoes d. Baseball boots

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

16) <u>What colour was his footwear?</u>

a. Black b. Dark brown c. Dark yellow d. Dark red

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

17) <u>Was he wearing any jewellery?</u> a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

---

<u>Please now take a few moments to recall as much of the appearance of INTRUDER TWO as you possibly can, then estimate the following characteristics:</u>

18) <u>Height</u>:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

19) <u>Weight</u>:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

20) Build/body shape: Please circle the letter of your choice...

a. Slim-lean b. Stocky-heavy build c. Overweight-fat

d. Athletic-fit e. other (please specify).....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

21) Age:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

Still concentrating on the appearance of intruder two, please answer the following forced-choice questions by circling the letter next to your chosen answer:

22) What nationality do you think he was?

a. Scottish b. English c. Welsh d. Irish

How confident are you in your answer? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

23) Did he wear spectacles? a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

24) What colour was his baseball cap?

a. Red b. White c. Blue d. Black

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

25) Did he have any facial hair? a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

26) What colour were his eyes?

a. Dark brown b. Light brown c. Blue d. Grey

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

27) What colour was his top?

a. Bottle green b. Navy blue c. Dark Red d. Black

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

28) Was there any writing on his top? a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

29) What colour trousers was he wearing?

a. Brown b. Blue c. Black d. Gray

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

30) What type of footwear was he wearing?

a. Boots b. Shoes c. Training shoes d. Baseball boots

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

31) What colour was his footwear?

a. Black b. Dark brown c. Dark yellow d. Dark red

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

32) Was he wearing any jewellery? a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

SECTION TWO: ACTIONS & OBJECTS

33) Did Intruder One bring anything into the room with him? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

34) What object did Intruder One pick up from beside the laboratory computer?

a. Plastic ruler **b. Plastic letter opener**
c. Wooden ruler **d. Metal letter opener**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

35) Which hand did Intruder One hold the object with?

a. Left Hand **b. Right Hand**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

36) Where did Intruder One throw the object?

a. Onto the floor **b. Onto the other participant's desk**
c. Next to the computer **d. At the other participant**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

37) Did Intruder Two bring anything into the room with him? **a. Yes** **b. No**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

38) What colour was the pen which Intruder One handed to Intruder Two?

a. Black **b. Blue** **c. Red** **d. Green**

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

39) Did both Intruder One and Intruder Two both eat a biscuit?

a. Yes b. No

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

SECTION THREE: VERBAL INTERACTION

40) What name did Intruder Two call Intruder One?

a. James b. Justin c. Jamie d. Johnny

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

41) After ascertaining that Penny Woolnough was not around Intruder One said:

"Ah, I really need to see her - do you have any idea.....?"

Please select the phrase Intruder One said which fits into the space

a. Where she is? b. How long she will be?

c. What she is doing? d. When she is coming back?

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

42) Who did Intruder Two say they would be late for a meeting with?

a. Dr Watson b. Dr Wilson c. Dr Williams d. Dr Wallis

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

43) Where did Intruder Two say that they had to go to for their meeting?

a. 1st floor b. 2nd floor c. 3rd floor d. basement

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

SECTION FOUR: GENERAL

44) How threatened did *you* feel *during* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

45) How threatened did *you* feel *immediately following* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

46) During the interaction to what extent did you perceive that *you* might be physically attacked?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

47) How angry did *you* feel *during* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

48) How angry did *you* feel *immediately following* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

49) How afraid did *you* feel *during* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

50) How afraid did *you* feel *immediately following* the interaction?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

51) Did you detect any bodily sensations(i.e. an increase in heart rate, sweating, or shaking) during the interaction, please give details...

.....

.....

.....

52) Was there any particular information asked about in this questionnaire that you feel you are unable to recall because you could not see it during the interaction? Please give details.....

.....

.....

.....

.....

.....

53) <u>Were you suspicious of the nature or purpose of the experiment at any point?</u>

a. Yes b. No

53) <u>If you were suspicious of the experiment, please give details of when and why you became suspicious</u>

.....

.....

.....

54) <u>Which aspect(s) of the interaction do you find most vivid/easiest to recall? Please give details</u>

.....

.....

.....

55) <u>Which aspect(s) of the interaction did you find most attention catching? Please give details</u>

.....

.....

.....

56) How tall are you?.....

57) How much do you weigh?.....

58) What build /body shape would you class yourself as?

a. Slim-lean b. Stocky-heavy build c. Overweight-fat

d. Athletic-fit e. other (please specify).....

Thank you for completing this questionnaire

If there are any other comments you would like to make please do so.....

.....

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Please make sure that you have answered ALL the questions.

Thank you.

Appendix 6: Recognition Questionnaire - Threatening Condition - Study Two

QUESTIONNAIRE MEASURE - T

DATE..... SUBJECT NUMBER.....

SUBJECT NAME.....

Please complete ALLTHE QUESTIONS that follow even if you have to MAKE A GUESS

If you do not understand anything, do not hesitate to ask. Thank you.

1) How long do you think the interaction lasted, from the moment the first intruder entered the laboratory to the moment both intruders left?

.....Hours.....Minutes.....Seconds

How confident are you in your estimation? Indicate your confidence by circling the appropriate number below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

For the purpose of the rest of this questionnaire *'Intruder One'* refers to the *first* individual entering the laboratory, whilst *'Intruder Two'* refers to the *second* individual entering the laboratory.

Please turn over.....

APP1 - Please take a few moments to recall as much of the appearance of _ *INTRUDER ONE* as you possibly can, then estimate the following characteristics:-

1)Height:.....

How confident are you in your estimation? Indicate your confidence below..

1 Very Unsure ..... 2 Unsure ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

2)Weight:.....

How confident are you in your estimation? Indicate your confidence below..

1 Very Unsure ..... 2 Unsure ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

3)Build/body shape: Please circle the letter of your choice...

a. Slim-lean b. Stocky-heavy build c. Overweight-fat

d. Athletic-fit e. other (please specify).....

How confident are you in your estimation? Indicate your confidence below..

1 Very Unsure ..... 2 Unsure ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

4) Age:.....

How confident are you in your estimation? Indicate your confidence below..

1 Very Unsure ..... 2 Unsure ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

Still considering the appearance of *INTRUDER 1* please answer the following questions:-

1) What were his glasses like?

a. Silver metal b. He wasn't wearing glasses

c. Gold metal d. Brown tortoiseshell

How confident are you in your answer? Please indicate your confidence below..

1 Very Unsure ..... 2 Unsure ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

2) What colour was his hair?

a. Ginger b. Dark Brown c. Blonde d. Black

How confident are you in your answer? Please indicate your confidence below..

1 Very Unsure ..... 2 Unsure ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

3) What colour was his sweatshirt?

a. White b. Blue c. Green d. Yellow

How confident are you in your answer? Please indicate your confidence below..

1 Very Unsure ..... 2 Unsure ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

4) **What colour was his Jacket?**

a. Brown b. Black c. Grey d. Blue

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) **What type of material was his jacket made of?**

a. Wool b. Denim c. Leather d. waterproof

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

6) **What colour trousers was he wearing?**

a. Dark Brown b. Light Blue c. Black d. Dark Green

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) **What type of trousers was he wearing?**

a. Casual (i.e., chinos) b. Jogging bottoms c. Jeans d. formal (i.e., suit trousers)

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) **Where was he wearing an earring?**

a. Right ear b. Left ear c. Nose d. He wasn't wearing an earring

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) **What colour footwear was he wearing?**

a. Brown b. Blue c. Black d. Green

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) **What type of footwear was he wearing?**

a. Boots b. Training shoes c. Shoes d. Baseball boots

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

11) **What colour was his baseball cap?**

a. White b. Blue c. Black d. He wasn't wearing a baseball cap

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

APP2 - Now please take a few moments to recall as much of the appearance of *INTRUDER TWO* as you possibly can, then estimate the following characteristics:-

1) Height:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

2) Weight:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) Build/body shape: Please circle the letter of your choice...

a. Slim-lean b. Stocky-heavy build c. Overweight-fat
d. Athletic-fit e. other (please specify).....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) Age:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

Still considering the appearance of *INTRUDER 2* please answer the following questions:-

1) What were his glasses like?

a. Silver metal b. He wasn't wearing any
c. Gold metal d. Brown tortoiseshell

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

2) What colour was his hair?

a. Ginger b. Dark Brownc. Brown/Blond d. Black

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) What colour was the T-shirt he was wearing underneath his overshirt?

a. Green b. Blue c. White d. Black

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) **What was the pattern of his overshirt?**

a. Horizontal Stripes b. Vertical stripes c. Plain d. Checked

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) **What was the colour of his overshirt?**

a. Black and white b. Red and blue c. green and blue d. White and Blue

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

6) **What colour trousers was he wearing?**

a. Green b. Blue c. Black d. Grey

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) **What type of trousers was he wearing?**

a. Casual (i.e., chinos) b. Jogging bottoms c. Jeans d. formal (i.e., suit trousers)

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) **Where was he wearing an earring?**

a. Right ear b. Left ear c. Nose d. He wasn't wearing an earring

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) **What colour footwear was he wearing?**

a. Brown b. Blue c. Black d. Green

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) **What type of footwear was he wearing?**

a. Boots b. Trainers c. Shoes d. Baseball boots

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

11) **What colour was his baseball cap?**

a. White b. Blue c. Black d. He wasn't wearing a baseball cap

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

ACTIONS - Now, please take a few moments to think about the *ACTIONS* of the intruders, then answer the following questions:-

1) What did Intruder One have in his hand when he came into the room?

a. A ruler b. Nothing c. A folder d. A book

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

2) What object did Intruder One pick up from the side?

a. Plastic ruler b. Plastic letter opener
c. Wooden ruler d. He didn't pick up anything

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) Where did Intruder One throw the object?

a. Onto the floor b. Onto the accused subject's desk
c. Back onto the side d. He didn't throw an object

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) What object did Intruder One pick up from the floor?

a. Plastic ruler b. Nothing
c. Wooden ruler d. Piece of paper

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) What did Intruder Two drop on the floor?

a. Plastic ruler b. Nothing
c. Wooden ruler d. Piece of paper

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

6) What did Intruder Two pick up from the floor?

a. Plastic ruler b. Nothing
c. Wooden ruler d. Piece of paper

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) What did Intruder Two have in his hand when he came into the room?

a. A ruler b. Nothing c. A folder d. A book

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) <u>What did Intruder One have in his hand when he left the room?</u>

a. A ruler b. Nothing c. A folder d. A book

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) <u>How did Intruder Two try and remove Intruder One from the room?</u>

a. He grabbed his left arm b. He grabbed his right arm

c. He didn't try and remove him d. He pulled both arms from behind

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) <u>What did Intruder Two have in his hand when he left the room?</u>

a. A ruler b. Nothing c. A folder d. A book

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

11) <u>What did Intruder Two do when he left the room?</u>

a. Nothing b. dropped a piece of paper c. left the door open d. Slammed the door

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

VERBAL - Now, please take a few moments to think about what was said during the interaction, then answer the following questions:-

1) <u>What name did Intruder Two call Intruder One?</u>

a. He didn't call him anything b. Charlie c. Charles d. Carl

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

2) <u>What name did Intruder One call Intruder Two?</u>

a. He didn't call him anything b. Charlie c. Charles d. Carl

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) <u>When did Intruder One say that he had seen you/the other participant with his girlfriend?</u>

a. Last night b. Yesterday c. Sunday d. Today

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) **Where did Intruder One say that he had seen you/the other participant with his girlfriend?**

a. North Street b. Market Street c. South Street d. He didn't say

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) **What did Intruder One say he was doing when he saw you with his girlfriend?**

a. He was driving b. He was in a friend's car
c. He didn't say d. He was cycling

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

6) **What was the name of Intruder One's girlfriend ?**

a. Rachel b. He didn't say c. Rebecca d. Ruth

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) **What did Intruder two say Intruder one should do?**

a. He didn't say b. Speak to his girlfriend
c. go and see his girlfriend d. phone his girlfriend

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) **Who did Intruder Two say they would be late for a meeting with?**

a. He didn't say a name b. Dr Wilson c. Dr Williams d. Dr Wallis

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) **What did Intruder One say you/the other participant had been doing with his girlfriend?**

a. Chatting her up b. Talking to her
c. Hanging out with her d. He didn't say

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) **What did Intruder One say as he walked out of the room and down the corridor?**

a. I'll have him b. I'll kill him
c. I'm warning him d. He didn't say anything

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

GENERAL - Now, please take a final few moments to the answer the following questions:-

1) **How threatened did *you* feel *during* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

2) **How threatened did *you* feel *immediately following* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

3) **During the interaction to what extent did *you* perceive that you might be physically attacked?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

4) **How angry did *you* feel *during* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

5) **How angry did *you* feel *immediately following* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

6) **How afraid did *you* feel *during* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

7) **How afraid did *you* feel *immediately following* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

8) Did *you* detect any bodily sensations(i.e. an increase in heart rate, sweating, or shaking) during the interaction, please give details...

.....

.....

.....

.....

9) Was there any particular information asked about in this questionnaire that you feel you are unable to recall because you could not see it during the interaction? Please give details.....

.....

.....

.....

10) How authentic do you feel the experiment was?.....

.....

.....

11) Were *you* suspicious of the nature or purpose of the experiment at any point?

a. Yes b. No

12) If you were suspicious of the experiment, please give details of when and why you became suspicious

.....

.....

.....

13 Have you ever been accused of anything like this in this manner before? If 'yes' please give details

.....

.....

.....

14) Which aspect(s) of the interaction do you find most vivid/easiest to recall? Please give details

.....

.....

.....

15) Which aspect(s) of the interaction did you find most attention catching? Please give details

.....

.....

.....

16) How tall are you?.....

17) How much do you weigh?.....

18) What build /body shape would you class yourself as?

a. Slim-lean b. Stocky-heavy build c. Overweight-fat
d. Athletic-fit e. other (please specify).....

Thankyou for completing this questionnaire

If there are any other comments you would like to make please do so overleaf.....

Thankyou for helping

Appendix 7: Recognition Questionnaire - Control Condition - Study Two

QUESTIONNAIRE MEASURE - C

DATE..... SUBJECT NUMBER.....

SUBJECT NAME.....

Please complete ALLTHE QUESTIONS that follow even if you have to MAKE A GUESS

If you do not understand anything, do not hesitate to ask. Thank you.

1) How long do you think the interaction lasted, from the moment the first intruder entered the laboratory to the moment both intruders left?

.....Hours.....Minutes.....Seconds

How confident are you in your estimation? Indicate your confidence by circling the appropriate number below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

For the purpose of the rest of this questionnaire *'Intruder One'* refers to the *first* individual entering the laboratory, whilst *'Intruder Two'* refers to the *second* individual entering the laboratory.

Please turn over.....

APP1 - Please take a few moments to recall as much of the appearance of _ *INTRUDER ONE* as you possibly can, then estimate the following characteristics:-

1)Height:.....

How confident are you in your estimation? Indicate your confidence below..

1 Very Unsure ..... 2 Unsure Slightly ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

2)Weight:.....

How confident are you in your estimation? Indicate your confidence below..

1 Very Unsure ..... 2 Unsure Slightly ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

3)Build/body shape: Please circle the letter of your choice...

a. Slim-lean b. Stocky-heavy build c. Overweight-fat

d. Athletic-fit e. other (please specify).....

How confident are you in your estimation? Indicate your confidence below..

1 Very Unsure ..... 2 Unsure Slightly ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

4) Age:.....

How confident are you in your estimation? Indicate your confidence below..

1 Very Unsure ..... 2 Unsure Slightly ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

Still considering the appearance of *INTRUDER 1* please answer the following questions:-

1) What were his glasses like?

a. Silver metal b. He wasn't wearing glasses

c. Gold metal d. Brown tortoiseshell

How confident are you in your answer? Please indicate your confidence below..

1 Very Unsure ..... 2 Unsure Slightly ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

2) What colour was his hair?

a. Ginger b. Dark Brown c. Blonde d. Black

How confident are you in your answer? Please indicate your confidence below..

1 Very Unsure ..... 2 Unsure Slightly ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

3) What colour was his sweatshirt?

a. White b. Blue c. Green d. Yellow

How confident are you in your answer? Please indicate your confidence below..

1 Very Unsure ..... 2 Unsure Slightly ..... 3 Slightly Unsure ..... 4 Slightly Confident ..... 5 Confident ..... 6 Absolutely Certain

4) **What colour was his Jacket?**

a. Brown b. Black c. Grey d. Blue

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) **What type of material was his jacket made of?**

a. Wool b. Denim c. Leather d. waterproof

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

6) **What colour trousers was he wearing?**

a. Dark Brown b. Light Blue c. Black d. Dark Green

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) **What type of trousers was he wearing?**

a. Casual (i.e., chinos) b. Jogging bottoms c. Jeans d. formal (i.e., suit trousers)

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) **Where was he wearing an earring?**

a. Right ear b. Left ear c. Nose d. He wasn't wearing an earring

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) **What colour footwear was he wearing?**

a. Brown b. Blue c. Black d. Green

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) **What type of footwear was he wearing?**

a. Boots b. Training shoes c. Shoes d. Baseball boots

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

11) **What colour was his baseball cap?**

a. White b. Blue c. Black d. He wasn't wearing a baseball cap

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

APP2 - Now please take a few moments to recall as much of the appearance of *INTRUDER TWO* as you possibly can, then estimate the following characteristics:-

1) Height:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

2) Weight:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) Build/body shape: Please circle the letter of your choice...

a. Slim-lean b. Stocky-heavy build c. Overweight-fat
d. Athletic-fit e. other (please specify).....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) Age:.....

How confident are you in your estimation? Indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

Still considering the appearance of *INTRUDER 2* please answer the following questions:-

1) What were his glasses like?

a. Silver metal b. He wasn't wearing any
c. Gold metal d. Brown tortoiseshell

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

2) What colour was his hair?

a. Ginger b. Dark Brownc. Brown/Blond d. Black

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) What colour was the T-shirt he was wearing underneath his overshirt?

a. Green b. Blue c. White d. Black

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) **What was the pattern of his overshirt?**

a. Horizontal Stripes b. Vertical stripes c. Plain d. Checked

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) **What was the colour of his overshirt?**

a. Black and white b. Red and blue c. green and blue d. White and Blue

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

6) **What colour trousers was he wearing?**

a. Green b. Blue c. Black d. Grey

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) **What type of trousers was he wearing?**

a. Casual (i.e., chinos) b. Jogging bottoms c. Jeans d. formal (i.e., suit trousers)

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) **Where was he wearing an earring?**

a. Right ear b. Left ear c. Nose d. He wasn't wearing an earring

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) **What colour footwear was he wearing?**

a. Brown b. Blue c. Black d. Green

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) **What type of footwear was he wearing?**

a. Boots b. Trainers c. Shoes d. Baseball boots

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

11) **What colour was his baseball cap?**

a. White b. Blue c. Black d. He wasn't wearing a baseball cap

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

ACTIONS - Now, please take a few moments to think about the *ACTIONS* of the intruders, then answer the following questions:-

1) What did Intruder One have in his hand when he came into the room?

a. A ruler b. Nothing c. A folder d. A book

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

2) What object did Intruder One pick up from the side?

a. Plastic ruler b. Plastic letter opener
c. Wooden ruler d. He didn't pick up an object

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) What did Intruder One do with the object?

a. Dropped it onto the floor b. Held it in his right hand
c. Held it in his left hand d. He didn't do anything with an object

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) What object did Intruder One pick up from the floor?

a. Plastic ruler b. Nothing
c. Wooden ruler d. Piece of paper

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

5) What did Intruder Two drop on the floor?

a. Plastic ruler b. Nothing
c. Wooden ruler d. Piece of paper

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

6) What did Intruder Two pick up from the floor?

a. Plastic ruler b. Nothing
c. Wooden ruler d. Piece of paper

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

7) What did Intruder Two have in his hand when he came into the room?

a. A ruler b. Nothing c. A folder d. A book

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

8) **What did Intruder One have in his hand when he left the room?**

a. A ruler b. Nothing c. A folder d. A book

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

9) **What colour was the pen which Intruder One handed to Intruder Two?**

a. Black b. Blue c. Red d. He didn't hand him a pen

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

10) **What did Intruder Two have in his hand when he left the room?**

a. A ruler b. Nothing c. A folder d. A book

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

11) **What did Intruder Two do when he left the room?**

a. Nothing b. dropped a piece of paper c. left the door open d. closed the door

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

VERBAL - Now, please take a few moments to think about what was said during the interaction, then answer the following questions:-

1) **What name did Intruder Two call Intruder One?**

a. He didn't call him anything b. Charlie c. Charles d. Carl

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

2) **What name did Intruder One call Intruder Two?**

a. He didn't call him anything b. Charlie c. Charles d. Carl

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

3) **What did Intruder Two say when he entered the room?**

a. Hurry up b. Have you found her? c. Where is she d. Something else

How confident are you in your answer? Please indicate your confidence below..

1	2	3	4	5	6
Very Unsure	Unsure	Slightly Unsure	Slightly Confident	Confident	Absolutely Certain

4) **Who did Intruder Two say they would be late for a meeting with?**

a. He didn't say a name b. Dr Wilson c. Dr Williams d. Dr Wallis

How confident are you in your answer? Please indicate your confidence below..

1 2 3 4 5 6
Very.....Unsure.....Slightly.....Slightly.....Confident.....Absolutely
Unsure Unsure Confident Certain

5) **Where did Intruder Two say that they had to go to for their meeting?**

a. 1st floor b. 2nd floor c. 3rd floor d. basement

How confident are you in your answer? Please indicate your confidence below..

1 2 3 4 5 6
Very.....Unsure.....Slightly.....Slightly.....Confident.....Absolutely
Unsure Unsure Confident Certain

6) **After ascertaining that Penny Woolnough was not around Intruder One said:**

"Ah, I really need to see her - do you have any idea.....?"

Please select the phrase Intruder One said which fits into the space

a. Where she is? b. How long she will be?

c. He didn't say the above phrase d. When she is coming back?

How confident are you in your answer? Please indicate your confidence below..

1 2 3 4 5 6
Very.....Unsure.....Slightly.....Slightly.....Confident.....Absolutely
Unsure Unsure Confident Certain

GENERAL - Now, please take a final few moments to the answer the following questions:-

1) **How threatened did *you* feel *during* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

2) **How threatened did *you* feel *immediately following* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

3) **During the interaction to what extent did *you* perceive that you might be physically attacked?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

4) **How angry did *you* feel *during* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

5) **How angry did *you* feel *immediately following* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

6) **How afraid did *you* feel *during* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

7) **How afraid did *you* feel *immediately following* the interaction?**

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

8) Did *you* detect any bodily sensations(i.e. an increase in heart rate, sweating, or shaking) during the interaction, please give details...

.....

.....

.....

.....

9) Was there any particular information asked about in this questionnaire that you feel you are unable to recall because you could not see it during the interaction? Please give details.....

.....

.....

.....

10) How authentic do you feel the experiment was?

.....

.....

.....

.....

11) Were *you* suspicious of the nature or purpose of the experiment at any point?

a. Yes b. No

12) If you were suspicious of the experiment, please give details of when and why you became suspicious

.....

.....

.....

13) Which aspect(s) of the interaction do you find most vivid/easiest to recall? Please give details

.....

.....

.....

14) Which aspect(s) of the interaction did you find most attention catching? Please give details

.....

.....

.....

15) How tall are you?.....

16) How much do you weigh?.....

17) What build /body shape would you class yourself as?

a. Slim-lean b. Stocky-heavy build c. Overweight-fat
d. Athletic-fit e. other (please specify).....

Thank you for completing this questionnaire

If there are any other comments you would like to make please do so overleaf.....

Thank you for helping

Appendix 8: Cycling Questionnaire

CYCLING QUESTIONNAIRE

DATE..... SUBJECT NUMBER.....

SUBJECT NAME.....

Please circle your ratings on the scales below each question - thankyou

1) How arousing did you find the cycling?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

2) How difficult did you find the cycling?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

3) How stressful did you find the cycling?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

4) How enjoyable did you find the cycling?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

5) How difficult did you find watching the video *and* cycling at the same time?

1 2 3 4 5 6
Not at all.....Very slightly.....Mildly.....Significantly.....Very.....Extremely

****** *Please note the change in rating scale for the next two questions* ******

6) How much of your attention do you think was devoted to the cycling?

1 2 3 4 5 6
None.....A little.....A fair bit.....Quite a lot.....Most.....All

7) How much of your attention do you think was devoted to watching the video?

1 2 3 4 5 6
None.....A little.....A fair bit.....Quite a lot.....Most.....All

Appendix 9: Statistical Output - Study One

PHYSIOLOGICAL AROUSAL

HEART RATE DURING: UNIVARIATE ANALYSIS OF VARIANCE (WITH BASELINE AS CO-VARIATE)

Tests of Between-Subjects Effects

Dependent Variable: DURING

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5557.603[a]	4	1389.401	11.894	.000
Intercept	83.176	1	83.176	.712	.406
BASELINE	2224.093	1	2224.093	19.039	.000
INCIDENT	2298.292	1	2298.292	19.674	.000
WITNESS	281.585	1	281.585	2.410	.131
INCIDENT * WITNESS	162.497	1	162.497	1.391	.248
Error	3387.684	29	116.817		
Total	263049.500	34			
Corrected Total	8945.286	33			

a. R Squared = .621 (Adjusted R Squared = .569)

HEART RATE AFTER: UNIVARIATE ANALYSIS OF VARIANCE (WITH BASELINE AS CO-VARIATE)

Tests of Between-Subjects Effects

Dependent Variable: AFTER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2493.826[a]	4	623.456	6.700	.001
Intercept	784.732	1	784.732	8.433	.007
BASELINE	758.390	1	758.390	8.150	.008
INCIDENT	1374.272	1	1374.272	14.768	.001
WITNESS	8.169	1	8.169	.088	.769
INCIDENT * WITNESS	6.420	1	6.420	.069	.795
Error	2698.666	29	93.057		
Total	255453.934	34			
Corrected Total	5192.492	33			

a. R Squared = .480 (Adjusted R Squared = .409)

SELF-REPORTED AROUSAL

STAI: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: stai state

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	37.400[a]	3	12.467	.195	.899
Intercept	55950.400	1	55950.400	873.391	.000
INCIDENT	4.900	1	4.900	.076	.784
WITNESS	28.900	1	28.900	.451	.506
INCIDENT * WITNESS	3.600	1	3.600	.056	.814
Error	2306.200	36	64.061		
Total	58294.000	40			
Corrected Total	2343.600	39			

a. R Squared = .016 (Adjusted R Squared = -.066)

MACKAY AROUSAL SCALE: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: mackay arousal

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	34.275[a]	3	11.425	4.545	.008
Intercept	748.225	1	748.225	297.636	.000
INCIDENT	21.025	1	21.025	8.364	.006
WITNESS	9.025	1	9.025	3.590	.066
INCIDENT * WITNESS	4.225	1	4.225	1.681	.203
Error	90.500	36	2.514		
Total	873.000	40			
Corrected Total	124.775	39			

a. R Squared = .275 (Adjusted R Squared = .214)

MACKAY STRESS SCALE: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: mackay stress

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	136.275[a]	3	45.425	14.158	.000
Intercept	403.225	1	403.225	125.681	.000
INCIDENT	126.025	1	126.025	39.281	.000
WITNESS	3.025	1	3.025	.943	.338
INCIDENT * WITNESS	7.225	1	7.225	2.252	.142
Error	115.500	36	3.208		
Total	655.000	40			
Corrected Total	251.775	39			

a. R Squared = .541 (Adjusted R Squared = .503)

THREAT DURING: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: threatened during

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	40.200[a]	3	13.400	14.105	.000
Intercept	211.600	1	211.600	222.737	.000
INCIDENT	36.100	1	36.100	38.000	.000
WITNESS	1.600	1	1.600	1.684	.203
INCIDENT * WITNESS	2.500	1	2.500	2.632	.113
Error	34.200	36	.950		
Total	286.000	40			
Corrected Total	74.400	39			

a. R Squared = .540 (Adjusted R Squared = .502)

THREAT IMMEDIATELY FOLLOWING: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: threatened immediately following

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	18.200[a]	3	6.067	8.598	.000
Intercept	102.400	1	102.400	145.134	.000
INCIDENT	12.100	1	12.100	17.150	.000
WITNESS	2.500	1	2.500	3.543	.068
INCIDENT * WITNESS	3.600	1	3.600	5.102	.030
Error	25.400	36	.706		
Total	146.000	40			
Corrected Total	43.600	39			

a. R Squared = .417 (Adjusted R Squared = .369)

THREAT IMMEDIATELY FOLLOWING: POSTHOC TUKEY'S TEST FOR INTERACTION OF INCIDENT BY WITNESS

threatened immediately following

Tukey HSD[a,b]

group	N	Subset	
		1	2
control victim	10	1.0000	
control bystander	10	1.1000	
threat bystander	10	1.6000	
threat victim	10		2.7000
Sig.		.393	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .706.

a. Uses Harmonic Mean Sample Size = 10.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: threatened immediately following
Tukey HSD

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
threat victim	threat bystander	1.1000*	.3756	.029	8.829E-02	2.1117
	control victim	1.7000*	.3756	.000	.6883	2.7117
	control bystander	1.6000*	.3756	.001	.5883	2.6117
threat bystander	threat victim	-1.1000*	.3756	.029	-2.1117	-8.8286E-02
	control victim	.6000	.3756	.393	-.4117	1.6117
	control bystander	.5000	.3756	.550	-.5117	1.5117
control victim	threat victim	-1.7000*	.3756	.000	-2.7117	-.6883
	threat bystander	-.6000	.3756	.393	-1.6117	.4117
	control bystander	-.1000	.3756	.993	-1.1117	.9117
control bystander	threat victim	-1.6000*	.3756	.001	-2.6117	-.5883
	threat bystander	-.5000	.3756	.550	-1.5117	.5117
	control victim	.1000	.3756	.993	-.9117	1.1117

Based on observed means.

*. The mean difference is significant at the .05 level.

PERCEIVED ATTACK DURING: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: perceived attack during

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	20.075[a]	3	6.692	9.301	.000
Intercept	119.025	1	119.025	165.440	.000
INCIDENT	18.225	1	18.225	25.332	.000
WITNESS	1.225	1	1.225	1.703	.200
INCIDENT * WITNESS	.625	1	.625	.869	.358
Error	25.900	36	.719		
Total	165.000	40			
Corrected Total	45.975	39			

a. R Squared = .437 (Adjusted R Squared = .390)

ANGRY DURING: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: angry during

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11.475[a]	3	3.825	3.732	.020
Intercept	140.625	1	140.625	137.195	.000
INCIDENT	7.225	1	7.225	7.049	.012
WITNESS	3.025	1	3.025	2.951	.094
INCIDENT * WITNESS	1.225	1	1.225	1.195	.282
Error	36.900	36	1.025		
Total	189.000	40			
Corrected Total	48.375	39			

a. R Squared = .237 (Adjusted R Squared = .174)

ANGRY IMMEDIATELY FOLLOWING: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: angry immediately following

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3.875[a]	3	1.292	1.458	.242
Intercept	99.225	1	99.225	111.978	.000
INCIDENT	3.025	1	3.025	3.414	.073
WITNESS	.225	1	.225	.254	.617
INCIDENT * WITNESS	.625	1	.625	.705	.407
Error	31.900	36	.886		
Total	135.000	40			
Corrected Total	35.775	39			

a. R Squared = .108 (Adjusted R Squared = .034)

AFRAID DURING: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: afraid during

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	25.800[a]	3	8.600	11.639	.000
Intercept	129.600	1	129.600	175.398	.000
INCIDENT	25.600	1	25.600	34.647	.000
WITNESS	1.000E-01	1	1.000E-01	.135	.715
INCIDENT * WITNESS	.100	1	.100	.135	.715
Error	26.600	36	.739		
Total	182.000	40			
Corrected Total	52.400	39			

a. R Squared = .492 (Adjusted R Squared = .450)

AFRAID IMMEDIATELY FOLLOWING: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: afraid immediately following

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6.875[a]	3	2.292	4.024	.014
Intercept	75.625	1	75.625	132.805	.000
INCIDENT	5.625	1	5.625	9.878	.003
WITNESS	.625	1	.625	1.098	.302
INCIDENT * WITNESS	.625	1	.625	1.098	.302
Error	20.500	36	.569		
Total	103.000	40			
Corrected Total	27.375	39			

a. R Squared = .251 (Adjusted R Squared = .189)

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL

HEART RATE DURING: SPEARMAN CORRELATIONS (ACROSS THE THREAT GROUP WITNESSES) OF 'RATED PERCEIVED THREAT DURING THE INCIDENT' AND 'RATED PERCEIVED ATTACK DURING THE INCIDENT' WITH THE ' STANDARDIZED RESIDUAL (TO TAKE ACCOUNT OF BASELINE VARIATION) OF HEART RATE DURING THE INCIDENT'

Correlations

			threatened during	perceived ttack during	Standardized Residual
Spearman's rh	threatened during	Correlation Coeffic	1.000	.736**	.255
		Sig. (2-tailed)	.	.003	.378
		N	14	14	14
	perceived attack dur	Correlation Coeffic	.736**	1.000	.048
		Sig. (2-tailed)	.003	.	.871
		N	14	14	14
	Standardized Residu	Correlation Coeffic	.255	.048	1.000
		Sig. (2-tailed)	.378	.871	.
		N	14	14	14

**. Correlation is significant at the .01 level (2-tailed).

HEART RATE AFTER: SPEARMAN CORRELATIONS (ACROSS THE THREAT GROUP WITNESSES) OF RATED 'PERCEIVED THREAT DURING THE INCIDENT' AND 'RATED PERCEIVED ATTACK DURING THE INCIDENT' WITH THE 'STANDARDIZED RESIDUAL (TO TAKE ACCOUNT OF BASELINE VARIATION) OF HEART RATE AFTER THE INCIDENT'

Correlations

			threatened during	perceived attack during	Standardized Residual
Spearman's rho	threatened during	Correlation Coefficie	1.000	.736**	.162
		Sig. (2-tailed)	.	.003	.580
		N	14	14	14
	perceived attack duri	Correlation Coefficie	.736**	1.000	.410
		Sig. (2-tailed)	.003	.	.145
		N	14	14	14
	Standardized Residu	Correlation Coefficie	.162	.410	1.000
		Sig. (2-tailed)	.580	.145	.
		N	14	14	14

**. Correlation is significant at the .01 level (2-tailed).

PERCENTAGE OF AVAILABLE DETAILS RECALLED

FREE RECALL: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: total free recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	13.754[a]	3	4.585	.184	.907
Intercept	5259.913	1	5259.913	210.671	.000
INCIDENT	5.410	1	5.410	.217	.644
WITNESS	1.612	1	1.612	.065	.801
INCIDENT * WITNESS	6.732	1	6.732	.270	.607
Error	898.828	36	24.967		
Total	6172.495	40			
Corrected Total	912.582	39			

a. R Squared = .015 (Adjusted R Squared = -.067)

FREE RECALL: UNIVARIATE ANALYSIS OF VARIANCE - CENTRAL VS. PERIPHERAL DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	2925.780	1	2925.780	51.176	.000
INFO * INCIDENT	Linear	.730	1	.730	.013	.911
INFO * WITNESS	Linear	27.308	1	27.308	.478	.494
INFO * INCIDENT * WITNESS	Linear	9.398	1	9.398	.164	.688
Error(INFO)	Linear	2058.153	36	57.171		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	11943.828	1	11943.828	234.296	.000
INCIDENT	17.354	1	17.354	.340	.563
WITNESS	6.183	1	6.183	.121	.730
INCIDENT * WITNESS	17.039	1	17.039	.334	.567
Error	1835.194	36	50.978		

FREE RECALL: UNIVARIATE ANALYSIS OF VARIANCE - INTRUDER 1 VS. INTRUDER 2 DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	589.644	1	589.644	53.273	.000
INFO * INCIDENT	Linear	53.645	1	53.645	4.847	.034
INFO * WITNESS	Linear	40.912	1	40.912	3.696	.062
INFO * INCIDENT * WITNESS	Linear	16.083	1	16.083	1.453	.236
Error(INFO)	Linear	398.462	36	11.068		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	10490.261	1	10490.261	208.862	.000
INCIDENT	15.798	1	15.798	.315	.578
WITNESS	3.745	1	3.745	.075	.786
INCIDENT * WITNESS	14.973	1	14.973	.298	.588
Error	1808.133	36	50.226		

FREE RECALL: POSTHOC TUKEY'S TEST - INTERACTION OF INFO (INTRUDER 1 VS INTRUDER 2 DETAIL) BY INCIDENT

INFO

Tukey HSD[a,b]

GROUP	N	Subset 1	Subset 2
control intruder 2	20	7.4730	
threat intruder 2	20	9.9995	9.9995
threat intruder 1	20		13.7915
control intruder 1	20		14.5405
Sig.		.468	.051

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 30.030.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
threat intruder 1	control intruder 1	-.7490	1.7329	.973	-5.3011	3.8031
	threat intruder 2	3.7920	1.7329	.136	-.7601	8.3441
	control intruder 2	6.3185*	1.7329	.003	1.7664	10.8706
control intruder 1	threat intruder 1	.7490	1.7329	.973	-3.8031	5.3011
	threat intruder 2	4.5410	1.7329	.051	-1.1086E-02	9.0931
	control intruder 2	7.0675*	1.7329	.001	2.5154	11.6196
threat intruder 2	threat intruder 1	-3.7920	1.7329	.136	-8.3441	.7601
	control intruder 1	-4.5410	1.7329	.051	-9.0931	1.109E-02
	control intruder 2	2.5265	1.7329	.468	-2.0256	7.0786
control intruder 2	threat intruder 1	-6.3185*	1.7329	.003	-10.8706	-1.7664
	control intruder 1	-7.0675*	1.7329	.001	-11.6196	-2.5154
	threat intruder 2	-2.5265	1.7329	.468	-7.0786	2.0256

Based on observed means.

*. The mean difference is significant at the .05 level.

FREE RECALL: UNIVARIATE ANALYSIS OF VARIANCE - ACTION VS. VERBAL VS. APPEARANCE DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	2860.31	2	1430.16	20.28	.000
INFO * INCIDENT	573.46	2	286.73	4.07	.021
INFO * WITNESS	57.04	2	28.52	.40	.669
INFO * INCIDENT * WIT	24.93	2	12.46	.18	.838
Error(INFO)	5078.22	72	70.53		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	19553.682	1	19553.682	235.691	.000
INCIDENT	6.017	1	6.017	.073	.789
WITNESS	10.133	1	10.133	.122	.729
INCIDENT * WITNESS	37.330	1	37.330	.450	.507
Error	2986.680	36	82.963		

FREE RECALL: POSTHOC TUKEY'S TEST - INTERACTION OF INFORMATION (ACTION VS VERBAL VS APPEARANCE) BY INCIDENT

FREEAVA

Tukey HSD[a,b]

GRPAVA	N	Subset 1	Subset 2	Subset 3
Control Appearance	20	5.5115		
Threat Appearance	20	6.8185		
Threat Verbal	20	11.6670	11.6670	
Control Action	20		15.1605	15.1605
Control Verbal	20		16.9515	16.9515
Threat Action	20			20.4815
Sig.		.204	.365	.358

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 71.880.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: FREEAVA
Tukey HSD

(I) GRPAVA	(J) GRPAVA	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Action	Control Action	5.3210	2.6810	.358	-2.4508	13.0928
	Threat Verbal	8.8145*	2.6810	.017	1.0427	16.5863
	Control Verbal	3.5300	2.6810	.775	-4.2418	11.3018
	Threat Appearance	13.6630*	2.6810	.000	5.8912	21.4348
	Control Appearance	14.9700*	2.6810	.000	7.1982	22.7418
Control Action	Threat Action	-5.3210	2.6810	.358	-13.0928	2.4508
	Threat Verbal	3.4935	2.6810	.783	-4.2783	11.2653
	Control Verbal	-1.7910	2.6810	.985	-9.5628	5.9808
	Threat Appearance	8.3420*	2.6810	.028	.5702	16.1138
	Control Appearance	9.6490*	2.6810	.006	1.8772	17.4208
Threat Verbal	Threat Action	-8.8145*	2.6810	.017	-16.5863	-1.0427
	Control Action	-3.4935	2.6810	.783	-11.2653	4.2783
	Control Verbal	-5.2845	2.6810	.365	-13.0563	2.4873
	Threat Appearance	4.8485	2.6810	.465	-2.9233	12.6203
	Control Appearance	6.1555	2.6810	.204	-1.6163	13.9273
Control Verbal	Threat Action	-3.5300	2.6810	.775	-11.3018	4.2418
	Control Action	1.7910	2.6810	.985	-5.9808	9.5628
	Threat Verbal	5.2845	2.6810	.365	-2.4873	13.0563
	Threat Appearance	10.1330*	2.6810	.003	2.3612	17.9048
	Control Appearance	11.4400*	2.6810	.001	3.6682	19.2118
Threat Appearance	Threat Action	-13.6630*	2.6810	.000	-21.4348	-5.8912
	Control Action	-8.3420*	2.6810	.028	-16.1138	-.5702
	Threat Verbal	-4.8485	2.6810	.465	-12.6203	2.9233
	Control Verbal	-10.1330*	2.6810	.003	-17.9048	-2.3612
	Control Appearance	1.3070	2.6810	.997	-6.4648	9.0788
Control Appearance	Threat Action	-14.9700*	2.6810	.000	-22.7418	-7.1982
	Control Action	-9.6490*	2.6810	.006	-17.4208	-1.8772
	Threat Verbal	-6.1555	2.6810	.204	-13.9273	1.6163
	Control Verbal	-11.4400*	2.6810	.001	-19.2118	-3.6682
	Threat Appearance	-1.3070	2.6810	.997	-9.0788	6.4648

Based on observed means.

*. The mean difference is significant at the .05 level.

CUED RECALL: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: total cued recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	79.148[a]	3	26.383	1.925	.143
Intercept	2813.000	1	2813.000	205.209	.000
INCIDENT	51.484	1	51.484	3.756	.061
WITNESS	4.225E-02	1	4.225E-02	.003	.956
INCIDENT * WITNESS	27.622	1	27.622	2.015	.164
Error	493.488	36	13.708		
Total	3385.636	40			
Corrected Total	572.636	39			

a. R Squared = .138 (Adjusted R Squared = .066)

CUED RECALL: UNIVARIATE ANALYSIS OF VARIANCE - CENTRAL VS. PERIPHERAL DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	335.749	1	335.749	12.488	.001
INFO * INCIDENT	Linear	2.922	1	2.922	.109	.744
INFO * WITNESS	Linear	2.517	1	2.517	.094	.761
INFO * INCIDENT * WITNESS	Linear	9.025	1	9.025	.336	.566
Error(INFO)	Linear	967.907	36	26.886		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	5293.770	1	5293.770	204.358	.000
INCIDENT	102.129	1	102.129	3.943	.055
WITNESS	1.891E-02	1	1.891E-02	.001	.979
INCIDENT * WITNESS	50.165	1	50.165	1.937	.173
Error	932.559	36	25.904		

CUED RECALL: UNIVARIATE ANALYSIS OF VARIANCE - INTRUDER 1 VS. INTRUDER 2 DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	147.370	1	147.370	25.514	.000
INFO * INCIDENT	Linear	.196	1	.196	.034	.855
INFO * WITNESS	Linear	5.387	1	5.387	.933	.341
INFO * INCIDENT * WITNESS	Linear	5.544	1	5.544	.960	.334
Error(INFO)	Linear	207.939	36	5.776		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	4921.326	1	4921.326	163.493	.000
INCIDENT	31.702	1	31.702	1.053	.312
WITNESS	1.670	1	1.670	.055	.815
INCIDENT * WITNESS	41.386	1	41.386	1.375	.249
Error	1083.644	36	30.101		

CUED RECALL: UNIVARIATE ANALYSIS OF VARIANCE - ACTION VS. VERBAL VS. APPEARANCE DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	447.58	2	223.79	5.45	.006
INFO * INCIDENT	206.44	2	103.22	2.52	.088
INFO * WITNESS	21.60	2	10.80	.26	.769
INFO * INCIDENT * WIT	16.90	2	8.45	.21	.814
Error(INFO)	2954.29	72	41.03		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	7479.565	1	7479.565	231.564	.000
INCIDENT	223.505	1	223.505	6.920	.012
WITNESS	.859	1	.859	.027	.871
INCIDENT * WITNESS	62.165	1	62.165	1.925	.174
Error	1162.806	36	32.300		

TOTAL RECALL (FREE + CUED): UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: total both recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	153.094[a]	3	51.031	1.055	.380
Intercept	15766.061	1	15766.061	326.087	.000
INCIDENT	90.390	1	90.390	1.870	.180
WITNESS	1.126	1	1.126	.023	.880
INCIDENT * WITNESS	61.578	1	61.578	1.274	.267
Error	1740.574	36	48.349		
Total	17659.730	40			
Corrected Total	1893.668	39			

a. R Squared = .081 (Adjusted R Squared = .004)

TOTAL RECALL (FREE + CUED): UNIVARIATE ANALYSIS OF VARIANCE - CENTRAL VS. PERIPHERAL DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	1279.440	1	1279.440	32.138	.000
INFO * INCIDENT	Linear	6.584	1	6.584	.165	.687
INFO * WITNESS	Linear	46.467	1	46.467	1.167	.287
INFO * INCIDENT * WITNESS	Linear	3.781E-03	1	3.781E-03	.000	.992
Error(INFO)	Linear	1433.173	36	39.810		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	33143.232	1	33143.232	334.901	.000
INCIDENT	203.490	1	203.490	2.056	.160
WITNESS	5.497	1	5.497	.056	.815
INCIDENT * WITNESS	125.576	1	125.576	1.269	.267
Error	3562.719	36	98.964		

TOTAL RECALL (FREE + CUED): UNIVARIATE ANALYSIS OF VARIANCE - INTRUDER 1 VS. INTRUDER 2 DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	1327.065	1	1327.065	98.375	.000
INFO * INCIDENT	Linear	60.465	1	60.465	4.482	.041
INFO * WITNESS	Linear	76.226	1	76.226	5.651	.023
INFO * INCIDENT * WITNESS	Linear	40.598	1	40.598	3.010	.091
Error(INFO)	Linear	485.634	36	13.490		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	29784.148	1	29784.148	290.056	.000
INCIDENT	92.171	1	92.171	.898	.350
WITNESS	.413	1	.413	.004	.950
INCIDENT * WITNESS	106.284	1	106.284	1.035	.316
Error	3696.628	36	102.684		

TOTAL RECALL (FREE + CUED): POSTHOC TUKEY'S TEST - INTERACTION OF INFO (INTRUDER 1 VS INTRUDER 2) BY INCIDENT

INFO

Tukey HSD[a,b]

GROUP	N	Subset		
		1	2	3
control intruder 2	20	13.2795		
threat intruder 2	20	17.1650	17.1650	
control intruder 1	20		23.1640	23.1640
threat intruder 1	20			23.5720
Sig.		.377	.069	.998

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 57.971.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
threat intruder 1	control intruder 1	.4080	2.4077	.998	-5.9166	6.7326
	threat intruder 2	6.4070*	2.4077	.046	8.238E-02	12.7316
	control intruder 2	10.2925*	2.4077	.000	3.9679	16.6171
control intruder 1	threat intruder 1	-.4080	2.4077	.998	-6.7326	5.9166
	threat intruder 2	5.9990	2.4077	.069	-.3256	12.3236
	control intruder 2	9.8845*	2.4077	.001	3.5599	16.2091
threat intruder 2	threat intruder 1	-6.4070*	2.4077	.046	-12.7316	-8.2375E-02
	control intruder 1	-5.9990	2.4077	.069	-12.3236	.3256
	control intruder 2	3.8855	2.4077	.377	-2.4391	10.2101
control intruder 2	threat intruder 1	-10.2925*	2.4077	.000	-16.6171	-3.9679
	control intruder 1	-9.8845*	2.4077	.001	-16.2091	-3.5599
	threat intruder 2	-3.8855	2.4077	.377	-10.2101	2.4391

Based on observed means.

