

Source Monitoring Difficulties in Facial and Role Identification in Multiple  
Perpetrator Crimes

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Abstract word count: 288

Main Body word count: 9,986

## Abstract

Real-life crime statistics indicate high rates of criminal activity involving multiple perpetrators. Despite this there is only a small body of research that considers identification accuracy when witnessing several unfamiliar faces. Further there is virtually no research that considers role identification as a unique aspect of multiple perpetrator crimes and the ability of eyewitnesses to pair the perpetrator to the role they played in the crime. Videos of a staged crime involving one, two, three, five and ten perpetrators were shown to students at the University of Cape Town (n=200). Eyewitness identification for multiple perpetrators was tested by providing participants with a series of line-ups from which they were required to make an identification decision. Further participants were asked to recall the unique roles played by each perpetrator. Their ability to accurately pair the perpetrator to their role was tested to determine the influence of source monitoring issues associated with multiple perpetrator crimes. Results showed a significant main effect for line-up, role and pairing accuracy ( $p < 0.01$ ). Further there was a significant interaction effect between identification type (line-up, role, and pair) and the number of targets ( $p < 0.01$ ). Line-up identification performance was not significant across the number of perpetrators. Findings supported the hypothesis that there is a significant difference between line-up accuracy, role accuracy and pairing accuracy performance as the number of perpetrators increases. Further it demonstrates that while role recall is a stable trait participants had significantly decreased pairing accuracy, demonstrating errors in source monitoring and subsequent misattribution of information. Studies that consider the processes behind independent encoding of related units of information and binding would contribute to knowledge of multiple perpetrator effects in this field.

Keywords: multiple perpetrators; line-up-identification; role-identification; source monitoring; eyewitness identification.

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## **Background**

Face identification refers to the cognitive process by which we associate different instances of the same person's face over a number of encounters (Bindemann, Sandford, Gillatt, Avetisyan & Megreya, 2012). This process is robust with familiar faces, even under poor conditions (Bindemann et al., 2012). However, numerous studies have demonstrated that this process is highly error prone for faces for which observers have limited perceptual experience (see, e.g., Hancock, Bruce, & Burton, 2002; Jenkins & Burton, 2008). While this may not be of consequence in everyday functioning, the fallibility of unfamiliar face recognition can be a short-coming in criminal investigations that depend on face identification as a means of suspect confirmation. For this reason face recognition has become a topic of practical and theoretical interest that has been studied extensively.

### **Face Identification in the Criminal Justice System**

Criminal investigations rely heavily on eyewitness testimony, and eyewitness identification evidence is given considerable weight by both investigators and courts (Hobson & Wilcock 2011; Hobson, Wilcock & Valentine, 2012). The use of identification parades is a common method available to criminal investigators, which has the authority to sway the direction of an impending investigation. However, ample research has established that mistaken identifications are the leading cause of miscarriages of justice (Egan, Pittner & Goldstein, 1977; Innocence Project). For example, evidence shows that the strength of eyewitness testimony has independently served to erroneously incriminate a number of innocent people. To date 336 people in the United States have been exonerated by DNA evidence (Innocence Project, n.d.). Of these cases of wrongful imprisonment, 75% of these are due to eyewitness identifications (Innocence Project, n.d.). These misidentifications are of concern because they threaten innocent people, and also provide false leads which can disrupt the progress of the investigation. Research has focused on determining the variables that influence face recognition accuracy in attempts to improve the accuracy of eyewitness identification and safeguard against wrongful convictions.

### **The Prevalence of Multiple Perpetrator Crime**

Almost all previous research on unfamiliar face recognition has considered identification accuracy through the lens of single perpetrator crimes by focusing on conditions where one target face is presented (Bindemann et al., 2012). Only a few isolated studies have explored the processes involved in viewing several faces simultaneously such as

in multiple perpetrator crimes. Here multiple perpetrator crimes refer to criminal activities committed by two or more people simultaneously. This gap in the knowledge is surprising considering that many real-life criminal and court cases involve multiple-perpetrator crimes. In the United States 20% of violent crime is committed by multiple perpetrators (National Criminal Justice Reference Service, 2001). The most often reported crimes committed by groups of people in the United States include assault, robbery and rape. South African crime statistics indicate similar patterns of crimes committed by multiple perpetrators including gang-rape, which in South Africa accounts for 33% to 50% of all rapes (Artz & Kunisaki, 2003 as cited in Horvath & Kelly, 2009), as well as gang-related crimes such as homicide and assault. Crime reports from the city of Johannesburg indicate that of the 1401 cases of rape that were reported, approximately 30% were committed by groups of two or more people (Statistics South Africa, 2013). Further, additional literature reports that 75% of sexual assaults committed by multiple perpetrators involve strangers (Swart, Gilchrist, Butchart, Seedat & Martin, 2000). This unfamiliarity with the perpetrators has a detrimental impact on the probability of later identification (Horvath & Kelly, 2009). The Annual Report from the South African police force indicates common patterns of criminal activity committed by multiple perpetrators where street robberies are often committed by smaller groups of people and larger-scale operations such as home invasion are committed by larger groups of people (South African Police Service, 2015). Data from the Victims of Crime Survey 2013/14 (Statistics South Africa) indicates frequent multiple perpetrator involvement in reported crimes that had occurred in the previous 12 months. The types of crime, the percentage that were committed by multiple perpetrators and the maximum number of perpetrators involved are reported as follows:

- 79.7% of robbery with a maximum of 32 people involved
- 48.4% of assault with a maximum of 22 people involved
- 45.9% of theft with a maximum of 14 people involved
- 36.4% of sexual assault with a maximum of 11 people involved

Considering the enormous prevalence of multiple perpetrator crimes in South Africa the ability of a witness to accurately identify several unfamiliar faces is of huge importance to both researchers and law enforcement.



## Multiple Perpetrator Identification Performance

Two opposing theories predict the accuracy of multiple perpetrator identifications. The first is that identification accuracy would decrease as the number of perpetrators increased due to a perceptual overload (Wall, 1965). Alternatively, Levine and Tapp (1973) argued that situations involving several perpetrators granted witnesses the opportunity to make comparative observations across features such as height and weight of the criminals, and that this would improve accuracy. Current findings are in favour of the former theory. A study by Tickner and Poulton (1975) on observation accuracy provides an indirect piece of research that is relevant to Wall's (1965) opinion: participants who watched a video of a city street and had to detect the appearance of several actors performed worse when they had to watch for 12 targets than when they were looking for only three. This supports Wall's (1965) claim that as the number of people to be recognized increases, recognition accuracy for those faces decreases.

The majority of face identification studies that consider multiple perpetrators have demonstrated decreased recognition accuracy for multiple targets. In an early study of multiple perpetrator crimes, Clifford and Hollin (1981) showed participants a video depicting either a violent crime (a robbery) or a non-violent interaction between a female actor and one, three, or five male actors. Eyewitnesses were then asked to view a series of target-present and target-absent photographic line-ups in order to identify the principal perpetrator. When the video depicted multiple perpetrators identification accuracy was poor with only 30% of participants accurately identifying the main assailant when he was accompanied by two other men and decreased further to only 20% of participants being able to accurately identify the main assailant when he was accompanied by three other men. While identification accuracy for a main assailant is decreased in the presence of additional perpetrators, identification accuracy is even poorer when recognition for all perpetrators is tested. Hobson and Wilcock (2011) tested recognition accuracy for three perpetrators and found that only 11.11 % of participants were able to accurately identify all three men while 30.5% of participants were not able to correctly identify any of the three men. This low identification rate is problematic for eyewitnesses who are required to make several suspect confirmations in cases of multiple perpetrator crimes.

