THE EFFECT OF CERTAIN VARIABLES ON THE RELIABILITY OF EYEWITNESS TESTIMONY

by

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Things are not the way they are;

Things are the way we are…

Maharaj Charan Singh Ji

I declare that this thesis, which is submitted to the University of the Free State for the degree PhD, is my own independent work and has not previously been submitted by me to another university/faculty. I hereby cede the copyright of the thesis to the University of the Free State.

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Arnót Venter Date

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ORIENTATION

In accordance with the regulations of the University of the Free State, this thesis is presented in article format. A list of contents and tables precedes each article. The questionnaires used to sample the participants' memories are presented in appendices at the end of the thesis.

By virtue of the fact that the accuracy of eyewitness testimony was researched in all the empirical articles the methodology employed was very similar. This may translate into a perception of overlap and repetition between articles. However, this situation is not unusual in the research community, where several articles based on a single study are published independently. Consequently, it is suggested that the reader view each article independently although they deal with interconnected facets of the same topic.

This thesis consists of the following eight articles --- instead of the required five --- which should also more than compensate for those cases where duplication did occur:

ARTICLE 1 - PERCEPTION AND MEMORY: IMPLICATIONS FOR EYEWITNESS TESTIMONY

ARTICLE 2 - ESTIMATOR VARIABLES AND EYEWITNESS TESTIMONY

ARTICLE 3 - SYSTEM VARIABLES AND EYEWITNESS TESTIMONY

ARTICLE 4 - MEMORY ACCURACY OF A REAL-LIFE SIMULATED INCIDENT

ARTICLE 5 - THE RELATIONSHIP BETWEEN MEMORY AND THE RECALL OF SPECIFIC DETAILS

ARTICLE 6 - THE EFFECT OF VIOLENT VERSUS NON-VIOLENT INCIDENTS ON EYEWITNESS MEMORY

ARTICLE 7 - METHOD OF QUESTIONING AND THE ACCURACY OF EYEWITNESS TESTIMONY

ARTICLE 8 - THE EFFECT OF CONFIDENCE AND METHOD OF QUESTIONING ON EYEWITNESS TESTIMONY

APPENDICES

Reader's orientation:

Article 5 serves as a follow-up article to Article 4 and therefore these two articles will be published as a unit. Whereas the statistical analysis in Article 4 provides general results (averages) about the memory accuracy of the participants in the study, the accuracy of responses regarding specific items was analysed in Article 5. As mentioned in the orientation this results in overlap and repetition between articles.

ARTICLE 1

PERCEPTION AND MEMORY: IMPLICATIONS FOR EYEWITNESS TESTIMONY

CONTENTS

ARTICLE 1

PERCEPTION AND MEMORY: IMPLICATIONS FOR EYEWITNESS TESTIMONY

INTRODUCTION

The eyewitness information supplied by the victim of a crime is the most common form of witnessing and often the single most important determinant in whether a case will be solved in a court of law (Brigham, Maass, Snyder & Spaulding, 1982; Memon & Wright, 2000; Yuille & Cutshall, 1986). The fate of the accused does often depend on other humans' eyewitness testimony, as innocent people may face the possibility of faulty imprisonment, financial ruin, and loss of reputation as a result of this testimony. A victim may also be dependent on witness accuracy; if a witness' testimony is not accepted, the victim may suffer from further exposure to the perpetrator, financial losses (through the rejection of insurance claims, court costs, or loss of revenue), or psychological trauma, while disillusionment with the legal system is inevitable (cf. Goodman, Redlich, Qin, Ghetti, Tyda, Schaaf & Hahn, 1999). As Samaha succinctly (1990, p. 370) states: "Faulty identifications present the greatest single threat to the achievement of our ideal that no innocent man shall be punished."

Due to a belief in the ultimate accuracy of human perception and memory, eyewitness testimony is regarded as an important basis for decision-making in courts (Bartol & Bartol, 1994). The following statement made in *Plaaslike Boeredienste (Edms) Bpk v CHEMFOS Bpk 1986 (1) SA 819 (A)* illustrates this viewpoint: "A witness' credit means not only his honesty but also his powers of perception, his memory and his accuracy of narration." The consequences of faulty perception and memory is demonstrated in the USA by evidence which indicated that 36 of the first 40 people, who were exonerated based on DNA evidence, had been convicted on the testimony provided by eyewitnesses (Connors, Lundregan, Miller & McEwen, 1996; Foxhall, 2000; Sinatra, 2000; Wells, Small, Penrod, Malpass, Fulero & Brimacombe, 1998). This number has recently increased to 62 of which 52 contained identifications from mistaken eyewitness identification (Kassin, Tubb, Hosch & Memon, 2001). Loftus (1993) justly emphasizes that being falsely accused of a crime, is one of the most devastating occurrences possible for a human

being and along with Kassin (1998) argue that the tragedy of this situation should force role players, such as legal professionals and researchers, to protect people against the danger of mistaken eyewitness testimony. However, due to the difficulty in objectively testing the accuracy of witnesses, the legal system often gives credit to or rejects the memory of witnesses without substantiation. If the potential unreliability of eyewitness testimony is considered to be one of the most serious problems in the administration of criminal justice (Loftus, 1980a; Navon, 1990; Robinson, Johnson & Herndon, 1997; Shaw & Skolnick, 1994), can the assumption be made that a given witness has a prodigious or even a better memory than others without an objective assessment of memory ability? (e.g. *Law Society Transvaal v Matthews 1989 (4) SA 389 (T*), and *Izaaks v Schneider 1991 (3) SA 675 (Nm)*). Fortunately there are indications that some judges, despite relying heavily on eyewitness testimony, are cognisant of the limitations of human memory (Penrod & Cutler, 1999). For example, in *Premier Wire and Steel Co Ltd v Maersk Line 1969 (3) SA 488 (C) and S v Nyembe 1982 (10) SA 835 (A)*, it was stated "the Judge knows that human memory is only too fallible….", while in *S v Mpetha and others (2) 1983 (1) SA 576 (C)* it was acknowledged that "a completely honest witness will be often betrayed by his memory." In *Penderis and Gulman v Liquidators of the Short-term business, AA Mutual Insurance Association Ltd and another 1991 (3) SA 342 (C*) it was mentioned that little reliance can be placed on memory. In *Sanderson v Attorney-General, Eastern Cape 1998 (2) SA 38 (CC)* it was stated that: "memory is a flimsy and wayward faculty." For this reason Wells, Wright and Bradfield (1999) stress the distinction between prevaricating or 'lying' and an honest mistake or 'unintentional error'.

Against the aforementioned background it should be clear that any person whose profession incorporates a reliance on memory should have at least a basic scientific knowledge of the way in which information is processed. Therefore the major goal of this article is to provide legal and other professionals with an overview of the two major components of the information-gathering process, namely perception and memory.

BASIC INFORMATION PROCESSING: PERCEPTION AND MEMORY

From light momentarily being projected through the lens of the eye onto the retina, vivid and detailed representations of the world can be created. The colours and objects of the world around us are perceived without apparent effort and most of us accept that the world exists exactly according to our perception. However, most people seldom pay attention to the way in which they perceive the world around them, or the process involved (Gregory & Colman, 1995; Shiffmann, 1996). This is regardless of daily exposure to illusions such as the mirage above the road on a hot day, the moon illusion (the moon appears larger when on the horizon), stroboscopic movement (a series of flashing lights can create illusionary movements) and forgetting names, appointments and where keys have been left. In this regard Shiffman (1996) appropriately emphasizes the importance of realising that the world created by our senses does not always correspond (exactly) with the physical reality of events and objects. Particular stimuli and the misinterpretation of sensory information often subject us to errors and systematic distortions, which misrepresent the world. This implies that our interpretation of crime events is also not always correct.

When a person recalls and identifies events, objects, and persons during and after an incident two fundamental, but exceedingly complicated mental processes are at work: perception and memory. In the first process, sensory inputs (what one sees, hears, smells, touches, tastes) are transformed and organized into meaningful experiences for the individual**,** whilst in the second, the transformed inputs are stored in the brain, ready to be recalled when needed (Bartol & Bartol, 1994). Wrightsman (1987) explains that in order to process information, a stimulus must first be perceived and then at least momentarily retained in order to be able to recall the stored information. There can be failures and errors at any step along the way which affect the accuracy of recollection.

According to Gregory and Colman (1995) the ancient Greeks were the first to give serious consideration to perception and memory by realising that the eyes cannot see and the ears cannot hear without the interpretation of the brain. Later research has shown that perception is more than just the reception of visual images and auditory vibrations. Observation and experience

include an incredibly rich world of interacting stimuli, most of which are inadequately represented by the senses. Buckhout (1974) states that selectivity and constructivism are important functioning modes of human perception and memory. Information processing is viewed as a decision-making process affected by the totality of a person's abilities, background, attitudes, motives and beliefs, which makes it a very subjective process. In, for example, a crime situation the perception process is often complicated by internal and external factors such as emotions and the short duration of the event. It can therefore be assumed that all these factors will have a significant impact on not only on the way events are perceived, but also on the testimony itself. For this reason Taylor (1981) postulates that any analysis of perception and memory should start with an acknowledgement of the human's restricted ability to process information.

The following discussion reviews the complicated processes of perception and memory in more detail.

PERCEPTION

Perception refers to the manner in which we give meaning to the information our senses receive from the environment at a specific point in time (cf. Hampson & Morris, 1996). Our senses gather this information through a process known as sensation. Sensation can be regarded as primarily a physiological process, whereas perception is more psychological and cognitive in nature. But sensation and perception are not two isolated processes: both are part of a coordinated procedure through which we obtain information and make sense of the world.

It is important to realise that information processing is not simply the passive recording of events by means of a biological process. Factors such as context of the event, emotional state, judgement, prior experience, expectations and memory play a role in these processes. These all attribute to a person's frame of reference that has been termed perceptual set (Louw & Edwards, 1997; Louw & Plug, 1997). Deutscher and Leonoff (1991) add that events are consciously and unconsciously screened and only a minimal number of environmental stimuli are selected. This has major implications for the eyewitness since they can hardly be objective when observing a

crime or incident.

The selective nature of the human visual system during perception was acknowledged in *S v Baleka and others (1) 1986 (4) SA 192 (T)* and *S v Banda and others 1989 (4) SA 519 (BG)*: "The video does not suffer from a fading of memory as do witnesses. The camera may be selective, but the witness' recollection is even more so." Authors such as Feldman (1996) and Horowitz Willging and Bordens (1998) warn that, although the analogy of the camera or video camera may be useful in understanding how perception works, it can be misleading. The camera does not interpret information, as human perception does. Generally the camera simply records what the photographer wants it to record and transfers the image on to a film. Factors such as prejudice, stereotyped beliefs, background, anxiety, and expectations do not affect the camera, as it does not selectively attend to some people and events by itself.

Furthermore it is only human that distortions of perception can occur. As a matter of fact, illusions (which derive from the normal process of misinterpreted sensations as in the aforementioned mirages and moon illusion) occur on a daily basis in everybody's life. Reconstruction of events and confabulation (filling gaps in memory) can also lead to a distortion of the truth, as has often been highlighted in court cases (e.g. *AECI Explosives and Chemicals Ltd v Ensign-Bickford (SA) Pty Ltd and others 1997 (3) SA 250 (T)*). Hannigan and Reinitz (2001) mention that schematic gap filling, which is an inferential error, occurs when compensation for failing to recall specific details of earlier events takes place. This is done by making inferences and then mistaking these inferences for events which had actually been experienced. An example of this in everyday life would be misplacing keys and then drawing from an earlier memory where the keys had been placed on the kitchen table. In this case the schema of the keys on the kitchen table will interfere with the correct memory that the keys had been left in the car. A good example of how gaps in memory can be filled is the arrest of a well-known Australian psychologist on a charge of rape after a woman had identified him in a line-up. It, however, became clear that at the time of the rape she was watching a programme on television in which the psychologist was discussing issues around eyewitness testimony. Ascribed to the fact that she could not remember the face of the rapist, she filled the gap in her memory by identifying a person (in this case the psychologist) she had seen at the time of the rape (Baddeley, 1990).

It is clear that our senses are not only physical entities, but social ones as well, as our perception of, and reaction to objects and events is dependent on factors such as past experiences and expectancies. The fact that conflicting eyewitness reports occur on a daily basis in our courts therefore comes as no surprise.

An awareness of the frailties of perception is important as it can have a limiting effect on the reliability of eyewitness testimony. However, in order to understand the origins of perceptual inaccuracies, knowledge of what is involved in the process of perception is required. This is the focus of the next section.

Process of perception

Cohen (1999) provides a clearer understanding of perception involving, which have been termed bottom-up and top-down processes. Bottom-up or data-driven processing consists of processing information, which reaches the sense organs from the outside world. Top-down or conceptually driven processing involves information already stored in semantic memory in the form of prior knowledge derived from past experience. These two kinds of processing could operate in combination in an eyewitness situation: Sensory data about a moving green object of a particular size and form may be yielded by a bottom-up process, while top-down processes based on stored knowledge enable this to be identified as a Mercedes. The fact that these two processes of sensory data and stored knowledge are so intertwined and difficult to isolate, it is sometimes impossible for eyewitnesses to distinguish between what they actually saw and what they thought they had seen. Bottom-up type processing is most often applied in everyday perception and may well be more appropriate for the perception of simple objects, whilst top-down processing would be appropriate in the perception of more complex events and incidents. Bottom-up processing is more precise than top-down processing, as it is less subjective, and therefore less prone to inaccurate interpretation. However, in many cases, eyewitness testimony involves top-down processing. If a person were to look at a stationary motorcar, they would most probably apply a simple bottom-up process. On the other hand when viewing an incident involving a few cars, such as in an accident, a top-down process would be applied with increased potential for

perceptual inaccuracy (Ainsworth, 1998; Haberlandt, 1994).

Perception as interpretation

As perception is characterized by a search for order and consistency, the complexity of the perceptual process is usually only appreciated when information is unfamiliar or complex. Because the simplest aspects of a given stimulus are the easiest to recognize and remember, simplification and organization takes place during perception. Even when a series of stimuli have no pattern, order and stability are still perceived (Wallach, 1985). Fouché (1992) indicates that this interpretation by means of simplification and organization may affect the recall of information, recognition of stimuli, and decision-making process, which may again impact on the accuracy of eyewitness testimony.

It is thus important to realise that the perceptual system is not a passive structure waiting to be activated by an external stimulus. It is rather an active exploratory system, which seeks out information from the environment, and it is highly selective in the information it gathers (Broadbent, 1957;Travers, 1970). Information is examined, interpreted and recorded, making perception an active, creative and subjective process.

Bias and subjectivity in perception

The end result of perception is often very selective and therefore inaccurate. Bias and subjective perception can lead to incorrect interpretation of information. Additionally, attention is not, and cannot be given to all stimuli, and consequently information is lost. This may provide a reason for the differing perceptions of different witnesses, observed in our courts on a daily basis.

The process of perception has been compared to that of an artist painting a picture. Before the artist creates an image on canvas, he first studies and interprets the scene to be painted, then translates it into visual imagery. Individual artists will produce different paintings of the same scene, as each artist would apply their own impressions and subjective interpretations to what they see. This explains why the various witnesses to a bank robbery may all have different

interpretations of the same incident --- each witness' attention may not only have been directed to a different part of the scene, but their subjective interpretation may also differ due to, for example, past experiences and their emotional state. Although this observation bias is acknowledged by the courts (e.g. *S v Bertrand 1975 (4) SA 142 (C)* and *S v Malefane 1974 (4) SA 613 (O)*) its frequency and extent of impact is still unknown.

Expectations and attributions in perception

According to Bartol (1983) expectations affect perception, as individuals are inclined to perceive what they expect to see and they tend to not perceive what they do not expect to see. This can be ascribed to the fact that people tend to have stereotyped beliefs, which are often controlled by society's perceptions, prejudices and attitudes (Kassin, 2001). In many demonstrations of perceptual illusions, people have been tricked into misperceiving reality (e.g. Müller-Lyer illusion, where the perceived length of a line is altered by the position of other lines bordering it). Furthermore many peoples' claims of UFO sightings have been found on closer investigation to be lenticular clouds or reflection of light in the sky.

MEMORY

Analysed information, stored in the brain through sensation and perception, and ready to be recalled, is referred to as memory (Loftus, 1979). Memory, according to Plug, Louw, Gouws and Meyer (1997), is simply the ability to recall previous experiences.

Although the Spanish proverb "memory, like women, is usually unfaithful", discredits the majority of women unfairly, it supports the finding of researchers that memory, like perception, is an active and distortion-prone process. A quote from the movie " Memento" provides almost a visual depiction of the creative skills of memory: "Memory can change the shape of a room. It can change the color of a car. And memories can be distorted. They are just an interpretation. They are not a record." Human memory is selective and subjective, as humans pay attention to only a limited amount of the large quantity of information around them and generally find it much easier to remember information that is clear and meaningful to them (cf. Miller, 1999).

Loftus is of the opinion that only "a flimsy curtain separates memory from imagination" (Loftus & Calvin, 2001, p. 55) and that we have the ability to recall events, which in fact did not happen (Garry, Manning & Loftus, 1996; Mazzoni, Loftus & Kirsch, 2001).

Manning and Loftus (1996) suggest that memories do not exist in isolation but rather in a world of other memories, which can interfere with one another. Horowitz et al. (1998) add that details of events are stored and during recall the original event is altered and recreated through the process of reconstructive memory. This can be ascribed to the dynamic nature of our memory. The reconstructive theory of memory entails that memory integrates perceptual information and past experience, as well as other subject-relevant information, which may be introduced later. Sara (2000) and other researchers support the notion that memory and perception are similar in the sense that current experiences or stimuli are comprehended and apprehended in the light of past experiences. This theory provides a good explanation for memory being highly malleable and easily subjected to change and distortion. Memory is thus very much a reconstructive, integrative process, developing with the flow of new experiences and thoughts (Bartol & Bartol, 1994; Braun, Ellis & Loftus, 2002). In *S v Ngcobo 1986 (1) SA 905 (N)* Didcott J set aside the conviction of the accused on two accounts of robbery after referring to an experiment reported by Elisabeth Loftus in which the malleability of memory was demonstrated. In his judgement he emphasised the dangers of eyewitness testimony in which the risk of mistaken identification is a grave and pervasive one (Skeen, 1987). Tredoux and Tredoux (1988), however, critisised the judgement in pointing out that the court was not entitled to refer to results of the experiment without allowing expert evidence. This notion is based on a decision of the Appellate Division in S v Collop 1981 (1) SA 150 (A). They also indicated that the experiment does not support the conclusion the court drew from it on the basis that the experiment (which was actually done by Buckhout) lacked internal validity. In our legal system the general practice of "refreshing" the memories of witnesses is permitted to help ensure that witnesses' testimonies, in some cases years after the event in question, corroborate with their original statement. In *Reckitt & Colman SA (Pty) Ltd v SC Johnson & Son (SA) (Pty) Ltd 1995 (1) SA 725 (T)* and *Nortje and another v Attorney-general, Cape and another 1995 (2) SA 480 (C)* the "refreshing of memory" was supported in this statement by the Judge: "There is surely nothing wrong in a witness refreshing his or her memory from a previous statement or document. The witness may even change his or

her evidence as a result." Refreshing of witness' memory can thus be seen as an acknowledgement by our legal system that people's memories can and, in some cases, do change over time.

As with perceptual processing, people are generally unaware of their memory processes. Although people generally can remember events well, they are not conscious of the complex neurological encoding, decoding, organization, storage, interpretation and association that preceded their final memory of it. Loftus (1980b) and Loftus and Palmer (1974) suggest that additional or post-event information can unknowingly be integrated into a memory, causing a change or distortion in that memory. This explains the differing accounts of people recalling the same event, despite their high confidence in their own report. This has major implications for eyewitness testimony and the legal system, as an honest eyewitness with the best intentions may still err and unconsciously distort his/her recall and identification. An example of this is mentioned in *S v Mpetha and others (2) 1983 (1) SA 576 (C).*

It is generally accepted that human beings find it more difficult to remember information as the time interval between first witnessing an event and later attempts to recall it increases. Although most researchers according to Yuille and Cutshall (1986) have found substantial loss and distortion of information over time, Wrightsman (1987) and Penrod, Loftus and Winkler (1982) make the point that there is also research indicating that, although early memory loss is rapid, the rate of loss decreases over time. This means that forgetting might be significant within the first twenty-four hours, but thereafter a more gradual process of forgetting will take place. The problem might however not only be with loss of information over time but the fact that Braun, Ellis and Loftus (2002) suggest that memories are more susceptible to alteration when passage of time allows the original memory to fade.

Tulving (1985) postulates that memory is comprised of a number of systems, with each system serving a somewhat different purpose and operating according to somewhat different principles. Together the systems form the capacity called memory which allows organisms to recall past experiences. These systems and the different stages of memory will be discussed in more detail in the next section**.**

Three stages of memory

Ericsson and Polson (1988) suggest that memory skill is best conceived as a hierarchy of many types of encoding processes, retrieval structures, and control processes. Although Baddeley (1976) states that it is almost impossible to try to separate memory experimentally into stages, the reconstructive approach of memory can be described theoretically within a three-stage sequential framework. The incorrect functioning of any one of these processes results in failure to remember (Goodman et al., 1999; Gudjonsson, 1992). The following is a more detailed description of the three stages of memory and the factors which influence them.

Acquisition. This is the input stage and refers to the perception and encoding of information into memory. It can be described as the process by which the nervous system develops representations of external stimuli such as physical objects and events and involves transferring information from the "short-term" or working memory to the "long-term" or more permanent memory. Although it is difficult to differentiate clearly between perception and this input stage, the point of acquisition or encoding is the point at which perception registers in the various areas of the cortex (Gudjonsson, 1992; Myers, 1998). During this stage a witness perceives an event and information is entered into the memory system and interpreted in the context of a person's previous knowledge and experience (Loftus, Green & Doyle, 1989).

Authors such as Geiselman (1994) and Goodman et al. (1999) identified many factors, present at the time of a crime event which may affect its encoding. These can be divided into witness factors (which include the characteristics of the eyewitnesses), stimulus or subject factors (which include the characteristics of perpetrators and frequently victims), and situational factors (which include the key elements of the crime event itself such as the duration of exposure and type of information e.g. violence vs. non-violence).

Retention. This is the second stage and is also known as storage, and it consists of the period of time between the observed event and eventual recollection. Bremner, Krystal, Southwick and Charney (1995) call retention a stage of consolidation. During retention, which can occur over

several weeks or more, the permanence of a memory trace is established. However, the memory trace is theoretically still susceptible to modification; it usually becomes less complete and accurate and may lead to forgetting. Furthermore, new information acquired during the retention interval can also distort or efface the original memory. This process is called retention interval and post-event interference (Cohen, 1999). *The Commisioner for Inland Revenue v Pick 'n Pay Wholesalers (Pty) Ltd 1987 (3) SA 453 (A)* provides support for the existence of interference: "Human memory is inherently and notoriously liable to error. It is a matter of common experience that during the stage of retention or storage in the memory, perceived information may be forgotten or it may be modified or added to or distorted by subsequent information. One is aware too that there can occur a process of unconscious reconstruction." Retention interval interference provides a good reason for courts to allow the "refreshing of memory" of witnesses. During the retention interval for eyewitness testimony the most important potential influences (apart from forgetting because of the passage of time) appear to be those from external sources such as co-witnesses, the police, the press and from internal sources such as the witness's personal reflections and rationalization of the event.

Retrieval. During this final stage the information previously encoded and retained is brought back into awareness. The most typical retrieval situations for witnesses include reporting to the police, viewing line-ups, recounting to friends and mental health professionals, and additionally testifying in court.

Gudjonsson (1992) indicates that failure in memory is very often the result of a witness' inability to retrieve information, rather than faulty acquisition or retention. He makes the distinction between information, which is potentially available in memory storage and information that is actually accessible at any point in time. Very few memories are accessible and retrievable on a given occasion. Events encoded during high levels of emotional arousal often tend to be more difficult to access, as has been acknowledged in cases such as *Titus v Shield Insurance Co Ltd 1980 (3) SA 119 (A)*: " excitement exaggerates … distortion in perception and memory." However, one should always be mindful that successful retrieval of information from memory is directly related to the quality of the acquisition, storage and retention of the original material (cf. Deutscher & Leonoff, 1991).

Models of memory

During the 1960's psychologists started to produce models to illustrate how memory processes might work (Ainsworth, 1998). The best-known models are the Brown-Peterson Distracter Technique, Broadbent's Filter Theory and the Atkinson-Shiffrin Buffer Model. These models divide memory into separate components, for example Short-Term and Long-Term Memory Systems.

There has been ongoing debate over whether memory is composed of a single system or multiple systems. The debate has centred on the postulation of separate systems for short-term memory (STM) and long-term memory (LTM). The suggested STM system retains small amounts of information for about 30 seconds, and thus contains new information (for example when you read and remember a telephone number from the telephone directory before you dial), or it can be information retrieved from LTM (such as when you consciously recall your identity number or address when filling out an application). This information can remain in STM indefinitely when it is rehearsed. In contrast the LTM system is, without the need for continuous rehearsal, capable of storing vast amounts of information, essentially forever. Baddeley (1989) provides the following evidence in support of a dichotomy**:**

- The STM has much less storage capacity than the LTM.
- The information processing system encompasses two separable components. One is relatively permanent, whilst the other demonstrates rapid forgetting in the absence of rehearsal.
- The long-term learning and serial recall of sequences of letters or words appears to be principally based on semantic coding, whilst the immediate recall of equivalent material appears to depend primarily on a speech-based phonological code.
- Neuropsychological evidence suggests that STM and LTM depend on separate underlying systems.

Researchers in favour of a single memory system, however, argue that there is neither a theoretical need, nor convincing empirical evidence for a separate memory systems approach

(Baddeley, 1989). Different models of memory will be discussed in more detail next.

The Brown-Peterson Distracter Technique

In 1959 Lloyd and Margaret Peterson discovered that if subjects were distracted from rehearsing a small amount of new information, the information would often be completely forgotten in a matter of seconds. The overall results provided strong evidence for the presence of at least two different memory systems. The STM system was of small capacity and greatly affected by whether or not a voluntary process such as rehearsal was allowed. In comparison the LTM system had been viewed as much more durable, had a bigger capacity and was less affected by rehearsal (Searleman & Herrmann, 1994).

Broadbent's Filter Theory

Broadbent (1958) proposed a general model, which holds that human information processing has selective-attention capabilities. The implication is that we attend to some stimuli while ignoring others. Memory has storage capabilities which involve retaining stimulus information in various forms and Broadbent's Filter theory recognized that the human brain was incapable of attending to and analysing all of the information perceived through the sense organs, having the capacity to process only a restricted amount of material at any one time. The filtering system was required to allow humans to attend to important aspects, and to filter out the unimportant and irrelevant, as well as precluded the system becoming overloaded. This may have negative implications for eyewitness memory, as there are often very diverse sensory experiences during an event. An eyewitness may be confronted with, for example, the sound of cars crashing, a variety of different subject behaviours, different colours and a number of emotions, which all have to be attended to at the same time. It is likely that some information would be filtered out and probably discarded. Information seeming of importance to the filtering system at the time of exposure, or encoding may not be important at the time of testimony. According to Ainsworth (1998), Broadbent and other researchers found that the filtering system could not be completely turned on or off. To illustrate: when a person is concentrating on a particular task the sound of voices or music in the background can be excluded. However, if one of the voices utters the person's name, the filter

may well attend to the voice and away from the immediate task. According to Cowan (1988), Broadbent's theory can be termed a "pipeline model", in which information is transferred in a fixed serial order from one storage structure to the next. Although in the field of cognitive psychology this remains the currently accepted scheme, many researchers are ambivalent towards it, as research findings have proved inconsistent and some authors view the theory as being overly simplistic. Consequently there has been a movement away from a model towards a variety of memory system representations, such as levels of processing, schemata, semantic networks and production systems. As incidents are never presented in a fixed serial order, this is of relevance to eyewitness testimony. The primary implication is that, as many stimuli are presented simultaneously, certain information may not be stored such that other information can be accommodated. For example, a witness may be distracted by sounds of an incident in such a way that important visual information relating to the incident is not stored. Müsseler and Wühr (2001), furthermore, have found that when two speeded response tasks are performed in close succession, performance on the second task is usually impaired. This means that when the second task involves visual identification or encoding of a specific event, it can be influenced by the response planning of the first task. If one is involved in a motor vehicle accident and response planning has to take place to try to avoid the accident, there is a good possibility that this will negatively affect the visual encoding of the event. Added to this, it is also a general fact that some senses are better developed than others, for example some people are better at encoding auditory information and others at the acquisition of visual information. This would imply that if a one's auditory senses are better developed than visual senses and one is exposed to an incident that requires a lot of visual encoding, one would properly better remember the auditory information and have problems recalling the visual aspects of the incident.

Broadbent made an important distinction between STM and LTM, which was further emphasized in the work of Atkinson and Shiffrin.

The Atkinson-Shiffrin Buffer Model

It is generally acknowledged that Richard Atkinson and Richard Shiffrin have developed the most influential information processing model. This is often referred to as the modal model.

The Atkinson-Shiffrin model conceptualises and presents memory in a three-stage system. According to this model, information entering the sense organs is initially held in a sensory store for a short period of time. If this information is attended to, it is transferred to the STM which, as previously mentioned, can hold a limited amount of information for up to about 30 seconds. After this period of time the information is either displaced by new information or, through rehearsal in the STM, passed into the LTM (Atkinson & Shiffrin, 1968; 1971). Atkinson and Shiffrin emphasized the distinction between STM and LTM, because they believed that information could only be passed into the LTM if it was first "rehearsed" in the STM. This implies that the longer a memory trace spends in the STM, the more likely it is to become permanently stored in the LTM.

According to Ainsworth (1998) a criticism against the Atkinson-Shiffrin model is the way in which information is supposedly transferred from the STM to the LTM. As indicated previously, information is automatically sent to the LTM store. This suggests that information about items that are encountered almost every day should be accurately stored in the LTM. This is, however, not the case, as people have difficulty describing in detail commonplace items. Without effort being used to study their design or colour, even everyday items like teacups and pens will not necessarily leave memory traces. And for eyewitnesses, who are very often exposed to information, which is new and unfamiliar in addition to having to contend with pressure and stress, there may be even more negative impact on memory processing. Again, this new, unfamiliar information may not be accurately stored in memory.

Levels of Processing Approach

Although still continuing to view memory as dichotomous, Craik and Lockhart (1972) proposed a "levels of processing" approach to memory. This replaced the concept of structurally separating the STM and LTM systems, with the assumption that the encoding of information was itself the principal factor determining memory trace durability. This implies that the more deeply an item

is encoded, the longer its trace is likely to last. Conversely, if only the superficial characteristics of information are attended to, a lasting memory is unlikely to be formed in the LTM store (Baddeley, 1989). The implication for eyewitness testimony is that in stressful situations, or in situations in which the duration of exposure is limited, memory of the incident may not be permanently stored in LTM. It furthermore seems that important details of the incident might not be stored as only superficial characteristics are attended to.

Working memory

Although many psychologists do not regard memory to be a unitary system, some view the distinction between STM and LTM to be of less importance than previously thought. Baddeley (1986, 1989) has introduced the notion of a *working memory*, which represents a multiple-component model of immediate memory, storing the representations necessary for current actions or simple everyday memory tasks such as problem solving. Lundqvist (1997) describes working memory as a cognitive conceptual system, which apart from storing information also has a function during the processes of rehearsal, elaboration, encoding, retrieval, and decision-making. An example would be adding 49 to 35 without using pen and paper or a calculator, which requires keeping both numbers in mind as well as thinking of the procedure to be used for addition (Cowan, 1988). Baddeley (1989) argues that despite the fact that the concept of working memory bears some resemblance to that of the STM, it fulfils different functions to those suggested by Atkinson and Shiffrin (1968). Baddeley (1986, 1989) recognized that a proper theory of working memory must include both storage and processing components and therefore rejected the idea that working memory reflects a single unitary system. He proposed a model, which assumed there are two auxiliary systems (coordinated by a Central Executive), termed the Visio-Spatial Sketchpad and the Phonological Loop. The Visio-Spatial Sketchpad is responsible for temporarily maintaining visual-spatial images, whilst the Phonological Loop retains speech-based information and translates visual information into a speech-based code. A good way of illustrating these concepts is to ask people to work out how many rooms there are in a house. People will first form a visual image of the house and then count the rooms they imagine from the inside or the outside. In this example the Visio-Spatial Sketchpad allows one to set up and manipulate a visual image, whilst the Phonological Loop allows sub-vocal counting (Baddeley,

1986; 1989). According to Baddeley most people encounter difficulty in trying to perform two tasks at once, if each requires the use of the same part of the system. For example driving a car and trying to rehearse a mental map could be problematic, as both tasks would need the services of the Visio-Spatial Sketchpad. This implies that an eyewitness would encounter problems when involved in a situation in which he or she is attacked by an offender and requires for example the Visio-spatial Sketchpad to direct action in the same situation. It would be difficult for the witness to try to remember important details about the attacker whilst trying to visually imagine a way out of the situation, and physically defend him or herself.

It seems that no one researcher has been able to determine how memory works. Searleman and Herrmann (1994) are of the opinion that although Baddeley's working memory theory has received some good support, the data is not consistent enough to answer the question of how information is processed. It is, however, important to note that all these theories provide grounds for the lack of reliability of eyewitness testimony.

In eyewitness situations, victims are sometimes required to provide a verbal account of what has happened or to identify a perpetrator. A distinction must therefore be made between recall memory and recognition memory. This is further discussed in the next section.

Recall memory versus Recognition memory

Many cognitive psychology researchers view recall and recognition as involving different memory processes. The instruction to memorize a list of words or numbers improves recall memory, but has no effect on recognition memory. This indicates that a given factor could affect one form of memory without affecting the other form (Robinson & Johnson, 1996).

According to Sanders and Simmons (1983), recognition is an easier and less involved process than recall. Research indicates that true recognition memory is very rapid, occurring in a matter of seconds (Benoit, 2000). Robinson and Johnson (1996) add that recall memory tends to be characterized by an intentional and effortful retrieval stage, whereas recognition memory tends to be based on the use of a less intentional and less effortful recall. This implies that an eyewitness

should find it much easier to recognize someone from a photograph or a line-up than to describe how the person looked or what clothes they were wearing.

Deutscher and Leonoff (1991) suggest that recall and recognition are both related to retrieval. Recall requires positive action providing either a verbal or a visual representation, whereas recognition can be compared to a multiple-choice test, where searching for a suitable match is required. Generally recognition memory is viewed as superior to recall memory, although both forms are inherently poor when the object to be recalled or recognized is a face. It is, however, possible that some people would find recognition memory more difficult and confusing than recall memory as can be demonstrated by a student's preference for an exam paper with multiple-choice questions or paragraph questions. Some students might find the multiple-choice questions easier, whilst others prefer paragraph questions. This might be dependent on personal attributes, such as how the work was studied, as well as whether the information to be recalled requires detail or just understanding. The implication for eyewitness testimony is that some people would have a better ability to verbally recall what has happened, but would find it difficult to visually identify the perpetrator. This may explain why so many victims of rape are able to correctly verbally recall all the details of the attack and even describe their assailant (e.g. well-known Cotton case in America, in which Cotton was falsely convicted and years later exonerated), but are unable to identify the correct offender in a line-up identification (which can be compared with a multiple-choice questionnaire) due to problems with recognition memory. Other victims may have superior recognition memory in terms of line-up identification, but may provide inconsistencies regarding recall memory. This has the horrendous potential outcome of some offenders being set free or erroneously be convictions being made as a result of weaknesses in recall or recognition memory.

Thus far attention has been focused on how memory works, and researchers have been unable to answer all of the questions posed. We may better understand how memory works if we learn more about the process of forgetting, to which we will next turn our attention.

Forgetting

Forgetting is defined as the temporary or permanent inability to recall something from memory, or to perform an act that was learned previously (Plug et al., 1997). The fact that we forget indicates according to Baddeley (1976) that information which has previously been stored in the memory store, gets lost in such a way that it cannot be located or retrieved when the specific information is required. Some research indicates that un-retrieved information is, regardless of the method used to try to retrieve it, in most cases, lost forever. Claims that hypnosis brings back "forgotten" information are unsubstantiated (Bartol & Bartol, 1994). Other researchers are of the opinion that forgetting is mostly non-permanent, but that there are factors which hamper recall (Fouché, 1992). In the case of eyewitness testimony these factors may include stress during witnessing of the event, violence of the event, stress at the time of recall, duration of exposure, delay before recall and the type of questioning used to recall information about the event.

It is generally accepted that forgetting is a time-dependent process and that human beings find it more difficult to remember information as the time interval between encoding and recalling increases. If a student has to write a test on the work he has been studying in that year, he should pass without difficulty. However, if he had to write the same test a few years later, he may have problems recollecting the material. In regard to court cases where there is generally an extended period of time between witnessing an event and testifying, the implication is that a lot of information may be forgotten. Although most researchers according to Yuille and Cutshall (1986) have found substantial loss and distortion of information over time, Wrightsman (1987) and Penrod, Loftus and Winkler (1982) highlight that there is also research indicating that despite the rapidity of early memory loss, the rate of loss decreases over time. Hermann Ebbinghaus was the first to indicate how rapid forgetting occurs. He postulated that a great deal of information is forgotten very soon after acquisition and that if information is remembered for as long as a day or two, it is likely to be retained for a much longer period (Goethals & Solomon, 1989; Parkin 1997).

This brings us to the question raised by theorists over the last century: should the loss of information be attributed to decay or interference? Lindsay and Norman (1977), and Reed (1992) propose a decay and interference theory for making predictions about whether the passage of time or the number of interfering items is the primary cause of forgetting. If memory simply decays

over time then the length of the retention interval should determine recall. If memory is disrupted by interference, then the number of interfering items should determine recall.

The "law of disuse" or "trace decay hypothesis" states that memories naturally deteriorate or decay over time, unless prevented by a process such as rehearsing (Baddeley, 1976; 1990). This viewpoint was supported in cases such as *George NO v Minister of Law and Order 1987 (4) SA 222 (SE).* In *In Re Mlambo 1992 (4) SA 144 (ZS*) the following quote from *R v Askov (1991) 49 CRR (Supreme Court of Canada)* was presented: "There can be no doubt that memories fade with time. Witnesses are likely to be more reliable testifying to events in the immediate past as opposed to events that transpired many months or even years before the trial. Not only is there an erosion of the witness' memory with the passage of time but there is bound to be an erosion of the witnesses themselves." Although many theorists support this view, others object that disuse does not always affect retention. An alternative explanation for forgetting was developed as the "interference theory". The basis of this theory, which was mentioned in *S v Bertrand 1975 (4) SA 142 (C)* and *S v Malefane 1974 (4) SA 613 (O)* is that all learning involves the formation of associations and exposure to a new event will make it more difficult to remember something previously learned. As more learning takes place some of the new associations will have elements in common with those already formed, and this interference results in forgetting (Bekerian & Bowers, 1983; Parkin, 1997). Cohen (1999), Baddeley (1990) and Haberlandt (1994) distinguish between two types of interference: retroactive interference in which later learning has an inhibiting effect on earlier learning, i.e. new information blocks out some prior knowledge, and proactive interference in which earlier learning absorbs some of the capacity available for later learning. In the legal context retroactive interference is especially applicable: A witness' memory may be changed by information acquired subsequent to observing the event, e.g. reading the press report, talking to other witnesses, being asked leading questions. Deffenbacher, Carr and Leu (1981) compared the effect of retroactive interference on memory for words, pictures and faces. They found that memory for nouns and objects was relatively immune to retroactive interference in a test given shortly after study, whilst memory for landscapes and faces was greatly affected by interference. However, when compared to other stimuli, faces demonstrated less susceptibility to interference at the longer retention interval and generally showed little long-term forgetting. How does this affect eyewitness testimony? Witnesses

generally testify about the people involved in an event, as well as its scenery, thus testimony involves faces, as well as landscape. Witnesses are usually questioned by the police immediately or shortly after an event i.e. at the time when they are most susceptible to interference, which may be provided by policemen asking leading questions, or by co-witnesses through discrepant information.