*. The mean difference is significant at the .05 level.

TOTAL RECALL (FREE + CUED): UNIVARIATE ANALYSIS OF VARIANCE - ACTION VS. VERBAL VS. APPEARANCE DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	1160.18	2	580.09	9.72	.000
INFO * INCIDENT	1082.44	2	541.22	9.07	.000
INFO * WITNESS	104.07	2	52.03	.87	.422
INFO * INCIDENT * WIT	12.07	2	6.03	.10	.904
Error(INFO)	4295.44	72	59.66		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	51216.966	1	51216.966	346.658	.000
INCIDENT	302.863	1	302.863	2.050	.161
WITNESS	16.890	1	16.890	.114	.737
INCIDENT * WITNESS	195.841	1	195.841	1.326	.257
Error	5318.813	36	147.745		

TOTAL RECALL (FREE + CUED): POSTHOC TUKEY'S TEST - INTERACTION OF INFORMATION (ACTION VS VERBAL VS APPEARANCE) BY INCIDENT

BOTHAVA

Tukey HSD[a,b]

GRPAVA	N	Subset 1	Subset 2
Control Appearance	20	16.3065	
Threat Appearance	20	17.2730	
Control Action	20	18.7100	
Threat Verbal	20	19.3750	
Control Verbal	20	22.1955	22.1955
Threat Action	20		30.0960
Sig.		.352	.088

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 87.220.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: BOTHAVA
Tukey HSD

(I) GRPAVA	(J) GRPAVA	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Action	Control Action	11.3860*	2.9533	.003	2.8250	19.9470
	Threat Verbal	10.7210*	2.9533	.006	2.1600	19.2820
	Control Verbal	7.9005	2.9533	.088	-.6605	16.4615
	Threat Appearance	12.8230*	2.9533	.000	4.2620	21.3840
	Control Appearance	13.7895*	2.9533	.000	5.2285	22.3505
Control Action	Threat Action	-11.3860*	2.9533	.003	-19.9470	-2.8250
	Threat Verbal	-.6650	2.9533	1.000	-9.2260	7.8960
	Control Verbal	-3.4855	2.9533	.845	-12.0465	5.0755
	Threat Appearance	1.4370	2.9533	.997	-7.1240	9.9980
	Control Appearance	2.4035	2.9533	.964	-6.1575	10.9645
Threat Verbal	Threat Action	-10.7210*	2.9533	.006	-19.2820	-2.1600
	Control Action	.6650	2.9533	1.000	-7.8960	9.2260
	Control Verbal	-2.8205	2.9533	.931	-11.3815	5.7405
	Threat Appearance	2.1020	2.9533	.980	-6.4590	10.6630
	Control Appearance	3.0685	2.9533	.904	-5.4925	11.6295
Control Verbal	Threat Action	-7.9005	2.9533	.088	-16.4615	.6605
	Control Action	3.4855	2.9533	.845	-5.0755	12.0465
	Threat Verbal	2.8205	2.9533	.931	-5.7405	11.3815
	Threat Appearance	4.9225	2.9533	.556	-3.6385	13.4835
	Control Appearance	5.8890	2.9533	.352	-2.6720	14.4500
Threat Appearance	Threat Action	-12.8230*	2.9533	.000	-21.3840	-4.2620
	Control Action	-1.4370	2.9533	.997	-9.9980	7.1240
	Threat Verbal	-2.1020	2.9533	.980	-10.6630	6.4590
	Control Verbal	-4.9225	2.9533	.556	-13.4835	3.6385
	Control Appearance	.9665	2.9533	.999	-7.5945	9.5275
Control Appearance	Threat Action	-13.7895*	2.9533	.000	-22.3505	-5.2285
	Control Action	-2.4035	2.9533	.964	-10.9645	6.1575
	Threat Verbal	-3.0685	2.9533	.904	-11.6295	5.4925
	Control Verbal	-5.8890	2.9533	.352	-14.4500	2.6720
	Threat Appearance	-.9665	2.9533	.999	-9.5275	7.5945

Based on observed means.

*. The mean difference is significant at the .05 level.

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL WITH PERCENTAGE OF AVAILABLE DETAILS RECALLED

PEARSON & SPEARMAN CORRELATIONS (ACROSS THE THREAT GROUP WITNESSES) OF THE VARIOUS MEASURES OF PROPORTION OF DETAILS RECALLED WITH: THE 'STANDARDIZED RESIDUALS (TO TAKE ACCOUNT OF BASELINE VARIATION) OF HEART RATE DURING THE INCIDENT AND HEART RATE IMMEDIATELY FOLLOWING THE INCIDENT' AND 'RATED PERCEIVED THREAT DURING THE INCIDENT' AND 'RATED PERCEIVED ATTACK DURING THE INCIDENT'

Percentage of Available Details: Free Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	.620*	.323	.178	.116

	Sig. (2-tailed)	.018	.260	.453	.627
	N	14	14	20	20
Central	Correlation	.469	.487	.057	.142
	Sig. (2-tailed)	.090	.078	.810	.550
	N	14	14	20	20
Peripheral	Correlation	.459	.013	.183	.142
	Sig. (2-tailed)	.099	.964	.440	.551
	N	14	14	20	20
Intruder 1	Correlation	.607*	.339	.162	.120
	Sig. (2-tailed)	.021	.235	.495	.615
	N	14	14	20	20
Intruder 2	Correlation	.582*	.273	.091	.052
	Sig. (2-tailed)	.029	.346	.704	.829
	N	14	14	20	20
Action	Correlation	.449	.491	.160	.218
	Sig. (2-tailed)	.107	.074	.501	.357
	N	14	14	20	20
Verbal	Correlation	.466	.348	-.353	-.253
	Sig. (2-tailed)	.093	.223	.127	.283
	N	14	14	20	20
Appearance	Correlation	.401	-.060	.226	.155
	Sig. (2-tailed)	.155	.838	.339	.514
	N	14	14	20	20

* Correlation is significant at the 0.05 level (2-tailed)

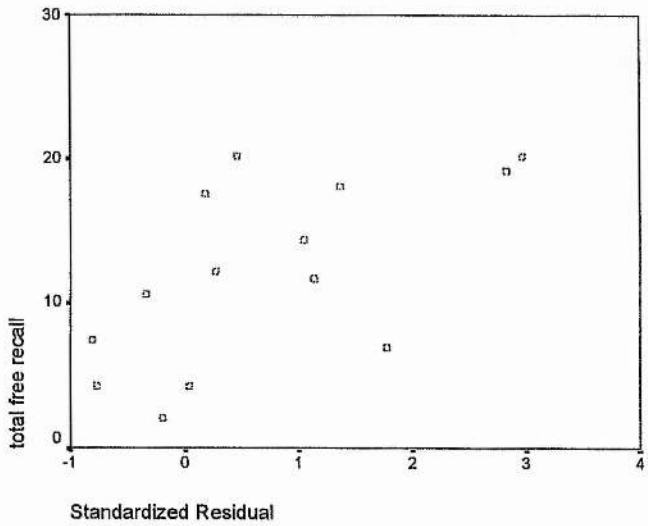
Percentage of Available Details: Cued Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	.476	.047	-.099	-.220
	Sig. (2-tailed)	.085	.874	.679	.352
	N	14	14	20	20
Central	Correlation	.347	.037	-.046	-.070
	Sig. (2-tailed)	.224	.899	.846	.769
	N	14	14	20	20
Peripheral	Correlation	.367	.034	.016	-.026
	Sig. (2-tailed)	.196	.908	.945	.913
	N	14	14	20	20
Intruder 1	Correlation	.459	.019	.145	-.091
	Sig. (2-tailed)	.099	.949	.542	.704
	N	14	14	20	20
Intruder 2	Correlation	.419	.082	-.342	-.316
	Sig. (2-tailed)	.136	.781	.140	.175
	N	14	14	20	20
Action	Correlation	.269	-.020	-.141	-.187
	Sig. (2-tailed)	.352	.947	.553	.431
	N	14	14	20	20
Verbal	Correlation	-.117	.127	.056	.123
	Sig. (2-tailed)	.690	.666	.814	.604
	N	14	14	20	20
Appearance	Correlation	.458	.033	.010	-.051
	Sig. (2-tailed)	.099	.910	.968	.832
	N	14	14	20	20

	Heart Rate	Heart Rate	Rated Threat	Rated

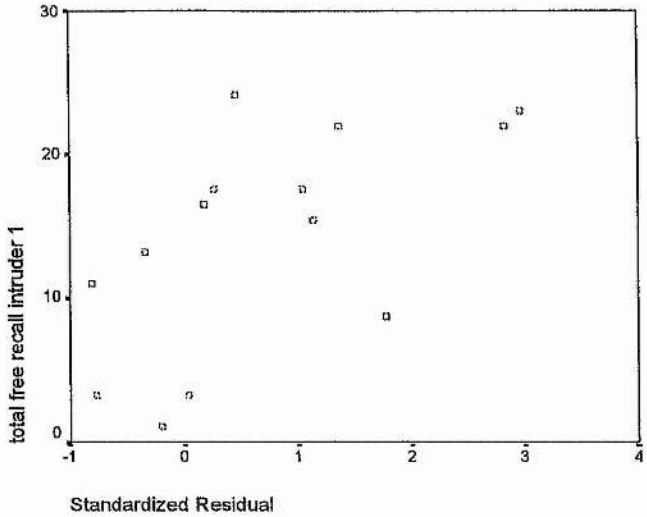
Percentage of Available Details: Total Recall		During (Residual Values) *PEARSON*	After (Residual Values) *PEARSON*	During *SPEARMAN*	Perceived Attack During *SPEARMAN*
Overall	Correlation	.700**	.265	.065	-.061
	Sig. (2-tailed)	.005	.360	.786	.799
	N	14	14	20	20
Central	Correlation	.579*	.440	-.019	.003
	Sig. (2-tailed)	.030	.115	.938	.990
	N	14	14	20	20
Peripheral	Correlation	.701**	.037	.193	.025
	Sig. (2-tailed)	.005	.901	.415	.915
	N	14	14	20	20
Intruder 1	Correlation	.649*	.253	.104	-.040
	Sig. (2-tailed)	.012	.383	.661	.868
	N	14	14	20	20
Intruder 2	Correlation	.655*	.236	-.045	-.147
	Sig. (2-tailed)	.011	.417	.851	.537
	N	14	14	20	20
Action	Correlation	.572*	.445	.140	.071
	Sig. (2-tailed)	.033	.111	.557	.766
	N	14	14	20	20
Verbal	Correlation	.386	.421	-.212	-.040
	Sig. (2-tailed)	.173	.134	.369	.866
	N	14	14	20	20
Appearance	Correlation	.642*	-.026	.134	-.021
	Sig. (2-tailed)	.013	.929	.573	.930
	N	14	14	20	20

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01level (2-tailed)

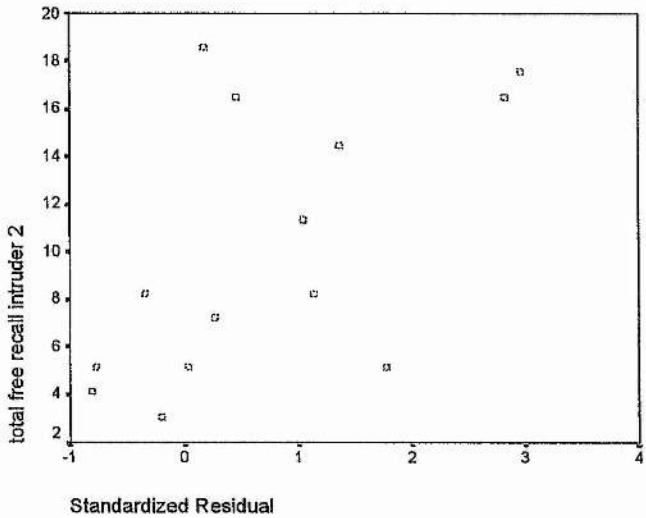
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH TOTAL FREE RECALL



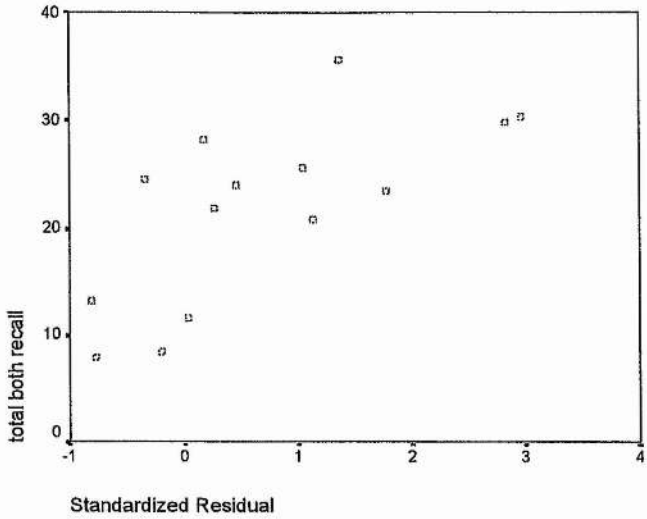
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH FREE RECALL FOR INTRUDER 1



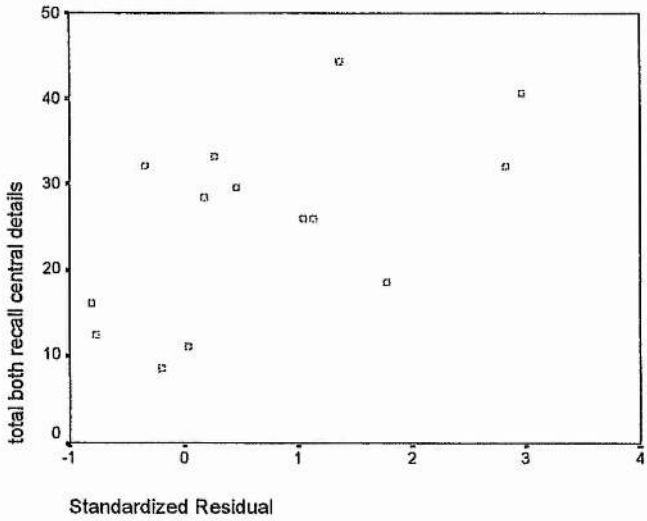
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) FREE RECALL FOR INTRUDER 2



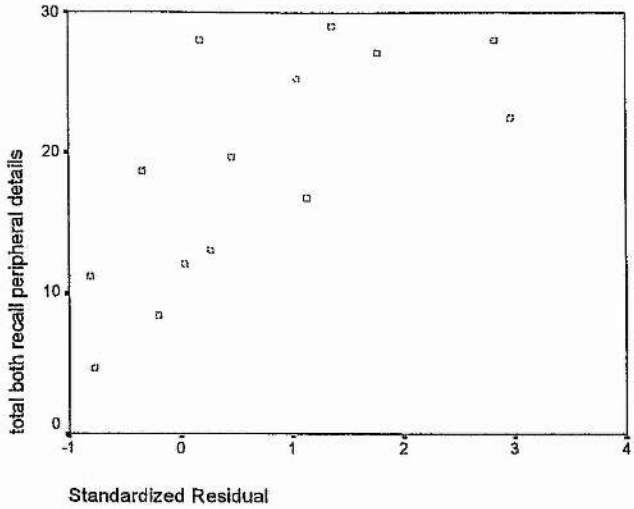
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH TOTAL RECALL



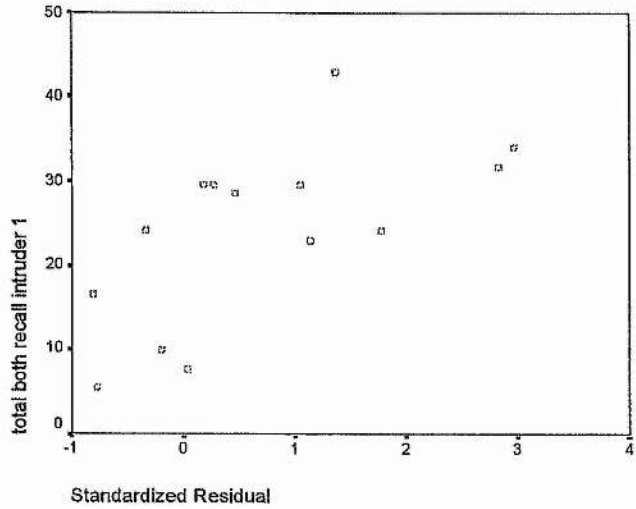
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH TOTAL RECALL FOR CENTRAL DETAILS



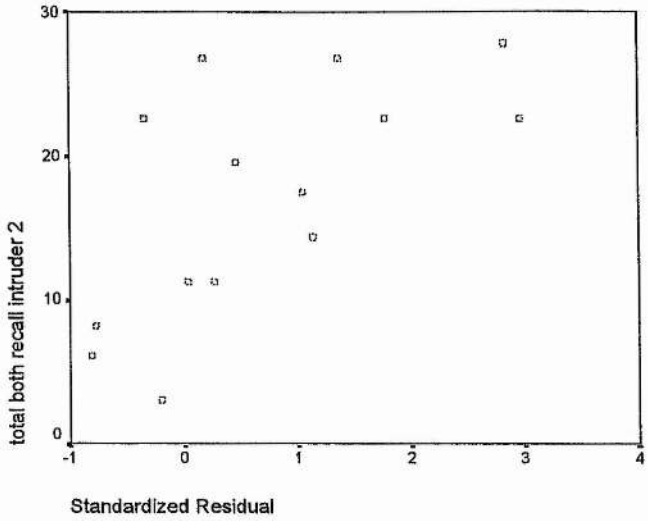
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH TOTAL RECALL FOR PERIPHERAL DETAILS



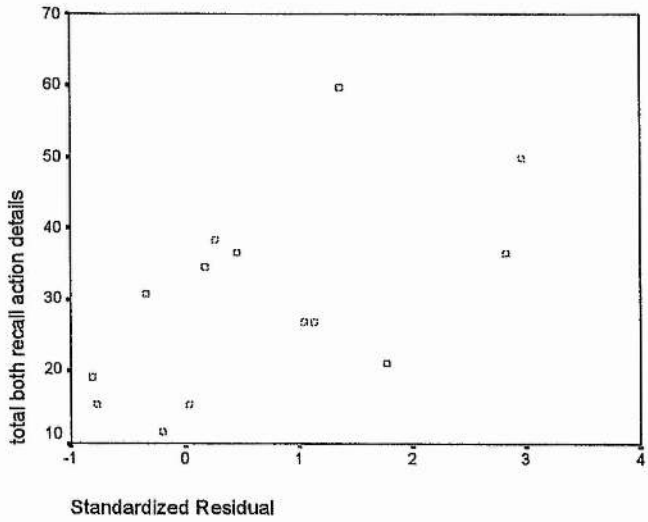
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH TOTAL RECALL FOR INTRUDER 1



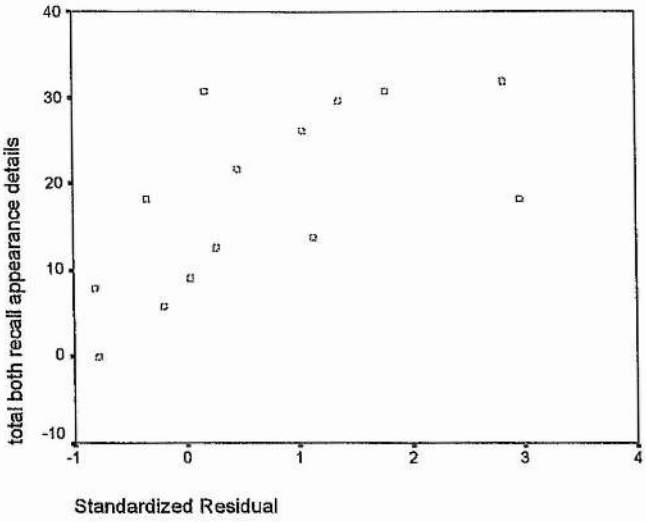
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH TOTAL RECALL FOR INTRUDER 2



SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH TOTAL RECALL FOR ACTION DETAILS



SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH TOTAL RECALL FOR APPEARANCE DETAILS



ACCURACY OF RECALL

FREE RECALL: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: total free recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	70.051[a]	3	23.350	.249	.861
Intercept	318039.072	1	318039.072	3397.407	.000
INCIDENT	12.713	1	12.713	.136	.715
WITNESS	47.764	1	47.764	.510	.480
INCIDENT * WITNESS	9.575	1	9.575	.102	.751
Error	3370.042	36	93.612		
Total	321479.166	40			
Corrected Total	3440.094	39			

a. R Squared = .020 (Adjusted R Squared = -.061)

FREE RECALL: UNIVARIATE ANALYSIS OF VARIANCE - CENTRAL VS. PERIPHERAL DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	7998.694	1	7998.694	55.399	.000
INFO * INCIDENT	Linear	744.624	1	744.624	5.157	.032
INFO * WITNESS	Linear	351.122	1	351.122	2.432	.132
INFO * INCIDENT * WITNESS	Linear	101.887	1	101.887	.706	.409
Error(INFO)	Linear	3465.211	24	144.384		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	371039.831	1	371039.831	2167.496	.000
INCIDENT	406.994	1	406.994	2.378	.136
WITNESS	428.566	1	428.566	2.504	.127
INCIDENT * WITNESS	5.420	1	5.420	.032	.860
Error	4108.406	24	171.184		

FREE RECALL: POSTHOC TUKEY'S TEST - INTERACTION OF INFO (CENTRAL VS PERIPHERAL) BY INCIDENT

INFO

Tukey HSD[a,b,c]

GROUP	N	Subset 1	Subset 2	Subset 3
threat peripheral	13	65.9062		
control peripheral	15		77.4427	
control central	20			94.5460
threat central	20			96.6485
Sig.		1.000	1.000	.954

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 134.033.

a. Uses Harmonic Mean Sample Size = 16.421.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
threat central	control central	2.1025	3.6611	.939	-7.5549	11.7599
	threat peripheral	30.7423*	4.1245	.000	19.8623	41.6224
	control peripheral	19.2058*	3.9544	.000	8.7747	29.6370
control central	threat central	-2.1025	3.6611	.939	-11.7599	7.5549
	threat peripheral	28.6398*	4.1245	.000	17.7598	39.5199
	control peripheral	17.1033*	3.9544	.000	6.6722	27.5345
threat peripheral	threat central	-30.7423*	4.1245	.000	-41.6224	-19.8623
	control central	-28.6398*	4.1245	.000	-39.5199	-17.7598
	control peripheral	-11.5365	4.3870	.051	-23.1088	3.582E-02
control peripheral	threat central	-19.2058*	3.9544	.000	-29.6370	-8.7747
	control central	-17.1033*	3.9544	.000	-27.5345	-6.6722
	threat peripheral	11.5365	4.3870	.051	-3.5815E-02	23.1088

Based on observed means.

*. The mean difference is significant at the .05 level.

FREE RECALL: UNIVARIATE ANALYSIS OF VARIANCE - INTRUDER 1 VS. INTRUDER 2 DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	254.184	1	254.184	3.059	.089
INFO * INCIDENT	Linear	53.595	1	53.595	.645	.427
INFO * WITNESS	Linear	28.322	1	28.322	.341	.563
INFO * INCIDENT * WITNESS	Linear	15.629	1	15.629	.188	.667
Error(INFO)	Linear	2991.241	36	83.090		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	631304.151	1	631304.151	3075.477	.000
INCIDENT	8.791	1	8.791	.043	.837
WITNESS	106.076	1	106.076	.517	.477
INCIDENT * WITNESS	22.134	1	22.134	.108	.745
Error	7389.732	36	205.270		

FREE RECALL: UNIVARIATE ANALYSIS OF VARIANCE - ACTION VS. VERBAL VS. APPEARANCE DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	10039.71	2	5019.86	28.03	.000
INFO * INCIDENT	1332.77	2	666.38	3.72	.033
INFO * WITNESS	232.68	2	116.34	.65	.528
INFO * INCIDENT * WIT	570.28	2	285.14	1.59	.217
Error(INFO * WITNESS)	6805.42	38	179.09		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	489386.925	1	489386.925	3438.553	.000
INCIDENT	41.001	1	41.001	.288	.598
WITNESS	338.788	1	338.788	2.380	.139
INCIDENT * WITNESS	79.281	1	79.281	.557	.465
Error	2704.147	19	142.324		

FREE RECALL: POSTHOC TUKEY'S TEST - INTERACTION OF INFORMATION (ACTION VS VERBAL VS APPEARANCE) BY INCIDENT

INFOAVA

Tukey HSD[a,b,c]

GRPAVA	N	Subset 1	2	3	4
Threat Appearance	12	63.5017			
Control Appearance	11		75.7982		
Control Verbal	20		87.0740	87.0740	
Threat Verbal	19			91.2363	91.2363
Control Action	20			97.8330	97.8330
Threat Action	20				99.2000
Sig.		1.000	.080	.108	.396

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 136.724.

a. Uses Harmonic Mean Sample Size = 15.920.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFOAVA

Tukey HSD

(I) GRPAVA	(J) GRPAVA	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Threat Action	Control Action	1.3670	3.6976	.999	-9.3861	12.1201
	Threat Verbal	7.9637	3.7460	.283	-2.9300	18.8574
	Control Verbal	12.1260*	3.6976	.018	1.3729	22.8791
	Threat Appearance	35.6983*	4.2696	.000	23.2817	48.1150
	Control Appearance	23.4018*	4.3893	.000	10.6373	36.1663
Control Action	Threat Action	-1.3670	3.6976	.999	-12.1201	9.3861
	Threat Verbal	6.5967	3.7460	.496	-4.2970	17.4904
	Control Verbal	10.7590*	3.6976	.050	5.890E-03	21.5121
	Threat Appearance	34.3313*	4.2696	.000	21.9147	46.7480
	Control Appearance	22.0348*	4.3893	.000	9.2703	34.7993
Threat Verbal	Threat Action	-7.9637	3.7460	.283	-18.8574	2.9300
	Control Action	-6.5967	3.7460	.496	-17.4904	4.2970
	Control Verbal	4.1623	3.7460	.876	-6.7314	15.0560
	Threat Appearance	27.7346*	4.3116	.000	15.1961	40.2732
	Control Appearance	15.4381*	4.4301	.009	2.5550	28.3213
Control Verbal	Threat Action	-12.1260*	3.6976	.018	-22.8791	-1.3729
	Control Action	-10.7590*	3.6976	.050	-21.5121	-5.8905E-03
	Threat Verbal	-4.1623	3.7460	.876	-15.0560	6.7314
	Threat Appearance	23.5723*	4.2696	.000	11.1557	35.9890
	Control Appearance	11.2758	4.3893	.115	-1.4887	24.0403
Threat Appearance	Threat Action	-35.6983*	4.2696	.000	-48.1150	-23.2817
	Control Action	-34.3313*	4.2696	.000	-46.7480	-21.9147
	Threat Verbal	-27.7346*	4.3116	.000	-40.2732	-15.1961
	Control Verbal	-23.5723*	4.2696	.000	-35.9890	-11.1557
	Control Appearance	-12.2965	4.8809	.129	-26.4907	1.8977
Control Appearance	Threat Action	-23.4018*	4.3893	.000	-36.1663	-10.6373
	Control Action	-22.0348*	4.3893	.000	-34.7993	-9.2703
	Threat Verbal	-15.4381*	4.4301	.009	-28.3213	-2.5550
	Control Verbal	-11.2758	4.3893	.115	-24.0403	1.4887
	Threat Appearance	12.2965	4.8809	.129	-1.8977	26.4907

Based on observed means.

*. The mean difference is significant at the .05 level.

CUED RECALL: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: total cued recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	314.428[a]	3	104.809	.348	.791
Intercept	210134.016	1	210134.016	697.620	.000
INCIDENT	299.537	1	299.537	.994	.325
WITNESS	14.884	1	14.884	.049	.825
INCIDENT * WITNESS	6.250E-03	1	6.250E-03	.000	.996
Error	10843.762	36	301.216		
Total	221292.206	40			
Corrected Total	11158.190	39			

a. R Squared = .028 (Adjusted R Squared = -.053)

CUED RECALL: UNIVARIATE ANALYSIS OF VARIANCE - CENTRAL VS. PERIPHERAL DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	14435.184	1	14435.184	47.903	.000
INFO * INCIDENT	Linear	35.256	1	35.256	.117	.735
INFO * WITNESS	Linear	1.102	1	1.102	.004	.952
INFO * INCIDENT * WITNESS	Linear	426.547	1	426.547	1.415	.243
Error(INFO)	Linear	9341.691	31	301.345		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	392150.212	1	392150.212	851.017	.000
INCIDENT	810.060	1	810.060	1.758	.195
WITNESS	207.648	1	207.648	.451	.507
INCIDENT * WITNESS	48.499	1	48.499	.105	.748
Error	14284.853	31	460.802		

CUED RECALL: UNIVARIATE ANALYSIS OF VARIANCE - INTRUDER 1 VS. INTRUDER 2 DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	115.479	1	115.479	.665	.420
INFO * INCIDENT	Linear	1079.626	1	1079.626	6.222	.018
INFO * WITNESS	Linear	1207.189	1	1207.189	6.957	.013
INFO * INCIDENT * WITNESS	Linear	4.856	1	4.856	.028	.868
Error(INFO)	Linear	5899.911	34	173.527		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	383104.314	1	383104.314	542.614	.000
INCIDENT	1381.350	1	1381.350	1.956	.171
WITNESS	126.113	1	126.113	.179	.675
INCIDENT * WITNESS	185.220	1	185.220	.262	.612
Error	24005.200	34	706.035		

CUED RECALL: POSTHOC TUKEY'S TEST - INTERACTION OF INFO (INTRUDER 1 VS INTRUDER 2) BY INCIDENT

INFO

Tukey HSD[a,b,c]

GROUP	N	Subset 1
control intruder 2	19	62.1932
threat intruder 1	20	72.8235
control intruder 1	20	73.1755
threat intruder 2	19	77.7242
Sig.		.102

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 435.181.

a. Uses Harmonic Mean Sample Size = 19.487.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO

Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
threat intruder 1	control intruder 1	-.3520	6.5968	1.000	-17.6912	16.9872
	threat intruder 2	-4.9007	6.6831	.883	-22.4666	12.6652
	control intruder 2	10.6303	6.6831	.390	-6.9355	28.1962
control intruder 1	threat intruder 1	.3520	6.5968	1.000	-16.9872	17.6912
	threat intruder 2	-4.5487	6.6831	.904	-22.1146	13.0172
	control intruder 2	10.9823	6.6831	.361	-6.5835	28.5482
threat intruder 2	threat intruder 1	4.9007	6.6831	.883	-12.6652	22.4666
	control intruder 1	4.5487	6.6831	.904	-13.0172	22.1146
	control intruder 2	15.5311	6.7682	.109	-2.2586	33.3207
control intruder 2	threat intruder 1	-10.6303	6.6831	.390	-28.1962	6.9355
	control intruder 1	-10.9823	6.6831	.361	-28.5482	6.5835
	threat intruder 2	-15.5311	6.7682	.109	-33.3207	2.2586

Based on observed means.

CUED RECALL: UNIVARIATE ANALYSIS OF VARIANCE - ACTION VS. VERBAL VS. APPEARANCE DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	13827.47	2	6913.73	13.51	.000
INFO * INCIDENT	2569.24	2	1284.62	2.51	.098
INFO * WITNESS	1088.96	2	544.48	1.06	.358
INFO * INCIDENT * WIT	580.48	2	290.24	.57	.573
Error(INFO)	15357.69	30	511.92		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	258170.032	1	258170.032	291.817	.000
INCIDENT	1612.083	1	1612.083	1.822	.197
WITNESS	188.412	1	188.412	.213	.651
INCIDENT * WITNESS	20.141	1	20.141	.023	.882
Error	13270.458	15	884.697		

TOTAL RECALL (FREE + CUED): UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: total both recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	162.487[a]	3	54.162	.792	.506
Intercept	262480.502	1	262480.502	3839.032	.000
INCIDENT	10.373	1	10.373	.152	.699
WITNESS	142.695	1	142.695	2.087	.157
INCIDENT * WITNESS	9.419	1	9.419	.138	.713
Error	2461.375	36	68.372		
Total	265104.364	40			
Corrected Total	2623.863	39			

a. R Squared = .062 (Adjusted R Squared = -.016)

TOTAL RECALL (FREE + CUED): UNIVARIATE ANALYSIS OF VARIANCE - CENTRAL VS. PERIPHERAL DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	18036.619	1	18036.619	112.979	.000
INFO * INCIDENT	Linear	1.081	1	1.081	.007	.935
INFO * WITNESS	Linear	15.435	1	15.435	.097	.758
INFO * INCIDENT * WITNESS	Linear	337.267	1	337.267	2.113	.155
Error(INFO)	Linear	5747.261	36	159.646		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	498430.322	1	498430.322	2565.200	.000
INCIDENT	107.416	1	107.416	.553	.462
WITNESS	34.611	1	34.611	.178	.675
INCIDENT * WITNESS	12.784	1	12.784	.066	.799
Error	6994.967	36	194.305		

TOTAL RECALL (FREE + CUED): UNIVARIATE ANALYSIS OF VARIANCE - INTRUDER 1 VS. INTRUDER 2 DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	255.756	1	255.756	3.047	.089
INFO * INCIDENT	Linear	610.955	1	610.955	7.279	.011
INFO * WITNESS	Linear	114.242	1	114.242	1.361	.251
INFO * INCIDENT * WITNESS	Linear	36.504	1	36.504	.435	.514
Error(INFO)	Linear	3021.451	36	83.929		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	519773.282	1	519773.282	3159.034	.000
INCIDENT	132.612	1	132.612	.806	.375
WITNESS	232.017	1	232.017	1.410	.243
INCIDENT * WITNESS	39.480	1	39.480	.240	.627
Error	5923.279	36	164.536		

TOTAL RECALL (FREE + CUED): POSTHOC TUKEY'S TEST - INTERACTION OF INFO (INTRUDER 1 VS INTRUDER 2) BY INCIDENT

INFO

Tukey HSD[a,b]

GROUP	N	Subset 1
control intruder 2	20	74.7660
threat intruder 1	20	80.9170
threat intruder 2	20	82.8680
control intruder 1	20	83.8690
Sig.		.054

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 123.250.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO

Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
threat intruder 1	control intruder 1	-2.9520	3.5107	.835	-12.1740	6.2700
	threat intruder 2	-1.9510	3.5107	.945	-11.1730	7.2710
	control intruder 2	6.1510	3.5107	.304	-3.0710	15.3730
control intruder 1	threat intruder 1	2.9520	3.5107	.835	-6.2700	12.1740
	threat intruder 2	1.0010	3.5107	.992	-8.2210	10.2230
	control intruder 2	9.1030	3.5107	.054	-.1190	18.3250
threat intruder 2	threat intruder 1	1.9510	3.5107	.945	-7.2710	11.1730
	control intruder 1	-1.0010	3.5107	.992	-10.2230	8.2210
	control intruder 2	8.1020	3.5107	.105	-1.1200	17.3240
control intruder 2	threat intruder 1	-6.1510	3.5107	.304	-15.3730	3.0710
	control intruder 1	-9.1030	3.5107	.054	-18.3250	.1190
	threat intruder 2	-8.1020	3.5107	.105	-17.3240	1.1200

Based on observed means.

TOTAL RECALL (FREE + CUED): UNIVARIATE ANALYSIS OF VARIANCE - ACTION VS. VERBAL VS. APPEARANCE DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	25855.71	2	12927.85	80.41	.000
INFO * INCIDENT	591.90	2	295.95	1.84	.166
INFO * WITNESS	148.92	2	74.46	.46	.631
INFO * INCIDENT * WIT	1112.03	2	556.01	3.46	.037
Error(INFO)	11254.66	70	160.78		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	778488.883	1	778488.883	4292.715	.000
INCIDENT	56.470	1	56.470	.311	.580
WITNESS	51.666	1	51.666	.285	.597
INCIDENT * WITNESS	2.542	1	2.542	.014	.906
Error	6347.291	35	181.351		

TOTAL RECALL (FREE + CUED): POSTHOC TUKEY'S TEST - INTERACTION OF INFORMATION (ACTION VS VERBAL VS APPEARANCE) BY INCIDENT BY WITNESS

Information Both Recall Act Verb App

Tukey HSD[a,b,c]

Group both recall act verb app	N	Subset				
		1	2	3	4	5
TBAP	9	54.6933				
CVAP	10	60.8380	60.8380			
CBAP	10	64.9880	64.9880			
TVAP	10	67.0160	67.0160	67.0160		
CBV	10		77.3390	77.3390	77.3390	
CVV	10			85.5040	85.5040	85.5040
TVV	10				86.4420	86.4420
TBV	10				92.7140	92.7140
TVA	10				96.0330	96.0330
CVA	10					98.0910
TBA	10					98.2150
CBA	10					99.0000
Sig.		.600	.171	.073	.067	.457

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 165.089.

a. Uses Harmonic Mean Sample Size = 9.908.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Multiple Comparisons

Dependent Variable: Information Both Recall Act Verb App
Tukey HSD

(I) Group both recall act verb app	(J) Group both recall act verb app	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
TVA	TBA	-2.1820	5.7461	1.000	-21.3833	17.0193
	CVA	-2.0580	5.7461	1.000	-21.2593	17.1433
	CBA	-2.9670	5.7461	1.000	-22.1683	16.2343
	TVV	9.5910	5.7461	.878	-9.6103	28.7923
	TBV	3.3190	5.7461	1.000	-15.8823	22.5203
	CVV	10.5290	5.7461	.796	-8.6723	29.7303
	CBV	18.6940	5.7461	.064	-.5073	37.8953
	TVAP	29.0170	5.7461	.000	9.8157	48.2183
	TBAP	41.3397	5.9036	.000	21.6122	61.0671
	CVAP	35.1950	5.7461	.000	15.9937	54.3963
	CBAP	31.0450	5.7461	.000	11.8437	50.2463
TBA	TVA	2.1820	5.7461	1.000	-17.0193	21.3833
	CVA	.1240	5.7461	1.000	-19.0773	19.3253
	CBA	-.7850	5.7461	1.000	-19.9863	18.4163
	TVV	11.7730	5.7461	.659	-7.4283	30.9743
	TBV	5.5010	5.7461	.998	-13.7003	24.7023
	CVV	12.7110	5.7461	.545	-6.4903	31.9123
	CBV	20.8760	5.7461	.021	1.6747	40.0773
	TVAP	31.1990	5.7461	.000	11.9977	50.4003
	TBAP	43.5217	5.9036	.000	23.7942	63.2491
	CVAP	37.3770	5.7461	.000	18.1757	56.5783
	CBAP	33.2270	5.7461	.000	14.0257	52.4283
CVA	TVA	2.0580	5.7461	1.000	-17.1433	21.2593
	TBA	-.1240	5.7461	1.000	-19.3253	19.0773

	CBA	-.9090	5.7461	1.000	-20.1103	18.2923
	TVV	11.6490	5.7461	.674	-7.5523	30.8503
	TBV	5.3770	5.7461	.999	-13.8243	24.5783
	CVV	12.5870	5.7461	.560	-6.6143	31.7883
	CBV	20.7520	5.7461	.022	1.5507	39.9533
	TVAP	31.0750	5.7461	.000	11.8737	50.2763
	TBAP	43.3977	5.9036	.000	23.6702	63.1251
	CVAP	37.2530	5.7461	.000	18.0517	56.4543
	CBAP	33.1030	5.7461	.000	13.9017	52.3043
CBA	TVA	2.9670	5.7461	1.000	-16.2343	22.1683
	TBA	.7850	5.7461	1.000	-18.4163	19.9863
	CVA	.9090	5.7461	1.000	-18.2923	20.1103
	TVV	12.5580	5.7461	.564	-6.6433	31.7593
	TBV	6.2860	5.7461	.994	-12.9153	25.4873
	CVV	13.4960	5.7461	.450	-5.7053	32.6973
	CBV	21.6610	5.7461	.014	2.4597	40.8623
	TVAP	31.9840	5.7461	.000	12.7827	51.1853
	TBAP	44.3067	5.9036	.000	24.5792	64.0341
	CVAP	38.1620	5.7461	.000	18.9607	57.3633
	CBAP	34.0120	5.7461	.000	14.8107	53.2133
TVV	TVA	-9.5910	5.7461	.878	-28.7923	9.6103
	TBA	-11.7730	5.7461	.659	-30.9743	7.4283
	CVA	-11.6490	5.7461	.674	-30.8503	7.5523
	CBA	-12.5580	5.7461	.564	-31.7593	6.6433
	TBV	-6.2720	5.7461	.994	-25.4733	12.9293
	CVV	.9380	5.7461	1.000	-18.2633	20.1393
	CBV	9.1030	5.7461	.911	-10.0983	28.3043
	TVAP	19.4260	5.7461	.045	.2247	38.6273
	TBAP	31.7487	5.9036	.000	12.0212	51.4761
	CVAP	25.6040	5.7461	.001	6.4027	44.8053
	CBAP	21.4540	5.7461	.015	2.2527	40.6553
TBV	TVA	-3.3190	5.7461	1.000	-22.5203	15.8823
	TBA	-5.5010	5.7461	.998	-24.7023	13.7003
	CVA	-5.3770	5.7461	.999	-24.5783	13.8243
	CBA	-6.2860	5.7461	.994	-25.4873	12.9153
	TVV	6.2720	5.7461	.994	-12.9293	25.4733
	CVV	7.2100	5.7461	.983	-11.9913	26.4113
	CBV	15.3750	5.7461	.253	-3.8263	34.5763
	TVAP	25.6980	5.7461	.001	6.4967	44.8993
	TBAP	38.0207	5.9036	.000	18.2932	57.7481
	CVAP	31.8760	5.7461	.000	12.6747	51.0773
	CBAP	27.7260	5.7461	.000	8.5247	46.9273
CVV	TVA	-10.5290	5.7461	.796	-29.7303	8.6723
	TBA	-12.7110	5.7461	.545	-31.9123	6.4903
	CVA	-12.5870	5.7461	.560	-31.7883	6.6143
	CBA	-13.4960	5.7461	.450	-32.6973	5.7053
	TVV	-.9380	5.7461	1.000	-20.1393	18.2633
	TBV	-7.2100	5.7461	.983	-26.4113	11.9913
	CBV	8.1650	5.7461	.957	-11.0363	27.3663
	TVAP	18.4880	5.7461	.070	-.7133	37.6893
	TBAP	30.8107	5.9036	.000	11.0832	50.5381
	CVAP	24.6660	5.7461	.002	5.4647	43.8673
	CBAP	20.5160	5.7461	.025	1.3147	39.7173
CBV	TVA	-18.6940	5.7461	.064	-37.8953	.5073
	TBA	-20.8760	5.7461	.021	-40.0773	-1.6747
	CVA	-20.7520	5.7461	.022	-39.9533	-1.5507
	CBA	-21.6610	5.7461	.014	-40.8623	-2.4597
	TVV	-9.1030	5.7461	.911	-28.3043	10.0983
	TBV	-15.3750	5.7461	.253	-34.5763	3.8263
	CVV	-8.1650	5.7461	.957	-27.3663	11.0363
	TVAP	10.3230	5.7461	.816	-8.8783	29.5243
	TBAP	22.6457	5.9036	.011	2.9182	42.3731
	CVAP	16.5010	5.7461	.166	-2.7003	35.7023
	CBAP	12.3510	5.7461	.589	-6.8503	31.5523
TVAP	TVA	-29.0170	5.7461	.000	-48.2183	-9.8157
	TBA	-31.1990	5.7461	.000	-50.4003	-11.9977
	CVA	-31.0750	5.7461	.000	-50.2763	-11.8737

	CBA	-31.9840	5.7461	.000	-51.1853	-12.7827
	TVV	-19.4260	5.7461	.045	-38.6273	-.2247
	TBV	-25.6980	5.7461	.001	-44.8993	-6.4967
	CVV	-18.4880	5.7461	.070	-37.6893	.7133
	CBV	-10.3230	5.7461	.816	-29.5243	8.8783
	TBAP	12.3227	5.9036	.633	-7.4048	32.0501
	CVAP	6.1780	5.7461	.995	-13.0233	25.3793
	CBAP	2.0280	5.7461	1.000	-17.1733	21.2293
TBAP	TVA	-41.3397	5.9036	.000	-61.0671	-21.6122
	TBA	-43.5217	5.9036	.000	-63.2491	-23.7942
	CVA	-43.3977	5.9036	.000	-63.1251	-23.6702
	CBA	-44.3067	5.9036	.000	-64.0341	-24.5792
	TVV	-31.7487	5.9036	.000	-51.4761	-12.0212
	TBV	-38.0207	5.9036	.000	-57.7481	-18.2932
	CVV	-30.8107	5.9036	.000	-50.5381	-11.0832
	CBV	-22.6457	5.9036	.011	-42.3731	-2.9182
	TVAP	-12.3227	5.9036	.633	-32.0501	7.4048
	CVAP	-6.1447	5.9036	.996	-25.8721	13.5828
	CBAP	-10.2947	5.9036	.844	-30.0221	9.4328
CVAP	TVA	-35.1950	5.7461	.000	-54.3963	-15.9937
	TBA	-37.3770	5.7461	.000	-56.5783	-18.1757
	CVA	-37.2530	5.7461	.000	-56.4543	-18.0517
	CBA	-38.1620	5.7461	.000	-57.3633	-18.9607
	TVV	-25.6040	5.7461	.001	-44.8053	-6.4027
	TBV	-31.8760	5.7461	.000	-51.0773	-12.6747
	CVV	-24.6660	5.7461	.002	-43.8673	-5.4647
	CBV	-16.5010	5.7461	.166	-35.7023	2.7003
	TVAP	-6.1780	5.7461	.995	-25.3793	13.0233
	TBAP	6.1447	5.9036	.996	-13.5828	25.8721
	CBAP	-4.1500	5.7461	1.000	-23.3513	15.0513
CBAP	TVA	-31.0450	5.7461	.000	-50.2463	-11.8437
	TBA	-33.2270	5.7461	.000	-52.4283	-14.0257
	CVA	-33.1030	5.7461	.000	-52.3043	-13.9017
	CBA	-34.0120	5.7461	.000	-53.2133	-14.8107
	TVV	-21.4540	5.7461	.015	-40.6553	-2.2527
	TBV	-27.7260	5.7461	.000	-46.9273	-8.5247
	CVV	-20.5160	5.7461	.025	-39.7173	-1.3147
	CBV	-12.3510	5.7461	.589	-31.5523	6.8503
	TVAP	-2.0280	5.7461	1.000	-21.2293	17.1733
	TBAP	10.2947	5.9036	.844	-9.4328	30.0221
	CVAP	4.1500	5.7461	1.000	-15.0513	23.3513

Based on observed means.