## **The Two-Face Disadvantage and the Practical Recognition Problem**

Eyewitness studies frequently report decreased identification accuracy for multiple perpetrators implicating a multiple perpetrator effect which remains poorly understood. One theory is that the effect results from disrupted encoding while a second theory implicates difficulty in the recognition stage. Evidence to the theory of encoding difficulty is attributable to the two-face disadvantage, a commonly founded effect in face recognition studies whereby the presentation of two faces during encoding results in decreased recognition accuracy. Megreya and Burton (2006) conducted a simple face recognition task where they presented participants with either a single target face or two target faces to study, with the possibility of identifying either of them at a later stage. Identification accuracy for the single target face was 59.5% this decreased to 34% when two faces were presented at encoding. This indicates decreased memory for an unfamiliar target face when accompanied by a second face. Bindemann et al. (2012) also considered the number of faces present at the encoding stage and concluded that the ability to accurately identify an unfamiliar target face from a line-up declines when the target is accompanied by a second face during encoding. One theory of this two-face disadvantage is that the effect results from increased task-demand. The two-face condition is therefore more difficult because of the increased number of mental comparisons that need to be made in conjunction with the number of potential targets (Megreya & Bindemann, 2011). A second theory implicates capacity limitations in face processing due to the assumption that cognitive functioning only allows one face to be encoded at a time (Megreya & Bindemann, 2011). Interestingly, Bindemann et al. (2012) found that presenting the two face targets in close proximity to each other on the screen during the initial encoding phase resulted in a higher two-face disadvantage than when faces were presented singularly on the screen or at a relative distance. This suggests that concurrent target persons exert an influence on each other and disrupt encoding. Accuracy therefore decreases because observers experience difficulties separating the defining characteristics of each facial identity (Megreya & Bindemann, 2011). Further there is evidence indicating that identification accuracy declines because observers experience difficulties in the integration of individual facial features, such as mouth, nose and eyes, into a coherent holistic percept (Palmero & Rhodes, 2002). In multiple perpetrator situations observers are required to divide their attention between two or more concomitant faces, leaving less available time and cognitive space to encode each face than when a single target is presented (Bindemann, Burton & Jenkins, 2005). These competing explanations illustrate that identification of multiple targets

differs in several aspects from single target identification, especially with regards to encoding. The limited capacity theory implies that faces are encoded, but in insufficient depth for later recognition. The second explanation implies that the presentation of multiple target faces impairs typical encoding processes. Thus distinguishing both identities and encoding targets as separable and integrated face precepts becomes overly challenging for eyewitnesses (Megreya & Bindemann, 2011).

While limited encoding is one explanation of multiple perpetrator effects, decreased identification accuracy in eyewitness studies could result from either encoding difficulties or practical recognition difficulties whereby eyewitnesses are often unsure as to which perpetrator they are meant to be identifying. Evidence to this claim is provided by Hobson et al. (2012) who conducted a survey among police officers in the United Kingdom about the issues they faced when conducting multiple perpetrator line-ups. Police officers consistently reported that eyewitnesses were confused about *which* perpetrator they were attempting to identify from a line-up. In order to lessen the negative effects multiple perpetrators have on identification accuracy participants should be given explicit instructions about whom to recognise from each line-up. To test this, Bindemann et al. (2012) introduced several manipulations developed from theories regarding the multiple perpetrator effect, namely the increased cognitive load as illustrated by the two-face disadvantage and the practical recognition problem. One of the manipulations was the number of required mental comparisons and the other was to inform the participant as to which target face they would be required to identify. In the four condition experiment participants in group one were asked to identify a single target face from a ten-person line-up. Participants in group two were shown two faces and asked to recognise one of them from a ten-person line-up but were not informed which one. Group three completed the same task as group two except the target face was clearly indicated by a coloured line below the picture. Group 4 saw two faces and were asked to identify them from a five-person line-up, this condition was equal to condition one in terms of the maximum number of mental comparisons required to identify the target. Accuracy rates decreased from 82.3% for one face to 65.7% for two faces replicating the two-face disadvantage found in previous studies. Accuracy for two faces was slightly higher when the target face was cued (74%) giving evidence to the practical recognition problem. However performance for group four which required the same number of mental comparisons as group one showed accuracy rates of 81% similar to results in the first condition

demonstrating that multiple perpetrator effects to some extent result from increased cognitive load on witnesses.

### **Role Identification**

Multiple perpetrator crimes come with a unique element in terms of eyewitness evidence; not only must eyewitnesses identify the culprits from a line-up, they are also responsible for recalling the role that each culprit had in the crime (Wells, & Pozzulo, 2006). Accurately recalling the role and correctly matching it to the perpetrator is important in the criminal justice system due to the varying sentences given to convicted criminals. Identifying the gunman, for example, will lead to a longer prison sentence than identifying the driver of the get-away car. A study by Hobson et al. (2012) administered questionnaires to police officers that with regards to role identification, and concluded that police officers commonly report that eyewitnesses tend to confuse roles among perpetrators. The most common finding regarding role assignment for multiple perpetrator crimes is that witnesses tend to label any target that they recognise from the line-up as the main assailant (Geiselman, Haghghi, & Stown, 1996). Hobson & Wilcock (2011) tested recognition for multiple perpetrators as well as correct role identification by asking participants to identify a face from a line-up and briefly describe the role that the perpetrator played. When specifically asked to recall the role for one perpetrator only 30.5% of participants were able to correctly do so. When asked to provide the roles for all 3 perpetrators only 16.7% of participants were able to correctly do so.

### **The Role of Source Monitoring in Multiple Perpetrator Effects**

The theory of source memory is one theoretical explanation for the influence of multiple perpetrators on identification accuracy and subsequent role recall (Hobson & Wilcock, 2011). Source memory is the process by which we are able to recall the source from which information was originally obtained (Johnson, Hashtroudi, & Lindsay, 1993). However under conditions where a witness's attention is divided, due to the presence of several culprits for example, normal perpetual processes can be disrupted resulting in difficulties in the accurate retrieval of information and subsequent misattributions. In one study Loftus and Greene (1980) tested the susceptibility of participant's memory for faces in the presence of misleading descriptions. Participants first viewed an individual and then were provided with either an accurate or inaccurate narrative description of the person prior to viewing them in a line-up. Of those who had received the inaccurate description, 69% of participants incorporated aspects of the incorrect description such as hair colour and distinct features such

as a moustache into their memory of the target and subsequently selected the wrong individual, based on their similarity to the inaccurate description. Participants were unable to distinguish between the original memory of the target and the memory of the description. They demonstrated a failure in source monitoring by combining elements of both memories and misattributing incorrect information to their memory of the target. The difficulty of multiple perpetrator crimes is that the memories originate from the same source, the crime scene. These perception-based memories consequently possess many of the same visual attributes (Johnson et al., 1993) making it difficult for a witness to differentiate between the memories. There are even cases where eyewitnesses identify innocent bystanders due to the familiarity of their face. Loftus (1976) describes a case where a ticket salesman was held-up at gun point; the salesman later identified a sailor as the perpetrator despite the sailor having a solid alibi. The week prior to the robbery the ticket salesman had sold tickets to the sailor several times and had confused his recognition of the sailor's face as recognition of the perpetrator. This misattribution of recognition is known as unconscious transference and further demonstrates difficulties in source monitoring for facial recognition. The number of similar memories originating from witnessing a multiple perpetrator crime prevents eyewitnesses from being able to correctly pair the face of the perpetrator and the unique role they played in the crime. This has implications for both prosecution and the reliability of the witnesses' statement if they are misattributing the activity of each perpetrator.

One study, conducted by Nortje (2017) as part of her thesis, considers this unique face-role pairing element of multiple perpetrator crimes. This experimental study considers the influence of set size on memory for faces, memory for facts and memory for face-fact pairs. Participants were initially presented with a target face to learn, then the face was paired with a unique fact written below it and finally the fact was presented on its own. At recognition participants were shown either the target face or a foil (a previously unseen face) and asked to identify it. They were then presented with either the original fact or a fact that had been slightly altered. Finally participants were presented with the original target faces and facts and asked to correctly match them. Results indicate that performance across the three memory tests differed significantly where recognition accuracy was highest for facts and slightly lower for face recognition accuracy. Lastly face-fact pairing accuracy was significantly worse indicating that while participants were able to recall both the roles and the faces independently their ability to match the two was significantly compromised.