There are factors, other than time, that cause memory to decay, even though time may be considered as the source of forgetting. Spear and Riccio (1994) explain that forgetting is merely a function of time, whilst it is the events taking place during the time period which really determine forgetting. Because memory, like perception, is an active process, it can be altered, distorted or replaced by the introduction of new material. Once changed, the original memory is lost, or at least very difficult to locate. These researchers further propose that memory is affected not only by post-event information, but also the psychological need to eliminate uncertainties and inconsistencies. In order to make sense of and complete fragmented events, details are added, which distort the original memory. This multi-factorial view was supported in a recent case *Minister of Safety and Security v Standard Bank of SA Ltd 1999 (3) SA 471 (W)*: " That evidence was given more than four and a half years after the date of the donation. Human memory is inherently and notoriously liable to error. One knows that people are less likely to be complete and accurate in their accounts after a long interval than after a short one. It is a matter of common experience that during the stage of retention or storage in the memory, perceived information may be forgotten or it may be modified or added to, or distorted by subsequent information. One is aware too that there can occur a process of unconscious reconstruction." This viewpoint was also mentioned in other cases such as *The Commissioner for Inland Revenue v Pick 'n Pay Wholesalers (Pty) Ltd 1987 (3) SA 453 (A).*

According to Bekerian and Bowers (1983) and Neisser (1982) theoretical interest in the interference theory has declined to only a few supporters as it has been made redundant by new theories. Loftus (1979, 1981) and Loftus and Loftus (1980) propose a model ("destructive updating") in which old memories are overwritten with new information, resulting in forgetting. According to Loftus and Ketchum (1991) as memory is being recalled, it is reconstructed and with each recollection the memory may be changed. Loftus (1997) mentions that she has

conducted more than 200 experiments (involving more than 20 000 participants) that indicate how misinformation violates memory. This occurs through successive events, suggestion, interrogation, increased understanding of what has happened, and changes to the context in which an event is viewed. It can, for example, easily happen that investigators in a case contaminate the witness's memory by providing information which support their hypothesis about a suspect. Loftus and Guyer (2002) support this notion that the bias of interviewers can influence reports of subjects to be congruent with their bias. Davies (1999) summarises three explanations for the causes of misinformation effect: New information eliminates the original memory by overwriting it, new information has filled the gap in the witness's memory or the new information has not obliterated the original memory but has supplanted it in the forefront of the witness's mind.

Reviewing literature one comes to the conclusion that the best explanation for forgetting is to realise that there are a number of sources for forgetting. These sources may include decay**,** retention intervals, and the acquisition of competing or conflicting memories that might interfere with the memory of a particular aspect of an event. Other factors involved in forgetting include stress during retrieval, the type of questioning used to retrieve information, and the context in which retrieval takes place, as well as estimator variables during the time of encoding (e.g. violence, stress, cross-racial factors or exposure time). Although all these sources can be reduced to a single, common factor as an obstacle in retrieval, one should not become dispossessed from the empirical fact that a variety of operationally distinct sources of forgetting exist.

Kapardis (1999) concludes that despite the controversy over how forgetting occurs, there is a general agreement that the human memory does not operate like a video-recorder (*S v Baleka and others (1) 1986 (4) SA 192 (T)*) as was explained earlier.

Role of context effects in memory retrieval

The extent to which the retrieval situation corresponds with the acquisition environment can significantly influence an eyewitness's ability to provide accurate testimony. Ensuring that the

encoding and retrieval contexts share as many cues as possible can determine improved recall (Goodman & Hahn, 1987). A distinction should be made between the external and internal context that can have an effect on memory. The external context refers to the external environment, whilst the internal context involves the internal physiological state of a subject and his internal mood states. Spear and Riccio (1994) indicate that there is no doubt that less retention can be expected if the context during recall or testing differs sufficiently from that during observation or learning. Gudjonsson (1992) agrees that external factors such as learning context can have an impact on memory retrieval. Proof was provided in a experiment by Godden and Baddeley (1975) in which divers had to learn words in one context (under water or on land) and had to recall these in another (under water or on land). They remembered 40% less if the learning and recall occurred in the different compared to the same environment.

The contextual effect, which involves the internal environment, is termed state-dependent memory and it carries the implication that events learned in one state can be remembered better when one is put back into the same state during recall. Two basic phenomena are related to state-dependent memory (Bower, 1981): the mood-congruity effect which implies that people attend better to events which match their own emotional state, for example if one is sad or depressed one would be better able to recall the details of a movie with sad or depressing contents compared to watching the movie when is happy. Reinstating or reliving the original "state" or "context" maximizes retrieval cues. Mood-state-dependent retention involves that an observer would have better recall of an event if they somehow reinstate during recall the original emotion they experienced during learning. According to Bower's (1981) "associative network theory" emotions serve as memory units, which become associated with certain features of the observed and experienced event. Sara (2000) also adds that the endogenous or physiological state could exert control over the retrieval of memory. Eich (1980) did research with people under influence of alcohol and cannabis and also found that when the recall-state matches the encoding state that retrieval is facilitated. This explains why some alcoholics only remember where they hid their alcohol whilst intoxicated, if they get drunk again.

If it is true that the psychological state or mood of the eyewitness, and the conditions under which information is being retrieved can have a major effect on the outcome of the testimony; the

question of how the courtroom environment in which testimony is given influences recall should be posed. This is a likely reason for the suggestion from researchers that children should be asked to testify in a "friendlier" environment instead of court where totally different and unfamiliar and fearful emotions are likely to be aroused (Dent, 1977; Saywitz, & Nathanson, 1993).

Clark, Stephenson and Kniveton (1990) state that research on memory has generally focused on describing the cognitive processes involved in memory, without taking the social origins of memory into account. They present research that argues that social factors related to the effects of social contexts in general, and intra-group processes determine some aspects of memory. If the recollections of different people in one group coincide, confidence in the accuracy of the recollection is likely to increase. This implies that when people have witnessed, for example, a bank robbery and afterwards share ideas about what has happened, the confidence of the eyewitnesses can be increased if their view of events is similar to that of other eyewitnesses. The reverse is also true: when discrepant accounts of the incident are shared**,** eyewitnesses may start to doubt their own testimonies. This relates to the post-information effect.

CONCLUSION

Much has been written over the past century on the topic of perception and memory. Many researchers have dedicated themselves to discovering how the remarkably complex entity of our memory system works. Although a clearer representation has emerged, much more clarification will be required before we have a full understanding of the processes involved.

There has been very little research on this important topic in the South African context. Therefore there is a need for ongoing scientific investigation into some of the questions found in both psychological and legal contexts. Increased understanding of the processes of memory and perception will have a positive effect in the field of eyewitness testimony by providing criteria which, when applied by psychologists, legal professionals and the police will help ensure more reliable assessment of eyewitness identification and testimony.

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ARTICLE 2

ESTIMATOR VARIABLES AND EYEWITNESS TESTIMONY

CONTENTS

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INTRODUCTION

"Misidentifications create a double horror. The wrong person is devastated by this personal tragedy, and the real criminal is still out on the streets, probably committing further crimes. All this makes eyewitness identification an ideal problem for psychological researchers who have an interest in real-world applications" (Loftus, 1993, p. 550).

Loftus's viewpoint illustrates the double bind of eyewitness testimony. On the one hand eyewitness testimony is often the most influential evidence that can be introduced in a legal proceeding and should therefore never be underestimated. On the other hand, numerous variables can influence the witness's ability to accurately identify persons, remember events and provide reliable testimony. The credibility of eyewitness testimony is therefore questioned as regularly as such testimony is presented. The concern about the reliability of eyewitness testimony has recently reached a new level, since research has shown that a significant number of people in the USA have been exonerated on the basis of DNA evidence after having been convicted on the grounds of someone's eyewitness testimony (Foxhall, 2000; Sinatra, 2000; Wells & Olson, 2003; Wells, Small, Penrod, Malpass, Fulero & Brimacombe, 1998). As it would almost be unimaginable to make court decisions without the assistance of eyewitnesses, there can hardly be any doubt that research in the field of law and psychology should be encouraged to bring about more clarity concerning the accuracy of identification and testimony. Equally important is that all role-players in this field should be kept informed via training and publications of such research and other relevant information.

Berger and Herringer (1991) point out that five factors have been identified by the American Supreme Court that are important for the admissibility of eyewitness testimony: the opportunity to view the offender at the crime event; the passage of time between the event and the identification or testimony, the level of certainty of the eyewitness; the accuracy of the witness's prior description of the offender, and the witness's degree of attention during the crime.

However, some variables that hamper these factors proposed by the Supreme Court are not mentioned, e.g. own-race bias, stress, violence, post-event information, suggestion and suggestibility of the witness.

Surveys were also executed at different times to assess the extent to which experts in the scientific community view various eyewitness phenomena as being reliable for presentation in court (Kassin, Ellsworth & Smith, 1989; Kassin, Tubb, Hosch & Memon, 2001). More than eighty percent of the eyewitness experts in both studies were in agreement that the following factors could have an effect on the reliability of eyewitness testimony: the confidence, expectations and degree of alcohol intoxication of the witness. A lack of consensus existed about the influence of factors such as stress, accuracy of testimony of child and older eyewitnesses, and occupation (in the case of trained observers, e.g. the police). However, caution should be exercised in accepting the opinion of these experts as reliable, as their consensus might be misguided, which would invalidate the generalisation of these phenomena (Elliot, 1993). This re-emphasises the need for the evaluation of findings of previous research, as well as for the conduction of new research in order to provide clarity regarding the reliability of eyewitness phenomena.

A distinction is currently being made between two kinds of variables that impact on eyewitness testimony (Wells, 1978; Wells, Malpass, Lindsay, Fisher, Turtle & Fulero, 2000; Wells & Olson, 2003). Estimator variables, over which the criminal justice system exerts little or no control, are classified into witness factors (e.g. lighting conditions, stress experienced by the witness during the event, as well as the occupation, age, gender, race, perceptual skills and individual differences of witnesses), target factors (e.g. the suspect's physical appearance and weapon focus) and situational factors (e.g. variables associated with the incident, such as the severity of the incident and a witness's opportunity to view the suspect). System variables, on the other hand, refer to factors that are directly under the control of the criminal justice system and can be altered to increase accuracy in court cases. These factors include the number of foils in a line-up, the selection of line-up members, post-event information, questioning techniques and court proceedings (Narby, Cutler & Penrod, 1996; Wingfield & Byrnes, 1981). The distinction between estimator and system variables is, however, not always sharply defined (Kapardis, 1999). Although the impact of the factors that can potentially influence eyewitness testimony

appears to be generally recognised, it also seems to be true that in-depth knowledge concerning aspects such as the interaction between these factors is often, if not mostly, lacking in those professions (e.g. the legal profession and the police force) where such knowledge could play a significant role.

An overview of the relationship between estimator variables and eyewitness testimony will be provided next, while the effects of system variables on eyewitness testimony are discussed in the next article.

WITNESS FACTORS

Witness factors concern the aspects affecting the eyewitness at the time of exposure to an event, or those factors which are intrinsic to the eyewitness that correlate with accuracy of recall, namely the stress and trauma which the witness experiences as a result of the event; occupation; age; gender; individual differences; confidence of the witness; expectations of the witness; and alcohol intoxication.

Stress experienced by the witness

Over the past few decades, psychologists have tried a variety of research approaches to determine how people remember emotional events (Christianson & Loftus, 1991). True to the tradition in scientific research, contradictory findings exist concerning the influence of stress (and trauma) on eyewitness testimony.

- On the one hand it has been found that stress is a likely mediator of memory performance in the forensic context (Saywitz & Nathanson, 1993). The general view among scientists has been that stress decreases attention, reduces motivation, and interferes with efficient memory searches. One of the earliest attempts to provide a theoretical framework in relating the effects of arousal to information processing was the Yerkes-Dodson Law. This suggested that extreme stress and anxiety would interfere with a person's ability to acquire and process information (Yarmey & Jones, 1983). Two major assumptions underlie the Yerkes-Dodson Law. Firstly, optimal performance is associated with moderate levels of arousal or motivation. Secondly,

higher levels of arousal or motivation are associated with better performance for easy tasks but lower performance for difficult tasks. This indicates an inverse relationship between arousal or motivational level and task difficulty (Searleman & Herrmann, 1994).

In 1959, Easterbrook proposed a hypothesis that offered an explanation and support for the two assumptions of the Yerkes-Dodson Law. This theory explained that when an animal experiences a high state of arousal, emotionality, or anxiety, its focus of attention narrows to only a few cues in the environment. This narrowing of cue utilisation has the beneficial effect of decreasing the number of irrelevant cues that the animal uses. However, any further reduction in cue utilisation, or further narrowing of attention, will have the detrimental effect of eliminating relevant cues (Searleman & Herrmann, 1994). For humans this would imply that as arousal increases, attention becomes so focused on central details that peripheral details are excluded. If arousal increases past the optimum level owing to the restriction of attention, even central cues can be excluded (Christianson & Loftus, 1991; Goodman, Hirschman, Hepps & Rudy, 1991).

Strong support for the Yerkson-Dodson Law and the Easterbrook Theory is found in eyewitness literature where research has indicated that high levels of emotional stress lead to an impairment in memory performance (Clifford & Hollin, 1981; Dobson & Markham, 1992; Siegel & Loftus, 1978). A single arousing aspect of an incident can have a repressing effect on memory with the result that the aspect is generalised to such an extent that it is equated with the memory of the whole incident, while severe emotional stress has the ability to cause false memories (Begley & Brant, 1994; Clifford & Scott, 1978).

Strong consensus exists among eyewitness experts that stress or event violence has a detrimental effect on memory, as a survey conducted 63 experts on eyewitness testimony indicated (Christianson & Hübinette, 1993). Seventy-nine percent of the experts believed that very high levels of stress impair the accuracy of eyewitness testimony. In a survey of 100 police file cases Kuehn (1974) indicated that the type of crime had been a significant factor affecting the completeness of reporting --- victims of robberies provided a significantly fuller report on their assailant than rape or assault victims did. It could be hypothesised that completeness of reporting decreased as emotionality of the crime increased.

o On the other hand, some researchers are of the opinion that witnesses to violent crimes and other real-life emotional events often perform better than eyewitness literature suggests, and that a strong emotional response does not reduce memory accuracy. Most eyewitness studies regarding memory for emotional events are largely based on laboratory findings and the results do not tally with eyewitness memory in respect of real-world situations. According to the findings of Yuille and Cutshall (1986; 1989) and Yuille and Tollestrup (1992), memories of real-life events, especially when victims or witnesses have been exposed to threat and trauma, tend to be detailed and accurate, even after an extended passage of time. This is corroborated by recent physiological studies which indicate that adrenalin causes increased consolidation of memory, thus providing a mechanism for heightened retention of stressful experiences (Goodman et al., 1991). Yuille and Cutshall's findings, however, have been criticised. Their work is based upon a single stressful event, and does not include an appropriate control event to support their conclusion about the stress-memory relationship. Extremely high accuracy scores had been obtained, which could be related to the fact that only the recall accuracy scores of those witnesses who were prepared to participate in the study had been reported. Those witnesses who felt that they had relatively incomplete or inaccurate memories may not have participated in the study (Christianson & Hübinette, 1993).

o The stress-memory relationship is possibly not so simplistic as to unambiguously reduce or increase memory recall. Various factors may affect this relationship. Firstly the "weapon focus phenomenon" illustrates that it should not be concluded from research results that all details of highly emotional events would be remembered more vividly or less vividly than the details of neutral events. The attention of a victim to a hijacking could be captured by a weapon, which would vividly isolate the weapon at the expense of other "less important" details. It is possible that in many studies, the memory for certain aspects of an emotional experience is actually quite good, but is simply not properly measured in the study (Christianson & Loftus, 1991).

Secondly, memory performance may vary across item information. This is demonstrated by Christianson and Hübinette's (1993) research findings based on the memories of 58 witnesses of 22 bank robberies. Fairly high accuracy scores in respect of many specific details about the robbers (e.g. actions, weapon, clothing) were obtained after an extended time interval by the eyewitnesses. Other details of the appearance of the robbers (e.g. footwear, hair and eye colour)

showed rather low accuracy scores. Some details might not have been processed and retained because of disadvantages in respect of the viewing point (the angle at which eyewitnesses had viewed certain details). However, it is also possible that the information was originally perceived and properly encoded, but that the witnesses could not recall these details later on. It was also found that specific aspects of the robberies (e.g. date, time, other people) were less accurately recalled, which is in conflict with the theory that circumstances associated with traumatic experiences are remembered in great detail and are almost immune to memory deterioration (Christianson & Hübinette, 1993).

Thirdly, stress might have both positive and negative effects on memory. Baddeley (1972), for example, mentions the possibility that stress may narrow attention, leading to poor memory for certain details, but that it may aid consolidation of other details which are retained particularly well. Christianson (1992), as well as Christianson and Loftus (1991), indicate that highly negative emotional events are relatively well retained, both in respect of the emotional event itself and in respect of the central, critical detail information concerning the emotion-eliciting event. In addition, over a period of time certain critical detail information concerning emotionally arousing events, along with some circumstantial information is less susceptible to being forgotten, compared with detail information in neutral events. However, they feel that it is safer to assume from current research that some central detail information from the emotional event is well remembered, while some peripheral detail information is poorly retained. Migueles and Garcia-Bajos (1999, p. 266), for example, found in a recent study, in which they examined the recall and recognition of actions and details concerning the central and peripheral information related to a kidnapping: "…when the materials allows for precise distinction between the actions and details of an emotional event, it is noted that eyewitness' attention is drawn to central actions to the detriment of descriptive details, while as for information not connected to the emotional focal point, as may be the case of more neutral events, attention is distributed more homogeneously between peripheral actions and details. As a consequence, more central actions are recalled and recognised than peripheral ones, but also more peripheral details than central."

The stress-memory relationship indeed appears to be complex and it cannot simply be concluded that the more negative the emotion or stress, the poorer the memory will be; nor, conversely that intense emotion leads to detailed, accurate, and persistent memory. The conflicting results in this

particular area could be the result of factors such as differences in methodology, e.g. the type of event that is presented (violent or non-violent), how the event is presented (real-life, simulation or video); the type of information which is required during recall (central or peripheral); and the passage of time after presentation of the event (immediate or delayed) (Christianson, 1992). It also goes without saying that the paradigm or theoretical orientation of the researcher can also influence the interpretation of the findings.

Training, experience and educational level of the witness

Another relevant aspect regarding memory ability is the differences in accuracy between trained and untrained subjects (Clifford & Richards, 1977). Do the police, for example, provide more accurate eyewitness testimony than civilians? A popular viewpoint is that police officers, because of their training and years of experience, should be more reliable eyewitnesses than civilians. Some evidence indeed supports this notion. Clark, Stephenson and Kniveton (1990) found that police subjects were consistently more accurate than students within different recall conditions (that is individually, in dyads and in four-person groups). Christianson, Karlsson and Persson (1998) assessed four groups on different aspects of a crime and their ability to recognise the perpetrator by using a series of slides to simulate a violent crime. The results indicated that police officers with at least three years' professional experience were more accurate than police recruits, civilian students and teachers at remembering details of the crime. The difference had been found not to be related to age, general working experience or better memory capacity *per se* among police officers.

Other researchers disagree, having found police officers to be no more proficient than the general public at perceiving and remembering events, actions and people; they have the same limitations in processing and recall as the average person. Members of the police might even be more likely to misinterpret events, owing to their past experience and training and might be inclined to regard non-criminal behaviour as criminal (Ainsworth, 1981; Clifford, 1976; Clifford & Richards, 1977). According to these findings it seems that experimental evidence has failed to confirm the belief that the training and practical experiences of police officers make them superior eyewitnesses for details of criminal events.

Many studies, however, have been carried out in laboratory settings where photographs and videotapes were used, which may have had an effect on the outcome of research findings. Clifford and Richards (1977) assessed the memory of police officers and civilians in a natural setting and found that the superiority of the memory performances of the police only manifested itself after the observers had had an opportunity of prolonged exposure. At short exposure there was no difference observed between the police officers and civilians in the amount of detail correctly recalled.

Kapardis (1999) summarises research findings on the comparison between the memory of police officers and civilians well by indicating that police officers are no more vigilant than civilians unless an event of long duration is involved; their recall is no more accurate than that of civilians. In fact they make more errors of commission while nevertheless appearing to feel very confident in their testimony; their cross-race recognition accuracy is as poor as that of civilians, even when police officers have worked in black neighbourhoods; generally there are conflicting findings as to whether their ability improves with length of service; and finally, they are prone to put criminal constructions on events they witness and even to report events and details that never existed.

As far as educational level is concerned, a distinction should be made between eyewitness identification tasks (as in police line-ups) and verbal recall (description of what has been seen). Adams-Price (1992) found that less educated individuals performed more accurately than more educated individuals in an identification task, which could be related to the fact that verbal rehearsal of a face apparently interferes with its later recognition. Well-educated individuals tend to engage in more verbal rehearsal than the less educated, which seems to result in better verbal recall than identification accuracy. However, Loftus, Levidow and Duensing (1992) found that subjects with high levels of education were more accurate than those with poor education, but that they did not show more resistance with regards to suggestibility. This means that when questioning regarding eyewitness events contains suggestive content, the more educated will not necessarily respond more accurately.

Age of the witness

All over the world, and especially in South Africa, there has been increased concern in the press and parliament about the crimes children are exposed to. More children than ever have to provide information to the police and testify in court about crimes such as rape, family violence and even murder. The question of whether the accuracy of eyewitness testimony is influenced by developmental differences is thus highly relevant.

To be able to testify in court a child must be legally competent. In order to meet the necessary criteria, the child must have the capacity to observe an event, recall information thoroughly and with accuracy, and be able to communicate effectively (Hollely & Müller, 1999). It is further expected that the child should be able to distinguish between truth and falsehood and that he/she should be aware of the obligation to speak the truth. However, children's ability to provide accurate eyewitness testimony is often hampered owing to problems with language skills, memory ability, suggestibility, knowledge of the legal system and emotional factors.

Research on whether child and elderly witnesses provide less accurate eyewitness testimony than adults has produced conflicting findings. However, most findings seem to indicate that child eyewitnesses are more suggestible than their adult counterparts, which makes their testimony less reliable (Candel, Merckelbach, Muris, Rasquin, & Bollen, 1998; Luus, Wells & Turtle, 1995). Ceci, Crossmann, Gilstrap and Scullin (1998) report in an overview on previously conducted research that 18 out of 20 studies support this finding.

Several studies also report broad-ranging developmental improvement for eyewitnesses. In one study, for example, it was found that the amount of correctly recalled information, the ability to answer specific questions, to make identifications, and to resist suggestion increased with age. The amount of incorrectly recalled information did not increase with age (Goodman & Reed, 1986). Another study indicated that completeness of free recall and memory tasks ranging from repeating a story to recalling word lists improved linearly across age groups ranging from pre-school to early adolescence (Leippe, Romanczyk & Manion, 1991). Young children tended to give highly incomplete memory reports, while recognition of once-seen faces and objects

improved with age.

In their study on suggestibility, Cohen and Harnick (1980) found 9-year-olds to be more suggestible than 12-year-olds and adults when questioned about a movie depicting various criminal activities. These researchers ascribed the differences in suggestibility to differences in participants' initial memory for events, as well as inferior initial encoding of the information.

In contrast with the abovementioned research findings, Dent (1992) indicates that children, even as young as six years, have the ability to be as accurate as adults when required to respond to objective, as well as suggestive questions. Marin, Holmes, Guth and Kovac (1979) indicated that even five-year-olds were as capable as adults of answering direct questions and identifying a person they had seen from a photograph, but that they were less capable than adults of providing a narrative description of what they had seen. Other researchers found that even very young children, when allowed to recall information freely or when information is elicited through the use of general questions, can give evidence that is as accurate as that given by adults. However, they consistently provide less information, which is explained by the fact that children make "errors of omission" and may not report all the information potentially available to them when answering general questions (Cassel & Bjorklund, 1995; Goodman & Reed, 1986; Hutcheson, Baxter, Telfer & Warden, 1995).

It has also been found that children have a pronounced guessing propensity compared to adults (Parker & Ryan, 1993). This could be explained by the view that children do not always indicate their failure to understand questions and that they are sometimes probably not even aware that they do not understand complex questions (Carter, Bottoms & Levine, 1996; Hollely & Müller, 1999).

Most eyewitness research studies have consisted of attempts to study memory in its "purist" form in laboratory settings without considering the emotional and contextual factors impacting on accuracy of reporting. The physical and psychological setting in which remembering and testimony occur, influences the ability to recall and is likely to have an effect on developmental differences (Coxon & Valentine, 1997; Luus, Wells & Turtle, 1995; Saywitz & Nathanson, 1993). Researchers seem to be in agreement that the type of questioning and the manner in which

children are questioned do affect their ability to recall accurately. Children may present more accurate testimony in a laboratory setting than under conditions with high forensic value (Luus & Wells, 1992; Peterson, Dowden & Tobin, 1999). It was found that children's memory strategies were far less efficient in an unfamiliar laboratory setting than in their home environment: they produced less complete descriptions of past events in free recall and made more errors in response to direct and misleading questions compared to their peer group questioned at school (Ceci, Bronfenbrenner & Baker, 1988). However, children in a warm, supportive environment were more likely to resist misleading suggestions than those interviewed under intimidating circumstances (Carter, Bottoms & Levine, 1996). All these results lend support to the notion that certain characteristics of the courtroom context interfere with children's ability to provide accurate testimony. Another aspect which tends to increase narrative recall and decrease suggestibility is encountered when children participate in an incident rather than merely observing it. It is argued that participation increases attention, which may improve the active processing and encoding of an event (Gross & Hayne, 1996; Rudy & Goodman, 1991).

Eyewitness research tends to focus very much on developmental differences between children and adults, often neglecting the investigation of the eyewitness capacity of the elderly. Although the elderly are being viewed as being honest in their testimonies, the general perception is that the elderly are forgetful and thus make less reliable eyewitnesses than young adults. Yarmey and Kent (1980), however, found that elderly subjects could be as accurate as young college students at identifying an assailant seen in a series of slides depicting a crime. But according to Adams-Price (1992), these results might have been skewed by the high drop out rate of older subjects. Most studies seem to indicate that the elderly are less accurate than other age groups in visual memory tasks, direct- and cross-examining tasks, as well as line-up tasks (Brimacombe, Quinton, Nance & Garrioch, 1997; Loftus, Levidow & Duensing, 1992; Searcy, Bartlett, Memon & Swanson, 2001). Coxon and Valentine (1997) indicate age differences to be less obvious when memory is tested on the basis of recognition. Another study found that the elderly were less accurate than 10-year-olds and college students in a free recall of shoplifting videos, whilst the 10-year-olds were less accurate than the college students and the elderly in a recognition test (List, 1986). Adams-Price (1992) found that her results provided some support for the hypothesis that eyewitness identification accuracy declines with age.

In conclusion, possibly the best explanation for developmental differences among eyewitnesses is the view of Durham and Dane (1999) that eyewitness ability improves with age up to a point and then declines as an individual grows older.

Gender of the witness

The question whether gender differences in the accuracy of eyewitness testimony exist, has been the subject of a long-standing debate in the eyewitness literature (Shaw & Skolnick, 1994).

It was originally believed that the eyewitness identifications of males were more reliable than those of females. William Stern, a German-American psychologist, who carried out the first empirical study on gender differences in eyewitness testimony in 1903 and 1904, suggested that male subjects were better at remembering facts and less influenced by misleading questions (Butts, Mixon, Mulekar & Bringmann, 1995). Later, some research confirmed this stance. For example, Kuehn (1974) found that female victims gave significantly less complete descriptions of assailants than did male victims, while Adams-Price (1992) reported that male subjects recalled more details from films than female subjects.

Other researchers found the contrary (Casiere & Ashton, 1996; Shepherd, Ellis & Davies, 1982; Yarmey, 1993). Marin et al. (1979) found that females performed as well as the males in general, but were significantly better at answering objective questions. A meta-analysis by Shapiro and Penrod (1986) indicated that females seemed to be slightly more likely than males to make correct identifications, but also slightly more likely than males to make false identifications. From this finding it can be deduced that females have a stronger tendency to report recognising a person than males, regardless of whether the person was actually seen. The magnitude of this gender difference, however, was not significant. Clifford and Scott (1978) are of the opinion that evidence suggests that females should be better witnesses than males --- females have a greater opportunity to learn to encode facial features than males, owing to greater exposure to magazines and cosmetic literature. Females are also reported to be more socially attentive and motivated than males, which should predispose females to be better at retaining and recalling socially

significant stimuli, of which faces form a special subclass. Evidence suggests that females attend to faces ontogenetically earlier than males, which could explain why a number of researchers found a significant female superiority with regard to recognition of face photographs. Furthermore, although face photograph research is characterised by artificiality and problems in respect of extrapolation to the situation outside the laboratory, female superiority has still manifested itself in situations in which the initially witnessed person appeared live or on videotape (Clifford & Scott, 1978).

Some studies indicate no gender differences in accuracy of reporting (Loftus, Levidow & Duensing, 1992) or resistance to misleading information (Butts et al., 1995). The mentioned study of William Stern was re-examined by Cunningham and Bringmann (1986), using adults of comparable ages, and no gender differences were found among adults or children. Brigham and Barkowitz (1978) and Narby, Cutler and Penrod (1996) conclude that the gender of the witness has little influence on identification accuracy.

The abovementioned equivocal results could possibly be explained by external variables which can impact on the respective gender. Females, for example, have been indicated to be more accurate about female-oriented details, whilst males were more accurate eyewitnesses about male-oriented details (Powers, Andriks & Loftus, 1979; Shaw & Skolnick, 1994). Females were also more accurate than males when a female rather than a male bystander or confederate in a crime had to be identified (Christiaanson, Ochalek & Sweeney, 1984; Yarmey & Kent, 1980). Research results also indicated that females were more accurate in situations in which structured testimony had to be provided, as well as when the questioner was supportive instead of antagonistic (Lipton, 1977). Clifford and Scott (1978) suggest that males and females do not differ significantly concerning non-violent conditions, but that in violent conditions females are significantly less accurate than male witnesses. Kuehn (1974) also found that females provided less complete reports than males in connection with crimes of high emotional loading. This is, however, discrepant with a study by Lipton (1977), who reported that female witnesses were better than males at recalling details from a violent videotaped scene of a shooting and robbery.

Confidence of the witness

The correlation between confidence and eyewitness accuracy, i.e. the degree of insight that eyewitnesses have into the accuracy of their memories, has been studied extensively (Robinson & Johnson, 1996; Smith, Lindsay & Pryke, 2000). The confidence-accuracy relationship has been viewed by the legal system as one of the most important indicators of witness accuracy. Responses of eyewitnesses who appear confident of their answers are more likely to be perceived as correct (Kapardis, 1999; Loftus, 1980). The confidence of a witness is sometimes even regarded as more important than objective evidence such as fingerprints, fibre analyses, and DNA matches (Johnson, 1998). This, however, could have distressing consequences, owing to the potential prevalence of confident yet inaccurate eyewitnesses.

Although the confidence-accuracy relationship appears to be highly valued by the legal system, there is some consensus that the confidence-accuracy correlation for eyewitness identifications tends to be relatively small (Kassin, 1985; Lindsay, Wells, & Rumpel, 1981; Robinson & Johnson, 1996; Smith, Kassin & Ellsworth, 1989). Empirical evidence suggests that the relationship between eyewitness confidence and accuracy is statistically unreliable and generally too weak to be useful in forensic settings (Shaw & McClure, 1996; Shaw, McClure & Wilkens, 2001; Wells & Bradfield, 1998). Wells and Leippe (1981), for example, found that the confidence expressed by those witnesses who identified an innocent line-up member, averaged at almost exactly the same level as the confidence expressed by witnesses who identified the guilty party. Other researchers also suggest that pre-line-up and line-up confidence are poor indicators of accuracy (Cutler & Penrod,1989; Yarmey, Yarmey & Yarmey, 1996).

The poor confidence-accuracy relationship could be explained by the fact that confidence and accuracy tend to be conflated, while they are actually two totally different concepts. Accuracy is related to factors influencing perception and memory, whilst confidence involves social phenomena such as self-belief, anxiety and rehearsal (Horowitz, Willging & Bordens, 1998; Wells et al., 2000).

Eyewitnesses' confidence can be influenced by external factors such as co-witnesses'

information, feedback or the satisfaction expressed by police officers when eyewitnesses are identifying a suspect (Wells & Bradfield, 1999; Wells et al. 2000;). It is further suggested that such inflation of confidence may be greater for inaccurate witnesses than it is for accurate witnesses (Wells, Ferguson & Lindsay, 1981). Wells and Bradfied (1998, p. 74) mention that " a confirming-feedback remark not only inflates eyewitnesses' recollections of how confident they were at the time, it also leads them to report that they had a better view of the culprit, that they were able to easily and quickly pick him out of a line-up, that his face just 'popped out' to them, that their memorial image of the gunman is particularly clear, and [that] they are adept at recognising faces of strangers." Thompson (1998) postulates that the feedback about accuracy of memories might have both general and specific effects on confidence-recall accuracy, which means that an increase in confidence-recall accuracy may be specific to the items for which feedback was provided or it may generalise to other instances of recall. It was further found by Kassin (1985), and Kassin, Rigby and Castillo (1991) that in a state of retrospective self-awareness as manipulated via videotape, that the correlation between confidence and accuracy increased significantly.

Yet not all researchers are in agreement with the general finding that the confidence-accuracy correlation is weak. Some support the view that eyewitness confidence may be a more reliable indicator of witness accuracy than the literature indicates (Read, Lindsay & Nicholls, 1998). Ebbesen (2000) emphasises that the conclusion that confidence is overestimated as a predictor of accuracy is based on assumptions. This conclusion, however, seems to be unreasonable in its application, owing to problems regarding the theory, methodology and research results of the laboratory studies on which it is mostly based. Fleet, Brigham and Bothwell (1987) support the opinion that there might be problems regarding the ecological validity of the finding that the confidence-accuracy relationship is unreliable. Some field studies indicated a significant correlation between confidence and accuracy. Brigham, Maass, Snyder and Spaulding (1982) indicated that 85% of eyewitnesses who were confident about their identifications, were correct. Robinson and Johnson (1996) found participants to have significant insight into the accuracy of their memory for the details of a crime event. The overall confidence-accuracy correlation was substantial and significant no matter which version of this correlation was computed, although the within-subject correlation tended to be stronger than the between-subjects correlation. A low,

but significant correlation between self-reported facial recognition skill and the proportion of correct identifications had also been found (Olsson & Juslin, 1999).

Several researchers suggest that factors that may have an adverse effect on the confidence-accuracy relationship need to be considered. Adams-Price (1992) and Kebell, Wagstaff and Covey (1996) suggested, for example, that insufficient attention has been paid to item difficulty and the question of whether questions asked focus on main or detailed points of an event. It seems that when questions, which vary in difficulty are used, the probability of producing "absolutely certain" or "pure guess" responses is maximised. Furthermore, the easier the questions the more confident and more accurate participants are in their responses. The confidence-accuracy correlation could thus possibly be considerably higher than has previously been reported. Kebbell, Wagstaff and Covey (1996) in conclusion suggest that a high confidence-accuracy correlation is most likely to occur when (a) the items to be remembered are relatively heterogeneous in terms of difficulty; (b) the calculations are performed on aggregate scores; and (c) subjects are "absolutely certain" of their responses. In addition to item difficulty, the manner in which eyewitnesses are questioned could also influence confidence ratings. In their meta-analytic review of 30 studies Sporer, Penrod, Read & Cutler (1995) found that recall memory questions had a significantly stronger confidence-accuracy correlation than recognition memory questions. They further emphasise that insight into the accuracy of the memory process also depends greatly on the intention and effort of the witness.

Expectations of the witness

The proverb which states that: "Things are not the way they are, but the way we are," implies that we often see things in the way we do, because of our subjective perceptions and opinions about ourselves and the world we live in. These perceptions and opinions create expectations that make individuals perceive what they expect to see, rather than what they do not expect to see (Bartol, 1983). The assumption that the expectations of an eyewitness influence perception and memory is explained by the fact that when an event is predictable, a witness' expectations support the encoding and recall of the event (Goodman et al. 1999; Goodman & Hahn, 1987). Foley (1993) also mentions that people tend to form first impressions of others and these first

impressions, although sometimes totally incorrect and subjective, continue to influence perceptions of later behaviour. This is the consequence of the tendency to fall back on the stereotyped beliefs of the world we live in. Such beliefs include racial prejudice, attitudes and stereotypes that can cause generalisations about criminal appearance and can influence eyewitness identification accuracy. An individual who fits the stereotype of a criminal is more likely to be convicted than other people (Ainsworth, 1998; Narby, Culter & Penrod, 1996). Goodman et al. (1999) add that whenever an event is viewed under ambiguous, fast-moving circumstances, expectations will tend to increase inaccurate observations. However, the opposite is also true: when an incident is neither too ambiguous nor too rapid, expectations generally provide support to perceptions.

Alcohol intoxication

Researchers agree that alcohol impairs sensory-motor, cognitive functions and information processing. In general the law also accepts this viewpoint (Kassin et al., 2001).

It seems that alcohol especially affects short-term memory (Zhang, Begleiter, Porjesz & Litke, 1997). Nordby, Watten, Raanaas and Magnussen (1999) studied the effects of alcohol on immediate ordered recall in a practical number-dialling task. The results showed that even moderate doses of alcohol affect the performance of short-term memory. Apart from short-term memory, alcohol intoxication has also been demonstrated to impair other areas such as working memory and speed of task completion (Zhang, Begleiter & Porjesz, 1997), visual and depth perception (Wegner & Fahle, 1999), and meta-memory judgement (Nelson et al., 1998).

Although researchers have found that numerous functional areas are impaired by alcohol and although inferences could be made on the basis thereof eyewitness testimony, a dearth of empirical findings concerning the effect of alcohol and other drugs on eyewitness testimony *per se* still exists. It is therefore important that variables such as the correlation between the traumatic intensity of a witnessed event and the blood alcohol level should be researched.

Individual differences

However, it is important to realise that the role of individual differences in respect of the abovementioned variables should always be taken into account. It should be remembered that the findings of the research usually refer to the average responses of a group and do not always reflect the golden rule in psychology, namely that every individual is unique. These individual differences manifest themselves mainly in two ways. Firstly, even people classified as belonging to the same specific personality type or IQ cluster show individual differences within the limits of that type or cluster. Secondly, owing to various internal and external factors the same individual can act differently at different times in the same or similar situations.

PERPETRATOR FACTORS

Perpetrator (target) factors involve the characteristics of the person who is to be identified, such as the suspect's physical characteristics and appearance. When a perpetrator is identified not only facial features are judged, but also non-facial information such as race, body shape, dimension and movement, which will be discussed next (Kapardis, 1999).

Cross-racial identification

There is wide concern about own-race bias in eyewitness identifications, as this could negatively affect the identification of persons of another race (Herrera, McQuiston, MacLin & Malpass, 2000). Despite the fact that Teitelbaum and Geiselman (1997) argue that some people in the legal system may fail to raise the issue because it may appear racist in nature, this topic has been widely discussed in eyewitness literature.

Most eyewitness memory experts hold the view that cross-racial identifications are less reliable than own-race identifications (Holguin, McQuiston, MacLin & Malpass, 2000; Chance & Goldstein, 1996). It seems that eyewitness testimony is especially unreliable when dealing with strangers (as opposed to acquaintances) of another race (Fine, 1999), a tendency that increases with the age of the witness at least into adulthood (Goodman et al., 1999). A meta-analysis carried out by Bothwell, Brigham and Malpass (1989) indicates that the own-race bias effect is

prevalent: it was observed in the case of both black and white subjects in 79% of the samples considered. Teitelbaum and Geiselman (1997) support the findings of Bothwell et al. by stating that two meta-analyses of 14 and 18 laboratory studies respectively, as well as two additional ecologically valid field studies, all confirmed the cross-race effect. More specifically a 10% to 50% difference in accuracy between own-race and cross-race identifications had been found. It was furthermore indicated that Latino and Asian participants had less difficulty in recognising white faces than black faces. Wright, Boyd and Tredoux (2001) found in their field study which was conducted in South Africa and England that there was a consistent pattern for own-race bias. They indicate that the odds for an accurate identification are twice as high when the participant and the person who has to be identified are of the same race compared to when they are from different races. Other researchers such as Chance, Goldstein and McBride (1975) and Feinman and Entwisle (1976) also corroborate the own-race bias effect, having obtained clear cross-over interactions for black and white subjects identifying black and white faces. Wingfield and Byrnes (1981) and Wells (1978) found that white witnesses distinguish more accurately among white suspects than they do among black suspects. Although the same applies to black witnesses, they seem to show only a small difference in their discriminatory recognition judgements for black versus white faces. Louw and Fouché (1996) also have found in a South African study that race and ethnicity do impact on face recognition with differential face recognition present in white subject, but not in black subjects.