* The mean difference is significant at the .05 level.

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL WITH RECALL ACCURACY

PEARSON & SPEARMAN CORRELATIONS (ACROSS THE THREAT GROUP WITNESSES) OF THE VARIOUS MEASURES OF RECALL ACCURACY WITH: THE 'STANDARDIZED RESIDUALS (TO TAKE ACCOUNT OF BASELINE VARIATION) OF HEART RATE DURING THE INCIDENT AND HEART RATE IMMEDIATELY FOLLOWING THE INCIDENT' AND 'RATED PERCEIVED THREAT DURING THE INCIDENT' AND 'RATED PERCEIVED ATTACK DURING THE INCIDENT'

Free Recall Accuracy	Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*

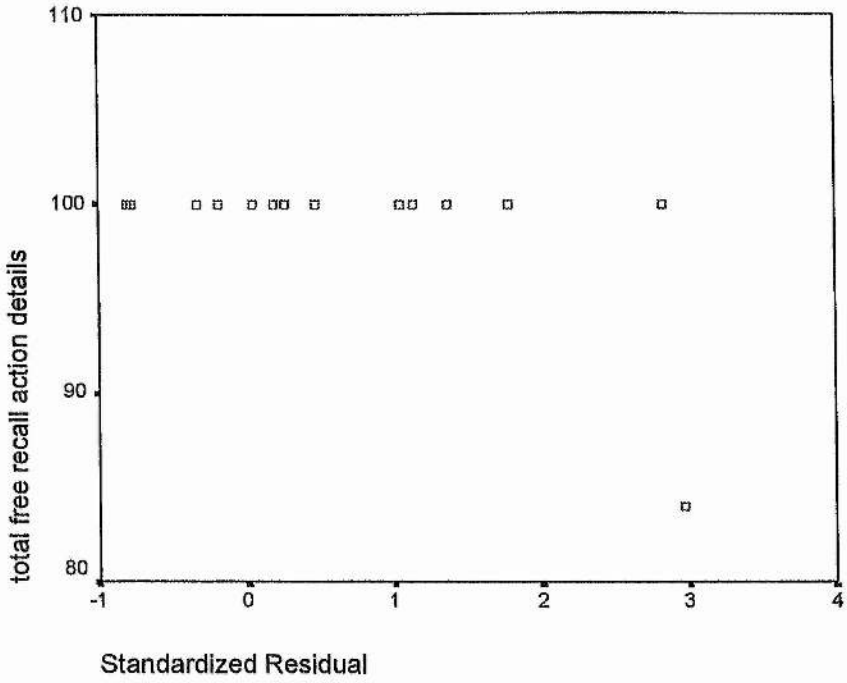
Overall	Correlation	-1.24	.339	-.123	-.028
	Sig. (2-tailed)	.673	.236	.606	.906
	N	14	14	20	20
Central	Correlation	.091	.043	.077	.005
	Sig. (2-tailed)	.757	.883	.747	.982
	N	14	14	20	20
Peripheral	Correlation	.426	.545	-.029	.026
	Sig. (2-tailed)	.220	.103	.925	.932
	N	10	10	13	13
Intruder 1	Correlation	-.244	.243	-.193	-.080
	Sig. (2-tailed)	.400	.402	.415	.739
	N	14	14	20	20
Intruder 2	Correlation	.002	.376	-.221	-.014
	Sig. (2-tailed)	.995	.185	.349	.954
	N	14	14	20	20
Action	Correlation	-.539*	-.205	-.144	.062
	Sig. (2-tailed)	.046	.481	.545	.796
	N	14	14	20	20
Verbal	Correlation	.485	.134	.001	-.210
	Sig. (2-tailed)	.093	.662	.997	.388
	N	13	13	19	19
Appearance	Correlation	.271	.522	-.217	.106
	Sig. (2-tailed)	.448	.121	.497	.743
	N	10	10	12	12

* Correlation is significant at the 0.05 level (2-tailed)

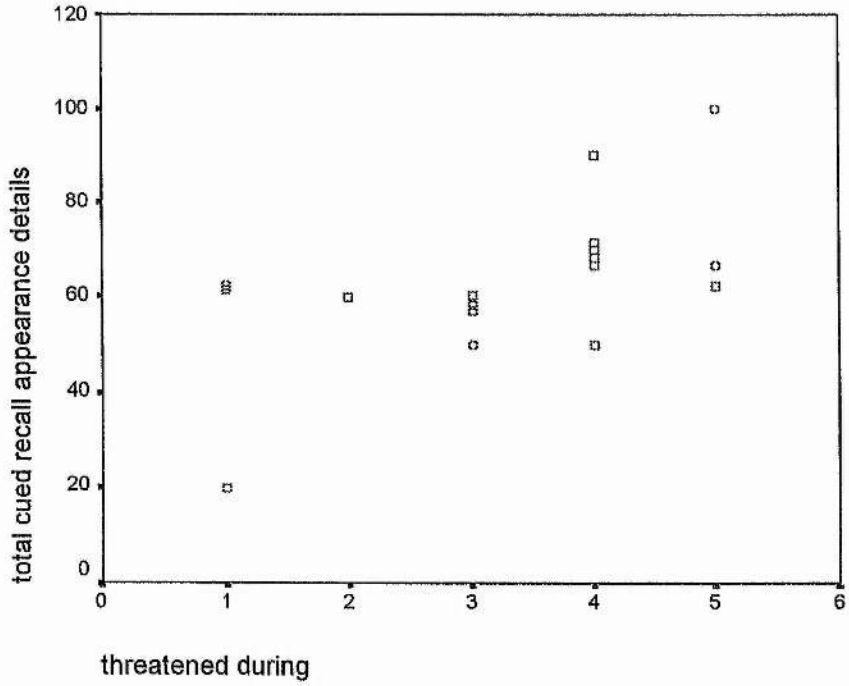
Cued Recall Accuracy		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	-.214	.019	.129	.121
	Sig. (2-tailed)	.463	.949	.587	.612
	N	14	14	20	20
Central	Correlation	-.045	.163	-.241	-.126
	Sig. (2-tailed)	.879	.578	.320	.608
	N	14	14	19	19
Peripheral	Correlation	-.202	-.043	.295	.083
	Sig. (2-tailed)	.488	.885	.220	.735
	N	14	14	19	19
Intruder 1	Correlation	-.088	-.112	.339	.163
	Sig. (2-tailed)	.765	.703	.143	.492
	N	14	14	20	20
Intruder 2	Correlation	-.381	.085	-.076	-.064
	Sig. (2-tailed)	.200	.784	.758	.794
	N	13	13	19	19
Action	Correlation	-.024	.273	-.015	.115
	Sig. (2-tailed)	.938	.367	.954	.650
	N	13	13	18	18
Verbal	Correlation	-.392	-.588	-.512	-.438
	Sig. (2-tailed)	.233	.057	.051	.102
	N	11	11	15	15
Appearance	Correlation	.067	-.088	.540*	.330
	Sig. (2-tailed)	.829	.775	.021	.181
	N	13	13	18	18

Total Recall Accuracy		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	-.133	.402	-.027	.141
	Sig. (2-tailed)	.649	.154	.909	.553
	N	14	14	20	20
Central	Correlation	-.172	.120	-.039	-.052
	Sig. (2-tailed)	.556	.684	.871	.827
	N	14	14	20	20
Peripheral	Correlation	.027	.307	.112	.111
	Sig. (2-tailed)	.928	.285	.639	.643
	N	14	14	20	20
Intruder 1	Correlation	-.093	.305	.149	.116
	Sig. (2-tailed)	.752	.289	.530	.627
	N	14	14	20	20
Intruder 2	Correlation	-.190	.364	-.113	.065
	Sig. (2-tailed)	.515	.201	.635	.784
	N	14	14	20	20
Action	Correlation	-.515	.172	-.052	.203
	Sig. (2-tailed)	.059	.557	.829	.391
	N	14	14	20	20
Verbal	Correlation	.095	-.233	-.298	-.475*
	Sig. (2-tailed)	.747	.422	.202	.034
	N	14	14	20	20
Appearance	Correlation	.371	.280	.077	.177
	Sig. (2-tailed)	.212	.354	.755	.468
	N	14	13	19	19

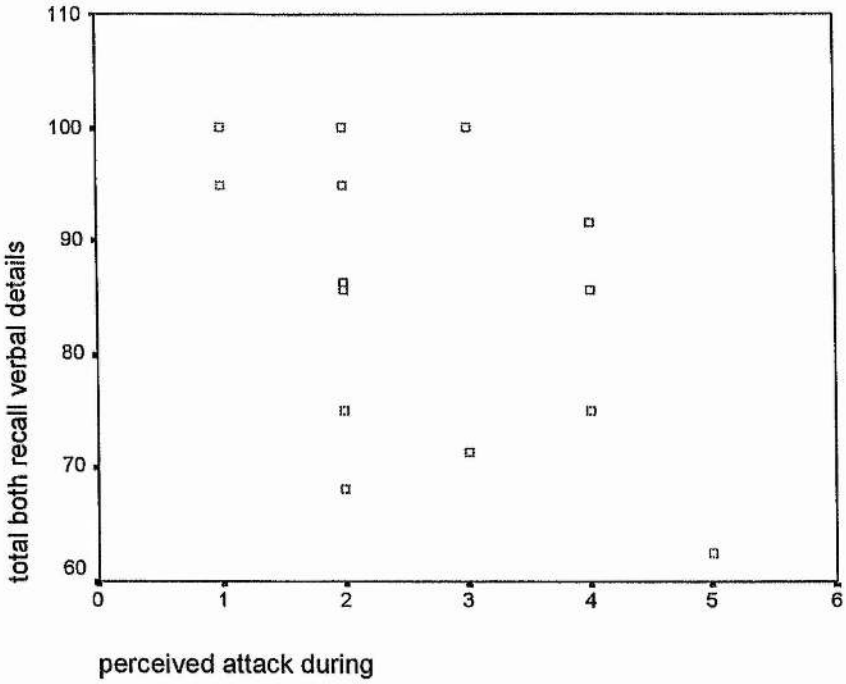
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH FREE RECALL ACCURACY FOR ACTION DETAILS



SCATTERPLOT OF RATED THREAT DURING THE INCIDENT WITH CUED RECALL ACCURACY FOR APPEARANCE DETAILS



SCATTERPLOT OF PERCEIVED ATTACK DURING THE INCIDENT WITH TOTAL RECALL ACCURACY FOR VERBAL DETAILS



RECOGNITION ACCURACY

2AFC QUESTIONS: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: accuracy for all 2AFC questions

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	997.866[a]	3	332.622	3.157	.036
Intercept	240262.400	1	240262.400	2280.287	.000
INCIDENT	745.805	1	745.805	7.078	.012
WITNESS	2.061	1	2.061	.020	.890
INCIDENT * WITNESS	250.000	1	250.000	2.373	.132
Error	3793.139	36	105.365		
Total	245053.405	40			
Corrected Total	4791.005	39			

a. R Squared = .208 (Adjusted R Squared = .142)

2AFC QUESTIONS: UNIVARIATE ANALYSIS OF VARIANCE - CENTRAL VS. PERIPHERAL DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	656.658	1	656.658	2.956	.094
INFO * INCIDENT	Linear	2041.816	1	2041.816	9.191	.004
INFO * WITNESS	Linear	135.668	1	135.668	.611	.440
INFO * INCIDENT * WITNESS	Linear	236.328	1	236.328	1.064	.309
Error(INFO)	Linear	7997.529	36	222.154		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	496786.721	1	496786.721	1803.959	.000
INCIDENT	3500.129	1	3500.129	12.710	.001
WITNESS	10.643	1	10.643	.039	.845
INCIDENT * WITNESS	861.328	1	861.328	3.128	.085
Error	9913.929	36	275.387		

2AFC QUESTIONS: POSTHOC TUKEY'S TEST - INTERACTION OF INFO (CENTRAL VS PERIPHERAL) BY INCIDENT

INFO

Tukey HSD[a,b]

GROUP	N	Subset 1	Subset 2
control central	20	70.0010	
control peripheral	20	74.3750	
threat peripheral	20	77.5000	
threat central	20		93.3340
Sig.		.446	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 252.045.

a. Uses Harmonic Mean Sample Size = 20.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
threat central	control central	23.3330*	5.0204	.000	10.1453	36.5207
	threat peripheral	15.8340*	5.0204	.012	2.6463	29.0217
	control peripheral	18.9590*	5.0204	.002	5.7713	32.1467
control central	threat central	-23.3330*	5.0204	.000	-36.5207	-10.1453
	threat peripheral	-7.4990	5.0204	.446	-20.6867	5.6887
	control peripheral	-4.3740	5.0204	.820	-17.5617	8.8137
threat peripheral	threat central	-15.8340*	5.0204	.012	-29.0217	-2.6463
	control central	7.4990	5.0204	.446	-5.6887	20.6867
	control peripheral	3.1250	5.0204	.925	-10.0627	16.3127
control peripheral	threat central	-18.9590*	5.0204	.002	-32.1467	-5.7713
	control central	4.3740	5.0204	.820	-8.8137	17.5617
	threat peripheral	-3.1250	5.0204	.925	-16.3127	10.0627

Based on observed means.

*. The mean difference is significant at the .05 level.

2AFC QUESTIONS: UNIVARIATE ANALYSIS OF VARIANCE - INTRUDER 1 VS. INTRUDER 2 DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	420.261	1	420.261	2.147	.152
INFO * INCIDENT	Linear	6.774	1	6.774	.035	.853
INFO * WITNESS	Linear	3.461	1	3.461	.018	.895
INFO * INCIDENT * WITNESS	Linear	16.781	1	16.781	.086	.771
Error(INFO)	Linear	7046.511	36	195.736		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	483082.661	1	483082.661	2058.954	.000
INCIDENT	1473.014	1	1473.014	6.278	.017
WITNESS	3.461	1	3.461	.015	.904
INCIDENT * WITNESS	483.341	1	483.341	2.060	.160
Error	8446.511	36	234.625		

4AFC QUESTIONS: UNIVARIATE ANALYSIS OF VARIANCE

Tests of Between-Subjects Effects

Dependent Variable: accuracy for all 4AFC questions

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	98.319[a]	3	32.773	.283	.838
Intercept	54325.744	1	54325.744	468.662	.000
INCIDENT	23.470	1	23.470	.202	.655
WITNESS	74.693	1	74.693	.644	.427
INCIDENT * WITNESS	.156	1	.156	.001	.971
Error	4173.001	36	115.917		
Total	58597.065	40			
Corrected Total	4271.321	39			

a. R Squared = .023 (Adjusted R Squared = -.058)

4AFC QUESTIONS: UNIVARIATE ANALYSIS OF VARIANCE - CENTRAL VS. PERIPHERAL DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	9055.066	1	9055.066	36.836	.000
INFO * INCIDENT	Linear	17.842	1	17.842	.073	.789
INFO * WITNESS	Linear	774.266	1	774.266	3.150	.084
INFO * INCIDENT * WITNESS	Linear	1011.469	1	1011.469	4.115	.050
Error(INFO)	Linear	8849.651	36	245.824		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	152738.494	1	152738.494	436.465	.000
INCIDENT	277.215	1	277.215	.792	.379
WITNESS	63.261	1	63.261	.181	.673
INCIDENT * WITNESS	478.046	1	478.046	1.366	.250
Error	12597.988	36	349.944		

4AFC QUESTIONS: POSTHOC TUKEY'S TEST - INTERACTION OF INFORMATION (CENTRAL VS PERIPHERAL) BY INCIDENT BY WITNESS

GRPINFO

Tukey HSD[a,b]

group central peripheral	N	Subset	
		1	2
threat bystander peripheral	10	30.5560	
control bystander peripheral	10	31.1120	
threat victim peripheral	10	32.7770	
control victim peripheral	10	37.7780	
control victim central	10	46.6670	46.6670
threat bystander central	10	50.0000	50.0000
threat victim central	10	54.0000	54.0000
control bystander central	10		66.6680
Sig.		.062	.176

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 297.884.

a. Uses Harmonic Mean Sample Size = 10.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: GRPINFO

Tukey HSD

(I) group central peripheral	(J) group central peripheral	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
threat victim peripheral	threat bystander peripheral	2.2210	7.7186	1.000	-21.8752	26.3172
	control victim peripheral	-5.0010	7.7186	.998	-29.0972	19.0952
	control bystander peripheral	1.6650	7.7186	1.000	-22.4312	25.7612
	threat victim central	-21.2230	7.7186	.125	-45.3192	2.8732
	threat bystander central	-17.2230	7.7186	.346	-41.3192	6.8732
	control victim central	-13.8900	7.7186	.622	-37.9862	10.2062
	control bystander central	-33.8910*	7.7186	.001	-57.9872	-9.7948
threat bystander peripheral	threat victim peripheral	-2.2210	7.7186	1.000	-26.3172	21.8752
	control victim peripheral	-7.2220	7.7186	.981	-31.3182	16.8742
	control bystander peripheral	-.5560	7.7186	1.000	-24.6522	23.5402
	threat victim central	-23.4440	7.7186	.062	-47.5402	.6522
	threat bystander central	-19.4440	7.7186	.204	-43.5402	4.6522
	control victim central	-16.1110	7.7186	.433	-40.2072	7.9852
	control bystander central	-36.1120*	7.7186	.000	-60.2082	-12.0158
control victim peripheral	threat victim peripheral	5.0010	7.7186	.998	-19.0952	29.0972
	threat bystander peripheral	7.2220	7.7186	.981	-16.8742	31.3182
	control bystander peripheral	6.6660	7.7186	.988	-17.4302	30.7622
	threat victim central	-16.2220	7.7186	.424	-40.3182	7.8742
	threat bystander central	-12.2220	7.7186	.758	-36.3182	11.8742
	control victim central	-8.8890	7.7186	.943	-32.9852	15.2072
	control bystander central	-28.8900*	7.7186	.008	-52.9862	-4.7938
control bystander peripheral	threat victim peripheral	-1.6650	7.7186	1.000	-25.7612	22.4312
	threat bystander peripheral	.5560	7.7186	1.000	-23.5402	24.6522
	control victim peripheral	-6.6660	7.7186	.988	-30.7622	17.4302
	threat victim central	-22.8880	7.7186	.075	-46.9842	1.2082
	threat bystander central	-18.8880	7.7186	.235	-42.9842	5.2082
	control victim central	-15.5550	7.7186	.479	-39.6512	8.5412
	control bystander central	-35.5560*	7.7186	.000	-59.6522	-11.4598
threat victim central	threat victim peripheral	21.2230	7.7186	.125	-2.8732	45.3192
	threat bystander peripheral	23.4440	7.7186	.062	-.6522	47.5402
	control victim peripheral	16.2220	7.7186	.424	-7.8742	40.3182
	control bystander peripheral	22.8880	7.7186	.075	-1.2082	46.9842
	threat bystander central	4.0000	7.7186	1.000	-20.0962	28.0962
	control victim central	7.3330	7.7186	.980	-16.7632	31.4292
	control bystander central	-12.6680	7.7186	.724	-36.7642	11.4282
threat bystander central	threat victim peripheral	17.2230	7.7186	.346	-6.8732	41.3192
	threat bystander peripheral	19.4440	7.7186	.204	-4.6522	43.5402
	control victim peripheral	12.2220	7.7186	.758	-11.8742	36.3182
	control bystander peripheral	18.8880	7.7186	.235	-5.2082	42.9842
	threat victim central	-4.0000	7.7186	1.000	-28.0962	20.0962
	control victim central	3.3330	7.7186	1.000	-20.7632	27.4292
	control bystander central	-16.6680	7.7186	.388	-40.7642	7.4282
control victim central	threat victim peripheral	13.8900	7.7186	.622	-10.2062	37.9862
	threat bystander peripheral	16.1110	7.7186	.433	-7.9852	40.2072
	control victim peripheral	8.8890	7.7186	.943	-15.2072	32.9852
	control bystander peripheral	15.5550	7.7186	.479	-8.5412	39.6512
	threat victim central	-7.3330	7.7186	.980	-31.4292	16.7632
	threat bystander central	-3.3330	7.7186	1.000	-27.4292	20.7632
	control bystander central	-20.0010	7.7186	.176	-44.0972	4.0952
control bystander central	threat victim peripheral	33.8910*	7.7186	.001	9.7948	57.9872
	threat bystander peripheral	36.1120*	7.7186	.000	12.0158	60.2082
	control victim peripheral	28.8900*	7.7186	.008	4.7938	52.9862
	control bystander peripheral	35.5560*	7.7186	.000	11.4598	59.6522
	threat victim central	12.6680	7.7186	.724	-11.4282	36.7642
	threat bystander central	16.6680	7.7186	.388	-7.4282	40.7642
	control victim central	20.0010	7.7186	.176	-4.0952	44.0972

Based on observed means.

*. The mean difference is significant at the .05 level.

4AFC QUESTIONS: UNIVARIATE ANALYSIS OF VARIANCE - INTRUDER 1 VS. INTRUDER 2 DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	1557.436	1	1557.436	6.627	.014
INFO * INCIDENT	Linear	50.849	1	50.849	.216	.645
INFO * WITNESS	Linear	64.548	1	64.548	.275	.603
INFO * INCIDENT * WITNESS	Linear	6.396	1	6.396	.027	.870
Error(INFO)	Linear	8460.719	36	235.020		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	105093.102	1	105093.102	443.390	.000
INCIDENT	31.702	1	31.702	.134	.717
WITNESS	177.846	1	177.846	.750	.392
INCIDENT * WITNESS	.907	1	.907	.004	.951
Error	8532.779	36	237.022		

4AFC QUESTIONS: UNIVARIATE ANALYSIS OF VARIANCE - ACTION VS. VERBAL VS. APPEARANCE DETAILS

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	30147.61	2	15073.81	25.38	.000
INFO * INCIDENT	591.39	2	295.69	.50	.610
INFO * WITNESS	274.35	2	137.18	.23	.794
INFO * INCIDENT * WIT	3910.86	2	1955.43	3.29	.043
Error(INFO)	42764.94	72	593.96		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	300832.577	1	300832.577	430.195	.000
INCIDENT	5222.449	1	5222.449	7.468	.010
WITNESS	333.267	1	333.267	.477	.494
INCIDENT * WITNESS	1446.713	1	1446.713	2.069	.159
Error	25174.572	36	699.294		

4AFC QUESTIONS: POSTHOC TUKEY'S TEST - INTERACTION OF INFORMATION (ACTION VS VERBAL VS APPEARANCE) BY INCIDENT BY WITNESS

INFO

Tukey HSD[a,b]

GROUP	N	Subset 1	Subset 2	Subset 3
CVV	10	25.0000		
CBV	10	27.5000		
CBAP	10	33.3340		
TBV	10	38.3330	38.3330	
CVAP	10	40.0000	40.0000	
TVV	10	41.6650	41.6650	
TVAP	10	53.7500	53.7500	53.7500
TBAP	10	56.2500	56.2500	56.2500
TBA	10	60.0000	60.0000	60.0000
CVA	10	60.0000	60.0000	60.0000
CBA	10		75.0000	75.0000
TVA	10			90.0000
Sig.		.091	.061	.068

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 629.070.

a. Uses Harmonic Mean Sample Size = 10.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
TVA	TBA	30.0000	11.2167	.253	-7.4741	67.4741
	CVA	30.0000	11.2167	.253	-7.4741	67.4741
	CBA	15.0000	11.2167	.972	-22.4741	52.4741
	TVV	48.3350	11.2167	.002	10.8609	85.8091
	TBV	51.6670	11.2167	.001	14.1929	89.1411

	CVV	65.0000	11.2167	.000	27.5259	102.4741
	CBV	62.5000	11.2167	.000	25.0259	99.9741
	TVAP	36.2500	11.2167	.068	-1.2241	73.7241
	TBAP	33.7500	11.2167	.120	-3.7241	71.2241
	CVAP	50.0000	11.2167	.001	12.5259	87.4741
	CBAP	56.6660	11.2167	.000	19.1919	94.1401
TBA	TVA	-30.0000	11.2167	.253	-67.4741	7.4741
	CVA	.0000	11.2167	1.000	-37.4741	37.4741
	CBA	-15.0000	11.2167	.972	-52.4741	22.4741
	TVV	18.3350	11.2167	.892	-19.1391	55.8091
	TBV	21.6670	11.2167	.737	-15.8071	59.1411
	CVV	35.0000	11.2167	.091	-2.4741	72.4741
	CBV	32.5000	11.2167	.157	-4.9741	69.9741
	TVAP	6.2500	11.2167	1.000	-31.2241	43.7241
	TBAP	3.7500	11.2167	1.000	-33.7241	41.2241
	CVAP	20.0000	11.2167	.823	-17.4741	57.4741
	CBAP	26.6660	11.2167	.430	-10.8081	64.1401
CVA	TVA	-30.0000	11.2167	.253	-67.4741	7.4741
	TBA	.0000	11.2167	1.000	-37.4741	37.4741
	CBA	-15.0000	11.2167	.972	-52.4741	22.4741
	TVV	18.3350	11.2167	.892	-19.1391	55.8091
	TBV	21.6670	11.2167	.737	-15.8071	59.1411
	CVV	35.0000	11.2167	.091	-2.4741	72.4741
	CBV	32.5000	11.2167	.157	-4.9741	69.9741
	TVAP	6.2500	11.2167	1.000	-31.2241	43.7241
	TBAP	3.7500	11.2167	1.000	-33.7241	41.2241
	CVAP	20.0000	11.2167	.823	-17.4741	57.4741
	CBAP	26.6660	11.2167	.430	-10.8081	64.1401
CBA	TVA	-15.0000	11.2167	.972	-52.4741	22.4741
	TBA	15.0000	11.2167	.972	-22.4741	52.4741
	CVA	15.0000	11.2167	.972	-22.4741	52.4741
	TVV	33.3350	11.2167	.132	-4.1391	70.8091
	TBV	36.6670	11.2167	.061	-.8071	74.1411
	CVV	50.0000	11.2167	.001	12.5259	87.4741
	CBV	47.5000	11.2167	.003	10.0259	84.9741
	TVAP	21.2500	11.2167	.760	-16.2241	58.7241
	TBAP	18.7500	11.2167	.877	-18.7241	56.2241
	CVAP	35.0000	11.2167	.091	-2.4741	72.4741
	CBAP	41.6660	11.2167	.016	4.1919	79.1401
TVV	TVA	-48.3350	11.2167	.002	-85.8091	-10.8609
	TBA	-18.3350	11.2167	.892	-55.8091	19.1391
	CVA	-18.3350	11.2167	.892	-55.8091	19.1391
	CBA	-33.3350	11.2167	.132	-70.8091	4.1391
	TBV	3.3320	11.2167	1.000	-34.1421	40.8061
	CVV	16.6650	11.2167	.941	-20.8091	54.1391
	CBV	14.1650	11.2167	.982	-23.3091	51.6391
	TVAP	-12.0850	11.2167	.995	-49.5591	25.3891
	TBAP	-14.5850	11.2167	.977	-52.0591	22.8891
	CVAP	1.6650	11.2167	1.000	-35.8091	39.1391
	CBAP	8.3310	11.2167	1.000	-29.1431	45.8051
TBV	TVA	-51.6670	11.2167	.001	-89.1411	-14.1929
	TBA	-21.6670	11.2167	.737	-59.1411	15.8071
	CVA	-21.6670	11.2167	.737	-59.1411	15.8071
	CBA	-36.6670	11.2167	.061	-74.1411	.8071
	TVV	-3.3320	11.2167	1.000	-40.8061	34.1421
	CVV	13.3330	11.2167	.989	-24.1411	50.8071
	CBV	10.8330	11.2167	.998	-26.6411	48.3071
	TVAP	-15.4170	11.2167	.966	-52.8911	22.0571
	TBAP	-17.9170	11.2167	.906	-55.3911	19.5571
	CVAP	-1.6670	11.2167	1.000	-39.1411	35.8071
	CBAP	4.9990	11.2167	1.000	-32.4751	42.4731
CVV	TVA	-65.0000	11.2167	.000	-102.4741	-27.5259
	TBA	-35.0000	11.2167	.091	-72.4741	2.4741
	CVA	-35.0000	11.2167	.091	-72.4741	2.4741
	CBA	-50.0000	11.2167	.001	-87.4741	-12.5259
	TVV	-16.6650	11.2167	.941	-54.1391	20.8091
	TBV	-13.3330	11.2167	.989	-50.8071	24.1411

	CBV	-2.5000	11.2167	1.000	-39.9741	34.9741
	TVAP	-28.7500	11.2167	.314	-66.2241	8.7241
	TBAP	-31.2500	11.2167	.201	-68.7241	6.2241
	CVAP	-15.0000	11.2167	.972	-52.4741	22.4741
	CBAP	-8.3340	11.2167	1.000	-45.8081	29.1401
CBV	TVA	-62.5000	11.2167	.000	-99.9741	-25.0259
	TBA	-32.5000	11.2167	.157	-69.9741	4.9741
	CVA	-32.5000	11.2167	.157	-69.9741	4.9741
	CBA	-47.5000	11.2167	.003	-84.9741	-10.0259
	TVV	-14.1650	11.2167	.982	-51.6391	23.3091
	TBV	-10.8330	11.2167	.998	-48.3071	26.6411
	CVV	2.5000	11.2167	1.000	-34.9741	39.9741
	TVAP	-26.2500	11.2167	.455	-63.7241	11.2241
	TBAP	-28.7500	11.2167	.314	-66.2241	8.7241
	CVAP	-12.5000	11.2167	.993	-49.9741	24.9741
	CBAP	-5.8340	11.2167	1.000	-43.3081	31.6401
TVAP	TVA	-36.2500	11.2167	.068	-73.7241	1.2241
	TBA	-6.2500	11.2167	1.000	-43.7241	31.2241
	CVA	-6.2500	11.2167	1.000	-43.7241	31.2241
	CBA	-21.2500	11.2167	.760	-58.7241	16.2241
	TVV	12.0850	11.2167	.995	-25.3891	49.5591
	TBV	15.4170	11.2167	.966	-22.0571	52.8911
	CVV	28.7500	11.2167	.314	-8.7241	66.2241
	CBV	26.2500	11.2167	.455	-11.2241	63.7241
	TBAP	-2.5000	11.2167	1.000	-39.9741	34.9741
	CVAP	13.7500	11.2167	.986	-23.7241	51.2241
	CBAP	20.4160	11.2167	.803	-17.0581	57.8901
TBAP	TVA	-33.7500	11.2167	.120	-71.2241	3.7241
	TBA	-3.7500	11.2167	1.000	-41.2241	33.7241
	CVA	-3.7500	11.2167	1.000	-41.2241	33.7241
	CBA	-18.7500	11.2167	.877	-56.2241	18.7241
	TVV	14.5850	11.2167	.977	-22.8891	52.0591
	TBV	17.9170	11.2167	.906	-19.5571	55.3911
	CVV	31.2500	11.2167	.201	-6.2241	68.7241
	CBV	28.7500	11.2167	.314	-8.7241	66.2241
	TVAP	2.5000	11.2167	1.000	-34.9741	39.9741
	CVAP	16.2500	11.2167	.951	-21.2241	53.7241
	CBAP	22.9160	11.2167	.663	-14.5581	60.3901
CVAP	TVA	-50.0000	11.2167	.001	-87.4741	-12.5259
	TBA	-20.0000	11.2167	.823	-57.4741	17.4741
	CVA	-20.0000	11.2167	.823	-57.4741	17.4741
	CBA	-35.0000	11.2167	.091	-72.4741	2.4741
	TVV	-1.6650	11.2167	1.000	-39.1391	35.8091
	TBV	1.6670	11.2167	1.000	-35.8071	39.1411
	CVV	15.0000	11.2167	.972	-22.4741	52.4741
	CBV	12.5000	11.2167	.993	-24.9741	49.9741
	TVAP	-13.7500	11.2167	.986	-51.2241	23.7241
	TBAP	-16.2500	11.2167	.951	-53.7241	21.2241
	CBAP	6.6660	11.2167	1.000	-30.8081	44.1401
CBAP	TVA	-56.6660	11.2167	.000	-94.1401	-19.1919
	TBA	-26.6660	11.2167	.430	-64.1401	10.8081
	CVA	-26.6660	11.2167	.430	-64.1401	10.8081
	CBA	-41.6660	11.2167	.016	-79.1401	-4.1919
	TVV	-8.3310	11.2167	1.000	-45.8051	29.1431
	TBV	-4.9990	11.2167	1.000	-42.4731	32.4751
	CVV	8.3340	11.2167	1.000	-29.1401	45.8081
	CBV	5.8340	11.2167	1.000	-31.6401	43.3081
	TVAP	-20.4160	11.2167	.803	-57.8901	17.0581
	TBAP	-22.9160	11.2167	.663	-60.3901	14.5581
	CVAP	-6.6660	11.2167	1.000	-44.1401	30.8081

Based on observed means.

* The mean difference is significant at the .05 level.

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL WITH RECOGNITION ACCURACY

PEARSON & SPEARMAN CORRELATIONS (ACROSS THE THREAT GROUP WITNESSES) OF THE VARIOUS MEASURES OF RECOGNITION ACCURACY WITH: THE 'STANDARDIZED RESIDUALS (TO TAKE ACCOUNT OF BASELINE VARIATION) OF HEART RATE DURING THE INCIDENT AND HEART RATE IMMEDIATELY FOLLOWING THE INCIDENT' AND 'RATED PERCEIVED THREAT DURING THE INCIDENT' AND 'RATED PERCEIVED ATTACK DURING THE INCIDENT'

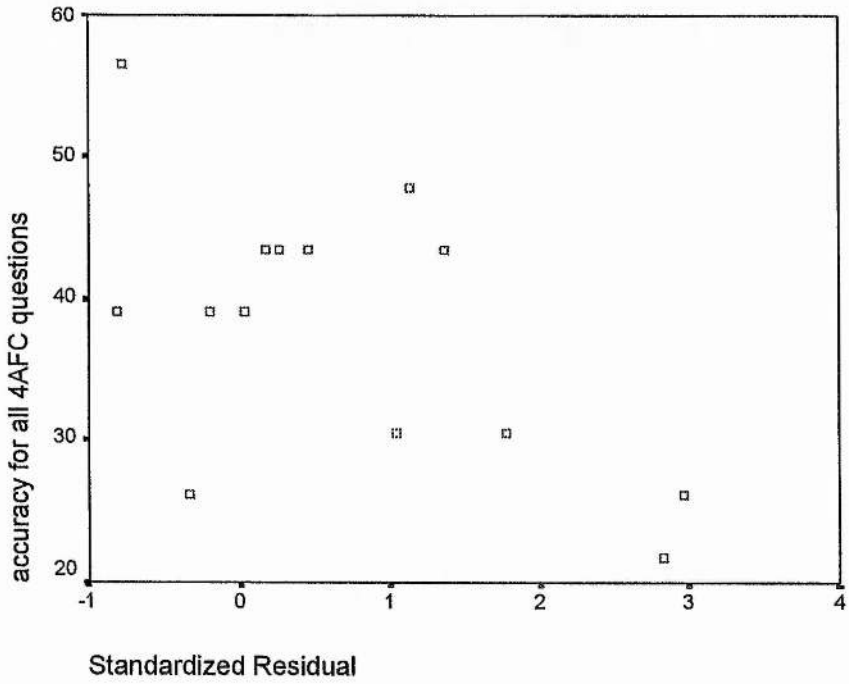
2AFC Recognition Accuracy		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	-.174	-.247	.230	.273
	Sig. (2-tailed)	.552	.395	.328	.244
	N	14	14	20	20
Central	Correlation	.107	.117	-.045	.022
	Sig. (2-tailed)	.715	.691	.851	.925
	N	14	14	20	20
Peripheral	Correlation	-.212	-.285	.341	.336
	Sig. (2-tailed)	.468	.324	.142	.148
	N	14	14	20	20
Intruder 1	Correlation	.250	-.094	.224	.022
	Sig. (2-tailed)	.390	.750	.342	.925
	N	14	14	20	20
Intruder 2	Correlation	-.274	-.193	.167	.336
	Sig. (2-tailed)	.344	.509	.482	.148
	N	14	14	20	20
Action	Correlation	.107	.117	-.045	.022
	Sig. (2-tailed)	.715	.691	.851	.925
	N	14	14	20	20
Verbal	Correlation	No 2AFC Verbal Questions	No 2AFC Verbal Questions	No 2AFC Verbal Questions	No 2AFC Verbal Questions
	Sig. (2-tailed)				
	N				
Appearance	Correlation	-.212	-.285	.341	.336
	Sig. (2-tailed)	.468	.324	.142	.148
	N	14	14	20	20

4AFC Recognition Accuracy		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	-.588*	.235	-.110	-.033
	Sig. (2-tailed)	.027	.419	.645	.890
	N	14	14	20	20
Central	Correlation	-.004	.566*	.023	.162
	Sig. (2-tailed)	.990	.035	.924	.494
	N	14	14	20	20
Peripheral	Correlation	-.738**	-.026	-.101	-.115
	Sig. (2-tailed)	.003	.929	.673	.630

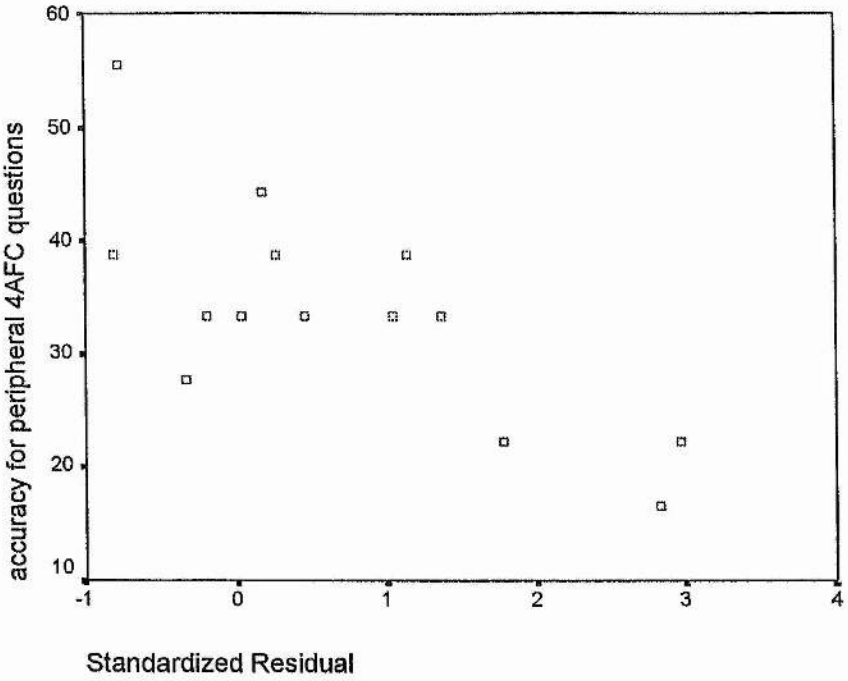
	N	14	14	20	20
Intruder 1	Correlation	.030	.412	-.081	-.173
	Sig. (2-tailed)	.918	.144	.735	.466
	N	14	14	20	20
Intruder 2	Correlation	-.855**	-.060	-.129	-.010
	Sig. (2-tailed)	.000	.839	.588	.966
	N	14	14	20	20
Action	Correlation	-.105	.176	.150	.193
	Sig. (2-tailed)	.720	.546	.529	.415
	N	14	14	20	20
Verbal	Correlation	-.380	.142	-.017	.016
	Sig. (2-tailed)	.180	.628	.944	.946
	N	14	14	20	20
Appearance	Correlation	-.562*	.150	-.338	.-.272
	Sig. (2-tailed)	.036	.609	.144	.246
	N	14	14	20	20

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01level (2-tailed)

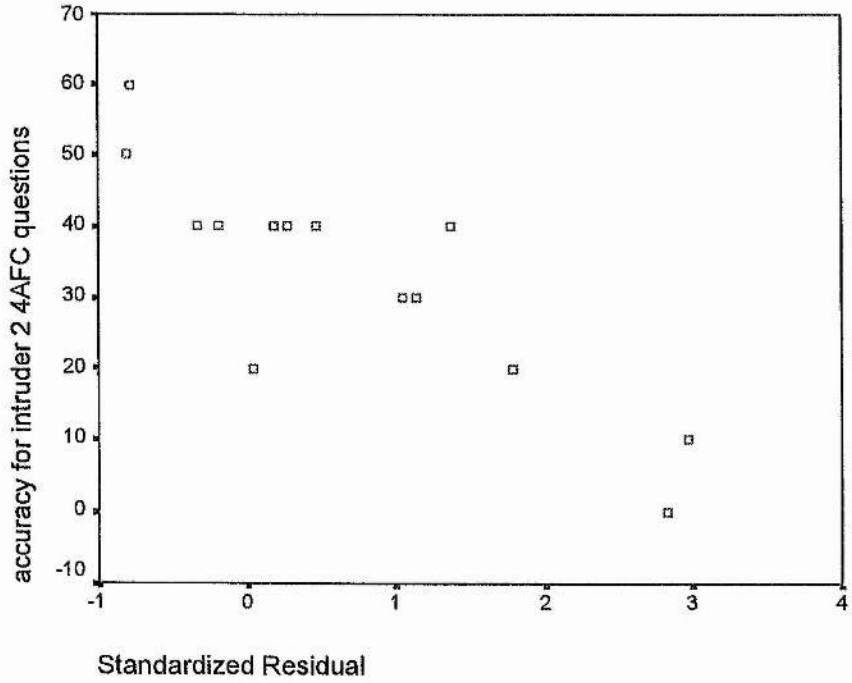
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH RECOGNITION ACCURACY FOR 4AFC QUESTIONS OVERALL



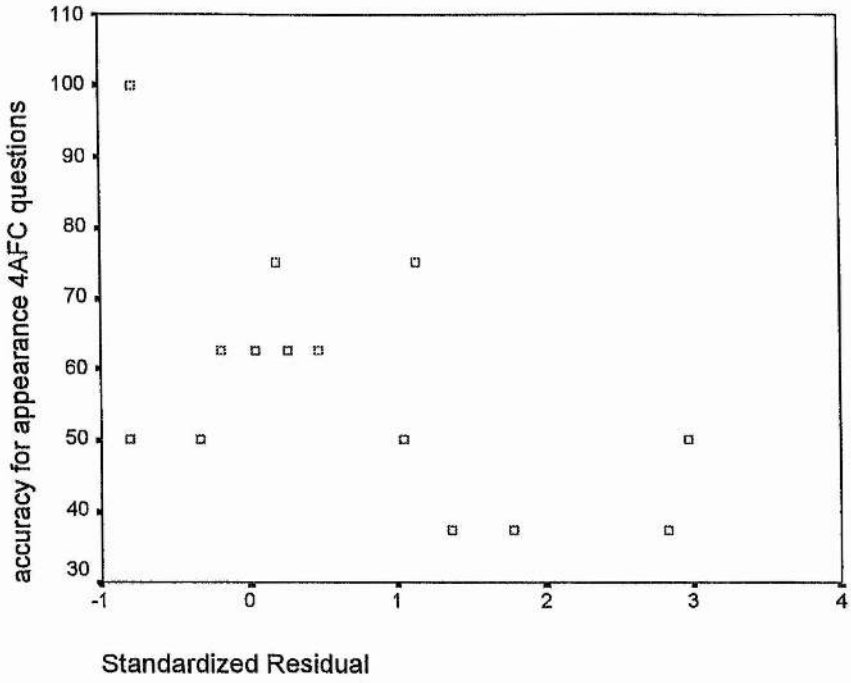
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH RECOGNITION ACCURACY FOR PERIPHERAL 4AFC QUESTIONS



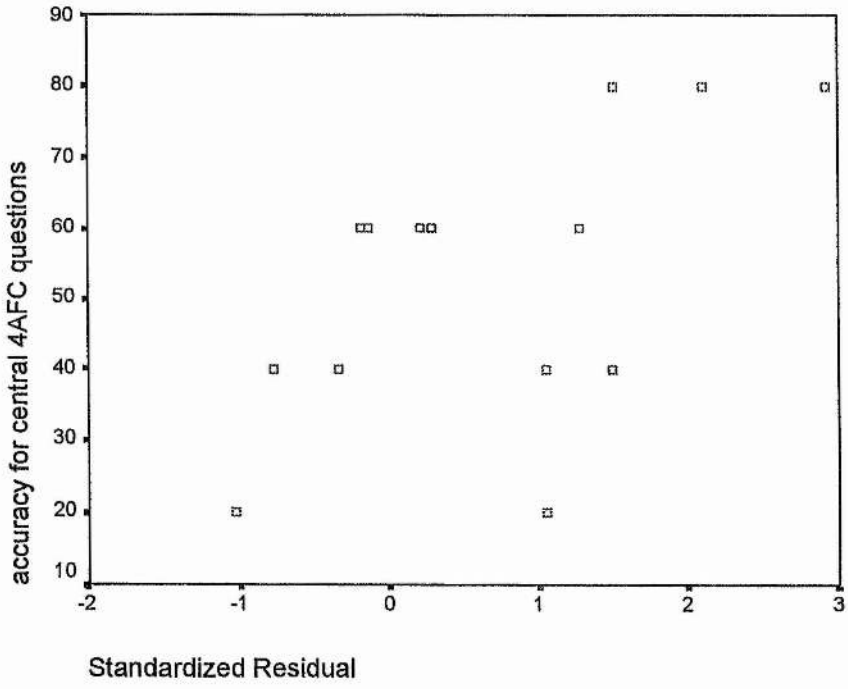
SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH RECOGNITION ACCURACY FOR INTRUDER 2 4AFC QUESTIONS



SCATTERPLOT OF HEART RATE DURING (STANDARDIZED RESIDUAL) WITH RECOGNITION ACCURACY FOR APPEARANCE 4AFC QUESTIONS



SCATTERPLOT OF HEART RATE AFTER (STANDARDIZED RESIDUAL) WITH RECOGNITION ACCURACY FOR CENTRAL 4AFC QUESTIONS OVERALL



IDENTIFICATION

LINEUP ONE

CONTINGENCY TABLE: INCIDENT BY WITNESS BY DECISION

witness type * decision type * incident type Crosstabulation

incident type				decision type: correct	decision type: incorrect	Total
threat	witness type	victim	Count	7	3	10
			Expected Count	5.0	5.0	10.0
		bystander	Count	3	7	10
			Expected Count	5.0	5.0	10.0
	Total		Count	10	10	20
			Expected Count	10.0	10.0	20.0
control	witness type	victim	Count	5	5	10
			Expected Count	6.0	4.0	10.0
		bystander	Count	7	3	10
			Expected Count	6.0	4.0	10.0
	Total		Count	12	8	20
			Expected Count	12.0	8.0	20.0

CONTINGENCY TABLE: INCIDENT BY DECISION

incident type * decision type Crosstabulation

			decision type: correct	decision type: incorrect	Total
incident type	threat	Count	10	10	20
		Expected Count	11.0	9.0	20.0
	control	Count	12	8	20
		Expected Count	11.0	9.0	20.0
Total		Count	22	18	40
		Expected Count	22.0	18.0	40.0

CHI-SQUARE TEST: INCIDENT BY DECISION

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.404[b]	1	.525		
Continuity Correction[a]	.101	1	.751		
Likelihood Ratio	.405	1	.525		
Fisher's Exact Test				.751	.376
Linear-by-Linear Association	.394	1	.530		
N of Valid Cases	40				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.00.