## **Limitations in the Literature**

An important distinction must be made between eyewitness identification and face recognition research. While face recognition research often makes use of multiple targets at the encoding phase, participants perform at normal levels (Shapiro & Penrod, 1986). Yet this performance is not mirrored in eyewitness research. This could be due to methodological procedures such as the types of memory tests used, but more likely due to the complex encoding scenarios used in eyewitness research. Currently there are very few published studies that deal with eyewitness memory for multiple perpetrators. Of those that do exist most presented multiple faces at encoding but only tested recognition for one face, usually the main assailant (e.g. Clifford & Hollin, 1981; Egan, Pittner & Goldstein, 1977; Megreya & Bindemann, 2011; Megreya & Burton, 2006). Studies that did test memory for all the perpetrators showed very low recognition accuracy rates of between 2%-11% (e.g. Hobson & Wilcock, 2011; Shepherd, 1983; Wells & Pozzulo, 2006). Further when testing identification of multiple perpetrators the maximum number of target faces that have been presented to participants is five when real-life crime statistics indicate the involvement of many more perpetrators. Currently there is no literature on the performance of eyewitnesses in situations with high numbers of perpetrators.

## **Conclusion**

It is a common notion to expect that as the number of to-be remembered items increases, limitations in attention result in decreasing identification accuracy for these items. In this regard the multiple perpetrator effect may point to a memory effect whereby one expects the retention of multiple items of any category, in this case faces, to be worse than for a single item (Bindemann et al., 2012). However in the field of eyewitness identification where eyewitness testimony is given such credible consideration it is imperative to quantify the failings of identification accuracy in order to assess the likelihood of correct selections. Further considering the magnitude of gang violence and crimes involving more than one perpetrator, especially in South Africa (Horvath & Kelly, 2009), more research must explore the accuracy of eyewitness identifications when witnesses have viewed one crime event with multiple perpetrators.

The research undertaken in this project will consider line-up identification accuracy for large numbers of perpetrators and by testing identification for each individual perpetrator,

not only the main assailant. Further it will consider source monitoring difficulties that accompany multiple perpetrator crimes by testing the ability of witnesses to accurately recall the roles that were played in the crime and their ability to correctly pair the perpetrator to their role in the crime. This is a unique element of multiple perpetrator crimes which is fundamental to the differential prosecution of criminals.

### **Specific Aims and Hypotheses**

The aim of this research is to determine the effect of multiple perpetrators on the accuracy of eyewitness identification. The following hypotheses will be tested:

#### **Line-up identification**

Line-up identification accuracy will decrease significantly as the number of perpetrators increases.

Rejection rates will increase significantly as the number of perpetrators increases.

#### **Role recall**

Role recall will remain higher than line-up identification accuracy but will decrease as the number of perpetrators increases.

#### **Pairing**

Accurate pairing of the correct target and the correct role will decrease significantly as the number of targets increases.

## Methods

### Design and Setting

This is an experimental design testing two independent variables. The first independent variable is the number of Perpetrators which has five levels (one, two, three, five and ten perpetrators). The second independent variable is the line-up condition that the participant views, this has two levels, target-absent (TA) and target-present (TP) line-ups where target-present line-ups contain the target perpetrator seen in the video and target-absent line-ups include an innocent suspect who has replaced the target. This was done in accordance with several other facial recognition studies to test the ability of the participant to discriminate between the selection of the target when he is present and the correct rejection of the line-up when the target is not present. Line-up Condition is a between-subjects factor for the single perpetrator condition as each participant saw only one line-up which was either TA or TP, but a within-subjects factor for the multiple perpetrator conditions (i.e. two, three, five and ten perpetrators) and was counter-balanced across each condition by alternating the order in which the line-up conditions were presented (Table 1). There are three dependent variables: Face Identification Accuracy, Role Identification Accuracy and Pairing Accuracy. Facial Identification Accuracy results from selecting the target in a target-present condition and correctly rejecting the line-up in the target-absent condition. Role Accuracy is scored for correctly providing a role that a perpetrator played in the video. The third dependent variable is the correct Pairing of the target face and the role that the target played in the video.

Additionally there were two sampling factors for each independent variable in the experiment: Video Version and Line-up Position. There are two versions of each encoding video for each of the five levels where the perpetrators in versions A and B are played by different actors to control for actor distinctiveness. There were also two versions of each Line-up Condition where the position of the target/suspect was changed to reduce presentation effect. Each of these, however, is a sampling factor and a counter-balancing technique and therefore not of interest to analyses.

In total, there were 5 X 2 X 2 X 2 cells for number of Perpetrators, Line-up Condition, Video Version and Line-up Position resulting in 40 experimental cells which were included in a randomization schedule. However with the exclusion of Line-up Position and Video Version, which were sampling factors there were 5 X 2 cells containing number of



Perpetrators and Line-up Condition (Table 1). The 40 cells in the randomization schedule were reduced to only 10 experimental cells in total for purposes of analyses.

## **Participants**

A convenience sampling method was used to recruit undergraduate Psychology students from the University of Cape Town through the SRPP system. Vula announcements were sent out regularly inviting students to participate in an ‘Intelligent behaviour’ study for which they received 3 SRPP points for 90 minutes of experiment time (Appendix A). This deception was necessary to prevent participants from expecting to be exposed to a set of faces and then studying these very well in anticipation of a recognition test. The participants were assigned to one of the 40 experimental conditions indicating the number of Perpetrators, Line-up Condition, Video Version and Line-up Position according to two randomization schedules, one for In-Group members (self-declared White South Africans) and a replicated schedule for Out-Group members. There were equal numbers of participants in each of the experimental conditions.

Two studies in the literature compared performance across the single perpetrator and multiple perpetrator conditions (Clifford & Hollin, 1981; Hobson & Wilcock, 2011). Using the proportions that were reported in these articles (roughly .35 for the single perpetrator group, and .15 for the five perpetrator group) a power calculation was done in R to estimate a sample size of 50 for one group totalling to 250 participants needed to meet the statistical power across all five conditions. However this was an over-estimation for the purposes of this study due to three main differences. Here recognition accuracy was tested for all perpetrators not only the main assailant, this study included a 30 min time-delay and additionally utilized target absent line-ups granting the participant the opportunity to reject the line-up unlike Clifford and Hollin’s (1981) study. Therefore the estimated sample size necessary for the study was 160 participants in total, 16 participants per each experimental cell.

In total, 200 participants were recruited, 20 participants in each experimental cell: 80 participants were In-Group members and 120 were Out-Group members. Participants had a mean age of 20.75 years ( $SD = 1.88$ ).

## **Inclusion Criteria**

Due to the influence of the well-established own-group effect, whereby members of any particular social group (be it age, gender or ethnicity) has decreased recognition accuracy for

faces of another group (Sporer, Trinkl & Guberova, 2007) participants and actors were required to constitute the same socio-geographical category. Since the actors used in the video were self-declared as South African, recruited participants had to be either South African or from neighbouring countries or additionally had spent the majority of their lives in South Africa.

## **Materials**

**Encoding video.** The encoding video depicts a staged theft in the Sleep Laboratory of the Department of Psychology at UCT. The videos are in colour and have no sound. All perpetrators were instructed to wear casual, non-distinctive clothing. The first video depicts the target - a white male who is carrying a backpack - entering the lab, checking a door and stealing a computer screen. His face is in close proximal view to the camera for three seconds to allow the participant adequate encoding opportunity. The main perpetrator performs the same actions across all five perpetrator conditions. Subsequent videos depict two, three, five, and ten perpetrators respectively performing unique roles (see Appendix B). The length of the single perpetrator video is 15 seconds long. Each video was lengthened by 15 seconds for each additional perpetrator to eliminate the confounding variable of inadequate time on encoding opportunity. This ensured that participants had equal opportunity to study each perpetrator for the same length of time. Therefore the 10 perpetrator video is 150 seconds long wherein each perpetrator approached the camera and had three seconds of close-range face exposure. Two versions of each video were filmed where actors played different roles to counter the effects of actor distinctiveness.

