

Stress at Encoding does not affect Witness Recall Memory or Face Identification

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Abstract

The effect of stress on witness memory has important implications yet remains unclear. While the current model suggests that at moderate levels stress should improve memories and impair it at higher levels, this has not been shown clearly. Using an experimental design, stress was induced in 20 participants using the Maastricht Acute Stress Test (MAST) while 20 controls underwent the placebo MAST. An unexpected mock crime was staged during the experiment, after the MAST procedure had been completed, in which a confederate entered the room and took the researchers phone. 28 participants completed an online version of the Self-Administered Interview the next day and were asked to make identifications from both a target absent and target present line-up. The Self-Administered Interview (SAI) was coded for memory of events, location and descriptions of the confederate. The effectiveness of the MAST was evaluated using self-report and physiological measures of stress. Participants in the experimental group scored significantly higher on self-report measures and there were also significant differences in change in heart rate and skin conductance between the experimental and control groups. Differences in performance on the SAI and face identification tasks was non-significant between the stress and no stress groups. These findings suggest that a state of acute stress at encoding does not affect subsequent recall or recognition. Further research is needed to see whether different levels of induced stress at encoding affect recognition and recall. The effects of other affective states should also be considered in future studies.

Keywords: Depression; Eyewitness; Face Identification; MAST; Memory; Stress

Witnessing a crime is typically a stressful experience. As witnesses are required to recall the events of the crime, it is important to understand how stress affects witness memory. Studies of eyewitness memory have examined the effects of stress at encoding on subsequent recall as well as the effect of stress during recall. Yet, findings from applied forensic psychology on stress and memory have not supported research from basic neuropsychology. This may be related to methodological differences between applied and basic research but may also be the result of a lack of consistency in eyewitness methodology (Sauerland et al., 2016). However, as stress is not the only state which influences memory other affective states should be considered (Houston, Clifford, Phillips, & Memon, 2013). There is a robust body of evidence which shows that depression has a significant effect on memory (Rock, Roiser, Riedel, & Blackwell, 2013). As depression is among the most common mental disorders globally, with a lifetime prevalence of between 10% and 15%, it is reasonable to assume that many witnesses of crimes are depressed (Lépine & Briley, 2011). Currently, there is no literature on the relationship between stress and depression on witness memory, yet as both states affect arousal such a relationship might exist (Drexler & Wolf, 2017). As both states can affect attention it is an important factor to consider and attempt to control (Pickel, 2015).

Stress and Memory

Witnessing a crime is a potentially dangerous and often stressful experience. During episodic experiences of stress, known as acute stress, a bodily response triggers the release of hormones which prepare the body for action. Several factors influence the effect of acute stress on memory, namely, the amount of stress experienced, the memory processes being used and the time since onset of stress (Shields, Sazma, & Yonelinas, 2016). Cortisol and cytokines are released by the body during a stress response. Cortisol is fast acting while cytokines take longer to affect memory. As witnesses to crime must recall the event after it has occurred, it is necessary to consider how acute stress affects memory over time. A study by Shields et al. (2016) found that a delay after administering cortisol improves recall. However, cytokines start to impair recall after such a delay. A follow up study found that stress only improves recall if the delay between encoding and recall was very brief, which is rarely the case in real settings (Shields, Sazma, McCullough, & Yonelinas, 2017). As neurological studies have found that acute stress reduces hippocampal activity, which is associated with poor recall, delay appears to impair recall (Drexler & Wolf, 2017).