LINEUP TWO

CONTINGENCY TABLE: INCIDENT BY WITNESS BY DECISION

witness type * decision type * incident type Crosstabulation

incident type				decision type: correct	decision type: incorrect	Total
threat	witness type	victim	Count	4	6	10
			Expected Count	4.5	5.5	10.0
		bystander	Count	5	5	10
			Expected Count	4.5	5.5	10.0
	Total		Count	9	11	20
			Expected Count	9.0	11.0	20.0
control	witness type	victim	Count	5	5	10
			Expected Count	4.5	5.5	10.0
		bystander	Count	4	6	10
			Expected Count	4.5	5.5	10.0
	Total		Count	9	11	20
			Expected Count	9.0	11.0	20.0

CONTINGENCY TABLE: INCIDENT BY DECISION

incident type * decision type Crosstabulation

			decision type		
			correct	incorrect	Total
incident type	threat	Count	9	11	20
		Expected Count	9.0	11.0	20.0
	control	Count	9	11	20
		Expected Count	9.0	11.0	20.0
Total		Count	18	22	40
		Expected Count	18.0	22.0	40.0

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL WITH IDENTIFICATION DECISION

POINT-BISERIAL CORRELATIONS (ACROSS THE THREAT GROUP WITNESSES) OF IDENTIFICATION ACCURACY WITH: THE STANDARDIZED RESIDUALS (TO TAKE ACCOUNT OF BASELINE VARIATION) OF HEART RATE DURING THE INCIDENT AND HEART RATE IMMEDIATELY FOLLOWING THE INCIDENT' AND 'RATED PERCEIVED THREAT DURING THE INCIDENT' AND 'RATED PERCEIVED ATTACK DURING THE INCIDENT'

Identification Decision		Lineup1 (Intruder 1)	Lineup 2 (Intruder 2)
Threat During	Correlation	-.040	.179
	Sig. (2-tailed)	.868	.449
	N	20	20
Perceived Attack During	Correlation	.000	.399
	Sig. (2-tailed)	1.000	.081
	N	20	20
Heart Rate During	Correlation	-.447	-.382
	Sig. (2-tailed)	.109	.178
	N	14	14
Heart Rate After	Correlation	.026	..310
	Sig. (2-tailed)	.930	.281
	N	14	14

Appendix 10: Statistical Output - Study Two

PHYSIOLOGICAL AROUSAL

Heart Rate During

- **Univariate Analysis of Variance (with baseline as co-variate)**

Tests of Between-Subjects Effects

Dependent Variable: DURING

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6036.340[a]	4	1509.085	45.310	.000
Intercept	228.916	1	228.916	6.873	.011
BASELINE	5838.268	1	5838.268	175.292	.000
INCIDENT	73.021	1	73.021	2.192	.144
WITNESS	244.918	1	244.918	7.354	.009
INCIDENT * WITNESS	138.924	1	138.924	4.171	.046
Error	1965.049	59	33.306		
Total	420035.395	64			
Corrected Total	8001.390	63			

a. R Squared = .754 (Adjusted R Squared = .738)

- **Posthoc Tukey's Test - Interaction of incident by witness (computed using standardized residual values of the heart rate data in order to take account for baseline of participant's resting heart rate levels)**

RESIDUR

Tukey HSD[a,b]

GROUP	N	Subset 1	Subset 2
threat bystander	16	-.3607	
control bystander	16	-.2135	
control victim	16	-3.43E-02	-3.43E-02
threat victim	16		.8563
Sig.		.798	.071

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1.022.

a. Uses Harmonic Mean Sample Size = 16.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: RESIDUR
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
threat victim	threat bystander	1.2170*	.3574	.006	.2727	2.1614
	control victim	.8905	.3574	.071	-5.3823E-02	1.8349
	control bystander	1.0698*	.3574	.020	.1254	2.0142
threat bystander	threat victim	-1.2170*	.3574	.006	-2.1614	-.2727
	control victim	-.3265	.3574	.798	-1.2709	.6179
	control bystander	-.1472	.3574	.976	-1.0916	.7972
control victim	threat victim	-.8905	.3574	.071	-1.8349	5.382E-02
	threat bystander	.3265	.3574	.798	-.6179	1.2709
	control bystander	.1793	.3574	.958	-.7651	1.1236
control bystander	threat victim	-1.0698*	.3574	.020	-2.0142	-.1254
	threat bystander	.1472	.3574	.976	-.7972	1.0916
	control victim	-.1793	.3574	.958	-1.1236	.7651

Based on observed means.

*. The mean difference is significant at the .05 level.

Heart Rate After

- **Univariate Analysis of Variance (with baseline as co-variate)**

Tests of Between-Subjects Effects

Dependent Variable: AFTER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6646.767[a]	4	1661.692	18.719	.000
Intercept	952.211	1	952.211	10.727	.002
BASELINE	4545.242	1	4545.242	51.203	.000
INCIDENT	1820.674	1	1820.674	20.510	.000
WITNESS	451.658	1	451.658	5.088	.028
INCIDENT * WITNESS	1375.940	1	1375.940	15.500	.000
Error	5237.421	59	88.770		
Total	488239.522	64			
Corrected Total	11884.187	63			

a. R Squared = .559 (Adjusted R Squared = .529)

- **Posthoc Tukey's Test - Interaction of incident by witness (computed using standardized residual values of the heart rate data in order to take account for baseline of participant's resting heart rate levels)**

RESIDAFT

Tukey HSD[a,b]

GROUP	N	Subset 1	Subset 2
control victim	16	-.4979	
control bystander	16	-.1353	
threat bystander	16	-9.44E-03	
threat victim	16		1.2760
Sig.		.356	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .696.

a. Uses Harmonic Mean Sample Size = 16.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: RESIDAFT
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
threat victim	threat bystander	1.2854*	.2949	.000	.5061	2.0647
	control victim	1.7739*	.2949	.000	.9946	2.5532
	control bystander	1.4113*	.2949	.000	.6320	2.1906
threat bystander	threat victim	-1.2854*	.2949	.000	-2.0647	-.5061
	control victim	.4885	.2949	.356	-.2908	1.2678
	control bystander	.1259	.2949	.974	-.6534	.9052
control victim	threat victim	-1.7739*	.2949	.000	-2.5532	-.9946
	threat bystander	-.4885	.2949	.356	-1.2678	.2908
	control bystander	-.3626	.2949	.611	-1.1419	.4167
control bystander	threat victim	-1.4113*	.2949	.000	-2.1906	-.6320
	threat bystander	-.1259	.2949	.974	-.9052	.6534
	control victim	.3626	.2949	.611	-.4167	1.1419

Based on observed means.

*. The mean difference is significant at the .05 level.

SELF-REPORTED AROUSAL

STAI

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: stai state

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	209.625[a]	3	69.875	.945	.425
Intercept	85264.000	1	85264.000	1153.158	.000
INCIDENT	138.063	1	138.063	1.867	.177
WITNESS	22.563	1	22.563	.305	.583
INCIDENT * WITNESS	49.000	1	49.000	.663	.419
Error	4436.375	60	73.940		
Total	89910.000	64			
Corrected Total	4646.000	63			

a. R Squared = .045 (Adjusted R Squared = -.003)

MacKay Arousal Scale

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: mackay arousal

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	18.922[a]	3	6.307	1.803	.156
Intercept	1048.141	1	1048.141	299.558	.000
INCIDENT	13.141	1	13.141	3.756	.057
WITNESS	5.641	1	5.641	1.612	.209
INCIDENT * WITNESS	.141	1	.141	.040	.842
Error	209.938	60	3.499		
Total	1277.000	64			
Corrected Total	228.859	63			

a. R Squared = .083 (Adjusted R Squared = .037)

MacKay Stress Scale

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: mackay stress

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	198.922[a]	3	66.307	23.411	.000
Intercept	558.141	1	558.141	197.063	.000
INCIDENT	192.516	1	192.516	67.972	.000
WITNESS	4.516	1	4.516	1.594	.212
INCIDENT * WITNESS	1.891	1	1.891	.668	.417
Error	169.938	60	2.832		
Total	927.000	64			
Corrected Total	368.859	63			

a. R Squared = .539 (Adjusted R Squared = .516)

Threat during

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: threatened during

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	36.563[a]	3	12.188	16.295	.000
Intercept	280.563	1	280.563	375.125	.000
INCIDENT	18.063	1	18.063	24.150	.000
WITNESS	12.250	1	12.250	16.379	.000
INCIDENT * WITNESS	6.250	1	6.250	8.357	.005
Error	44.875	60	.748		
Total	362.000	64			
Corrected Total	81.438	63			

a. R Squared = .449 (Adjusted R Squared = .421)

- **Posthoc Tukey's Test - Interaction of incident by witness**

threatened during

Tukey HSD[a,b]

witnessing group	N	Subset 1	Subset 2
Control Bystander	16	1.4375	
Control Victim	16	1.6875	
Threat Bystander	16	1.8750	
Threat Victim	16		3.3750
Sig.		.485	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .748.

a. Uses Harmonic Mean Sample Size = 16.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: threatened during
Tukey HSD

(I) witnessing group	(J) witnessing group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Victim	Threat Bystander	1.5000*	.3058	.000	.6920	2.3080
	Control Victim	1.6875*	.3058	.000	.8795	2.4955
	Control Bystander	1.9375*	.3058	.000	1.1295	2.7455
Threat Bystander	Threat Victim	-1.5000*	.3058	.000	-2.3080	-.6920
	Control Victim	.1875	.3058	.927	-.6205	.9955
	Control Bystander	.4375	.3058	.485	-.3705	1.2455
Control Victim	Threat Victim	-1.6875*	.3058	.000	-2.4955	-.8795
	Threat Bystander	-.1875	.3058	.927	-.9955	.6205
	Control Bystander	.2500	.3058	.846	-.5580	1.0580
Control Bystander	Threat Victim	-1.9375*	.3058	.000	-2.7455	-1.1295
	Threat Bystander	-.4375	.3058	.485	-1.2455	.3705
	Control Victim	-.2500	.3058	.846	-1.0580	.5580

Based on observed means.

*. The mean difference is significant at the .05 level.

Threat immediately following

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: threatened immediately following

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3.922[a]	3	1.307	1.571	.206
Intercept	153.141	1	153.141	183.999	.000
INCIDENT	2.641	1	2.641	3.173	.080
WITNESS	1.563E-02	1	1.563E-02	.019	.891
INCIDENT * WITNESS	1.266	1	1.266	1.521	.222
Error	49.938	60	.832		
Total	207.000	64			
Corrected Total	53.859	63			

a. R Squared = .073 (Adjusted R Squared = .026)

Perceived attack during

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: perceived attack during

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	22.297[a]	3	7.432	15.213	.000
Intercept	159.391	1	159.391	326.258	.000
INCIDENT	13.141	1	13.141	26.898	.000
WITNESS	3.516	1	3.516	7.196	.009
INCIDENT * WITNESS	5.641	1	5.641	11.546	.001
Error	29.313	60	.489		
Total	211.000	64			
Corrected Total	51.609	63			

a. R Squared = .432 (Adjusted R Squared = .404)

- **Posthoc Tukey's Test - Interaction of incident by witness**

perceived attack during

Tukey HSD[a,b]

witnessing group	N	Subset 1	Subset 2
Control Victim	16	1.0625	
Control Bystander	16	1.1875	
Threat Bystander	16	1.5000	
Threat Victim	16		2.5625
Sig.		.298	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = .489.

a. Uses Harmonic Mean Sample Size = 16.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: perceived attack during
Tukey HSD

(I) witnessing group	(J) witnessing group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Victim	Threat Bystander	1.0625*	.2471	.000	.4095	1.7155
	Control Victim	1.5000*	.2471	.000	.8470	2.1530
	Control Bystander	1.3750*	.2471	.000	.7220	2.0280
Threat Bystander	Threat Victim	-1.0625*	.2471	.000	-1.7155	-.4095
	Control Victim	.4375	.2471	.298	-.2155	1.0905
	Control Bystander	.3125	.2471	.589	-.3405	.9655
Control Victim	Threat Victim	-1.5000*	.2471	.000	-2.1530	-.8470
	Threat Bystander	-.4375	.2471	.298	-1.0905	.2155
	Control Bystander	-.1250	.2471	.957	-.7780	.5280
Control Bystander	Threat Victim	-1.3750*	.2471	.000	-2.0280	-.7220
	Threat Bystander	-.3125	.2471	.589	-.9655	.3405
	Control Victim	.1250	.2471	.957	-.5280	.7780

Based on observed means.

*. The mean difference is significant at the .05 level.

Angry during

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: angry during

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.297[a]	3	.432	.432	.731
Intercept	185.641	1	185.641	185.447	.000
INCIDENT	1.563E-02	1	1.563E-02	.016	.901
WITNESS	1.563E-02	1	1.563E-02	.016	.901
INCIDENT * WITNESS	1.266	1	1.266	1.264	.265
Error	60.063	60	1.001		
Total	247.000	64			
Corrected Total	61.359	63			

a. R Squared = .021 (Adjusted R Squared = -.028)

Angry immediately following

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: angry immediately following

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4.875[a]	3	1.625	1.551	.211
Intercept	182.250	1	182.250	173.917	.000
INCIDENT	1.563	1	1.563	1.491	.227
WITNESS	.250	1	.250	.239	.627
INCIDENT * WITNESS	3.063	1	3.063	2.922	.093
Error	62.875	60	1.048		
Total	250.000	64			
Corrected Total	67.750	63			

a. R Squared = .072 (Adjusted R Squared = .026)

Afraid during

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: afraid during

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	20.875[a]	3	6.958	14.459	.000
Intercept	210.250	1	210.250	436.883	.000
INCIDENT	18.063	1	18.063	37.532	.000
WITNESS	2.250	1	2.250	4.675	.035
INCIDENT * WITNESS	.563	1	.563	1.169	.284
Error	28.875	60	.481		
Total	260.000	64			
Corrected Total	49.750	63			

a. R Squared = .420 (Adjusted R Squared = .391)

Afraid immediately following

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: afraid immediately following

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4.812[a]	3	1.604	2.312	.085
Intercept	115.563	1	115.563	166.577	.000
INCIDENT	4.000	1	4.000	5.766	.019
WITNESS	.250	1	.250	.360	.551
INCIDENT * WITNESS	.563	1	.563	.811	.371
Error	41.625	60	.694		
Total	162.000	64			
Corrected Total	46.437	63			

a. R Squared = .104 (Adjusted R Squared = .059)

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL

Heart Rate During

- **Spearman Correlations (across the threat group witnesses) of rated perceived threat during the incident and rated perceived chance of attack during the incident with the standardized residual (to take account of baseline variation) of heart rate during the incident**

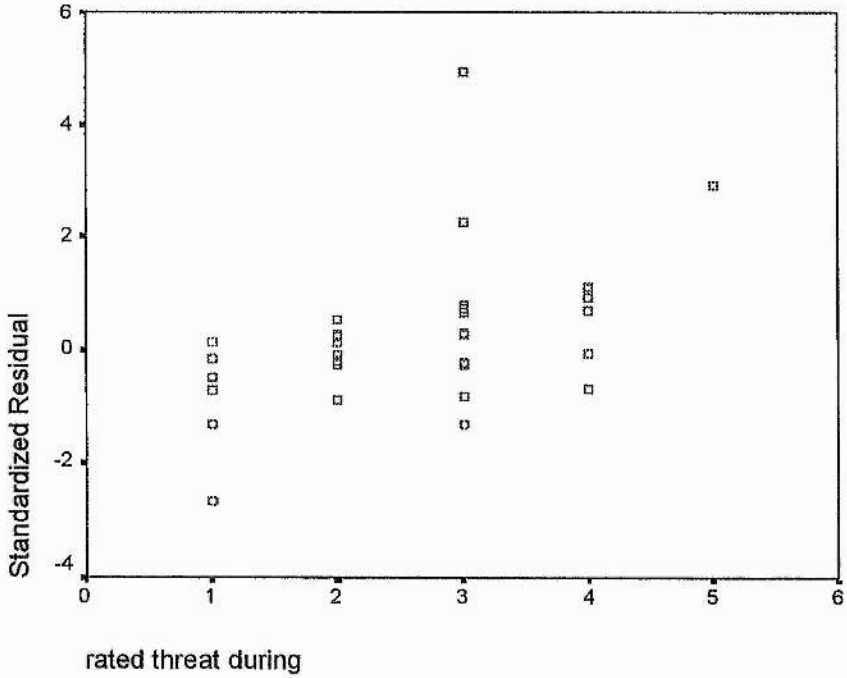
Correlations

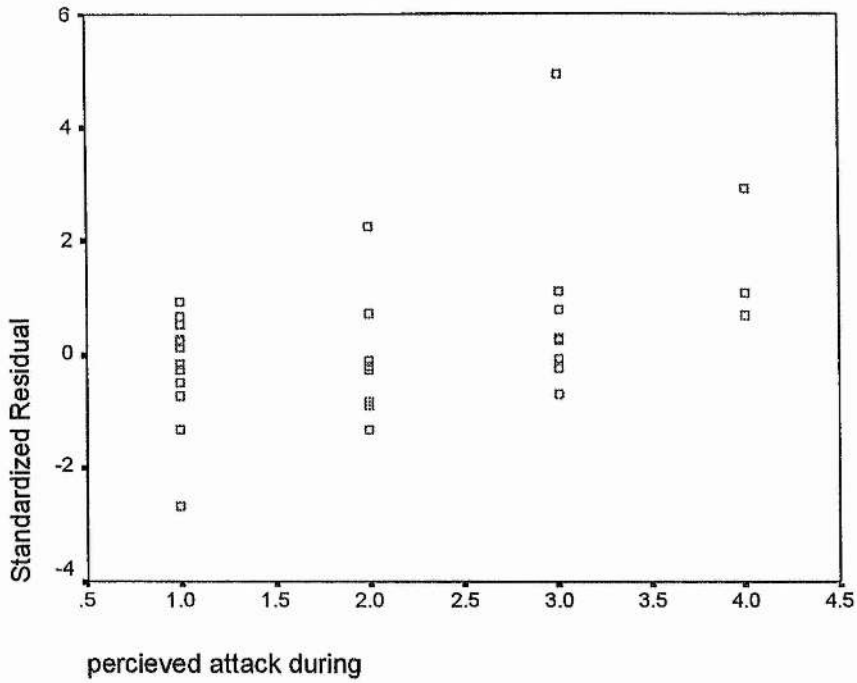
			Standardized Residual	threatened during	perceived attack during
Spearman's rho	Standardized Residual	Correlation Coefficient	1.000	.553**	.396*
		Sig. (2-tailed)	.	.001	.025
		N	32	32	32
	threatened during	Correlation Coefficient	.553**	1.000	.773**
		Sig. (2-tailed)	.001	.	.000
		N	32	32	32
	perceived attack during	Correlation Coefficient	.396*	.773**	1.000
		Sig. (2-tailed)	.025	.000	.
		N	32	32	32

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

Scatterplots for significant correlations from above:





Heart Rate After

- **Spearman Correlations (across the threat group witnesses) of rated perceived threat during the incident and rated perceived chance of attack during the incident with the standardized residual (to take account of baseline variation) of heart rate after the incident**

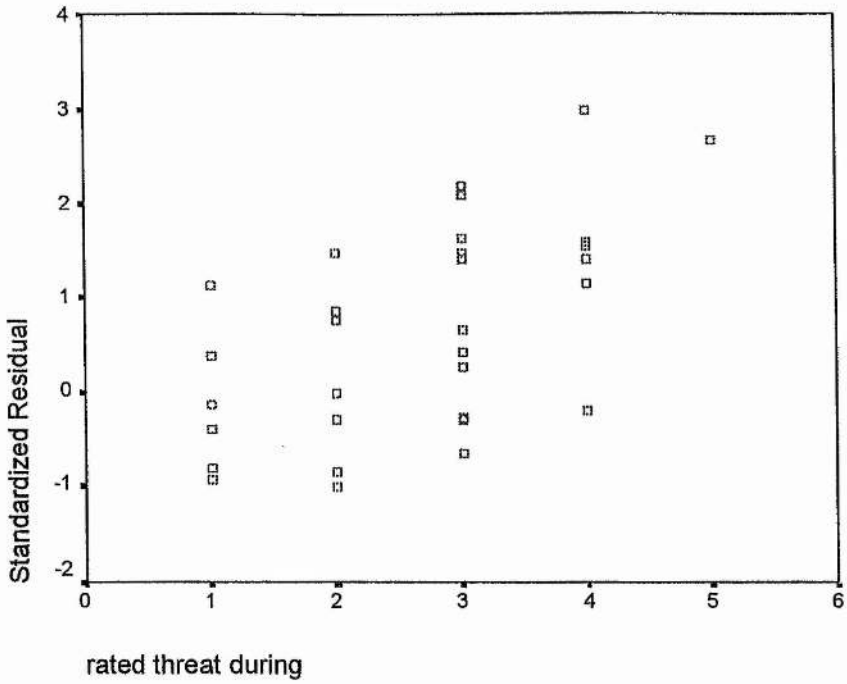
Correlations

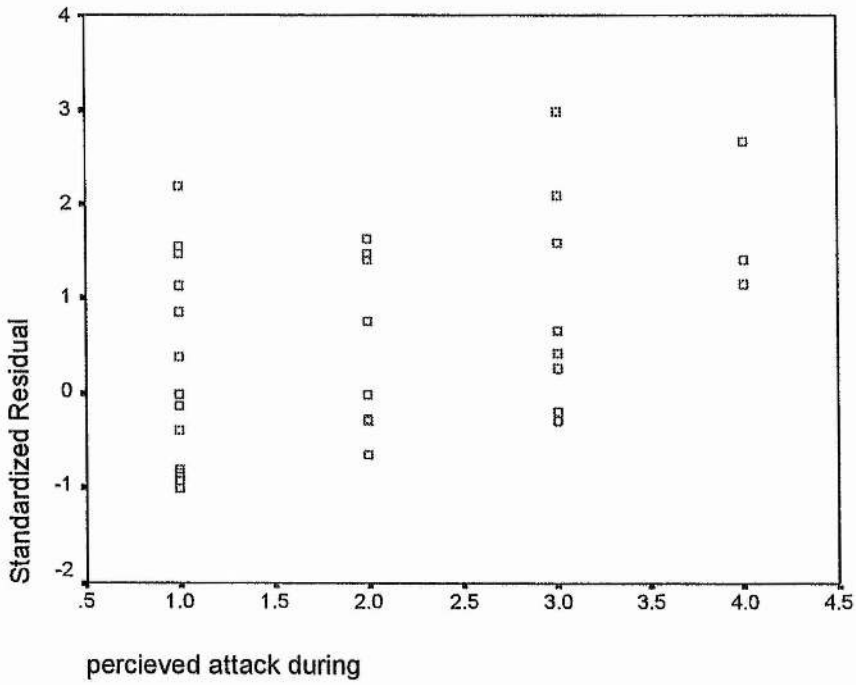
			Standardized Residual	threatened during	perceived attack during
Spearman's rho	Standardized Residual	Correlation Coefficient	1.000	.578**	.366*
		Sig. (2-tailed)	.	.001	.039
		N	32	32	32
	threatened during	Correlation Coefficient	.578**	1.000	.773**
		Sig. (2-tailed)	.001	.	.000
		N	32	32	32
	perceived attack during	Correlation Coefficient	.366*	.773**	1.000
		Sig. (2-tailed)	.039	.000	.
		N	32	32	32

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

Scatterplots for significant correlations from above:





PERCENTAGE OF AVAILABLE DETAILS RECALLED

Free Recall

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total free recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	191.203[a]	3	63.734	3.491	.021
Intercept	7168.797	1	7168.797	392.626	.000
INCIDENT	85.216	1	85.216	4.667	.035
WITNESS	97.540	1	97.540	5.342	.024
INCIDENT * WITNESS	8.446	1	8.446	.463	.499
Error	1095.516	60	18.259		
Total	8455.516	64			
Corrected Total	1286.718	63			

a. R Squared = .149 (Adjusted R Squared = .106)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	5412.941	1	5412.941	194.541	.000
INFO * INCIDENT	Linear	2.404	1	2.404	.086	.770
INFO * WITNESS	Linear	1.744	1	1.744	.063	.803
INFO * INCIDENT * WITNESS	Linear	1.128E-03	1	1.128E-03	.000	.995
Error(INFO)	Linear	1669.448	60	27.824		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	17338.013	1	17338.013	463.696	.000
INCIDENT	106.507	1	106.507	2.848	.097
WITNESS	201.402	1	201.402	5.386	.024
INCIDENT * WITNESS	17.317	1	17.317	.463	.499
Error	2243.456	60	37.391		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	1279.042	1	1279.042	93.903	.000
INFO * INCIDENT	Linear	4.083	1	4.083	.300	.586
INFO * WITNESS	Linear	13.184	1	13.184	.968	.329
INFO * INCIDENT * WITNESS	Linear	14.797	1	14.797	1.086	.301
Error(INFO)	Linear	817.255	60	13.621		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	13159.286	1	13159.286	385.584	.000
INCIDENT	211.562	1	211.562	6.199	.016
WITNESS	178.180	1	178.180	5.221	.026
INCIDENT * WITNESS	11.919	1	11.919	.349	.557
Error	2047.693	60	34.128		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	5471.21	2	2735.60	70.85	.000
INFO * INCIDENT	248.71	2	124.36	3.22	.043
INFO * WITNESS	46.56	2	23.28	.60	.549
INFO * INCIDENT * WIT	6.85	2	3.42	.09	.915
Error(INFO)	4633.67	120	38.61		

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Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	26159.006	1	26159.006	488.825	.000
INCIDENT	275.377	1	275.377	5.146	.027
WITNESS	269.043	1	269.043	5.028	.029
INCIDENT * WITNESS	20.935	1	20.935	.391	.534
Error	3210.842	60	53.514		

- **Posthoc Tukey's Test - Interaction of information (Action vs Verbal vs Appearance) by incident**

total free recall action details

Tukey HSD[a,b]

GROUP	N	Subset			
		1	2	3	4
CAP	32	4.4069			
TAP	32	6.9313	6.9313		
TV	32		10.4825		
CV	32		10.9375		
CA	32			16.0800	
TA	32				21.1963
Sig.		.650	.151	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 44.021.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: total free recall action details

Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
TA	CA	5.1163*	1.6587	.025	.3894	9.8431
	TV	10.7137*	1.6587	.000	5.9869	15.4406
	CV	10.2587*	1.6587	.000	5.5319	14.9856
	TAP	14.2650*	1.6587	.000	9.5382	18.9918
	CAP	16.7894*	1.6587	.000	12.0625	21.5162
CA	TA	-5.1163*	1.6587	.025	-9.8431	-.3894
	TV	5.5975*	1.6587	.010	.8707	10.3243
	CV	5.1425*	1.6587	.024	.4157	9.8693
	TAP	9.1487*	1.6587	.000	4.4219	13.8756
	CAP	11.6731*	1.6587	.000	6.9463	16.4000
TV	TA	-10.7137*	1.6587	.000	-15.4406	-5.9869
	CA	-5.5975*	1.6587	.010	-10.3243	-.8707
	CV	-.4550	1.6587	1.000	-5.1818	4.2718
	TAP	3.5513	1.6587	.266	-1.1756	8.2781
	CAP	6.0756*	1.6587	.003	1.3488	10.8025
CV	TA	-10.2587*	1.6587	.000	-14.9856	-5.5319
	CA	-5.1425*	1.6587	.024	-9.8693	-.4157
	TV	.4550	1.6587	1.000	-4.2718	5.1818
	TAP	4.0063	1.6587	.151	-.7206	8.7331
	CAP	6.5306*	1.6587	.001	1.8038	11.2575
TAP	TA	-14.2650*	1.6587	.000	-18.9918	-9.5382
	CA	-9.1487*	1.6587	.000	-13.8756	-4.4219
	TV	-3.5513	1.6587	.266	-8.2781	1.1756
	CV	-4.0063	1.6587	.151	-8.7331	.7206
	CAP	2.5244	1.6587	.650	-2.2025	7.2512
CAP	TA	-16.7894*	1.6587	.000	-21.5162	-12.0625
	CA	-11.6731*	1.6587	.000	-16.4000	-6.9463
	TV	-6.0756*	1.6587	.003	-10.8025	-1.3488
	CV	-6.5306*	1.6587	.001	-11.2575	-1.8038
	TAP	-2.5244	1.6587	.650	-7.2512	2.2025

Based on observed means.

*. The mean difference is significant at the .05 level.

Cued Recall

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total cued recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	50.875[a]	3	16.958	.962	.416
Intercept	7126.103	1	7126.103	404.446	.000
INCIDENT	18.094	1	18.094	1.027	.315
WITNESS	7.392	1	7.392	.420	.520
INCIDENT * WITNESS	25.389	1	25.389	1.441	.235
Error	1057.164	60	17.619		
Total	8234.142	64			
Corrected Total	1108.039	63			

a. R Squared = .046 (Adjusted R Squared = -.002)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	491.059	1	491.059	22.112	.000
INFO * INCIDENT	Linear	.167	1	.167	.008	.931
INFO * WITNESS	Linear	64.284	1	64.284	2.895	.094
INFO * INCIDENT * WITNESS	Linear	16.755	1	16.755	.754	.389
Error(INFO)	Linear	1332.485	60	22.208		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	13413.787	1	13413.787	384.098	.000
INCIDENT	44.663	1	44.663	1.279	.263
WITNESS	24.948	1	24.948	.714	.401
INCIDENT * WITNESS	45.375	1	45.375	1.299	.259
Error	2095.367	60	34.923		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	117.715	1	117.715	8.000	.006
INFO * INCIDENT	Linear	6.261	1	6.261	.426	.517
INFO * WITNESS	Linear	.982	1	.982	.067	.797
INFO * INCIDENT * WITNESS	Linear	10.482	1	10.482	.712	.402
Error(INFO)	Linear	882.864	60	14.714		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	13875.489	1	13875.489	374.496	.000
INCIDENT	45.066	1	45.066	1.216	.274
WITNESS	14.967	1	14.967	.404	.527
INCIDENT * WITNESS	45.089	1	45.089	1.217	.274
Error	2223.064	60	37.051		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	2289.80	2	1144.90	33.84	.000
INFO * INCIDENT	208.03	2	104.01	3.07	.050
INFO * WITNESS	92.34	2	46.17	1.36	.259
INFO * INCIDENT * WIT	59.52	2	29.76	.88	.418
Error(INFO)	4060.12	120	33.83		

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Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	18347.675	1	18347.675	364.871	.000
INCIDENT	72.177	1	72.177	1.435	.236
WITNESS	51.315	1	51.315	1.020	.316
INCIDENT * WITNESS	60.840	1	60.840	1.210	.276
Error	3017.126	60	50.285		

- **Posthoc Tukey's Test - Interaction of information (Action vs Verbal vs Appearance) by incident**

INFOCUED

Tukey HSD[a,b]

GROUP	N	Subset		
		1	2	3
TV	32	5.5334		
CV	32	6.2497		
CA	32	7.0966	7.0966	
TA	32		11.2100	11.2100
CAP	32			14.1409
TAP	32			14.4225
Sig.		.920	.093	.317

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 39.469.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFOCUED
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
TA	CA	4.1134	1.5706	.093	-.3623	8.5892
	TV	5.6766*	1.5706	.004	1.2008	10.1523
	CV	4.9603*	1.5706	.020	.4845	9.4361
	TAP	-3.2125	1.5706	.317	-7.6883	1.2633
	CAP	-2.9309	1.5706	.423	-7.4067	1.5448
CA	TA	-4.1134	1.5706	.093	-8.5892	.3623
	TV	1.5631	1.5706	.920	-2.9127	6.0389
	CV	.8469	1.5706	.995	-3.6289	5.3227
	TAP	-7.3259*	1.5706	.000	-11.8017	-2.8502
	CAP	-7.0444*	1.5706	.000	-11.5202	-2.5686
TV	TA	-5.6766*	1.5706	.004	-10.1523	-1.2008
	CA	-1.5631	1.5706	.920	-6.0389	2.9127
	CV	-.7163	1.5706	.998	-5.1920	3.7595
	TAP	-8.8891*	1.5706	.000	-13.3648	-4.4133
	CAP	-8.6075*	1.5706	.000	-13.0833	-4.1317
CV	TA	-4.9603*	1.5706	.020	-9.4361	-.4845
	CA	-.8469	1.5706	.995	-5.3227	3.6289
	TV	.7163	1.5706	.998	-3.7595	5.1920
	TAP	-8.1728*	1.5706	.000	-12.6486	-3.6970
	CAP	-7.8913*	1.5706	.000	-12.3670	-3.4155
TAP	TA	3.2125	1.5706	.317	-1.2633	7.6883
	CA	7.3259*	1.5706	.000	2.8502	11.8017
	TV	8.8891*	1.5706	.000	4.4133	13.3648
	CV	8.1728*	1.5706	.000	3.6970	12.6486
	CAP	.2816	1.5706	1.000	-4.1942	4.7573
CAP	TA	2.9309	1.5706	.423	-1.5448	7.4067
	CA	7.0444*	1.5706	.000	2.5686	11.5202
	TV	8.6075*	1.5706	.000	4.1317	13.0833
	CV	7.8913*	1.5706	.000	3.4155	12.3670
	TAP	-.2816	1.5706	1.000	-4.7573	4.1942

Based on observed means.

*. The mean difference is significant at the .05 level.

Total Recall (Free + Cued)

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total both recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	403.503[a]	3	134.501	3.985	.012
Intercept	28588.892	1	28588.892	846.983	.000
INCIDENT	181.643	1	181.643	5.381	.024
WITNESS	158.697	1	158.697	4.702	.034
INCIDENT * WITNESS	63.163	1	63.163	1.871	.176
Error	2025.229	60	33.754		
Total	31017.623	64			
Corrected Total	2428.731	63			

a. R Squared = .166 (Adjusted R Squared = .124)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	2642.736	1	2642.736	88.299	.000
INFO * INCIDENT	Linear	3.847	1	3.847	.129	.721
INFO * WITNESS	Linear	87.071	1	87.071	2.909	.093
INFO * INCIDENT * WITNESS	Linear	16.481	1	16.481	.551	.461
Error(INFO)	Linear	1795.765	60	29.929		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	61254.813	1	61254.813	895.633	.000
INCIDENT	289.171	1	289.171	4.228	.044
WITNESS	368.256	1	368.256	5.384	.024
INCIDENT * WITNESS	118.830	1	118.830	1.737	.192
Error	4103.565	60	68.393		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	2174.701	1	2174.701	143.087	.000
INFO * INCIDENT	Linear	20.560	1	20.560	1.353	.249
INFO * WITNESS	Linear	6.956	1	6.956	.458	.501
INFO * INCIDENT * WITNESS	Linear	49.925	1	49.925	3.285	.075
Error(INFO)	Linear	911.909	60	15.198		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	54055.542	1	54055.542	794.283	.000
INCIDENT	452.403	1	452.403	6.648	.012
WITNESS	296.279	1	296.279	4.353	.041
INCIDENT * WITNESS	103.392	1	103.392	1.519	.223
Error	4083.345	60	68.056		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	4221.32	2	2110.66	39.32	.000
INFO * INCIDENT	880.96	2	440.48	8.21	.000
INFO * WITNESS	87.62	2	43.81	.82	.445
INFO * INCIDENT * WIT	105.55	2	52.78	.98	.377
Error(INFO)	6441.24	120	53.68		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	88322.950	1	88322.950	915.634	.000
INCIDENT	628.975	1	628.975	6.521	.013
WITNESS	555.662	1	555.662	5.760	.020
INCIDENT * WITNESS	153.207	1	153.207	1.588	.212
Error	5787.660	60	96.461		

- **Posthoc Tukey's Test - Interaction of information (Action vs Verbal vs Appearance) by incident**

total both recall action details

Tukey HSD[a,b]

GROUP	N	Subset		
		1	2	3
TV	32	16.0156		
CV	32	17.1875		
CAP	32	18.5491	18.5491	
TAP	32	21.3541	21.3541	
CA	32		23.1775	
TA	32			32.4041
Sig.		.112	.236	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 70.597.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: total both recall action details

Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
TA	CA	9.2266*	2.1005	.000	3.2406	15.2125
	TV	16.3884*	2.1005	.000	10.4025	22.3744
	CV	15.2166*	2.1005	.000	9.2306	21.2025
	TAP	11.0500*	2.1005	.000	5.0641	17.0359
	CAP	13.8550*	2.1005	.000	7.8691	19.8409
CA	TA	-9.2266*	2.1005	.000	-15.2125	-3.2406
	TV	7.1619*	2.1005	.009	1.1759	13.1478
	CV	5.9900*	2.1005	.050	4.065E-03	11.9759
	TAP	1.8234	2.1005	.954	-4.1625	7.8094
	CAP	4.6284	2.1005	.236	-1.3575	10.6144
TV	TA	-16.3884*	2.1005	.000	-22.3744	-10.4025
	CA	-7.1619*	2.1005	.009	-13.1478	-1.1759
	CV	-1.1719	2.1005	.994	-7.1578	4.8141
	TAP	-5.3384	2.1005	.112	-11.3244	.6475
	CAP	-2.5334	2.1005	.834	-8.5194	3.4525
CV	TA	-15.2166*	2.1005	.000	-21.2025	-9.2306
	CA	-5.9900*	2.1005	.050	-11.9759	-4.0651E-03
	TV	1.1719	2.1005	.994	-4.8141	7.1578
	TAP	-4.1666	2.1005	.352	-10.1525	1.8194
	CAP	-1.3616	2.1005	.987	-7.3475	4.6244
TAP	TA	-11.0500*	2.1005	.000	-17.0359	-5.0641
	CA	-1.8234	2.1005	.954	-7.8094	4.1625
	TV	5.3384	2.1005	.112	-.6475	11.3244
	CV	4.1666	2.1005	.352	-1.8194	10.1525
	CAP	2.8050	2.1005	.765	-3.1809	8.7909
CAP	TA	-13.8550*	2.1005	.000	-19.8409	-7.8691
	CA	-4.6284	2.1005	.236	-10.6144	1.3575
	TV	2.5334	2.1005	.834	-3.4525	8.5194
	CV	1.3616	2.1005	.987	-4.6244	7.3475
	TAP	-2.8050	2.1005	.765	-8.7909	3.1809

Based on observed means.

*. The mean difference is significant at the .05 level.