**Line-ups.** Colour photographs of the actors were taken on the day of filming. Frontal view photographs of the actors with neutral expressions that were standardized for intraocular distance were used for the line-ups. Currently there are no published guidelines for how to build line-ups for multiple perpetrators, however, guidelines stipulated by Malpass, Tredoux & McQuiston-Surrett (2007) which consider line-up bias and line-up size (number of viable alternative fillers) were adapted accordingly. Firstly model descriptions were created from 'averaged' descriptions provided by an independent sample. Participants (n=12) viewed the target images and provided physical descriptions of the actors, and the most frequently noted features (defined as being mentioned by more than half of the participants) comprised the modal descriptions. Next, the two researchers worked independently to select fillers from a database of colour photographs of white, South African males. Due to the similarity of the

model descriptions, fillers were selected in reference to both the model descriptions and each actors photograph. The researchers then collaborated in selecting one suspect and five foils for each of the ten actors. Here a suspect refers to a foil that has been selected to consistently replace the target in target-absent line-up conditions based on closest resemblance to the target. None of the foils or the suspects appeared in more than one target's line-up. Final line-ups consisted of photos of six men (standardized for inter-ocular distance and colour) on a grey background with the numbers one to six respectively below each image. All the men were edited to wear a white t-shirt. There were a total of four versions of the final line-ups for each actor: two versions of the target-present line-ups and two versions of the target-absent line-ups, where the target has been replaced by a selected suspect. In both versions of the line-ups, positions of the target/suspect have been changed to control for presentation effect.

### **Procedure**

This study was conducted in accordance to the University of Cape Town's stipulations for ethical conduct involving human subjects. Ethical approval for this project which forms part of a larger set of experiments was granted by the University of Cape Town's Research Ethics Committee (Appendix C). Participants were provided with a consent form which they were required to read and sign before proceeding with the experiment (Appendix D). Demographic information (age, gender, ethnicity and nationality) was then collected from each participant.

The procedure of the experiment consists of three stages; encoding, distraction and recognition.

### **Encoding.**

Participants were informed that they would be watching a video of a theft in a computer laboratory filmed from the perspective of a CCTV camera. After watching the video, they then completed a distractor task for five minutes. The task required them to write a paragraph answering a question on intelligent behaviour. After this, participants were instructed to complete a written statement about what they had seen in the video. They were asked to assume that they were making a statement at a police station and had to describe what they witnessed in the video in as much detail as possible. Once they made the statement, they had to answer a series of open-ended questions that asked about the crime in more detail (Appendix E).

**Distraction.**

After completing their statements participants completed a second, longer distractor task where they watched a 30 minute nature documentary on cephalopods and had to list examples of intelligent behaviours discussed in the video. This was done in order to prevent the participants from rehearsing the information they had provided in the first stage of the experiment. Neither distractor task presented the participants with human faces, to prevent confusion and subsequent source monitoring issues. Further both distractor tasks were designed in accordance to the theme of intelligence so as not to reveal the eyewitness nature of the study.

**Recognition.**

In the last stage participants received standardized instructions regarding line-up procedure (Appendix F), and were warned that the target may or may not be present in the line-up. They then viewed either a target-absent (TA) or target-present (TP) line-up, and had unlimited time in which to make a decision. They were given the option to reject the line-up if they believed the target was not present in the line-up or they were not confident enough to make a decision. Upon making a decision they were asked to rate their confidence on a scale of 1-100. If participants rejected the line-up they were probed for the reason behind their decision through responses given to four metacognitive questions. When participants did identify someone from the line-up they were then asked to state the role that the perpetrator played in the crime. Their confidence for the role was also rated on a scale from 1-100. These participants were also presented with metacognitive questions about how they made their line-up decisions (Appendix G). Participants in the Single Perpetrator condition completed this procedure once, whereas participants in the Multiple Perpetrator conditions repeated this procedure for all the line-ups in their experimental condition. In order to make the results of this study comparable to previous eyewitness studies, which always tested recognition accuracy for the main assailant, participants always saw the line-up for the main assailant first. Subsequent line-ups were presented in a randomised order as a counter-balancing technique.

In the second phase of the experiment, after participants had viewed all the line-ups, only the multiple perpetrator participants were given a questionnaire to complete (Appendix H) regarding the cognitive processes behind their selections. Participants were then debriefed and thanked for their participation.

## Results

This study forms part of a larger study on eyewitness identification for multiple perpetrator crimes. Therefore data from this study is limited to accuracy data for line-up identification, role identification and pairing.

### Coding data

Line-up responses were recoded into:

- hits which is the correct selection of the target in a target-present line-up;
- incorrect rejections which is the rejection of the line-up on the assumption that the target is not present when in fact he is;
- misses which is the selection of a foil instead of the target;
- correct rejection which is the rejection of a target-absent line-up with the knowledge that the target is not present;
- suspect identification which is the selection of a designated innocent suspect;
- foil identification which is the is the selection of any person in the line-up other than the suspect

Recollections of the roles were provided by the participants in the form of written statements. To code role accuracy researchers worked independently to create a code book containing accurate descriptions of the roles played by each actor, agreement between the researchers was then checked before coding accuracy for each role. There was high agreement between the two raters for roles,  $k > .80$  (95% CI, .824 to .877,  $p < .01$ ) and pairing  $k > .80$  (95% CI, .777 to .841,  $p < .01$ ). Each perpetrator played a unique and distinct role in the video which was kept consistent across all 5 perpetrator conditions, this aided subsequent coding. An accuracy score of 1 was given to each role that had been played by any of the actors seen in the videos.

Additional codes were created in relation to role accuracy:

- 999 was given to participants who had rejected the line-up as they were not required to provide a role;
- 998 was given to participants who stated that they did not recall the role;

- 997 was given to participants who had repeated the same role for more than one of the actors;
- 996 was given to participants who had combined more than one correct role

With the exception of 999 each of the additional codes resulted in an accuracy score of zero for the role.

Finally pairing accuracy was coded as 1 if the identification decision was a hit and if they provided the correct role played by that actor in the crime.

### **Statistical Analyses**

Due to the novel and exploratory nature of this study, data was grouped and analysed in a number of ways using several statistical methods. Data was analysed using the statistical programme SPSS (version 23.0). Group differences in the data were analysed using a series of analysis of variance (ANOVA) and chi-squared analyses, where alpha was set at .05, as well as a likelihood probability ratio. To test group differences in line-up decisions across the number of perpetrators chi-squared analyses were selected over ANOVA due to the mixed-designs element of the experiment where condition one was between-subjects and additional conditions were within-subjects. Further data was grouped and analysed according to the three independent variables: line-up identification accuracy, role accuracy, and pairing accuracy.

### **Line-up Identification**

Line-up identification Accuracy was determined by a series of line-up decisions described previously under coding.

Table 2 shows participants responses to target-present and target-absent line-up conditions. Responses are expressed as values proportional to the number of line-ups seen in each condition. Considering that the one-target condition is a between-subjects variable where participants saw either a target-present or a target-absent line-up proportions were calculated according to 20 participants, half the number of participants in each cell. While Conditions 2, 3, 5 and 10 are within-subjects variables so proportions were calculated for 40 participants. The one perpetrator condition is the baseline to which the multiple perpetrator conditions are compared. Further in accordance to previous eyewitness literature target-present and target-absent line-ups were analysed separately. Therefore the proportion of

response to the target-present line-ups, and the proportion of responses to the target-absent line-ups each add to 100.

False alarm decisions were separated into suspect identifications and foil identifications. For purposes of analyses only suspect identification rates were calculated.