While stress has consistently been shown to impair recall, it may improve or impair

encoding (Drexler & Wolf, 2017). Mild or moderate stress during encoding has been shown to improve memory, yet intense stress impairs memory. The body's response to stress has been graphically represented as an inverted U-shape, in which the positive effects of stress on encoding reach a peak and subsequently begin to drop after the level of stress becomes too high (Drexler & Wolf, 2017). This curve is not symmetrical, having a steep drop off as stress increases which results in catastrophic forgetting where information is not adequately encoded (Nixon, 1982). A meta-analysis looking at high stress during witness' encoding of a crime found that stress reduced witness memory of details (Deffenbacher, Bornstein, Penrod, & McGorty, 2004). The authors suggest that witnessing a crime produces intense rather than moderate stress. These findings suggest that poor encoding due to high levels of arousal impair witness' ability to adequately recall events. However, studies on witness memory have not found consistently found this (Krix et al., 2016). As different studies have used different methods of stress induction, which may induce varying degrees of stress, methodological differences may be responsible for this lack of clarity (Sauerland et al., 2016).

Studies have also found that stress at encoding may have different effects on subsequent recall and recognition tasks (Het, Ramlow, & Wolf, 2005). As witnesses to a crime are required to both recall events, which rely on explicit memory systems, and recognise perpetrators, an implicit memory task, this distinction is important (Vakil Wasserman, & Tibon, 2018). Basic research from neuropsychology suggests that stress at encoding should benefit recall tasks more than recognition tasks (Het et al., 2005). A field study by Morgan et al. (2004) found that a high intensity stressor increased false alarms and reduced successful identification rates. In contrast, laboratory research from forensic psychology has shown no effect of stress on witness identification (Sauerland et al., 2016). As the study by Morgan et al. (2004) used military recruits as participants, they were able to induce greater stress than a typical lab study. This supports the theory suggesting that high levels of stress negatively impact performance (Nixon, 1982).

External factors, such as length of exposure to a stressor, its intensity, and time between onset of stress and recall affect memory performance (Levine & Edelstein, 2009). As methodological differences between studies vary these factors, this may explain inconsistencies in the literature on stress and performance (Sauerland et al., 2016). However, internal factors, such as individual differences in baseline levels of stress or arousal, may affect the extent to which stress impacts memory. As some people's cognitive performance is more resilient to increasing demands, the point at which stress impairs memory will vary (Plieger et al., 2016). Plieger et al. (2016) found that stress facilitates selective attention, and

subsequent recall, on cognitively undemanding tasks but impairs selective attention on more demanding tasks. If this impairment is a result of over arousal, lower baseline arousal may counter the negative effects of high arousal (Drexler & Wolf, 2017). As depression affects arousal a possible interaction between stress and depression should be considered.

Depression and Cognition

. Depression is among the most prevalent psychiatric disorders globally (Lépine & Briley, 2011). It is also among the disorders with the highest 12-month prevalence rate in South Africa (Williams et al., 2008). While depression is generally considered an affective disorder, it also produces changes in cognition (Gotlib, & Joormann, 2010). The current consensus of the literature is that affect and cognition cannot be considered separately (Rock et al., 2013). The DSM-V criteria and the Beck Depression Inventory II (BDI-II), commonly used to screen for depression, include cognitive deficits, which may impair memory, alongside affective measures of mood and motivation (Beck, Steer, & Brown, 1996). Participants with Major Depressive Disorder (MDD) perform worse than healthy controls on list recall tasks (Bearden et al., 2006). They are also slower and less accurate on tests of working memory (Rose & Ebmeier, 2006). These tests examine explicit memory and show that depression impairs recall. Participants' ability to search for previously learnt stimuli is also impaired (Hartlage, Alloy, Vázquez, & Dykman, 1993). These explicit memory tasks require effortful processing to probe one's memory (Rose & Ebmeier, 2006). Explicit memory is important for the type of recall used by witnesses during interviews. This suggests that depression may impair a witness's ability to recall events.