However, Lindsay and Wells (1983) have questioned whether the effect of an own-race bias exists at all. They regard the view that cross-race identification is less accurate than own-race identification as premature and oversimplified. Despite their scepticism they acknowledge that various studies indicate that race does have some influence on facial recognition. The pattern of that influence, however, varies across studies and the only consistent finding seems to be that white witnesses identifying white faces produce the highest rate of accuracy. Analysis of the results of a South African study by Aronstam (1980) showed no differences in reliability of testimony between groups, and thus no racial bias. Egeth (1993) holds the opinion that although own-race bias may exist, the magnitude of the cross-race effect is small, and that cross-race identifications would only be inaccurate in about 15% more cases than same-race identifications.

Weapon focus

The weapon focus effect refers to the diminished ability of an eyewitness to subsequently identify a perpetrator when a weapon was used in a crime. The arousal properties of the weapon may induce fear in witnesses, causing them to concentrate on the weapon instead of on the perpetrator. This focus on the weapon may leave little processing time and attention for other details such as the perpetrator's face, which could be related to the fact that incongruous and unexpected objects result in earlier, more frequent and longer eye fixations than more usual, everyday objects do (Shaw & Skolnick, 1994; Loftus, 1979).

According to a meta-analytic review of the weapon focus effect in 19 studies, 6 studies corroborated the weapon focus effect, none suggested a significant opposite effect, and 13 indicated no significant differences between weapon-present and weapon-absent conditions (Steblay, 1992). Despite the high number of non-conforming results regarding the reliability of the weapon focus phenomenon, nearly 60% of experts in the eyewitness testimony field viewed the weapon focus effect as reliable enough to present in courtroom testimony.

In another meta-analysis it was found that the impact of the weapon-focus effect was small when the perpetrator had to be identified in a line-up, while it was moderate when eyewitnesses had to give a description of the perpetrator in his or her absence (Egeth, 1993). However, it seems that stronger weapon focus effects are obtained with more complex stimuli and higher arousal levels (Shaw and Skolnick, 1994).

SITUATIONAL FACTORS

Situational factors refer to the characteristics of the crime event, and include variables such as crime seriousness and the duration of exposure to the crime.

Crime seriousness

It is generally accepted that the seriousness of the crime can affect the accuracy and detail of the testimony of both the witness and the victim. It was found that victims of robberies provided better descriptions than rape or assault victims and that injured victims provided less complete descriptions than uninjured victims (Kuehn, 1974). Researchers such as Clifford and Scott (1978) and Berger and Herringer (1991) further found that there was a large decrease in witness' ability to remember details of violent incidents as compared to less violent incidents in a film. The violence also negatively influenced the level of confidence of the participants during recall. The reason for these findings can possibly be found in the impact of the associated stress and emotionality of the event. This suggests that a single arousing aspect of an event can have a repressing effect that generalises to include the whole event (as discussed earlier in this article under witness factors).

The seriousness of the crime, however, does not only relate to the emotional and violent content of a crime, but also, for example, to the value of stolen goods. It was found that witnesses were more accurate in identifying a suspect from a photograph when the stolen object in a staged crime was worth $50 than when the object was worth $1.50. However, if the subject did not know the value of the stolen goods until 60 seconds after the theft, the value had no effect on the later recognition of the suspect (Leippe, Wells & Ostrom, 1978). This implies that the value of the stolen goods has to be known at the time of the crime in order to produce an effect on recognition.

True to tradition, contrasting evidence, to the effect that identification accuracy is better for violent than for non-violent crimes, has also been found (Wright & McDaid, 1996; Yuille & Cutshall, 1986; 1989). This finding is explained in terms of the physiological view that adrenalin causes increased consolidation of memory, or that the human brain evolved to retain memories of information possessing high survival value (Brown & Kulik, 1977; Goodman et al., 1991).

Further research is therefore necessary to determine the role, not only of individual differences but also of situational variables before the final word can be spoken.

Duration of exposure

The ability to recall an incident is strongly related to the total duration of exposure. Naka, Itsukushima and Itoh (1996) found in a correlation analysis that both the quantity (duration of contact) and the quality (the uniqueness of, for example, the perpetrator) can predict accuracy and detail of memory. With regard to eyewitness testimony, this implies that the longer the time during which the eyewitness has an opportunity to study, for example, a perpetrator's face, the more clearly the memory of that person's face will be encoded. This of course results in more accurate identification more accurate. Unfortunately, as Horowitz, Willging and Bordens (1998) rightly indicate, most of the time an eyewitness has little time to study the situation and the people involved. As most crimes occur quickly, many factors, and especially detailed aspects and features, have to contend for attention, with the result that a significant amount of information is lost. Ebbesen and Konecni (1997), however, emphasise that the question for researchers should not be whether longer exposure increases accuracy, but what the functional relation is between exposure duration and accuracy. This means that the issue of interest to the courts would be what the difference in accuracy is for one minute of exposure, compared to two minutes and 30 minutes.

CONCLUSION

There can hardly be any doubt that estimator variables can play a significant role in the reliability of eyewitness identification and testimony. It is equally true, however, that the final word on the subject has not yet been spoken, as too many contaminating factors --- ranging from different methodologies used by researchers to the inability to control the estimator variables --- seem to have a conflicting impact on the results. This should motivate further psycho-legal research in this area and encourage studies which relate better to real-life situations, instead of merely attempting to bring about a general understanding of how memory and perception work, and what their exact role in eyewitness testimony entails.

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ARTICLE 3

SYSTEM VARIABLES AND EYEWITNESS TESTIMONY

CONTENTS

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SYSTEM VARIABLES AND EYEWITNESS TESTIMONY

INTRODUCTION

When an incident or crime takes place, different factors (estimator variables) may influence the ability of eyewitnesses to accurately encode and remember the event. However, estimator variables are not the only or even the main determinants that can significantly influence the recall of an eyewitness. After having witnessed the event, other factors associated with the police investigation and court procedures may exacerbate the inability of eyewitnesses to accurately identify perpetrators or recall events. These factors are known as system variables. They specifically refer to factors which have the potential to influence eyewitness accuracy between the first contact with law enforcement and the final testimony in court (cf. Kapardis, 1999; Wells, Malpass, Lindsay, Fisher, Turtle & Fulero, 2000). Examples of system variables are the retention interval, post-event influences (e.g. suggestion, co-witness information and line-up instruction bias), and stress during identification of the suspect and during testimony. Köhnken and Maass (1988), however, indicate that although research suggests that system variables have a significant influence on the accuracy of recall, as well as identification, they have received less attention than estimator variables.

RETENTION INTERVAL

The retention interval refers to the passage of time between the acquisition and encoding of information about an event or suspect, and the point in time where until retrieval is required from the eyewitness, either through identification in a line-up or by means of providing testimony to law enforcement personnel (Brigham, Wasserman & Meissner, 1999). Owing to the fact that eyewitnesses very often testify in court months to years after the witnessed event, the extent to which eyewitnesses can retain accurate memories of events that have been witnessed such a long time ago is of great importance. The view of many researchers is that accuracy of recall decreases with delay. This may be one of the most important factors determining the accuracy of eyewitness identification (Berger & Herringer, 1991; Lipton,

1977; Wingfield & Byrnes, 1981; Sara, 2000; Sinatra, 2000). Owing to the fact that eyewitnesses' memories are not static, with passage of time they become more susceptible to interferences such as misinformation and suggestion (Müller, 2000; Schreiber, Wentura & Bilsky, 2001). This may be the basis for the finding that witnesses' recall of a criminal incident soon after it has occurred, tends to produce significantly better descriptions of the culprit compared to those produced one week later (Yarmey & Morris, 1998); also that the and decline in accuracy increases considerably after a 24-hour delay compared to a 2-hour delay (Brigham, Maass, Snyder & Spaulding, 1982). When an eyewitness is afforded the opportunity to recall information immediately after an event, this seems to result at least partly in precluding the problem of forgetting, which means that initial accuracy is retained over a longer period of time (Warren & Lane, 1995).

It was found that delay influences the ability to recall for various facial features differently. Evidence suggests that the eyes and mouth are more susceptible than the rest of the face to recognition decrement after a delay. Hair is the memory's best-stored facial feature and the ability to recall it is least affected after a delay (Walker-Smith, 1978).

An important question pertains to the relationship between age (developmental differences) and memory decay. Flin, Boon, Knox and Bull (1992) indicate that, although relatively little psychological research has focused on this particular aspect, the legal profession appears to believe that children's memories fade faster than those of adults. They found that when children and adults were interviewed shortly after an event and again five months later, the adults were able to retain the accuracy of their initial recall levels, while the children's accuracy of recall had decayed over this period. Although the children forgot significantly more than the adults did over a five-month period, the groups did not differ much in accuracy of recall when tested after one day. These results suggest that although younger children are often able to understand and encode an event, their memory fades over the long term to a greater extent than that of adults. In one of the few studies that focused on the elderly Searcy, Bartlett, Memon and Swanson (2001) found older adults (62 to 79 years) to be less accurate than younger adults (18 to 30 years) in a line-up task after a retention period of one month.

The relationship between age and retention interval does not seem to be straightforward, as it varies with age and the length of the delay period. It is, however, clear that although no consistent pattern exists, the accuracy of recall for people of all ages does decrease with delay (Cassel & Bjorklund, 1995). Ebbesen and Konecni (1997) agree that although research indicates that memory tends to fade faster immediately after exposure, before it starts levelling off, it is difficult to predict the precise forgetting curve. In order to be able to predict the forgetting curve, one needs an exact knowledge of the specific conditions of exposure, how memory is measured, the subjects involved and their motivation to provide accurate testimony.

POST-EVENT INFLUENCES

Research has yielded evidence that the memory of an original eyewitness event can be distorted by new information in the interval between witnessing the incident and testifying. Information from other witnesses, the police and interviewers could cause a weakening of memory traces, or clouding of the memory (Coxon & Valentine, 1997; Loftus & Hoffman, 1989). Loftus (1980) views post-event information as a serious threat to eyewitness testimony as it implies that if post-event information can so easily reconstruct a memory of something that was witnessed, then it could also alter the construction of a memory of an event which was never actually witnessed. However it is, not only post-event information that influences the memories of eyewitnesses, but also pre-event information. This may bias witnesses' expectations of what may happen during the event and then, subsequently, their recall (Lindsay & Johnson, 1989). If an eyewitness has previously been subjected, for example, to a bank robbery or hijacking and finds himself or herself in a similar situation again, there may be a possibility that the previously encoded information may interfere with the information stored concerning the last incident. This happens very often in everyday life, for example when one, has misplaced keys and looks for them in a place where they were put the day before.

The effect of post-event information can be explained as follows. If an eyewitness to a crime is certain that the perpetrator had brown hair and then, after the event, sees someone with blonde hair who looks very similar, this may have a confusing effect on the eyewitness's

memory. Through a process of compromise the memory can be altered. This is referred to as the misinformation effect or retroactive interference (Horowitz, Willging & Bordens, 1998).

Different opinions exist on how post-event information influences memory. According to the memory impairment hypothesis, post-event information and original event information either become integrated ("blend together"), or post-event information can "overwrite" (replace or alter) the memory of the original event. Subsequently the memory of the original event is irrevocably lost (Loftus, 1977; 1979a; 1979b; 1980; Loftus, Miller & Burns, 1978). Retrieval competition between post-event information is and original event information attributed to the existence of more salient recent post-event information which can cause problems with recall. Post-event information can also interfere with original information by filling memory gaps. This phenomenon relates to an encoding problem or demand characteristic which can influence the eyewitness to respond in a particular way (Qin, Quas, Redlich & Goodman, 1997). For example, an eyewitness is uncertain what the colour of a suspect's jacket was. A police officer asks whether he/she also saw that the suspect was wearing a red jacket. The memory gap of uncertainty about the colour of the jacket may be filled if the eyewitness starts revisiting his memory and visualising the offender with a red jacket, which might be inaccurate.

Bekerian and Bowers (1983) and Bowers and Bekerian (1984) suggest that there is no evidence that the loss of the original memory is inevitable once new, conflicting information is presented. Although they agree with Loftus that the encoding of new information can result in a new memory trace with some old information being transferred or incorporated, they point out that the old memory does still exist. This argument suggests that post-event information does not replace, but coexists with the original memory. Access to the old memory depends on whether subjects are biased towards the use appropriate retrieval strategies for accessing old memories. This is the reason why the effects of misleading information are dependent on the type of retrieval conditions existing at the time of testing. Morton, Hammersley and Bekerian (1985) suggest that post-event information does not replace the initial memory, but only the accessibility to the memory.

A factor that can exacerbate the misinformation effect and influence the recall of accurate information is the manner in which information is retrieved from eyewitnesses (Bowers & Bekerian, 1984). This relates, for example, to the way eyewitnesses are questioned by the police or in court. Schreiber, Wentura and Bilsky (2001) mention that the way in which misinformation is being presented is important, as it is highly possible that if misinformation is introduced too strongly and is too discrepant from original information, the misinformation effect becomes weaker. It is also true that the misinformation effect becomes stronger if there is a long delay between the event and questioning (Zykowski & Singg, 1999).

The most important post-event influences include suggestion, co-witness information and line-up instruction bias, and will be discussed in more detail next.

Suggestion

The much-publicised "day-care ritual cases" during the 1980s in the United States and Europe, in which interviews were criticised as being highly suggestive and directive, created an awareness of the effect of reinforcement of false allegations or testimony (Garven, Wood, & Malpass, 2000; Garven, Wood, Malpass, & Shaw, 1998). In the McMartin case in the United States for example, members of a family who were running a child-care centre were charged with child sexual abuse. They were kept in custody for years after rather questionable evidence was obtained from the children by means of suggestive questioning. This often happens when an interviewer starts out with the presumption that something has happened (e.g. child abuse) and instead of establishing the truth, he or she uses the interview to confirm his or her hypothesis about the specific event (Ainsworth, 1998).

Suggestive or leading questioning refers to the contamination of, or the introduction of errors into someone's memory of an event by asking questions containing an item of information that never existed in the original event (Kapardis, 1999). Suggestibility, on the other hand, refers to the lack of resistance of the memory to outside information or pressure, or the extent to which presented post-event information is accepted and incorporated into memory recollections (Horowitz, Willging & Bordens, 1998). This definition is criticised by Ceci and Bruck (1993) because it implies that suggestibility is always an unconscious process and that

it is only a memory-based, as opposed to a social phenomenon. It also implies that suggestibility only results from the presentation of information following an event as opposed to preceding it. Ceci and Bruck for this reason support a broader definition of suggestibility which involves the degree to which encoding, storage, retrieval, and reporting of events can be influenced by a range of social and psychological factors. This definition implies that through confabulation or malingering an eyewitness can accept information and be fully aware that it is different from the originally perceived event. It also entails that suggestibility can result from the presentation of information preceding or following an event and that it can result from social as well as cognitive factors. This broader view suggests that eyewitnesses can easily be influenced by suggestions, leading questions, bribes, threats, as well as other forms of misinformation. Endres (1997) also supports the view that suggestibility is a function of situational and individual factors, and possibly their interaction. Situational factors may include a poor memory of an event, uncertainty and good trust in the interviewer. Individual factors, on the other hand, relate to cognitive and temperamental components of the eyewitness. This means, for example, that the degree of intelligence and personality factors such as self-confidence and emotional sensitivity could influence suggestibility. Foley (1993) explains that, owing to the ambiguous, stressful and unusual circumstances of many eyewitness situations, eyewitnesses tend to lack confidence and also to rely on additional information from other people to interpret the event, which makes them more susceptible to influences and suggestions.

Some research findings support the view that questions asked subsequently to an event can cause a reconstruction in an eyewitness's memory of that event (Holst & Pezdek, 1992; Loftus & Hoffman, 1989; Loftus & Palmer, 1974). It has further been found that questions containing a definite article produce fewer uncertain responses and more recollection of events that never occurred, than questions containing an indefinite article (Loftus & Zanni, 1975). When eyewitnesses are allowed to freely narrate what they have seen, accuracy is relatively high, but there is a tendency to leave out many details. When questions are introduced more information is elicited, but an increase in errors occurs, owing to the fact that the wording of questions can lead to inaccuracy of answers (Hampson & Morris, 1996).

The most important question still to be answered is that of which mechanism is involved in producing the observed suggestibility effect among eyewitnesses. A factor that may play a role, is what is termed as destructive updating or overwriting, whereby the memory of the original event is destroyed and the memory in respect of the suggested detail becomes an integral part of the memory of the event itself. This leads subjects to perceive the suggested detail as something seen during the event itself (Loftus, 1979a; Lindsay, 1994). According to Pirolli and Mitterer (1984), claims of the occurrence of overwriting may not be warranted, as old and new information are possibly stored separately, in which case recalling would depend on the relative availability of the respective encodings.

An alternative interpretation entails the concept of supplementation, in terms of which it is hypothesised that the relevant information was not encoded during the original event and that the witness subsequently relies upon misleading post-event information to make a response when questioned (Coxon & Valentine, 1997). The source-monitoring hypothesis implies that suggestions can coexist with memory presentations and are sometimes misidentified automatically, or after conscious deliberation, as memories of the event itself at the time of retrieval. Witnesses have access to traces of both the original and the misleading event information but find it impossible to distinguish between the sources of this information. The more recent misleading information is more vivid in the memory and may be more likely to be retrieved (Bekerian & Bowers, 1983; Coxon & Valentine, 1997; Memon & Wright, 2000).

Unconscious transference is a way in which source-monitoring errors can take place. This occurs when one remembers something seen in one context after it has been encoded in another context (Memon & Wright, 2000). Other researchers have argued that the misinformation effect is the result of social rather than of cognitive mechanisms. For example, misled subjects may recall the misleading information because they trust the experimenter or simply because they want to please the experimenter. Subjects may comply with what they perceive to be the wishes of an experimenter by agreeing that misleading information is true or subsequently producing an answer containing the misleading information that the experimenter introduced earlier in the procedure (Coxon & Valentine, 1997). Although suggestibility effects can be ascribed to social factors (e.g. in respect of the

person presenting the suggestion), Ceci and Bruck (1993) suggest that this does not fully account for this problem.

Another factor that can affect the suggestibility of a witness, especially in experimental situations, is the commitment of the witness to make an effort to provide accurate information. Commitment may be important in protecting the witness against pressure effects when suggestions are presented. Subjects with no commitment seem to be more likely to change their eyewitness accounts under pressure from, for example, the police or other legal professionals or co-witnesses (Bregman & McAllister, 1982). Weinberg, Wadsworth and Baron (1983) also indicate that whenever questions which impose certain implications, demands or threats, are asked, witnesses appear more likely to alter their memories of the event. The fact that there may be consequences for the subject or the person who is finally identified if wrong information is given, may also impact on the testimony of the eyewitness.

Many studies concerning suggestibility involve developmental differences. Ceci and Bruck (1993) and Ackil and Zaragoza (1995) assert that despite contrary findings, there do appear to be significant age differences in respect of suggestibility. Ceci and Bruck indicate that pre-school-age children seemed to be the most suggestible, on the basis of the fact that in approximately 83% of the developmental studies, pre-school-age children were the most suggestible group. A fairly recent and widely publicised study to research the suggestibility of children is reported by Bruck, Ceci, Francocur and Barr (1995). During this study, children were examined by a paediatrician. The doctor conducted an external genital exam, during which he touched the child's external genitals and examined the buttocks, in the case of half of the subjects. The other half of the subjects, who kept their clothing on, were examined spinally for scoliosis. Afterwards 62% of the children examined genitally reported the touching of the genitals, whilst 62% of the spinally examined children also indicated that their genitals were touched. Other studies support these findings, confirming that it is highly possible to suggest an entire false event to a child, which can then become part of the child's memory. Moreover, supporting details are often quite vivid even for implausible events (Manning & Loftus, 1996; McBrien & Dagenbach, 1998). Pezdek and Roe (1997) found that

it is relatively easier to suggestively change a memory of an event that did occur, than to plant an event in the memory or erase an event from the memory.

Horowitz, Willging and Bordens (1998) conclude that although children are more suggestible than adults, this should not be overemphasised, as recent research suggests that adults can also be victims of implanted or suggested memories. The findings of Ackil and Zaragoza (1995) revealed that although all participants in their study claimed to remember seeing suggested details, the magnitude of this effect varied with age. College students made fewer source errors than third- and fifth-grade pupils, who in turn made fewer source errors than first-grade pupils did. The findings indicate that these age differences reflect developmental differences in respect of the tendency to mistake suggested information for actually witnessed events. It is suggested that the incidence and magnitude of these age-related differences will depend on the relative ability of participants to discriminate between the original and the misleading event. Ackil and Zaragoza's (1995) study provides evidence that although all age-groups make source misattribution errors, young children are particularly susceptible to serious memory errors, in believing they remember seeing details that were only suggested to them. This could seriously undermine the credibility and usefulness of children's testimonies in court proceedings.

Compared to the large number of studies investigating suggestibility in children, Coxon and Valentine (1997) indicate that very little research has focused on the effects of suggestions on elderly people's memory of events. Two other studies (Cohen & Faulkner, 1989; Loftus, Levidow & Duensing, 1992) found the elderly to be more suggestible than young adults, as they were more likely than younger adults to recall misleading information as if it had actually been encountered during the original event. Coxon and Valentine (1997), however, found that elderly people provided fewer correct answers than the children, but also fewer incorrect answers. This finding is related to the fact that children were more likely to guess if they did not know an answer. It was further confirmed that children were more susceptible to misleading suggestive questions than young adults and the elderly.

It seems that the method of questioning impacts tremendously on suggestibility and consequently on the accuracy of responses. In this regard Walker (1993) emphasises that it is

of the utmost importance that questions should be posed in such a way that eyewitnesses can understand the words and terminology, in other words, that there is no uncertainty about what is meant. Even more attention should be given to this aspect in South Africa, owing to the fact that there are 11 official languages. The importance of facilitating the communicative competence of a child witness cannot be overemphasised (Saywitz, Snyder & Nathanson, 1999). In order to elicit accurate responses, yes/no questions should be avoided, because of their linguistic complexity and often suggestive nature. Children make more errors and almost never say "I don't know" in response to yes/no questions, but are more accurate and more willing to reveal their lack of memory when the question posed to them has a wh-question word in it (Peterson, Dowden & Tobin, 1999). It is therefore important to interview witnesses with open-ended questions, which most often elicit more information, and to avoid questions that would lead the witness to answer in a certain way (Foxhall, 2000). According to Ceci and Bruck (1993) age-related differences in recognition memory are less pronounced than age-related differences in free recall, and at times are even non-existent. Hollely and Müller (1999) also indicate that research suggests that children can be taught to resist suggestion, by being prepared to do so through resistance or assertiveness training.

Apart from the method of questioning, suggestibility can also be affected by other factors. McNichol, Shute and Tucker (1999) and Rudy and Goodman (1991) are of the opinion that participation in the event, instead of only observing, lowers suggestibility and resistance increases against leading questions. McNichol, Shute and Tucker also concluded from their study with 6 and 7-year-olds that children who have experienced repeated events, have increased recall and more accurate memories although they may, confuse the timing of details of these events. This means that a child who has been subjected to abuse or molestation should be able to recall an event quite accurately, but may tend to find it difficult to correctly recall, for example, when or even exactly how many times it happened. Social incentives (e.g. promises or gifts) that are sometimes offered, or alternatively punishments that are threatened during interviews, have been found to increase false allegations of events (Garven et al., 1998).

Co-witness information

Co-witness information refers to any post-event information that has been directly or indirectly obtained from another witness(es). This happens especially when the eyewitness has been told by other witnesses what the latter have seen, or when a police interviewer inadvertently contaminates testimonies by telling eyewitnesses what other witnesses have said (Corey, 2001). In cases where eyewitnesses have been exposed to the same event (e.g. a bank robbery or motor vehicle accident), it would afterwards be natural for them to verify and compare what they have seen and experienced, before questioning or testifying in order to make sense of what has happened. When an eyewitness is uncertain about what happened there is a possibility that, after he or she has discussed it with a co-witness or received input about other witnesses' identifications or testimonies, the newly obtained details of the event could be incorporated into the eyewitness's memory, and also influence his or her confidence in reporting the event. The findings of Roediger, Meade and Bergman (2001) confirm the view that when eyewitnesses are uncertain or less confident about the witnessed event, they are be more inclined to integrate misleading information into their own memories.

Shaw, Garven and Wood (1997) conducted three experiments to investigate the combined influence of co-witness information and suggestive questioning on the accuracy of testimonies of eyewitnesses. In all these studies it was found that co-witness information had an immediate effect on the accuracy of the memory reports of eyewitnesses. Participants were more likely to provide the same incorrect responses immediately after they had received incorrect information about co-witnesses' responses than when they had received no co-witness information, or when they had received correct co-witness information. Wright, Self and Justice (2000) demonstrated in their two experiments that where people were allowed to discuss a crime scene, 15 of the 19 pairs of people involved came to an agreement and conformed. Regarding the effect of co-witness information on confidence, Luus and Wells (1994) found that when eyewitnesses of a staged theft were told that their co-witness had identified the same person an increase in their confidence occurred, while confidence decreased when they were told that their co-witness had identified someone else, or stated that the suspect was not in the line-up. Brimacombe (1998) agrees as it was found that whenever the eyewitness believed that a co-witness's information or identification correlated

with testimony being given, the eyewitness was observed to be more accurate, confident and more persuasive. Corey (2001) found that co-witness information influenced eyewitnesses' memory reports immediately after a staged event, as well as one week later. However, she also indicated that during the one-week retesting, when eyewitnesses were told to disregard co-witness information, that they were mostly capable of doing so. The above findings indicate the important role that law enforcement personnel have to play in being aware of the co-witness effect, as well as in encouraging witnesses not to discuss the event with other co-witnesses.

Although the abovementioned findings represent the findings and viewpoints of the majority of researchers, some authors do not support this stance. For example, Yarmey and Morris (1998) hold the opinion that in some circumstances collaborative or joint decisions can improve eyewitness testimony, as well as reduce false identification. They also rejected the hypothesis that discussing an incident generally produces more fabrications than refraining from discussing it, and found no confidence-accuracy correlations to be significant in their study. Thompson (2002) indicates that the effect of collaboration depends on the information that is required to be recalled. The retrieval of an event that is strongly represented within the memory system will be less affected by collaborative strategies in comparison with retrieval tasks which involve the learning of new materials. She furthermore argues that the acceptance of collaborative information is also dependent on who the supplier of information is. Eyewitnesses would be more likely to be influenced by information from a credible source.

Line-up instruction bias

Line-up instruction bias refers to two aspects. Firstly, when eyewitnesses are required to identify a suspect from a line-up, many may feel pressured by law enforcement personnel, personal factors, or others (family and friends) to make a positive identification. Secondly, through intentional or unintentional verbal and non-verbal cues by others (e.g. police officer, attorney, other witnesses, or other line-up members), the perception, memory or recognition ability of the eyewitness can be influenced or biased (Brigham, Wasserman & Meissner, 1999). If, for example, the police officer tells the eyewitness that the suspect is in the line-up,

this may cause the eyewitness to mistakenly believe that someone has to be identified, and may increase the chance of misidentification (Cutler, Penrod & Martens, 1987).

The hypothesis that biased instructions significantly affect eyewitness line-up identification performance is supported by a meta-analytic review carried out by Steblay (1997). This factor was also viewed by 63 experts to be the second most predictable phenomenon in eyewitness research (Kassin, Ellsworth & Smith, 1989).

There seem to be various explanations for line-up instruction bias. Whenever the witness is encouraged to identify someone from a line-up, even by guessing, this instructional bias appears to relax the witness' decision criterion. This means the eyewitness would put less pressure on himself or herself to make an accurate identification (Köhnken & Maass, 1988). This view tallies with Sanders and Warnick's (1981) finding that when participants were asked to identify a suspect from a video-line-up, the chance of misidentification increased significantly when they were not allowed to provide a "don't know" response.

Positive feedback or rewards from law enforcement personnel for making a positive identification (confirming feedback) or negative labelling for making no identification (disconfirming feedback) can also influence the accuracy of line-up identifications (Wells & Olson, 2003). Saying "Well done, you identified the suspect!" can enhance the eyewitness's confidence, while saying "Actually the suspect was number 4" can decrease confidence about the accuracy of identification. As a result, the witness may possibly change his or her memory of the observed event. Findings indicate that confirming feedback has a much stronger effect on the inflation of certainty of recollections than disconfirming feedback has on the deflation of certainty of recollections (Wells, Olson & Charman, 2002). It is suggested that in the case of confirming feedback, the eyewitness is likely to remember that the suspect was seen for a longer time and under better viewing conditions than previously reported (Wells & Bradfield, 1998). Feedback can further lead eyewitnesses to behave in a compliant manner in order to please those in authority. Moreover, eyewitnesses tend to be more prepared to change their original responses when they receive a negative label ("poor eyewitness") and to submit to leading questions (Roper & Shewan, 2002). Bradfield, Wells and Olson (2002) indicate that although the post-identification effect also involves

eyewitnesses who make accurate identifications, the effect is much stronger for those who make inaccurate identifications.

A concern in comparing real-life studies with laboratory studies is the fact that subjects are more cautious in choosing a perpetrator in high-realism studies, which could have an effect on the outcome of the results (Steblay, 1997). This could be related to the fact that in high-realism studies, the witnesses may feel that there will be real consequences for the perpetrators or themselves if they make a false identification. Köhnken and Maass (1988) postulate that whenever witnesses are aware that the situation is only an experimental one, with no consequences for either the offender or themselves, this limits the ecological validity of the study: "Rather than increasing the false-alarm rate, instructional bias was found to increase the frequency of 'don't know' responses, indicating that subjects used a stricter decision criterion" (p.364). These findings suggest that subjects in real-life situations use a stricter criterion and are less susceptible to instructional bias than are subjects in laboratory experiments without high real-life realism. However, this may further indicate that eyewitnesses are more accurate than their reputation suggests. Kassin, Rigby and Castillo (1991) indicate that, according to the accuracy-confidence relationship, witnesses may think more critically about the task, their own performance and their own level of certainty when they know that an identification will mean real consequences for themselves and for the accused. These researchers, however, suggest that owing to contradictory results, available research does not clearly answer the research question as to whether confidence is being affected by perceived consequences.

To avoid line-up instruction bias it is recommended that there should only be one suspect at a time in a line-up and that it should also be ensured that "fillers" are people who fit the general description that the witness has given. The witness should also be told that the perpetrator may not be in the line-up (Foxhall, 2000). Brigham, Meissner and Wasserman (1999) also recommend that a double-blind procedure should be followed in which neither the administrator of the line-up nor the eyewitness is aware of whether the suspect is present in the line-up, as this would exclude the possibility of confirmatory feedback from the person administrating the line-up.

STRESS DURING IDENTIFICATION AND TESTIMONY

The negative consequences of stress are well known. Stress has an impact on various areas of an individual's functioning (Carson, Butcher & Mineka, 2000; Weiten, 2001). The physiological effects range from an accelerated heartbeat, blood flow and respiration to the slowing down of the digestive processes and metabolism. Stress is also associated with certain illnesses such as coronary heart disease, migraines, diabetes, asthma and epilepsy. Psychological consequences include a wide variety of symptoms ranging from anxiety, anger and a lack of self-confidence to more serious mental disorders such as mood disorders, sexual dysfunctions, substance abuse and eating disorders. Stress also impacts negatively on task performance in the workplace as it can lead to a decrease in concentration, poor academic performance and burnout.

When these consequences of stress are taken into account, it goes without saying that stress could have a significant impact on an individual's perception and memory, and therefore also on his or her eyewitness testimony.

So much research focuses mainly on the stress experienced during the witnessed event, which could cause researchers and law enforcement personnel to underestimate the anxiety and fear experienced by eyewitnesses when they are interviewed or when they have to testify in court. According to findings of a witness satisfaction survey conducted in the UK, three in five witnesses experienced anxiety about attending court and especially about being confronted by the defendant (Angle, Malam & Carey, 2003). This would be even more true for child witnesses, even if the event in question were not stressful (Moston, 1992). Müller and Hollely (2001, p. 330) indicate that the accusatorial environment, in which the South African legal system operates, "creates increased stress for (child) witnesses and does not provide a framework within which an accurate and truthful account can be obtained". Müller (2000) refers to the fact that court cases are presented in an unfamiliar formal courtroom setting with strange, formal and specialised language and procedure. Added to this cross-examination is most often hostile, intimidating and confusing. Moreover, in many cases the witness further has to face the person who assaulted him or her or someone else, which causes added mental stress and suffering, or even long-term psychological damage (Müller & Hollely, 2000).

Questioning, even by public prosecutors, often takes place in such a way that the witness may feel that he or she is the guilty party. It goes without saying that these practices would cause stress for adults, but even more so for children.

It appears that most research findings about the conditions in which recall testimony takes place refer to children. Saywitz and Nathanson (1993), for example, indicate that under conditions of heightened emotional arousal, children's memory performance may be less detailed and accurate. The fear and anxiety that children sometimes experience during questioning may result in withdrawal, saying as little as possible, or a total refusal to testify. As a result of ineffective information processing, child witnesses under high levels of stress may be unable to translate their memories into verbal responses, or to generate and employ needed retrieval strategies. Therefore, depriving the child of traditional social support during questioning because of the judicial system's fear of contamination, could have enormous stressful consequences for the witness (Moston, 1992).

Dent (1977) indicates that relaxed recall situations have produced high levels of accurate recognition, whilst stressful identification parade experiments have generally produced very low levels of accurate recognition. In support of this finding, Saywitz and Nathanson (1993) found that children questioned in a simulated courtroom environment made less complete descriptions of past events by means of free recall, compared to their peer group questioned at school. Those questioned at school made fewer errors in response to direct questions and their responses were less influenced by misleading information in comparison with those of their peer group questioned in the courtroom situation. Results of this nature seem to be related to the stressful conditions under which a subject is required to perform the recognition task. Goodman and Schwarz-Kenney (1992, p.18) argue that children will tend to have more sophisticated skills and display increased accuracy when "events are familiar, tasks are simplified, surroundings are supportive, and the social/emotional climate is favourable." However, when conducted in such a way that the need for sensitivity to the child is taken into consideration, questioning can have a positive and therapeutic effect (Müller, 2000).

If stress decreases the accuracy of testimony, the question should be posed concerning the extent to which this relates to "context state-dependent memory". This argument postulates

that reinstating or reliving the original "state" or "context" of an event maximises retrieval cues. Goodman and Hahn (1987) argue that ensuring that the encoding and retrieval contexts share as many cues as possible can determine improved recall. This would mean that when an eyewitness, for example, has experienced a very stressful hijacking, taking the person back to the original crime scene should enhance the accuracy of testimony. However, it is general knowledge that after such a traumatic event, many victims would try to avoid the scene of the crime because of post-traumatic stress. This would make it difficult to reinstate the context in order to increase recall as well as the accuracy of testimony. This may be the reason why many victims of traumatic experiences are hesitant to testify against the perpetrator not only do they fear having to face the suspect; they also resist the prospect of having to relive the event.

CONCLUSION

Owing to the fact that system variables, in contrast with estimator variables, can to a large extent be controlled in order to enhance accuracy of identification and recall, it seems to be of the utmost importance that more research should be done to assist the legal system to improve investigation and court procedures. Owing to inconsistent findings in the field of eyewitness research, eyewitness experts are unable to confidently stand up in court and predict how accurately eyewitnesses will be able to identify suspects or testify about events. The task of these experts is made more difficult by the ethical restrictions in respect of using real-life eyewitness events in research. Therefore, it is only through the careful construction of simulation research methodologies that capture the essence of conditions that real eyewitnesses experience, that eyewitness research can be rendered forensically relevant to the legal system. Such real-life simulations should, however, not only refer to the event which the eyewitnesses are exposed to, but also to the conditions of identification and testimony.

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ARTICLE 4

MEMORY ACCURACY OF A REAL-LIFE SIMULATED INCIDENT

CONTENTS

TABLES

ARTICLE 4

MEMORY ACCURACY OF A REAL-LIFE SIMULATED INCIDENT

INTRODUCTION

Since the earliest times the courts have placed a very heavy emphasis on the role played by eyewitnesses. However, it is equally true that research during the last few decades has indicated that the courts have unrealistic expectations concerning the ability of eyewitnesses to provide accurate and objective testimony. Ainsworth (1998, p. 33) forthrightly states: "The assumption made by the Criminal Justice System that witnesses will 'tell the truth, the whole truth and nothing but the truth' appears to be naïve, simplistic and unrealistic. Courts need perhaps to recognise the complexities of human memory, and to be aware of its many failings." Human perception and memory are malleable, subjective and selective, while people also unwittingly tend to confabulate and thus fill memory gaps. It therefore cannot be denied that psychological research in the area of eyewitness testimony should be emphasised for the maintenance of a fair judicial system.

However, research in this important field of perception and memory has not been without controversy. One of the most debatable areas concerns laboratory versus real-life research.

Memory research has mostly been conducted in the laboratory, using experimental techniques to answer theoretical questions about the underlying mechanisms of memory (cf. Yuille & Cutshall, 1986; 1989). This has caused controversy concerning the external validity or generalisability of laboratory research, with many claiming that studying memory in the laboratory does not always shed light on remembering and forgetting in the outside world. This is, of course, also true for court settings (cf. Müller, 2003). In this regard Davies (1992, p. 265) states: "Nowhere are the problems of generalisability and reliability of research findings more acute than in the study of eyewitnessing." Life in general includes complex experiences embedded in a rich context of ongoing events and surrounding objects, which laboratory research does not have to contend with. Moreover, eyewitness testimony in a real-life situation is also mostly based on an incident witnessed once, under non-optimal

circumstances and very often with a high emotional content (Brigham, Maass, Snyder & Spaulding, 1982; Cohen, Kiss & Le Voi, 1993). Such variables make it very difficult to calibrate answers or revisit whether the correct answer was provided. It is also possible that subjects in real-life eyewitness contexts --- involving serious consequences for the witness and the perpetrator --- tend to think more critically about the task than those in laboratory conditions. The mentioned controversy is illustrated by McCloskey and Egeth (1983) who hold the opinion that laboratory and case studies have limited value with almost useless results, while Yuille and Daylen (1998, pp. 157-158) state that it is naïve of researchers to believe that audio-visual stimuli presented in laboratory contexts would be found stressful at all: "Studies that employ such films as stimuli generally bear no relationship to the impact of real-life violence or threatened violence on victims of crime." On the basis of these factors a strong call can be made for studies on memory outside the laboratory in order to be able to generalise it for purposes such as that of eyewitness testimony.

However, laboratory research does have its advantages. For example, in comparison with the real-life researcher, the laboratory researcher is much better able to control the research conditions, e.g. the nature, duration and timing of presentation, the test environment and instructions to the subjects. This can contribute significantly to the establishment of the cause-effect relationship between variables, a very important component in psychological research. Concerning the general criticism that laboratory research is artificial and a distortion of reality, the international expert Wells (1993) states that there is not enough evidence that this is indeed the case. Laboratory research thus has a place in eyewitness research and can make significant contributions (Wells, Malpass, Lindsay, Fisher, Turtle & Fulero, 2000; Wells & Olson, 2002).

Acknowledging the fact that laboratory and real-life research have limitations, the present researcher decided to combine the two research approaches, making use of the strengths of both methodologies. More specifically, in this study a real-life situation is combined with laboratory conditions by creating a stressful situation in the classroom to determine the influence of certain variables on the accuracy of eyewitness reporting.