**Table 2.**

*Identification decisions (proportion) as a function of Line-up Type (target-present, target-absent) and Number of Perpetrators*

Number of Perpetrators	Target-Present			Target-Absent		
	Hits	Incorrect Rejection	Misses	Correct Rejection	Suspect Identification	Foil Identification
1	.55 (.11)	.20 (.09)	.25 (.10)	.50 (.11)	.05 (.05)	.45 (.11)
2	.38 (.08)	.15 (.06)	.47 (.08)	.38 (.08)	.05 (.03)	.58 (.08)
3	.42 (.07)	.24 (.06)	.34 (.07)	.44 (.07)	.05 (.03)	.51 (.07)
5	.29 (.05)	.30 (.05)	.41 (.06)	.44 (.06)	.03 (.02)	.54 (.06)
10	.27 (.04)	.34 (.04)	.39 (.04)	.45 (.04)	.05 (.02)	.51 (.04)

*Note: The one perpetrator condition was a between-subjects condition where participants saw either a TP or TA line-up while the other conditions were within-subject. Therefore proportions were calculated according to Line-up Condition.*

*Standard Errors in parenthesis.*

Just over half of participants in the one-target condition correctly identified the target, but performance dropped to 38% in the 2 perpetrator condition (Table 2). This mimics the results of the two-face disadvantage found in previous literature. With the exception of a minor increase in the three perpetrator condition, hit rates continue to decrease until only 27% of participants were able to correctly identify the target in the line-up at the ten perpetrator condition. In contrast the number of incorrect rejections is increasing as the number of perpetrators increases. At the two perpetrator condition only 15% of participants

are incorrectly rejecting the line-up this increases to 34% at the ten perpetrator condition. This increase suggests that participants are becoming more confused and less willing to make an identification decision as the number of perpetrators increases. Rates of misses are quite high across all perpetrator conditions, this pattern is less obvious. However there is a clear increase in misses between the single perpetrator condition at 25% and the two perpetrator condition which increases to 47%.

Looking at the identifications decisions in the target-absent condition (Table 2) there is a similar pattern in the number of correct rejections, where in the two perpetrator condition participants are rejecting the line-up 38% of the time and at the ten perpetrator condition this rejection rates increases to 45%.

### **Chi-analyses for Line-up Identification Decisions**

Condition one is an in-between subjects variable where participants saw either a TP or TA line-up. Frequencies used in the chi-analyses were therefore weighted according to n=20 participants so that each condition was comparable to condition one.

For the target-present line-up condition, a chi-square analysis was conducted to determine if the frequencies of correct and incorrect responses was associated with the number of targets seen. Here a correct response is the frequency of hits while an incorrect response is the combined frequencies of incorrect rejections and misses (Table 3). The Chi analysis revealed that the frequencies of response type (correct/incorrect) were not significantly different across the number of perpetrators  $X^2(4) = 5.18, p = .27$

**Table 3.**

*Frequencies of Correct and Incorrect line-up decisions for Target-Present line-up condition*

Number of perpetrators	Correct	Incorrect
1	11.00	9.00
2	7.50	12.50
3	9.60	10.30
5	6.20	13.40
10	5.40	14.60



An additional Chi-analysis considering the differences in the frequencies of correct and incorrect line-up decisions resulting from target-absent conditions (Table 4), namely a correct rejection and a suspect identification showed no significant differences between correct and incorrect responses according to the number of perpetrators  $X^2(4) = 0.02, p = 1.00$

**Table 4.**

*Frequencies of Correct and Incorrect line-up decisions for Target-Absent line-up condition*

Number of perpetrators	Correct	Incorrect
1	10.00	1.00
2	7.50	1.00
3	9.30	1.00
5	9.20	0.60
10	9.00	0.90

### **Line-up Rejections**

Participants were given the option to reject the line-up if they were not willing to make a line-up decision because they were unsure about whether the target was present or not. Those who rejected the line-up are classified as non-choosers and those who made a decision were classified as choosers. Table 5 shows the weighted frequencies of non-choosers which was the combination of correct and incorrect rejections; as well as choosers which is the sum of other line-up decisions including hits, misses and total false alarms (suspect + foil identification). The table shows that the numbers of non-choosers is increasing as the number of perpetrators increases while the number of choosers is decreasing. A chi-analysis was run to more formally analyse these frequencies. The results of the chi indicate no significant differences between the number of choosers and non-choosers according to the number of perpetrators  $X^2(4) = 1.75, p = .78$

**Table 5.***Frequencies of Choosers and Non-Choosers*

Number of perpetrators	Choosers	Non-Choosers
1	26.00	13.00
2	29.50	10.50
3	26.55	13.67
5	25.00	15.00
10	24.20	15.80

In addition the number of the number of correct and incorrect rejections (according to line-up type, TA/TP) (Table 6.) were analysed using a chi analysis. Results of this analysis were not significant  $X^2(4) = 1.35, p = .85$

**Table 6.***Proportions of Correct Rejections and Incorrect Rejections*

Number of perpetrators	Correct Rejections	Incorrect Rejections
1	10.00	10.00
2	7.50	12.50
3	9.30	10.70
5	9.20	10.80
10	9.00	11.00

### **Discrimination ability**

Due to the novel nature of this study, selecting the appropriate analyses to determine differential performance across perpetrator conditions was difficult. Clarke (2012) alludes to the difficulty of deciding statistically if one experimental condition performs better than another by considering the costs and benefits of potential prosecution, namely whether the number of correct identifications of the suspect are proportional to the number of incorrect identifications of innocent persons. Majority of eyewitness literature considers this cost/benefit ratio by analysing frequencies of Hits and False Alarms in relation to each other. This is done in order to determine the discrimination ability of the eyewitness between identification of the target when the target is present and rejection of the line-up when the target is absent. The ability to discriminate between target presence and absence ensures that line-up decisions are not calculated at rates of chance. Further it counters the influence of guessing and response bias.

Clarke (2012) recommends a number of methods in which to calculate this discrimination ability, unfortunately not all are appropriate for this study. One recommended method is  $d'$ , a method used in signal detection theory (Stanislaw & Todorov, 1999). However  $d'$  is unstable at low values especially in the one perpetrator condition where the values vary greatly. Therefore an additional method provided by Clarke (2012) was utilised. The proportional changes in correct and false identification rates were assessed using an all-purpose measure of effect size, Pearson's  $r$ . If the rates of correct and false alarm rates are changing proportionally, then  $r$  will be zero; however if they are changing disproportionately, then  $r$  will be either positive or negative depending on whether false alarm rate is decreasing proportionately more or less than hit rate.

A correlation calculation of hit and suspect identification rates showed  $r = -.01$  which according to Clarke (2012) suggests that suspect identification rates are decreasing proportionally less than hit rates resulting in more type 2 errors in identification. A false negative in eyewitness studies implies that participants are more likely to dismiss a guilty person than incorrectly identify an innocent person.

The proportional difference between hit and suspect identification rates were calculated for each condition (Table 7) and then compared using a one-way analysis of variance. However results of the ANOVA reveal no significant changes in the proportional differences of hits and suspect identifications across the five conditions  $F(3, 156) = 1.02, p = .39$ .

**Table 7.**

*Proportional Difference between Hits and Suspect Identifications*

Number of perpetrators	Hits	Suspect Identifications	Proportional Difference
1	.55	.05	.50
2	.38	.05	.33
3	.42	.05	.37
5	.29	.03	.26
10	.27	.05	.22

### Line-up, Role and Pairing Accuracy

Line-up identification accuracy has been studied extensively in terms of eyewitness literature. However, as mentioned, multiple perpetrator crimes come with the unique element of role recall and subsequent pairing of the perpetrator and their specific role in the crime. Table 8 shows the proportional values of accurate responses provided by participants.

**Table 8.**

*Total accuracy (proportion) as a function of Type of Memory and Number of Perpetrators*

Perpetrators	Line-up Accuracy	Role Accuracy	Pairing Accuracy
1	.52 (.08)	.96 (.04)	.42 (.10)
2	.38 (.06)	.85 (.06)	.19 (.07)
3	.45 (.05)	.75 (.05)	.28 (.07)
5	.38 (.04)	.69 (.04)	.14 (.04)
10	.36 (.03)	.50 (.03)	.13 (.03)
Overall average	.39 (.30)	.70 (.31)	.18 (.29)

*Note: Line-up Accuracy is the addition of Hit rates in TP line-ups and Correct Rejections in TA line-ups.*

*Role accuracy is any correct role identification for the number of perpetrators in each condition.*

*Pairing Accuracy results from the combination of a Hit in a TP line-up and the correct role.*

*Standard Errors in parentheses.*

Accurate line-up responses includes hits in target-present line-ups and correct rejections in target-absent line-ups. Role accuracy refers to participants recalling any correct role played by the actors in the video. However, a correct pair was coded when the participant accurately identified the target face *and* provided the correct specific role played by that target. Table 8 shows that overall performance decreases as the number of targets increase. Descriptive data indicates that role recall accuracy was highest with a mean of  $M=.70$   $SD = .31$  followed by line-up identification accuracy with a mean of  $M= .39$   $SD = .30$  and last was pairing accuracy  $M= .18$   $SD=.29$

Line-up accuracy decreased from 52% in the single perpetrator condition to 36% in the ten perpetrator condition. Role accuracy was much higher overall than line-up accuracy and declined from 96% for the single perpetrator condition to 50% for the ten perpetrator condition. Finally, pairing accuracy had the lowest accuracy rates of the three tests, with performance decreasing from 42% in the single perpetrator condition to only 13% in the ten perpetrator condition. There is a slightly different pattern of accuracy across the line-up and pairing variables in the three perpetrator condition where performance increased slightly from the two perpetrator condition; this is addressed in the discussion.