CORRELATION OF PHYSIOLOGICAL/PSYCHOLOGICAL AROUSAL WITH PERCENTAGE OF AVAILABLE DETAILS RECALLED

- **Pearson & Spearman correlations (across the threat group witnesses) of the various measures of percentage of available details recalled with: the 'standardized residuals (to take account of baseline variation) of heart rate during the incident and heart rate immediately following the incident' and**

'rated perceived threat during the incident' and 'rated perceived chance of attack during the incident'

Correlations - Percentage of available details - Free Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	.187	.113	.336	.382*
	Sig. (2-tailed)	.307	.537	.060	.031
	N	32	32	32	32
Central	Correlation	.123	.002	.161	.163
	Sig. (2-tailed)	.501	.991	.378	.372
	N	32	32	32	32
Peripheral	Correlation	.145	.151	.347	.451**
	Sig. (2-tailed)	.430	.410	.052	.010
	N	32	32	32	32
Intruder 1	Correlation	.248	.069	.288	.394*
	Sig. (2-tailed)	.171	.706	.109	.026
	N	32	32	32	32
Intruder 2	Correlation	.001	.141	.397*	.339
	Sig. (2-tailed)	.994	.440	.024	.057
	N	32	32	32	32
Action	Correlation	-.009	-.024	.053	-.051
	Sig. (2-tailed)	.962	.895	.774	.781
	N	32	32	32	32
Verbal	Correlation	.229	.070	.144	.302
	Sig. (2-tailed)	.206	.704	.431	.093
	N	32	32	32	32
Appearance	Correlation	.160	.142	.344	.422*
	Sig. (2-tailed)	.383	.437	.054	.016
	N	32	32	32	32

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01level (2-tailed)

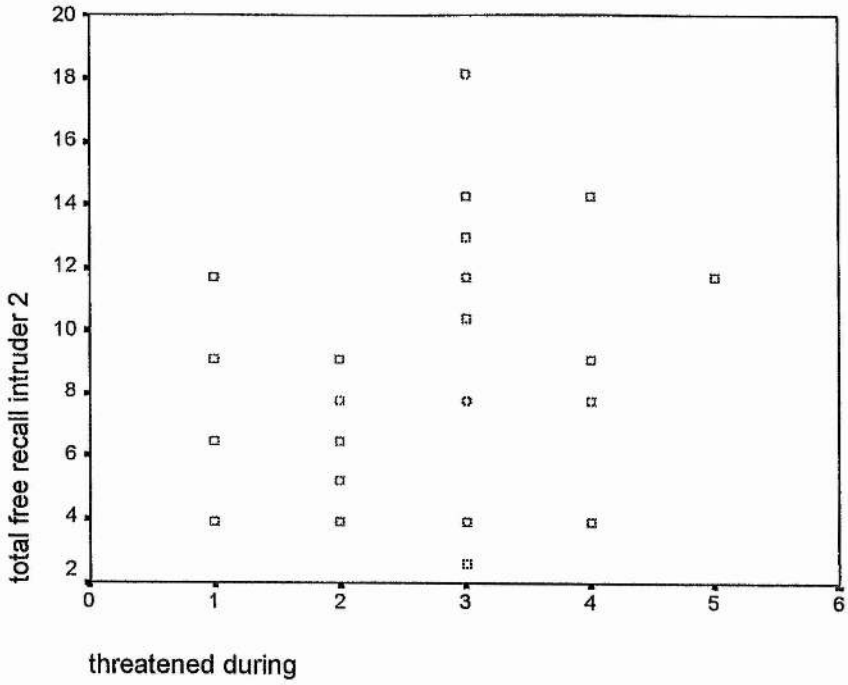
Correlations - Percentage of available details - Cued Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	-.140	.094	-.077	-.066
	Sig. (2-tailed)	.445	.609	.675	.719
	N	32	32	32	32
Central	Correlation	.027	.292	.217	.120
	Sig. (2-tailed)	.884	.105	.233	.515
	N	32	32	32	32
Peripheral	Correlation	-.214	-.104	-.209	-.081
	Sig. (2-tailed)	.240	.570	.252	.660
	N	32	32	32	32
Intruder 1	Correlation	-.248	-.001	-.153	-.180
	Sig. (2-tailed)	.171	.998	.405	.324
	N	32	32	32	32
Intruder 2	Correlation	.027	.170	.045	.154
	Sig. (2-tailed)	.883	.353	.806	.400
	N	32	32	32	32

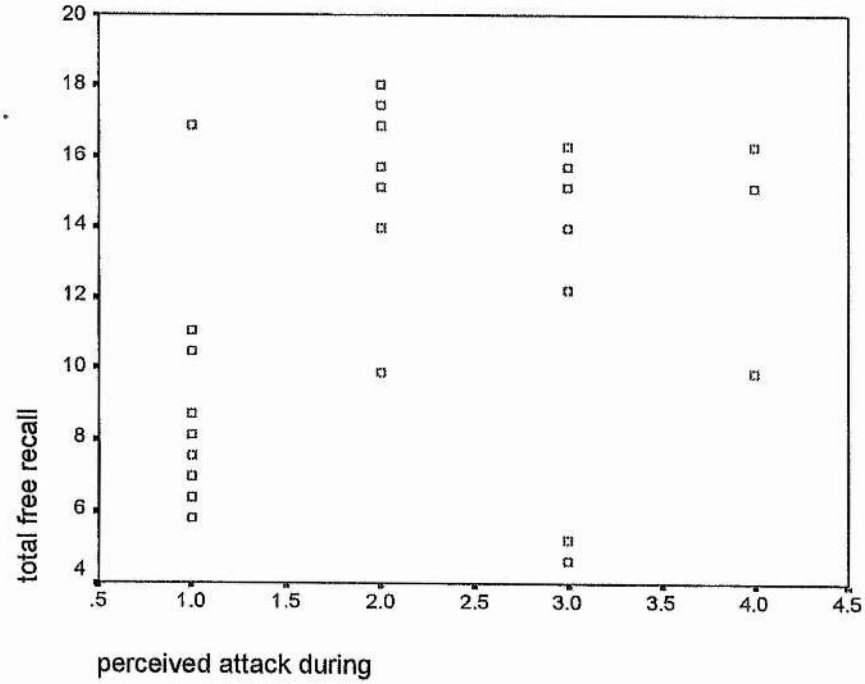
Action	Correlation	.062	.254	.175	.226
	Sig. (2-tailed)	.737	.160	.337	.213
	N	32	32	32	32
Verbal	Correlation	.004	.148	.157	-.029
	Sig. (2-tailed)	.984	.420	.390	.873
	N	32	32	32	32
Appearance	Correlation	-.254	-.127	-.246	-.110
	Sig. (2-tailed)	.161	.490	.174	.548
	N	32	32	32	32

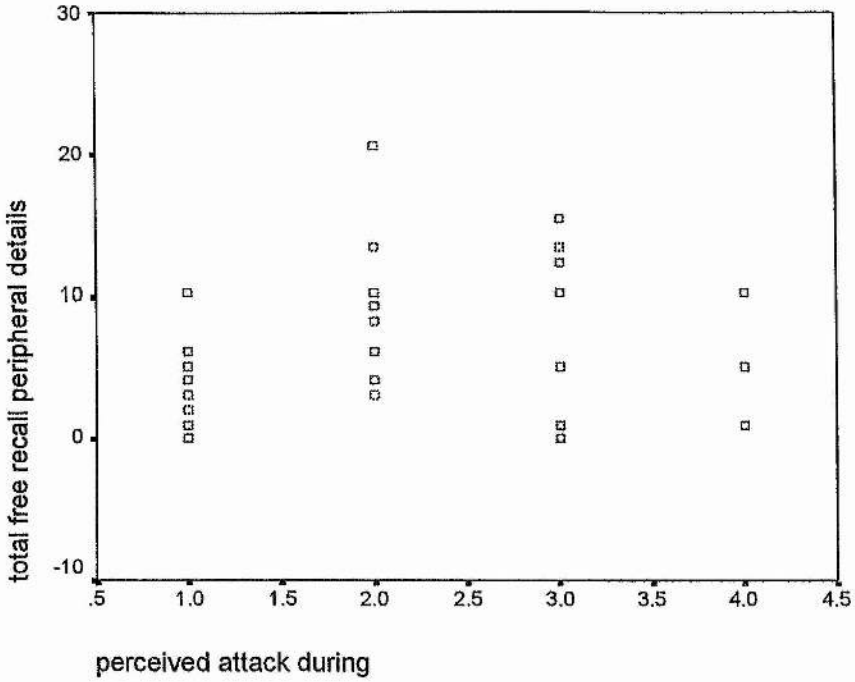
Correlations - Percentage of available details - Both Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	.048	.171	.238	.356*
	Sig. (2-tailed)	.793	.348	.189	.045
	N	32	32	32	32
Central	Correlation	.137	.233	.332	.262
	Sig. (2-tailed)	.454	.199	.063	.147
	N	32	32	32	32
Peripheral	Correlation	-.045	.051	.019	.211
	Sig. (2-tailed)	.805	.780	.917	.246
	N	32	32	32	32
Intruder 1	Correlation	.059	.072	.101	.191
	Sig. (2-tailed)	.749	.695	.584	.296
	N	32	32	32	32
Intruder 2	Correlation	.024	.244	.315	.380*
	Sig. (2-tailed)	.898	.178	.079	.032
	N	32	32	32	32
Action	Correlation	.041	.180	.218	.198
	Sig. (2-tailed)	.822	.325	.230	.277
	N	32	32	32	32
Verbal	Correlation	.228	.198	.220	.225
	Sig. (2-tailed)	.210	.278	.225	.215
	N	32	32	32	32
Appearance	Correlation	-.057	.030	.037	.214
	Sig. (2-tailed)	.758	.869	.841	.240
	N	32	32	32	32

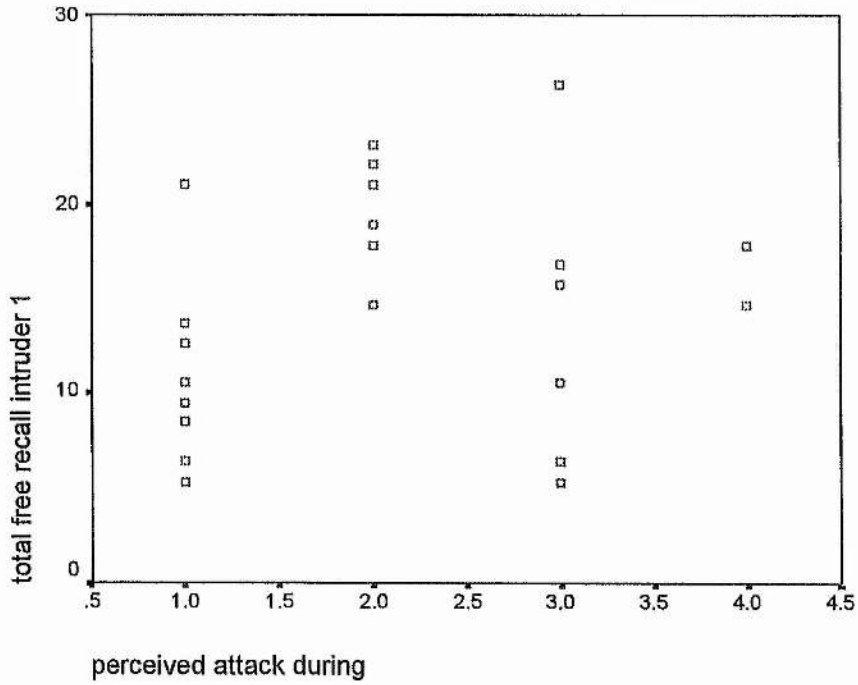
* Correlation is significant at the 0.05 level (2-tailed)

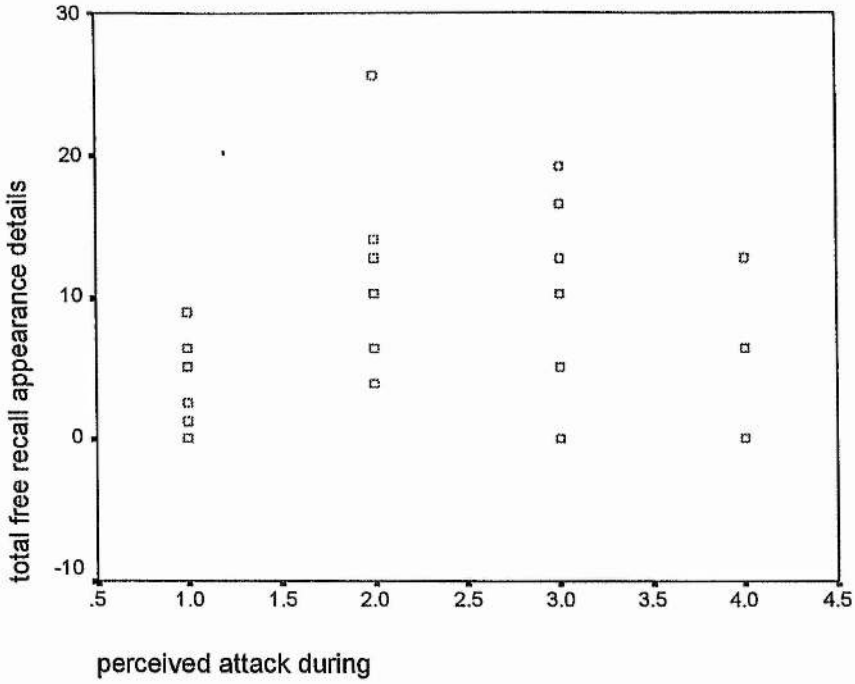
Scatterplots of significant correlations for the above:

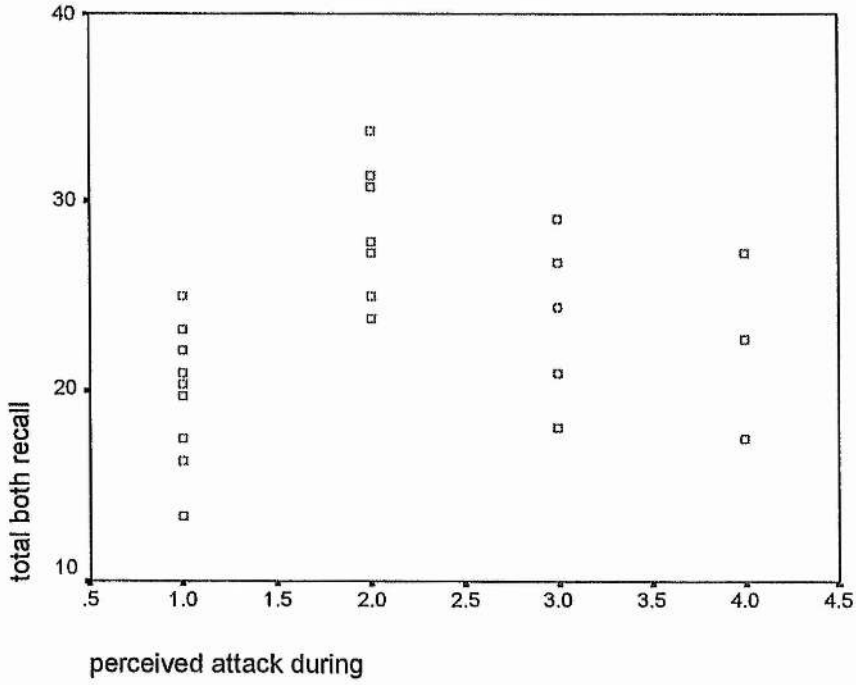

total free recall intruder 2
threatened during

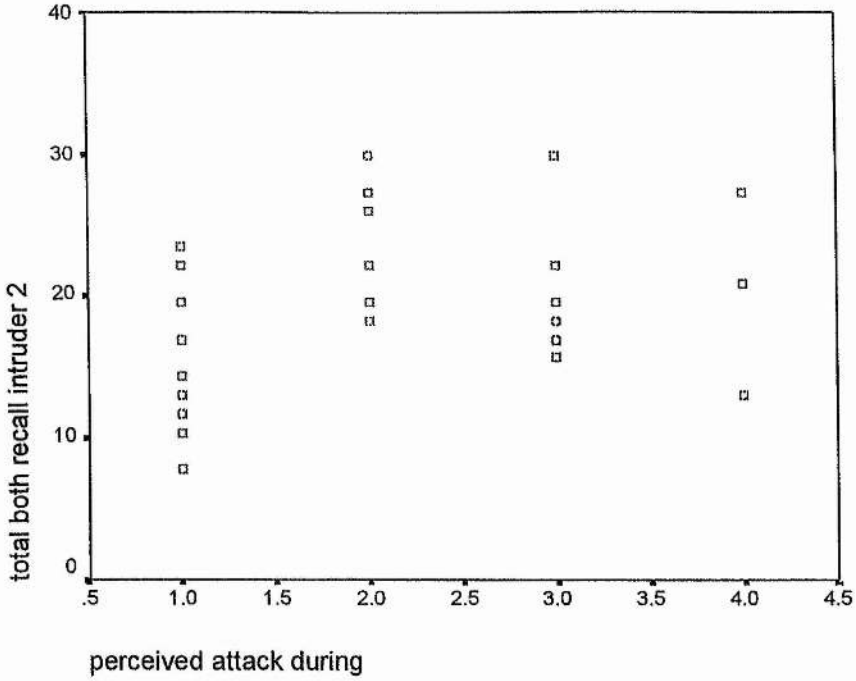

total free recall
perceived attack during


total free recall peripheral details
30
20
10
0
-10
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
perceived attack during


total free recall intruder 1
30
20
10
0
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
perceived attack during


total free recall appearance details
30
20
10
0
-10
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
perceived attack during


total both recall
40
30
20
10
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
perceived attack during



ACCURACY OF RECALL

Free Recall

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total free recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	230.554[a]	3	76.851	1.202	.317
Intercept	527105.040	1	527105.040	8246.785	.000
INCIDENT	216.458	1	216.458	3.387	.071
WITNESS	13.268	1	13.268	.208	.650
INCIDENT * WITNESS	.828	1	.828	.013	.910
Error	3834.986	60	63.916		
Total	531170.580	64			
Corrected Total	4065.539	63			

a. R Squared = .057 (Adjusted R Squared = .010)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	10463.478	1	10463.478	46.385	.000
INFO * INCIDENT	Linear	3766.182	1	3766.182	16.695	.000
INFO * WITNESS	Linear	623.872	1	623.872	2.766	.103
INFO * INCIDENT * WITNESS	Linear	1024.235	1	1024.235	4.540	.039
Error(INFO)	Linear	9925.550	44	225.581		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	676832.774	1	676832.774	2295.537	.000
INCIDENT	4479.605	1	4479.605	15.193	.000
WITNESS	801.579	1	801.579	2.719	.106
INCIDENT * WITNESS	1192.132	1	1192.132	4.043	.051
Error	12973.282	44	294.847		

- **Posthoc Tukey's Test - Interaction of incident by information**

INFO

Tukey HSD[a,b,c]

GRP2WAY	N	Subset 1	Subset 2
Control Peripheral	22	60.6427	
Threat Peripheral	26		86.9231
Control Central	32		93.8175
Threat Central	32		95.5606
Sig.		1.000	.187

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 249.603.

a. Uses Harmonic Mean Sample Size = 27.319.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO

Tukey HSD

(I) GRP2WAY	(J) GRP2WAY	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Threat Central	Control Central	1.7431	3.9497	.971	-8.5636	12.0499
	Threat Peripheral	8.6375	4.1714	.169	-2.2476	19.5227
	Control Peripheral	34.9179*	4.3756	.000	23.4999	46.3359
Control Central	Threat Central	-1.7431	3.9497	.971	-12.0499	8.5636
	Threat Peripheral	6.8944	4.1714	.354	-3.9907	17.7795
	Control Peripheral	33.1748*	4.3756	.000	21.7567	44.5928
Threat Peripheral	Threat Central	-8.6375	4.1714	.169	-19.5227	2.2476
	Control Central	-6.8944	4.1714	.354	-17.7795	3.9907
	Control Peripheral	26.2803*	4.5766	.000	14.3376	38.2231
Control Peripheral	Threat Central	-34.9179*	4.3756	.000	-46.3359	-23.4999
	Control Central	-33.1748*	4.3756	.000	-44.5928	-21.7567
	Threat Peripheral	-26.2803*	4.5766	.000	-38.2231	-14.3376

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Posthoc Tukey's Test - Interaction of incident by witness by information**

INFO

Tukey HSD[a,b,c]

GRP3WAY	N	Subset		
		1	2	3
Control Bystanders Peripheral	11	48.3709		
Control Victims Peripheral	11		72.9145	
Threat Victims Peripheral	13		85.5669	85.5669
Threat Bystanders Peripheral	13		88.2792	88.2792
Control Victims Central	16			92.9388
Control Bystanders Central	16			94.6962
Threat Bystanders Central	16			95.2850
Threat Victims Central	16			95.8363
Sig.		1.000	.145	.633

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 226.625.

a. Uses Harmonic Mean Sample Size = 13.660.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFO
Tukey HSD

(I) GRP3WAY	(J) GRP3WAY	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Victims Central	Threat Bystanders Central	.5512	5.3224	1.000	-15.9139	17.0164
	Control Victims Central	2.8975	5.3224	.999	-13.5677	19.3627
	Control Bystanders Central	1.1400	5.3224	1.000	-15.3252	17.6052
	Threat Victims Peripheral	10.2693	5.6211	.603	-7.1199	27.6585
	Threat Bystanders Peripheral	7.5570	5.6211	.879	-9.8322	24.9462
	Control Victims Peripheral	22.9217*	5.8963	.004	4.6812	41.1622
	Control Bystanders Peripheral	47.4653*	5.8963	.000	29.2248	65.7059
Threat Bystanders Central	Threat Victims Central	-.5512	5.3224	1.000	-17.0164	15.9139
	Control Victims Central	2.3463	5.3224	1.000	-14.1189	18.8114
	Control Bystanders Central	.5888	5.3224	1.000	-15.8764	17.0539
	Threat Victims Peripheral	9.7181	5.6211	.669	-7.6711	27.1073
	Threat Bystanders Peripheral	7.0058	5.6211	.916	-10.3934	24.3950
	Control Victims Peripheral	22.3705*	5.8963	.006	4.1299	40.6110
	Control Bystanders Peripheral	46.9141*	5.8963	.000	28.6736	65.1546
Control Victims Central	Threat Victims Central	-2.8975	5.3224	.999	-19.3627	13.5677
	Threat Bystanders Central	-2.3463	5.3224	1.000	-18.8114	14.1189
	Control Bystanders Central	-1.7575	5.3224	1.000	-18.2227	14.7077
	Threat Victims Peripheral	7.3718	5.6211	.893	-10.0174	24.7610
	Threat Bystanders Peripheral	4.6595	5.6211	.991	-12.7297	22.0487
	Control Victims Peripheral	20.0242*	5.8963	.021	1.7837	38.2647
	Control Bystanders Peripheral	44.5678*	5.8963	.000	26.3273	62.8084
Control Bystanders Central	Threat Victims Central	-1.1400	5.3224	1.000	-17.6052	15.3252
	Threat Bystanders Central	-.5888	5.3224	1.000	-17.0539	15.8764
	Control Victims Central	1.7575	5.3224	1.000	-14.7077	18.2227
	Threat Victims Peripheral	9.1293	5.6211	.735	-8.2599	26.5185
	Threat Bystanders Peripheral	6.4170	5.6211	.946	-10.9722	23.8062
	Control Victims Peripheral	21.7817*	5.8963	.008	3.5412	40.0222
	Control Bystanders Peripheral	46.3253*	5.8963	.000	28.0848	64.5659
Threat Victims Peripheral	Threat Victims Central	-10.2693	5.6211	.603	-27.6585	7.1199
	Threat Bystanders Central	-9.7181	5.6211	.669	-27.1073	7.6711
	Control Victims Central	-7.3718	5.6211	.893	-24.7610	10.0174
	Control Bystanders Central	-9.1293	5.6211	.735	-26.5185	8.2599
	Threat Bystanders Peripheral	-2.7123	5.9047	1.000	-20.9788	15.5542
	Control Victims Peripheral	12.6524	6.1672	.453	-6.4284	31.7311
	Control Bystanders Peripheral	37.1960*	6.1672	.000	18.1173	56.2747
Threat Bystanders Peripheral	Threat Victims Central	-7.5570	5.6211	.879	-24.9462	9.8322
	Threat Bystanders Central	-7.0058	5.6211	.916	-24.3950	10.3934
	Control Victims Central	-4.6595	5.6211	.991	-22.0487	12.7297
	Control Bystanders Central	-6.4170	5.6211	.946	-23.8062	10.9722
	Threat Victims Peripheral	2.7123	5.9047	1.000	-15.5542	20.9788
	Control Victims Peripheral	15.3647	6.1672	.211	-3.7140	34.4434
	Control Bystanders Peripheral	39.9083*	6.1672	.000	20.8296	58.9871
Control Victims Peripheral	Threat Victims Central	-22.9217*	5.8963	.004	-41.1622	-4.6812
	Threat Bystanders Central	-22.3705*	5.8963	.006	-40.6110	-4.1299
	Control Victims Central	-20.0242*	5.8963	.021	-38.2647	-1.7837
	Control Bystanders Central	-21.7817*	5.8963	.008	-40.0222	-3.5412
	Threat Victims Peripheral	-12.6524	6.1672	.453	-31.7311	6.4284
	Threat Bystanders Peripheral	-15.3647	6.1672	.211	-34.4434	3.7140
	Control Bystanders Peripheral	24.5436*	6.4191	.005	4.6659	44.4014
Control Bystanders Peripheral	Threat Victims Central	-47.4653*	5.8963	.000	-65.7059	-29.2248
	Threat Bystanders Central	-46.9141*	5.8963	.000	-65.1546	-28.6736
	Control Victims Central	-44.5678*	5.8963	.000	-62.8084	-26.3273
	Control Bystanders Central	-46.3253*	5.8963	.000	-64.5659	-28.0848
	Threat Victims Peripheral	-37.1960*	6.1672	.000	-56.2747	-18.1173
	Threat Bystanders Peripheral	-39.9083*	6.1672	.000	-58.9871	-20.8296
	Control Victims Peripheral	-24.5436*	6.4191	.005	-44.4014	-4.6659

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	1274.683	1	1274.683	4.247	.044
INFO * INCIDENT	Linear	855.583	1	855.583	2.850	.097
INFO * WITNESS	Linear	13.410	1	13.410	.045	.833
INFO * INCIDENT * WITNESS	Linear	162.608	1	162.608	.542	.465
Error(INFO)	Linear	18009.247	60	300.154		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1008986.478	1	1008986.478	3919.019	.000
INCIDENT	1570.031	1	1570.031	6.098	.016
WITNESS	156.269	1	156.269	.607	.439
INCIDENT * WITNESS	121.817	1	121.817	.473	.494
Error	15447.537	60	257.459		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	5933.25	2	2966.62	20.04	.000
INFO * INCIDENT	250.10	2	125.05	.84	.434
INFO * WITNESS	306.19	2	153.10	1.03	.361
INFO * INCIDENT * WITNESS	127.59	2	63.80	.43	.652
Error(INFO)	10657.40	72	148.02		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	895925.864	1	895925.864	4296.418	.000
INCIDENT	628.369	1	628.369	3.013	.091
WITNESS	115.412	1	115.412	.553	.462
INCIDENT * WITNESS	100.552	1	100.552	.482	.492
Error	7507.029	36	208.529		

Cued Recall

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total cued recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	99.195[a]	3	33.065	.267	.849
Intercept	363599.955	1	363599.955	2931.488	.000
INCIDENT	80.910	1	80.910	.652	.422
WITNESS	9.456E-02	1	9.456E-02	.001	.978
INCIDENT * WITNESS	18.190	1	18.190	.147	.703
Error	7441.953	60	124.033		
Total	371141.103	64			
Corrected Total	7541.148	63			

a. R Squared = .013 (Adjusted R Squared = -.036)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	9738.048	1	9738.048	20.827	.000
INFO * INCIDENT	Linear	169.815	1	169.815	.363	.549
INFO * WITNESS	Linear	323.217	1	323.217	.691	.409
INFO * INCIDENT * WITNESS	Linear	165.342	1	165.342	.354	.554
Error(INFO)	Linear	27118.856	58	467.566		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	761358.889	1	761358.889	2608.921	.000
INCIDENT	10.362	1	10.362	.036	.851
WITNESS	43.150	1	43.150	.148	.702
INCIDENT * WITNESS	58.726	1	58.726	.201	.655
Error	16926.081	58	291.829		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	2521.236	1	2521.236	8.416	.005
INFO * INCIDENT	Linear	255.218	1	255.218	.852	.360
INFO * WITNESS	Linear	738.556	1	738.556	2.465	.122
INFO * INCIDENT * WITNESS	Linear	5.264E-02	1	5.264E-02	.000	.989
Error(INFO)	Linear	17674.598	59	299.569		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	688310.709	1	688310.709	2084.546	.000
INCIDENT	35.844	1	35.844	.109	.743
WITNESS	37.056	1	37.056	.112	.739
INCIDENT * WITNESS	180.362	1	180.362	.546	.463
Error	19481.616	59	330.197		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	9055.04	2	4527.52	14.35	.000
INFO * INCIDENT	539.15	2	269.58	.85	.429
INFO * WITNESS	2117.40	2	1058.70	3.36	.040
INFO * INCIDENT * WIT	305.68	2	152.84	.48	.618
Error(INFO)	26502.66	84	315.51		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	874217.525	1	874217.525	2608.118	.000
INCIDENT	91.579	1	91.579	.273	.604
WITNESS	677.795	1	677.795	2.022	.162
INCIDENT * WITNESS	468.499	1	468.499	1.398	.244
Error	14078.018	42	335.191		

Total Recall (Free + Cued)

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total both recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	15.959[a]	3	5.320	.104	.957
Intercept	440725.037	1	440725.037	8630.890	.000
INCIDENT	14.128	1	14.128	.277	.601
WITNESS	.803	1	.803	.016	.901
INCIDENT * WITNESS	1.028	1	1.028	.020	.888
Error	3063.821	60	51.064		
Total	443804.817	64			
Corrected Total	3079.780	63			

a. R Squared = .005 (Adjusted R Squared = -.045)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	13955.566	1	13955.566	128.624	.000
INFO * INCIDENT	Linear	46.429	1	46.429	.428	.516
INFO * WITNESS	Linear	9.488	1	9.488	.087	.768
INFO * INCIDENT * WITNESS	Linear	116.644	1	116.644	1.075	.304
Error(INFO)	Linear	6509.933	60	108.499		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	865025.130	1	865025.130	9664.113	.000
INCIDENT	25.001	1	25.001	.279	.599
WITNESS	17.798	1	17.798	.199	.657
INCIDENT * WITNESS	5.742	1	5.742	.064	.801
Error	5370.540	60	89.509		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	2561.401	1	2561.401	20.251	.000
INFO * INCIDENT	Linear	14.171	1	14.171	.112	.739
INFO * WITNESS	Linear	290.074	1	290.074	2.293	.135
INFO * INCIDENT * WITNESS	Linear	12.606	1	12.606	.100	.753
Error(INFO)	Linear	7588.910	60	126.482		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	847405.084	1	847405.084	6296.297	.000
INCIDENT	138.799	1	138.799	1.031	.314
WITNESS	17.427	1	17.427	.129	.720
INCIDENT * WITNESS	12.097	1	12.097	.090	.765
Error	8075.271	60	134.588		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	15836.13	2	7918.06	56.49	.000
INFO * INCIDENT	236.09	2	118.04	.84	.433
INFO * WITNESS	244.29	2	122.15	.87	.421
INFO * INCIDENT * WITNESS	148.17	2	74.09	.53	.591
Error(INFO)	16818.70	120	140.16		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1361364.128	1	1361364.128	11420.938	.000
INCIDENT	45.757	1	45.757	.384	.538
WITNESS	2.356	1	2.356	.020	.889
INCIDENT * WITNESS	14.035	1	14.035	.118	.733
Error	7151.939	60	119.199		

CORRELATION OF PHYSIOLOGICAL/PSYCHOLOGICAL AROUSAL WITH RECALL ACCURACY

- **Pearson & Spearman correlations (across the threat group witnesses) of the various measures of recall accuracy with: the 'standardized residuals (to take account of baseline variation) of heart rate during the incident and heart rate immediately following the incident' and 'rated perceived threat during the incident' and 'rated perceived chance of attack during the incident'**

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01level (2-tailed)

Correlations - Free Recall Accuracy		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	-.202	-.067	-.312	-.436*
	Sig. (2-tailed)	.267	.715	.082	.013
	N	32	32	32	32
Central	Correlation	-.227	.121	-.102	-.245
	Sig. (2-tailed)	.211	.509	.580	.177
	N	32	32	32	32
Peripheral	Correlation	-.100	-.094	-.306	-.340
	Sig. (2-tailed)	.628	.647	.128	.089
	N	32	32	26	26
Intruder 1	Correlation	-.222	-.021	-.255	-.262
	Sig. (2-tailed)	.222	.909	.159	.148
	N	32	32	32	32
Intruder 2	Correlation	.024	-.112	-.216	-.398*
	Sig. (2-tailed)	.895	.543	.236	.024
	N	32	32	32	32
Action	Correlation	-.202	-.098	-.125	-.207
	Sig. (2-tailed)	.918	.595	.497	.256
	N	32	32	32	32
Verbal	Correlation	.019	.183	.123	.044
	Sig. (2-tailed)	.918	.317	.504	.812
	N	32	32	32	32
Appearance	Correlation	-.161	-.025	-.316	-.373
	Sig. (2-tailed)	.464	.909	.142	.080
	N	32	32	23	23

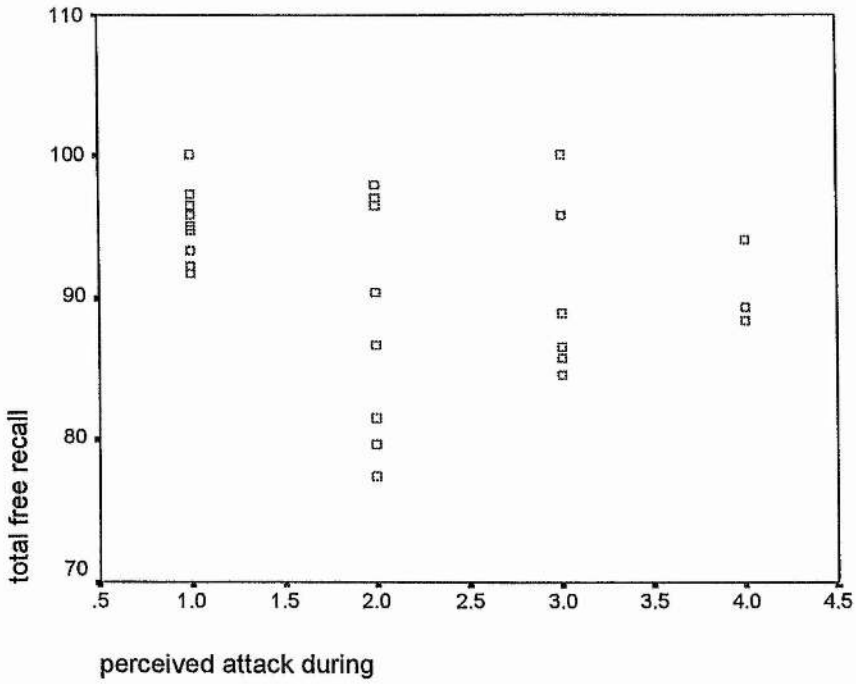
* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01level (2-tailed)

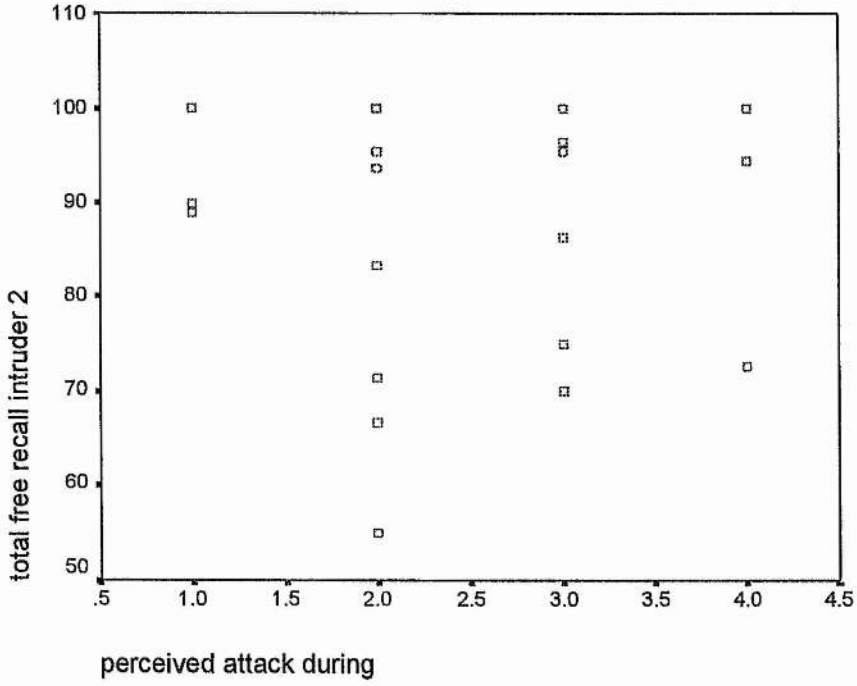
Correlations - Cued Recall Accuracy		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	-.017	.129	.205	.254
	Sig. (2-tailed)	.928	.482	.261	.161
	N	32	32	32	32
Central	Correlation	.057	.098	.137	.013
	Sig. (2-tailed)	.763	.605	.471	.946
	N	30	30	30	30

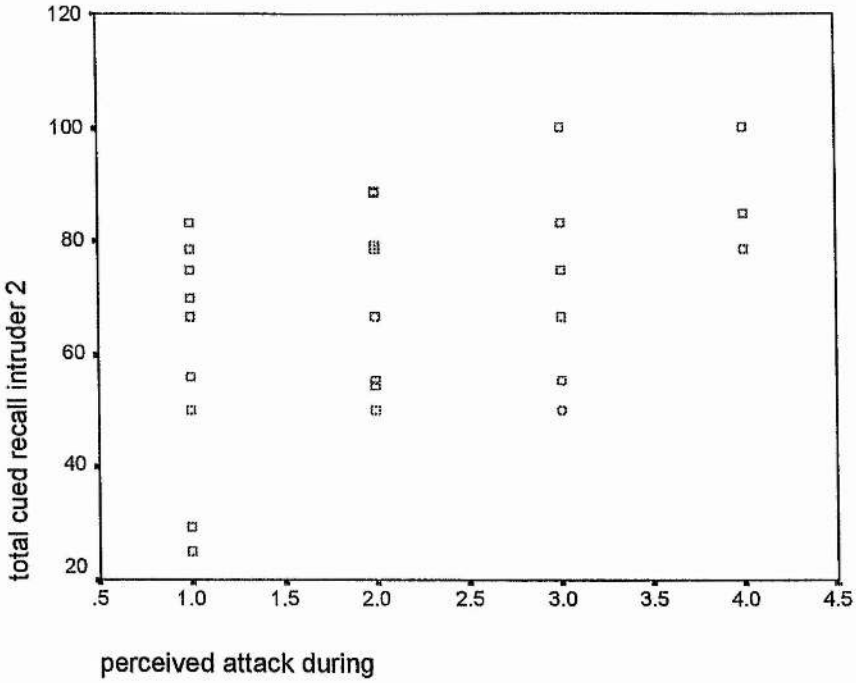
Peripheral	Correlation	-.070	-.037	-.046	.140
	Sig. (2-tailed)	.703	.842	.803	.446
	N	32	32	32	32
Intruder 1	Correlation	-.003	-.018	.068	-.052
	Sig. (2-tailed)	.988	.921	.713	.775
	N	32	32	32	32
Intruder 2	Correlation	.018	.207	.179	.368*
	Sig. (2-tailed)	.922	.256	.327	.038
	N	32	32	32	32
Action	Correlation	.009	.096	.308	.080
	Sig. (2-tailed)	.965	.627	.111	.685
	N	28	28	28	28
Verbal	Correlation	-.003	.083	.093	-.034
	Sig. (2-tailed)	.989	.686	.653	.869
	N	26	26	26	26
Appearance	Correlation	-.146	-.156	-.125	.082
	Sig. (2-tailed)	.426	.394	.496	.656
	N	32	32	32	32

Correlations - Both Recall Accuracy		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Threat During *SPEARMAN*	Rated Perceived Attack During *SPEARMAN*
Overall	Correlation	-.095	-.046	-.074	.028
	Sig. (2-tailed)	.604	.802	.687	.880
	N	32	32	32	32
Central	Correlation	-.066	.061	.018	-.138
	Sig. (2-tailed)	.722	.741	.921	.451
	N	32	32	32	32
Peripheral	Correlation	-.111	-.094	-.131	.071
	Sig. (2-tailed)	.547	.608	.474	.700
	N	32	32	32	32
Intruder 1	Correlation	-.075	.-041	.015	-.078
	Sig. (2-tailed)	.684	.822	.935	.672
	N	32	32	32	32
Intruder 2	Correlation	-.129	-.041	.057	.090
	Sig. (2-tailed)	.482	.824	.755	.623
	N	32	32	32	32
Action	Correlation	-.126	-.026	.171	-.024
	Sig. (2-tailed)	.491	.888	.348	.898
	N	32	32	32	32
Verbal	Correlation	.053	.178	.160	.026
	Sig. (2-tailed)	.773	.329	.382	.888
	N	32	32	32	32
Appearance	Correlation	-.122	-.108	-.122	.111
	Sig. (2-tailed)	.507	.557	.507	.545
	N	32	32	32	32

Scatterplots for the significant correlations from above:


110
100
90
80
70
total free recall
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
perceived attack during


110
100
90
80
70
60
50
total free recall intruder 2
.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
perceived attack during



4AFC RECOGNITION ACCURACY

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: accuracy across all questions

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1815.082[a]	3	605.027	9.575	.000
Intercept	169918.115	1	169918.115	2689.028	.000
INCIDENT	1752.574	1	1752.574	27.735	.000
WITNESS	5.411	1	5.411	.086	.771
INCIDENT * WITNESS	57.097	1	57.097	.904	.346
Error	3791.365	60	63.189		
Total	175524.562	64			
Corrected Total	5606.447	63			

a. R Squared = .324 (Adjusted R Squared = .290)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	87.467	1	87.467	.706	.404
INFO * INCIDENT	Linear	1946.958	1	1946.958	15.713	.000
INFO * WITNESS	Linear	405.520	1	405.520	3.273	.075
INFO * INCIDENT * WITNESS	Linear	.129	1	.129	.001	.974
Error(INFO)	Linear	7434.556	60	123.909		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	341690.611	1	341690.611	2452.624	.000
INCIDENT	5083.218	1	5083.218	36.487	.000
WITNESS	5.400	1	5.400	.039	.845
INCIDENT * WITNESS	106.598	1	106.598	.765	.385
Error	8358.982	60	139.316		

- **Post hoc Tukey's test - Interaction of Incident by Information**

INFOCP

Tukey HSD[a,b]

GROUPCP	N	Subset		
		1	2	3
Control Central	32	42.2916		
Control Peripheral	32	48.4384	48.4384	
Threat Peripheral	32		53.2419	
Threat Central	32			62.6953
Sig.		.139	.337	1.000

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 131.542.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFOCP
Tukey HSD

(I) GROUPCP	(J) GROUPCP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Central	Control Central	20.4038*	2.8673	.000	13.0376	27.7699
	Threat Peripheral	9.4534*	2.8673	.005	2.0873	16.8196
	Control Peripheral	14.2569*	2.8673	.000	6.8907	21.6230
Control Central	Threat Central	-20.4038*	2.8673	.000	-27.7699	-13.0376
	Threat Peripheral	-10.9503*	2.8673	.001	-18.3165	-3.5841
	Control Peripheral	-6.1469	2.8673	.139	-13.5130	1.2193
Threat Peripheral	Threat Central	-9.4534*	2.8673	.005	-16.8196	-2.0873
	Control Central	10.9503*	2.8673	.001	3.5841	18.3165
	Control Peripheral	4.8034	2.8673	.337	-2.5627	12.1696
Control Peripheral	Threat Central	-14.2569*	2.8673	.000	-21.6230	-6.8907
	Control Central	6.1469	2.8673	.139	-1.2193	13.5130
	Threat Peripheral	-4.8034	2.8673	.337	-12.1696	2.5627

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	337.480	1	337.480	3.594	.063
INFO * INCIDENT	Linear	406.695	1	406.695	4.331	.042
INFO * WITNESS	Linear	1.140	1	1.140	.012	.913
INFO * INCIDENT * WITNESS	Linear	2.977	1	2.977	.032	.859
Error(INFO)	Linear	5634.145	60	93.902		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	339282.031	1	339282.031	2683.657	.000
INCIDENT	3453.636	1	3453.636	27.318	.000
WITNESS	11.092	1	11.092	.088	.768
INCIDENT * WITNESS	114.761	1	114.761	.908	.345
Error	7585.515	60	126.425		

- **Post hoc Tukey's test - Interaction of Incident by Information**

INFOINT

Tukey HSD[a,b]

GROUPINT	N	Subset 1	Subset 2	Subset 3
Control Intruder 1	32	46.1313		
Control Intruder 2	32	46.4488		
Threat Intruder 2	32		53.2725	
Threat Intruder 1	32			60.0850
Sig.		.999	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 107.658.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFOINT
Tukey HSD

(I) GROUPINT	(J) GROUPINT	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Intruder 1	Control Intruder 1	13.9537*	2.5940	.000	7.2898	20.6177
	Threat Intruder 2	6.8125*	2.5940	.043	.1485	13.4765
	Control Intruder 2	13.6362*	2.5940	.000	6.9723	20.3002
Control Intruder 1	Threat Intruder 1	-13.9537*	2.5940	.000	-20.6177	-7.2898
	Threat Intruder 2	-7.1412*	2.5940	.030	-13.8052	-.4773
	Control Intruder 2	-.3175	2.5940	.999	-6.9815	6.3465
Threat Intruder 2	Threat Intruder 1	-6.8125*	2.5940	.043	-13.4765	-.1485
	Control Intruder 1	7.1412*	2.5940	.030	.4773	13.8052
	Control Intruder 2	6.8237*	2.5940	.042	.1598	13.4877
Control Intruder 2	Threat Intruder 1	-13.6362*	2.5940	.000	-20.3002	-6.9723
	Control Intruder 1	.3175	2.5940	.999	-6.3465	6.9815
	Threat Intruder 2	-6.8237*	2.5940	.042	-13.4877	-.1598

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	27756.06	2	13878.03	76.48	.000
INFO * INCIDENT	4980.01	2	2490.00	13.72	.000
INFO * WITNESS	862.87	2	431.43	2.38	.097
INFO * INCIDENT * WIT	302.83	2	151.42	.83	.437
Error(INFO)	21774.27	120	181.45		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	470419.290	1	470419.290	2392.437	.000
INCIDENT	6683.402	1	6683.402	33.990	.000
WITNESS	11.628	1	11.628	.059	.809
INCIDENT * WITNESS	139.486	1	139.486	.709	.403
Error	11797.661	60	196.628		

- **Posthoc Tukey's Test - Interaction of information (Action vs Verbal vs Appearance) by incident**

INFOAVA

Tukey HSD[a,b]

GROUPAVA	N	Subset			
		1	2	3	4
CV	32	30.9375			
TV	32	34.3750			
CA	32		46.8747		
CAP	32		52.9834	52.9834	
TAP	32			58.8069	
TA	32				73.0134
Sig.		.917	.476	.531	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 187.574.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: INFOAVA
Tukey HSD

(I) GROUPAVA	(J) GROUPAVA	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
TA	CA	26.1387*	3.4239	.000	16.3815	35.8960
	TV	38.6384*	3.4239	.000	28.8812	48.3957
	CV	42.0759*	3.4239	.000	32.3187	51.8332
	TAP	14.2066*	3.4239	.000	4.4493	23.9638
	CAP	20.0300*	3.4239	.000	10.2728	29.7872
CA	TA	-26.1387*	3.4239	.000	-35.8960	-16.3815
	TV	12.4997*	3.4239	.004	2.7425	22.2569
	CV	15.9372*	3.4239	.000	6.1800	25.6944
	TAP	-11.9322*	3.4239	.007	-21.6894	-2.1750
	CAP	-6.1088	3.4239	.476	-15.8660	3.6485
TV	TA	-38.6384*	3.4239	.000	-48.3957	-28.8812
	CA	-12.4997*	3.4239	.004	-22.2569	-2.7425
	CV	3.4375	3.4239	.917	-6.3197	13.1947
	TAP	-24.4319*	3.4239	.000	-34.1891	-14.6746
	CAP	-18.6084*	3.4239	.000	-28.3657	-8.8512
CV	TA	-42.0759*	3.4239	.000	-51.8332	-32.3187
	CA	-15.9372*	3.4239	.000	-25.6944	-6.1800
	TV	-3.4375	3.4239	.917	-13.1947	6.3197
	TAP	-27.8694*	3.4239	.000	-37.6266	-18.1121
	CAP	-22.0459*	3.4239	.000	-31.8032	-12.2887
TAP	TA	-14.2066*	3.4239	.000	-23.9638	-4.4493
	CA	11.9322*	3.4239	.007	2.1750	21.6894
	TV	24.4319*	3.4239	.000	14.6746	34.1891
	CV	27.8694*	3.4239	.000	18.1121	37.6266
	CAP	5.8234	3.4239	.531	-3.9338	15.5807
CAP	TA	-20.0300*	3.4239	.000	-29.7872	-10.2728
	CA	6.1088	3.4239	.476	-3.6485	15.8660
	TV	18.6084*	3.4239	.000	8.8512	28.3657
	CV	22.0459*	3.4239	.000	12.2887	31.8032
	TAP	-5.8234	3.4239	.531	-15.5807	3.9338

Based on observed means.

*. The mean difference is significant at the .05 level.