THE RELATIONSHIP BETWEEN CERTAIN BIOGRAPHICAL VARIABLES AND EYEWITNESS TESTIMONY

In order to provide a theoretical background, a short summary of the biographical variables expected to play a role in this study will be presented next. It will become evident that researchers have often demonstrated inconsistent research findings.

o *Stress*. Witnesses often experience stress in forensic contexts. However, the exact effect of stress on memory has not been determined, as research has yet to demonstrate unequivocal support for one of the opposing views as to whether stress decreases or enhances accuracy of memory (Yuille, Davies, Gibling, Marxsen & Porter, 1994). The reason for this unsatisfactory situation mainly lies in the complexity of executing such research. For example, providing an explanation for the stress-memory relationship tends to become problematic, as inducing high levels of stress in subjects presents ethical problems. It is also not always possible to take advantage of naturally occurring stressful events, as this requires a great deal of pre-meditation and planning. Additionally, the calibration and interpretation of stress levels are difficult, because stress is a global term that has various meanings (Parker, Bahrick, Lundy, Fivush & Levitt, 1998). The different views regarding the question of whether stress has an enhancing or restricting effect on memory performance are discussed in detail in Article 2.

o *Retention interval*. Human beings forget easily, especially as far as visual information is concerned. The question of whether eyewitnesses can retain accurate memories of events after a passage of time has raised great concern in our court system as eyewitnesses are mostly only given an opportunity to testify many months and even years after witnessing the event (cf. Bartol & Bartol, 1994; Sinatra, 2000). Although the general view of researchers is that accuracy of recall decreases with delay, other findings suggest that the effect of delay on memory is relatively insignificant (Berger & Herringer, 1991; Wingfield & Byrnes, 1981; Yuille et al., 1994). (See Article 3 for a more detailed discussion on the influence of delay on memory recall.)

o *Occupation*. The general expectation is that people in certain occupations, such as the police, would do better in eyewitness situations than civilians or other occupational groups. Research findings, however, seem to present contradictory evidence (see Article 2), i.e. some researchers indicate that the police are more accurate than other groups (Christianson, Karlsson & Persson, 1998; Clark, Stephenson & Kniveton, 1990), while others could not find any significant differences (Ainsworth, 1981; Clifford, 1976; Clifford & Richards, 1977; Yarmey & Jones, 1983). The same supposition applies to the criterion of educational level, which also presents opposing research findings (Adams-Price, 1992; Loftus, Levidow & Duensing, 1992).

o *Age*. People of all ages fall victim to crime and have to provide testimony in court. However, a question that remains relatively unexplored concerns developmental differences in memory for stressful events (see Article 2). Conflicting evidence seems to exist about the ability of children to accurately recall and testify about events witnessed under stressful circumstances (Eisen, Goodman, Qin & Davis, 1998; Goodman, Hirschman, Hepps & Rudy, 1991; Quas, Goodman, Bidrose, Pipe, Craw & Ablin, 1999). Although the general belief is that adults remember better than children (and the elderly), Goodman et al. (1991) present research findings across four studies on developmental differences which indicate that stress had never been conclusively associated with a predictable negative effect on memory. On the contrary, when stress was very high and children became nearly hysterical with fear, stress was associated with enhanced memory. It should, however, be noted that forgetting did occur and that the children's memory of the stressful event faded to much the same extent as it might have done for a non-stressful event.

o *Gender*. Findings on the relationship between gender and accuracy of recall literally present all possible answers (see Article 2). Findings of some researchers indicate that men are more reliable eyewitnesses than women (Adams-Price, 1992; Kuehn, 1974), while other evidence demonstrates that women are more accurate than men (Casiere & Ashton, 1996; Shepherd, Ellis & Davies, 1982), or that no differences exist between the two genders (Butts, Mixon, Mulekar & Bringmann, 1995; Cunningham & Bringmann, 1986; Loftus, Levidow & Duensing, 1992).

o *Race*. Wells and Olson (2003) indicate that no consistent overall differences that can be attributable to race have been found. The large majority of eyewitness research has been carried out in the controversial area of same-race versus cross-race face recognition. Many memory experts are of the opinion that cross-racial identifications are less reliable than same-race-identifications (Bothwell, Brigham & Malpass, 1989; Chance & Goldstein, 1996; Holguin, McQuiston, MacLin & Malpass, 2000). Other researchers, however, have questioned whether own-race bias exists at all, as it is argued that the conclusion that cross-race identification is less accurate than same-race identification is premature and based on an oversimplified view of the impact of race on identification accuracy (Brigham et al., 1982; Lindsay & Wells, 1983).

The aforementioned conflicting results concerning the relationship between certain variables and eyewitness testimony may rightly be viewed as confusing. However, this situation is not unfamiliar in most sciences, although the discrepancies may not be as substantial in certain other sciences as they are in the human sciences such as psychology and law. As far as psychology is concerned, such contradictory findings may well be explained by the "golden principle" that every individual is unique and will therefore respond in a unique way. It is furthermore important to further realise that the final response of a person will be determined by the unique interaction between the individual and impacting variables such as the abovementioned factors of stress, passage of time, occupation, age, gender and race. Against this background it should be clear that not only can the testimony of eyewitnesses differ from individual to individual, but that the type, time and place of the event, along with the manner in which information is being retrieved, may also impact on the accuracy of eyewitness testimony.

The inconsistent findings in the area of eyewitness testimony should not discourage researchers but rather stimulate them to do more comprehensive and in-depth research. One area in particular which should be taken into account concerns the fact that basically all research on eyewitness testimony has originated in Europe and especially in America. New research could make a particularly valuable contribution in countries such as South Africa with its unique multi-cultural context, to achieve more clarity on the specific correlation between various variables and the accuracy of eyewitness testimony. This is the precise

purpose of this study.

METHOD

In order to achieve the aim of this study, permission was obtained to draw participants from the following four groups: primary school children between 12 and 14 years old (from two schools in Thabong and Riebeeckstad respectively), students from two Universities (the University of the Free State in Bloemfontein and Vista University in Welkom), the public (including lecturers and business people from Welkom), and members of the South African Police College in Pretoria. However, it soon became evident that practical problems would prevent the attainment of the goal of randomly selecting the participants. For example, all the participants already belonged to specific groups or classes within their respective institutions and organisations. Randomly selecting participants would have meant singling out individuals from these groups, which could have exposed the researcher's objective of creating an unexpected and simulated real-life incident. Furthermore, such a procedure would have caused significant and unacceptable disruptions for these groups. Consequently, the researcher decided to make use of an availability sample.

The total research sample consisted of 295 participants who were randomly divided into a short-term memory and a long-term memory group. The distribution of the sample regarding the specific biographical variables is indicated in Table 1.

Table 1. Frequency distribution regarding the biographical variables

Biographical variable	N	%
Occupation:		
Scholars	94	31,9
Students	61	20,7
Public	49	16,6
Police	91	30,8
Age:		
12 – 14 years	94	31,9
18 – 25 years	100	33,9
26 – 30 years	58	19,7
31 – 40 years	26	8,8
41 – 50 years	10	3,4
51 – 60 years	7	2,4
Gender:		
Male	171	58,0
Female	124	42,0
Race:		
Black	168	56,9
White	97	32,9
Coloured	21	7,1
Indian	7	2,4
Other (Oriental)	2	0,7

As the small number of participants in certain categories could have impeded the statistical analyses, two rearrangements were made. Firstly, the number of age categories was reduced to only three, namely 12 to 14 years (N = 94), 18 to 25 years (N = 100), and 26 years and older (N = 101). Secondly, as 89,9% of the research sample (i.e. 265 of the 295 subjects) consisted of black and white participants, it was decided to exclude the other racial groups.

The following procedure was followed to assess the participants' eyewitness accuracy:

o *Memory event*. The different groups were told that a speaker was going to address them. Immediately after the speaker had introduced himself, an unknown white male barged into the classroom. The assailant shoved the lecturer and clearly said to him in English: "I will never trust you again". He left the room immediately after the attack. The speaker did not respond physically or verbally to this attack. The simulation lasted approximately 20 seconds.

The "assailant" was a 19-year-old male, 1,88 metres tall, and weighed 80 kilograms. He was neatly dressed in black trousers, a green sweatshirt, a brown jacket and was wearing black shoes. He had long brown hair, no facial hair, and was wearing beads around his neck. He wore glasses. He did not carry a weapon.

o *Debriefing*. After the incident all participants were immediately debriefed by being informed about the purpose of the experiment.

o *Measuring instrument*. Immediately after they had been informed about the purpose of the experiment, all participants in the short-term memory group were handed a questionnaire (Appendix A) to complete. The participants in the long-term memory group completed the questionnaire five to six weeks after the memory incident.

o *Statistical analysis*. In this study it was necessary to compare the average accuracy scores for different short-term and long-term memory groups, as well as different occupational groups. In cases where only two groups were compared the purpose of the testing was to establish whether there was a difference between the mean of one population (μ_1) and the mean of a second population (μ_2). The simplest way to test for the difference between the means of two independent groups is the *t*-test. The null hypothesis had been tested by means of the formula H_0: $\mu_1 - \mu_2 = 0$ or, equivalently, $\mu_1 = \mu_2$. The alternative hypothesis is: H_1: $\mu_1 \neq \mu_2$. However, in some cases the means of more than two groups had to be compared, which placed a restriction on the use of the *t*-test. The *analysis of variance* is useful to address this broader requirement with the null hypothesis in the form of H_0: $\mu_1 = \mu_2 = \mu_3 = \ldots \mu_p$ and the alternative hypothesis as follows: H_1: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \ldots \mu_p$. In cases where more than two groups were present and a significant difference had been indicated, it was necessary to determine the specific differences between these groups. The post-hoc *t*-test was used for this purpose is called the Scheffé-test (Howell, 2002; McCall, 1990).

RESULTS

In order to achieve the aim of this study, three analyses were carried out. Firstly, all the participants were grouped together, regardless of the influence of biographical variables. A

comparison was then made between the averages of short-term and long-term memory results to determine whether deterioration in the accuracy of memory had taken place after a five to six-week period. Secondly, an inter-group comparative analysis was carried out between the average short-term and long-term scores of the respective biographical groups. Thirdly, an intra-group comparative analysis was carried out between certain biographical variables (occupation, age, gender and race) and both short-term and long-term memory accuracy respectively.

Relationship between retention period and memory accuracy

In order to determine the differences in the averages of the short-term and long-term memory groups the *t*-test for two independent groups was used. The results are presented in Table 2.

Table 2. Difference between short-term and long-term memory

Term	**N**	$\bar{x}$	**s**	***t***	***p***
Short-term	164	12,65	2,53	1,052	0,2937
Long-term	131	12,34	2,62		

The results in which the average accuracy scores for the short-term and long-term memory groups as a whole are compared (see Table 2) do not indicate a significant difference. This means that there was not a significant deterioration in accuracy of memory after the retention period of five to six weeks between the witnessing and recalling of the event.

Inter-group analyses of the relationship between retention period and memory accuracy

The *t*-test for two independent groups was used to compare the averages of the short-term and long-term memory accuracy scores for the respective biographical groups.

Occupation

The *t*-test results for the four different occupational groups are presented in Table 3.

Table 3. Relationship between term of memory and accuracy within the different occupational groups

Occupation	Term	N	$\bar{x}$	s	*t*	*p*
Scholars	Short-term Long-term	51 43	13,24 13,65	2,20 2,27	-0,901	0,3698
Students	Short-term Long-term	32 29	11,91 10,48	2,10 2,81	2,254	0,0279*
Public	Short-term Long-term	24 25	11,17 11,88	2,59 2,09	-0,8535	0,3977
Police	Short-term Long-term	57 34	13,18 12,59	2,16 2,26	1,232	0,2211

* $p \leq 0,05$

According to Table 3, only the *t*-test results of the students indicate a significantly higher average memory accuracy score (on the 5%-level) for the short-term group compared to the long-term group. This means that only the students displayed a significant decrease in memory accuracy for an eyewitness task after a retention period of five to six weeks.

Age

Table 4 contains the *t*-test results for the different age groups in respect of the differences in short-term and long-term memory accuracy scores.

Table 4. Relationship between term of memory and accuracy within the different age groups

Age	Term	N	$\bar{x}$	s	*t*	*p*
12 – 14-year-olds	Short-term Long-term	51 43	13,24 13,65	2,20 2,27	-0,9013	0,3698
18 – 25-year-olds	Short-term Long-term	57 43	12,60 11,47	2,51 3,01	2,049	0,0431*
26 years and older	Short-term Long-term	56 45	12,18 11,91	2,76 2,02	0,5620	0,5879

* $p \leq 0,05$

It is evident from Table 4 that in the case of only the 18 to 25-year-olds was there a significant difference between the short-term and long-term memory average accuracy scores. The short-term group from this age group were significantly more accurate than the long-term group on the 5%-level. No significant differences were found for the other two groups.

Gender

The *t*-test results for the two gender groups with regard to differences in short-term and long-term memory average accuracy scores can be viewed in Table 5.

Table 5. Relationship between term of memory and accuracy within the different gender groups

Gender	**Term**	**N**	$\bar{x}$	**s**	***t***	***p***
Male	Short-term	83	12,49	2,57	0,5476	0,5847
	Long-term	88	12,27	2,71		
Female	Short-term	81	12,81	2,49	0,7480	0,4559
	Long-term	43	12,47	2,45		

According to the *t*-test for two independent groups, no significant differences were encountered in a comparison of the short-term memory average accuracy scores with the long-term memory average accuracy scores of the males and females respectively (Table 5).

Race

The *t*-test results in respect of the differences between the short-term and long-term memory average accuracy scores of the two racial groups are presented in Table 6.

Table 6. Relationship between term of memory and accuracy within the different race groups

Race	**Term**	**N**	$\bar{x}$	**s**	***t***	***p***
Blacks	Short-term	100	12,59	2,67	0,9349	0,3512
	Long-term	68	12,19	2,77		
Whites	Short-term	46	12,63	2,32	0,2494	0,8036
	Long-term	51	12,51	2,43		

The *t*-test for independent groups as indicated in Table 6 does not indicate any significant differences when the short-term and long-term memory average accuracy scores of the respective black and white participants are compared.

Intra-group analyses of the relationship between retention period and memory accuracy

The intra-group comparative analysis of the biographical groups (according to occupation, age, gender and race), regarding both short-term and long-term memory average accuracy scores respectively, is presented next.

Occupation

To determine whether there was a difference in the average memory accuracy scores for the four occupational groups a one-way analysis of variance was carried out. The results for the short-term and long-term memory groups appear in Table 7.

Table 7. Differences in accuracy between the respective short-term and long-term memory occupational groups

Term	***F***	***P***
Short-term	5,90	0,0008**
Long-term	10,81	0,0001**

** $p \leq 0,01$

Table 7 indicates significant differences in the averages for the four occupational groups regarding short-term and long-term memory accuracy scores on the 1%-level. Owing the fact that four occupational groups were included, a post-*t*-test (Scheffé-test) was performed in order to identify the specific group differences for the short-term memory and long-term memory groups respectively. The results are indicated in Table 8.

Table 8. Differences in accuracy between the respective short-term and long-term memory occupational groups (*Scheffé-test*)

Term	Groups	N	$\bar{x}$	s	Groups with differences
Short-term	Scholars (group 1)	51	13,24	2,20	Group 3 from 1 Group 3 from 4
	Students (group 2)	32	11,91	2,10	
	Public (group 3)	24	11,17	2,59	
	Police (group 4)	57	13,18	2,16	
Long-term	Scholars (group 1)	43	13,65	2,27	Group 1 from 2 Group 1 from 3 Group 4 from 2
	Students (group 2)	29	10,48	2,81	
	Public (group 3)	25	11,88	2,09	
	Police (group 4)	34	12,59	2,26	

For the short-term memory group the Scheffé-results (see Table 8) indicate that the public's average memory accuracy score differs significantly on the 5%-level from those of the scholars and the police. It appears that the public had a significantly lower average score than the mentioned two groups.

For the long-term memory group the Scheffé-results (see Table 8) indicate that the average memory accuracy score of the scholars is significantly different (on the 5%-level) from those of the students and the public, while the average memory accuracy scores of the students and police also differ significantly. Further analysis indicates that the average long-term memory accuracy score of the students (group 2) is significantly lower than those of the scholars and police (group 1 and 4). The results also indicate that the scholars obtained a significantly higher average memory accuracy score than the public.

Age

As mentioned before, three age groups were formed, namely 12 to 14 years, 18 to 25 years and 26 years and older. A one-way analysis of variance (see Table 9) was carried out to determine whether a difference in the average short-term and long-term memory accuracy scores existed for the three age groups.

Table 9. Differences in accuracy between the respective short-term and long-term memory age groups

Term	***F***	***P***
Short-term	2,39	0,0944
Long-term	9,49	0,0001**

** $p \leq 0,01$

Table 9 indicates that no significant differences are evident regarding the short-term average memory accuracy scores for the three age groups. However, it is evident that differences exist on the 1%-level exist regarding the long-term average memory accuracy scores for the three age groups. Owing to the fact that three age groups were included, a post *t*-test (Scheffé-test) was carried out to identify the specific group differences. These results can be viewed in Table 10.

Table 10. Differences in accuracy between the long-term memory age groups

Groups	**N**	$\bar{x}$	**s**	**Groups with differences**
12 – 14-year-olds (group 1)	43	13,65	2,27	Group 1 from 2 Group 1 from 3
18 – 25-year-olds (group 2)	43	11,47	3,01	
26 years and older (group 3)	45	11,91	2,02	

According to the Scheffé-results (see Table 10) the average long-term memory accuracy score of the children's group (12 to 14 years) differs significantly on the 5%-level from the average scores of the other two age groups. In comparison with the other two groups the children's group obtained a significantly higher long-term memory average score.

Gender

To determine the difference in average memory accuracy scores for the short-term and long-term gender groups respectively the *t*-test for two independent groups (see Table 11) was employed.

Table 11. Differences in accuracy between the respective short-term and long-term memory gender groups

Term	Gender	N	$\bar{x}$	s	*t*	*p*
Short-term	Male Female	83 81	12,49 12,81	2,57 2,49	-0,8119	0,4180
Long-term	Male Female	88 43	12,27 12,47	2,71 2,45	-0,3936	0,6945

According to the results displayed in Table 11, there is not a significant difference in either the short-term or the long-term memory average accuracy scores for the two genders. From this, it can be concluded that the perception and memory of males and females are equally reliable or perhaps equally unreliable.

Race

To determine the difference in average memory accuracy scores for the short-term and long-term racial groups the *t*-test for two independent groups was used. Table 12 presents the results.

Table 12. Differences in accuracy between the respective short-term and long-term memory racial groups

Term	Race	N	$\bar{x}$	s	*t*	*p*
Short-term	Black White	100 46	12,59 12,63	2,67 2,32	-0,0883	0,9297
Long-term	Black White	68 51	12,19 12,51	2,77 2,43	-0,6540	0,5144

The *t*-test results indicate no significant differences in the short-term or long-term memory average accuracy scores for the two races (see Table 12). This implies that no corroboration had been found in this study in respect of differences in memory performance for the two racial groups.

DISCUSSION

The finding of this study, namely that there did not seem to be a significant deterioration in

memory performance for the long-term memory group in comparison to the short-term group after a five to six-week period is meaningful. This is in keeping with the opinion of Berger and Herringer (1991), Wingfield and Byrnes (1981) and Yuille et al. (1994) that the effect of passage of time is often insubstantial. Although there might have been a substantial loss of information within the first few minutes after viewing the incident, a decreased loss of information takes place after that (Penrod, Loftus & Winkler, 1982; Wrightsman, 1987). The present finding supports Hermann Ebbinghaus' theory, namely that a great deal of information is forgotten very soon after acquisition and that if information is remembered for as long as a day or two, it is likely to be retained for a much longer period (Goethals & Solomon, 1989; Parkin 1997). The disconcertingly poor performance of the short-term memory group and the insignificant decline in accuracy of responses for the long-term memory group could therefore be explained by a rapid rate of forgetting soon after acquisition and a slower rate of forgetting after that. This finding seems to emphasise researchers' view that the reliability of eyewitness testimony in general is questionable and not only after an extended period of time has elapsed between acquisition and recall (Huff, Rattner & Sagarin, 1996; Loftus & Calvin, 2001; Smith, Lindsay & Pryke, 2000; Spinney, 2000). The emotional content of the incident as well as the unanticipated and startling manner in which it was presented could also be responsible for the poor accuracy average scores, which makes this simulated incident more practically relevant compared to the showing of videos and slides.

Despite the fact that no significant difference between the average scores of the short-term and the long-term memory groups as a whole was indicated, it is important to take into account that certain biographical variables (in the present case occupation and age) may influence the accuracy of memory over a passage of time. However, it is possible that there could be a significant overlap between occupation and age, as most students also belong in this age group. It should furthermore be taken into account that a passage of time longer than the present five to six weeks allotted for the purpose of this study may have a greater effect on memory performance. This is important as the passage of time between witnessing an event and testifying in court is usually much longer than the passage of time used in this study.

The finding that scholars did not achieve lower memory accuracy scores than the other occupational groups is in contrast with the general expectancy and the results of many researchers (Candel, Merckelbach, Muris, Rasquin & Bollen, 1998; Ceci, Crossman, Gilstrap & Scullin, 1998; Leippe, Romanczyk & Manion, 1991; Luus, Wells & Turtle, 1995). However, the result supports evidence that indicates that when children are questioned in a non-suggestive manner they are not less reliable than adults (Cassel & Bjorklund, 1995; Dent, 1992; Goodman & Reed, 1986). The expectation that members of the police, on the basis of their training, would perform significantly better in eyewitness tasks than all the other groups was also not met, as they did not achieve significantly higher average memory accuracy scores than the scholars. This seems to be in accordance with the findings of Ainsworth (1981), Clifford (1976), Clifford and Richards (1977), and Yarmey and Jones (1983) which indicate that training would not necessarily enhance the ability of members of the police to perceive and remember events.

The finding that the 12 to 14-year-olds achieved significantly more accurate long-term memory average accuracy scores than both the older age groups may be surprising to some. However, several explanations could be offered. Firstly, the age of the children in this study may have had an effect on the outcome. They were older than children used in other comparative studies, e.g. List (1986) used 10-year-olds and found them to be less accurate than college students. Secondly, the manner in which the information was retrieved needs to be taken into consideration. Children consistently provide less information when there is opportunity for free recall, as they tend to make "errors of omission" and may not report all the information potentially available (Cassel & Bjorklund, 1995; Goodman & Reed, 1986; Hutcheson, Baxter, Telfer & Warden, 1995). It has also been found that children are more inclined to guess in comparison to adults (Parker & Ryan, 1993), because they do not always want to indicate their failure to understand questions and are probably often not even aware that they do not understand complex questions (Carter, Bottoms & Levine, 1996; Hollely & Müller, 1999). In the present study they were provided with multiple-choice questionnaires in which they were given the opportunity to choose the answer that they felt was most appropriate. This would have enhanced the children's guessing propensity and the chances of their omitting information were reduced. Thirdly, the physical and psychological context in which the event and recall occurred may have had a positive effect on the children's

accuracy scores (Coxon & Valentine, 1997; Luus, Wells & Turtle, 1995; Saywitz & Nathanson, 1993). The school setting in which the event and recall took place would have been a familiar environment to the children and this may have been instrumental in ensuring more accurate scores in comparison with an unfamiliar and hostile environment, such as the court, for example (Carter, Bottoms & Levine, 1996; Luus & Wells, 1992; Peterson, Dowden & Tobin, 1999). This supports the notion that children should be questioned in a friendly environment (as well as in a less suggestive manner), instead of in the court environment, which would probably be mostly perceived as intimidating. The fact that this was a classroom incident in which there may have been a perception on the part of the children that they were active participators in the event may also have increased their accuracy of recall. For example, children's memory demonstrates increased narrative recall and decreased suggestibility when they participate in an incident rather than merely observing it. It is argued that participation increases attention, which may improve the active processing and encoding of an event (Gross & Hayne, 1996; Rudy & Goodman, 1991).

As neither the average short-term nor the long-term gender accuracy scores indicated significant differences, it can be deduced that gender has little effect on perception and memory. This finding enjoys support from certain other researchers (Butts et al., 1995; Loftus, Levidow & Duensing, 1992; Narby, Cutler & Penrod, 1996), although others have indicated differences (Adams-Price, 1992; Casiere & Ashton, 1996; Kuehn, 1974; Shepherd, Ellis & Davies, 1982). Further investigation is needed to determine whether there is a correlation between gender and accuracy in respect of specific questions.

Although no significant differences were found between the average accuracy scores of the two racial groups, it should be noted that two white people were observed in the memory event, which means that only the black participants were confronted with cross-racial identification. This, however, did not seem to pose problems regarding the average accuracy scores for the black participants, which supports Egeth's (1993) theory that the magnitude of the cross-race effect is most often minimal. It would, however, be of interest to investigate whether there are race-related differences regarding specific items.

CONCLUSION

The study, which was aimed at investigating the influence of certain variables on the accuracy of eyewitness testimony, yielded the following main findings:

- There were no significant differences between the average accuracy scores of the short-term and long-term memory groups as a whole.
- The short-term memory average scores of the students and the 18 to 25-year-olds were significantly better than those of the corresponding long-term memory group. No significant differences, however, had been found for the gender and racial groups.
- The children (12 to 14-year-olds) obtained significantly higher average accuracy scores than the adults with regard to long-term memory. In respect of long-term memory, the scholars also performed significantly better than all other occupational groups, except the members of the police.

Certain limitations of the study should, however, be kept in mind when interpreting the results:

Firstly, with regard to creating stress, it was not possible to measure or calibrate the levels of stress that the participants experienced. Although the incident was unexpected and the assumption could be made from the reaction of the participants that the event had created stress for some participants, it is difficult to deduce in what way the event affected the participants. The fact that debriefing was done before the completion of the questionnaires may also have had a restricting effect on the impact of stress on the participants, as physiological indicators of stress such as heart rate and blood pressure may have returned to normal by the time questionnaires had to be completed (Ebbesen & Konecni, 1997). The realisation that there would be no consequences for the perpetrator or themselves when completing the questionnaires may have further decreased the stress impact.

Secondly, the finding concerning the passage of time would have had more value if the study had been conducted in such a way that there was a significantly longer period (e.g. 6 to 12 months) between the incident and the time of recall for the long-term memory group. Such a

delay would possibly be more in accordance with the time which usually expires before a witness has to testify. This could, however, have increased the drop-out rate of participants in the long-term group, which already seemed to pose a problem after the five to six-week retention period of this study.

Thirdly, the fact that the members of the police who had just completed their training participated in this study presents a limitation. It would have been of more value to compare policemen who were actively involved in the field and who were experienced in dealing with real crime, with recruits in the stages before training and just after training. Such a finding could have contributed towards rendering the present conflicting data more representative in this regard (Christianson, Karlsson & Persson, 1998; Clifford & Richards, 1977).

Fourthly, using 12 to 14-year-olds instead of younger children may have been a limitation. The inclusion of younger children, as well as more elderly people, might have presented a better opportunity to compare developmental differences over a broader spectrum. However, ethical concerns existed in respect of exposing very young children to the type of incident that had been presented.

Fifthly, both the two "actors" in the incident were white, which made the investigation of the race-bias effect more difficult. Including a black "actor" and a white "actor" or making use of actors from an Oriental group would have provided a more realistic perspective on the accuracy of memory of the two racial groups who participated.

Sixthly, the fact that multiple choice questions were used in the questionnaire may also have had an effect on the outcome of the study, as this might have caused many participants to guess. This also differs from the way eyewitnesses are usually questioned in court situations or by police, which is mostly experienced as very stressful.

Lastly, the long-term group, but not the short-term group, may have had a chance to talk about the incident afterwards, which might have had a refreshing effect on their memories. This should possibly not be seen as a confounding variable, however, as this also tends to happen in situations where people are asked to testify in court about an incident they

witnessed. They have an opportunity to retell and rehearse the incident many times before actually testifying, which can account for the misinformation effect or the reconstruction of memories.

Doing research on eyewitness testimony remains difficult owing to ethical concerns and the question as to whether laboratory studies have the same impact as real-life studies on memory performance. Although an attempt it was made in this study to construct a simulated incident with all the ingredients of a real-life event, the way the information was retrieved gave the end product of the research the semblance of a laboratory study. To make an impact in the area of eyewitness testimony in coming up with results which are less affected by confounding variables, it would not only be important for researchers in this field to reconstruct events which have the qualities of real-life incidents, but also to ensure that the measuring instruments correspond with the way eyewitnesses are questioned in legal situations. This would be in concurrence with Ebbesen and Konecni's (1997, p. 3) stipulation: "Before results from studies that claim to deal with eyewitness memory can be applied to real witnesses of real crimes, however, researchers must establish that they have created the same (or at least very similar) memory processes and motivational states in their subjects as are experienced by witnesses and victims of actual crimes." This would unfortunately mean that participants would sometimes have to be subjected to deception without immediate debriefing in order to come up with results which would not be questioned by other researchers or the court for that matter. This would, however, provide more clarity to this field, which seems to be encumbered by the equivocal results of laboratory studies. The hope is therefore expressed that research in this important psycho-legal field will be continued, and that such researchers will do everything possible to avoid the research limitations mentioned.

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ARTICLE 5

THE RELATIONSHIP BETWEEN MEMORY AND THE RECALL OF SPECIFIC DETAILS

CONTENTS

TABLES

ARTICLE 5

THE RELATIONSHIP BETWEEN MEMORY AND THE RECALL OF SPECIFIC DETAILS

INTRODUCTION

As mentioned before (see Article 4)**,** the courts are very often solely dependent on the accuracy of an eyewitness' identification or testimony in order to determine the fate of a crime suspect (Bartol & Bartol, 1994; Memon & Wright, 2000). However, it is especially true that the reliability of human perception and memory and its consequent contribution to eyewitness testimony is widely questioned (Robinson, Johnson & Herndon, 1997; Shaw & Skolnick, 1994). Perception is seen by many to be a subjective cognitive interpretation of events with the result that its value mainly lies in the "eye of the beholder". Memory is also viewed as malleable and reconstructive, as pre-event and post-event information tend to easily distort or change short-term as well as long-term memory (Buckhout, 1974; Shiffman, 1996).

Confusing human perception and memory with the analogy of a video camera may be responsible for some people's belief in the ultimate accuracy of information processing. The camera simply records and stores the visual information that the photographer wants, without subjectively interpreting information as human perception does (Feldman, 1996; Horowitz Willging & Bordens, 1998). Variables such as witness factors (e.g. stress, occupation, gender, age and race), perpetrator factors (e.g. cross-racial identification and weapon focus) and retention interval do not affect the camera as it does not have a "psychological history" nor a cognitive processing capacity that might influence perception subjectively as is the case with human beings.

The specific details of the suspect and the event the eyewitness attends to, depend on what captures the attention (Adams-Price, 1992). Bekerian (1993) indicates that some eyewitnesses may tend to focus on a specific feature (e.g. weapon or face) or set of features (e.g. clothing), while others may orientate themselves to other features (e.g. the person's moustache or glasses). Eyewitnesses are most likely to perceive and remember the central

details of an event --- that is the actions of the event such as the assault or hijacking. The peripheral details such as the clothing and physical features of the perpetrator are less likely to be encoded as accurately as the central and action details (Clifford & Scott, 1978; Goodman, Redlich, Qin, Ghetti, Tyda, Schaaf & Hahn 1999; Tichner & Poulton, 1975). In this regard, Christianson and Hübinette (1993) presented a study which was based upon the memories of 58 witnesses of 22 bank robberies in Stockholm between 1989 and 1990. With respect to the recall of many specific details about the robbers (e.g. action, weapon, clothing) relatively high accuracy rates were found, while for other details about the appearance of the robbers (e.g. footwear, hair and eye colour) the witnesses showed a rather low accuracy. The specific circumstances of the robberies (e.g. date, time, other people) was less accurately recalled. It should further be mentioned that evidence suggests that accuracy for specific details are also differently affected by the retention interval between witnessing an event and testimony --- the eyes and mouth are more vulnerable than the rest of the face, while hair is the best-stored facial feature (Walker-Smith, 1978). Davies, Ellis and Shepherd (1978) found in a photo-fit construction study that only limited deterioration in memory would occur for faces after an extended delay. Researching which aspects participants recall more or less accurately should assist in the maintenance and promotion of a fairer judicial system.

Kapardis (1999) indicates that very limited attention has been given to the role of non-facial information in eyewitness research and emphasizes that researchers should give more attention to perpetrator appearance in general. This would therefore include the perpetrator's weight, height, gait, gender, race and other appearance-related aspects such as clothing. In this regard Tollestrup, Turtle and Yuille (1994) indicate that eyewitnesses tend to overestimate the suspect's age, but underestimate the suspect's weight and height. In a significant finding by Yuille and Cutshall (1986) in which they examined actual eyewitness accounts they found at an initial police interview, 82% of action details, 76% of person description details, and 89% of object details were accurately reported. Only minimal deterioration took place after a five-month retention interval. However, the three variables that produced significant inaccuracies were height, weight and age.

It also seems that not much research has been done concerning the relationship between biographical variables and the recall of specific details. Research has provided little insight into predicting the relationship between demographic variables and memory accuracy.

With respect to gender, few differences in memory performance have been sited. Loftus, Levidow & Duensing (1992) indicate it is believed that females would better remember the face of a stranger, a conversation with a friend or their first kiss, while males would better remember where they parked a car and the reconstruction of a complex block pattern. These views are, however, based on perceptions and not empirical evidence. As far as actual research is concerned, Powers, Andriks and Loftus (1979) found that males tended to remember male orientated details better than females, while females recalled female orientated details more accurately. Loftus, Banaji, Schooler and Foster (1987) found that females more than men were inclined to overestimate the duration of an event. There are also indications that females may also be more focussed on clothing than males (Brigham, Wasserman & Meissner, 1999). Clifford and Scott (1978) suggests that females should be better at encoding facial features than males due to greater exposure to cosmetic literature which emphasizes facial characteristics and traits.

Regarding age it was found that children recalled central details better than peripheral details after suffering a traumatic injury. The amount of detail remembered increased with age (Peterson & Bell, 1996). Leippe, Romanzyk and Manion (1991) indicate that when children participate in events, they remember the salient central details better. In such cases important peripheral and situational details are less accurately recalled. Leippe and his coworkers also found that especially suggestibility increased when children were questioned about peripheral and non-action related matters, for example, clothing of the observed person.

With respect to occupation, the question whether trained subjects perform better on eyewitness tasks than untrained subjects has also been addressed by a few researchers. One finding by Clifford (1976) suggests that police officers remembered more details about clothing and appearance than civilians. However, they made more errors relating to actions, reporting seeing more than actually happened. Although the police officers initially remembered more accurately than the civilians, after a week's retention they made more errors. Authors such as Clifford and Richards (1977) and Ainsworth (1981) indicate that police officers are no better than untrained subjects with respect to events, actions or people.

As far as race is concerned, no consistent overall differences have been found (Wells & Olson, 2003). However, research has indicated that an own-race bias exists; that is, that

people tend to recognize their own race more easily than another race (Holguin, McQuiston, MacLin & Malpass, 2000; Wright, Boyd & Tredoux, 2001). The fact that one's own race is more distinguishable than another race seems to be based on familiarity, past experience and contact with one's race as a whole (Bothwell, Brigham & Malpass, 1989; Rosen, 2001). In comparing blacks and whites in South Africa, Aronstam (1980) found no differences regarding reliability of testimony between reports taken as a whole, the description of the sequence of events or for the description of the participants. It appears that although many studies have investigated the cross-race effect, no research could be traced on the type of details black compared to white witnesses focus on in eyewitness situations. Further research in this regard is therefore needed.

Against the aforementioned background the aim of this study is to investigate the relationship between biographical variables (occupation, age, gender and race) and specific event details as portrayed by the different items of the questionnaire. The focus will be on both short-term and long-term memory. This means that the objective will be to determine whether accuracy differences exist among biographical subgroups concerning the recall of details of an incident, as well as the effect of delay on accuracy. As this article serves as a follow-up to the previous article (Article 4) the same participants and methodology were employed. Duplication and overlapping should therefore be viewed in this light.

METHOD

With the respect to the selection of a sample to achieve the aim of this study, permission was obtained to draw participants from the following four groups: primary school children between 12 and 14 years old (from two schools in Thabong and Riebeeckstad respectively), students from two universities (the University of the Free State in Bloemfontein and Vista University in Welkom), the public (including lecturers and business people from Welkom), and members of the South African Police College in Pretoria. Owing to the fact that all the participants already belonged to specific groups or classes within their respective institutions and organisations, the attainment of the goal of randomly selecting the participants was prevented. Randomly selecting participants would have meant singling out individuals from these groups, which could have exposed the researcher's objective of creating an unexpected and simulated real-life incident. Furthermore, such a procedure would have caused

significant and unacceptable disruptions for these groups. For this reason the researcher decided to make use of an availability sample.

The total research sample consisted of 295 participants who were randomly divided into a short-term memory and a long-term memory group. The distribution of the sample regarding the specific biographical variables is indicated in Table 1.

Table 1. Frequency distribution regarding the biographical variables

Biographical variable	**N**	**%**
Occupation:		
Scholars	94	31,9
Students	61	20,7
Public	49	16,6
Police	91	30,8
Age:		
12 – 14 years	94	31,9
18 – 25 years	100	33,9
26 – 30 years	58	19,7
31 – 40 years	26	8,8
41 – 50 years	10	3,4
51 – 60 years	7	2,4
Gender		
Male	171	58,0
Female	124	42,0
Race		
Black	168	56,9
White	97	32,9
Coloured	21	7,1
Indian	7	2,4
Other (Oriental)	2	0,7

As the small number of participants in certain categories could have impeded the statistical analyses, two rearrangements were made. Firstly, the number of age categories was reduced to three, namely 12 to14 years (N = 94), 18 to 25 years (N = 100), and 26-years and older (N = 101). Secondly, as 89,9% of the research sample (i.e. 265 of the 295 subjects) consisted of black and white participants, it was decided to exclude the other racial groups.

The following procedure was followed to assess the participants' eyewitness accuracy:

o *Memory Event.* The different groups were told that a speaker was going to address them. Immediately after the speaker had introduced himself, an unknown white male assailant barged into the classroom. The assailant shoved the lecturer and clearly said to him in English: "I will never trust you again". He left the room immediately after the attack. The speaker did not respond physically or verbally to this attack. The simulation lasted approximately 20 seconds.

The "assailant" was a 19-year-old male, 1,88 metres tall, and weighed 80 kilograms. He was neatly dressed in black trousers, a green sweatshirt, a brown jacket and was wearing black shoes. He had long brown hair, no facial hair, and was wearing beads around his neck. He wore glasses. He did not carry a weapon.

o *Debriefing.* After the incident all participants were immediately debriefed by being informed about the purpose of the experiment.

o *Measuring instrument.* Immediately after they had been informed about the purpose of the experiment, all participants in the short-term memory group were asked to complete a questionnaire (Appendix A). The participants in the long-term memory group completed the questionnaire five to six weeks after the memory incident.

For the purpose of this study the details that were focussed on in the questionnaire were divided in different groups as follows:

- *Obvious physiognomic details* which included Items 2 (gender), 3 (race), 6 (length of hair), 7 (colour of hair), 8 (glasses), 14 (facial hair), 16 (facial scars) and 17 (obvious physical abnormalities).
- *Less pronounced physiognomic details* which included Items 1 (age), 4 (height) and 5 (weight).
- *Clothing details* which included Items 9 (colour of shirt), 10 (colour of trousers), 11 (colour of shoes), 12a (whether he was wearing a jacket), 12b (colour of jacket), 13 (whether he was wearing a tie) and 15 (whether he was wearing jewellery).
- *Circumstantial details* which included Items 18 (whether he was carrying a weapon), 19 (language spoken), 20 (the time of the incident) and 21 (the duration of the

incident)

- *Action-related details* which included Items 22 (whether the assailant said anything), 23 (the action of the assailant) and 24 (the reaction of the victim).

o *Statistical analysis.* To investigate the relationship between the variables (which were all measured on the nominal level), the χ^2-test for independence was used. Due to the fact that a significant χ^2 value only indicated whether the two variables were not dependent, it was also of importance to determine the degree of the relationship between the variables (Howell, 2002). In order to achieve this, Cramer's phi (ϕ) coefficient was determined which presented a coefficient between 0 and 1. The closer the coefficient was to 1, the stronger the relationship between the two variables involved.

In order to provide evidence on the practical interest of the statistical significant results, the practical significance of results was also investigated. For the measurement of practical significance, effect sizes were determined. To determine the practical significance of the χ^2 value, the effect size (w) was calculated as follows (Steyn, 1999):

$$w = \sqrt{\chi^2 / N}$$

In order to interpret these effect sizes, the following directive values were used:

$w = 0{,}1$: small effect
$w = 0{,}3$: medium effect
$w = 0{,}5$: big effect

Only when statistical significant results (on the 1%- or 5%-level) had been found, were the corresponding effect sizes calculated.

RESULTS

The first analysis involves the relationship between term of memory (short vs. long) and the accuracy of eyewitnesses' responses on specific questions. The second analysis presents the

correlation between different biographical variables (occupation, age, gender and race), and short-term and long-term memory of the individual items.

Relationship between retention period and memory accuracy

To achieve the goal of the first analysis the χ^2-test is utilized. The results, together with the frequencies and row percentages of the concerned items, are presented in Table 2.