Analysis of the three independent variables was done using a mixed-designs ANOVA. The hypothesis of the differential performance across these groups was directional with the assumption that role accuracy which would be higher than line-up identification and that both of these would be higher than pairing accuracy. This assumption of linearity was based on results of a previous face recognition study (Nortje, 2017). Due to this the ANOVA was done with planned contrasts, no additional post-hoc testing was done.

Mauchly's test indicates that the assumption of sphericity has been violated ( $p < 0.01$ ) therefore the Greenhouse-Geisser estimate was interpreted.

Results of the ANOVA indicate a significant main effect for identification type,  $F(2,234.57) = 182.87, p < 0.01$ . Planned contrasts showed that role accuracy was better than line-up identification,  $F(1,150) = 92.272, p < .01$ , and that line-up identification was better than pairing accuracy,  $F(1,150) = 108.73, p < .01$ .

There was also a significant interaction effect for identification type and number of perpetrators,  $F(6, 235.57) = 3.96, p < 0.01$ . Planned contrasts showed that there was a significant interaction between role accuracy and line-up accuracy across the number of targets,  $F(3,150) = 4.604, p < .01$ . Memory performance for role accuracy decreased at greater rate than performance for line-up accuracy as the number of targets increased. Planned contrasts showed that there was no significant difference between line-up accuracy and role accuracy across target conditions,  $F(3,150) = .852, p = .467$ . Thus, the change in performance between line-up accuracy and pairing accuracy did not differ as the number of targets increased.

## Discussion

### Line-up Identification

Eyewitness memory has been studied extensively in psychology. Despite this little is known about identification performance for multiple perpetrators. Of the existing multiple perpetrator literature, studies have mainly only explored eyewitness memory for a main assailant and very few studies have considered scenarios with more than two perpetrators. The purpose of this study was to determine identification accuracy for all perpetrators and to test the effect of set size on identification performance. Differential performance across the groups was not significant however proportional frequencies of line-up decisions show a pattern of decreasing identification accuracy as the number of perpetrators increases as evidenced by the decreasing number of hits. Identification accuracy in this study may have declined due to errors in encoding, because faces that are shown in close proximity to each other may disrupt independent encoding of each face (Bindemann et al., 2012). This is most feasible in the multiple perpetrator conditions (especially as the number of targets increased), because the 'crime' was filmed in a small room. This may have prevented participants from encoding each face independently and therefore decreasing recognition accuracy.

Further, cost/benefit analysis to determine the proportion of hits and false alarms was not significant. This is interesting, because the design of this experiment included both a target-present and a target-absent condition. Shapiro and Penrod (1986) concluded that TP/TA conditions have a significant effect on identification accuracy where the inclusion of a TA condition has been shown to increase false alarm rates by 25%. In contrast, Clarke's (2012) proportional differences ratio indicated that false alarm rates were decreasing proportionately less than hit rates, suggesting that participants were becoming conservative in their decisions and less likely to select a suspect if they were not certain. Considering the weight eyewitness identification is given and the high numbers of false identifications that have led to imprisonment these results are promising for real-world applications. This study suggests that in cases of multiple perpetrator crimes participants are *less* likely to select an innocent person; however this is at the cost of *not* identifying a potentially guilty person. Interestingly, the frequencies of choosers increased while non-choosers decreased as the number of perpetrators increased. Suggesting that participants were rejecting the line-ups more often. These rejection decisions are implying increased participant confusion and conservative decision-making. A possible explanation is that participants viewing multiple

line-ups have an increased perception of the difficulty of the task and its subsequent fallibility (Megreya & Bindemann, 2011) and so refrain from committing to any decision. This high rejection rate is another form of cost to police investigators who are subsequently denied suspect confirmation and potential prosecution.

It must be noted that while multiple perpetrator identification performance was lower than single perpetrator performance, there was a slight increase in identification accuracy for the three perpetrator condition. This increase is counter-intuitive, but may be because the actors in the three perpetrator condition were viewed as being more distinctive, and thus easier to remember.

Identification accuracy for an atypical face is often higher (Shapiro & Penrod, 1986) because the face is coded more distinctively and memory for that face is robust (Valentine & Bruce, 1986). Possible future research could investigate the effect of distinctiveness on memory.

### **Role Recall and Pairing**

Role recall and pairing were the most novel aspects of this study and little literature currently exists to outline relevant theories. Inferences about performance are therefore postulatory. Results indicate high accuracy performance for role recall across the number of perpetrators, indicating that the ability to retain this information is a stable trait. Pairing accuracy however was low at base-line levels and decreased significantly as the number of perpetrators increased. This apparent contradiction between high retention and low pairing may be contributable to the function of semantic associative memory whereby mental items are categorized as a single unit in memory if the signals share spatial contact and temporal contact (Kohonen, 2012). When witnessing a multiple perpetrator crime -where the information signals occur simultaneously and in the same area - the relevant information is stored as one memory unit. This unit represents a type of schema, and therefore distinguishing aspects of the memory unit is overly challenging.

Another theory is that witnessing a single crime event with multiple perpetrators introduces a binding problem in working memory. Perceptual representations of an event are encoded by distributed networks in the brain. These networks are responsible for relaying fragments of the representation and binding them into a coherent memory unit (Treisman, 1996). Errors in pairing may then result from issues in binding differential information such as face memory and semantic role memory together. These networks are also responsible for

distinguishing the information from each other. Thus, in cases of multiple perpetrator crimes where the information signals share a spatio-temporal context, face and semantic information may be bound together to such an extent that it is exceedingly difficult to delineate the information into distinctive face-role pairs.

Finally issues in pairing may result from source monitoring difficulties. Source monitoring is the process by which we are able to recall the source from which we acquired a piece of information (Johnson, Hashtroudi, & Lindsay, 1993). In research on multiple perpetrators, information pertaining to face-role pairings originates from the same source, and shares many of the same visual attributes resulting in unintentional misattribution of information. Additional research has concluded that source monitoring can be extended to different dimensions of a memory (Lindsay, 2014) and is responsible for tracking elements such as voice, face or name recognition. One important aspect of the source monitoring framework is the degree of similarity shared by elements of the memory (Johnson, De Leonardi, Hashtroudi & Ferguson, 2014). For example, participants were asked to recall a conversation they had witnessed and identify which of the speakers had said what. Results indicated that participants were more likely to confuse which aspects of the conversation had been discussed by each speaker when the speakers shared perceptual similarity. Source monitoring errors therefore occur more often as a result of the degree of similarity in the memory source. As it pertains to this study, role recall accuracy was high because the roles were highly dissimilar from each other and thus easier to remember whereas the faces appear very similar resulting in errors in source monitoring. In terms of pairing, the distinctive roles are not enough to independently cue the participant to the identity of the perpetrator, resulting in source monitoring errors and low pairing ability.

### **Limitations**

Limitations of this study are related to issues of ecological validity when conducting eyewitness experiments in laboratory settings. The first is the delay interval between witnessing the crime and the subsequent identification, which in this experiment was 30 minutes. In real-life situations eyewitnesses are required to make an identification several weeks after the event (Hobson & Wilcock, 2011) and long retention intervals have been shown to decrease identification accuracy (Shapiro & Penrod, 1986). Secondly the crime event simulated in this experiment was non-violent. This was done intentionally as a control, but it is not necessarily comparable to real-life crime events that typically involve multiple



perpetrators, such as hijacking, assault and rape. Violent crime conditions have been found to significantly affect identification accuracy as the number of perpetrators increases (Clifford & Hollin, 1981).