CORRELATION OF PHYSIOLOGICAL/PSYCHOLOGICAL AROUSAL WITH 4AFC RECOGNITION ACCURACY

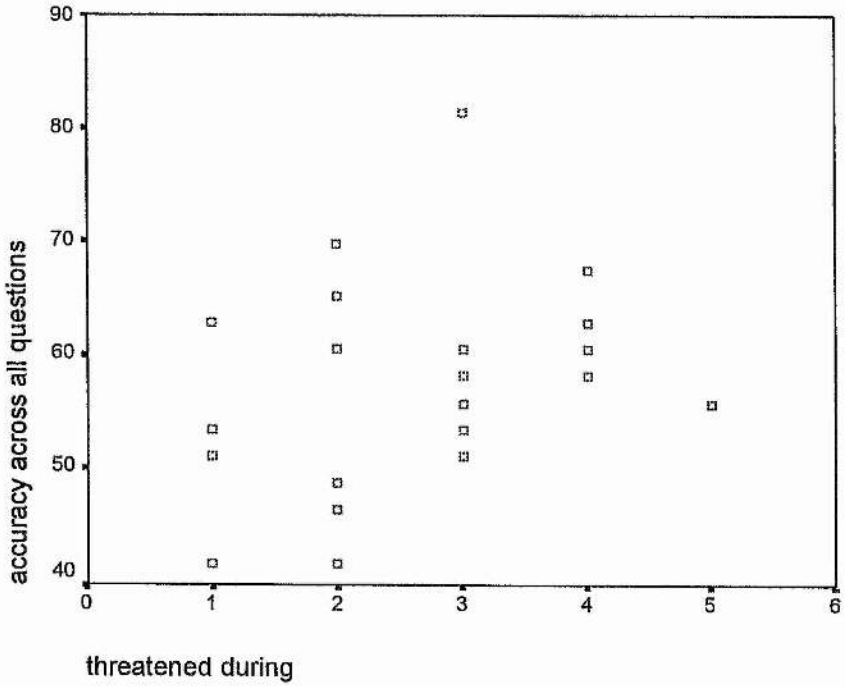
- **Pearson & Spearman correlations (across the threat group witnesses) of the various measures of recognition accuracy with: the 'standardized residuals (to take account of baseline variation) of heart rate during the incident and heart rate immediately following the incident' and 'rated perceived threat during the incident' and 'rated perceived chance of attack during the incident'**

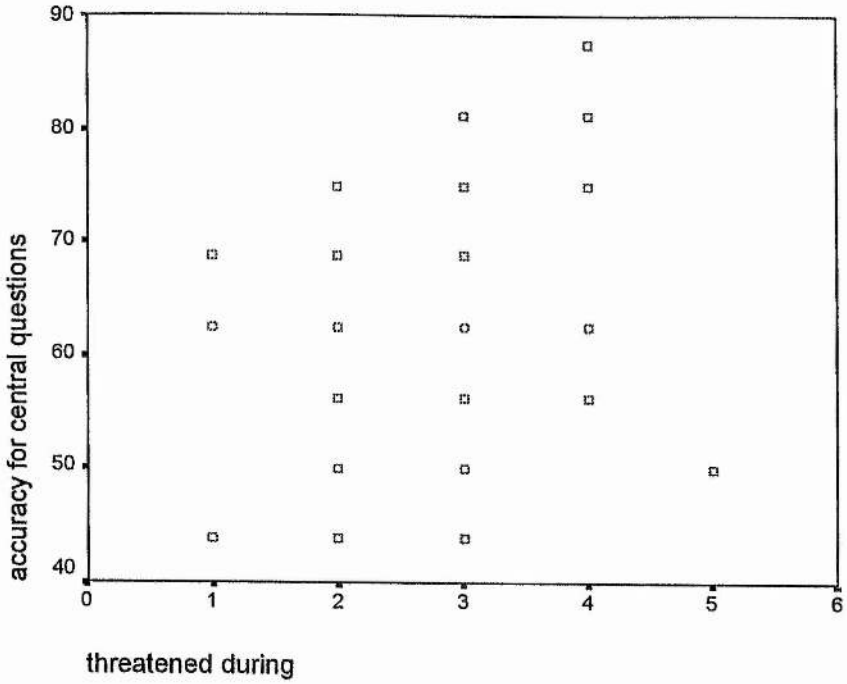
Correlations - 4AFC	Heart Rate During (Residual Values)	Heart Rate After (Residual Values)	Rated Threat During	Rated Perceived Attack During

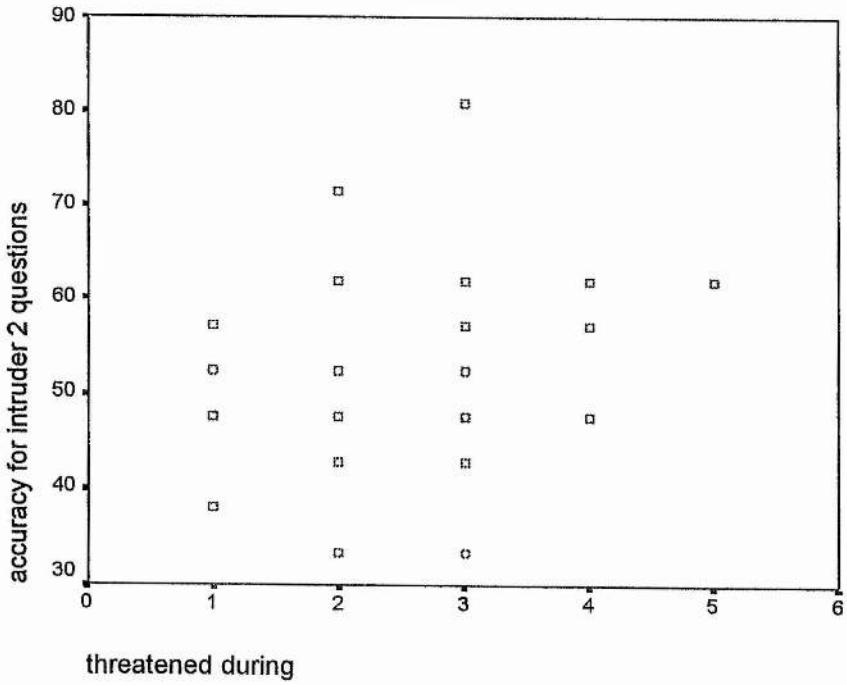
		PEARSON	*PEARSON*	*SPEARMAN*	*SPEARMAN*
Overall	Correlation	-.055	.101	.391*	.387*
	Sig. (2-tailed)	.766	.584	.027	.028
	N	32	32	32	32
Central	Correlation	.047	.304	.374*	.196
	Sig. (2-tailed)	.800	.091	.035	.283
	N	32	32	32	32
Peripheral	Correlation	-.105	-.100	.218	.348
	Sig. (2-tailed)	.568	.587	.230	.051
	N	32	32	32	32
Intruder 1	Correlation	.099	.113	.260	.293
	Sig. (2-tailed)	.591	.539	.150	.103
	N	32	32	32	32
Intruder 2	Correlation	-.197	.043	.359*	.318
	Sig. (2-tailed)	.281	.816	.044	.076
	N	32	32	32	32
Action	Correlation	.013	.177	.364*	.225
	Sig. (2-tailed)	.942	.334	.041	.216
	N	32	32	32	32
Verbal	Correlation	.103	.136	.137	.130
	Sig. (2-tailed)	.576	.458	.456	.480
	N	32	32	32	32
Appearance	Correlation	-.131	-.055	.198	.290
	Sig. (2-tailed)	.474	.767	.277	.107
	N	32	32	32	32

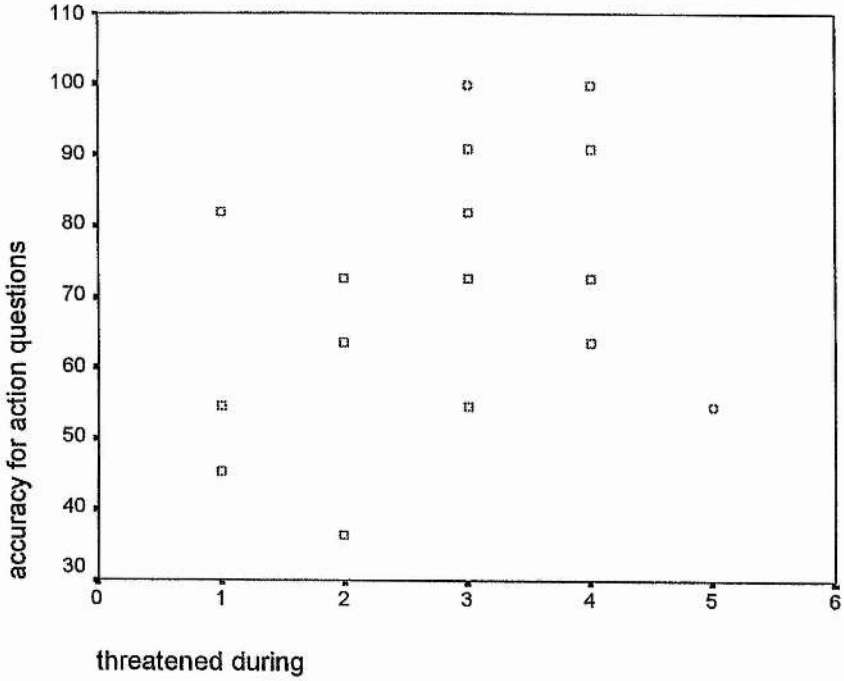
* Correlation is significant at the 0.05 level (2-tailed)

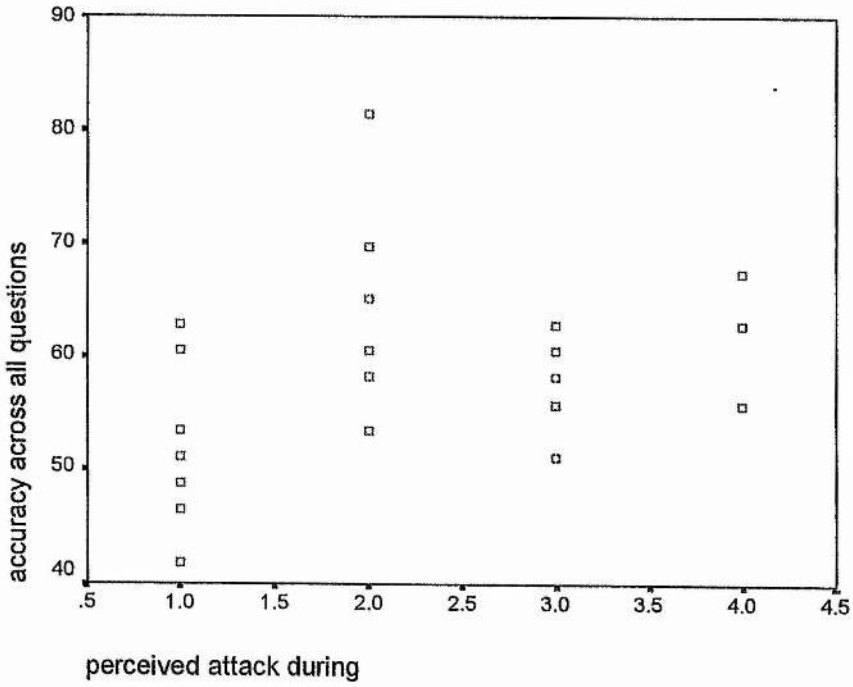
Scatterplots for significant correlations from above:




accuracy for central questions
90
80
70
60
50
40
0
1
2
3
4
5
6
threatened during


accuracy for intruder 2 questions
90
80
70
60
50
40
30
0
1
2
3
4
5
6
threatened during





IDENTIFICATION

LINEUP ONE

CONTINGENCY TABLE: INCIDENT BY WITNESS BY DECISION

witness type * decision * incident Crosstabulation

incident				decision: correct	decision: incorrect	Total
threat	witness type	victim	Count	8	8	16
			Expected Count	10.0	6.0	16.0
		bystander	Count	12	4	16
			Expected Count	10.0	6.0	16.0
	Total		Count	20	12	32
			Expected Count	20.0	12.0	32.0
control	witness type	victim	Count	7	9	16
			Expected Count	5.5	10.5	16.0
		bystander	Count	4	12	16
			Expected Count	5.5	10.5	16.0
	Total		Count	11	21	32
			Expected Count	11.0	21.0	32.0

3-WAY LOG-LINEAR ANALYSIS: INCIDENT BY WITNESS BY DECISION

```
* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * *

DATA   Information

          8 unweighted cases accepted.
          0 cases rejected because of out-of-range factor values.
          0 cases rejected because of missing data.
         64 weighted cases will be used in the analysis.


FACTOR Information

   Factor  Level  Label
   INCIDENT     2  incident
   WITNESS      2  witness type
   DECISION     2  decision

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * *

DESIGN 1 has generating class

    INCIDENT*WITNESS*DECISION

 Note: For saturated models   .500 has been added to all observed cells.
 This value may be changed by using the CRITERIA = DELTA subcommand.


The Iterative Proportional Fit algorithm converged at iteration 1.
The maximum difference between observed and fitted marginal totals is
.000
```

```
and the convergence criterion is      .250

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


 Observed, Expected Frequencies and Residuals.

       Factor           Code                 OBS count  EXP count  Residual
Std Resid


  INCIDENT         threat
   WITNESS          victim
    DECISION         correct                       8.5        8.5        .00
 .00
    DECISION         incorrec                      8.5        8.5        .00
 .00
   WITNESS          bystande
    DECISION         correct                      12.5       12.5        .00
 .00
    DECISION         incorrec                      4.5        4.5        .00
 .00

  INCIDENT         control
   WITNESS          victim
    DECISION         correct                       7.5        7.5        .00
 .00
    DECISION         incorrec                      9.5        9.5        .00
 .00
   WITNESS          bystande
    DECISION         correct                       4.5        4.5        .00
 .00
    DECISION         incorrec                     12.5       12.5        .00
 .00

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - -


 Goodness-of-fit test statistics

    Likelihood ratio chi square =      .00000    DF = 0   P = 1.000
             Pearson chi square =      .00000    DF = 0   P = 1.000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * *

Tests that K-way and higher order effects are zero.

         K     DF    L.R. Chisq    Prob  Pearson Chisq    Prob
Iteration

         3      1         3.355   .0670          3.317   .0686
2
         2      4         8.560   .0731          8.196   .0847
2
         1      7         8.623   .2809          8.250   .3111
0

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

```
Tests that K-way effects are zero.

         K      DF    L.R. Chisq     Prob  Pearson Chisq     Prob
Iteration

         1       3          .063    .9959           .054    .9967
0
         2       3         5.205    .1574          4.879    .1809
0
         3       1         3.355    .0670          3.317    .0686
0

* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * *

Backward Elimination (p = .050) for DESIGN 1 with generating class

  INCIDENT*WITNESS*DECISION

 Likelihood ratio chi square =       .00000    DF = 0  P = 1.000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


If Deleted Simple Effect is                      DF   L.R. Chisq Change
Prob  Iter

 INCIDENT*WITNESS*DECISION                        1              3.355
.0670     2

Step 1

  The best model has generating class

      INCIDENT*WITNESS
      INCIDENT*DECISION
      WITNESS*DECISION

  Likelihood ratio chi square =     3.35537    DF = 1  P =  .067

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - -


If Deleted Simple Effect is                      DF   L.R. Chisq Change
Prob  Iter

 INCIDENT*WITNESS                                 1               .005
.9417     2
 INCIDENT*DECISION                                1              5.142
.0234     2
 WITNESS*DECISION                                 1               .068
.7944     2