Table 2. Relationship between memory and specific details

	Short-term (n=164)		Long-term (n=131)		χ	ϕ	
	Right	**Wrong**	**Right**	**Wrong**			
Question 1	8 (4,9)	156 (95,1)	5 (3,8)	126 (96,2)	0,195	-0,026	
Question 2	159 (97,0)	5 (3,0)	127 (96,9)	4 (3,1)	0,000	-0,000	
Question 3	150 (91,5)	14 (8,5)	125 (95,4)	6 (4,6)	1,804	0,078	
Question 4	69 (42,1)	95 (57,9)	52 (39,7)	79 (60,3)	0,170	-0,024	
Question 5	77 (47,0)	87 (53,0)	60 (45,8)	71 (54,2)	0,039	-0,011	
Question 6	132 (80,5)	32 (19,5)	104 (79,4)	27 (20,6)	0,055	-0,014	
Question 7	56 (34,1)	108 (65,9)	63 (48,1)	68 (51,9)	5,885*	0,141	0,14
Question 8	99 (60,4)	65 (39,6)	53 (40,5)	78 (59,5)	11,556**	-0,198	0,20
Question 9	7 (4,3)	157 (95,7)	7 (5,3)	124 (94,7)	0,186	0,025	
Question 10	20 (12,2)	144 (87,8)	39 (29,8)	92 (70,2)	14,061**	0,218	0,22
Question 11	87 (53,0)	77 (47,0)	66 (50,4)	65 (49,6)	0,208	-0,027	
Question 12a	113 (68,9)	51 (31,1)	78 (59,5)	53 (40,5)	2,796	-0,097	
Question 12b	73 (44,5)	91 (55,5)	52 (39,7)	79 (60,3)	0,692	-0,048	
Question 13	82 (50,0)	82 (50,0)	68 (51,9)	63 (48,1)	0,106	0,019	
Question 14	11 (6,7)	153 (93,3)	10 (7,6)	121 (92,4)	0,095	0,018	
Question 15	5 (3,0)	159 (97,0)	6 (4,6)	125 (95,4)	0,476	0,040	
Question 16	86 (52,4)	78 (47,6)	69 (52,7)	62 (47,3)	0,002	0,002	
Question 17	110 (67,1)	54 (32,9)	104 (79,4)	27 (20,6)	5,546*	0,137	0,14
Question 18	125 (76,2)	39 (23,8)	104 (79,4)	27 (20,6)	0,421	0,038	
Question 19	133 (81,1)	31 (18,9)	109 (83,2)	22 (16,8)	0,220	0,027	
Question 20	113 (68,9)	51 (31,1)	52 (39,7)	79 (60,3)	25,206**	-0,292	0,29
Question 21	125 (76,2)	39 (23,8)	79 (60,3)	52 (39,7)	8,646**	-0,171	0,17
Question 22	126 (76,8)	38 (23,2)	85 (64,9)	46 (35,1)	5,101*	-0,131	0,13
Question 23	47 (28,7)	117 (71,3)	57 (43,5)	74 (56,5)	7,039**	0,154	0,15
Question 24	135 (82,3)	29 (17,7)	94 (71,8)	37 (28,2)	4,677*	-0,126	0,13

** $p \leq 0{,}01$
* $p \leq 0{,}05$

From Table 2 it is clear that there is a significant correlation between the term of memory and the accuracy of eyewitnesses' responses and specific details (items): 8, 10, 20, 21 and 23 on the 1%-level and items 7, 17, 22 and 24 on the 5%-level.

A significantly larger proportion eyewitnesses in the short-term group compared with the long-term group answered items 8, 20, 21, 22 and 24 correctly, while a significantly larger proportion in the long-term group compared with the short-term group answered items 7, 10, 17 and 23 correctly.

The analysis of accuracy on specific items indicates significantly more short-term memory

group participants remembered item 8 (obvious physiognomic detail), items 20 and 21 (circumstantial details), as well as items 22 and 24 (action-related details) better. Significantly more long-term memory group participants remembered items 7 and 17 (obvious physiognomic details), item 10 (clothing detail) and item 23 (action-related detail) better.

Relationship between biographical groups and memory accuracy

The relationship between the respective short-term and long-term biographical groups (occupation, age, gender and race) and accuracy of memory is investigated by expressing the number of participants in each of the biographical categories who answered a question correctly as a percentage of the specific category. The χ^2-test was used to calculate whether there was a significant relationship between a specific biographical variable and the accuracy of the eyewitnesses' responses to the 25 questions (items).

Occupation

The results concerning occupation, together with the row percentages regarding the 25 questions are presented in Table 3 (short-term memory) and Table 4 (long-term memory).

o **Short-term memory**

Table 3. Relationship between short-term memory and occupation

	Scholar (n=51)		Student (n=32)		Public (n=24)		Police (n=57)		χ	ϕ	
	Right	Wrong	Right	Wrong	Right	Wrong	Right	Wrong			
Question 1	6 (11,8)	45 (88,2)	0 (0,0)	32 (100)	1 (4,2)	23 (95,8)	1 (1,7)	56 (98,3)	8,078*	0,222	0,22
Question 2	49 (96,1)	2 (3,9)	32 (100)	0 (0,0)	23 (95,8)	1 (4,2)	55 (96,5)	2 (3,5)	1,280	0,088	
Question 3	40 (78,4)	11 (21,6)	32 (100)	0 (0,0)	22 (91,7)	2 (8,3)	56 (98,2)	1 (1,8)	17,439**	0,326	0,33
Question 4	24 (47,1)	27 (52,9)	13 (40,6)	19 (59,4)	8 (33,3)	16 (66,7)	24 (42,1)	33 (57,9)	1,300	0,089	
Question 5	22 (43,1)	29 (56,9)	10 (31,2)	22 (68,8)	7 (29,2)	17 (70,8)	38 (66,7)	19 (33,3)	15,408**	0,307	0,31
Question 6	44 (86,3)	7 (13,7)	20 (62,5)	12 (37,5)	18 (75,0)	6 (25,0)	50 (87,7)	7 (12,3)	10,038*	0,247	0,25
Question 7	15 (29,4)	36 (70,6)	13 (40,6)	19 (59,4)	6 (25,0)	18 (75,0)	22 (38,6)	35 (61,4)	2,501	0,123	
Question 8	36 (70,6)	15 (29,4)	21 (65,6)	11 (34,4)	9 (37,5)	15 (62,5)	33 (57,9)	24 (42,1)	7,988*	0,221	0,22
Question 9	3 (5,9)	48 (94,1)	0 (0,0)	32 (100)	2 (8,3)	22 (91,7)	2 (3,5)	55 (96,5)	2,803	0,131	
Question 10	6 (11,8)	45 (88,2)	2 (6,2)	30 (93,8)	1 (4,2)	23 (95,8)	11 (19,3)	46 (80,7)	5,196	0,178	
Question 11	40 (78,4)	11 (21,6)	5 (15,6)	27 (84,4)	10 (41,7)	14 (58,3)	32 (56,1)	25 (43,9)	32,653**	0,446	0,45
Question 12a	38 (74,5)	13 (25,5)	22 (68,8)	10 (31,2)	15 (62,5)	9 (37,5)	38 (66,7)	19 (33,3)	1,341	0,090	
Question 12b	28 (54,9)	23 (45,1)	13 (40,6)	19 (59,4)	8 (33,3)	16 (66,7)	24 (42,1)	33 (57,9)	3,773	0,152	
Question 13	36 (70,6)	15 (29,4)	17 (53,1)	15 (46,9)	13 (54,2)	11 (45,8)	16 (28,1)	41 (71,9)	19,904**	0,348	0,35
Question 14	7 (13,7)	44 (86,3)	2 (6,2)	30 (93,8)	0 (0,0)	24 (100)	2 (3,5)	55 (96,5)	6,683	0,202	
Question 15	2 (3,9)	49 (96,1)	1 (3,1)	31 (96,9)	1 (4,2)	23 (95,8)	1 (1,7)	56 (98,3)	0,557	0,058	
Question 16	36 (70,6)	15 (29,4)	6 (18,7)	26 (81,3)	11 (45,8)	13 (54,2)	33 (57,9)	24 (42,1)	22,398**	0,370	0,37
Question 17	24 (47,1)	27 (52,9)	23 (71,9)	9 (28,1)	17 (70,8)	7 (29,2)	46 (80,7)	11 (19,3)	14,532**	0,298	0,30
Question 18	46 (90,2)	5 (9,8)	29 (90,6)	3 (9,4)	14 (58,3)	10 (41,7)	36 (63,2)	21 (36,8)	18,761**	0,338	0,34
Question 19	41 (80,4)	10 (19,6)	24 (75,0)	8 (25,0)	17 (70,8)	7 (29,2)	51 (89,5)	6 (10,5)	5,051	0,175	
Question 20	20 (39,2)	31 (60,8)	25 (78,1)	7 (21,9)	13 (54,2)	11 (45,8)	55 (96,5)	2 (3,5)	44,927**	0,523	0,52
Question 21	39 (76,5)	12 (23,5)	27 (84,4)	5 (15,6)	15 (62,5)	9 (37,5)	44 (77,2)	13 (22,8)	3,698	0,150	
Question 22	36 (70,6)	15 (29,4)	24 (75,0)	8 (25,0)	19 (79,2)	5 (20,8)	47 (82,5)	10 (17,5)	2,263	0,117	
Question 23	32 (62,8)	19 (37,2)	5 (15,6)	27 (84,4)	5 (20,8)	19 (79,2)	5 (8,8)	52 (91,2)	43,386**	0,514	0,51
Question 24	33 (64,7)	18 (35,3)	28 (87,5)	4 (12,5)	21 (87,5)	3 (12,5)	53 (93,0)	4 (7,0)	16,355**	0,316	0,32

** $p \leq 0{,}01$
* $p \leq 0{,}05$

According to Table 3 there is a significant correlation between occupational group and the accuracy of short-term memory of certain details (items). This is true for Items 3, 5, 11, 13, 16, 17, 18, 20, 23 and 24 (1%-level), as well as for Items 1, 7, and 8 (5%-level).

In comparison with the other three occupational groups, a significantly larger proportion of scholars answered Item 1 (less pronounced physiognomic detail) and Item 24 (action-related detail) correctly. However, a significantly larger proportion scholars answered Items 3, 17 (obvious physiognomic details) and Item 23 (action-related detail) incorrectly in comparison with the other groups.

A significantly larger proportion of students answered Items 7, 16 (obvious details) and Item 11 (clothing detail) incorrectly. Item 8 (obvious physiognomic detail) was answered incorrectly by a significantly larger proportion of the public. Furthermore, a significantly larger proportion of the public and the police answered Item 18 (circumstantial detail) incorrectly.

Although it was expected that the members of the police would, based on their training, perform significantly better than the other groups, a significantly larger proportion of them managed to answer only Items 5 (less pronounced physiognomic detail) and 20 (circumstantial detail) more correctly than the other groups. Furthermore, a significantly larger proportion of the members of the police also answered Item 13 (clothing related detail) inaccurately.

- **Long-term memory**

Table 4. Relationship between long-term memory and occupation

	Scholar (n=43)		Student (n=29)		Public (n=25)		Police (n=34)		χ	ϕ	
	Right	Wrong	Right	Wrong	Right	Wrong	Right	Wrong			
Question 1	4 (9,3)	39 (90,7)	1 (3,4)	28 (96,6)	0 (0,0)	25 (100)	0 (0,0)	34 (100)	5,877	0,212	
Question 2	41 (95,4)	2 (4,6)	27 (93,1)	2 (6,9)	25 (100)	0 (0,0)	34 (100)	0 (0,0)	3,676	0,168	
Question 3	41 (95,4)	2 (4,6)	26 (89,7)	3 (10,3)	24 (96,0)	1 (4,0)	34 (100)	0 (0,0)	3,857	0,172	
Question 4	17 (39,5)	26 (60,5)	12 (41,4)	17 (58,6)	8 (32,0)	17 (68,0)	15 (44,1)	19 (55,9)	0,931	0,084	
Question 5	19 (44,2)	24 (55,8)	11 (37,9)	18 (62,1)	11 (44,0)	14 (56,0)	19 (55,9)	15 (44,1)	2,193	0,129	
Question 6	37 (86,1)	6 (13,9)	20 (69,0)	9 (31,0)	22 (88,0)	3 (12,0)	25 (73,5)	9 (26,5)	4,937	0,194	
Question 7	20 (46,5)	23 (53,5)	14 (22,2)	15 (51,7)	11 (44,0)	14 (56,0)	18 (52,9)	16 (47,1)	0,531	0,064	
Question 8	17 (39,5)	26 (60,5)	13 (44,8)	16 (55,2)	8 (32,0)	17 (68,0)	15 (44,1)	19 (55,9)	1,177	0,095	
Question 9	4 (9,3)	39 (90,7)	0 (0,0)	29 (100)	0 (0,0)	25 (100)	3 (8,8)	31 (91,2)	5,195	0,199	
Question 10	23 (53,5)	20 (46,5)	2 (6,9)	27 (93,1)	3 (12,0)	22 (88,0)	11 (32,3)	23 (67,7)	22,711**	0,416	0,42
Question 11	28 (65,1)	15 (34,9)	9 (31,0)	20 (69,0)	8 (32,0)	17 (68,0)	21 (61,8)	13 (38,2)	13,218**	0,318	0,32
Question 12a	34 (79,1)	9 (20,9)	17 (58,6)	12 (41,4)	14 (56,0)	11 (44,0)	13 (38,2)	21 (61,8)	13,355**	0,319	0,30
Question 12b	23 (53,5)	20 (46,5)	11 (37,9)	18 (62,1)	12 (48,0)	13 (52,0)	6 (17,6)	28 (82,4)	11,080*	0,291	0,29
Question 13	32 (74,4)	11 (25,6)	16 (55,2)	13 (44,8)	13 (52,0)	12 (48,0)	7 (20,6)	27 (79,4)	22,212**	0,412	0,41
Question 14	3 (7,0)	40 (93,0)	3 (10,3)	26 (89,7)	2 (8,0)	23 (92,0)	2 (5,9)	32 (94,1)	0,481	0,061	
Question 15	2 (4,6)	41 (95,4)	0 (0,0)	29 (100)	1 (4,0)	24 (96,0)	3 (8,8)	31 (91,2)	2,813	0,147	
Question 16	28 (65,1)	15 (34,9)	8 (27,6)	21 (72,4)	8 (32,0)	17 (68,0)	25 (73,5)	9 (26,5)	20,211**	0,393	0,39
Question 17	33 (76,7)	10 (23,3)	21 (72,4)	8 (27,6)	20 (80,0)	5 (20,0)	30 (88,2)	4 (11,8)	2,678	0,143	
Question 18	37 (86,1)	6 (13,9)	22 (75,9)	7 (24,1)	20 (80,0)	5 (20,0)	25 (73,5)	9 (26,5)	2,104	0,127	
Question 19	38 (88,4)	5 (11,6)	20 (69,0)	9 (31,0)	20 (80,0)	5 (20,0)	31 (91,2)	3 (8,8)	6,760	0,227	
Question 20	18 (41,9)	25 (58,1)	7 (24,1)	22 (75,9)	8 (32,0)	17 (68,0)	19 (55,9)	15 (44,1)	7,356	0,237	
Question 21	29 (67,4)	14 (32,6)	14 (48,3)	15 (51,7)	15 (60,0)	10 (40,0)	21 (61,8)	13 (38,2)	2,699	0,144	
Question 22	29 (67,4)	14 (32,6)	12 (41,4)	17 (58,6)	21 (84,0)	4 (16,0)	23 (67,7)	11 (32,3)	11,279**	0,293	0,29
Question 23	29 (67,4)	14 (32,6)	8 (27,6)	21 (72,4)	13 (52,0)	12 (48,0)	7 (20,6)	27 (79,4)	21, 013**	0,401	0,40
Question 24	24 (55,8)	19 (44,2)	21 (72,4)	8 (27,6)	22 (88,0)	3 (12,0)	27 (79,4)	7 (20,6)	9,637*	0,271	0,27

** $p \leq 0,01$
* $p \leq 0,05$

From Table 4 it is clear that a significant relationship exists between occupational group and the accuracy of long-term memory of certain details (items). This is evident in the case of Items 10, 11, 12a, 13, 16, 22 and 23 (1%-level) and Items 12b and 24 (5%-level).

A significantly larger proportion of scholars outscored the other three occupational groups regarding Item 12a (clothing detail). However, significantly more scholars responded inaccurately to Item 24 (action-related detail). A significantly larger proportion of the scholars and the public in comparison with the other groups answered Item 23 (action-related

detail) correctly. It is further evident that a significantly larger proportion of the scholars and the police in comparison with the other two groups were accurate concerning Items 10, 11 (clothing details) and 16 (obvious physiognomic detail). However, the clothing details also seemed to present some problems to the members of the police, as a significantly larger proportion of them in comparison with the other groups answered Items 12b and 13 (both clothing related details) incorrectly. The students were the only occupational group unable to answer any items significantly more accurately than the other groups. One item (Item 22) was furthermore answered incorrectly by a significantly larger proportion of students than any other group.

Age

For the biographical variable age the participants were divided into three age groups, namely 12 to 14 years, 18 to 25 years, and 26 years and older. The results, together with the frequencies and row percentages, are indicated in Table 5 (short-term) and Table 6 (long-term).

o **Short-term memory**

Table 5. Relationship between short-term memory and age

	12 – 14 years (n=51)		18 – 25 years (n=57)		26 years and older (n=56)		χ	ϕ	
	Right	Wrong	Right	Wrong	Right	Wrong			
Question 1	6 (11,8)	45 (88,2)	0 (0,0)	57 (100)	2 (3,6)	54 (96,4)	8,342*	0,226	0,23
Question 2	49 (96,1)	2 (3,9)	55 (96,5)	2 (3,5)	55 (98,2)	1 (1,8)	0,474	0,054	
Question 3	40 (78,4)	11 (21,6)	56 (98,3)	1 (1,7)	54 (96,4)	2 (3,6)	16,220**	0,314	0,31
Question 4	24 (47,1)	27 (52,9)	21 (36,8)	36 (63,2)	24 (42,9)	32 (57,1)	1,174	0,085	
Question 5	22 (43,1)	29 (56,9)	27 (47,4)	30 (52,6)	28 (50,0)	28 (50,0)	0,511	0,056	
Question 6	44 (86,3)	7 (13,7)	42 (73,7)	15 (26,3)	46 (82,1)	10 (17,9)	2,865	0,132	
Question 7	15 (29,4)	36 (70,6)	22 (38,6)	35 (61,4)	19 (33,9)	37 (66,1)	1,012	0,079	
Question 8	36 (70,6)	15 (29,4)	33 (57,9)	24 (42,1)	30 (53,6)	26 (46,4)	3,453	0,145	
Question 9	3 (5,9)	48 (94,1)	0 (0,0)	57 (100)	4 (7,1)	52 (92,9)	3,999	0,156	
Question 10	6 (11,8)	45 (88,2)	9 (15,8)	48 (84,2)	5 (8,9)	51 (91,1)	1,255	0,087	
Question 11	40 (78,4)	11 (21,6)	22 (38,6)	35 (61,4)	25 (44,6)	31 (55,4)	19,561**	0,345	0,34
Question 12a	38 (74,5)	13 (25,5)	41 (71,9)	16 (28,1)	34 (60,7)	22 (39,3)	2,744	0,129	
Question 12b	28 (54,9)	23 (45,1)	24 (42,1)	33 (57,9)	21 (37,5)	35 (62,5)	3,478	0,146	
Question 13	36 (70,6)	15 (29,4)	26 (45,6)	31 (54,4)	20 (35,7)	36 (64,4)	13,657**	0,289	0,29
Question 14	7 (13,7)	44 (86,3)	4 (7,0)	53 (93,0)	0 (0,0)	56 (100)	8,049*	0,222	0,22
Question 15	2 (3,9)	49 (96,1)	3 (5,3)	54 (94,7)	0 (0,0)	56 (100)	2,838	0,132	
Question 16	36 (70,6)	15 (29,4)	24 (42,1)	33 (57,9)	26 (46,4)	30 (53,6)	9,987**	0,247	0,25
Question 17	24 (47,1)	27 (52,9)	43 (75,4)	14 (24,6)	43 (76,8)	13 (23,2)	13,448**	0,286	0,29
Question 18	46 (90,2)	5 (9,8)	47 (82,5)	10 (17,5)	32 (57,1)	24 (42,9)	17,963**	0,331	0,33
Question 19	41 (80,4)	10 (19,6)	47 (82,5)	10 (17,5)	45 (80,4)	11 (19,6)	0,105	0,025	
Question 20	20 (39,2)	31 (60,8)	47 (82,5)	10 (17,5)	46 (82,1)	10 (17,9)	30,445**	0,431	0,43
Question 21	39 (76,5)	12 (23,5)	44 (77,2)	13 (22,8)	42 (75,0)	14 (25,0)	0,078	0,022	
Question 22	36 (70,6)	15 (29,4)	45 (79,0)	12 (21,0)	45 (80,4)	11 (19,6)	1,651	0,100	
Question 23	32 (62,8)	19 (37,2)	9 (15,8)	48 (84,2)	6 (10,7)	50 (89,3)	42,419**	0,509	0,51
Question 24	33 (64,7)	18 (35,3)	51 (89,5)	6 (10,5)	51 (91,1)	5 (8,9)	15,821**	0,311	0,31

** $p \leq 0{,}01$

* $p \leq 0{,}05$

It is evident from Table 5 that there is a significant correlation between age and the accuracy of short-term memory of certain details (items): 3, 11, 13, 16, 17, 18, 20, 23 and 24 (1%-level) and Items 1 and 14 (5%-level).

A significantly larger proportion of the 12 to 14-year-olds answered more items correctly, but also incorrectly than the other groups. A significantly larger proportion of 12 to 14-year-olds outscored the other groups on Items 14, 16 (obvious physiognomic details), 1 (less pronounced physiognomic detail), 11 and 13 (clothing details) and 23 (action-related detail). However, a significantly larger proportion was also more incorrect on Items 3, 17 (obvious physiognomic details), 20 (circumstantial detail) and 24 (action-related detail).

The 18 to 25-year-olds and the 26 years and older group were unable to answer any items more correctly than the other age groups. A significantly larger proportion of the 26 years and older group answered Item 18 (circumstantial detail) incorrectly in comparison with the other two age groups.

o **Long-term memory**

Table 6. Relationship between long-term memory and age

	12 – 14 years (n=43)		18 – 25 years (n=43)		26 years and older (n=45)		χ	ϕ	
	Right	Wrong	Right	Wrong	Right	Wrong			
Question 1	4 (9,3)	39 (90,7)	1 (2,3)	42 (97,7)	0 (0,0)	45 (100)	5,571	0,206	
Question 2	41 (95,4)	2 (4,6)	43 (100)	0 (0,0)	43 (95,6)	2 (4,4)	2,019	0,124	
Question 3	41 (95,4)	2 (4,6)	41 (95,4)	2 (4,6)	43 (95,6)	2 (4,4)	0,003	0,005	
Question 4	17 (39,5)	26 (60,5)	20 (46,5)	23 (53,5)	15 (33,3)	30 (66,7)	1,596	0,110	
Question 5	19 (44,2)	24 (55,8)	23 (53,5)	20 (46,5)	18 (40,0)	27 (60,0)	1,679	0,113	
Question 6	37 (86,1)	6 (13,9)	29 (67,4)	14 (32,6)	38 (84,4)	7 (15,6)	5,619	0,207	
Question 7	20 (46,5)	23 (53,5)	21 (48,8)	22 (51,2)	22 (48,9)	23 (51,1)	0,064	0,022	
Question 8	17 (39,5)	26 (60,5)	15 (34,9)	28 (65,1)	21 (46,7)	24 (53,3)	1,290	0,099	
Question 9	4 (9,3)	39 (90,7)	2 (4,6)	41 (95,4)	1 (2,2)	44 (97,8)	2,240	0,131	
Question 10	23 (53,5)	20 (46,5)	6 (13,9)	37 (86,1)	10 (22,2)	35 (77,8)	17,941**	0,370	0,37
Question 11	28 (65,1)	15 (34,9)	21 (48,8)	22 (51,2)	17 (37,8)	28 (62,2)	6,635*	0,225	0,23
Question 12a	34 (79,1)	9 (20,9)	21 (48,8)	22 (51,2)	23 (51,1)	22 (48,9)	10,180**	0,279	0,28
Question 12b	23 (53,5)	20 (46,5)	14 (32,6)	29 (67,4)	15 (33,3)	30 (66,7)	5,093	0,197	
Question 13	32 (74,4)	11 (25,6)	18 (41,9)	25 (58,1)	18 (40,0)	27 (60,0)	13,023**	0,315	0,32
Question 14	3 (7,0)	40 (93,0)	4 (9,3)	39 (90,7)	3 (6,7)	42 (93,3)	0,256	0,044	
Question 15	2 (4,6)	41 (95,4)	1 (2,3)	42 (97,7)	3 (6,7)	42 (93,3)	0,949	0,085	
Question 16	28 (65,1)	15 (34,9)	19 (44,2)	24 (55,8)	22 (48,9)	23 (51,1)	4,172	0,178	
Question 17	33 (76,7)	10 (23,3)	32 (74,4)	11 (25,6)	39 (86,7)	6 (13,3)	2,290	0,132	
Question 18	37 (86,1)	6 (13,9)	31 (72,1)	12 (27,9)	36 (80,0)	9 (20,0)	2,574	0,140	
Question 19	38 (88,4)	5 (11,6)	34 (79,1)	9 (20,9)	37 (82,2)	8 (17,8)	1,379	0,103	
Question 20	18 (41,9)	25 (58,1)	16 (37,2)	27 (62,8)	18 (40,0)	27 (60,0)	0,197	0,039	
Question 21	29 (67,4)	14 (32,6)	25 (58,1)	18 (41,9)	25 (55,6)	20 (44,4)	1,423	0,104	
Question 22	29 (67,4)	14 (32,6)	26 (60,5)	17 (39,5)	30 (66,7)	15 (33,3)	0,555	0,065	
Question 23	29 (67,4)	14 (32,6)	11 (25,6)	32 (74,4)	17 (37,8)	28 (62,2)	16,245**	0,352	0,35
Question 24	24 (55,8)	19 (44,2)	33 (76,7)	10 (23,3)	37 (82,2)	8 (17,8)	8,352*	0,253	0,25

** $p \leq 0{,}01$

* $p \leq 0{,}05$

According to Table 6 a significant correlation between age and the accuracy of long-term memory exists on certain details (items). This relates specifically to Items 10, 12a, 13 and 23 (1%-level) and Items 11 and 24 (5%-level).

In comparison with the other age groups, a significantly larger proportion 12 to 14-year-olds answered Items 10, 11, 12a, 13 (clothing details) and 23 (action-related detail) correctly. However, a significantly larger proportion of this group answered Item 24 (action-related detail) incorrectly. No significant differences were indicated for obvious and less pronounced physiognomic or circumstantial details.

Gender

The frequencies and row percentages of the results of the different genders are found in Table 7 (short-term memory) and Table 8 (long-term memory).

o **Short-term memory**

Table 7. Relationship between short-term memory and gender

	Male (n=83)		Female (n=81)		χ	ϕ	
	Right	Wrong	Right	Wrong			
Question 1	4 (4,8)	79 (95,2)	4 (4,9)	77 (95,1)	0,001	0,003	
Question 2	82 (98,8)	1 (1,2)	77 (95,1)	4 (4,9)	1,933	-0,109	
Question 3	80 (96,4)	3 (3,6)	70 (86,4)	11 (13,6)	5,214*	-0,178	0,18
Question 4	29 (34,9)	54 (65,1)	40 (49,4)	41 (50,6)	3,509	0,146	
Question 5	30 (36,1)	53 (63,9)	47 (58,0)	34 (42,0)	7,879**	0,219	0,22
Question 6	68 (81,9)	15 (18,1)	64 (79,0)	17 (21,0)	0,222	-0,037	
Question 7	31 (37,3)	52 (62,7)	25 (30,9)	56 (69,1)	0,767	-0,068	
Question 8	50 (60,2)	33 (39,8)	49 (60,5)	32 (39,5)	0,001	0,003	
Question 9	0 (0,0)	83 (100)	7 (8,6)	74 (91,4)	7,493**	0,214	0,21
Question 10	8 (9,6)	75 (90,4)	12 (14,8)	69 (85,2)	1,026	0,079	
Question 11	40 (48,2)	43 (51,8)	47 (58,0)	34 (42,0)	1,591	0,098	
Question 12a	58 (69,9)	25 (30,1)	55 (67,9)	26 (32,1)	0,075	-0,021	
Question 12b	38 (45,8)	45 (54,2)	35 (43,2)	46 (56,8)	0,110	-0,026	
Question 13	40 (48,2)	43 (51,8)	42 (51,9)	39 (48,1)	0,220	0,037	
Question 14	5 (6,0)	78 (94,0)	6 (7,4)	75 (92,6)	0,125	0,028	
Question 15	5 (6,0)	78 (94,0)	0 (0,0)	81 (100)	5,033*	-0,175	0,18
Question 16	44 (53,0)	39 (47,0)	42 (51,9)	39 (48,1)	0,022	-0,012	
Question 17	54 (65,1)	29 (34,9)	56 (69,1)	25 (30,9)	0,308	0,043	
Question 18	68 (81,9)	15 (18,1)	57 (70,4)	24 (29,6)	3,021	-0,136	
Question 19	70 (84,3)	13 (15,7)	63 (77,8)	18 (22,2)	1,151	-0,084	
Question 20	56 (67,5)	27 (32,5)	57 (70,4)	24 (29,6)	0,161	0,031	
Question 21	64 (77,1)	19 (22,9)	61 (75,3)	20 (24,7)	0,073	-0,021	
Question 22	62 (74,7)	21 (25,3)	64 (79,0)	17 (21,0)	0,428	0,051	
Question 23	20 (24,1)	63 (75,9)	27 (33,3)	54 (66,7)	1,711	0,102	
Question 24	69 (83,1)	14 (16,9)	66 (81,5)	15 (18,5)	0,077	-0,022	

** $p \leq 0{,}01$
* $p \leq 0{,}05$

Table 7 indicates there is a significant correlation between gender and the accuracy of short-term memory of certain details (items). This is true regarding Items 5 and 9 (1%-level) and Items 3 and 15 (5%-level).

A significantly larger proportion of males than females was more accurate on Item 3 (obvious physiognomic detail) and 15 (clothing detail), while a significantly larger proportion of females than males answered Item 5 (less pronounced physiognomic detail) and 9 (clothing detail) accurately. No significant differences were evident regarding the circumstantial and the action-related details.

o **Long-term memory**

Table 8. Relationship between long-term memory and gender

	Male (n=88)		Female (n=43)		χ	ϕ	
	Right	Wrong	Right	Wrong			
Question 1	4 (4,5)	84 (95,5)	1 (2,3)	42 (97,7)	0,388	-0,054	
Question 2	85 (96,6)	3 (3,4)	42 (97,7)	1 (2,3)	0,115	0,030	
Question 3	84 (95,5)	4 (4,5)	41 (95,4)	2 (4,6)	0,001	-0,002	
Question 4	31 (35,2)	57 (64,8)	21 (48,8)	22 (51,2)	2,235	0,131	
Question 5	38 (43,2)	50 (56,8)	22 (51,2)	21 (48,8)	0,741	0,075	
Question 6	68 (77,3)	20 (22,7)	36 (83,7)	7 (16,3)	0,734	0,075	
Question 7	43 (48,9)	45 (51,1)	20 (46,5)	23 (53,5)	0,064	-0,022	
Question 8	34 (38,6)	54 (61,4)	19 (44,2)	24 (55,8)	0,369	0,053	
Question 9	6 (6,8)	82 (93,2)	1 (2,3)	42 (97,7)	1,153	-0,094	
Question 10	24 (27,3)	64 (72,7)	15 (34,9)	28 (65,1)	0,800	0,078	
Question 11	43 (48,9)	45 (51,1)	23 (53,5)	20 (46,5)	0,247	0,043	
Question 12a	45 (51,1)	43 (48,9)	33 (76,7)	10 (23,3)	7,863**	0,245	0,25
Question 12b	28 (31,8)	60 (68,2)	24 (55,8)	19 (44,2)	6,948**	0,230	0,23
Question 13	43 (48,9)	45 (51,1)	25 (58,1)	18 (41,9)	0,996	0,087	
Question 14	6 (6,8)	82 (93,2)	4 (9,3)	39 (90,7)	0,253	0,044	
Question 15	6 (6,8)	82 (93,2)	0 (0,0)	43 (100)	3,073	-0,153	
Question 16	50 (56,8)	38 (43,2)	19 (44,2)	24 (55,8)	1,849	-0,119	
Question 17	72 (81,8)	16 (18,2)	32 (74,4)	11 (25,6)	0,967	-0,086	
Question 18	70 (79,6)	18 (20,4)	34 (79,1)	9 (20,9)	0,004	-0,006	
Question 19	77 (87,5)	11 (12,5)	32 (74,4)	11 (25,6)	3,537	-0,164	
Question 20	38 (43,2)	50 (56,8)	14 (32,6)	29 (67,4)	1,362	-0,102	
Question 21	55 (62,5)	33 (37,5)	24 (55,8)	19 (44,2)	0,539	-0,064	
Question 22	58 (65,9)	30 (34,1)	27 (62,8)	16 (37,2)	0,123	-0,031	
Question 23	35 (39,8)	53 (60,2)	22 (51,2)	21 (48,8)	1,525	0,108	
Question 24	65 (73,9)	23 (26,1)	29 (67,4)	14 (32,6)	0,588	-0,067	

** $p \leq 0,01$
* $p \leq 0,05$

According to Table 8 there is a significant correlation between gender and the accuracy of long-term memory regarding only two details: Items 12a and 12b (1%-level). In comparison with the male participants, a significantly larger proportion of females answered Items 12a and 12b (clothing details) correctly. No significant differences were found regarding items which reflected obvious physiognomic details, less pronounced physiognomic details,

circumstantial and action-related details.

Race

With respect to race, the frequencies and row percentages of the different items are presented in Table 9 (short-term) and Table 10 (long-term).

o **Short-term memory**

Table 9. Relationship between short-term memory and race

	Black (n=100)		White (n=46)		χ	ϕ	
	Right	Wrong	Right	Wrong			
Question 1	7 (7,0)	93 (93,0)	0 (0,0)	46 (100)	3,382	-0,152	
Question 2	97 (97,0)	3 (3,0)	45 (97,8)	1 (2,2)	0,081	0,024	
Question 3	87 (87,0)	13 (13,0)	46 (100)	0 (0,0)	6,565**	0,212	0,21
Question 4	35 (35,0)	65 (65,0)	28 (60,9)	18 (39,1)	8,595**	0,243	0,24
Question 5	40 (40,0)	60 (60,0)	23 (50,0)	23 (50,0)	1,284	0,094	
Question 6	71 (71,0)	29 (29,0)	44 (95,7)	2 (4,3)	11,449**	0,280	0,28
Question 7	39 (39,0)	61 (61,0)	15 (32,6)	31 (67,4)	0,552	-0,062	
Question 8	61 (61,0)	39 (39,0)	29 (63,0)	17 (37,0)	0,056	0,020	
Question 9	4 (4,0)	96 (96,0)	2 (4,3)	44 (95,7)	0,010	0,008	
Question 10	14 (14,0)	86 (86,0)	4 (8,7)	42 (91,3)	0,820	-0,075	
Question 11	50 (50,0)	50 (50,0)	25 (54,4)	21 (45,6)	0,238	0,040	
Question 12a	65 (65,0)	35 (35,0)	36 (78,3)	10 (21,8)	2,598	0,133	
Question 12b	44 (44,0)	56 (56,0)	22 (47,8)	24 (52,2)	0,186	0,036	
Question 13	55 (55,0)	45 (45,0)	24 (52,2)	22 (47,8)	0,101	-0,026	
Question 14	8 (8,0)	92 (92,0)	3 (6,5)	43 (93,5)	0,099	-0,026	
Question 15	4 (4,0)	96 (96,0)	1 (2,2)	45 (97,8)	0,318	-0,047	
Question 16	58 (58,0)	42 (42,0)	20 (43,5)	26 (56,5)	2,670	-0,135	
Question 17	72 (72,0)	28 (28,0)	21 (45,7)	25 (54,3)	9,459**	-0,255	0,25
Question 18	74 (74,0)	26 (26,0)	37 (80,4)	9 (19,6)	0,716	0,070	
Question 19	86 (86,0)	14 (14,0)	31 (67,4)	15 (32,6)	6,854**	-0,217	0,22
Question 20	75 (75,0)	25 (25,0)	23 (50,0)	23 (50,0)	8,923**	-0,247	0,25
Question 21	72 (72,0)	28 (28,0)	40 (87,0)	6 (13,0)	3,945*	0,164	0,16
Question 22	74 (74,0)	26 (26,0)	34 (73,9)	12 (26,1)	0,000	-0,001	
Question 23	29 (29,0)	71 (71,0)	14 (30,4)	32 (69,6)	0,031	0,015	
Question 24	82 (82,0)	18 (18,0)	36 (78,3)	10 (21,7)	0,284	-0,044	

** $p \leq 0{,}01$
* $p \leq 0{,}05$

Table 9 indicates a significant correlation between race and short-term memory concerning certain details. This entails Items 3, 4, 6, 17, 19 and 20 (1%-level) and Item 21(5%-level).

Concerning race, a significantly larger proportion of black participants answered Items 17 (obvious physiognomic detail) and Items 19 and 20 (circumstantial details) correctly. A significantly larger proportion white participants answered Items 3 and 6 (obvious physiognomic details), Item 4 (less pronounced physiognomic detail) and Item 21 (circumstantial detail) correctly. There are no significant differences regarding items that referred to action-related details, less pronounced physiognomic details and clothing details.

o **Long-term memory**

Table 10. Relationship between long-term memory and race

	Black (n=68)		White (n=51)		χ	ϕ	
	Right	**Wrong**	**Right**	**Wrong**			
Question 1	4 (5,9)	64 (94,1)	1 (2,0)	50 (98,0)	1,113	-0,097	
Question 2	66 (97,1)	2 (2,9)	49 (96,1)	2 (3,9)	0,086	-0,027	
Question 3	67 (98,5)	1 (1,5)	46 (90,2)	5 (9,8)	4,227*	-0,188	0,19
Question 4	22 (32,3)	46 (67,7)	23 (45,1)	28 (54,9)	2,013	0,130	
Question 5	21 (30,9)	47 (69,1)	32 (62,8)	19 (37,2)	11,978**	0,317	0,32
Question 6	50 (73,5)	18 (26,5)	45 (88,2)	6 (11,8)	3,914*	0,181	0,18
Question 7	35 (51,5)	33 (48,5)	20 (39,2)	31 (60,8)	1,761	-0,122	
Question 8	36 (52,9)	32 (47,1)	14 (27,4)	37 (72,6)	7,772**	-0,256	0,26
Question 9	1 (1,5)	67 (98,5)	4 (7,8)	47 (92,2)	2,940	0,157	
Question 10	22 (32,3)	46 (67,7)	15 (29,4)	36 (70,6)	0,118	-0,031	
Question 11	33 (48,5)	35 (51,5)	27 (52,9)	24 (47,1)	0,227	0,044	
Question 12a	44 (64,7)	24 (35,3)	30 (58,8)	21 (41,2)	0,429	-0,060	
Question 12b	29 (42,6)	39 (57,4)	21 (41,2)	30 (58,8)	0,026	-0,015	
Question 13	37 (54,4)	31 (45,6)	29 (56,9)	22 (43,1)	0,071	0,024	
Question 14	5 (7,3)	63 (92,7)	5 (9,8)	46 (90,2)	0,227	0,044	
Question 15	3 (4,4)	65 (95,6)	3 (5,9)	48 (94,1)	0,132	0,033	
Question 16	44 (64,7)	24 (35,3)	18 (35,3)	33 (64,7)	10,102**	-0,291	0,33
Question 17	54 (79,4)	14 (20,6)	40 (78,4)	11 (21,6)	0,017	-0,012	
Question 18	56 (82,4)	12 (17,6)	39 (76,5)	12 (23,5)	0,626	-0,073	
Question 19	62 (91,2)	6 (8,8)	36 (70,6)	15 (29,4)	8,500**	-0,267	0,27
Question 20	24 (35,3)	44 (64,7)	20 (39,2)	31 (60,8)	0,192	0,040	
Question 21	40 (58,8)	28 (41,2)	31 (60,8)	20 (39,2)	0,047	0,020	
Question 22	34 (50 0)	34 (50,0)	41 (80,4)	10 (19,6)	11,551**	0,312	0,31
Question 23	25 (36,8)	43 (63,2)	28 (54,9)	23 (45,1)	3,881*	0,181	0,18
Question 24	44 (64,7)	24 (35,3)	42 (82,4)	9 (17,6)	4,529*	0,195	0,20

** $p \leq 0,01$
* $p \leq 0,05$

It is evident from Table 10 that there was a significant correlation between race and long-term memory of some details (items). This correlation is only true for Items 5, 8, 16, 19 and 22 (1%-level) and Items 3, 6, 23 and 24 (5%-level).