Another potential issue relates to line-up bias. Line-up bias refers to the extent to which mock witnesses select a suspect at rates higher or lower than chance. In target-absent conditions the target was replaced by a suspect and further these suspect identifications were used to calculate significance. It is possible that the line-up was biased in favour of the suspect in that no one identified him, and this could explain the low rates of suspect identification. However, there are currently no guidelines for how to build and evaluate line-ups with multiple perpetrators. It is possible that some line-ups were better quality than others due to the limited number of suitable faces in the database used. Future research should focus on this sampling difficulty, and clarify guidelines for evaluating multiple perpetrator line-ups.

### **Future Directions for Research**

Identification accuracy for multiple perpetrator crimes is still largely under researched with huge potential for future consideration. Further the theoretical framework surrounding multiple perpetrator effects is not comprehensive. Some theories focus on disrupted and insufficient encoding, whereas others suggest recognition errors due to confusion about which perpetrator should be identified. Research suggests that different processes govern identification of single and multiple perpetrators respectively. Especially in relation to instances of pop-out effects, number of mental comparisons and cognitive load (Megreya & Bindemann, 2011), these processes should be delineated in order to ascertain the origins of multiple perpetrator effects and subsequently improve recognition accuracy. In order to do this, studies should focus on manipulating variables in encoding and recognition stages independently.

### **Encoding**

Future research could consider the manipulation of variables already known to affect identification accuracy in single perpetrator crimes and determine the extent these would have on eyewitness memory for multiple perpetrators. To incorporate theories of source monitoring future research could manipulate the degree of perceptual and semantic similarity between two information sources (for example witnessing the crime event and reading a co-witnesses' statement about the crime) and test the extent to which information is

misattributed to each source. Further future research should consider designing experiments with real-life crime statistics in mind with regards to set-size and violent crime events. While this study extends the literature by considering larger groups of perpetrators, real life-crime statistics indicate the involvement of as many as 32 people simultaneously, the influence of such a massive increase in set size should be explored. Other minor manipulations regarding ecological validity could be made such as moving from viewing a video of a staged crime to witnessing a staged crime event in a more naturalistic setting.

### **Recognition**

Future research could include various manipulations of recognition tasks. For example, manipulating line-up instructions so that the eyewitness knows *which* perpetrator they should be identifying; this may aid in the contextualisation of the memory source. Additionally, the presentation of multiple line-up can be tested further. For example, multiple perpetrator research has presented line-ups in a sequential format: each perpetrator is placed in their own line-up, and these line-ups are presented sequentially but *only* after an eyewitness has made a decision. However, memory performance may be aided if eyewitnesses are able to view all the line-ups, before making any decisions. Lastly, South African guidelines about line-up construction allow two suspects in the same line-up if they resemble each other closely, but there is very little, if any, research on the effect this format has on identification accuracy compared to placing the suspects in two separate line-ups. This would provide information about the reliability of current procedural practice.

### **Conclusion**

This study attempted to ascertain whether identification accuracy decreased as the number of perpetrators increased. Further this study sought to investigate a unique aspect of multiple perpetrator crimes, that of role recall and the ability to accurately pair a perpetrator with their unique role in the crime. This is one of the first studies to test identification accuracy performance for such a large number of perpetrators. It is also one of few studies to test identification accuracy for all perpetrators and not only the main assailant. In addition while previous literature acknowledged the unique aspect of role identification in multiple perpetrator crimes this study extended the literature by explicitly testing role recall accuracy and correct pairing, which has an influence on real-life investigations and sentencing. Results pertaining to line-up identification accuracy were not significant. However results pertaining to role recall and pairing accuracy support the hypothesis that as the number of perpetrators

increases role identification and subsequent pairing decreases. Further there is a difference between these three types of memory performance: Role recall was better than line-up identification, which was better than pairing ability. Considering the high numbers of real-life crimes that involve multiple perpetrators and the relatively small body of relevant research, this study has contributed to the understanding of face identification in larger set sizes and demonstrates the caution law enforcers should take when dealing with eyewitness testimony for multiple perpetrator crimes, especially in differential sentencing for perpetrators based on eyewitness testimony regarding their supposed role in the crime.

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**Table 1**  
**Table of experimental Conditions**

Table 1

*Experimental cell conditions*

<i>Condition</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>5</i>	<i>10</i>
Version A	TP TA	TP,TA TA,TP	TP,TA,TP TA,TP,TA	TP,TA,TP,TA,TP TA,TP,TA,TP,TA	TP,TA,TP,TA,TP, TA,TP,TA,TP,TA TA,TP,TA,TP,TA, TP,TA,TP,TA,TP
Version B	TP TA	TP,TA TA,TP	TP,TA,TP TA,TP,TA	TP,TA,TP,TA,TP TA,TP,TA,TP,TA	TP,TA,TP,TA,TP, TA,TP,TA,TP,TA TA,TP,TA,TP,TA, TP,TA,TP,TA,TP

Note: *Version A and B is the video version where actors had been changed.*

*TP (target-present) and TA (target-absent) is the line-up condition.*

## Appendix A

### Vula announcement requesting participants

Intelligent Behaviour Study

Dear students,

Michaela and I are collecting data for her Honours project, and **we need your help!** We're conducting a study on intelligent behaviour (in humans and animals), and we need you to participate. The entire experiment is computer-based, and will take between **60 and 90 minutes**; therefore, you will earn between **2 and 3 SRPP points**.

We've made a number of sign-up slots on Vula. Please take a look at the schedule and choose a slot that suits you. The slot will tell you if you're earning 2 or 3 SRPP points. We'll be collecting data on Mondays-Fridays for the next few weeks, until we have our complete sample. There is no exclusion criteria, except that we are looking for South African participants who can understand/speak/read English (our instructions are in English).

**The venue is the GCS lab.**

**We will upload your points while you participate so that they reflect immediately.**

Please consider participating in this exciting and interesting research! We would love to have you in our study and we appreciate your time and effort! We will debrief you fully so that you understand the nature of this study.

Please, if you do sign up and you can't make it, then remove your name from the list or email the researcher so that we can find someone else. We need a big sample, and every person counts.

I'll keep uploading slots and I hope to see you soon!

Kind regards



## Appendix B

### List of roles actors had in the crime video

Actor	Role	1 perpetrator	2 perpetrators	3 perpetrators	5 perpetrators	10 perpetrators
1	Main assailant, steals computer screen and keyboard, instructs other actors	x	x	x	x	x
2	Rummages through filing cabinet.	-	x	x	x	x
3	Films crime on his cell phone, takes photos with other actors.	-	-	x	x	x
4	Acts as lookout, peers out the door	-	-	-	x	x
5	Writes on the walls with chalk	-	-	-	x	x
6	Moves chairs across the room.	-	-	-	-	x
7	Rolls a cigarette	-	-	-	-	x
8	Finds a bunch of keys and attempts to unlock doors.	-	-	-	-	x
9	Takes cool drink out of the fridge and drinks it.	-	-	-	-	x
10	Throws toilet paper around the room and makes a mess.	-	-	-	-	x

## Appendix C

## Ethical Approval

**FACULTY OF HUMANITIES**  
**PROPOSAL APPROVAL FORM**

<b>DOCTORATE</b> <small>(A research proposal must accompany this form)</small>	<b>RESEARCH MASTERS</b> <small>(A research proposal must accompany this form)</small>	<b>C/W MASTERS</b>
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**SECTION A: (To be completed by candidate)**  
Please complete this form and return it to the Faculty Office once you have obtained the signatures of the supervisor(s) and Head of Department.