However, a review by Austin, Mitchell and Goodwin (2001) found no difference in implicit memory tasks between participants with MDD and healthy controls. These tasks involve priming, causing feelings of familiarity when selecting stimuli, rather than explicitly asking participants to recall previously viewed stimuli (Hartlage et al., 1993). It has recently been shown that these implicit and explicit memory systems develop differently and support performance of different memory tasks (Vakil et al., 2018). Implicit memory is important to eyewitness tasks that involve recognising previously seen faces in a line-up, as familiarity can influence these decisions (Yonelinas, 2002). As implicit memory does not require effortful cognitive processing, poor performance on explicit recall tasks in participants with MDD may result from a loss of motivation (Austin et al., 2001). Austin et al. (2001) also found inconsistent correlations between severity of depression and memory impairment. This suggests that specific cognitive deficits or low arousal associated with depression may be

responsible for the observed memory impairment seen in recall but not recognition (Austin et al., 2001).

A meta-analysis by Rock et al. (2013) on memory and depression found that participants with high depression scores remember negative stimuli better than either neutral or positive stimuli. In comparison, participants with low depression scores remember both positive and negative stimuli better than neutral ones (Rock et al., 2013). Everaert, Duyck and Koster (2015) suggest that an attentional bias rather than a memory bias underlies these findings. The meta-analysis by Rock et al. (2013) supports this as they found deficits in attention and executive functioning in participants with depression. Quinn and Joormann (2015) observed that depressive symptoms predicted poor sustained attention. These deficits were found both in participants with severe depression and those with sub-clinical depression, which suggests that common traits or symptoms of people with depression impair attention (Rock et al., 2013). Therefore, attention should be considered as a mediator between emotional states and memory, because emotional states affect attention and attention affects memory (Everaert et al., 2015).

Attention and Memory

The question of what will be encoded is relevant to studies of witness memory. Before one can remember details of an event one must notice and attend to it. There have been cases of inattention blindness where people who were present at a crime scene failed to notice the crime as they were focussed elsewhere (Pickel, 2015). One explanation is that people focused on goal related tasks do not attend unrelated stimuli resulting in them missing the event. Another is that attention acts like a beam of light; information on which the beam is centred is better encoded. Levine and Edelman (2009) consider goal related behaviour to attract the focus of this attentional beam while other information falls on the periphery. As our attentional resources are limited, not everything in the environment can be attended to. If multiple stimuli are present, some will be prioritized. This results in poor memory of peripheral or less salient stimuli (Pickel, 2015). If a witness is occupied with a task while a crime such as a theft takes place, they may not attend the crime as their task will be more salient.

Emotional events, such as fear inducing crimes, tend to be conspicuous and thus attract attention which reduces encoding of other information (Drexler & Wolf, 2017). Events that are moderately emotionally arousing will be remembered well and improve later recall as they attract attention (De Quervain, Aerni, Schelling, & Roozendaal, 2009). However, high

levels of emotional arousal may impair encoding and reduce memory of details, even for well attended stimuli (Drexler & Wolf, 2017). As experiences of stress and emotion use cognitive resources, too much arousal will impair cognition. Arousal will also impair memory in situations where cognitive demands are high (Levine & Edelstein, 2009). As remembering the events of a crime requires memory of non-emotional details as well as the emotionally arousing event, emotion and stress should impair memory of neutral information (Hoscheidt, LaBar, Ryan, Jacobs, & Nadel, 2014). As crimes often involve a central, salient event as well as more neutral information such as contextual information about the crime scene, both neutral and emotional memories must be recalled by witnesses.

In summary, recall and recognition performance may be affected by states that influence attention and processing at encoding. Acute stress and depression are two such factors which may affect memory. Memory for salient emotional stimuli is different to that for neutral stimuli interacts differently with both stress and depression. As crimes are typically salient events, methodological differences between forensic psychology and neuropsychology might account for the range of reported effects of stress on memory. Within the field of forensic psychology, differences in methodology such as crime event and delay between encoding and recall may have produced inconsistencies in this literature. At high levels, stress and depression are both expected to impair memory. However, at moderate levels the effects are less clear. Differences in baseline arousal may result in participants with high depression scores reacting differently to induced stress than those with low scores (Drexler & Wolf, 2017).