A significantly larger proportion black eyewitnesses in comparison with the white eyewitnesses answered Items 3, 8, 16 (obvious appearance-related details) and 9 (circumstantial-related detail) correctly. However, a significantly larger proportion of white eyewitnesses in comparison with black eyewitnesses answered Items 6 (obvious physiognomic detail), 5 (less pronounced physiognomic detail) and 22, 23 and 24 (action-related details) correctly. No significant differences regarding clothing details were evident.

DISCUSSION

Although the findings of this study yielded some interesting results, it was difficult to detect

specific patterns regarding the recall of definite details. The main findings concerning the two primary aims of research (the relation between, firstly, retention period and accuracy of recall; and secondly, biographical variables and accuracy of recall) will be discussed next:

In contrast with the significant differences found regarding the obvious physiognomic details, the finding that no significant memory differences regarding the less pronounced physiognomic details were present, is not surprising. The latter requires more estimation (e.g. concerning specific age, weight and height of the assailant) which has the same effect on short-term and long-term memory.

The fact that the short-term memory group remembered some circumstantial details significantly better than the long-term memory group, was also not unexpected. Due to the fact that the questionnaire was completed immediately after the incident these items would have been easier for the short-term memory participants to answer (e.g. by looking at their watches to see at what time the incident happened).

The researcher's expectation (cf. Goodman et al., 1999) that retention period would have a more significant effect on physiognomic and clothing details than action-related details was not met. The long-term memory group did not remember significantly more action-related details than the short-term memory group and the short-term memory group did not recall significantly more appearance and clothing details than the long-term memory group. It is, however, possible that proactive and retroactive interference had a more significant effect on the actions performed than the appearance and clothing of the perpetrator (see Article 1). A more suitable explanation for this, however, may be that memory is affected by both post-event information and the psychological need to eliminate uncertainties and inconsistencies (cf. Spear & Riccio, 1994). In order to make sense of and complete fragmented events such as the incident, to which participants were exposed, details are added which distort the original memory. A further explanation is Loftus's (1979; 1980) model of "destructive updating" in which old memories are overwritten with new information through recalling the event a few times or talking about it with others. Post-event misinformation or specifically co-witness information could have distorted the original memories of the long-term group through participants talking about the event. Because of the nature of the incident they would have been more likely to talk about the actions of the assailant and the victim, instead of

about their appearance and clothing. Therefore misinformation could have had a more distorting effect on the memory for the action-related items.

The one consistent finding regarding occupation (that no significant differences for the long-term memory groups regarding the less pronounced physiognomic details and circumstantial evidence were found) was that all the groups had similar difficulties in recalling these details after the retention period. Although the finding that members of the police did not outscore the other groups could be surprising in certain circles, it should be taken into account that the South African Police students did not receive significant and in-depth training in this field. It would be interesting to determine via future research whether proper training in this regard does lead to a significant improvement in this important area for police officers.

The finding that the 12 to 14-year-olds in the short-term memory group answered more items correctly and incorrectly than the other groups might be related to their guessing propensity. Their long-term memory results in which they outscored the other groups regarding certain details seems to support evidence that indicates that when children are questioned in a non-suggestive manner they are not less reliable than adults (Cassel & Bjorklund, 1995; Dent, 1992; Goodman & Reed, 1986).

Research has clearly indicated differences in cognitive performance between the two genders (Kolb & Winshaw, 2001). As far as eyewitness identification evidence is concerned, Brigham, Wasserman and Meissner (1999) found that females tend to focus more on clothing details than males. However, the present finding shows that such differences only find expression in a few details with respect to perception and memory. Although significantly more females in the present study recalled certain clothing details correctly, this only represents about a quarter of the total clothing details. This would not justify the conclusion that females are more accurate in this or any other aspect of eyewitness identification. This finding is supported by Butts, Mixon, Mulekar and Bringmann (1995), Loftus, Levidow and Duensing (1992), and Narby, Cutler and Penrod (1996) (also see Article 4).

Regarding race, the significant differences with respect to certain details for long-term memory suggest that interference or destructive updating affects blacks and whites differently. This refers specifically to the finding that a significantly larger proportion of whites answered action-related items correctly, while a significantly larger proportion of

blacks was more accurate in answering obvious physiognomic details. Very confusing is the fact that in the short-term memory group significantly more whites answered the item about race of the assailant correctly, while in the long-term memory group again significantly more blacks answered this item correctly. As this is difficult to explain, it would be very difficult to draw any conclusion about race-bias. The fact that both races answered approximately the same number of details more correctly than the other race indicates no or very little difference in the accuracy of perception and memory for the two races. This is in accordance with Wells and Olson's (2003) view that no consistent overall differences attributable to race have been found.

CONCLUSION

The study aimed at investigating whether the analysis of items would provide more clarity on the relationship between certain biographical variables and the accuracy of eyewitness testimony, yielded the following main findings:

- As a whole, the short-term and long-term memory groups showed no significant differences regarding details related to less pronounced physiognomic details. Significant differences were indicated for only certain items related to obvious physiognomic details, clothing details, circumstantial evidence and action-related details.
- Regarding occupation, significant differences in the short-term were found for some of the items related to obvious physiognomy, less pronounced physiognomy, clothing, action, and circumstantial evidence. However, for the long-term groups no significant differences were found for less pronounced physiognomic details and circumstantial evidence.
- The age group findings indicated significant differences in the short-term group concerning certain items related to obvious physiognomy, less pronounced physiognomy, clothing, action and circumstantial evidence. In the long-term age groups, no significant differences were found for items related to obvious and less pronounced physiognomy and circumstantial evidence.
- With respect to gender, no significant differences regarding action-related and circumstantial evidence were found. However, significant differences were found

regarding certain obvious physiognomic details, less pronounced physiognomic details and clothing details.

- Regarding the different races in the short-term memory group, no significant differences were found regarding items related to action, less pronounced physiognomy and clothing. However, significant differences were indicated in certain items related to obvious physiognomic details and circumstantial evidence. Although no significant differences were found in any clothing details in the long-term memory group, certain items related to obvious physiognomy, less pronounced physiognomy, action and circumstantial evidence displayed significant differences.

Certain limitations of the study should, however, be kept in mind when interpreting the results:

Firstly, the questions were posed as multiple-choice questions which could have enhanced participants' inclination to guess. This is also different from the manner in which witnesses are questioned by the police or in court.

Secondly, regarding the retention interval of the long-term memory group, it would have had more value if the study had been conducted to provide a 6 to 12-month period between the incident and the time of recall for the long-term group. Such a delay would possibly be more in accordance of what happens in most court cases. This could, however, have increased the drop-out rate of participants in the long-term group, which already posed a problem after a 5 to 6 week period.

Thirdly, a very important limitation involves the stress aspect. It is argued that stress of an event may influence the accuracy of recall of specific features of the perpetrator and the incident. It was, however, difficult to estimate the degree of stress that the participants experienced during the event and when they completed the questionnaire.

Fourthly, although difficult, it would have made analysis easier if an equal number of items had been included for the different types of questions (e.g. for physical appearance, clothing and actions). This shortcoming, however, only became apparent during the analysis of data.

Fifthly, the questions focussed mainly on the details of the perpetrator as this is usually the line of questioning by law enforcement officers. Asking questions about other details, for example, about the place where the event took place and about the victim, would have added value to the study. This would have given an indication of how attention is divided and whether eyewitnesses' attention is captured by the more central details of an event to the detriment of less obvious peripheral information.

Sixthly, the degree of difficulty of questions would also have impacted on the accuracy of recall. It was, however, difficult to determine which questions were easier and which were more difficult, as this would have depended on the subjective interpretation of the researcher. It might have been better to include a Likert scale and allow the participants to determine the degree of difficulty of questions posed

From the present findings it is clear that studying perception and memory for the purpose of providing answers about the accuracy of eyewitness testimony is not simple. Results are not always clear and unequivocal, which is an indication of how little is known about the workings of perception and memory. Very few studies have investigated not only the type of details perceived and remembered better by different biographical groups, but also in which situations and after different retention periods. Lack of research in this area should urge researchers to investigate this topic further with sound methodologies that support real-life applications. If more clarity exists about the type of information different biographical groups tend to answer more accurately it would be helpful to link this with the manner in which questions are posed to eyewitnesses. To achieve this, analysis of items, especially with regard to type of details focussed on and the degree of difficulty of items, is important. This should assist law enforcement personnel in posing their questions in such a way that the maximum amount of information with the highest accuracy is retrieved.

Against the findings of the present study, the fundamental message seems to be that this important field cannot be neglected any longer. This problem can be addressed in different ways. Firstly, further research can provide clarity regarding many of the present vague and contradictory findings. Secondly, training should be provided to individuals such as law enforcement personnel, which should create an awareness that an effort is needed in this area to increase the accuracy of eyewitness testimony.

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ARTICLE 6

THE EFFECT OF VIOLENT VERSUS NON-VIOLENT INCIDENTS ON EYEWITNESS MEMORY

CONTENTS

TABLES

ARTICLE 6

THE EFFECT OF VIOLENT VERSUS NON-VIOLENT INCIDENTS ON EYEWITNESS MEMORY

We are exposed to criminal events on a daily basis, whether in real-life situations as victims or observers, or to artificially created events such as on television or in the movies. How well these incidents will be recalled at a later stage depends a great deal on general information processing by our senses and the brain in which the stages of acquisition, retention and retrieval play a vital role. It seems, however, that the recall of events extends further than simple perception and memory, as most researchers view eyewitness memory as malleable and unreliable (Foxhall, 2000; Sinatra, 2000; Wells & Olson, 2003). It is a well-known fact among researchers and acknowledged by the courts that various factors at the time of a perceived event and afterwards can influence memory accuracy when an eyewitness has to provide testimony. However, different opinions exist about how and to what extent these various variables influence the accuracy of perception and memory.

One of the variables on which researchers have focussed is the effect of violent versus non-violent incidents on the accuracy of eyewitness memory. Research in this area is especially important in South Africa where violence has creased to such an extent that it has reached endemic proportions (Glanz, 1989; Shaw, 2002; Van Rensburg, 1999). Against this background the aim of the study is firstly to determine the accuracy of short-term and long-term memory after exposure to a violent and non-violent incident. Secondly, the effect of different biographical variables on short-term and long-term memory will be investigated.

RELATIONSHIP BETWEEN NON-VIOLENCE VERSUS VIOLENCE AND MEMORY

The general view is that the perception of violent events, and especially the stress that accompanies it, decreases the ability of eyewitnesses to accurately encode and recall events. This view is based mainly on a defence mechanism perspective. The reaction to trauma or violence is explained as a reaction of dissociation during which the traumatic event is

compartmentalised and not properly processed (Saywitz & Nathanson, 1993). It is further argued that even a single aspect of a violent or emotional event could have a repressing effect that generalises to the whole event (Begley & Brant, 1994; Clifford & Scott, 1978). Kuehn (1974) states that the type of crime is a significant factor affecting the accuracy and completeness of report. Victims of robberies provided a significantly fuller report of their assailants than rape or assault victims did. This is explained by the research finding that victims of more violent crimes in which they were injured provided less complete descriptions those in which they were not injured (Kuehn, 1974; Leippe, Wells & Ostrom, 1978; Wingfield & Byrnes, 1981). It could therefore be hypothesised that the accuracy and completeness of reports decrease with the increase of stress associated with the violence of the event. It was also found that recall was less accurate for a violent film than for a non-violent film, despite the fact that the physical descriptions of the targets for both films were identical (Berger & Herringer, 1991; Clifford & Scott, 1978).

Contrary to the aforementioned findings and viewpoints, some researchers hold the opinion that memory performance is increased when subjected to violent and emotional events. They indicate that the "artificial" laboratory research on which most eyewitness research is based, may not provide a true reflection of the observation capabilities of eyewitnesses of violent crimes and other real-life emotional events. Yuille and Cutshall (1986; 1989), for example, found that memories from real traumas are not only more detailed, accurate, persistent than, but also qualitatively different from memories of laboratory-induced traumatic events. This could be accounted for by the physiological explanation that enhanced adrenalin secretion as a consequence of the stress may cause increased consolidation of memory; thus providing a mechanism for heightened retention of stressful experiences (Goodman, Hirschman, Hepps & Rudy, 1991). All this could be explained by either the fact that people are more likely to ponder on unique experiences or by the so-called "flashbulb memories effect", according to which more intense and emotional reactions lead to better memory of attendant circumstances over time. The latter is explained as the adaptive value of retaining memories of aversive experiences or of information possessing high survival value (Brown & Kulik, 1977). Researchers such as Lang, Newhagen and Reeves (1996), and Furnham and Gunter (1987) furthermore indicate that people pay more attention to, as well as remember violent content from news clips better than non-violent content.

Supporters of the view that violent events lead to better memory also indicate that retention of these traumatic events is better than that for non-violent events when identification or testimony is required after an extended period of time. For example, after a 12 to 20 week interval between observation and recall, participants who were subjected to a stressful or violent situation were more accurate than those recalling a non-stressful or non-violent situation (Yuille & Cutshall, 1986; Yuille, Davies, Gibling, Marxsen & Porter, 1994).

Some researchers, however, view the effect of arousal that accompanies the witnessing of violent incidents as more complex than simply leading to increased or decreased memory performance. Firstly, when an emotionally provoking or violent situation occurs, stress may narrow attention, leading to poorer memory for certain details, but may aid consolidation so that other attendant details are retained particularly well (Baddeley, 1972; Christianson, 1992). Migueles and Garcia-Bajos (1999, p. 266) researched the recall and recognition of actions and details concerning the central and peripheral information of a kidnapping and came to the conclusion: "…when the materials allows for precise distinction between the actions and details of an emotional event, it is noted that eyewitness' attention is drawn to central actions to the detriment of descriptive details, while as for information not connected to the emotional focal point, as may be the case of more neutral events, attention is distributed more homogeneously between peripheral actions and details. As a consequence, more central actions are recalled and recognised than peripheral ones, but also more peripheral details than central."

Secondly, it is possible that accuracy of responses may vary across different items or questions being asked about the incident. Based on this viewpoint, Christianson and Hübinette (1993) disagree with the statement of Yuille and Cutshall (1989) that emotional memories are generally accurate and detailed. They found that although high accuracy rates were indicated in this study, the memory performance varied considerably between different items of information. Although Christianson and Hübinette's own findings demonstrate relatively high accuracy rates with respect to memory of many specific details about the robbers (e.g. action, weapon, clothing), other details of the appearance of the robbers (e.g. footwear, hair and eye colour) showed a rather low performance. They also found that recollection of the specific circumstances of the robberies (e.g. date, time, other people) was less accurate. This is in conflict with the "flashbulb" memory theory that circumstances

associated with traumatic experiences are remembered in great detail and are almost immune to deterioration. Christianson and Hübinette (1993) and Christianson (1992) agree that the relationship between degree of emotion and memory for detailed information of violent events is complex, but emphasise that emotional events are remembered differently from neutral events. It should therefore not be concluded that the more negative the emotion or stress, the poorer the memory; or the opposite, that intense emotion leads to generally detailed, accurate, and persistent memory.

Thirdly, the weapon focus effect is viewed as adding to the complexity of perception and memory. This phenomenon refers to the diminished ability of an eyewitness to subsequently identify a perpetrator when a weapon was used in a crime. The arousal properties of the weapon may induce fear among witnesses, causing them to concentrate on the weapon instead of on the perpetrator. When a perpetrator holds a weapon such as a gun in his hand, witnesses are distracted by the weapon. This leaves little processing time and attention for other details such as perceiving the perpetrator's face (Loftus, 1979). The weapon effect among eyewitnesses may be attributable to the fact that the weapon is novel or incongruous in a particular situation. Studies of visual processing have demonstrated that incongruous objects result in earlier more frequent and longer eye fixations than more probable objects do. Owing to the fact that the perception of a weapon is not only arousing but also often unexpected, the weapon focus effect may actually be a salient object effect. This means that a weapon may be only one of a number of interesting objects, any of which could produce a memory deficit. If this notion is accepted there should be a decrease in the accuracy of eyewitness identification when a perpetrator carries any object that is incongruous in the context of a particular situation (Shaw & Skolnick, 1994).

Egeth (1993) holds the view that a meta-analysis of weapon-focus studies showed that the size of the weapon-focus effect was small where suspects had to be identified in a line-up. In those cases where accuracy was dependent on a neutral description the effect was only moderate. Shaw and Skolnick (1994) found no weapon focus effect in their study, but ascribed this to the absence of arousing stimulus conditions. They also refer to a meta-analysis of weapon focus studies where it was found that stronger weapon focus effects are obtained with more complex stimuli and higher arousal levels.

In another meta-analytic review of the weapon focus effect Steblay (1992) found that six studies supported the weapon focus effect, no studies suggested a significant opposite effect and 13 studies indicated no significant differences between weapon-present and weapon-absent conditions. She argues that although the number of non-conforming results may lead to concern about the reliability of the weapon focus phenomenon, 56,6% of experts in the eyewitness testimony field viewed the weapon focus effect as reliable enough to present in courtroom testimony. She concludes that the data provide evidence that weapon focus poses a significant impact.

Against this background of conflicting results and viewpoints, possibly the simplest way to arrive at a conclusion is to view the correlation between stress caused by violence or seriousness of an incident and memory accuracy as a curvilinear relationship. This means that stress can improve memory accuracy through attention and encoding up to a point before it decreases because of arousal and avoidance factors (Leippe, Wells & Ostrom, 1978). However, before any assumptions are made based on this explanation it would be important to acknowledge individual differences of eyewitnesses, as well as different situations and levels of violence to which eyewitnesses are exposed (Eisen, Goodman, Qin & Davis, 1998).

BIOGRAPHICAL VARIABLES AND MEMORY ACCURACY

In presenting a summary of the biographical variables (occupation, age, gender and race) and their relationship to the accuracy of memory it will become evident that researchers have often demonstrated inconsistent research findings.

o *Occupation*. It would be easy to assume that owing to their education, training and experience, some people should perform better in eyewitness situations than others. For example, members of the police, due to their training and experience, would be better prepared for violent situations, than civilians and would therefore be better eyewitnesses. Although not directly related to violent situations research findings present equivocal results concerning the competence of police as eyewitnesses (see Article 2). Some researchers found the eyewitness testimony of police to be more accurate than other occupational groups (Christianson, Karlsson & Persson, 1998; Clark, Stephenson & Kniveton, 1990), while others

could not find any significant differences (Ainsworth, 1981; Clifford, 1976; Clifford & Richards, 1977; Yarmey & Jones, 1983).

o *Age*. Most findings seem to indicate that child eyewitnesses are more suggestible than their adult counterparts, which makes their testimony less reliable (Candel, Merckelbach, Muris, Rasquin & Bollen, 1998; Luus, Wells & Turtle, 1995). However, research findings of four studies with regard to age differences did not indicate that stress (which one would assume would be a consequence of violence) had a reliable negative effect on memory as far as age is concerned. In this regard Goodman et al (1991) posed that when stress was very high and children became nearly hysterical with fear, stress was associated with enhanced memory. It should, however, be emphasised that forgetting did occur and that the children's memory for the stressful event faded as much as it might have done for a non-stressful event.

o *Gender*. The findings on the relationship between gender and eyewitness accuracy have presented equivocal results (see Article 2). Some researchers proposed that males performed better than females (Adams-Price, 1992; Kuehn, 1974), while others presented findings that females were more accurate than males (Casiere & Ashton, 1996; Shepherd, Ellis & Davies, 1982), or that gender differences were non-existent (Butts, Mixon, Mulekar & Bringmann, 1995; Cunningham & Bringmann, 1986; Loftus, Levidow & Duensing, 1992). Concerning the effect of violent and non-violent incidents, Clifford and Scott (1978) found significant differences between the two genders were not emphasised when exposed to non-violent conditions. However, after viewing violent conditions, females performed significantly worse than male eyewitnesses. Lipton (1977) to the contrary, found that female eyewitnesses were better than males at recalling details from a violent videotaped scene.

o *Race.* Many researchers seem to avoid research comparing the perceptual and memory accuracy of different races, as it may be viewed as racist in nature (Teitelbaum & Geiselman, 1997). Although findings suggest no differences in this regard (Wells & Olson, 2003), most research questions have focussed on the own-race bias effect. This holds that people find it easier to identify people from their own race or who are familiar and that cross-racial identifications are less reliable than own-race identifications (Bothwell, Brigham & Malpass 1989; Chance & Goldstein, 1996; Fine, 1999; Holguin, McQuiston, MacLin & Malpass, 2000). Other researchers, however, have questioned whether own-race bias exists at all (Brigham, Maass, Snyder & Spaulding, 1982; Lindsay & Wells, 1983). The

relationship between race and accuracy of memory after exposure to violence versus non-violence does not appear to have received attention.

METHOD

In order to achieve the aim of this study, permission was obtained to draw participants from the following three groups: students from two Universities (the University of the Free State in Bloemfontein and Vista University in Welkom), the business sector (including people from the banking sector in Bloemfontein), and students from the South African Police College in Pretoria. No children were involved in the study due to ethical concerns regarding the effect of exposure to a violent incident. However, it soon became evident that practical problems would prevent the attainment of the goal of randomly selecting the participants. All the participants already belonged to specific groups or classes within their respective institutions and organisations. Randomly selecting participants would have meant singling out individuals from these groups, which would have created significant and unacceptable disruptions for these groups. For this reason the researcher decided to make use of an availability sample.

The total research sample consisted of 474 respondents and was divided into two groups – one exposed to a violent video and the other to a non-violent video. They were further divided into a short-term memory and a long-term memory group.

The biographical characteristics of the first group of 254 respondents who were exposed to a non-violent incident are indicated in Table 1 with specific reference to the relevant biographical variables.

Table 1. Frequency distribution of a group that witnessed a non-violent incident

Biographical variables	N	%
Occupational group:		
Student	88	34,6
Business sector	80	31,5
Police	86	33,9
Age:		
18 – 25 years	137	53,9
26 – 30 years	78	30,7
31 – 40 years	30	11,8
41 – 50 years	6	2,4
51 – 60 years	3	1,2
Sex:		
Male	111	43,7
Female	143	56,3
Race:		
Black	130	51,2
White	100	39,4
Coloured	18	7,1
Indian	5	2,0
Other	1	0,4

Due to a smaller number of participants in all the groups of 31 years and older, the number of age categories was reduced to only two categories, namely 18 to 25 years (N = 137) and 26 years and older (N = 117).

The majority (90,6%) of the research sample consisted of black (51,2%) and white (39,4%) participants. Owing to this the other race categories are not referred to in the study when the different race groups are compared.

The distribution of the second group consisting of 220 respondents who were exposed to a violent incident is indicated in Table 2 with specific reference to the relevant biographical variables.

Table 2. Frequency distribution of the group that witnessed a violent incident

Biographical variable	N	%
Occupational group:		
Student	68	30,9
Public/business sector	77	35,0
Police	75	34,1
Age:		
18 – 25 years	105	47,7
26 – 30 years	65	29,5
31 – 40 years	43	19,5
41 – 50 years	6	2,7
51 – 60 years	1	0,5
Sex:		
Male	132	60,0
Female	88	40,0
Race:		
Black	131	59,5
White	53	24,1
Coloured	21	9,5
Indian	13	5,9
Other	2	0,9

As with the non-violent group the three occupational groups were equally distributed. Two categories were constructed due to the relatively few participants in the groups of 31 years and older: 18 to 25 years (N = 105) and 26 years and older (N = 115).

More than 80% of the total number of respondents consisted of black (59,5%) and white (24,1%) participants. Due to the relatively few participants in each of the other race groups, these groups were disregarded when different race groups were compared.

o *Memory Event.* All participants were well informed about the purpose of the study. One group of participants watched a non-violent video displaying a car chase, while another group of participants watched a bank robbery involving a violent shoot-out. Both videos were approximately one minute long.

o *Measuring instrument.* All participants in the short-term memory groups were asked to complete the questionnaires immediately after the memory incident (Appendix B and C). The participants of the long-term memory groups completed the questionnaires five to six weeks after the memory incident.

o *Procedure of analysis*. In this study it was necessary to compare the average accuracy scores for different short-term and long-term memory groups, as well as different occupational groups. In cases where only two groups were compared, the purpose was testing for a difference between the mean of one population (μ_1) and the mean of a second population (μ_2). The simplest way to test for the difference between the means of two independent groups is the *t*-test. The null hypothesis had been tested in the form H_0: $\mu_1 - \mu_2 = 0$ or, equivalently, $\mu_1 = \mu_2$. The alternative hypothesis again is: H_1: $\mu_1 \neq \mu_2$. However, in some cases the means of more than two groups had to be compared, which placed a restriction on the use of the *t*-test. The *analysis of variance* is useful to address this broader requirement with the null hypothesis in the form of H_0: $\mu_1 = \mu_2 = \mu_3 = \ldots \mu_p$ and the alternative hypothesis: H_1: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \ldots \mu_p$. In cases where more than two groups were present and a significant difference had been indicated the specific differences between these groups needed to be determined. The post hoc *t*-test used for this purpose is known as the Scheffé-test (Howell, 2002; McCall, 1990).

RESULTS

In order to achieve the aim of this study, three analyses were carried out. Firstly, all the participants were grouped together, regardless of the influence of biographical variables. A comparison was then made between the averages of short-term and long-term memory results to determine whether deterioration in the accuracy of memory took place after a five to six week period. Secondly, an inter-group comparative analysis was made between the average short-term and long-term scores of the respective biographical groups. Thirdly, an intra-group comparative analysis was made between certain biographical variables (occupation, age, gender and race) and both short-term and long-term memory accuracy respectively.

Relationship between retention period and memory accuracy

The *t*-test for two independent groups was used to determine the differences in the averages of the short-term and long-term memory groups that viewed the non-violent and violent videos respectively. The results are presented in Table 3.

Table 3. Relationship between short- and long-term memory and type of incident

Content	Term	N	$\bar{x}$	s	*t*	*p*
Non-violent	Short-term Long-term	140 114	10,50 8,45	2,42 3,01	5,887	0,0001**
Violent	Short-term Long-term	129 91	8,78 7,05	2,49 2,98	4,657	0,0001**

** $p \leq 0,01$

The results of Table 3 show significant differences on the 1%-level between the average scores of the short-term and long-term memory groups that viewed the non-violent, as well as the violent video, after a five to six week retention period. The average scores of the short-term memory groups are significantly higher than those of the long-term memory groups.

Inter-group analyses of the relationship between retention period and memory accuracy

The *t*-test for two independent groups was employed to compare the averages of the short-term and long-term memory accuracy scores for the respective biographical groups.

Occupation

The *t*-test results for the four occupational groups are presented in Table 4.

Table 4. Relationship between term of memory and accuracy within the different occupational groups for the different incidents

Content	Occupation	Term	N	$\bar{x}$	s	*t*	*p*
Non-violent	Students	Short-term Long-term	51 37	10,90 9,32	2,26 3,37	2,471	0,0164*
	Public	Short-term Long-term	47 33	9,81 7,09	2,89 2,35	4,466	0,0001**
	Police	Short-term Long-term	42 44	10,79 8,73	1,87 2,84	3,989	0,0002**
Violent	Students	Short-term Long-term	52 16	8,77 5,75	3,17 4,05	3,112	0,0027**
	Public	Short-term Long-term	37 40	8,73 7,43	2,02 2,63	2,426	0,0177*
	Police	Short-term Long-term	40 35	8,83 7,23	1,82 2,69	3,039	0,0033**

* $p \leq 0,05$
** $p \leq 0,01$

Significant differences exist between the average short-term and long-term memory groups regarding the non-violent and violent videos (see Table 4). There is a significant decrease in the average scores for the students (on the 5%-level for the non-violent and on the 1%-level for the violent video), public (on the 1%-level for the non-violent and on the 5%-level for the violent video) and police (on the 1%-level for both the non-violent and the violent video) after a five to six week retention period.

Age

Table 5 contains the *t*-test results for the different age groups with respect to the differences in short-term and long-term memory accuracy scores.

Table 5. Relationship between term of memory and accuracy within the different age groups for the different incidents

Content	Age	Term	N	$\bar{x}$	s	*t*	*p*
Non-violent	18 – 25-year-olds	Short-term Long-term	76 61	10,88 8,97	2,44 3,19	3,975	0,0001**
	26 years and older	Short-term Long-term	64 53	10,05 7,85	2,34 2,69	4,724	0,0001**
Violent	18 – 25-year-olds	Short-term Long-term	69 36	9,01 6,86	2,93 3,01	3,541	0,0006**
	26 years and older	Short-term Long-term	60 55	8,50 7,18	1,84 2,96	2,833	0,0057**

* $p \leq 0,01$

Table 5 indicates that significant differences are present for both age groups on the 1%-level regarding the non-violent and violent video content. The average short-term memory scores for the 18 to 25-year-olds and the 26 years and older participants are significantly better than those of the long-term memory groups.

Gender

The *t*-test results for the two gender groups with regard to differences in short-term and long-term average memory accuracy scores can be viewed in Table 6.

Table 6. Relationship between term of memory and accuracy within the different gender groups for the different incidents

Content	Gender	Term	N	$\bar{x}$	s	*t*	*p*
Non-violent	Male	Short-term	60	10,52	2,46	4,038	0,0001**
		Long-term	51	8,43	2,98		
	Female	Short-term	80	10,49	2,41	4,432	0,0001**
		Long-term	63	8,46	3,06		
Violent	Male	Short-term	80	8,78	2,73	2,861	0,0049**
		Long-term	52	7,33	3,00		
	Female	Short-term	49	8,78	2,04	3,915	0,0002**
		Long-term	39	6,69	2,94		

** $p \leq 0,01$

Significant differences on the 1%-level (see Table 6) are evident between the average short-term memory and long-term memory groups for both genders with respect to the non-violent and violent videos. A significant deterioration in memory performance after an extended retention period occurred, as the average short-term memory scores for both the males and the females are significantly higher than those of the long-term memory group.

Race

The *t*-test results to investigate the differences between the short-term and long-term average memory accuracy scores of the two racial groups are presented in Table 7.

Table 7. Relationship between term of memory and accuracy within the different racial groups for the different incidents

Content	Race	Term	N	$\bar{x}$	s	*t*	*p*
Non-violent	Blacks	Short-term	80	9,98	2,53	4,019	0,0001**
		Long-term	50	8,08	2,75		
	Whites	Short-term	48	11,08	2,22	4,471	0,0001**
		Long-term	52	8,60	3,28		
Violent	Blacks	Short-term	80	8,45	2,20	3,654	0,0005**
		Long-term	51	6,61	3,14		
	Whites	Short-term	29	9,66	3,53	2,012	0,0495*
		Long-term	24	7,79	3,13		

* $p \leq 0,05$
** $p \leq 0,01$

Significant differences between the average short-term and long-term memory scores are present (see Table 7) for both racial groups that witnessed a non-violent or violent video. This is evident on the 1%-level for all groups except for the white group that viewed the violent video for which the significant difference appeared on the 5%-level. After a five to six week retention period significant deterioration in memory occurred, as the short-term memory average scores are significantly higher than those of the long-term memory group.

Intra-group analysis of the relationship between retention period and memory accuracy

The intra-group comparative analysis of the biographical groups (occupation, age, gender and race), regarding both short-term and long-term memory accuracy scores respectively, is presented next.

Occupation

To determine whether there was a difference between the respective short-term and long-term average memory accuracy scores for the four occupational groups a one-way analysis of variance was done and the results for the short-term and long-term memory groups appear in Table 8.

Table 8. Differences in accuracy between the respective short-term and long-term memory occupational groups within the different incidents

Content	**Term**	***F***	***P***
Non-violent	Short-term	3,00	0,0533
	Long-term	5,51	0,0052**
Violent	Short-term	0,01	0,9859
	Long-term	1,95	0,1486

** $p \leq 0,01$

Table 8 indicates that there is only a significant difference (on the 1%-level) in the average long-term memory accuracy scores for the three occupational groups who viewed the non-violent video. Due to the fact that three occupational groups were included, a post *t*-test (Scheffé-test) was done in order to identify the specific group differences for the long-term memory group that viewed a non-violent video. The results are indicated in Table 9.

Table 9. Differences in accuracy between the long-term memory occupational groups with respect to the non-violent incident

Content	Term	Groups	N	$\bar{x}$	s	Groups with differences
Non-violent	Long-term	Students (group 1)	37	9,32	3,37	Group 1 from 2
		Public (group 2)	33	7,09	2,35	
		Police (group 3)	44	8,73	2,84	

According to the Scheffé results in Table 9 the average long-term accuracy score of the students (group 1) was significantly higher than that of the public on the 5%-level.

Age

As mentioned before two age groups were constructed, namely 18 to 25 years and 26 years and older. A one-way analysis of variance (see Table 10) was done to determine whether a difference in the average short-term and long-term memory accuracy scores existed for the three age groups.

Table 10. Differences in accuracy between the respective short-term and long-term memory age groups within the different incidents

Content	Term	Age	N	$\bar{x}$	s	*t*	*p*
Non-violent	Short-term	18 – 25-year-olds	76	10,88	2,44	2,055	0,0417*
		26 years and older	64	10,05	2,34		
	Long-term	18 – 25-year-olds	61	8,97	3,20	2,002	0,0477*
		26 years and older	53	7,85	2,69		
Violent	Short-term	18 – 25-year-olds	69	9,01	2,93	1,175	0,2424
		26 years and older	60	8,50	1,84		
	Long-term	18 – 25-year-olds	36	6,86	3,01	-0,501	0,6178
		26 years and older	55	7,18	2,97		

* $p \leq 0,05$

It is evident on the 5%-level that regarding the non-violent video the 18 to 25-year-olds obtained significantly higher short-term and long-term memory average scores than the 26 years and older groups (see Table 10). No significant differences were indicated for the respective short-term and long-term memory age groups that were exposed to a violent video.

Gender

To research the differences between the average memory accuracy scores for the short-term and long-term gender groups respectively, the *t*-test for two independent groups (see Table 11) was utilized.

Table 11. Differences in accuracy between the respective short-term and long-term memory gender groups within the different incidents

Content	Term	Age	N	$\bar{x}$	s	*t*	*p*
Non-violent	Short-term	Male Female	60 80	10,52 10,49	2,46 2,41	0,070	0,9441
	Long-term	Male Female	51 63	8,43 8,46	2,98 3,06	-0,0508	0,9596
Violent	Short-term	Male Female	80 49	8,75 8,76	2,73 2,04	-0,001	0,9991
	Long-term	Male Female	52 39	7,33 6,69	3,00 2,94	1,007	0,3167

The results presented in Table 11 show no significant differences between the average accuracy gender scores for either of the respective short-term or long-term memory groups.

Race

The *t*-test for two independent groups was used to ascertain the difference between the average memory accuracy scores for the respective short-term and long-term racial groups. The results are found in Table12.

Table 12. Differences in accuracy between the respective short-term and long-term memory racial groups within the different incidents

Content	Term	Age	N	$\bar{x}$	s	*t*	*p*
Non-violent	Short-term	Black White	80 48	9,98 11,08	2,53 2,22	-2,509	0,0134*
	Long-term	Black White	50 52	8,08 8,60	2,75 3,28	-0,860	0,3918
Violent	Short-term	Black White	80 29	8,45 9,66	2,20 3,53	-1,722	0,0936
	Long-term	Black White	51 24	6,61 7,79	3,14 3,13	-1,527	0,1322

* $p \leq 0,05$

According to Table 12 the only significant difference regarding race is between the short-term memory average scores of the blacks and whites. The whites obtained significantly higher short-term memory average scores than the blacks on the 5%-level.

DISCUSSION

The primary finding of this study that there was a significant deterioration in memory performance after the five to six week retention period for participants who viewed the non-violent video and the violent video, is noteworthy. This was also true for the different biographical groups. The results supports the view that accuracy of recall decreases with delay and may be one of the most important factors determining the accuracy of eyewitness identification (Lipton, 1977; Sara, 2000; Sinatra, 2000; Wingfield & Byrnes, 1981). Yarmey and Morris (1998) also indicate that witnesses' recollection of a criminal incident decreased significantly after a one week delay, while Brigham et al. (1982) reported that accuracy declined considerably when a statement was made 24 hours compared to 2 hours after an observed incident. The present and other findings therefore confirm that eyewitnesses' memories are not immutable and that, with the passage of time, they become more susceptible to interferences such as misinformation and suggestion (Schreiber, Wentura & Bilsky, 2001).

No support was found for findings (e.g. Yuille & Cutshall, 1986; 1986) that suggest violence and the accompanying stress should increase accuracy and retention of detailed information after an extended passage of time. However, Yuille and Cutshall's findings were based on real-life incidents where the threat and trauma were real, which was not the case in the present study. It is possible that the video would not have created a high enough stress level and accompanying adequate adrenalin secretion which is viewed to be responsible for increased consolidation of memory (Goodman et al., 1991).

Concerning occupational group differences, the expectancy that members of the police, on the basis of their training, would obtain significantly higher short-term and long-term memory scores than the other groups (Clark, Stephenson & Kniveton, 1990), was not met. This seems to be in accordance with the results of Ainsworth (1981), Clifford (1976) Clifford

and Richards (1977), and Yarmey and Jones (1983) that training would not necessarily enhance the ability of the police to perceive and remember events better.

The 18 to 25-year-olds obtained significantly higher short-term as well as long-term memory scores than the group 26 years and older after exposure to the non-violent video. The fact that no significant differences were found for the violent video could be ascribed to the fact that the content of the violent video was so difficult for both groups that accuracy was low and subsequent differences between the groups were limited. It is felt however, that the range of age groups who participated in the study make it difficult to draw conclusions. If children and older people had been included differences in accuracy might have been emphasised more and would have been more easily explained.

The absence of gender differences in the short-term and long-term results indicates that gender has little effect on perception and memory. This finding enjoys support by other researchers (Butts et al., 1995; Loftus, Levidow & Duensing, 1992; Narby, Cutler & Penrod, 1996), although others have found gender differences (Adams-Price, 1992; Casiere & Ashton, 1996; Kuehn, 1974; Shepherd, Ellis & Davies, 1982). No support in this study could be found for Clifford and Scott (1978) and Kuehn's (1974) suggestion that in violent or high emotional conditions females are significantly less accurate than male witnesses. Neither is there support for Lipton (1977) who reported that female witnesses are better than males in recalling details from a violent videotaped scene of a shooting and robbery.

Very few significant differences were found between the memory performances of the two racial groups. With the exception of the short-term group that viewed a non-violent video in which the whites obtained significantly higher accuracy scores than the blacks, no other significant differences were found. It is difficult to determine what the own-race bias effect had on the outcome without analysing the specific items individually. Although only white actors appeared in the violent video no significant differences were found between the two races, which appears to question the cross-race effect. However, in the non-violent video in which black and white actors appeared the whites performed significantly better regarding short-term memory. The assumption can be made that after an extended period of time and for violent situations differences in racial perception are not accentuated. It is possible that after a passage of time memory deteriorates to such an extent that differences in memory

performance become minimal. The content of the violent video might also have been so difficult that accuracy of perception and memory was reduced in such a manner that racial differences in performance were minimised.

CONCLUSION

The main findings of the study may be summarised as follows:

- Regarding both the non-violent and violent video a significant decrease in the accuracy of the average scores occurred after a five to six week retention period when the short-term and long-term memory groups were compared as a whole.
- With respect to all the biographical groups that were exposed to the non-violent and violent video, significantly higher average scores were obtained by the short-term memory groups than by the long-term memory groups.
- The 18 to 25-year-olds who viewed the non-violent video obtained significantly higher short-term and long-term average memory scores than the 26 years and older. No significant differences were found for the violent video.
- No significant differences were indicated for either the short-term or long-term memory gender groups regarding both the non-violent and violent video.
- Concerning the two racial groups, the only difference found was for the non-violent video where the whites obtained significantly higher short-term memory average scores than the blacks. No significant differences were indicated for the long-term groups or those groups who watched the violent video.

Certain limitations need to be considered when interpreting these results:

Firstly, the two videos contained scenes with a totally different content. The violent video contained more details compared with the non-violent video, which would have made it more difficult for participants to encode and retain information. It is also possible that videos are not comparable to a real-life incident and the violent video would therefore not have had the subsequent stressful impact on participants as real-life incident (cf. Yuille & Daylen, 1998).
Secondly, related to the fact that this was a laboratory study, all the participants were informed that they were participating in a research study. This could have had an effect on

the outcome of the study, as the participants would not have experienced the stress one would normally experience in such real-life incidents. The fact that there were no consequences for the participants or the people being observed in providing inaccurate information, could also have had an effect on the outcome of the study as participants would think less critically about the task (cf. Kassin, Rigby & Castillo, 1991; Köhnken & Maass, 1988). Furthermore the camera used to record the incidents, does not move the way the eye does and would have excluded certain peripheral details that could have distracted the participants' attention and affected their perception.