Surname	Nortje				First Name(s)	Alicia
Title	Mr.	Ms.	Mrs.	<input checked="" type="radio"/> Miss	Student No	NR TALI 003
Address	6A Parry Road, Claremont, Cape Town					
Telephone(Home)	0216711525			Work/Cell	0836882828	


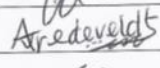


*Note: Your UCT Email address is the default email address for all official communication – make sure that you access it regularly.*

Department	Psychology
Title of Dissertation: Investigating facial recognition for multiple-perpetrator crimes	

Qualifications held			
Degree/Diploma	Major(s) & Subjects	Month/Year awarded	University
MA	Psychological Research (coursework: Neuropsychology)	2011	UCT
Honours	Psychology	2007	UCT
BA	Psychological Counselling	2006	UNISA

Signature of candidate:  Date: 29 July 2013

**SECTION B:**

	Name	Signature	Date
Supervisor	C G Tredoux		29/6/13
Co-supervisor (if applicable)	A Vredevelde		31/07/13
HOD	J Marcan-Smith		31/07/13
Deputy-Dean: Research			
Ethics approval obtained where applicable	on behalf of Departmental Ethics Committee	 (C. Ward)	30/7/2013

## Appendix D

### Consent Form

Human Intelligence Experiment

Dear student,

Thank you for expressing interest in this study. This study is about intelligence behaviour in humans and animals – you will view a video exhibiting forms of intelligent behaviour and then be asked to complete a series of questions. We not be testing your intelligence (i.e. IQ score), we want to identify what you think is intelligent behaviour.

This experiment is a computer-based experiment, and thus, will take place at a computer.

**Inclusion/Exclusion criteria:** We are only recruiting students who identify as South Africans. It is important that you can speak, read and understand English, as the instructions are in English.

**SRPP Points:** In exchange for participating, you will earn \_\_\_\_\_ SRPP points. Please keep in mind that in order to earn these points, you need (1) participate in the entire session, and (2) you need to try your best. Remember, the data from this experiment is important, and your participation is valued.

**Risks:** There are no foreseeable risks in this experiment. You should not experience any anxiety, stress or negative psychology or physiological effects from participating in this study. However, if you do want to withdraw your consent, and end your participation before the experiment is over, then you may do so. However, if you do end the experiment early, the researcher will keep the data and may still publish it.

**Data:** All data collected will be anonymous and confidential. Only the researcher will be able to connect your data to you. However, if the data is published in any form (manuscript, thesis, PowerPoint presentation), it will be coded with a participant number.

I have read the above description of the experiment, and give my voluntary consent to participate.

I understand that my participation is voluntary, and that I can withdraw my participation at any stage. By giving consent, I state that I understand English (can read and write it), and that I have normal, or corrected-to-normal vision.

Name: \_\_\_\_\_

Student number: \_\_\_\_\_

Date: \_\_\_\_\_

Course for points: \_\_\_\_\_

Number of points: \_\_\_\_\_

## **Appendix E**

### **Statement Questions**

#### **Single perpetrator**

1. How many people were involved in the crime?
2. Please describe the physical appearance of the person who committed the crime.  
Consider that your description may be used to find and identify this person at a later stage.
3. What did the perpetrator do in the video of the crime?
4. Please describe what the perpetrator did in the form of a timeline from the beginning until the end of the video.
5. Was anything stolen from the laboratory.

#### **Multiple perpetrators**

1. How many people were involved in the crime?
2. Please describe the physical appearance of each person who committed the crime.  
Consider that your description may be used to find and identify these people at a later stage.
3. What did each perpetrator do in the video of the crime?
4. Please describe what each perpetrator did in the form of a timeline from the beginning until the end of the video.
5. Was anything stolen from the laboratory.
6. Did one of the perpetrators appear to be in charge? If yes, who?

## **Appendix F**

### **Line-up Instructions**

#### **For the single perpetrator condition**

You will be presented a line-up consisting of six men.

Your Task is to identify which of these men was the perpetrator in the film that you watched,  
if he is present in the line-up.

Please make your choice by pressing the number below his head; If you do not know or do  
not recognise him, please press 0.

You will not be able to revisit the line-up to change your decisions.

Please press SPACEBAR to continue.

#### **For the multiple perpetrator condition**

You will be presented with several line-ups consisting of six men.

Your Task is to identify which of these men was one of the perpetrators in the film that  
you watched, if he is present in the line-up.

Please make your choice by pressing the number below his head; If you do not know or do  
not recognise him, please press 0.

You will not be able to revisit previous line-ups to change your decisions.

Please press SPACEBAR to continue.

## Appendix G

### Lineup Decision Questions

#### Chooser

**I compared the faces from the photographs with my memory of the perpetrators to help me make my decision**

No, this is not at all what happened         Yes, this is exactly what happened.

**1 2 3 4 5 6 7**

**I immediately recognised the person, he stood out from the others.**

No, this is not at all what happened         Yes, this is exactly what happened.

**1 2 3 4 5 6 7**

**I had to make a lot of effort to arrive at my answer.**

No, this is not at all what happened         Yes, this is exactly what happened.

**1 2 3 4 5 6 7**

#### Non-chooser

**I had to make a lot of effort to arrive at my answer.**

No, this is not at all what happened         Yes, this is exactly what happened.

**1 2 3 4 5 6 7**

**I didn't identify anyone because I couldn't decide between the faces of the lineup**

No, this is not at all what happened         Yes, this is exactly what happened.

**1 2 3 4 5 6 7**

**I didn't identify anyone because the perpetrator was not in the lineup.**

No, this is not at all what happened         Yes, this is exactly what happened.

**1 2 3 4 5 6 7**

**I didn't choose anyone because I was confused about which person (in the video that I watched) I was supposed to identify in this lineup.**

No, this is not at all what happened         Yes, this is exactly what happened.

**1 2 3 4 5 6 7**

## Appendix H Questionnaire

**For the experimenter to complete:**

Participant number: \_\_\_\_\_

Date: \_\_\_\_\_

**1. Which would you have preferred (Please circle which option you would have preferred):**

Option 1: Seeing **all** the lineups **before** making any decision/s

Option 2, what you did: Viewing the lineups, one at a time, making one decision from each before moving to the next lineup.

**2. How much easier do you think it would it have been to make your identifications if you were allowed to see ALL the lineups BEFORE making any identifications? (Please circle your response)**

It would not have been any easier	1 - 2 - 3 - 4 - 5 - 6 - 7	It would have made the task extremely easy
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**3. After seeing some of the lineups, I wanted to go back to change some of my decisions. (Please tick your response)**

**YES**, this  
happened to me

**NO**, this did  
not happen to me.

4. I confused my memory of some of the perpetrators with each other (Please circle your response).

This did not happen to me at all	1 - 2 - 3 - 4 - 5 - 6 - 7	This is exactly what happened to me
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5. Some of the perpetrators were easier to remember than others.

This did not happen to me at all	1 - 2 - 3 - 4 - 5 - 6 - 7	This is exactly what happened to me
----------------------------------	---------------------------	-------------------------------------

6. It was easier to remember perpetrators who I saw at the beginning or the end of the video.

All the perpetrators were difficult to remember, regardless of when they appeared in the film.	1 - 2 - 3 - 4 - 5 - 6 - 7	Perpetrators who appeared at the beginning or end were easier to remember than others.
--	---------------------------	--

7. Which option would you have preferred?

What you had:  
**Multiple lineups**, each containing **one** suspect

**One big lineup** containing **all** the suspects



8. Please explain your answer for Question 6 in the box below:

9. How much did remembering one perpetrator's face help you to remember the other perpetrators in the other lineups? (Please circle your answer)

Remembering one perpetrator's face <u>did</u> <u>not</u> help me remember any other faces AT ALL.	1 - 2 - 3 - 4 - 5 - 6 - 7	Remembering one perpetrator's face <u>ALWAYS</u> helped me remember another face.
---	---------------------------	---

10. I was confused about which each perpetrator did in the crime. Even though I could recognise them from the lineup, I was not certain about what specific tasks they performed in the crime.

This did not happen to me at all	1 - 2 - 3 - 4 - 5 - 6 - 7	This is exactly what happened to me
--	---------------------------	--

**11. Sometimes I didn't know which perpetrator I was looking for in the lineup.**

This did not happen to me at all	1 - 2 - 3 - 4 - 5 - 6 - 7	This is exactly what happened to me
--	---------------------------	--