Step 2

  The best model has generating class

      INCIDENT*DECISION
      WITNESS*DECISION

  Likelihood ratio chi square =     3.36072    DF = 2  P =  .186
```

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - -

If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 INCIDENT*DECISION                              1              5.137
.0234     2
 WITNESS*DECISION                               1               .063
.8025     2
-

* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * * *
* * * *

Step 3

  The best model has generating class

      INCIDENT*DECISION
      WITNESS

  Likelihood ratio chi square =     3.42329    DF = 3  P =  .331

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If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 INCIDENT*DECISION                              1              5.137
.0234     2
 WITNESS                                        1               .000
1.0000     2

Step 4

  The best model has generating class

      INCIDENT*DECISION

  Likelihood ratio chi square =     3.42329    DF = 4  P =  .490

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If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 INCIDENT*DECISION                              1              5.137
.0234     2

Step 5

  The best model has generating class

      INCIDENT*DECISION

  Likelihood ratio chi square =     3.42329    DF = 4  P =  .490
```

```
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* * * * * * * * H I E R A R C H I C A L   L O G   L I N E A R * * * *
* * * *

The final model has generating class

    INCIDENT*DECISION

The Iterative Proportional Fit algorithm converged at iteration 0.
The maximum difference between observed and fitted marginal totals is
.000
and the convergence criterion is      .250

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- - - -


 Observed, Expected Frequencies and Residuals.

       Factor          Code            OBS count  EXP count  Residual
Std Resid


  INCIDENT        threat
   WITNESS         victim
    DECISION        correct                 8.0        8.0       .00
.00
    DECISION        incorrec                8.0        8.0       .00
.00
   WITNESS         bystande
    DECISION        correct                12.0       12.0       .00
.00
    DECISION        incorrec                4.0        4.0       .00
.00

  INCIDENT        control
   WITNESS         victim
    DECISION        correct                 7.0        7.0       .00
.00
    DECISION        incorrec                9.0        9.0       .00
.00
   WITNESS         bystande
    DECISION        correct                 4.0        4.0       .00
.00
    DECISION        incorrec               12.0       12.0       .00
.00

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 Goodness-of-fit test statistics

    Likelihood ratio chi square =      .00000    DF = 4  P = 1.000
             Pearson chi square =      .00000    DF = 4  P = 1.000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

CONTINGENCY TABLE: INCIDENT BY DECISION

incident * decision Crosstabulation

			decision		
			correct	incorrect	Total
incident	threat	Count	20	12	32
		Expected Count	15.5	16.5	32.0
	control	Count	11	21	32
		Expected Count	15.5	16.5	32.0
Total		Count	31	33	64
		Expected Count	31.0	33.0	64.0

LINEUP TWO

CONTINGENCY TABLE: INCIDENT BY WITNESS BY DECISION

decision * witness type * incident Crosstabulation

				witness type		
incident				victim	bystander	Total
threat	decision	correct	Count	5	2	7
			Expected Count	3.5	3.5	7.0
		incorrect	Count	11	14	25
			Expected Count	12.5	12.5	25.0
	Total		Count	16	16	32
			Expected Count	16.0	16.0	32.0
control	decision	correct	Count	4	4	8
			Expected Count	4.0	4.0	8.0
		incorrect	Count	12	12	24
			Expected Count	12.0	12.0	24.0
	Total		Count	16	16	32
			Expected Count	16.0	16.0	32.0

CONTINGENCY TABLE: INCIDENT BY DECISION

incident * decision Crosstabulation

			decision		
			correct	incorrect	Total
incident	threat	Count	7	25	32
		Expected Count	7.5	24.5	32.0
	control	Count	8	24	32
		Expected Count	7.5	24.5	32.0
Total		Count	15	49	64
		Expected Count	15.0	49.0	64.0

CHI-SQUARE TEST: INCIDENT BY DECISION

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.087[b]	1	.768		
Continuity Correction[a]	.000	1	1.000		
Likelihood Ratio	.087	1	.768		
Fisher's Exact Test				1.000	.500
Linear-by-Linear Association	.086	1	.770		
N of Valid Cases	64				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.50.

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL WITH IDENTIFICATION ACCURACY (CORRECT VS. INCORRECT)

POINT-BISERIAL CORRELATIONS (ACROSS THE THREAT GROUP WITNESSES) OF IDENTIFICATION ACCURACY WITH: THE STANDARDIZED RESIDUALS (TO TAKE ACCOUNT OF BASELINE VARIATION) OF HEART RATE DURING THE INCIDENT AND HEART RATE IMMEDIATELY FOLLOWING THE INCIDENT' AND 'RATED PERCEIVED THREAT DURING THE INCIDENT' AND 'RATED PERCEIVED CHANCE OF ATTACK DURING THE INCIDENT'

Identification Accuracy		Lineup 1 (Intruder 1)	Lineup 2 (intruder 2)
Threat During	Correlation	.030	-.113
	Sig. (2-tailed)	.871	.536
	N	32	32
Perceived Attack During	Correlation	.103	.165
	Sig. (2-tailed)	.574	.366
	N	32	32
Heart Rate During	Correlation	-.136	-.072
	Sig. (2-tailed)	.457	.696
	N	32	32
Heart Rate After	Correlation	.087	-.102
	Sig. (2-tailed)	.634	.579
	N	32	32

Appendix 11: Statistical Output - Exercise Bicycle Study

PHYSIOLOGICAL AROUSAL

Heart Rate During

- **Univariate Analysis of Variance (with baseline as co-variate)**

Tests of Between-Subjects Effects

Dependent Variable: DURING

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	81432.305[a]	4	20358.076	258.090	.000
Intercept	3745.732	1	3745.732	47.487	.000
BASELINE	6375.361	1	6375.361	80.824	.000
VIDEO	616.744	1	616.744	7.819	.007
AROUSAL	66033.480	1	66033.480	837.142	.000
VIDEO * AROUSAL	906.487	1	906.487	11.492	.001
Error	4653.899	59	78.880		
Total	866144.782	64			
Corrected Total	86086.203	63			

a. R Squared = .946 (Adjusted R Squared = .942)

- **Posthoc Tukey's Test - Interaction of video by arousal (computed using standardized residual values of the heart rate data in order to take account for baseline of participant's resting heart rate levels)**

Standardized Residual

Tukey HSD[a,b]

witnessing group	N	Subset 1	Subset 2	Subset 3
Control Rest	16	-.9322494		
Threat Rest	16	-.9295511		
Control Exercise	16		.7032888	
Threat Exercise	16			1.1585117
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 8.136E-02.

a. Uses Harmonic Mean Sample Size = 16.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: Standardized Residual
Tukey HSD

(I) witnessing group	(J) witnessing group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Threat Exercise	Threat Rest	2.0880628*	.1008433	.000	1.8215799	2.3545457
	Control Exercise	.4552230*	.1008433	.000	.1887401	.7217059
	Control Rest	2.0907611*	.1008433	.000	1.8242782	2.3572440
Threat Rest	Threat Exercise	-2.0880628*	.1008433	.000	-2.3545457	-1.8215799
	Control Exercise	-1.6328399*	.1008433	.000	-1.8993228	-1.3663570
	Control Rest	2.698E-03	.1008433	1.000	-.2637847	.2691812
Control Exercise	Threat Exercise	-.4552230*	.1008433	.000	-.7217059	-.1887401
	Threat Rest	1.6328399*	.1008433	.000	1.3663570	1.8993228
	Control Rest	1.6355381*	.1008433	.000	1.3690552	1.9020210
Control Rest	Threat Exercise	-2.0907611*	.1008433	.000	-2.3572440	-1.8242782
	Threat Rest	-2.698E-03	.1008433	1.000	-.2691812	.2637847
	Control Exercise	-1.6355381*	.1008433	.000	-1.9020210	-1.3690552

Based on observed means.

*. The mean difference is significant at the .05 level.

Heart Rate After

- **Univariate Analysis of Variance (with baseline as co-variate)**

Tests of Between-Subjects Effects

Dependent Variable: AFTER

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	79408.851[a]	4	19852.213	267.109	.000
Intercept	4260.933	1	4260.933	57.330	.000
BASELINE	5954.523	1	5954.523	80.117	.000
VIDEO	431.918	1	431.918	5.811	.019
AROUSAL	65336.104	1	65336.104	879.088	.000
VIDEO * AROUSAL	279.332	1	279.332	3.758	.057
Error	4385.035	59	74.323		
Total	879831.678	64			
Corrected Total	83793.886	63			

a. R Squared = .948 (Adjusted R Squared = .944)

SELF-REPORTED AROUSAL

STAI

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: stai state

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	516.625[a]	3	172.208	3.045	.036
Intercept	67340.250	1	67340.250	1190.765	.000
VIDEO	430.563	1	430.563	7.614	.008
AROUSAL	81.000	1	81.000	1.432	.236
VIDEO * AROUSAL	5.063	1	5.063	.090	.766
Error	3393.125	60	56.552		
Total	71250.000	64			
Corrected Total	3909.750	63			

a. R Squared = .132 (Adjusted R Squared = .089)

MacKay Arousal Scale

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: mackay arousal

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12.562[a]	3	4.187	1.306	.281
Intercept	885.063	1	885.063	276.043	.000
VIDEO	1.000	1	1.000	.312	.579
AROUSAL	10.563	1	10.563	3.294	.075
VIDEO * AROUSAL	1.000	1	1.000	.312	.579
Error	192.375	60	3.206		
Total	1090.000	64			
Corrected Total	204.937	63			

a. R Squared = .061 (Adjusted R Squared = .014)

MacKay Stress Scale

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: mackay stress

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10.875[a]	3	3.625	.867	.463
Intercept	156.250	1	156.250	37.369	.000
VIDEO	6.250E-02	1	6.250E-02	.015	.903
AROUSAL	.250	1	.250	.060	.808
VIDEO * AROUSAL	10.563	1	10.563	2.526	.117
Error	250.875	60	4.181		
Total	418.000	64			
Corrected Total	261.750	63			

a. R Squared = .042 (Adjusted R Squared = -.006)

Threat whilst watching

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: threatened whilst watching

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4.563[a]	3	1.521	1.463	.234
Intercept	189.063	1	189.063	181.864	.000
VIDEO	.000	1	.000	.000	1.000
AROUSAL	.563	1	.563	.541	.465
VIDEO * AROUSAL	4.000	1	4.000	3.848	.054
Error	62.375	60	1.040		
Total	256.000	64			
Corrected Total	66.938	63			

a. R Squared = .068 (Adjusted R Squared = .022)

Threat immediately following

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: threatened immediately after

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.000[a]	3	.333	.468	.706
Intercept	132.250	1	132.250	185.614	.000
VIDEO	.000	1	.000	.000	1.000
AROUSAL	.000	1	.000	.000	1.000
VIDEO * AROUSAL	1.000	1	1.000	1.404	.241
Error	42.750	60	.713		
Total	176.000	64			
Corrected Total	43.750	63			

a. R Squared = .023 (Adjusted R Squared = -.026)

Angry whilst watching

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: angry whilst watching

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.422[a]	3	.474	.887	.453
Intercept	97.516	1	97.516	182.485	.000
VIDEO	1.266	1	1.266	2.368	.129
AROUSAL	1.563E-02	1	1.563E-02	.029	.865
VIDEO * AROUSAL	.141	1	.141	.263	.610
Error	32.063	60	.534		
Total	131.000	64			
Corrected Total	33.484	63			

a. R Squared = .042 (Adjusted R Squared = -.005)

Angry immediately following

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: angry immediately after

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.547[a]	3	.182	.459	.712
Intercept	92.641	1	92.641	233.425	.000
VIDEO	1.563E-02	1	1.563E-02	.039	.843
AROUSAL	.141	1	.141	.354	.554
VIDEO * AROUSAL	.391	1	.391	.984	.325
Error	23.813	60	.397		
Total	117.000	64			
Corrected Total	24.359	63			

a. R Squared = .022 (Adjusted R Squared = -.026)

Afraid whilst watching

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: afraid whilst watching

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	3.375[a]	3	1.125	1.241	.303
Intercept	156.250	1	156.250	172.414	.000
VIDEO	.563	1	.563	.621	.434
AROUSAL	.563	1	.563	.621	.434
VIDEO * AROUSAL	2.250	1	2.250	2.483	.120
Error	54.375	60	.906		
Total	214.000	64			
Corrected Total	57.750	63			

a. R Squared = .058 (Adjusted R Squared = .011)

Afraid immediately following

Tests of Between-Subjects Effects

Dependent Variable: afraid immediately after

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.297[a]	3	.432	.859	.467
Intercept	97.516	1	97.516	193.820	.000
VIDEO	1.266	1	1.266	2.516	.118
AROUSAL	1.563E-02	1	1.563E-02	.031	.861
VIDEO * AROUSAL	1.563E-02	1	1.563E-02	.031	.861
Error	30.188	60	.503		
Total	129.000	64			
Corrected Total	31.484	63			

a. R Squared = .041 (Adjusted R Squared = -.007)

How arousing they found cycling/sitting

Tests of Between-Subjects Effects

Dependent Variable: how arousing cycling/sitting

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	26.250[a]	3	8.750	8.235	.000
Intercept	256.000	1	256.000	240.941	.000
VIDEO	1.000	1	1.000	.941	.336
AROUSAL	25.000	1	25.000	23.529	.000
VIDEO * AROUSAL	.250	1	.250	.235	.629
Error	63.750	60	1.063		
Total	346.000	64			
Corrected Total	90.000	63			

a. R Squared = .292 (Adjusted R Squared = .256)

How difficult they found cycling/sitting

Tests of Between-Subjects Effects

Dependent Variable: difficult cycling/sitting

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	32.500[a]	3	10.833	16.049	.000
Intercept	225.000	1	225.000	333.333	.000
VIDEO	.000	1	.000	.000	1.000
AROUSAL	30.250	1	30.250	44.815	.000
VIDEO * AROUSAL	2.250	1	2.250	3.333	.073
Error	40.500	60	.675		
Total	298.000	64			
Corrected Total	73.000	63			

a. R Squared = .445 (Adjusted R Squared = .417)

How stressful they found cycling/sitting

Tests of Between-Subjects Effects

Dependent Variable: stressful sitting/cycling

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14.687[a]	3	4.896	8.969	.000
Intercept	162.563	1	162.563	297.824	.000
VIDEO	6.250E-02	1	6.250E-02	.115	.736
AROUSAL	14.063	1	14.063	25.763	.000
VIDEO * AROUSAL	.563	1	.563	1.031	.314
Error	32.750	60	.546		
Total	210.000	64			
Corrected Total	47.437	63			

a. R Squared = .310 (Adjusted R Squared = .275)

How enjoyable they found cycling/sitting

Tests of Between-Subjects Effects

Dependent Variable: enjoyable sitting/cycling

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	14.750[a]	3	4.917	4.664	.005
Intercept	324.000	1	324.000	307.352	.000
VIDEO	.250	1	.250	.237	.628
AROUSAL	12.250	1	12.250	11.621	.001
VIDEO * AROUSAL	2.250	1	2.250	2.134	.149
Error	63.250	60	1.054		
Total	402.000	64			
Corrected Total	78.000	63			

a. R Squared = .189 (Adjusted R Squared = .149)

How difficult they found cycling whilst watching the video

Tests of Between-Subjects Effects

Dependent Variable: difficult cycling/sitting and watching

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	29.672[a]	3	9.891	5.975	.001
Intercept	260.016	1	260.016	157.089	.000
VIDEO	.391	1	.391	.236	.629
AROUSAL	28.891	1	28.891	17.454	.000
VIDEO * AROUSAL	.391	1	.391	.236	.629
Error	99.313	60	1.655		
Total	389.000	64			
Corrected Total	128.984	63			

a. R Squared = .230 (Adjusted R Squared = .192)

SELF-REPORTED ATTENTION

How much attention was devoted to cycling

Tests of Between-Subjects Effects

Dependent Variable: attention to sitting/cycling

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	30.797[a]	3	10.266	10.631	.000
Intercept	356.266	1	356.266	368.948	.000
VIDEO	1.563E-02	1	1.563E-02	.016	.899
AROUSAL	28.891	1	28.891	29.919	.000
VIDEO * AROUSAL	1.891	1	1.891	1.958	.167
Error	57.938	60	.966		
Total	445.000	64			
Corrected Total	88.734	63			

a. R Squared = .347 (Adjusted R Squared = .314)

How much attention was devoted to watching the video

Tests of Between-Subjects Effects

Dependent Variable: attention to video

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5.422[a]	3	1.807	1.042	.381
Intercept	669.516	1	669.516	386.027	.000
VIDEO	2.641	1	2.641	1.523	.222
AROUSAL	2.641	1	2.641	1.523	.222
VIDEO * AROUSAL	.141	1	.141	.081	.777
Error	104.063	60	1.734		
Total	779.000	64			
Corrected Total	109.484	63			

a. R Squared = .050 (Adjusted R Squared = .002)

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL

Heart Rate During

- **Spearman correlations (across the exercise group witnesses) of 'rated arousal whilst cycling' and 'rated attention devoted to watching the video' with the 'standardized residual (to take account of baseline variation) of heart rate during the video'**

Correlations

			Standardized Residual	how arousing cycling/sitting	attention to video
Spearman's rho	Standardized Residual	Correlation Coefficient	1.000	.027	-.011
		Sig. (2-tailed)	.	.882	.953
		N	32	32	32
	how arousing cycling/sitting	Correlation Coefficient	.027	1.000	.325
		Sig. (2-tailed)	.882	.	.070
		N	32	32	32
	attention to video	Correlation Coefficient	-.011	.325	1.000
		Sig. (2-tailed)	.953	.070	.
		N	32	32	32

Heart Rate After

- **Spearman correlations (across the exercise group witnesses) of 'rated arousal whilst cycling' and 'rated attention devoted to watching the video' with the 'standardized residual (to take account of baseline variation) of heart rate after the video'**

Correlations

			Standardized Residual	how arousing cycling/sitting	attention to video
Spearman's rho	Standardized Residual	Correlation Coefficient	1.000	.054	-.053
		Sig. (2-tailed)	.	.770	.775
		N	32	32	32
	how arousing cycling/sitting	Correlation Coefficient	.054	1.000	.325
		Sig. (2-tailed)	.770	.	.070
		N	32	32	32
	attention to video	Correlation Coefficient	-.053	.325	1.000
		Sig. (2-tailed)	.775	.070	.
		N	32	32	32

PERCENTAGE OF AVAILABLE DETAILS RECALLED

Free Recall

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total free recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	108.084[a]	3	36.028	1.995	.124
Intercept	8187.535	1	8187.535	453.303	.000
VIDEO	26.832	1	26.832	1.486	.228
AROUSAL	35.790	1	35.790	1.982	.164
VIDEO * AROUSAL	45.461	1	45.461	2.517	.118
Error	1083.716	60	18.062		
Total	9379.335	64			
Corrected Total	1191.800	63			

a. R Squared = .091 (Adjusted R Squared = .045)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	6700.623	1	6700.623	237.792	.000
INFO * VIDEO	Linear	31.156	1	31.156	1.106	.297
INFO * AROUSAL	Linear	14.587	1	14.587	.518	.475
INFO * VIDEO * AROUSAL	Linear	62.846	1	62.846	2.230	.141
Error(INFO)	Linear	1690.711	60	28.179		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	18550.510	1	18550.510	531.207	.000
VIDEO	114.856	1	114.856	3.289	.075
AROUSAL	81.074	1	81.074	2.322	.133
VIDEO * AROUSAL	111.508	1	111.508	3.193	.079
Error	2095.284	60	34.921		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	897.291	1	897.291	93.193	.000
INFO * VIDEO	Linear	174.892	1	174.892	18.164	.000
INFO * AROUSAL	Linear	7.772	1	7.772	.807	.373
INFO * VIDEO * AROUSAL	Linear	52.097	1	52.097	5.411	.023
Error(INFO)	Linear	577.698	60	9.628		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	14948.934	1	14948.934	436.311	.000
VIDEO	15.708	1	15.708	.458	.501
AROUSAL	59.569	1	59.569	1.739	.192
VIDEO * AROUSAL	66.875	1	66.875	1.952	.168
Error	2055.729	60	34.262		

- **Posthoc Tukey's Test - Interaction of information (Intruder 1 vs. Intruder 2) by video**

Int by video free recall prop

Tukey HSD[a,b]

group 2 way	N	Subset		
		1	2	3
Control Intruder 2	32	7.3406		
Threat Intruder 2	32	8.9778	8.9778	
Threat Intruder 1	32		11.9353	11.9353
Control Intruder 1	32			14.9738
Sig.		.516	.063	.053

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 22.740.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: Int by video free recall prop

Tukey HSD

(I) group 2 way	(J) group 2 way	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Threat Intruder 1	Control Intruder 1	-3.0384	1.1922	.053	-6.1011	2.425E-02
	Threat Intruder 2	2.9575	1.1922	.063	-.1052	6.0202
	Control Intruder 2	4.5947*	1.1922	.001	1.5320	7.6574
Control Intruder 1	Threat Intruder 1	3.0384	1.1922	.053	-2.4255E-02	6.1011
	Threat Intruder 2	5.9959*	1.1922	.000	2.9332	9.0586
	Control Intruder 2	7.6331*	1.1922	.000	4.5704	10.6958
Threat Intruder 2	Threat Intruder 1	-2.9575	1.1922	.063	-6.0202	.1052
	Control Intruder 1	-5.9959*	1.1922	.000	-9.0586	-2.9332
	Control Intruder 2	1.6372	1.1922	.516	-1.4255	4.6999
Control Intruder 2	Threat Intruder 1	-4.5947*	1.1922	.001	-7.6574	-1.5320
	Control Intruder 1	-7.6331*	1.1922	.000	-10.6958	-4.5704
	Threat Intruder 2	-1.6372	1.1922	.516	-4.6999	1.4255

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Posthoc Tukey's Test - Interaction of information (Intruder 1 vs. Intruder 2) by video by arousal (exercise vs. rest)**

int by video by exercise free recall prop

Tukey HSD[a,b]

Group 3 way	N	Subset		
		1	2	3
Control Exer Int 2	16	6.8200		
Control Rest Int 2	16	7.8613	7.8613	
Threat Exer Int 2	16	8.6269	8.6269	
Threat Rest Int 2	16	9.3288	9.3288	
Threat Rest Int 1	16	11.5031	11.5031	
Threat Exer Int 1	16		12.3675	12.3675
Control Exer Int 1	16		12.6844	12.6844
Control Rest Int 1	16			17.2631
Sig.		.098	.079	.071

Means for groups in homogeneous subsets are displayed.

Based on Type III Sum of Squares

The error term is Mean Square(Error) = 21.945.

a. Uses Harmonic Mean Sample Size = 16.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: int by video by exercise free recall prop

Tukey HSD

(I) Group 3 way	(J) Group 3 way	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Exer Int 1	Threat Rest Int 1	.8644	1.6562	1.000	-4.2454	5.9741
	Control Exer Int 1	-.3169	1.6562	1.000	-5.4266	4.7929
	Control Rest Int 1	-4.8956	1.6562	.071	-10.0054	.2141
	Threat Exer Int 2	3.7406	1.6562	.325	-1.3691	8.8504
	Threat Rest Int 2	3.0388	1.6562	.598	-2.0710	8.1485
	Control Exer Int 2	5.5475*	1.6562	.023	.4378	10.6572
	Control Rest Int 2	4.5063	1.6562	.126	-.6035	9.6160
Threat Rest Int 1	Threat Exer Int 1	-.8644	1.6562	1.000	-5.9741	4.2454
	Control Exer Int 1	-1.1812	1.6562	.996	-6.2910	3.9285
	Control Rest Int 1	-5.7600*	1.6562	.016	-10.8697	-.6503
	Threat Exer Int 2	2.8762	1.6562	.663	-2.2335	7.9860
	Threat Rest Int 2	2.1744	1.6562	.892	-2.9354	7.2841
	Control Exer Int 2	4.6831	1.6562	.098	-.4266	9.7929
	Control Rest Int 2	3.6419	1.6562	.360	-1.4679	8.7516
Control Exer Int 1	Threat Exer Int 1	.3169	1.6562	1.000	-4.7929	5.4266
	Threat Rest Int 1	1.1812	1.6562	.996	-3.9285	6.2910
	Control Rest Int 1	-4.5787	1.6562	.114	-9.6885	.5310
	Threat Exer Int 2	4.0575	1.6562	.228	-1.0522	9.1672
	Threat Rest Int 2	3.3556	1.6562	.469	-1.7541	8.4654
	Control Exer Int 2	5.8644*	1.6562	.013	.7546	10.9741
	Control Rest Int 2	4.8231	1.6562	.079	-.2866	9.9329
Control Rest Int 1	Threat Exer Int 1	4.8956	1.6562	.071	-.2141	10.0054
	Threat Rest Int 1	5.7600*	1.6562	.016	.6503	10.8697
	Control Exer Int 1	4.5787	1.6562	.114	-.5310	9.6885
	Threat Exer Int 2	8.6362*	1.6562	.000	3.5265	13.7460
	Threat Rest Int 2	7.9344*	1.6562	.000	2.8246	13.0441
	Control Exer Int 2	10.4431*	1.6562	.000	5.3334	15.5529
	Control Rest Int 2	9.4019*	1.6562	.000	4.2921	14.5116
Threat Exer Int 2	Threat Exer Int 1	-3.7406	1.6562	.325	-8.8504	1.3691
	Threat Rest Int 1	-2.8762	1.6562	.663	-7.9860	2.2335
	Control Exer Int 1	-4.0575	1.6562	.228	-9.1672	1.0522
	Control Rest Int 1	-8.6362*	1.6562	.000	-13.7460	-3.5265
	Threat Rest Int 2	-.7019	1.6562	1.000	-5.8116	4.4079
	Control Exer Int 2	1.8069	1.6562	.958	-3.3029	6.9166
	Control Rest Int 2	.7656	1.6562	1.000	-4.3441	5.8754
Threat Rest Int 2	Threat Exer Int 1	-3.0388	1.6562	.598	-8.1485	2.0710
	Threat Rest Int 1	-2.1744	1.6562	.892	-7.2841	2.9354
	Control Exer Int 1	-3.3556	1.6562	.469	-8.4654	1.7541
	Control Rest Int 1	-7.9344*	1.6562	.000	-13.0441	-2.8246
	Threat Exer Int 2	.7019	1.6562	1.000	-4.4079	5.8116
	Control Exer Int 2	2.5087	1.6562	.798	-2.6010	7.6185
	Control Rest Int 2	1.4675	1.6562	.987	-3.6422	6.5772
Control Exer Int 2	Threat Exer Int 1	-5.5475*	1.6562	.023	-10.6572	-.4378
	Threat Rest Int 1	-4.6831	1.6562	.098	-9.7929	.4266
	Control Exer Int 1	-5.8644*	1.6562	.013	-10.9741	-.7546
	Control Rest Int 1	-10.4431*	1.6562	.000	-15.5529	-5.3334
	Threat Exer Int 2	-1.8069	1.6562	.958	-6.9166	3.3029
	Threat Rest Int 2	-2.5087	1.6562	.798	-7.6185	2.6010
	Control Rest Int 2	-1.0412	1.6562	.998	-6.1510	4.0685
Control Rest Int 2	Threat Exer Int 1	-4.5063	1.6562	.126	-9.6160	.6035
	Threat Rest Int 1	-3.6419	1.6562	.360	-8.7516	1.4679
	Control Exer Int 1	-4.8231	1.6562	.079	-9.9329	.2866
	Control Rest Int 1	-9.4019*	1.6562	.000	-14.5116	-4.2921
	Threat Exer Int 2	-.7656	1.6562	1.000	-5.8754	4.3441
	Threat Rest Int 2	-1.4675	1.6562	.987	-6.5772	3.6422
	Control Exer Int 2	1.0412	1.6562	.998	-4.0685	6.1510

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	6319.85	2	3159.92	77.48	.000
INFO * VIDEO	3.46	2	1.73	.04	.958
INFO * AROUSAL	25.24	2	12.62	.31	.734
INFO * VIDEO * AROUS	112.25	2	56.12	1.38	.257
Error(INFO)	4894.09	120	40.78		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	29256.663	1	29256.663	517.596	.000
VIDEO	63.411	1	63.411	1.122	.294
AROUSAL	113.868	1	113.868	2.014	.161
VIDEO * AROUSAL	185.496	1	185.496	3.282	.075
Error	3391.450	60	56.524		

Cued Recall

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total free recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	108.084[a]	3	36.028	1.995	.124
Intercept	8187.535	1	8187.535	453.303	.000
VIDEO	26.832	1	26.832	1.486	.228
AROUSAL	35.790	1	35.790	1.982	.164
VIDEO * AROUSAL	45.461	1	45.461	2.517	.118
Error	1083.716	60	18.062		
Total	9379.335	64			
Corrected Total	1191.800	63			

a. R Squared = .091 (Adjusted R Squared = .045)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	519.870	1	519.870	37.454	.000
INFO * VIDEO	Linear	33.825	1	33.825	2.437	.124
INFO * AROUSAL	Linear	.230	1	.230	.017	.898
INFO * VIDEO * AROUSAL	Linear	3.843	1	3.843	.277	.601
Error(INFO)	Linear	832.806	60	13.880		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	7454.816	1	7454.816	289.596	.000
VIDEO	2.808	1	2.808	.109	.742
AROUSAL	36.061	1	36.061	1.401	.241
VIDEO * AROUSAL	6.873	1	6.873	.267	.607
Error	1544.527	60	25.742		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	2.850	1	2.850	.237	.628
INFO * VIDEO	Linear	2.959	1	2.959	.246	.622
INFO * AROUSAL	Linear	64.838	1	64.838	5.383	.024
INFO * VIDEO * AROUSAL	Linear	4.198	1	4.198	.349	.557
Error(INFO)	Linear	722.683	60	12.045		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	8678.702	1	8678.702	303.361	.000
VIDEO	5.823	1	5.823	.204	.654
AROUSAL	21.962	1	21.962	.768	.384
VIDEO * AROUSAL	2.767	1	2.767	.097	.757
Error	1716.509	60	28.608		

- **Posthoc Tukey's Test - Interaction of information (intruder 1 vs. intruder 2) by arousal (exercise vs. rest)**

int by exercise cued recall prop

Tukey HSD[a,b]

group 2 way	N	Subset 1
Rest Intruder 1	32	7.2575
Exer Intruder 2	32	7.7875
Rest Intruder 2	32	8.3825
Exer Intruder 1	32	9.5094
Sig.		.179

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 19.798.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: int by exercise cued recall prop
Tukey HSD

(I) group 2 way	(J) group 2 way	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Exer Intruder 1	Rest Intruder 1	2.2519	1.1124	.179	-.6058	5.1096
	Exer Intruder 2	1.7219	1.1124	.409	-1.1358	4.5796
	Rest Intruder 2	1.1269	1.1124	.742	-1.7308	3.9846
Rest Intruder 1	Exer Intruder 1	-2.2519	1.1124	.179	-5.1096	.6058
	Exer Intruder 2	-.5300	1.1124	.964	-3.3877	2.3277
	Rest Intruder 2	-1.1250	1.1124	.743	-3.9827	1.7327
Exer Intruder 2	Exer Intruder 1	-1.7219	1.1124	.409	-4.5796	1.1358
	Rest Intruder 1	.5300	1.1124	.964	-2.3277	3.3877
	Rest Intruder 2	-.5950	1.1124	.951	-3.4527	2.2627
Rest Intruder 2	Exer Intruder 1	-1.1269	1.1124	.742	-3.9846	1.7308
	Rest Intruder 1	1.1250	1.1124	.743	-1.7327	3.9827
	Exer Intruder 2	.5950	1.1124	.951	-2.2627	3.4527

Based on observed means.

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	1777.67	2	888.83	32.20	.000
INFO * VIDEO	136.02	2	68.01	2.46	.089
INFO * AROUSAL	30.57	2	15.29	.55	.576
INFO * VIDEO * AROUS	4.75	2	2.38	.09	.918
Error(INFO)	3312.91	120	27.61		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	11286.253	1	11286.253	269.751	.000
VIDEO	.780	1	.780	.019	.892
AROUSAL	42.394	1	42.394	1.013	.318
VIDEO * AROUSAL	5.796	1	5.796	.139	.711
Error	2510.370	60	41.840		

Total Recall (Free + Cued)

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total both recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	42.217[a]	3	14.072	.349	.790
Intercept	24548.622	1	24548.622	608.673	.000
VIDEO	14.421	1	14.421	.358	.552
AROUSAL	2.395	1	2.395	.059	.808
VIDEO * AROUSAL	25.402	1	25.402	.630	.431
Error	2419.881	60	40.331		
Total	27010.721	64			
Corrected Total	2462.099	63			

a. R Squared = .017 (Adjusted R Squared = -.032)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	3487.064	1	3487.064	103.163	.000
INFO * VIDEO	Linear	129.826	1	129.826	3.841	.055
INFO * AROUSAL	Linear	18.506	1	18.506	.547	.462
INFO * VIDEO * AROUSAL	Linear	35.585	1	35.585	1.053	.309
Error(INFO)	Linear	2028.092	60	33.802		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	49525.519	1	49525.519	636.559	.000
VIDEO	81.744	1	81.744	1.051	.309
AROUSAL	9.037	1	9.037	.116	.734
VIDEO * AROUSAL	63.099	1	63.099	.811	.371
Error	4668.119	60	77.802		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	1001.225	1	1001.225	54.994	.000
INFO * VIDEO	Linear	223.793	1	223.793	12.292	.001
INFO * AROUSAL	Linear	27.779	1	27.779	1.526	.222
INFO * VIDEO * AROUSAL	Linear	26.782	1	26.782	1.471	.230
Error(INFO)	Linear	1092.365	60	18.206		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	46406.192	1	46406.192	589.155	.000
VIDEO	2.373	1	2.373	.030	.863
AROUSAL	9.240	1	9.240	.117	.733
VIDEO * AROUSAL	42.332	1	42.332	.537	.466
Error	4726.046	60	78.767		

- **Posthoc Tukey's Test - Interaction of information (Intruder 1 vs. Intruder 2) by video**

int by video both recall prop

Tukey HSD[a,b]

group 2 way	N	Subset 1	Subset 2	Subset 3
Control Intruder 2	32	15.0578		
Threat Intruder 2	32	17.4300	17.4300	
Threat Intruder 1	32		20.3791	20.3791
Control Intruder 1	32			23.2959
Sig.		.517	.320	.330

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 47.779.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: int by video both recall prop
Tukey HSD

(I) group 2 way	(J) group 2 way	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Threat Intruder 1	Control Intruder 1	-2.9169	1.7281	.330	-7.3563	1.5225
	Threat Intruder 2	2.9491	1.7281	.320	-1.4904	7.3885
	Control Intruder 2	5.3213*	1.7281	.011	.8818	9.7607
Control Intruder 1	Threat Intruder 1	2.9169	1.7281	.330	-1.5225	7.3563
	Threat Intruder 2	5.8659*	1.7281	.004	1.4265	10.3054
	Control Intruder 2	8.2381*	1.7281	.000	3.7987	12.6775
Threat Intruder 2	Threat Intruder 1	-2.9491	1.7281	.320	-7.3885	1.4904
	Control Intruder 1	-5.8659*	1.7281	.004	-10.3054	-1.4265
	Control Intruder 2	2.3722	1.7281	.517	-2.0672	6.8116
Control Intruder 2	Threat Intruder 1	-5.3213*	1.7281	.011	-9.7607	-.8818
	Control Intruder 1	-8.2381*	1.7281	.000	-12.6775	-3.7987
	Threat Intruder 2	-2.3722	1.7281	.517	-6.8116	2.0672

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	2693.71	2	1346.86	21.20	.000
INFO * VIDEO	126.90	2	63.45	1.00	.371
INFO * AROUSAL	57.43	2	28.71	.45	.637
INFO * VIDEO * AROUS	160.75	2	80.37	1.27	.286
Error(INFO)	7623.33	120	63.53		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	76883.623	1	76883.623	617.437	.000
VIDEO	50.092	1	50.092	.402	.528
AROUSAL	17.370	1	17.370	.139	.710
VIDEO * AROUSAL	125.728	1	125.728	1.010	.319
Error	7471.230	60	124.520		

CORRELATION OF PHYSIOLOGICAL/PSYCHOLOGICAL AROUSAL WITH PERCENTAGE OF AVAILABLE DETAILS RECALLED

- **Pearson & Spearman correlations (across exercise group witnesses) of the various measures of percentage of available details recalled with: the standardized residuals (to take account of baseline variation) of heart rate during the video and heart rate immediately following the video as well as rated arousal whilst cycling.**

Percentage of Available Details: Free Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Arousal Whilst Cycling *SPEARMAN*
Overall	Correlation	.243	.294	.313
	Sig. (2-tailed)	.180	.102	.081
	N	32	32	32
Central	Correlation	.211	.281	.294
	Sig. (2-tailed)	.247	.120	.103
	N	32	32	32
Peripheral	Correlation	.098	.111	.066
	Sig. (2-tailed)	.593	.547	.720
	N	32	32	32
Intruder 1	Correlation	.259	.342	.170
	Sig. (2-tailed)	.153	.055	.353
	N	32	32	32
Intruder 2	Correlation	.134	.102	.284
	Sig. (2-tailed)	.465	.578	.115
	N	32	32	32
Action	Correlation	.081	.176	.395*
	Sig. (2-tailed)	.661	.335	.025
	N	32	32	32
Verbal	Correlation	.268	.212	.080
	Sig. (2-tailed)	.138	.244	.663
	N	32	32	32
Appearance	Correlation	.137	.181	.107
	Sig. (2-tailed)	.456	.322	.560
	N	32	32	32

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01level (2-tailed)

Percentage of Available Details: Cued Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Arousal Whilst Cycling *SPEARMAN*
Overall	Correlation	.327	.359*	.305
	Sig. (2-tailed)	.068	.043	.089
	N	32	32	32
Central	Correlation	-.009	.009	.098
	Sig. (2-tailed)	.959	.961	.595
	N	32	32	32
Peripheral	Correlation	.445*	.474*	.360*
	Sig. (2-tailed)	.011	.006	.043
	N	32	32	32
Intruder 1	Correlation	.219	.236	.071
	Sig. (2-tailed)	.228	.193	.700
	N	32	32	32
Intruder 2	Correlation	.393*	.439*	.408*
	Sig. (2-tailed)	.026	.012	.020
	N	32	32	32
Action	Correlation	.156	.163	.033
	Sig. (2-tailed)	.394	.371	.857
	N	32	32	32
Verbal	Correlation	.018	.062	.215
	Sig. (2-tailed)	.922	.735	.238
	N	32	32	32
Appearance	Correlation	.410*	.429*	.277
	Sig. (2-tailed)	.020	.014	.125
	N	32	32	32

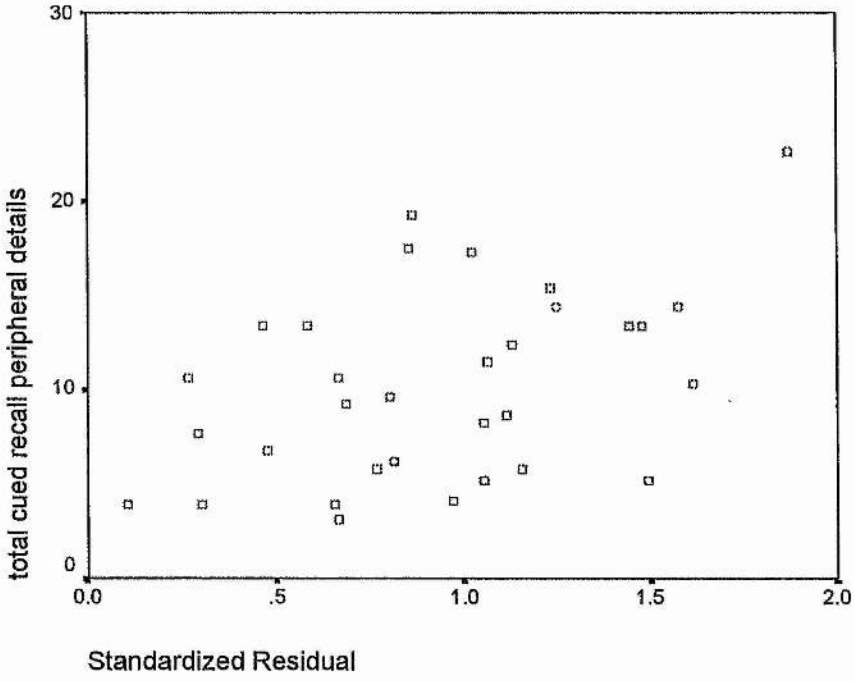
Percentage of Available Details: Total (Both) Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Arousal Whilst Cycling *SPEARMAN*
Overall	Correlation	.350*	.402*	.397*
	Sig. (2-tailed)	.050	.023	.025
	N	32	32	32
Central	Correlation	.154	.216	.286
	Sig. (2-tailed)	.401	.236	.112
	N	32	32	32
Peripheral	Correlation	.411*	.442*	.344
	Sig. (2-tailed)	.019	.011	.054
	N	32	32	32
Intruder 1	Correlation	.312	.380*	.193
	Sig. (2-tailed)	.082	.032	.289
	N	32	32	32
Intruder 2	Correlation	.346	.358*	.416*
	Sig. (2-tailed)	.052	.044	.018
	N	32	32	32
Action	Correlation	.150	.223	.320
	Sig. (2-tailed)	.412	.221	.074
	N	32	32	32

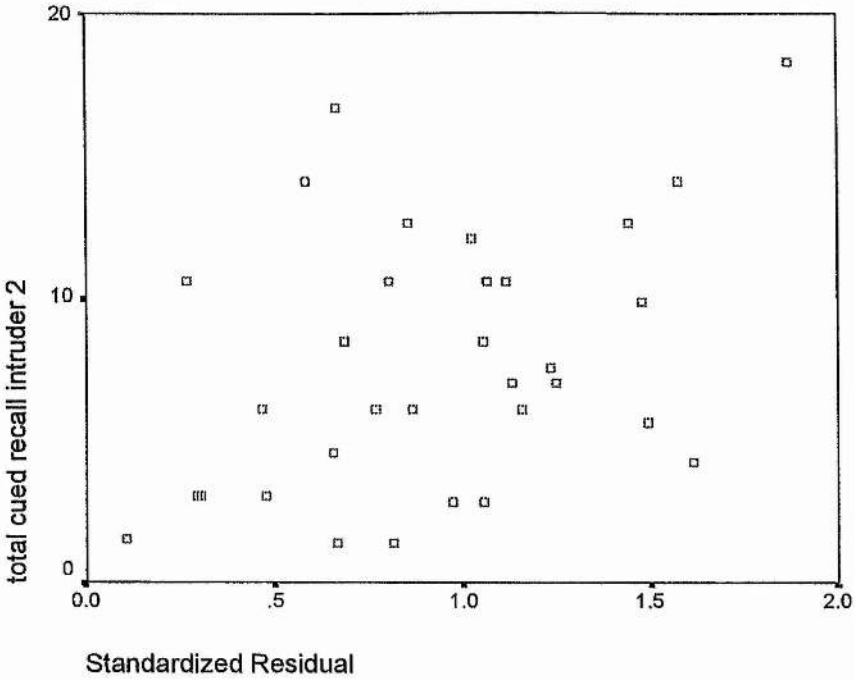
Verbal	Correlation	.195	.184	.146
	Sig. (2-tailed)	.284	.314	.426
	N	32	32	32
Appearance	Correlation	.384*	.430*	.210
	Sig. (2-tailed)	.030	.014	.248
	N	32	32	32

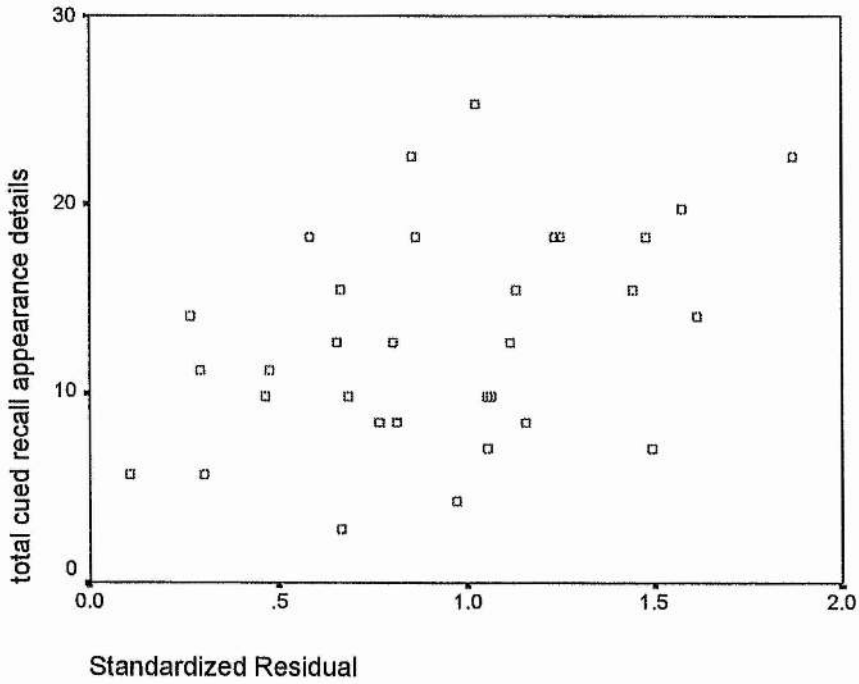
* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01level (2-tailed)

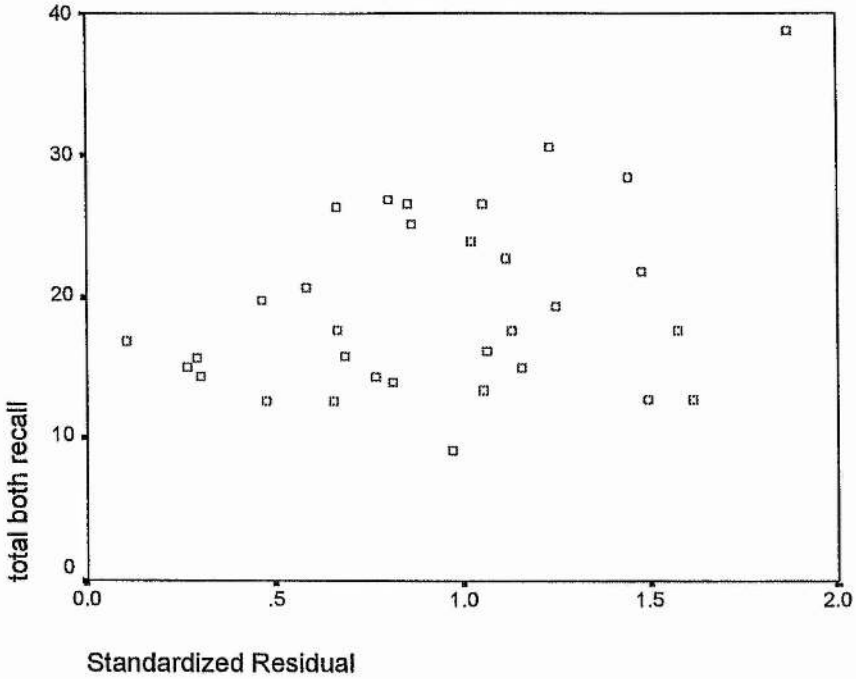
Scatterplots for significant correlations from above:

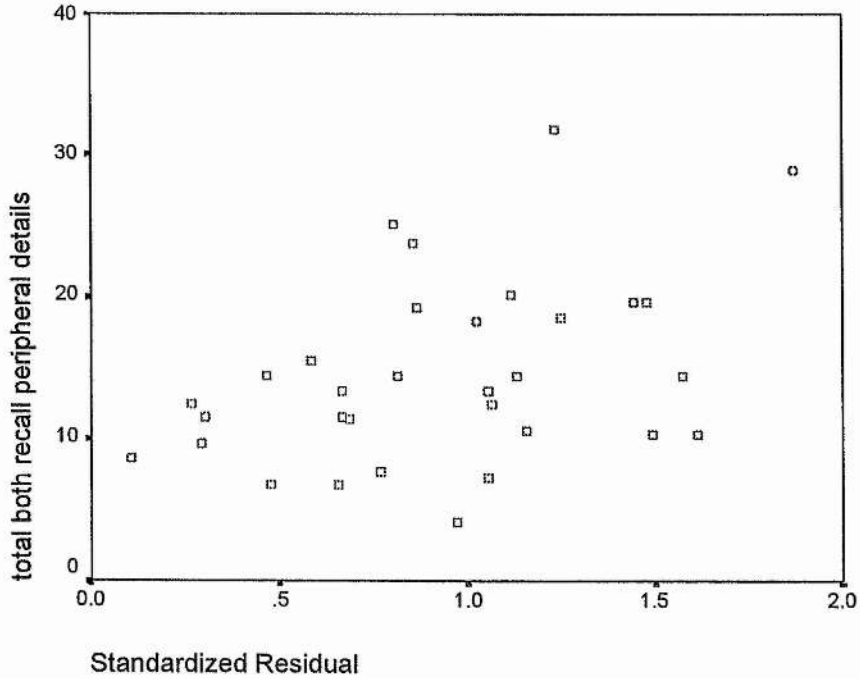
Heart Rate During:

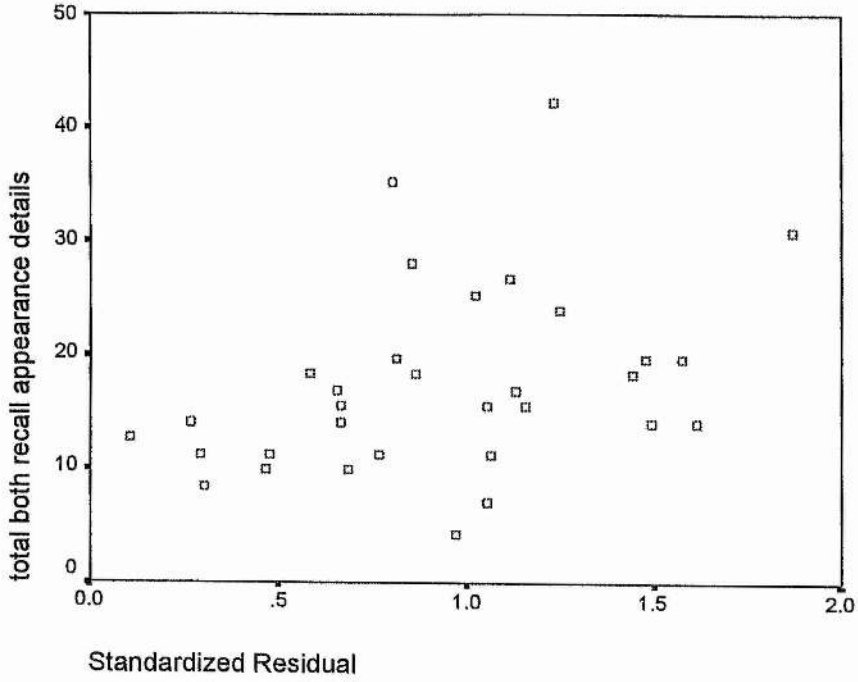



total cued recall intruder 2
20
10
0
0.0
.5
1.0
1.5
2.0
Standardized Residual

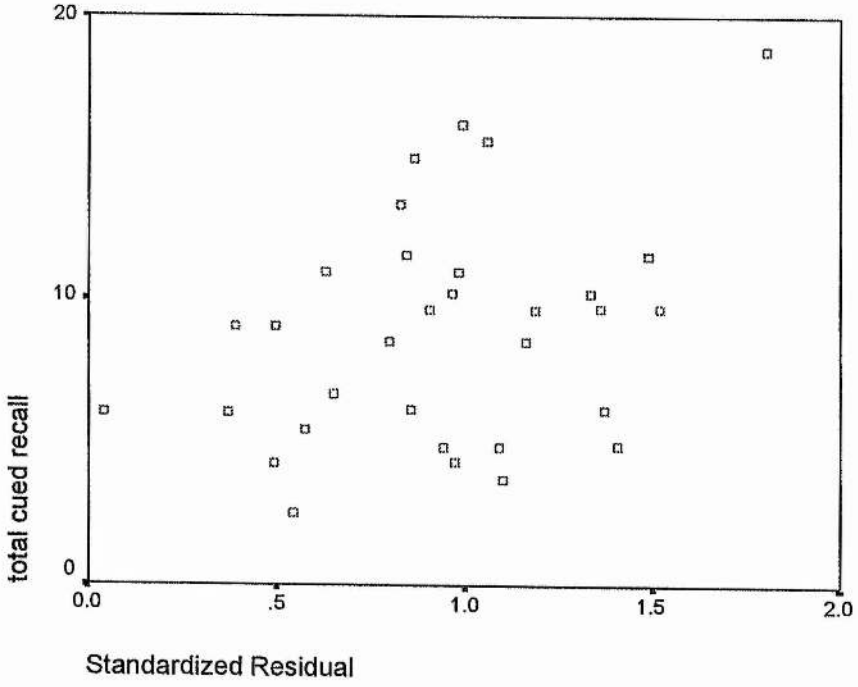

total cued recall appearance details
30
20
10
0
0.0
.5
1.0
1.5
2.0
Standardized Residual

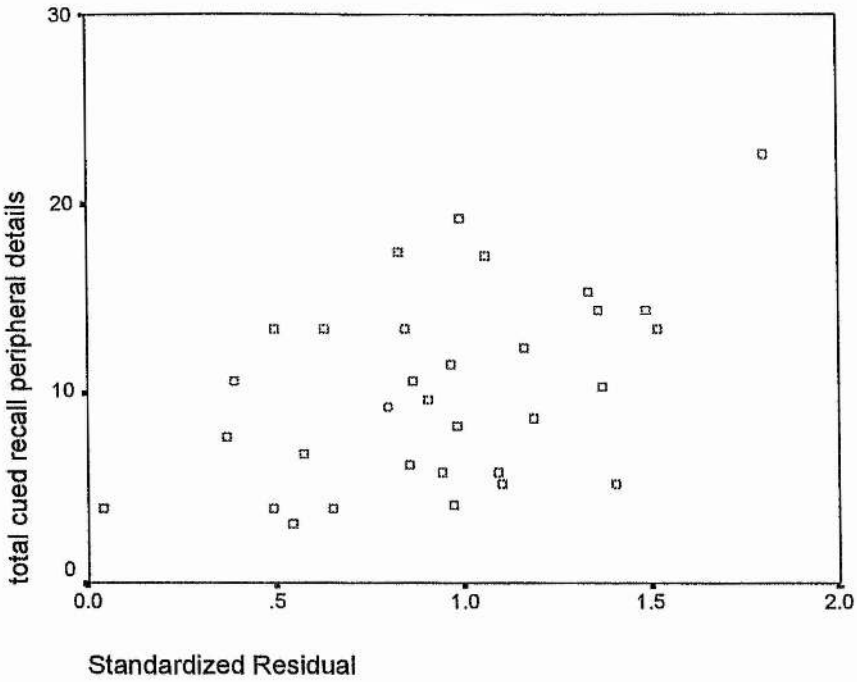

40
30
20
10
0
total both recall
0.0
.5
1.0
1.5
2.0
Standardized Residual

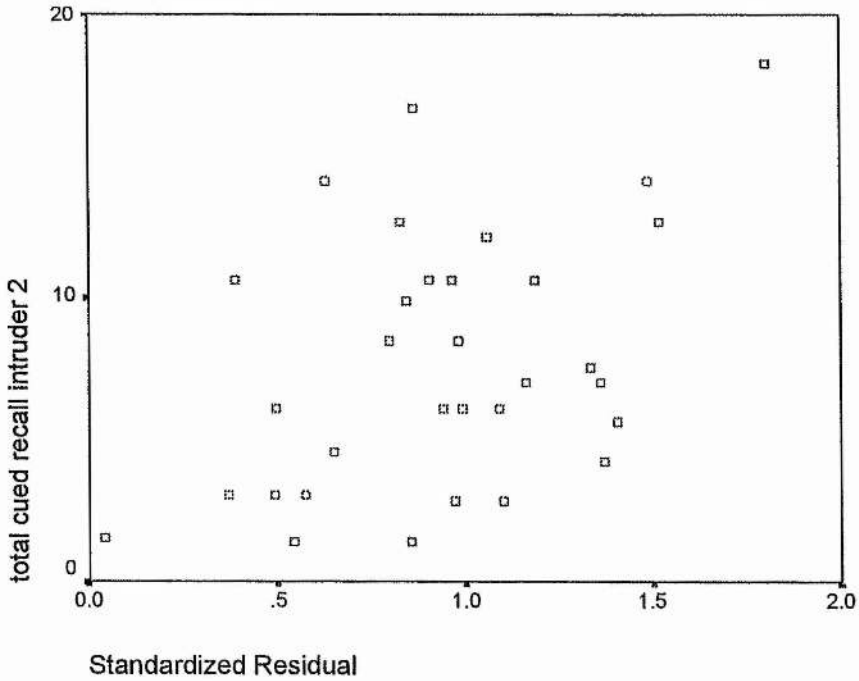

40
30
20
10
0
total both recall peripheral details
0.0
.5
1.0
1.5
2.0
Standardized Residual

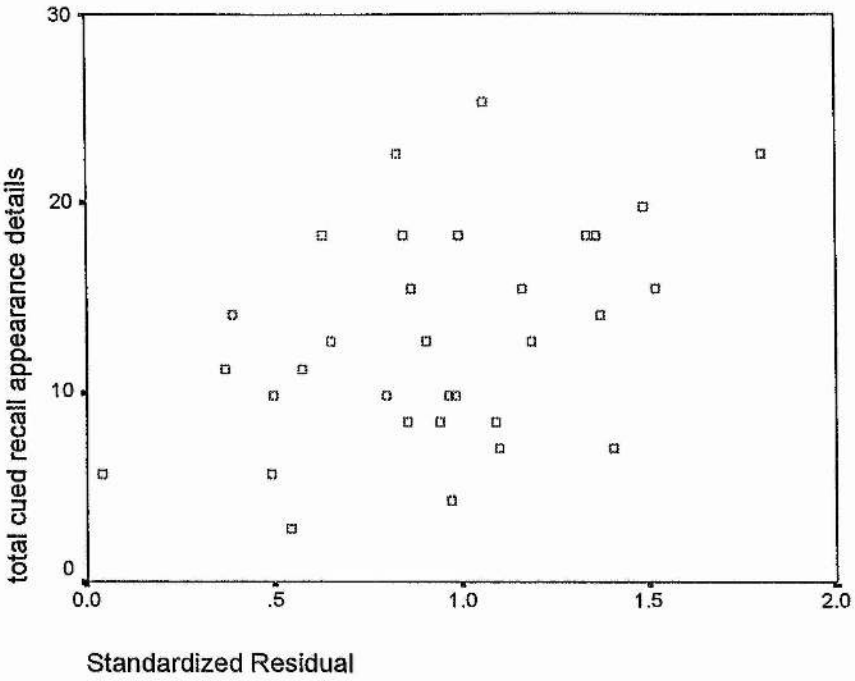


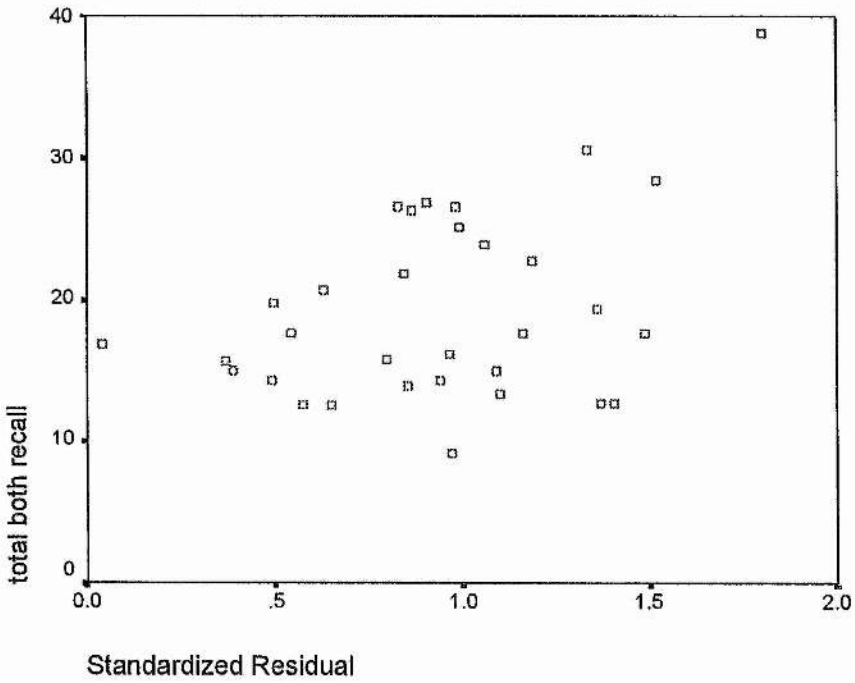
Heart Rate After:

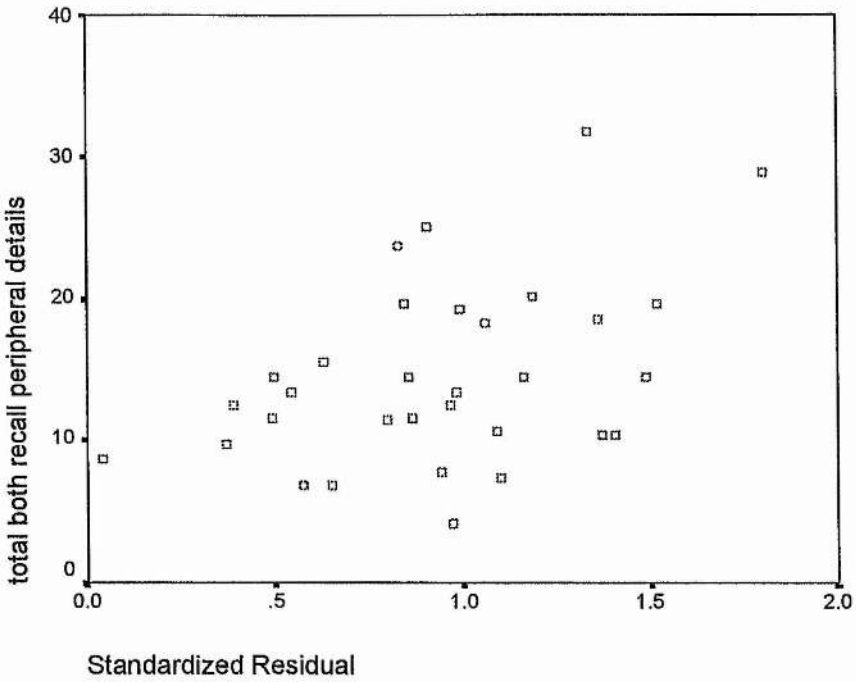


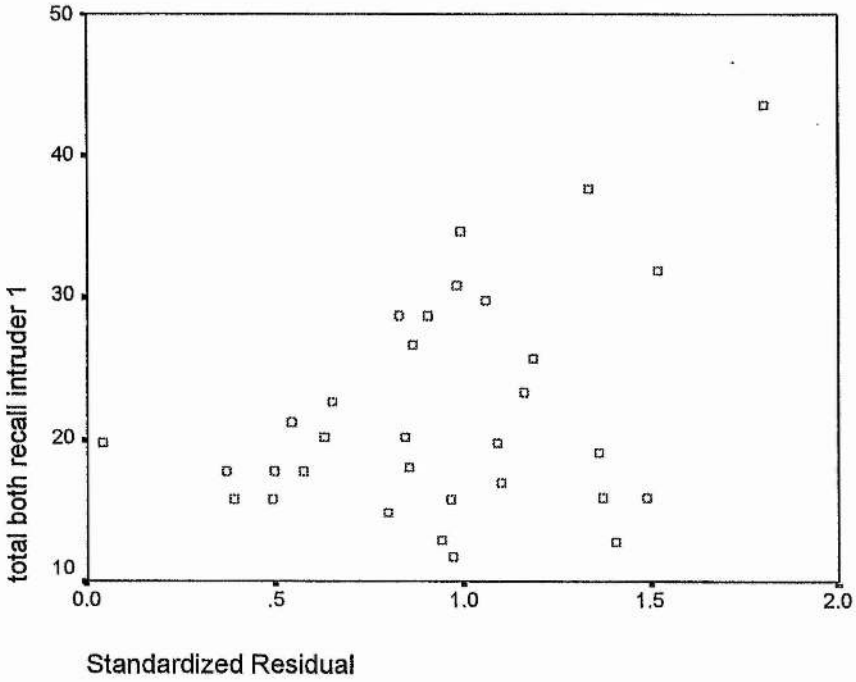

30
20
10
0
total cued recall peripheral details
0.0
.5
1.0
1.5
2.0
Standardized Residual

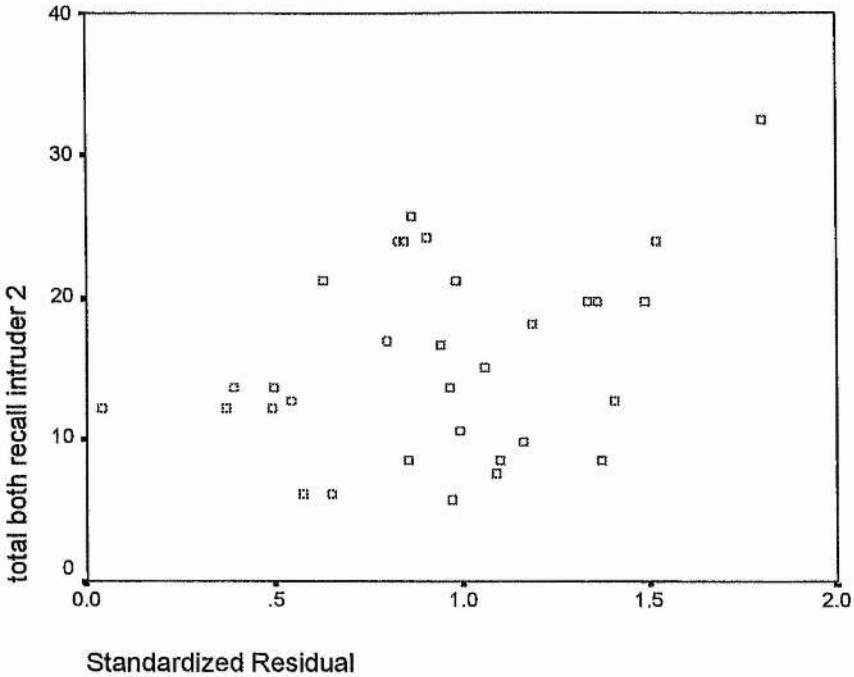

20
10
0
total cued recall intruder 2
0.0
.5
1.0
1.5
2.0
Standardized Residual

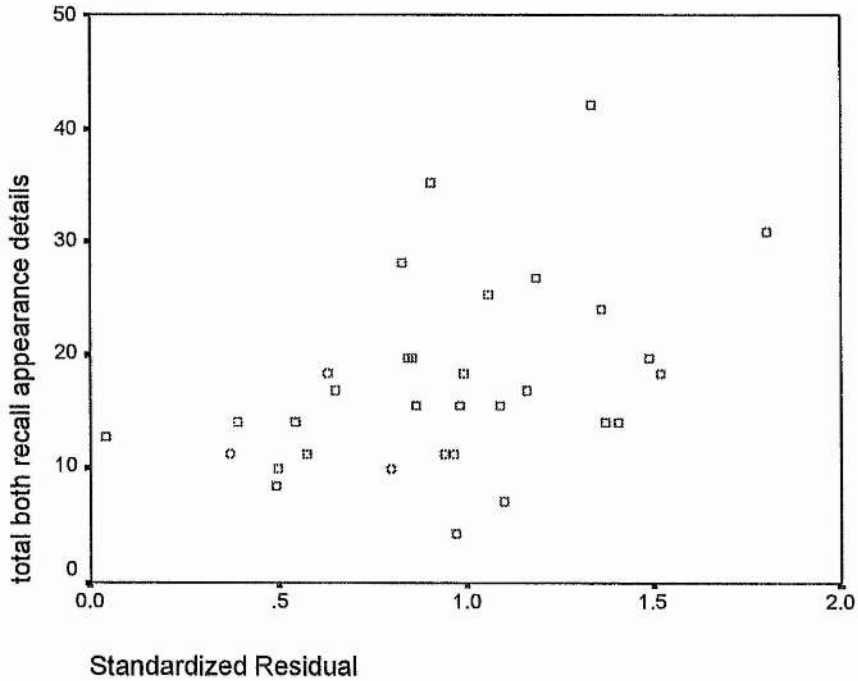

total cued recall appearance details
30
20
10
0
0.0
.5
1.0
1.5
2.0
Standardized Residual


total both recall
40
30
20
10
0
0.0
.5
1.0
1.5
2.0
Standardized Residual

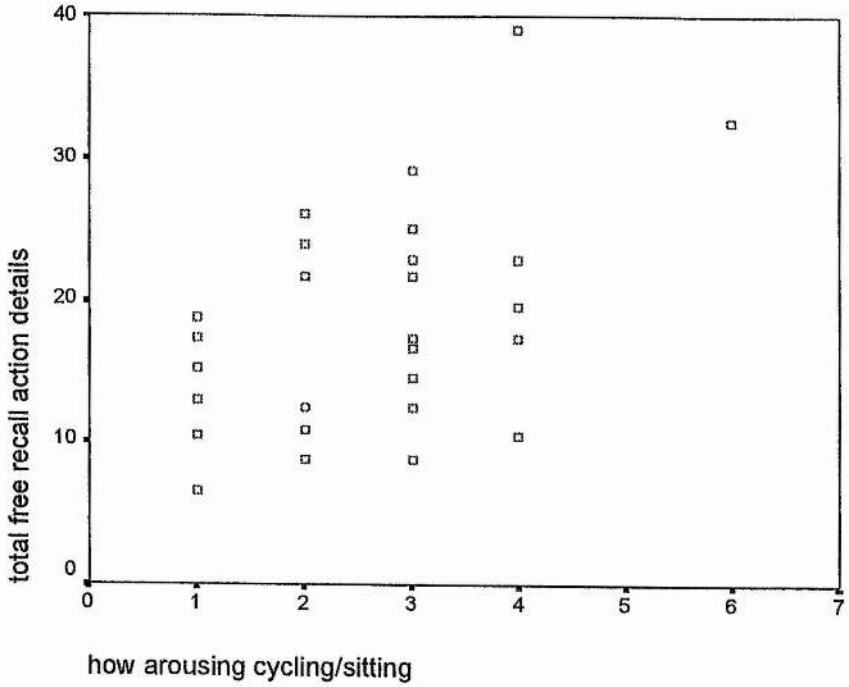

total both recall peripheral details
40
30
20
10
0
0.0
.5
1.0
1.5
2.0
Standardized Residual

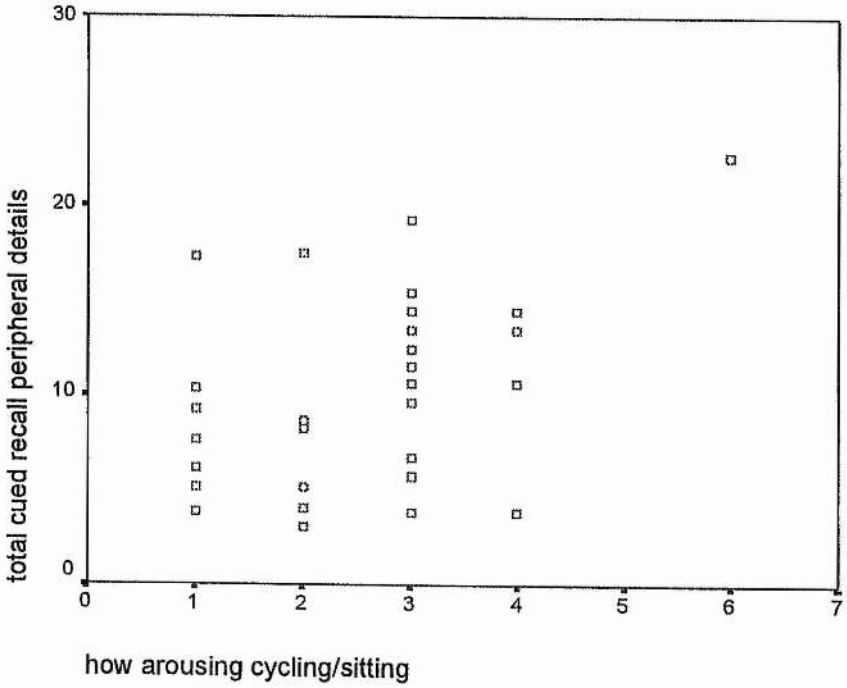

total both recall intruder 1
50
40
30
20
10
0.0
.5
1.0
1.5
2.0
Standardized Residual

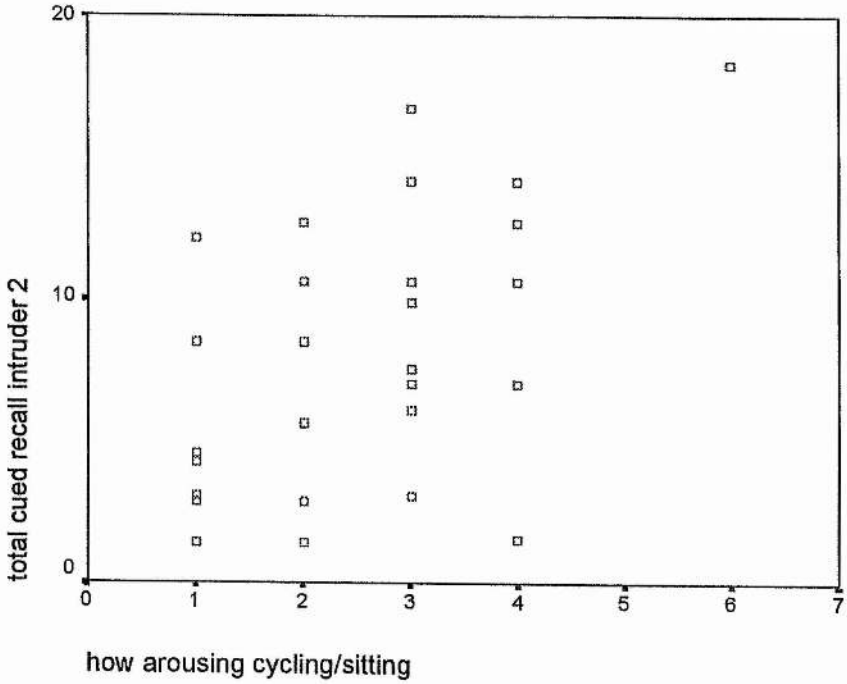


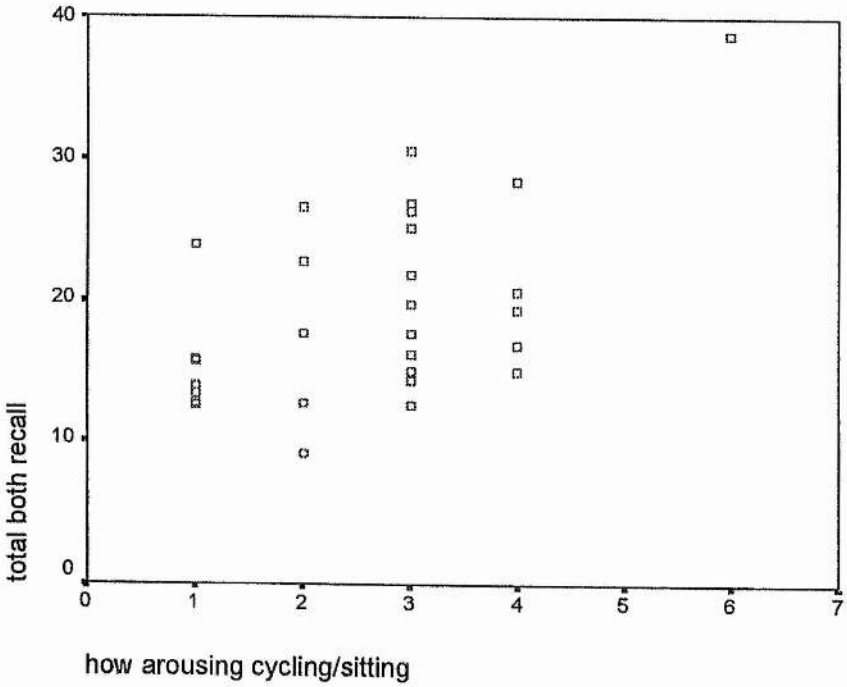


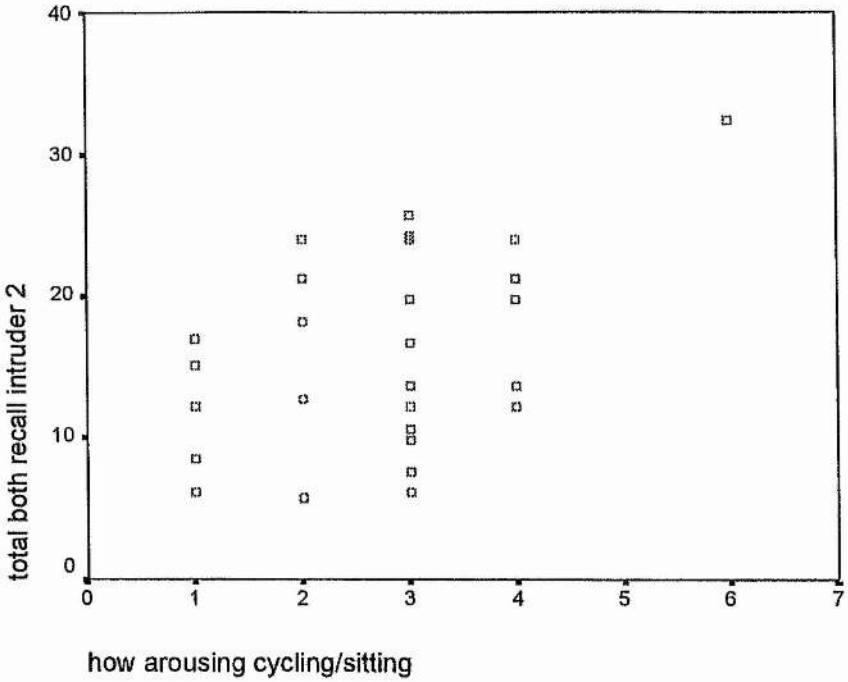
Rated Arousal Whilst Cycling:


total free recall action details
how arousing cycling/sitting
0
10
20
30
40
0
1
2
3
4
5
6
7


total cued recall peripheral details
how arousing cycling/sitting
0
10
20
30
0
1
2
3
4
5
6
7


total cued recall intruder 2
20
10
0
0
1
2
3
4
5
6
7
how arousing cycling/sitting


total both recall
40
30
20
10
0
0
1
2
3
4
5
6
7
how arousing cycling/sitting



ACCURACY OF RECALL

Free Recall

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total free recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	70.403[a]	3	23.468	.316	.814
Intercept	515708.902	1	515708.902	6947.806	.000
VIDEO	69.535	1	69.535	.937	.337
AROUSAL	.131	1	.131	.002	.967
VIDEO * AROUSAL	.737	1	.737	.010	.921
Error	4453.569	60	74.226		
Total	520232.874	64			
Corrected Total	4523.972	63			

a. R Squared = .016 (Adjusted R Squared = -.034)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	12137.930	1	12137.930	29.316	.000
INFO * VIDEO	Linear	87.986	1	87.986	.213	.647
INFO * AROUSAL	Linear	427.760	1	427.760	1.033	.314
INFO * VIDEO * AROUSAL	Linear	610.032	1	610.032	1.473	.231
Error(INFO)	Linear	20287.752	49	414.036		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	732957.050	1	732957.050	1911.587	.000
VIDEO	315.517	1	315.517	.823	.369
AROUSAL	176.516	1	176.516	.460	.501
VIDEO * AROUSAL	464.540	1	464.540	1.212	.276
Error	18787.995	49	383.428		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	2539.885	1	2539.885	17.574	.000
INFO * VIDEO	Linear	53.665	1	53.665	.371	.545
INFO * AROUSAL	Linear	48.216	1	48.216	.334	.566
INFO * VIDEO * AROUSAL	Linear	832.626	1	832.626	5.761	.020
Error(INFO)	Linear	8671.597	60	144.527		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	998651.914	1	998651.914	5165.892	.000
VIDEO	100.643	1	100.643	.521	.473
AROUSAL	30.949	1	30.949	.160	.690
VIDEO * AROUSAL	278.716	1	278.716	1.442	.235
Error	11598.988	60	193.316		

- **Posthoc Tukey's Test - Interaction of info (Central vs Peripheral) by video by arousal**

int by video by exercise free recall acc

Tukey HSD[a,b]

Group 3 way	N	Subset	
		1	2
Threat Rest Int 2	16	79.4194	
Control Exer Int 2	16	80.2769	80.2769
Threat Exer Int 2	16	85.2606	85.2606
Control Rest Int 2	16	90.5400	90.5400
Threat Exer Int 1	16	91.5913	91.5913
Control Rest Int 1	16	91.8256	91.8256
Threat Rest Int 1	16	93.4969	93.4969
Control Exer Int 1	16		94.2194
Sig.		.053	.057

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 168.922.

a. Uses Harmonic Mean Sample Size = 16.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: int by video by exercise free recall acc

Tukey HSD

(I) Group 3 way	(J) Group 3 way	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Threat Exer Int 1	Threat Rest Int 1	-1.9056	4.5951	1.000	-16.0822	12.2710
	Control Exer Int 1	-2.6281	4.5951	.999	-16.8047	11.5485
	Control Rest Int 1	-.2344	4.5951	1.000	-14.4110	13.9422
	Threat Exer Int 2	6.3306	4.5951	.866	-7.8460	20.5072
	Threat Rest Int 2	12.1719	4.5951	.149	-2.0047	26.3485
	Control Exer Int 2	11.3144	4.5951	.222	-2.8622	25.4910
	Control Rest Int 2	1.0513	4.5951	1.000	-13.1253	15.2278
Threat Rest Int 1	Threat Exer Int 1	1.9056	4.5951	1.000	-12.2710	16.0822
	Control Exer Int 1	-.7225	4.5951	1.000	-14.8991	13.4541
	Control Rest Int 1	1.6713	4.5951	1.000	-12.5053	15.8478
	Threat Exer Int 2	8.2363	4.5951	.626	-5.9403	22.4128
	Threat Rest Int 2	14.0775	4.5951	.053	-9.9085E-02	28.2541
	Control Exer Int 2	13.2200	4.5951	.087	-.9566	27.3966
	Control Rest Int 2	2.9569	4.5951	.998	-11.2197	17.1335
Control Exer Int 1	Threat Exer Int 1	2.6281	4.5951	.999	-11.5485	16.8047
	Threat Rest Int 1	.7225	4.5951	1.000	-13.4541	14.8991
	Control Rest Int 1	2.3937	4.5951	1.000	-11.7828	16.5703
	Threat Exer Int 2	8.9587	4.5951	.520	-5.2178	23.1353
	Threat Rest Int 2	14.8000*	4.5951	.034	.6234	28.9766
	Control Exer Int 2	13.9425	4.5951	.057	-.2341	28.1191
	Control Rest Int 2	3.6794	4.5951	.993	-10.4972	17.8560
Control Rest Int 1	Threat Exer Int 1	.2344	4.5951	1.000	-13.9422	14.4110
	Threat Rest Int 1	-1.6713	4.5951	1.000	-15.8478	12.5053
	Control Exer Int 1	-2.3937	4.5951	1.000	-16.5703	11.7828
	Threat Exer Int 2	6.5650	4.5951	.842	-7.6116	20.7416
	Threat Rest Int 2	12.4063	4.5951	.133	-1.7703	26.5828
	Control Exer Int 2	11.5488	4.5951	.200	-2.6278	25.7253
	Control Rest Int 2	1.2856	4.5951	1.000	-12.8910	15.4622
Threat Exer Int 2	Threat Exer Int 1	-6.3306	4.5951	.866	-20.5072	7.8460
	Threat Rest Int 1	-8.2363	4.5951	.626	-22.4128	5.9403
	Control Exer Int 1	-8.9587	4.5951	.520	-23.1353	5.2178
	Control Rest Int 1	-6.5650	4.5951	.842	-20.7416	7.6116
	Threat Rest Int 2	5.8412	4.5951	.908	-8.3353	20.0178
	Control Exer Int 2	4.9838	4.5951	.959	-9.1928	19.1603
	Control Rest Int 2	-5.2794	4.5951	.944	-19.4560	8.8972
Threat Rest Int 2	Threat Exer Int 1	-12.1719	4.5951	.149	-26.3485	2.0047
	Threat Rest Int 1	-14.0775	4.5951	.053	-28.2541	9.909E-02
	Control Exer Int 1	-14.8000*	4.5951	.034	-28.9766	-.6234
	Control Rest Int 1	-12.4063	4.5951	.133	-26.5828	1.7703
	Threat Exer Int 2	-5.8412	4.5951	.908	-20.0178	8.3353
	Control Exer Int 2	-.8575	4.5951	1.000	-15.0341	13.3191
	Control Rest Int 2	-11.1206	4.5951	.241	-25.2972	3.0560
Control Exer Int 2	Threat Exer Int 1	-11.3144	4.5951	.222	-25.4910	2.8622
	Threat Rest Int 1	-13.2200	4.5951	.087	-27.3966	.9566
	Control Exer Int 1	-13.9425	4.5951	.057	-28.1191	.2341
	Control Rest Int 1	-11.5488	4.5951	.200	-25.7253	2.6278
	Threat Exer Int 2	-4.9838	4.5951	.959	-19.1603	9.1928
	Threat Rest Int 2	.8575	4.5951	1.000	-13.3191	15.0341
	Control Rest Int 2	-10.2631	4.5951	.340	-24.4397	3.9135
Control Rest Int 2	Threat Exer Int 1	-1.0513	4.5951	1.000	-15.2278	13.1253
	Threat Rest Int 1	-2.9569	4.5951	.998	-17.1335	11.2197
	Control Exer Int 1	-3.6794	4.5951	.993	-17.8560	10.4972
	Control Rest Int 1	-1.2856	4.5951	1.000	-15.4622	12.8910
	Threat Exer Int 2	5.2794	4.5951	.944	-8.8972	19.4560
	Threat Rest Int 2	11.1206	4.5951	.241	-3.0560	25.2972
	Control Exer Int 2	10.2631	4.5951	.340	-3.9135	24.4397

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	6094.66	2	3047.33	8.78	.000
INFO * AROUSAL	23.90	2	11.95	.03	.966
INFO * VIDEO	657.08	2	328.54	.95	.393
INFO * VIDEO * AROUS	165.72	2	82.86	.24	.788
Error(INFO)	24300.05	70	347.14		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	877306.435	1	877306.435	3254.979	.000
VIDEO	550.788	1	550.788	2.044	.162
AROUSAL	188.806	1	188.806	.701	.408
VIDEO * AROUSAL	148.881	1	148.881	.552	.462
Error	9433.463	35	269.528		

Cued Recall

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total cued recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1158.171[a]	3	386.057	1.614	.196
Intercept	287238.383	1	287238.383	1200.577	.000
VIDEO	42.723	1	42.723	.179	.674
AROUSAL	705.234	1	705.234	2.948	.091
VIDEO * AROUSAL	410.214	1	410.214	1.715	.195
Error	14355.017	60	239.250		
Total	302751.571	64			
Corrected Total	15513.189	63			

a. R Squared = .075 (Adjusted R Squared = .028)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	23305.369	1	23305.369	13.449	.001
INFO * VIDEO	Linear	719.559	1	719.559	.415	.522
INFO * AROUSAL	Linear	2031.522	1	2031.522	1.172	.284
INFO * VIDEO * AROUSAL	Linear	823.414	1	823.414	.475	.494
Error(INFO)	Linear	93572.282	54	1732.820		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	655541.610	1	655541.610	609.435	.000
VIDEO	27.725	1	27.725	.026	.873
AROUSAL	4034.390	1	4034.390	3.751	.058
VIDEO * AROUSAL	2626.288	1	2626.288	2.442	.124
Error	58085.354	54	1075.655		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	2681.312	1	2681.312	3.156	.081
INFO * VIDEO	Linear	416.755	1	416.755	.491	.486
INFO * AROUSAL	Linear	195.203	1	195.203	.230	.633
INFO * VIDEO * AROUSAL	Linear	92.309	1	92.309	.109	.743
Error(INFO)	Linear	50126.787	59	849.607		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	571073.767	1	571073.767	853.463	.000
VIDEO	390.834	1	390.834	.584	.448
AROUSAL	2871.976	1	2871.976	4.292	.043
VIDEO * AROUSAL	2390.276	1	2390.276	3.572	.064
Error	39478.417	59	669.126		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	5855.08	2	2927.54	5.01	.010
INFO * AROUSAL	28.05	2	14.03	.02	.976
INFO * VIDEO	2908.49	2	1454.24	2.49	.092
INFO * VIDEO * AROUS	600.75	2	300.37	.51	.601
Error(INFO)	32712.20	56	584.15		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	512008.933	1	512008.933	793.325	.000
VIDEO	3646.176	1	3646.176	5.650	.025
AROUSAL	1912.994	1	1912.994	2.964	.096
VIDEO * AROUSAL	540.670	1	540.670	.838	.368
Error	18071.103	28	645.397		

Total Recall (Free + Cued)

- **Univariate Analysis of Variance**

Tests of Between-Subjects Effects

Dependent Variable: total both recall

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	97.403[a]	3	32.468	.429	.733
Intercept	411256.071	1	411256.071	5433.380	.000
VIDEO	68.517	1	68.517	.905	.345
AROUSAL	24.975	1	24.975	.330	.568
VIDEO * AROUSAL	3.911	1	3.911	.052	.821
Error	4541.439	60	75.691		
Total	415894.912	64			
Corrected Total	4638.841	63			

a. R Squared = .021 (Adjusted R Squared = -.028)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	25023.497	1	25023.497	104.652	.000
INFO * VIDEO	Linear	481.017	1	481.017	2.012	.161
INFO * AROUSAL	Linear	51.334	1	51.334	.215	.645
INFO * VIDEO * AROUSAL	Linear	3.072	1	3.072	.013	.910
Error(INFO)	Linear	14107.546	59	239.111		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	776846.726	1	776846.726	4399.625	.000
VIDEO	91.691	1	91.691	.519	.474
AROUSAL	210.697	1	210.697	1.193	.279
VIDEO * AROUSAL	18.065	1	18.065	.102	.750
Error	10417.695	59	176.571		

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	5458.558	1	5458.558	28.990	.000
INFO * VIDEO	Linear	201.302	1	201.302	1.069	.305
INFO * AROUSAL	Linear	154.265	1	154.265	.819	.369
INFO * VIDEO * AROUSAL	Linear	9.461	1	9.461	.050	.823
Error(INFO)	Linear	11297.488	60	188.291		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	787176.823	1	787176.823	3986.003	.000
VIDEO	1.531E-04	1	1.531E-04	.000	.999
AROUSAL	183.505	1	183.505	.929	.339
VIDEO * AROUSAL	92.786	1	92.786	.470	.496
Error	11849.117	60	197.485		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	26659.20	2	13329.60	66.89	.000
INFO * AROUSAL	11.15	2	5.57	.03	.972
INFO * VIDEO	898.73	2	449.37	2.25	.109
INFO * VIDEO * AROUS	311.28	2	155.64	.78	.460
Error(INFO)	23116.40	116	199.28		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1242523.748	1	1242523.748	5135.715	.000
VIDEO	1.470E-02	1	1.470E-02	.000	.994
AROUSAL	309.630	1	309.630	1.280	.263
VIDEO * AROUSAL	19.045	1	19.045	.079	.780
Error	14032.393	58	241.938		

CORRELATION OF PHYSIOLOGICAL/PSYCHOLOGICAL AROUSAL WITH RECALL ACCURACY

- **Pearson & Spearman correlations (across the exercise group witnesses) of the various measures of recall accuracy with: the standardized residuals (to take account of baseline variation) of heart rate during the video and heart rate immediately following the video as well as rated arousal whilst cycling.**

Correlations - Accuracy of Free Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Arousal Whilst Cycling *SPEARMAN*
Overall	Correlation	-.028	-.071	-.081
	Sig. (2-tailed)	.877	.698	.660
	N	32	32	32
Central	Correlation	.036	-.052	.048
	Sig. (2-tailed)	.844	.776	.796
	N	32	32	32
Peripheral	Correlation	-.067	-.078	-.124
	Sig. (2-tailed)	.741	.699	.537

	N	27	27	27
Intruder 1	Correlation	.011	-.115	.089
	Sig. (2-tailed)	.950	.530	.627
	N	32	32	32
Intruder 2	Correlation	.068	.061	.006
	Sig. (2-tailed)	.711	.740	.974
	N	32	32	32
Action	Correlation	-.057	-.128	-.198
	Sig. (2-tailed)	.758	.486	.278
	N	32	32	32
Verbal	Correlation	.206	.224	.141
	Sig. (2-tailed)	.267	.226	.450
	N	31	31	31
Appearance	Correlation	-.205	-.210	-.243
	Sig. (2-tailed)	.400	.388	.316
	N	19	19	19

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01level (2-tailed)

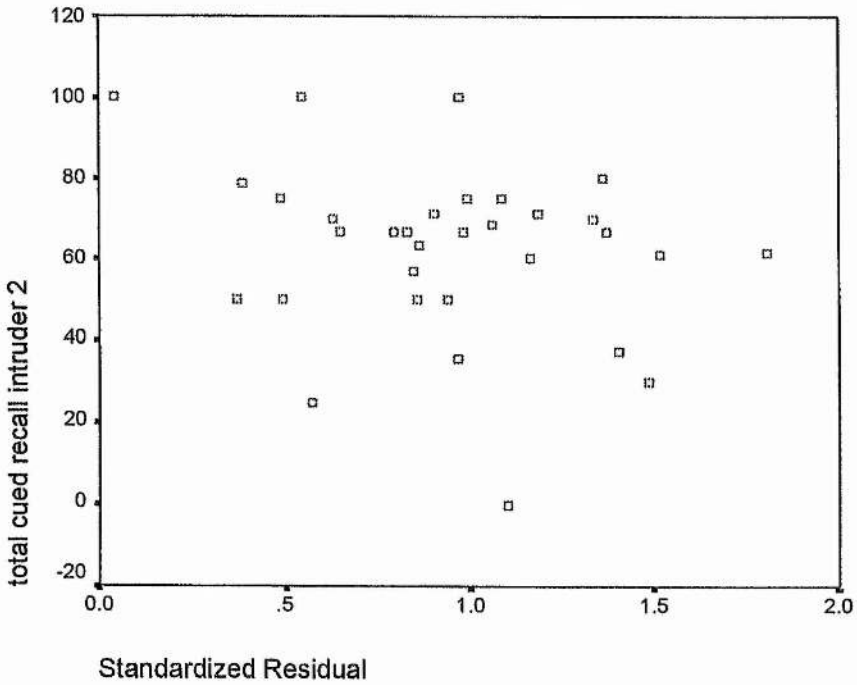
Correlations - Accuracy of Cued Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Arousal Whilst Cycling *SPEARMAN*
Overall	Correlation	-.203	-.284	.079
	Sig. (2-tailed)	.265	.116	.668
	N	32	32	32
Central	Correlation	-.094	-.138	.062
	Sig. (2-tailed)	.617	.460	.739
	N	31	31	31
Peripheral	Correlation	-.261	-.314	-.151
	Sig. (2-tailed)	.149	.080	.411
	N	32	32	32
Intruder 1	Correlation	-.003	-.084	.057
	Sig. (2-tailed)	.988	.648	.756
	N	32	32	32
Intruder 2	Correlation	-.315	-.356*	.231
	Sig. (2-tailed)	.079	.045	.203
	N	32	32	32
Action	Correlation	.006	-.096	-.048
	Sig. (2-tailed)	.975	.640	.815
	N	26	26	26
Verbal	Correlation	-.291	-.334	.019
	Sig. (2-tailed)	.189	.128	.932
	N	22	22	22
Appearance	Correlation	-.170	-.222	.022
	Sig. (2-tailed)	.352	.221	.904
	N	32	32	32

Correlations - Accuracy of Both Recall		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Arousal Whilst Cycling *SPEARMAN*
Overall	Correlation	-.187	-.268	-.011

	Sig. (2-tailed)	.306	.139	.953
	N	32	32	32
Central	Correlation	.117	.041	.057
	Sig. (2-tailed)	.523	.822	.755
	N	32	32	32
Peripheral	Correlation	-.225	-.268	-.222
	Sig. (2-tailed)	.216	.139	.221
	N	32	32	32
Intruder 1	Correlation	.021	-.094	-.012
	Sig. (2-tailed)	.908	.608	.946
	N	32	32	32
Intruder 2	Correlation	-.316	-.306	.020
	Sig. (2-tailed)	.078	.089	.913
	N	32	32	32
Action	Correlation	-.058	-.143	-.195
	Sig. (2-tailed)	.752	.433	.285
	N	32	32	32
Verbal	Correlation	.073	.067	.084
	Sig. (2-tailed)	.696	.718	.652
	N	31	31	31
Appearance	Correlation	-.159	-.226	-.028
	Sig. (2-tailed)	.386	.214	.878
	N	32	32	32

* Correlation is significant at the 0.05 level (2-tailed)

Scatterplot for significant correlation above:



4AFC RECOGNITION

- **Univariate Analysis of Variance - Accuracy across all questions**

Tests of Between-Subjects Effects

Dependent Variable: accuracy across all questions

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	334.185[a]	3	111.395	2.075	.113
Intercept	170158.313	1	170158.313	3169.925	.000
VIDEO	219.855	1	219.855	4.096	.047
AROUSAL	61.623	1	61.623	1.148	.288
VIDEO * AROUSAL	52.708	1	52.708	.982	.326
Error	3220.738	60	53.679		
Total	173713.236	64			
Corrected Total	3554.923	63			

a. R Squared = .094 (Adjusted R Squared = .049)

- **Univariate Analysis of Variance - Central vs. Peripheral Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	1117.936	1	1117.936	8.442	.005
INFO *VIDEO	Linear	744.787	1	744.787	5.624	.021
INFO * AROUSAL	Linear	5.176	1	5.176	.039	.844
INFO * VIDEO * WITNESS	Linear	.351	1	.351	.003	.959
Error(INFO)	Linear	7945.841	60	132.431		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	350535.645	1	350535.645	2684.672	.000
VIDEO	773.031	1	773.031	5.920	.018
AROUSAL	137.324	1	137.324	1.052	.309
VIDEO * AROUSAL	103.356	1	103.356	.792	.377
Error	7834.157	60	130.569		

- **Posthoc Tukey's Test - Interaction of info (Central vs Peripheral) by video**

Tukey HSD[a,b]

INFO	N	Subset	
		1	2
control peripheral	32	49.3306	
threat peripheral	32	49.4213	
control central	32	50.4169	
threat central	32		60.1563
Sig.		.981	1.000

Means for groups in homogeneous subsets are
Based on Type III Sum of Squares
The error term is Mean Square(Error) =

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: accuracy
Tukey HSD

(I) INFO	(J) INFO	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
threat central	control central	9.7394*	2.8421	.003	2.4378	17.0409
	threat peripheral	10.7350*	2.8421	.001	3.4335	18.0365
	control peripheral	10.8256*	2.8421	.001	3.5241	18.1272
control central	threat central	-9.7394*	2.8421	.003	-17.0409	-2.4378
	threat peripheral	.9956	2.8421	.985	-6.3059	8.2972
	control peripheral	1.0862	2.8421	.981	-6.2153	8.3878
threat peripheral	threat central	-10.7350*	2.8421	.001	-18.0365	-3.4335
	control central	-.9956	2.8421	.985	-8.2972	6.3059
	control peripheral	9.063E-02	2.8421	1.000	-7.2109	7.3922
control peripheral	threat central	-10.8256*	2.8421	.001	-18.1272	-3.5241
	control central	-1.0862	2.8421	.981	-8.3878	6.2153
	threat peripheral	-9.0625E-02	2.8421	1.000	-7.3922	7.2109

Based on observed means.

*. The mean difference is significant at the .05 level.

- **Univariate Analysis of Variance - Intruder 1 vs. Intruder 2 Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	INFO	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	Linear	565.615	1	565.615	5.682	.020
INFO * VIDEO	Linear	298.321	1	298.321	2.997	.089
INFO * AROUSAL	Linear	265.047	1	265.047	2.663	.108
INFO * VIDEO * AROUSAL	Linear	6.877	1	6.877	.069	.794
Error(INFO)	Linear	5972.612	60	99.544		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	340779.817	1	340779.817	3168.582	.000
VIDEO	417.063	1	417.063	3.878	.054
AROUSAL	121.856	1	121.856	1.133	.291
VIDEO * AROUSAL	113.534	1	113.534	1.056	.308
Error	6452.977	60	107.550		

- **Univariate Analysis of Variance - Action vs. Verbal vs. Appearance Details**

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
INFO	28487.54	2	14243.77	81.03	.000
INFO * VIDEO	2032.87	2	1016.43	5.78	.004
INFO * AROUSAL	171.69	2	85.85	.49	.615
INFO * VIDEO * AROUS	101.11	2	50.55	.29	.751
Error(INFO)	21.092.99	120	175.77		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable:

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	496609.247	1	496609.247	2700.066	.000
VIDEO	1259.828	1	1259.828	6.850	.011
AROUSAL	160.381	1	160.381	.872	.354
VIDEO * AROUSAL	184.436	1	184.436	1.003	.321
Error	11035.490	60	183.925		

- **Posthoc Tukey's Test - Interaction of information (Action vs Verbal vs Appearance) by video**

recog act verb app by video

Tukey HSD[a,b]

recog act verb app by video	N	Subset		
		1	2	3
control verb	32	34.3750		
threat verb	32	36.2500		
threat appearance	32		51.8472	
control appearance	32		52.5575	
control act	32		57.9559	
threat act	32			72.1606
Sig.		.993	.439	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 176.054.

a. Uses Harmonic Mean Sample Size = 32.000.

b. Alpha = .05.

Multiple Comparisons

Dependent Variable: recog act verb app by video
Tukey HSD

(I) recog act verb app by video	(J) recog act verb app by video	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
threat act	control act	14.2047*	3.3171	.000	4.7518	23.6576
	threat verb	35.9106*	3.3171	.000	26.4578	45.3635
	control verb	37.7856*	3.3171	.000	28.3328	47.2385
	threat appearance	20.3134*	3.3171	.000	10.8606	29.7663
	control appearance	19.6031*	3.3171	.000	10.1503	29.0560
control act	threat act	-14.2047*	3.3171	.000	-23.6576	-4.7518
	threat verb	21.7059*	3.3171	.000	12.2531	31.1588
	control verb	23.5809*	3.3171	.000	14.1281	33.0338
	threat appearance	6.1088	3.3171	.439	-3.3441	15.5616
	control appearance	5.3984	3.3171	.580	-4.0544	14.8513
threat verb	threat act	-35.9106*	3.3171	.000	-45.3635	-26.4578
	control act	-21.7059*	3.3171	.000	-31.1588	-12.2531
	control verb	1.8750	3.3171	.993	-7.5779	11.3279
	threat appearance	-15.5972*	3.3171	.000	-25.0501	-6.1443
	control appearance	-16.3075*	3.3171	.000	-25.7604	-6.8546
control verb	threat act	-37.7856*	3.3171	.000	-47.2385	-28.3328
	control act	-23.5809*	3.3171	.000	-33.0338	-14.1281
	threat verb	-1.8750	3.3171	.993	-11.3279	7.5779
	threat appearance	-17.4722*	3.3171	.000	-26.9251	-8.0193
	control appearance	-18.1825*	3.3171	.000	-27.6354	-8.7296
threat appearance	threat act	-20.3134*	3.3171	.000	-29.7663	-10.8606
	control act	-6.1088	3.3171	.439	-15.5616	3.3441
	threat verb	15.5972*	3.3171	.000	6.1443	25.0501
	control verb	17.4722*	3.3171	.000	8.0193	26.9251
	control appearance	-.7103	3.3171	1.000	-10.1632	8.7426
control appearance	threat act	-19.6031*	3.3171	.000	-29.0560	-10.1503
	control act	-5.3984	3.3171	.580	-14.8513	4.0544
	threat verb	16.3075*	3.3171	.000	6.8546	25.7604
	control verb	18.1825*	3.3171	.000	8.7296	27.6354
	threat appearance	.7103	3.3171	1.000	-8.7426	10.1632

Based on observed means.

*. The mean difference is significant at the .05 level.

CORRELATION OF PHYSIOLOGICAL/PSYCHOLOGICAL AROUSAL WITH RECOGNITION ACCURACY

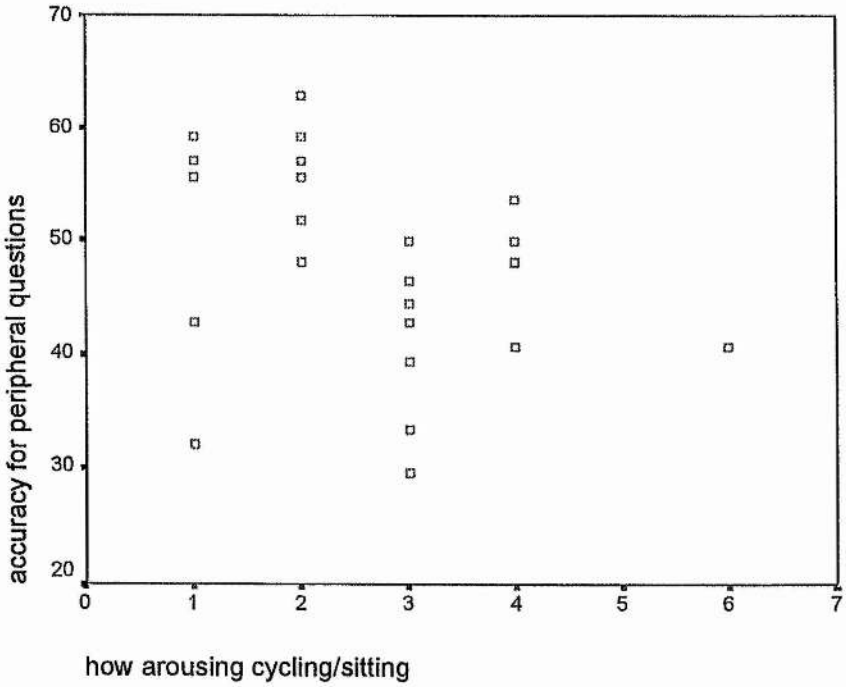
- **Pearson & Spearman correlations (across the exercise group witnesses) of the various measures of recognition accuracy with: the standardized residuals (to take account of baseline variation) of heart rate during the video and heart rate immediately following the video as well as rated arousal whilst cycling.**

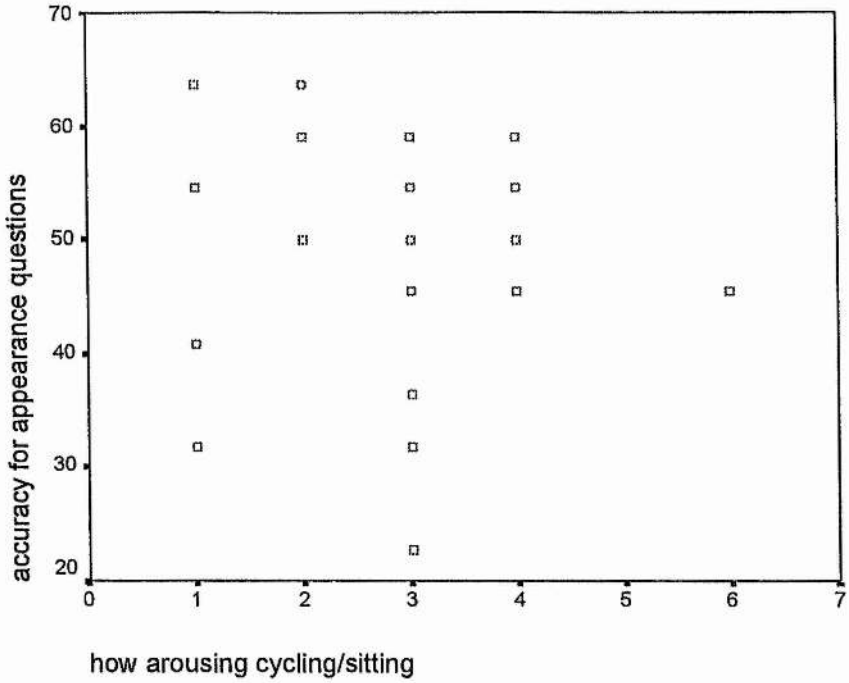
Correlations - 4AFC		Heart Rate During (Residual Values) *PEARSON*	Heart Rate After (Residual Values) *PEARSON*	Rated Arousal Whilst Cycling *SPEARMAN*
Overall	Correlation	.119	.082	-.153

	Sig. (2-tailed)	.518	.657	.404
	N	32	32	32
Central	Correlation	.277	.168	.178
	Sig. (2-tailed)	.125	.358	.330
	N	32	32	32
Peripheral	Correlation	-.141	-.075	-.454**
	Sig. (2-tailed)	.442	.682	.009
	N	32	32	32
Intruder 1	Correlation	-.027	.016	-.021
	Sig. (2-tailed)	.884	.931	.911
	N	32	32	32
Intruder 2	Correlation	.200	.102	-.205
	Sig. (2-tailed)	.273	.578	.260
	N	32	32	32
Action	Correlation	.201	.081	.058
	Sig. (2-tailed)	.269	.658	.753
	N	32	32	32
Verbal	Correlation	.145	.034	.011
	Sig. (2-tailed)	.427	.853	.950
	N	32	32	32
Appearance	Correlation	-.112	.019	-.368*
	Sig. (2-tailed)	.541	.918	.029
	N	32	32	32

* Correlation is significant at the 0.05 level (2-tailed)

Scatterplots for significant correlations above:





IDENTIFICATION

LINEUP ONE

CONTINGENCY TABLE: VIDEO BY AROUSAL BY DECISION

arousal * decision * video Crosstabulation

video				decision		Total
				correct	incorrect	
threat	arousal	exercise	Count	6	10	16
			Expected Count	6.5	9.5	16.0
		rest	Count	7	9	16
			Expected Count	6.5	9.5	16.0
	Total		Count	13	19	32
			Expected Count	13.0	19.0	32.0
control	arousal	exercise	Count	7	9	16
			Expected Count	6.5	9.5	16.0
		rest	Count	6	10	16
			Expected Count	6.5	9.5	16.0
	Total		Count	13	19	32
			Expected Count	13.0	19.0	32.0

3-WAY LOG-LINEAR ANALYSIS: VIDEO BY AROUSAL BY DECISION