Thirdly, the interval between the short-term and long-term group was possibly not long enough to have a significant effect. A six-month and longer period between the incident and the time of recall for the long-term group would possibly would have been more comparable to what happens in real-life legal procedures and would consequently have had more value. However, this could have increased the drop-out rate of participants.

Fourthly, the members of the police who participated in this study had just completed their training. It would have been easier to generalise the results if members of the police who were actively involved in the field with real crime experiences could have been compared with recruits before training and just after training.

Fifthly, in order to investigate developmental differences the results would have made more impact if participants from different age groups had participated. Although there were ethical concerns in exposing children to the violent video, including more older people would at least have provided insight into whether and how perception and memory deteriorate with age.

In the sixth place, it was difficult to investigate the own-race bias effect. Although black and white actors were fairly equally distributed in the non-violent video, all the actors in the violent video were white. Including black and white "actors" or making use of actors from an oriental group would have provided a more realistic perspective of the accuracy of memory of the two racial groups who participated.

Lastly, the fact that multiple choice questions were used in the questionnaire could also have had an effect on the outcome of the study as it could have increased the guessing propensity

of participants. Presenting questionnaires is also very different from the manner in which eyewitnesses are questioned by law enforcement personnel.

Although the aforementioned limitations of this study could cast doubts on the generalisability of results, it is equally true that these limitations are part and parcel of eyewitness research and therefore apply to basically all research in this field. This area of research is, however, so important in the psycho-legal arena that these limitations should not be used as an excuse to disregard the present findings. Nor should they serve as a reason for pessimism regarding the possibility of overcoming the practical problems. It is important that research should continue and should focus especially on finding a methodological design which will enable us to apply the findings in practice.

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ARTICLE 7

METHOD OF QUESTIONING AND THE ACCURACY OF EYEWITNESS TESTIMONY

CONTENTS

TABLES

ARTICLE 7

METHOD OF QUESTIONING AND THE ACCURACY OF EYEWITNESS TESTIMONY

The accuracy of perception and memory is being viewed as of crucial importance by the legal system for the successful prosecution of offenders (cf. Bartol & Bartol, 1994). However, the reliability of perception and memory is not always above reproach. Consequently the role of eyewitness testimony in the maintenance of justice is often a cause for concern to the legal system (Foxhall, 2000; Loftus & Calvin, 2001; Sinatra, 2000).

A number of variables are being viewed as having a potential impact on the malleability of eyewitness testimony. Estimator variables refer to uncontrollable factors that are an integral part of the observed event and include, for example, witness, perpetrator and situational factors. System variables, however, can be controlled by the legal system and include factors such as the retention interval, post-event information and the stress experienced by the witness during recall (Wells, Malpass, Lindsay, Fisher, Turtle & Fulero, 2000). One of these system variables that contributes to inaccurate recall by witnesses, but which is often neglected by researchers and presiding officers alike, is the method of questioning. For law enforcement personnel the interview is indispensable for obtaining information about an event or suspect from eyewitnesses. The important role of questioning is illustrated by the finding that police officers spend approximately 70% to 80% of their working time interviewing people (Köhnken, 1998). Understandably, the largest focus of these interviews concerns questioning people about past events which must be retrieved from memory.

When the police or other legal professionals question witnesses tactics are often used to intimidate, unsettle and break down the confidence and credibility of witnesses. These methods are not always conducive to eliciting the truth or accurate testimony from witnesses. The manner in which questioning is conducted is specifically viewed as a post-event factor which can impact negatively on the accuracy of eyewitness testimony. In fact, research suggests that the interview after an event could actually cause a weakening of memory traces, or clouding of memory (Coxon & Valentine, 1997; Loftus & Hoffman, 1989). The manner

of questioning can easily reconstruct memory for something that was witnessed, and could even construct memory of an event that was never witnessed. Although the legal system does have the responsibility to discover the truth, as well as a duty to protect the witnesses testifying against abuse in court, very little research has been done in South Africa about the influence of questioning techniques on memory accuracy (Hollely & Müller, 1999; Müller & Hollely, 2003). In order to improve the manner in which witnesses are questioned by law enforcement personnel there needs to be an understanding of the manner in which information can be retrieved from memory (i.e. recall versus recognition) by employing different questioning techniques. The aim of this study is to investigate how different questioning techniques which require different retrieval strategies can influence the accuracy of recall. The theoretical discussion that follows serves as background to the method employed to investigate the relationship between the questioning techniques and accuracy of memory.

RECALL MEMORY VERSUS RECOGNITION MEMORY

Regarding memory retrieval after a witnessed event, a distinction should be made between recall and recognition memory as many cognitive psychology researchers view these two retrieval types as involving different processes (Robinson & Johnson, 1996). Benoit (2000) indicates that true recognition memory is very rapid and occurs in a matter of seconds. According to Sanders and Simmons (1983), recognition memory is an easier and less involved process than recall memory. Whereas recognition memory most often requires the use of a less intentional recall with less effort, recall memory tends to be characterised by an intentional retrieval stage with effort (Robinson & Johnson, 1996). Recognition memory is therefore viewed as requiring a simpler and less complicated process of retrieval than recall memory. Deutscher and Leonoff (1991) suggest that this could be explained by the fact that recall memory requires a positive action providing either a verbal or a visual representation, whereas recognition can be compared to a multiple-choice test, where searching for a suitable match is required. Although both forms are inherently poor when the object to be recalled or recognised is a face, recognition memory is generally viewed as being more accurate than recall memory. It is, however, possible that some people would find recognition memory more difficult and confusing than recall memory. For example, some people may find multiple-choice type questions more difficult than paragraph questions. In the same way,

many victims of rape are able to recall all the details of the attack and even describe their assailant correctly in detail, but are unable to identify the correct offender in line-up identifications due to problems with recognition memory. However, it is possible that recognition memory would provide more of an opportunity for eyewitnesses to guess when they feel uncertain, whereas with recall memory they would possibly be prepared to give a "don't know" response. This implies that in cases where information was not well encoded eyewitnesses may prefer recognition recall to recognition memory. They therefore choose the option that most closely resembles the picture they have stored in memory. Recognition memory and therefore line-up identification should thus not always be viewed as infallible as is often supposed.

As the mechanism of retrieval (recognition versus recall memory) is often linked to the manner in which questioning takes place, a short overview of the different questioning techniques will be given next.

QUESTIONING TECHNIQUES

Law enforcement personnel employ different questioning techniques to enable eyewitnesses to make identifications or to testify about what was witnessed. Questioning serves the purpose of eliciting the truth, but is also sometimes used to intimidate witnesses to make identifications or statements of what is believed to be the truth.

According to Müller (2000) witnesses are confronted with two types of questions. Firstly, open questions refer to recall memory questions and provide the eyewitness with an opportunity to elaborate, describe and explain events. These open-ended questions are related to recall memory questions where the eyewitness has an opportunity to volunteer information in a free narrative style. This seems to increase the likelihood of accurate responses. The accuracy of responses to open-ended questions may, however, be dependent on the language development of the eyewitness. For example, although their responses may be accurate, younger children are inclined to volunteer less free-recall information than older children and adults (Steller & Boychuk, 1992). This means developmental or age differences may be emphasised not by the accuracy of recall, but by the completion of a statement.

Secondly, closed questions are related to recognition memory questions and require a specific response such as with multiple-choice questions or questions that only require a yes or no response. This method of questioning is restrictive and can undermine especially the credibility of child witnesses, because of the linguistic complexity and the very often, suggestive content. "Can you" questions also form part of this category and have the ability to exert unnecessary pressure on the eyewitness (Foxhall, 2000; Walker & Hunt, 1998; Wells et al., 2000). These closed-ended questions often contain a definite article and tend to produce fewer "uncertain" and "I don't know" responses, but produce more "recognition" of events that have never occurred. Children almost never say, "I don't know" to yes/no questions, but are more accurate and more willing to reveal their lack of memory when the questions contain a "wh-question word" (Loftus & Zanni, 1975; Peterson, Dowden & Tobin, 1999). This refers to questions starting with "who", "where", "when" and "what" that are all related to the open-ended question category. Ceci and Bruck (1993) indicate that age differences in recognition memory are less pronounced than age differences in free recall, and at times even non-existent. It is, however, possible that recognition memory questions may increase the guessing propensity of children if these questions produce fewer "I don't know" responses. This may also be the reason for misidentifications with photo- or line-up constructions as the eyewitness is given an opportunity to choose the perpetrator from a limited number of suspects. This may put pressure on the eyewitness to choose someone, although the real perpetrator may not be present.

It seems from the aforementioned that the manner in which retrieval takes place (recall versus recognition memory), as well the questioning technique (open-ended versus closed-ended) employed by law enforcement personnel can have an important influence on the accuracy of eyewitness identification or testimony. If this is true, it is important to investigate what this influence is and consequently how questioning can be improved by the legal system to enhance accuracy of recall by eyewitnesses. This is the exact purpose of this study. To simplify the research, open-ended questions were matched with recall memory, while closed-ended questions were matched with recognition memory. Therefore, the first goal of this study was to determine a possible correlation between method of questioning (open-ended versus closed-ended) and the accuracy of the eyewitness memory. Secondly, it was aimed at determining the effect of the method of questioning (open-ended versus closed-ended) on the

accuracy of responses in the case of specific biographical variables (occupation, age, gender and race).

METHOD

The researcher decided to make use of an availability sample, as the participants he aimed to include in his research already belonged to specific groups or classes within their respective institutions and organisations. Permission was obtained to draw participants from the following four groups: primary school children between 11 and 14 years old (from two schools in Thabong and Hennenman), students from two universities (the University of the Free State in Bloemfontein and Vista University in Welkom), the public (including lecturers and business people from Welkom and Bloemfontein), and students from the South African Police College in Pretoria.

The total research sample consisted of 412 respondents and the distribution of this sample regarding the specific biographical variables is indicated in Table 1.

Table 1. Frequency distribution regarding biographical variables

Biographical variable	**N**	**%**
Profession:		
Scholar	114	27,7
Student	107	26,0
Public/Business sector	85	20,6
Police	106	25,7
Age:		
12 – 14 years	114	27,6
18 – 25 years	165	40,0
26 – 30 years	79	19,2
31 – 40 years	42	10,2
41 – 50 years	8	1,9
51 – 60 years	2	0,5
Older than 60 years	2	0,5
Sex:		
Male	217	52,7
Female	195	47,3
Race:		
Black	209	50,7
White	171	41,5
Coloured	25	6,1
Indian	7	1,7

As the small number of participants in certain categories could have impeded the statistical analyses, two rearrangements were made. Firstly, the age categories were reduced to three, namely 11 to 14 years (N = 114), 18 to 25 years (N = 165), and 26 years and older (N = 133). Secondly, as 92,2% of the research sample (i.e. 380 of the 412 subjects) consisted of black and white participants, it was decided to exclude the other racial groups.

o *Memory Event*. All groups viewed a video clip of one minute 30 seconds which presents a lecturer writing on a white board with a red pen: 20 + 50 = 70. While the lecturer is writing on the board, the third student from the front is talking to the student at the back of the group of students. While these two students are having their discussion, the student second from the front turns in his desk and removes an eraser (but in such a way that it is impossible for the observers to see what he is removing) of the pencil case from the student third from the front. He puts the object in his shirt pocket with his right hand. Immediately after that he puts his left hand in the same pocket and removes R 20-00, which he passes on to the student in front. This student puts the R 20-00 in his pencil case. When the student third from the front opens his pencil case, he exclaims: "There is a thief in this class!"

o *Measuring instrument*. Immediately after viewing the video, all the participants were asked to complete a questionnaire with 15 questions and to indicate how confident they were about their responses. One group was given a questionnaire that contained closed questions (Appendix D), while the other group received a questionnaire with open-ended questions (Appendix E).

o *Statistical analysis*. In this study it was necessary to compare the average accuracy scores for different open-ended and closed-ended questioning groups, as well as different occupational groups. In cases where only two groups were compared the purpose was testing for a difference between the mean of one population (μ_1) and the mean of a second population (μ_2). The simplest way to test for the difference between the means of two independent groups is the *t*-test. The null hypothesis was tested in the form H_0: $\mu_1 - \mu_2 = 0$ or, equivalently, $\mu_1 = \mu_2$. The alternative hypothesis is: H_1: $\mu_1 \neq \mu_2$. However, in some cases the means of more than two groups had to be compared, which restricted the use of the *t*-test. The analysis of variance is useful to address this broader requirement with the null hypothesis

in the form of H_0: $\mu_1 = \mu_2 = \mu_3 = \ldots \mu_p$ and the alternative hypothesis: H_1: $\mu_1 \neq \mu_2 \neq \mu_3 \neq \ldots \mu_p$. In cases where more than two groups were present and a significant difference had been indicated the specific differences between these groups needed to be determined. The post-hoc *t*-test used for this purpose is known as the Scheffé-test (Howell, 2002; McCall, 1990).

RESULTS

To meet the aim of the study, the results of the relationship between the method of questioning and accuracy of memory and the relationship between the method of questioning and different biographical variables are presented.

Relationship between method of questioning and memory accuracy

Table 2 presents the results concerning whether the method of questioning (open-ended versus closed-ended) has an effect on the accuracy of memory of eyewitnesses after witnessing a short video. The *t*-test for two independent groups was used.

Table 2. Differences between the open-ended and closed-ended average accuracy scores

Type of question	N	$\bar{x}$	s	*t*	*p*
Open-ended	208	6,84	2,64	-8,225	0,0001**
Closed-ended	204	8,80	2,17		

** $p \leq$ 0,01

It is clear from Table 2 that the average accuracy score of the participants who responded to the closed-ended questions was significantly higher (1%-level) than that of the eyewitnesses who responded to the open-ended questions.

Relationship between method of questioning and different biographical variables

The results of the method of questioning and the different biographical variables (occupation, age, gender and race) are presented next.

Occupation

A one-way analysis of variance was employed to determine whether there was a difference between the respective open-ended and closed-ended questioning average accuracy scores for the four occupational groups a one-way analysis of variance was employed. The results appear in Table 3.

Table 3. Relationship between occupation and method of questioning

Method of questioning	***F***	***P***
Open-ended	7,42	0,0001**
Closed-ended	5,03	0,0022**

** $p \leq$ 0,01

Table 3 shows a significant difference on the 1%-level regarding the open-ended and closed-ended questioning average accuracy scores for the four occupational groups (occupation, age, gender and race). Due to the fact that four occupational groups were used, a post-*t*-test, namely the Scheffé-test was employed to identify the specific group differences. The results are presented in Table 4.

Table 4. Differences in accuracy between the occupational groups within the respective methods of questioning

Method of questioning	**Occupational groups**	**N**	$\bar{x}$	**s**	**Groups with differences**
Open-ended	Scholars (group 1)	61	6,05	2,34	Group 3 from 1 Group 3 from 2 Group 3 from 4
	Students (group 2)	53	6,68	2,98	
	Public (group 3)	41	8,41	2,42	
	Police (group 4)	53	6,70	2,31	
Closed-ended	Scholars (group 1)	53	7,91	1,81	Group 1 from 2
	Students (group 2)	54	9,44	2,26	
	Public (group 3)	44	9,02	1,85	
	Police (group 4)	53	8,87	2,41	

According to Table 4 the open-ended questioning average accuracy scores for the public was significantly higher than those of the other three occupational groups. Regarding the closed-ended questioning, it is evident that the students obtained a significantly higher average accuracy score than the scholars.

The open-ended and closed-ended questioning average accuracy scores for the respective occupational groups were also compared (Table 5). The *t*-test for independent groups was employed.

Table 5. Differences in accuracy scores between the methods of questioning within the respective occupational groups

Occupation	Type of question	N	$\bar{x}$	s	*t*	*p*
Scholars	Open-ended Closed-ended	61 53	6,05 7,91	2,34 1,81	-4,682	0,0001**
Students	Open-ended Closed-ended	53 54	6,68 9,44	2,99 2,26	-5,406	0,0001**
Public	Open-ended Closed-ended	41 44	8,41 9,02	2,42 1,85	-1,308	0,1946
Police	Open-ended Closed-ended	53 53	6,70 8,87	2,31 2,41	-4,733	0,0001**

** $p \leq 0,01$

Table 5 depicts that for scholars, students and the police the closed-ended questioning average scores are significantly higher than those for open-ended questions. No significant difference was indicated for the public.

Age

As displayed in Table 1 the three age groups comprised of 11 to 14-year-olds, 18 to 25-year-olds and 26 years and older. To determine whether there was a difference between the open-ended and closed-ended questioning average accuracy scores for the three age groups, a one-way analysis of variance was carried out. The results appear in Table 6.

Table 6. Differences in accuracy between the age groups within the respective methods of questioning

Type of question	*F*	*P*
Open-ended	0,54	0,5813
Closed-ended	5,65	0,0042**

** $p \leq 0,01$

Regarding the open-ended questioning no significant differences were found among the average accuracy scores for the three age groups. However, with respect to the closed-ended

questioning, a significant difference on the 1%-level is indicated. The Scheffé-test was employed as a post *t*-test to determine specific group differences. Table 7 reflects the results.

Table 7. Differences in accuracy between age groups with respect to the closed-ended questioning method

Type of questioning	Occupational groups	N	$\bar{x}$	s	Groups with differences
Closed-ended	11 - 14-year-olds (group 1)	28	8,50	1,78	Group 2 from 3
	18 - 25-year-olds (group 2)	85	9,58	2,21	
	26 years and older (group 3)	66	8,53	2,07	

Regarding the closed-ended questions, Table 7 indicate that the 18 to 25-year-olds obtained a significantly higher average accuracy score than the 26 years and older group.

Subsequently the open-ended and closed-ended questioning average accuracy scores for the respective age groups were compared. The *t*-test for independent groups was employed to determine the differences in average scores between the two methods of questioning within the three age groups (see Table 8).

Table 8. Differences in accuracy between the methods of questioning within the respective age groups

Age	Type of question	N	$\bar{x}$	s	*t*	*p*
11 - 14-year-olds	Open-ended	41	6,71	1,71	-4,217	0,0001**
	Closed-ended	28	8,50	1,77		
18 - 25-year-olds	Open-ended	80	7,15	2,86	-6,111	0,0001**
	Closed-ended	85	9,58	2,21		
26 years and older	Open-ended	67	7,19	2,51	-3,350	0,0011**
	Closed-ended	66	8,53	2,07		

** $p \leq 0,01$

According to Table 8 it is clear that on the 1%-level all the age groups obtained significantly higher closed-ended than open-ended questioning average accuracy scores.

Gender

Table 9 shows the *t*-test results for independent groups, which was employed to determine the respective open-ended and closed-ended questioning average accuracy scores of the two gender groups.

Table 9. Differences in accuracy between the genders within the respective methods of questioning

Type of questioning	Gender	N	$\bar{x}$	s	*t*	*p*
Open-ended	Male Female	112 96	6,60 7,13	2,57 2,72	-1,437	0,1523
Closed-ended	Male Female	105 99	8,74 8,87	2,17 2,18	-0,413	0,6803

The results as presented in Table 9 do not indicate any significant differences between the average scores of the two genders for either the open-ended and closed-ended questions.

The open-ended and closed-ended questioning average accuracy scores for the respective gender groups were also compared. The results of the *t*-test for independent groups are displayed in Table 10.

Table 10. Differences in accuracy between the methods of questioning within the respective gender groups

Gender	Type of question	N	$\bar{x}$	s	*t*	*p*
Male	Open-ended Closed-ended	112 105	6,60 8,74	2,57 2,17	-6,625	0,0001**
Female	Open-ended Closed-ended	96 99	7,13 8,87	2,72 2,18	-4,949	0,0001**

** $p \leq$ 0,01

The results in Table 10 show that both genders obtained a significant higher average accuracy score on the 1%-level for the closed-ended questioning method than for the open-ended questioning method.

Race

The *t*-test for independent groups was administered for the purpose of determining the respective open-ended and closed-ended average accuracy scores for the two race groups (see Table 11).

Table 11. Differences in accuracy scores between the races within the respective methods of questioning

Type of questioning	Gender	N	$\bar{x}$	s	*t*	*p*
Open-ended	Black White	106 88	5,56 8,16	2,44 2,16	-7,792	0,0001**
Closed-ended	Black White	103 83	7,76 9,72	1,91 1,81	-7,148	0,0001**

** $p \leq 0{,}01$

Table 11 indicates that the whites obtained a significantly higher average accuracy score (1%-level) than the blacks regarding the open-ended and closed-ended questioning methods.

With respect to the comparison of the open-ended and closed-ended average accuracy scores for the respective race groups, the results of the *t*-test for independent groups are presented in Table 12.

Table 12. Differences in accuracy scores between the methods of questioning within the respective race groups

Race	Type of question	N	$\bar{x}$	s	*t*	*p*
Blacks	Open-ended Closed-ended	106 103	5,56 7,76	2,44 1,91	-7,255	0,0001**
Whites	Open-ended Closed-ended	88 83	8,16 9,72	2,16 1,81	-5,116	0,0001**

** $p \leq 0{,}01$

The average accuracy scores of the closed-ended method of questioning were found to be significantly higher on the 1%-level than the average accuracy scores of the open-ended method of questioning (see Table 12) for both racial groups.

DISCUSSION

The finding that the respondents to the closed-ended questions obtained significantly higher average accuracy scores than the respondents to the open-ended questions (that is with the exception of the public as occupational group), can be explained in various ways. Firstly, the closed-ended questions are related to recognition memory which requires less intentional and effortful recall. Recognition memory is therefore generally viewed as being more accurate than recall memory (Deutscher & Leonoff, 1991; Robinson & Johnson, 1996). Secondly, due to the fact that the closed-ended questioning technique included true/false responses, it

would have increased the guessing propensity of the participants. In responding to an answer the participant would, even if guessing, have a fifty percent chance of being right. Thirdly, the open-ended questions could have provided more difficulty for those with problems expressing themselves well in writing. Fourthly, some of the closed-ended questions contained suggestive content. Some of these positive leading questions could have provided clues if a participant had difficulty remembering some details about the event.

The comparison between the accuracy scores of the different biographical groups within the respective methods of questioning revealed significant differences. Regarding occupation significant differences were more pronounced for the open-ended than for the closed-ended questions. The public obtained significantly higher scores than all the other groups (with the scholars obtaining the weakest average accuracy score). This could be related to the verbal superiority (especially in the written form) of the public compared to the other groups which would be required when responding to open-ended questions. The finding that the scholars obtained the weakest average score can be explained by the fact that children tend to volunteer less information (Steller & Boychuk, 1992). For the closed-ended questions the only significant difference was that students performed significantly better than the scholars. Again the scholars obtained the lowest average accuracy score. The closed-ended questions might have been problematic for them, because of the linguistic complexity and the suggestive content, which is often an intrinsic component of closed-ended questions. The suggestive content could have led the scholars to produce more recognition of events that have occurred (Foxhall, 2000; Loftus & Zanni, 1975; Walker & Hunt, 1998; Wells et al., 2000).

With respect to age as biographical variable only significant differences were only indicated for the closed-ended questions. This finding seems to be supported by some research findings. Although children tend to report less information than older people, they can be accurate when questioned with free-recall questions in a non-suggestive manner (Cassel & Bjorkland, 1995; Goodman & Reed, 1986; Hutcheson, Baxter, Telfer & Warden, 1995).

No significant differences were found regarding either the open-ended, or the closed-ended questions when the accuracy of responses of the two genders were compared. It therefore seems that type of questioning does not emphasise gender differences. This finding, that the

gender of the witness has little influence on identification accuracy, is supported by Brigham and Barkowitz (1978), and Narby, Cutler and Penrod (1996).

With regard to race, the finding suggests that the blacks experienced more problems than the whites in responding accurately to both the open-ended and closed-ended questions. As the questionnaire was in English, it is possible that language difficulty could have had an impact on the accuracy of responses. For most of the blacks English is their second language which could have restricted their ability to understand questions, as well as respond appropriately in writing. Some closed-ended questions could have been linguistically more complex and also contained some suggestive content which could also have decreased the accuracy of their responses.

CONCLUSION

The aim of this study to investigate the relationship between the accuracy of responses and the method of questioning and the relationship between the method of questioning and the accuracy of responses of specific biographical groups, provided the following main findings:

- A significant relationship exists between accuracy of memory and type of questioning. The average accuracy scores of the participants who responded to the closed-ended questions were significantly more accurate than those who answered open-ended questions.
- Investigating the relationship between the average accuracy scores of biographical variables and type of questioning revealed that all groups except the public were significantly more accurate in responding to the closed-ended than open-ended questions.
- The scholars obtained the lowest average accuracy scores compared with the other occupational groups in responding to both the open-ended and closed-ended questions. Their average scores were, however, not always significantly lower than those of the other groups. Regarding the open-ended questions the public obtained a significantly higher score than all the other occupational groups.

- The 18 to 25-year-olds obtained a significantly higher average accuracy score than the other age groups with respect to the closed-ended questions. No significant difference was indicated for the open-ended questions in relation to age.
- Regarding gender, no significant differences on either open-ended or closed-ended questions were indicated.
- With respect to race, the whites performed significantly better than the blacks when responding to both open-ended and closed-ended questions.

As for any research study some limitations need to be taken into consideration when interpreting the results.

A videotaped simulated incident was viewed by participants which could have had a different impact on accuracy of reporting compared with a real-life incident where the participant is unprepared and not sure what to expect. In this instance, the eye of the participant followed the eye of the video camera, and focussed on specific aspects which might not have been perceived by the participant. This means many central details were included in the video at the expense of peripheral details. In real-life peripheral details are sometimes responsible for distracting the attention of the eyewitness.

The participants in this study were provided with questionnaires which is very different from what happens in real-life situations. Being questioned verbally and individually would have been more threatening and intimidating than completing a questionnaire, which has no real consequences for the witness or the suspect. Verbal questioning would most likely have made participants more hesitant and cautious about their responses, as the emotional tone and disposition of the interviewer would also have had an impact (especially regarding questions with suggestive content). The expectation to respond to the closed-ended questions with only a true or false response, could have increased guessing by participants.

However, some participants might have found it easier to respond verbally to questions due to restricted reading and writing skills. This would have had an implication especially for the open-ended questions which would have required better writing skills than for the closed-ended questions. Verbally questioning also provides more of an opportunity to clarify uncertainty about questions.

Another limitation of the questionnaires is the fact that no opportunity was provided for participants to indicate when they were uncertain about their responses. Thus, participants were forced to respond which would have increased the likelihood of guessing when uncertain.

It should be mentioned that some of the closed-ended questions contained suggestive content that could have led participants to answer them more easily accurately or inaccurately. Investigating the individual effect of these items to see in what way participants were able to reject the misleading content is an important research area for future researchers.

With regard to the biographical groups, including both younger children and elderly people would have had more value. The fact that the age variable included only three groups can be seen as a limitation as it restricts the generalisability of results.

Investigating the effect of questioning on the accuracy of eyewitnesses' testimonies has real importance, as it is a system variable that can be controlled by the legal system. Results in this regard can provide the legal system with answers to the best way of ensuring accuracy of testimonies is increased. Researching the relationship between accuracy of testimony and type of questioning can be improved by making use of simulations that resemble real-life instead of videos. It is further important that the way participants are questioned is aligned with the manner in which law-enforcement personnel question eyewitnesses, as well as posing the questions after a longer retention interval. Participants may respond differently to open-ended and closed-ended questions after a shorter and extended retention interval between witnessing the event and testimony.

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ARTICLE 8

THE EFFECT OF CONFIDENCE AND METHOD OF QUESTIONING ON EYEWITNESS TESTIMONY

CONTENTS

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ARTICLE 8

THE EFFECT OF CONFIDENCE AND METHOD OF QUESTIONING ON EYEWITNESS TESTIMONY

The reliability of eyewitness testimony has been under suspicion as faulty eyewitness identification and testimony are being viewed as the most common cause for faulty convictions (Connors, Lundregan, Miller & McEwen, 1996; Foxhall, 2000; Wright & Justice, 2000). One of the reasons for the malleability of eyewitness memory relates to the observed credibility of eyewitnesses which is most often based on the perceived confidence of the witness (Smith, Lindsay & Pryke, 2000; Yarmey & Kent, 1980). This means that law enforcement personnel would more readily accept the testimony of an eyewitness which appears confident as accurate in comparison with somebody who is uncertain. Obviously, this may result in distressing consequences, as eyewitnesses often believe they remember better than they actually do. The confidence-accuracy relationship is internationally a well-researched area in the field of eyewitness testimony. However, like other eyewitness research areas, researchers have produced conflicting results about the reliability of this relationship. This area also seems to have received little, if any, empirical attention in the South African context.

The primary aim of this study is to fill this void locally. At the same time the results should hopefully contribute to the international debate on the confidence-accuracy relationship. Two additional aspects will also be covered, namely the correlation between the method of questioning and accuracy, as well as between method of questioning and confidence of eyewitnesses. Most international studies in this regard have centred on the averages of responses. However, in this study an item analysis will be conducted to determine whether the mentioned relationships are influenced by the content of the various items during questioning.

THE CONFIDENCE-ACCURACY RELATIONSHIP

Whenever eyewitnesses have to identify a suspect or testify about an event witnessed, they do so with a certain degree of confidence. Research on the eyewitness confidence-accuracy correlation assesses the degree of insight that eyewitnesses have into the accuracy of their memories (Robinson & Johnson, 1996; Thompson, 1998). Several authors and researchers suggest that the confidence with which an eyewitness recalls information does have an important impact on the verdict of a trial, as responses of eyewitnesses that appear confident of their answers are more likely to be perceived as correct (Kapardis, 1999; Kebbell, Wagstaff & Covey, 1996; Wells, Ferguson & Lindsay, 1981). Judges, police officers, attorneys and public prosecutors do rely a great deal on witness confidence, as eyewitness confidence is considered to be one of the most important indicators of witness accuracy, often even as stronger evidence than fingerprints, fibre analyses, or DNA matches (Adams-Price, 1992; Johnson, 1998; Loftus, 1980; Smith, Kassin & Ellsworth, 1989). However, Wells et al. (2000) warn against over-reliance on the reliability of the confidence-accuracy relationship, as it seems to be based on the fact that two concepts are fused, although actually being totally different. Accuracy is affected by perception and memory, while confidence is influenced by social phenomena such as self-belief, anxiety and rehearsal.

Many researchers have found the confidence-accuracy relationship to be unreliable and it should therefore be treated with caution in the application of justice (Kassin, Rigby & Castillo, 1991; Lindsay, Wells & Rumpel, 1981; Shaw, McClure & Wilkens, 2001; Sporer, Penrod, Read & Cutler, 1995; Wells & Bradfield, 1998). The increased concern about the weak accuracy-confidence relationship is due to the fact that eyewitnesses' confidence may become inflated without the corresponding increase in accuracy of recall. Distressing in this regard is the possibility that the inflation of confidence may even be greater for inaccurate witnesses than for accurate witnesses (Wells, Ferguson & Lindsay, 1981), as well as cause witnesses to make quicker identifications and report that they had better and clearer views of the suspects than they would normally do (Wells & Bradfied, 1998). This unfounded increase in confidence is often the result of co-witness information, feedback received from law enforcement personnel during or after identification and testimony, or the manner in which questioning is conducted (Brimacombe, 1998; Miller, 1999; Smith, Lindsay & Pryke, 2000; Wells et al. 2000). However, with respect to feedback, Kassin (1985) and Kassin,

Rigby and Castillo (1991) indicate that a possibility exists that feedback can actually increase the confidence-accuracy correlation. In a state of retrospective self-awareness as manipulated via videotape it was found that the correlation between confidence and accuracy increased significantly.

Another factor which can impact on the confidence-accuracy relationship, is the intention and effort of the witness during identification or testifying. In laboratory research situations lack of motivation to provide accurate identification or testimony may be the consequence of lack of interest in the research process and the fact that participants know that a wrong identification would not have any consequences for themselves or for the accused. If an incorrect identification or testimony may carry consequences for themselves and for the suspect it would make eyewitnesses think more critically about the task, their own performance and this may affect their confidence (Kassin, Rigby & Castillo, 1991; Robinson & Johnson, 1996). This means that participants in laboratory contexts may experience increased confidence in comparison with the eyewitnesses of real-life situations. Ebbesen (2000) presents a very critical review of confidence-accuracy statements in laboratory situations and states that most confidence-accuracy studies have problems regarding ecological validity and should not be compared to actual crime situations. Read, Lindsay and Nicholls (1998) in support propose that laboratory studies often understate the magnitude of the confidence-accuracy relationship. Confident real-world identifications are often more likely to be accurate than those identifications made without confidence (Brigham, Maass, Snyder & Spaulding, 1982; Ebbeson & Rienick, 1998; Olsson & Juslin, 1999).

Perfect, Watson and Wagstaff (1993) attempted to explain why inflation of confidence of eyewitnesses occurs. In eyewitness situations it is difficult to estimate confidence about accuracy of memory, as people generally do not receive feedback about their eyewitness memory, whereas in general life through experience one learns to estimate confidence with performance. In eyewitness memory there is very seldom a yardstick to compare recall with, as the memory for an event is inherently subjective and personalised. Perfect and his co-workers furthermore present a very important claim. Within-subject measures of the confidence-accuracy correlation which focuses on the computation of individual questions as the unit of analysis, tend to be higher than between subject measures which use participants as the unit of analysis. Smith, Kassin and Ellsworth (1989) found both within and between-

subjects correlations to be too low to be a useful predictor of accuracy. Robinson and Johnson (1996) state although this factor could be partly held responsible, the difference in recognition and recall memory may explain the inconsistent findings in this area of study. These researchers found that recall memory questions provided higher accuracy-confidence relationship than recognition memory questions.

Kebbel, Wagstaff and Covey (1996) suggest that the low correlations may be due to relatively small variation in the difficulty of the items used in the memory tests. Clark (1997) indicates that the similarity among items may play a role in the direction of the confidence-accuracy relationship. Lindsay, Read and Sharma (1998) add that very few studies have examined the relationship between confidence and accuracy over a wide array of different events/criminals.

METHOD OF QUESTIONING

An important post-event system variable which could account for the unreliability of the confidence-accuracy relationship is the manner in which questions are posed to eyewitnesses. Different methods of questioning would require that eyewitnesses apply one of the two general retrieval strategies, namely recall or recognition memory. Research yields that recall memory questions lead to a significant higher confidence-accuracy relationship than recognition memory questions. It is hypothesised that recall memory requires more effort than recognition memory and consequently would strengthen the confidence-accuracy relationship (Robinson & Johnson 1996; Sporer, Penrod, Read & Cutler, 1995).

According to Müller (2000) people who testify in court usually have to respond to open- or closed ended questions. Open-ended questions provide an opportunity to describe, explain and elaborate on events, while closed ended questions limit the respondent to a particular response, and mostly involves only yes or no and true or false. The latter type is indicated to be problematic, especially to children, because of the linguistic complexity and suggestive nature. Loftus and Zanni (1975) found that questions containing an indefinite item/object produced more uncertain and "I don't know" responses compared to questions containing a definite item/object, which produced more "recognition" of events that never occurred. The reason for this could be that the definite item/object implies something specific or known to

such an extent that the eyewitness could feel that he or she should know the answer. Suggestive or leading questions are therefore more likely to be closed-ended than open-ended. Open-ended questions on the contrary are less leading and encourage eyewitness to take a more active role and also elicit more information. “Can you” questions are often non-productive and problematic due to their complexity (Foxhall, 2000; Walker & Hunt, 1998; Wells et al., 2000). Children tend to make more errors and almost never say, “I don’t know” to yes/no questions, but are more accurate and more willing to reveal their lack of memory when the question posed to them is open-ended or has a wh-question (who, which etc.) word in it (Peterson, Dowden & Tobin, 1999). However, age differences in recognition memory have been found to be less pronounced than in free recall and at times even non-existent. This indicates that preschoolers’ recognition memory can be as accurate as adults when the task does not emphasise verbal recall (Ceci, Ross & Toglia, 1987). Children’s free-recall can be as accurate as that of older children and adults, but they tend to volunteer less free-recall information than the older children (Hollely & Müller, 1999; Steller & Boychuk, 1992).

It is expected that eyewitnesses who find it more difficult to express themselves verbally would prefer to answer closed-ended questions and be more confident in certain situations about their answers. The fact that closed-ended questions very often contain questions with leading and suggestive content could also inflate the confidence of eyewitnesses and make them more sure about their responses. Closed-ended questions would also give an easier opportunity for eyewitnesses to guess instead of narrating their eyewitness accounts. Especially children would possibly prefer closed-ended questions due to reduced linguistic skills. It is, however, expected that although closed-ended questions would possibly enhance or inflate the confidence of eyewitnesses it would not necessarily ensure a corresponding increase in the accuracy of the responses.

It is not only the method of questioning that is important from a system variable perspective, but also the details these questions focus on. This reasoning is based on the fact that central details, which refer to specific actions of an event, tend to capture the attention of eyewitnesses. On the other hand, the peripheral details that include the clothing and physical features of the suspect are less likely to be recalled from memory as accurately as the central or action details (Clifford & Scott, 1978; Goodman et al., 1999; Tichner & Poulton, 1975). It is also highly likely that eyewitnesses would feel more confident in reporting about these

central details than the peripheral details. According to a noteworthy finding by Yuille and Cutshall (1986), actual eyewitnesses were found at an initial police interview to report 82% action details, 76% person description details, and 89% object details accurately. Furthermore, only minimal deterioration took place after a five-month retention interval. With regard to the recall of specific details, Christianson and Hübinette (1993) presented important findings. Their real-life witnesses of bank robberies recalled many specific details about the robbers (e.g. action, weapon, clothing) better than details about the appearance of the robbers (e.g. footwear, hair and eye colour). Specific circumstantial details of the robberies (e.g. date, time, other people) were also less accurately recalled.

METHOD

In order to achieve the aim of this study, permission was obtained to draw participants from the following four groups: primary school children between 11 and 14 years old (from two schools in Thabong and Riebeeckstad respectively), students from two universities (the University of the Free State in Bloemfontein and Vista University in Welkom), the public (including lecturers and business people from Welkom), and students from the South African Police College in Pretoria. Owing to the fact that all the participants already belonged to specific groups or classes within their respective institutions and organisations the goal of randomly selecting the participants was not attained. Such a procedure would have caused significant and unacceptable disruptions for these groups. The researcher therefore made use of an availability sample.

The total research sample consisted of 412 respondents and the distribution of this sample regarding the specific biographical variables is indicated in Table 1.

As the small number of participants in certain categories could have impeded on the statistical analyses, two rearrangements were made. Firstly, the age categories were combined into only three, namely 11 to 14 years (N = 114), 18 to 25 years (N = 165), and 26 years and older (N = 133). Secondly, as 92,2% of the research sample (i.e. 380 of the 412 subjects) consisted of black and white participants, it was decided to exclude the other racial groups.

Table 1. Frequency distribution regarding biographical variables

Biographical variable	N	%
Profession:		
Scholar	114	27,7
Student	107	26,0
Public/Business sector	85	20,6
Police	106	25,7
Age:		
12 – 14 years	114	27,6
18 – 25 years	165	40,0
26 – 30 years	79	19,2
31 – 40 years	42	10,2
41 – 50 years	8	1,9
51 – 60 years	2	0,5
Older than 60 years	2	0,5
Sex:		
Male	217	52,7
Female	195	47,3
Race:		
Black	209	50,7
White	171	41,5
Coloured	25	6,1
Indian	7	1,7

o *Memory Event*. All groups viewed a video clip of one minute 30 seconds which presents a lecturer writing on a white board with a red pen: 20 + 50 = 70. While the lecturer is writing on the board, the third student from the front is talking to the student at the back of the group of students. While these two students are having their discussion, the student second from the front turns in his desk and removes an eraser (but in such a way that it is impossible for the observers to see what he is removing) from the pencil case of the student third from the front. He puts the object in his shirt pocket with his right hand. Immediately after that he puts his left hand in the same pocket and removes R 20-00, which he passes on to the student in front. This student puts the R 20-00 in his pencil case. When the student third from the front opens his pencil case he exclaims: "There is a thief in this class!"

o *Measuring instrument*. Immediately after viewing the video, all the participants completed a questionnaire with 15 questions and indicated how confident they were about their responses. One group was given a questionnaire that contained closed questions of which some had a suggestive content (Appendix D), while the other group received a questionnaire with open-ended questions (Appendix E).

The Likert scale was used to indicate their degree of confidence in their responses, which ranged from totally certain to totally uncertain. For the purpose of analysing the data the five indicators of confidence were reduced to the following three:

- Very certain
- Fairly certain
- Uncertain

For the purpose of this study the details focussed on in the questionnaire were divided into central details (everything related to the crime) and clothing and circumstantial details (everything not directly related to the crime). These two groups included the following items:

- *Central details*: Items 8 (person writing in a book), 9 (what was stolen), 10 (race of the person who had stolen), 12 (how much money did he remove), 13 (hand with which money was removed), 14 (pocket in which money was put), 15 (what did the student say)
- *Clothing and circumstantial details*: Items 1 (what was written on the board), 2 (colour of shirt), 3 (colour of trousers), 4 (colour of shoes), 5 (glasses), 6 (number of males), 7 (colour of jacket), 11 (colour of pencil case).

o *Procedure of analysis.* To investigate the relationship between the variables (which were all measured on the nominal scale) the χ^2-test for independence was used. In view of the fact that a significant χ^2-value only indicated whether the two variables were independent, it was also important to investigate the degree of the relationship between the variables (Howell, 2002). To accomplish this, Cramér's phi (ϕ) coefficient was calculated, which would have produced a coefficient that lay between 0 and 1. The closer the coefficient was to 1, the stronger the relationship would have been between the two concerning variables.

Effect sizes were measure to judge the practical significance of statistically significant results. To determine the practical significance of the χ^2-value, the effect size (w) was calculated as follows (Steyn, 1999):

$$w = \sqrt{\chi^2} / N$$

In order to interpret these effect sizes, the following directive values will be used:

$w = 0,1$: small effect
$w = 0,3$: medium effect
$w = 0,5$: large effect

Only when the statistically significant results (on the 1%- or 5%-level) had been found, were the corresponding effect sizes measured.

RESULTS

The χ^2-test was used to meet the aims of this study. The results of the relationship between confidence and accuracy, the method of questioning and accuracy, and the method of questioning and confidence are discussed:

Relationship between confidence and memory accuracy

The results of the first analysis, together with the frequencies and row percentages, are presented in Table 2.

Table 2. Relationship between confidence and accuracy

Question	Very certain		Fairly certain		Uncertain		χ^2	ϕ	*w*
	Right	Wrong	Right	Wrong	Right	Wrong			
Question 1	262 (78,0)	74 (22,0)	14 (41,2)	20 (58,8)	15 (35,7)	27 (64,3)	47,644**	0,340	0,34
Question 2	138 (57,0)	104 (43,0)	36 (43,9)	46 (56,1)	27 (30,7)	61 (69,3)	18,901**	0,214	0,21
Question 3	201 (79,8)	51 (20,2)	31 (49,2)	32 (50,8)	32 (33,0)	65 (67,0)	73,711**	0,423	0,42
Question 4	67 (30,6)	152 (69,4)	17 (25,0)	51 (75,0)	44 (35,2)	81 (64,8)	2,189	0,073	
Question 5	134 (48,7)	141 (51,3)	27 (46,5)	31 (53,5)	37 (46,8)	42 (53,2)	0,149	0,019	
Question 6	229 (72,7)	86 (27,3)	16 (41,0)	23 (59,0)	20 (34,5)	38 (65,5)	41,356**	0,317	0,32
Question 7	146 (67,6)	70 (32,4)	35 (41,7)	49 (58,3)	32 (28,6)	80 (71,4)	49,227**	0,346	0,35
Question 8	55 (30,0)	128 (70,0)	35 (36,8)	60 (63,2)	31 (23,1)	103 (76,9)	5,110	0,111	
Question 9	42 (12,8)	286 (87,2)	6 (21,4)	22 (78,6)	17 (30,4)	39 (69,6)	11,813**	0,169	0,17
Question 10	260 (80,8)	62 (19,2)	15 (48,4)	16 (51,6)	27 (45,8)	32 (54,2)	41,812**	0,319	0,32
Question 11	182 (73,1)	67 (26,9)	27 (40,3)	40 (59,7)	29 (30,2)	67 (69,8)	62,237**	0,389	0,39
Question 12	246 (80,4)	60 (19,6)	27 (71,0)	11 (29,0)	26 (38,2)	42 (61,8)	49,724**	0,347	0,35
Question 13	76 (31,8)	163 (68,2)	25 (35,2)	46 (64,8)	38 (37,2)	64 (62,8)	1,035	0,050	
Question 14	190 (70,4)	80 (29,6)	38 (53,5)	33 (46,5)	30 (42,2)	41 (57,8)	22,022**	0,231	0,23
Question 15	207 (69,0)	93 (31,0)	7 (28,0)	18 (72,0)	23 (26,4)	64 (73,6)	59,499**	0,380	0,38

** $p \leq 0{,}01$
* $p \leq 0{,}05$

From Table 2 it appears that there is a significant correlation between accuracy of memory and the degree of confidence that the participants had in their responses to 11 of the 15 questions. This specifically concerns Items 1, 2, 3, 6, 7**,** 9**,** 10, 11, 12, 14 and 15 on the 1%-level.

A larger proportion of eyewitnesses who were very certain of their responses than those who were fairly certain or very uncertain answered Items 1, 2, 3, 6, 7, 10, 11, 14 and 15 correctly. A larger proportion of eyewitnesses who were very or fairly certain of their responses than those who were uncertain, answered Item 12 correctly. Six of the 15 items are details related to clothing and circumstantial evidence, while four are central detail items. This further indicates that for 75% of the total number of items containing clothing and circumstantial details, a significant relationship between confidence and accuracy is present. Regarding items containing central details, a significant relationship is indicated for only 57%. Regarding one central detail item (Item 9) it was found that in comparison with those who were uncertain of their response, more participants who very certain answered this item incorrectly. Although it was impossible to see what the stolen object was, a significantly larger proportion of respondents in the very certain group assumed that money had been stolen. It would be interesting to investigate further what effect the type of questioning had on this central and very important detail of the event.

With regard to the items that did not indicate a significant relationship between confidence and accuracy, two items (Items 8 and 13) belong to the central detail category and two (Items 4 and 5) contain peripheral details. The two central detail items represent 29% of the total number of central items, while the two peripheral detail items represent 25% of the total number of peripheral detail items.

Relationship between method of questioning and memory accuracy

The results of the relationship between the method of questioning (open-ended versus closed-ended) and accuracy of recall, together with the frequencies and row percentages, are reflected in Table 3.

Table 3. Relationship between method of questioning and accuracy.

Question	Open-ended		Closed-ended		χ^2	ϕ	w
	Right	Wrong	Right	Wrong			
Question 1	120 (57,7)	88 (42,3)	171 (83,8)	33 (16,2)	33,903**	0,287	0,29
Question 2	70 (33,6)	138 (66,4)	131 (64,2)	73 (35,8)	38,501**	0,306	0,31
Question 3	116 (55,8)	92 (44,2)	148 (72,6)	56 (27,4)	12,598**	0,175	0,17
Question 4	54 (26,0)	154 (74,0)	74 (36,3)	130 (63,7)	5,115*	0,111	0,11
Question 5	100 (48,1)	108 (51,9)	98 (48,0)	106 (52,0)	0,000	-0,000	
Question 6	111 (53,4)	97 (46,6)	154 (75,5)	50 (24,5)	21,968**	0,231	0,23
Question 7	86 (41,3)	122 (58,7)	127 (62,3)	77 (37,7)	18,031**	0,209	0,21
Question 8	29 (13,9)	179 (86,1)	92 (45,1)	112 (54,9)	48,193**	0,342	0,34
Question 9	20 (9,6)	188 (90,4)	45 (22,1)	159 (77,9)	12,001**	0,171	0,17
Question 10	153 (73,6)	55 (26,4)	149 (73,0)	55 (27,0)	0,014	-0,006	
Question 11	100 (48,1)	108 (51,9)	138 (67,7)	66 (32,3)	16,168**	0,198	0,20
Question 12	143 (68,8)	65 (31,2)	156 (76,5)	48 (23,5)	3,084	0,087	
Question 13	65 (31,2)	143 (68,8)	74 (36,3)	130 (63,7)	1,163	0,053	
Question 14	142 (68,3)	66 (31,7)	116 (56,9)	88 (43,1)	5,725*	-0,118	0,12
Question 15	114 (54,8)	94 (45,2)	123 (60,3)	81 (39,7)	1,269	0,055	

** $p \leq 0{,}01$
* $p \leq 0{,}05$

Table 3 indicates that there is a significant correlation between the method of questioning (open-ended/closed-ended) and the accuracy of the eyewitnesses' responses regarding 10 of the 15 items. This refers to Items 1, 2, 3, 6, 7, 8, 9 and 11 on the 1%-level, and Items 4 and 14 on the 5%-level.

A significantly larger proportion of eyewitnesses who answered the closed-ended questions answered Items 1, 2, 3, 4, 6, 7, 8, 9, and 11 correctly compared with the eyewitnesses who answered the open-ended questions correctly. Seven of these items contain clothing and circumstantial details, which refer to 88% of the total number of clothing and circumstantial items, while only two items (29%) involve central details. Furthermore, a significantly larger

proportion of eyewitnesses who answered the open-ended questions, answered Item 14 (central detail) correctly.

Relationship between method of questioning and confidence

Table 4 presents the results of a possible correlation between the method of questioning (open-ended versus closed-ended) and the degree of confidence of the respondents.

Table 4. Correlation between method of questioning and confidence

Question	Very certain		Fairly certain		Uncertain		χ^2	ϕ	w
	Open-ended	Closed-ended	Open-ended	Closed-ended	Open-ended	Closed-ended			
Question 1	158 (47,0)	178 (53,0)	22 (64,7)	12 (35,3)	28 (66,7)	14 (33,3)	8,760*	0,146	0,15
Question 2	115 (47,5)	127 (52,5)	41 (50,0)	41 (50,0)	52 (59,1)	36 (40,9)	3,466	0,092	
Question 3	123 (48,8)	129 (51,2)	30 (47,6)	33 (52,4)	55 (56,7)	42 (43,3)	1,989	0,069	
Question 4	96 (43,8)	123 (56,2)	41 (60,3)	27 (39,7)	71 (56,8)	54 (43,2)	8,485*	0,144	0,14
Question 5	134 (48,7)	141 (51,3)	30 (51,7)	28 (48,3)	44 (55,7)	35 (44,3)	1,234	0,055	
Question 6	145 (46,0)	170 (54,0)	26 (66,7)	13 (33,3)	37 (63,8)	21 (36,2)	10,693**	0,161	0,16
Question 7	93 (43,1)	123 (56,9)	47 (56,0)	37 (44,0)	68 (60,7)	44 (39,3)	10,462**	0,159	0,16
Question 8	95 (51,9)	88 (48,1)	46 (48,4)	49 (51,6)	67 (50,0)	67 (50,0)	0,324	0,028	
Question 9	158 (48,2)	170 (51,8)	13 (46,4)	15 (53,6)	37 (66,1)	19 (33,9)	6,329*	0,124	0,12
Question 10	152 (47,2)	170 (52,8)	16 (51,6)	15 (48,4)	40 (67,8)	19 (32,2)	8,475*	0,143	
Question 11	120 (48,2)	129 (51,8)	36 (53,7)	31 (46,3)	52 (54,2)	44 (45,8)	1,326	0,057	
Question 12	138 (45,1)	168 (54,9)	23 (60,5)	15 (39,5)	47 (69,1)	21 (30,9)	14,529**	0,188	0,19
Question 13	121 (50,6)	118 (49,4)	34 (47,9)	37 (52,1)	53 (52,0)	49 (48,0)	0,282	0,026	
Question 14	126 (46,7)	144 (53,3)	39 (54,9)	32 (45,1)	43 (60,6)	28 (39,4)	5,021	0,110	
Question 15	132 (44,0)	168 (56,0)	15 (60,0)	10 (40,0)	61 (70,1)	26 (29,9)	19,363**	0,217	0,22

** $p \leq 0{,}01$
* $p \leq 0{,}05$

From Table 4 it is clear that there is a significant correlation between method of question (open-ended/closed-ended) and the degree of confidence on 8 of the 15 items. This concerns Items 6, 7, 12 en 15 on the 1%-level and items 1, 4, 9 en 10 on the 5%-level.

A significantly larger proportion of eyewitnesses that answered the closed-ended questions indicated that they were very certain about their responses compared with those who answered the open-ended questions. This refers to Items 1, 4, 6, 7, 12 and 15. Four of these items are related to peripheral details (Items 1, 4, 6 and 7), which make out 50% of the total number of clothing and circumstantial details. Two of these items concern central details (Items 12 and 15) that represent 29% of the total number of central details. A larger proportion of eyewitnesses who answered the closed-ended questions were very or fairly

certain of two items. The two items (9 and 10) also contain central details which represent 29% of the total number of central details.

DISCUSSION

The finding that there is a significant positive relationship between the degree of confidence of respondents and the accuracy of 67% of their responses is in contrast with the large number of research studies that suggest this relationship is weak at best (Kassin, 1985; Penrod & Cutler, 1995; Shaw, McClure & Wilkens, 2001; Smith, Kassin & Ellsworth, 1989; Smith, Lindsay & Pryke 2000; Wells & Bradfield, 1998). This result, however, is supported by Ebbesen's (2000) view that this perception is based on a non-intuitive assumption. However, surprising was the finding that the confidence-accuracy relationship was higher for more clothing and circumstantial details out of the total number of items related to clothing and circumstances, than for central details out of the total number of central details. Possible explanations are that the central details were more difficult than the clothing and circumstantial details or that the witnesses' confidence was more falsely inflated for the central details of the event. This explains the finding that there was a significant relationship for the very important central detail that was stolen. A significant number of participants seem to have made the assumption that money was stolen and were very confident about this. The fact that participants were more accurate about the clothing and circumstantial details can a cause for concern, as in order to make a conviction in court the focus would be more on the central actions of the event. For example, although it was impossible for the participants to see what had been stolen, a large percentage of them were highly confident that money had been stolen. An assumption such as this can result in a false conviction.

The finding that closed-ended questions provided a higher rate of accuracy than open-ended questions was expected. Closed-ended questions are generally related to recognition memory which requires minimal intentional and cognition effort than recall memory. Recognition memory is therefore generally viewed as being more accurate than recall memory (Deutscher & Leonoff, 1991; Robinson & Johnson, 1996). It is further possible that a requirement of only true/false responses to the closed-ended questions would have increased the guessing propensity of the participants. In responding to an answer the participant would, even if guessing, have a fifty per cent chance of being right. For those participants who found it

difficult to express themselves in the written form, the open-ended questions could have provided more problems than the closed-ended questions. The suggestive content of some of the closed-ended questions could have provided some clues if a participant had forgotten some details about the event.

The core result, that a significantly larger proportion of participants who responded to closed-ended questions were more confident about their responses than those who answered the open-ended questions, supports the finding that the closed-ended questions provided a higher rate of accuracy. This is in contrast to Robinson and Johnson's (1996) view that, because recall memory requires a higher level of intentional retrieval, confidence levels should be higher than those for recognition memory. However, in the present study the respondents needed to respond only with true/false responses to the closed-ended questions of which some contained suggestive content. This could have inflated the confidence of participants, while responding to the open-ended questions could have caused some hesitancy in responding. With regard to confidence about specific details, the finding that the participants were more confident about the central details, was expected.

CONCLUSION

In this study the relationship between confidence and accuracy, the method of questioning and accuracy, and the method of questioning and confidence were investigated. In order to meet these aims the main summarised findings are discussed. Firstly, regarding the relationship between confidence and accuracy of recall it was found that:

- there was a significant correlation between the accuracy of memory and confidence regarding more than 70% of the items.
- for 60% of the items there was a significantly larger proportion of participants who were very certain and responded accurately to their responses.
- for more clothing and circumstantial details (75%) there was a significant relationship between accuracy and confidence than for central details (57%).

Secondly, the findings for the relationship between type of questioning and accuracy were:

- A significant relationship was found for 67% of the total number of items.
- Ninety per cent of the items that displayed a significant relationship between type of questioning and accuracy, involved closed-ended questions. This means there was a significant higher degree of accuracy regarding the responses to closed-ended questions in comparison to open-ended questions.
- With regard to the respective details, 70% of the total number of details that indicated a significant relationship between type of questioning and accuracy, concerned clothing and circumstantial details.

Thirdly, the relationship between type of questioning and confidence indicated that:

- there was a significant relationship in for 53% of the items.
- all of the items which indicated a significant relationship concerned closed-ended questions. Therefore there was a significantly higher degree of confidence regarding the responses to closed-ended questions than to the open-ended questions.
- with respect to the details that displayed a significant relationship between confidence and type of questioning 50% involved circumstantial and clothing details and 50% concerned central details. However, with regard to the items that displayed a significant relationship between confidence and type of questioning, the respondents were very certain about 67% of clothing and circumstantial details.

However, when interpreting the results the following limitations of the study should be kept in mind:

Firstly, the simulated videotaped incident would not have had the same impact as a real-life incident, as in real-life incidents eyewitnesses are usually unprepared for what is about to happen. Due to the fact that the incident was video-taped, the camera focussed on the incident in such a way that it followed the action. This is, however, different from the manner in which the eyes perceive. Furthermore it was a very simple, uncomplicated incident with very

"slow" action which is different from real-life where events usually follow in much quicker succession.
Secondly, the fact that providing the wrong answer would not have had any consequences for the participants or for the "actors" in the simulated videotaped incident, would have made the participants less cautious about their responses.

Thirdly, the questions were presented in questionnaire form instead of verbally and individually. The method in this study thus does not correspond to the way questioning normally takes place in court as well as during investigations. If questioning had taken place individually, it would have been more intimidating to eyewitnesses which could have undermined their confidence. It is not only the content of questions which has an effect on the confidence of eyewitnesses, but also the manner in which questions are asked and the tone of voice of the interviewer.

Fourthly, it is possible that the guessing propensity of the respondents to the closed-ended questions was increased due to the fact that they only needed to respond with true/false responses. Those respondents who found it difficult to express their eyewitness accounts in the written form due to weaker linguistic skills, would also have struggled more with the open-ended questions than with the closed-ended questions.

Fifthly, although difficult, it would have made analysis easier if an equal number of items were included for the different types of questions (e.g. for physical appearance, clothing and actions). This shortcoming, however, only became apparent during the analysis of data.

What happens during an event cannot be controlled by the eyewitness --- that is the estimator variables which include the lighting conditions, the appearance of the perpetrator, the factors related to the incident itself. However, the system variables that can be controlled to a large extent to enhance accuracy of recall need to be researched, especially in the South African context, which has a different legal system from the countries where most research has been done. This would include the manner in which eyewitnesses are questioned as to restrict the possibility that confidence of eyewitnesses are falsely inflated. The opposite is also true, that law enforcement professionals need to avoid using tactics that break down the confidence and self-belief of eyewitnesses to such an extent that they are unable to make accurate

identifications or provide truthful testimony. Further research in this regard is necessary with real-life applications, as confidence in real-life applications would be under different pressure to that which participants experience in laboratory situations. This would hopefully lead to a better understanding of the role of confidence of eyewitnesses and the effect it has on the perception of law enforcement personnel.

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SUMMARY

The single most important determinant of whether a case will be solved in a court of law is often the information supplied by the witness or victim of a crime (Yuille & Cutshall, 1986). Eyewitness testimony is viewed as powerful in courts, due to a belief in the ultimate accuracy of observation and human memory (Bartol & Bartol, 1994). Despite the credibility ascribed to eyewitness testimony by law, Shaw and Skolnick (1994) indicate that studies of human perception and memory have demonstrated that such testimony is susceptible to errors.

A distinction is currently being made between two kinds of variables that impact on eyewitness testimony (Wells, 1978; Wells & Olson, 2003). Estimator variables, over which the criminal justice system exerts little or no control, are classified into witness factors (e.g. stress experienced by the witness during the event, as well as the occupation, age, gender, race, and individual differences of witnesses), target factors (e.g. the suspect's physical appearance and weapon focus) and situational factors (e.g. variables associated with the incident, such as the severity of the incident and a witness's opportunity to view the suspect). System variables, on the other hand, refer to factors that are directly under the control of the criminal justice system and can be altered to increase accuracy in court cases. These factors include the number of foils in a line-up, the selection of line-up members, post-event information, questioning techniques and court proceedings (Narby, Cutler & Penrod, 1996; Wingfield & Byrnes, 1981). Although the impact of the factors that can potentially influence eyewitness testimony appears to be generally recognised, it also seems to be true that in-depth knowledge concerning aspects such as the interaction between these factors is often, if not mostly, lacking in those professions (e.g. the legal profession and the police force) where such knowledge could play a significant role.

The purpose of this study was to investigate the reliability of perception and memory and more specifically the variables that may affect the reliability of eyewitness testimony. The thesis consists of eight articles, namely three literature review articles and five empirical articles. The findings of these empirical articles are presented next.

The first empirical study, which was aimed at investigating the influence of certain variables on the accuracy of eyewitness testimony after exposure to a real-life incident, yielded the

following main findings:

- There were no significant differences between the average accuracy scores of the short-term and long-term memory groups as a whole.
- The short-term memory average scores of the students and the 18 to 25-year-olds were significantly better than those of the corresponding long-term memory group. No significant differences, however, had been found for the gender and racial groups.
- The children (12 to 14-year-olds) obtained significantly higher average accuracy scores than the adults with regard to long-term memory. In respect of long-term memory, the scholars also performed significantly better than all other occupational groups, except the members of the police.

The second study (which is linked to the first) aimed at investigating whether the analysis of items would provide more clarity on the relationship between certain biographical variables and the accuracy of eyewitness testimony, yielded the following main findings:

- As a whole, the short-term and long-term memory groups showed no significant differences regarding details related to less pronounced physiognomic details. Significant differences were indicated for only certain items related to obvious physiognomic details, clothing details, circumstantial evidence and action-related details.
- Regarding occupation, significant differences in the short-term were found for some of the items related to obvious physiognomy, less pronounced physiognomy, clothing, action, and circumstantial evidence. However, for the long-term groups no significant differences were found for less pronounced physiognomic details and circumstantial evidence.
- The age group findings indicated significant differences in the short-term group concerning certain items related to obvious physiognomy, less pronounced physiognomy, clothing, action and circumstantial evidence. In the long-term age groups, no significant differences were found for items related to obvious and less pronounced physiognomy and circumstantial evidence.

- With respect to gender, no significant differences regarding action-related and circumstantial evidence were found. However, significant differences were found regarding certain obvious physiognomic details, less pronounced physiognomic details and clothing details.
- Regarding the different races in the short-term memory group, no significant differences were found regarding items related to action, less pronounced physiognomy and clothing. However, significant differences were indicated in certain items related to obvious physiognomic details and circumstantial evidence. Although no significant differences were found in any clothing details in the long-term memory group, certain items related to obvious physiognomy, less pronounced physiognomy, action and circumstantial evidence displayed significant differences.

The main findings of the third study, which investigated memory performance after exposure to a violent and a non-violent incident, may be summarised as follows:

- Regarding both the non-violent and violent video a significant decrease in the accuracy of the average scores occurred after a five to six week retention period when the short-term and long-term memory groups were compared as a whole.
- With respect to all the biographical groups that were exposed to the non-violent and violent video, significantly higher average scores were obtained by the short-term memory groups than by the long-term memory groups.
- The 18 to 25-year-olds who viewed the non-violent video obtained significantly higher short-term and long-term average memory scores than the 26 years and older. No significant differences were found for the violent video.
- No significant differences were indicated for either the short-term or long-term memory gender groups regarding both the non-violent and violent video.
- Concerning the two racial groups, the only difference found was for the non-violent video where the whites obtained significantly higher short-term memory average scores than the blacks. No significant differences were indicated for the long-term groups or those groups who watched the violent video.

The aim of the fourth study to investigate the relationship between the accuracy of responses and the method of questioning and the relationship between the method of questioning and the accuracy of responses of specific biographical groups, provided the following main findings:

- A significant relationship exists between accuracy of memory and type of questioning. The average accuracy scores of the participants who responded to the closed-ended questions were significantly more accurate than those who answered open-ended questions.
- Investigating the relationship between the average accuracy scores of biographical variables and type of questioning revealed that all groups except the public were significantly more accurate in responding to the closed-ended than open-ended questions.
- The scholars obtained the lowest average accuracy scores compared with the other occupational groups in responding to both the open-ended and closed-ended questions. Their average scores were, however, not always significantly lower than those of the other groups. Regarding the open-ended questions the public obtained a significantly higher score than all the other occupational groups.
- The 18 to 25-year-olds obtained a significantly higher average accuracy score than the other age groups with respect to the closed-ended questions. No significant difference was indicated for the open-ended questions in relation to age.
- Regarding gender, no significant differences on either open-ended or closed-ended questions were indicated.
- With respect to race, the whites performed significantly better than the blacks when responding to both open-ended and closed-ended questions.

In the fifth study the relationship between confidence and accuracy, the method of questioning and accuracy, and the method of questioning and confidence were investigated. Firstly, regarding the relationship between confidence and accuracy of recall it was found that:

- there was a significant correlation between the accuracy of memory and confidence regarding more than 70% of the items.

- for 60% of the items there was a significantly larger proportion of participants who were very certain and responded accurately to their responses.
- for more clothing and circumstantial details (75%) there was a significant relationship between accuracy and confidence than for central details (57%).

Secondly, the findings for the relationship between type of questioning and accuracy were:

- A significant relationship was found for 67% of the total number of items.
- Ninety per cent of the items that displayed a significant relationship between type of questioning and accuracy, involved closed-ended questions. This means there was a significant higher degree of accuracy regarding the responses to closed-ended questions in comparison to open-ended questions.
- With regard to the respective details, 70% of the total number of details that indicated a significant relationship between type of questioning and accuracy, concerned clothing and circumstantial details.

Thirdly, the relationship between type of questioning and confidence indicated that:

- there was a significant relationship in for 53% of the items.
- all of the items which indicated a significant relationship concerned closed-ended questions. Therefore there was a significantly higher degree of confidence regarding the responses to closed-ended questions than to the open-ended questions.
- with respect to the details that displayed a significant relationship between confidence and type of questioning 50% involved circumstantial and clothing details and 50% concerned central details. However, with regard to the items that displayed a significant relationship between confidence and type of questioning, the respondents were very certain about 67% of clothing and circumstantial details.

These results indicate that estimator and system variables need to be further researched in the South African context, as most existing findings are based on American and European research. Doing research on eyewitness testimony remains difficult owing to ethical concerns and the question as to whether laboratory studies have the same impact as real-life studies on memory performance. To make an impact in the area of eyewitness testimony in

coming up with results which are less affected by confounding variables, it would not only be important for researchers in this field to reconstruct events which have the qualities of real-life incidents, but also to ensure that the measuring instruments correspond with the way eyewitnesses are questioned in legal situations.

Appendix A

An empirical investigation to assess the effect of short- and long-term memory on eyewitness testimony in a stressful situation.

QUESTIONNAIRE 1

All the following questions pertain the incident you have witnessed in class. Mark the correct answer in the block with an X. If you mark other, specify in the space provided. If you are uncertain of the relevant answer, mark uncertain.

1. What was the age of the assailant?

18 - 20 years		1
21 - 30 years		2
31 - 40 years		3
41 – 50 years		4
51 – 60 years		5
61 – 70 years		6
Uncertain		7

2. What was the gender of the assailant?

Male		1
Female		2
Uncertain		3

3. What was the race of the assailant?

White		1
Black		2
Indian		3
Colored		4
Other .....……..		5
Uncertain		6

4. What was the height of the assailant?

1.31- 1.5 metres		1
1.51 - 1.7 metres		2
1.71 - 1.9 metres		3
Taller than 1.9 metres		4
Other ……..……..		5
Uncertain		6

5. What was the weight of the assailant?

40 - 60 kilogram		1
61 - 80 kilogram		2
81 - 100 kilogram		3
101 - 120 kilogram		4
Other .....…….....….....….		5
Uncertain		6

6. What was the length of the assailant's hair?

No hair		1
Bald		2
Short hair		3
Long hair		4
Other .....…….....…..		5
Uncertain		6

7. What was the colour of the assailant's hair?

Blond		1
Brown		2
Red		3
Black		4
Grey		5
Other .....…….		6
Uncertain		7

8. Did the assailant wear glasses?

Yes		1
No		2
Uncertain		3

9. What was the colour of the assailant's shirt or jersey?

White		1
Brown		2
Red		3
Blue		4
Green		5
Other .....……..		6
Uncertain		7

10. What was the colour of the assailant's trousers?

Black		1
Brown		2
White		3
Blue		4
Green		5
Other .....……..		6
Uncertain		7

11. What was the colour of the assailant's shoes?

White		1
Black		2
Brown		3
Blue		4
Other .....……		5
Uncertain		6

12a. Did the assailant wear a jacket?

Yes		1
No		2
Uncertain		3

12b. If answered yes, what was the colour of the jacket?

Brown		1
Black		2
Blue		3
Grey		4
Other .....…….		5
Uncertain		6

13. Did the assailant wear a tie?

Yes		1
No		2
Uncertain		3

14. Did the assailant have any facial hair?

No		1
Beard		2
Moustache		3
Beard and Moustache		4
Other .....……..……..		5
Uncertain		6

15. Did the assailant wear any jewelry?

No		1
Watch		2
Earring(s)		3
Neck chain(s)		4
Arm chain(s)		5
Other .....…….		6
Uncertain		7

16. Did the assailant have any facial scars?

Yes		1
No		2
Uncertain		3

17. Did the assailant have any obvious physical abnormalities, like for example limping?

Yes		1
No		2
Uncertain		3

18. Did the assailant carry a weapon?

Yes		1
No		2
Uncertain		3

19. What language did the assailant speak?

Afrikaans		1
English		2
Black African language e.g. Sotho, Zoeloe or Xhosa		3
Other .....…….....……		4
Uncertain		5

20. At what time did the incident happen?

08h00-08h59		1

09h00-09h59		2
10h00-10h59		3
11h00-11h59		4
12h00-12h59		5
13h00-13h59		6
14h00-14h59		7
15h00-15h59		8
16h00-16h59		9
17h00-17h59		10
18h00-18h59		11
Other .....…..……		12
Uncertain		13

21. How much time expired from the time the assailant entered and left the room?

0 – 30 seconds		1
31 – 60 seconds		2
61 seconds - 2 minutes		3
2 - 5 minutes		4
More than 5 minutes		5
Other ……		6
Uncertain		7

22. Did the assailant say anything to the lecturer/speaker?

Yes		1
No		2
Uncertain		3

23. What did the assailant do to the lecturer/speaker?

Hit the lecturer/speaker		1

Pushed the lecturer/speaker		2
Grabbed the lecturer/speaker		3
Did not touch the lecturer/speaker		4
Other .....……		5
Uncertain		6

24. How did the lecturer/speaker react on the attack?

Hit the assailant		1
Pushed the assailant		2
Grabbed the assailant		3
Did not touch the assailant		4
Other .....…….		5
Uncertain		6

Appendix B

An empirical investigation to assess the effect of a non-violent incident on eyewitness testimony.

QUESTIONNAIRE 2

Please answer all the following questions by marking the appropriate block with an X.

1. What was the colour of the offender's car in this movie scene?

Red		1
Black		2
Yellow		3
Green		4
Other .....……..		5
Uncertain		6

2. How many stripes did the offender's car have?

One		1
Two		2
Three		3
Other .....……..		4
Uncertain		5

3. What was the colour of the stripes?

Blue		1
Red		2
Black		3
Yellow		4
Other .....……..		5
Uncertain		6

4. What was the race of the offending driver?

White		1
Black		2
Indian		3
Coloured		4
Other .....……		5
Uncertain		6

5. What was the race of the policeman depicted in this scene?

White		1
Black		2
Indian		3
Coloured		4
Other .....……..		5
Uncertain		6

6. How many police vehicles were chasing the offender's car?

One		1
Two		1
Three		2
Four		3
Other .....……..		4
Uncertain		5

7. What was the colour of the policevehicle(s)?

Black and white		1
Blue and white		2
Dark and light brown		3
Black		4
Other .....……..		5
Uncertain		6

8. What was the colour of the offender's clothes?

White		1
Black		2
Blue		3
Orange		4
Other .....……..		5
Uncertain		6

9. What was the colour of the offender's shoes?

Grey		1
White		2
Black		3
Brown		4
Other .....……..		5
Uncertain		6

10. What was the race of the person regulating the traffic?

White		1
Black		2
Indian		3
Coloured		4
Other .....……..		5
Uncertain		6

11. What was the colour of the flag, which the person used to regulate the traffic?

Blue		1
White		2
Yellow		3
Red		4
Other .....……..		5
Uncertain		6

12. What was the colour of the helmet of the person regulating the traffic?

Blue		1
White		2
Yellow		3
Red		4
Other .....……		5
Uncertain		6

13. Which person was wearing glasses?

Offender		1
Policeman		2
Person regulating the traffic		3
Pedestrian		4
Other .....……..		5
Uncertain		6

14. What was the colour of the truck standing in the road?

Blue		1
Brown		2
Yellow		3
White		4
Other .....…….		5
Uncertain		6

15. What was the colour of the drums on the truck, through which the offender drove?

Red and white		1
Blue and yellow		2
Black and white		3
Green and yellow		4
Other .....……..		5
Uncertain		6

16. The person regulating the traffic tried to get out of the way of the offender's car. To which side did he

run?

Forward		1
To his right		2
To his left		3
Backwards		4
Other .....……..		5
Uncertain		6

17. At some stage in this scene the offender turned into another street. In which direction did he turn?

To his right		1
To his left		2
Other .....……..		3
Uncertain		4

Appendix C

An empirical investigation to assess the effect of a violent incident on eyewitness testimony.

QUESTIONNAIRE 3

Please answer all the following questions by making an X in the appropriate block.

1. How many people were depicted in this movie scene?

One		1
Two		2
Three		3
Four		4
Five		5
Six		6
Seven		7
Eight		8
Other ..…….		9
Uncertain		10

2. How many people were wearing masks?

One		1
Two		2
Three		3
Four		4
Other .....……		5
Uncertain		6

3. How many people were exchanging fire?

One		1
Two		2
Three		3
Four		4
Five		5
Six		6
Other .....……		7
Uncertain		8

4. How many people in total were wounded and/or killed by gunfire?

One		1
Two		2
Three		3
Four		4
Five		5
Six		6
Other .....…….		7
Uncertain		8

5. Who fired the first shot?

Person standing on the counter		1
Policeman dressed in uniform		2
Person lying next to policeman		3
Someone else in this scene		4
Uncertain		5

6. Who was the first person being wounded or killed by gunfire?

Person standing on the counter		1
Policeman dressed in uniform		2
Person lying next to policeman		3
Someone else in this scene		4
Uncertain		5

7. What was the predominant colour of the clothes of the person standing on the counter?

Blue		1
Black		2
Grey		3
Brown		4
Other .....……		5
Uncertain		6

8. What was the colour of the gloves of this man standing on the counter?

Black		1
White		2
Blue		3
Grey		4
Other .....……		5
Uncertain		6

9. What was the colour of the shirt of the person lying on the floor next to the policeman?

White		1
Green		2
Black		3
Grey		4
Brown		5
Other		6
Uncertain		7

10. What was the predominant colour of the policeman's uniform?

Green		1
Blue		2
Black		3
Grey		4
Brown		5
Other		6
Uncertain		7

11. What was the race of the man lying next to the policeman?

White		1
Black		2
Indian		3
Coloured		4
Other		5
Uncertain		6

12. What was the race of the man standing on the counter?

White		1
Black		2
Indian		3
Coloured		4
Other .....……		5
Uncertain		6

13. What was the race of the policeman in uniform?

White		1
Black		2
Indian		3
Colored		4
Other .....……..		5
Uncertain		6

14. What was the colour of the hair of the policeman in uniform?

Blond		1
Brown		2
Red		3
Black		4
Grey		5
Other .....…….		6
Uncertain		7

15. What was the length of the hair of the policeman in uniform?

No hair		1
Bald		2
Short hair		3
Long hair		4
Other .....……		5
Uncertain		6

16. In which hand(s) did the person standing on counter hold his weapon?

Right hand		1
Left hand		2
Both hands		3
Uncertain		4

17. What type of weapon did the man standing on the counter have?

Crossbow		1
Gun/rifle		2
Pistol/revolver		3
Other .....……		4
Uncertain		5

18. In which hand(s) did the man lying next to the policeman have his weapon?

Right hand		1
Left hand		2
Both hands		3
Uncertain		4

19. What was the colour of the weapon of this man lying next to the policeman?

White		1

Black		2
Silver		3
Brown		4
Other .....……..		5
Uncertain		6

20. This man lying next to the policeman was wearing a ring. On which finger was the ring?

Thumb		1
Index finger		2
Middle finger		3
Ring finger		4
Little finger		5
Uncertain		6

21. How long did this total movie scene last approximately?

Less than 30 seconds		1
30 – 60 seconds		2
1 - 2 minutes		3
2 - 5 minutes		4
Other .....……..		5
Uncertain		6

Appendix E

An empirical investigation to assess the relationship between accuracy of memory and confidence of reporting.

QUESTIONNAIRE 4a

Answer all the following questions in the space provided. Kindly also indicate on the five point scale underneath each written answer how confident you are about the correctness of your answer. Do this by making an X in the appropriate confidence column.

Key: 1 = totally certain 2 = very certain 3 = confident 4 = uncertain 5 = very uncertain

1. What did the lecturer write on the board?

.....				
1	2	3	4	5

2. What was the colour of the lecturer's shirt?

.....				
1	2	3	4	5

3. What was the colour of the lecturer's trousers?

.....				
1	2	3	4	5

4. What was the colour of the lecturer's shoes?

.....				
1	2	3	4	5

5. Did the lecturer wear glasses?

.....				
1	2	3	4	5

6. How many male students did you see in this scene?

.....				
1	2	3	4	5

7. What was the colour of the jacket of the student sitting in front?

.....				
1	2	3	4	5

8. Which student was writing in a book?

.....				
1	2	3	4	5

9. What did the student second from the front steal from the pencil case belonging to the student third from the front?

.....				
1	2	3	4	5

10. What was the race of this student, who had stolen?

.....				
1	2	3	4	5

11. What was the colour of the pencil case of the student sitting third from the front?

.....				
1	2	3	4	5

12. How much money did the student sitting second from the front remove from his/her pocket?

.....				
1	2	3	4	5

13. With which hand did this student remove the money from his/her pocket?

.....				
1	2	3	4	5

14. Where did the student sitting in front put the money, he/she received?

.....				
1	2	3	4	5

15. What did the student third from the front say when he realized that something was missing from his/her pencil case?

....				
1	2	3	4	5

Appendix D

An empirical investigation to assess the relationship between accuracy of memory and confidence of reporting.

QUESTIONNAIRE 4b

Answer all the following questions as well as you can by making an X in the appropriate "True" or "False"- column. Kindly also indicate underneath each answer how confident you are about the correctness of your answer. Do this by making an X in the appropriate confidence column.

Key: 1 = totally certain 2 = very certain 3 = confident 4 = uncertain 5 = very uncertain

1. The lecturer wrote on the board: "20 + 50 = 70".

True				a
False				b
1	2	3	4	5

2. Did you notice that the lecturer was wearing a green shirt and a tie.

True				a
False				b
1	2	3	4	5

3. The lecturer was wearing blue trousers.

True				a
False				b
1	2	3	4	5

4. Did you notice that the lecturer was wearing black shoes?

True				a
False				b
1	2	3	4	5

5. The lecturer was indeed wearing glasses.

True					a
False					b
1	2	3	4	5	

6. There were three male students in this scene.

True					a
False					b
1	2	3	4	5	

7. The student sitting in front was wearing a blue jacket.

True					a
False					b
1	2	3	4	5	

8. The student sitting second from the front was wearing a ring and was writing in a book.

True					a
False					b
1	2	3	4	5	

9. Did you notice the student sitting second from the front was black.

True					a
False					b
1	2	3	4	5	

10. You certainly noticed that the student, sitting second from the front, stole money?

True				A
False				B
1	2	3	4	5

11. The student sitting third from the front had a pencil case lying on his/her desk.

True				a
False				b
1	2	3	4	5

12. Did you notice that the student second from the front removed R20 from his/her pocket and passed it on to the student in front?

True				a
False				b
1	2	3	4	5

13. The student second from the front used his/her right hand to remove the R20 from his/her pocket.

True				a
False				b
1	2	3	4	5

14. Did you notice that the student in front put the money in a blue pencil case?

True				a
False				b
1	2	3	4	5

15. You must have heard the student sitting third from the front saying: "Someone stole my money!"

True				a

False				b
1	2	3	4	5

KEYWORDS

Keywords from the title:

Eyewitness testimony

Keywords from the different articles:

Perception and memory

Estimator variables

System variables

Memory accuracy of a real-life simulated incident

Relationship between memory and the recall of specific details

The effect of violent versus non-violent incidents on eyewitness memory

Method of questioning and the accuracy of eyewitness testimony

The effect of confidence and method of questioning on eyewitness testimony