```
* * * * * * * * H I E R A R C H I C A L   L O G   L I N E A R * * *
* * * * *

DATA   Information

          8 unweighted cases accepted.
          0 cases rejected because of out-of-range factor values.
          0 cases rejected because of missing data.
         64 weighted cases will be used in the analysis.


FACTOR Information

   Factor  Level  Label
   VIDEO       2  video
   AROUSAL     2  arousal
   DECISION    2  decision

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - -

-

* * * * * * * * H I E R A R C H I C A L   L O G   L I N E A R * * *
* * * * *

DESIGN 1 has generating class

    VIDEO*AROUSAL*DECISION

 Note: For saturated models    .500 has been added to all observed
cells.
 This value may be changed by using the CRITERIA = DELTA subcommand.


The Iterative Proportional Fit algorithm converged at iteration 1.
The maximum difference between observed and fitted marginal totals is
.000
and the convergence criterion is     .250

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - -


 Observed, Expected Frequencies and Residuals.

       Factor          Code            OBS count  EXP count  Residual
Std Resid


  VIDEO           threat
   AROUSAL         exercise
    DECISION        correct                 6.5        6.5       .00
.00
    DECISION        incorrec               10.5       10.5       .00
.00
   AROUSAL         rest
```

```
    DECISION        correct                    7.5        7.5        .00
.00
    DECISION        incorrec                   9.5        9.5        .00
.00

  VIDEO           control
   AROUSAL         exercise
    DECISION        correct                    7.5        7.5        .00
.00
    DECISION        incorrec                   9.5        9.5        .00
.00
   AROUSAL         rest
    DECISION        correct                    6.5        6.5        .00
.00
    DECISION        incorrec                  10.5       10.5        .00
.00

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 Goodness-of-fit test statistics

    Likelihood ratio chi square =      .00000    DF = 0  P = 1.000
             Pearson chi square =      .00000    DF = 0  P = 1.000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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* * * * * * * * H I E R A R C H I C A L   L O G   L I N E A R * * *
* * * * *

Tests that K-way and higher order effects are zero.

         K      DF   L.R. Chisq    Prob  Pearson Chisq    Prob
Iteration

         3       1         .259   .6106           .259   .6107
2
         2       4         .259   .9923           .259   .9923
2
         1       7        2.523   .9254          2.500   .9271
0

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Tests that K-way effects are zero.

         K      DF   L.R. Chisq    Prob  Pearson Chisq    Prob
Iteration

         1       3        2.263   .5196          2.241   .5239
0
         2       3         .000  1.0000           .000  1.0000
0
         3       1         .259   .6106           .259   .6107
0
-
```

```
* * * * * * * * H I E R A R C H I C A L   L O G   L I N E A R * * *
* * * * *

Backward Elimination (p = .050) for DESIGN 1 with generating class

  VIDEO*AROUSAL*DECISION

 Likelihood ratio chi square =      .00000    DF = 0  P = 1.000

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
- - - - -


If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 VIDEO*AROUSAL*DECISION                         1                .259
.6106     2

Step 1

  The best model has generating class

      VIDEO*AROUSAL
      VIDEO*DECISION
      AROUSAL*DECISION

  Likelihood ratio chi square =      .25931    DF = 1  P =  .611

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If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 VIDEO*AROUSAL                                  1                .000
1.0000     2

Step 2

  The best model has generating class

      VIDEO*DECISION
      AROUSAL*DECISION

  Likelihood ratio chi square =      .25931    DF = 2  P =  .878

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If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 VIDEO*DECISION                                 1                .000
1.0000     2

-

* * * * * * * * H I E R A R C H I C A L   L O G   L I N E A R * * *
* * * * *
```

```
Step 3

  The best model has generating class

      AROUSAL*DECISION
      VIDEO

  Likelihood ratio chi square =      .25931    DF = 3  P =  .967

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If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 AROUSAL*DECISION                               1                .000
1.0000     2

Step 4

  The best model has generating class

      VIDEO
      AROUSAL
      DECISION

  Likelihood ratio chi square =      .25931    DF = 4  P =  .992

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If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 VIDEO                                          1                .000
1.0000     2

Step 5

  The best model has generating class

      AROUSAL
      DECISION

  Likelihood ratio chi square =      .25931    DF = 5  P =  .998

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If Deleted Simple Effect is                    DF   L.R. Chisq Change
Prob  Iter

 AROUSAL                                        1                .000
1.0000     2
-

* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * *
* * * * *

Step 6
```

```
  The best model has generating class

      DECISION

  Likelihood ratio chi square =      .25931    DF = 6   P = 1.000

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If Deleted Simple Effect is                      DF   L.R. Chisq Change
Prob  Iter

 DECISION                                         1              2.263
.1325     0

Step 7

  The best model has no factors (constant only model)

  Likelihood ratio chi square =     2.52268    DF = 7   P =  .925

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Step 8

  The best model has no factors (constant only model)

  Likelihood ratio chi square =     2.52268    DF = 7   P =  .925

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_


* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * *
* * * * *

The final model has no factors (constant only model)
_


* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * *
* * * * *

The Iterative Proportional Fit algorithm converged at iteration 0.
The maximum difference between observed and fitted marginal totals is
8.000
and the convergence criterion is     .250

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 Observed, Expected Frequencies and Residuals.

       Factor          Code            OBS count  EXP count  Residual
Std Resid
```

```
  VIDEO            threat
   AROUSAL          exercise
    DECISION         correct                  6.0         8.0      -2.00
-.71
    DECISION         incorrec                10.0         8.0       2.00
.71
   AROUSAL          rest
    DECISION         correct                  7.0         8.0      -1.00
-.35
    DECISION         incorrec                 9.0         8.0       1.00
.35

  VIDEO            control
   AROUSAL          exercise
    DECISION         correct                  7.0         8.0      -1.00
-.35
    DECISION         incorrec                 9.0         8.0       1.00
.35
   AROUSAL          rest
    DECISION         correct                  6.0         8.0      -2.00
-.71
    DECISION         incorrec                10.0         8.0       2.00
.71

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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 Goodness-of-fit test statistics

    Likelihood ratio chi square =     2.52268    DF = 7  P =  .925
             Pearson chi square =     2.50000    DF = 7  P =  .927

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
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```

LINEUP TWO

CONTINGENCY TABLE: AROUSAL BY VIDEO BY DECISION

arousal * decision * video Crosstabulation

video				decision		Total
				correct	incorrect	
threat	arousal	exercise	Count	7	9	16
			Expected Count	6.5	9.5	16.0
		rest	Count	6	10	16
			Expected Count	6.5	9.5	16.0
	Total		Count	13	19	32
			Expected Count	13.0	19.0	32.0
control	arousal	exercise	Count	2	14	16
			Expected Count	3.5	12.5	16.0
		rest	Count	5	11	16
			Expected Count	3.5	12.5	16.0
	Total		Count	7	25	32
			Expected Count	7.0	25.0	32.0

CONTINGENCY TABLE: VIDEO BY DECISION

video * decision Crosstabulation

			decision		Total
			correct	incorrect	
video	threat	Count	13	19	32
		Expected Count	10.0	22.0	32.0
	control	Count	7	25	32
		Expected Count	10.0	22.0	32.0
Total		Count	20	44	64
		Expected Count	20.0	44.0	64.0

CHI-SQUARE TEST: VIDEO BY DECISION

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.618[b]	1	.106		
Continuity Correction[a]	1.818	1	.178		
Likelihood Ratio	2.649	1	.104		
Fisher's Exact Test				.177	.088
Linear-by-Linear Association	2.577	1	.108		
N of Valid Cases	64				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.00.

CORRELATION OF PHYSIOLOGICAL & PSYCHOLOGICAL AROUSAL WITH IDENTIFICATION ACCURACY (CORRECT VS. INCORRECT)

POINT-BISERIAL CORRELATIONS (ACROSS THE EXERCISE GROUP WITNESSES) OF IDENTIFICATION ACCURACY WITH: THE STANDARDIZED RESIDUALS (TO TAKE ACCOUNT OF BASELINE VARIATION) OF HEART RATE DURING THE INCIDENT AND HEART RATE IMMEDIATELY FOLLOWING THE INCIDENT AS WELL AS RATED AROUSAL WHILST CYCLING

Identification Accuracy		Lineup 1 (Intruder 1)	Lineup 2 (intruder 2)
Rated Arousal whilst cycling	Correlation	.014	-.015
	Sig. (2-tailed)	.940	.935
	N	32	32
Heart Rate During	Correlation	-.192	.168
	Sig. (2-tailed)	.291	.357
	N	32	32
Heart Rate After	Correlation	-.074	.205
	Sig. (2-tailed)	.689	.261
	N	32	32

Appendix 12: Data & Statistical Output - CCTV Study

1. RANKED SERIOUSNESS - LEVEL OF AGREEMENT AMONGST JUDGES

The mean level of agreement across raters was r = .81.

Correlations

			JUDGE1	JUDGE2	JUDGE3	JUDGE4	JUDGE5	JUDGE6	JUDGE7
Spearman's rho	JUDGE1	Correlation Coefficient	1.000	.738*	.905**	.905**	.786*	.714*	.905**
		Sig. (2-tailed)	.	.037	.002	.002	.021	.047	.002
		N	8	8	8	8	8	8	8
	JUDGE2	Correlation Coefficient	.738*	1.000	.833*	.833*	.690	.905**	.833*
		Sig. (2-tailed)	.037	.	.010	.010	.058	.002	.010
		N	8	8	8	8	8	8	8
	JUDGE3	Correlation Coefficient	.905**	.833*	1.000	1.000**	.833*	.667	.952**
		Sig. (2-tailed)	.002	.010	.	.	.010	.071	.000
		N	8	8	8	8	8	8	8
	JUDGE4	Correlation Coefficient	.905**	.833*	1.000**	1.000	.833*	.667	.952**
		Sig. (2-tailed)	.002	.010	.	.	.010	.071	.000
		N	8	8	8	8	8	8	8
	JUDGE5	Correlation Coefficient	.786*	.690	.833*	.833*	1.000	.452	.929**
		Sig. (2-tailed)	.021	.058	.010	.010	.	.260	.001
		N	8	8	8	8	8	8	8
	JUDGE6	Correlation Coefficient	.714*	.905**	.667	.667	.452	1.000	.667
		Sig. (2-tailed)	.047	.002	.071	.071	.260	.	.071
		N	8	8	8	8	8	8	8
	JUDGE7	Correlation Coefficient	.905**	.833*	.952**	.952**	.929**	.667	1.000
		Sig. (2-tailed)	.002	.010	.000	.000	.001	.071	.
		N	8	8	8	8	8	8	8

*. Correlation is significant at the .05 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

Proximity Matrix

	Correlation between Vectors of Values						
	JUDGE1	JUDGE2	JUDGE3	JUDGE4	JUDGE5	JUDGE6	JUDGE7
JUDGE1		.738	.905	.905	.786	.714	.905
JUDGE2	.738		.833	.833	.690	.905	.833
JUDGE3	.905	.833		1.000	.833	.667	.952
JUDGE4	.905	.833	1.000		.833	.667	.952
JUDGE5	.786	.690	.833	.833		.452	.929
JUDGE6	.714	.905	.667	.667	.452		.667
JUDGE7	.905	.833	.952	.952	.929	.667	

This is a similarity matrix

2. BREAKDOWN OF DETAILS REPORTED FOR EACH CASE

A full breakdown for each case concerning the total number of details and the percentage of unclassifiable details reported for action, verbal and appearance details.

Case 1			Action	Appearance	Verbal	Total
	1	B	26	3	2	31
Total	2	B	37	2	4	43
Amount	3	B	27	1	3	31
	4	B	27	2	1	30
Mean			29.25	2.00	2.50	33.75
	1	B	46.15	33.33	100.00	48.39
%	2	B	40.54	100.00	100.00	48.84
Unclassifiable	3	B	22.22	0.00	100.00	29.03
	4	B	33.33	0.00	100.00	33.33
Mean			35.90	37.50	100.00	40.74

Case 2			Action	Appearance	Verbal	Total
Total	1	B	23	0	1	24
Amount	2	V	41	0	8	49
	3	V	57	9	11	77
Mean			40.33	3.00	6.67	50.00
%	1	B	34.78	-	100.00	37.50
Unclassifiable	2	V	56.10	-	100.00	63.27
	3	V	47.37	55.56	100.00	55.84
Mean			47.93	55.56	100.00	55.33

Case 3			Action	Appearance	Verbal	Total
Total	1	B	10	0	3	13
Amount	2	B	11	0	5	16
Mean			10.50	0	4.00	14.50
%	1	B	20.00	-	100.00	38.46
Unclassifiable	2	B	72.73	-	100.00	81.25
Mean			47.73	-	100.00	62.07

Case 4			Action	Appearance	Verbal	Total
Total	1	V	30	0	0	30
Amount	2	V	27	0	0	27
Mean			28.50	0	0	28.50
%	1	V	50.00	-	-	50.00
Unclassifiable	2	V	44.44	-	-	44.44
Mean			47.37	-	-	47.37

Case 5			Action	Appearance	Verbal	Total
Total	1	V	19	3	6	28
Amount	2	B	21	4	3	28
Mean			20.00	3.50	4.50	28.00
%	1	V	63.16	66.67	100.00	71.43
Unclassifiable	2	B	61.90	100.00	100.00	71.43
Mean			62.50	85.71	100.00	71.43

Case 6			Action	Appearance	Verbal	Total
Total	1	V	22	0	4	26
Amount	2	V	15	0	4	19
Mean			18.50	0	4.0	22.50
%	1	V	63.64	-	100.00	69.23
Unclassifiable	2	V	33.33	-	100.00	47.37
Mean			51.35	-	100.00	60.00

Case 7			Action	Appearance	Verbal	Total
Total	1	B	21	0	8	29
Amount	2	V	17	0	2	19
Mean			19	0	5	24.00
%	1	B	28.57	-	100.00	48.28
Unclassifiable	2	V	29.41	-	100.00	36.84
Mean			28.95	-	100.00	43.75
%	1	B	66.67	-	-	66.67
Accurate	2	V	58.33	-	-	58.33
Mean			62.96	-	-	62.96

Case 8			Action	Appearance	Verbal	Total
Total	1	B	9	0	0	9
Amount	2	V	11	4	2	17
Mean			10.00	2.00	1.00	13.00
%	1	B	44.44	-	-	44.44
Unclassifiable	2	V	45.45	0.00	100.00	41.18
Mean			45.00	0.00	100.00	42.31

3. ANOVA - RATED EXTENT OF INJURIES AND ACTION DETAILS REPORTED

Univariate ANOVA comparing the action details reported when the incidents were grouped according to ratings of perceived seriousness of injury to victim (i.e., comparing incidents with the highest injury ratings (incidents 1, 2, 6 and 7) with those rated to be lowest in injury (incidents 3, 4, 5 and 8)).

Tests of Between-Subjects Effects

Dependent Variable: ACTION

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	553.495[a]	1	553.495	5.213	.036
Intercept	9559.811	1	9559.811	90.030	.000
GROUP	553.495	1	553.495	5.213	.036
Error	1805.136	17	106.184		
Total	12922.000	19			
Corrected Total	2358.632	18			

a. R Squared = .235 (Adjusted R Squared = .190)