Rationale and Research Aims

As witness testimony has far-reaching consequences, knowledge that can help establish its accuracy is important. This is relevant both for supporting reliable and discrediting unreliable evidence provided by witnesses. As depression often impairs memory, the testimony of depressed participants may be considered unreliable. However, as research on depression and memory has not been undertaken in ecologically valid eyewitness paradigms, previous research may not be generalizable. By understanding the interaction between stress and depression for eyewitness events, the accuracy of witnesses' memory may be evaluated from an informed position. This would allow for accurate testimony to be identified and for unreliable evidence to be disregarded. By using a reliable method of stress induction and a standardized live mock crime, it may be possible to investigate the effect of

important factors while controlling for others. Based on the reviewed literature this study aimed to test the following hypotheses:

- 1) It was hypothesized that stress would have a positive impact on recall memory.
- 2) Conversely it was hypothesized that stress would not affect recognition memory.
- 3) Depression was predicted to adversely affect recall but not recognition.
- 4) Stress was also predicted to affect attention resulting in some details being better recalled than others.

Methods

Design and Setting

This research used an experimental design to investigate the effect of induced stress, the independent variable, on two dependant variables, namely recall and face recognition. Recall was divided into ability to remember details of the location, events and perpetrator's appearance while face recognition will be tested with Target-Absent (TA) and Target-Present (TP) line-ups. Research was conducted in the Department of Psychology at the University of Cape Town (UCT).

Participants

Sample. Participants were recruited via the Student Research Participation Program (SRPP) run by the Psychology Department at UCT. This method of convenience sampling connects undergraduate psychology students, who must participate in research to write their exams, and researchers in the department. Participants were recruited via an advert on the university online portal (see Appendix A). 180 students were screened for eligibility. Of these, 123 were invited to take part in the laboratory session. 70 block-randomised laboratory sessions were arranged for individual participants. 40 participants (8 men) came to take part in the 45-minute lab session, completing the MAST, over 12 weeks with 28 (6 men) providing a full set of memory data.

Exclusion criteria. Students diagnosed with a psychiatric disorder were excluded from the study. It was expected that students with high levels of trait anxiety, or who were affected by psychological trauma and may have experienced adverse effects were also excluded. Furthermore, students with previous head injuries were excluded to avoid confounding variables.

Materials

The 4-item Primary Care Post-Traumatic Stress Disorder Screen (PC-PTSD).

The PC-PTSD is a concise screening test comprising four yes/no questions (Prins et al., 2003; see Appendix B). It asks about any trauma experienced by the participant that currently affects them. Participants who answered ‘yes’ to three or more items were excluded from this study (Prins et al., 2003). Though brief, the PC-PTSD has shown good content validity for identifying symptoms of trauma. The PC-PTSD displays good criterion validity when compared to longer measures of PTSD (Brewin et al., 2002). It has also demonstrated good test-retest reliability with $r = 0.83$ (Prins et al., 2003). The PC-PTSD is recommended as a practical measure for detecting PTSD symptomology (Davis, Whitworth, & Rickett, 2009). It has been used in studies conducted in South Africa with high internal consistency shown ($\alpha = .89$) (for example Peltzer & Louw, 2013; Peltzer, 2014).

State-Trait Anxiety Inventory Form Y1 and Y2 (STAI-Trait and STAI-State).

This self-report questionnaire has two parts, with 20 items each, measuring state and trait anxiety. Items are rated using a 4-point Likert scale (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI-Trait measures general anxiety symptoms (see Appendix C). A score ≥ 59 indicates severe anxiety and will be used as a cut off to screen participants (Spielberger et al., 1983). The STAI-State (see Appendix D) measures current levels of anxiety. Scores were used as a measure of stress. The STAI has been used in studies with undergraduate populations with high levels of internal consistency ($\alpha = .92$), and test-retest reliability ($r = .69$ to $.89$) (Spielberger & Vagg, 1984). A study in South Africa by Jordaan, Spangenberg, Watson, and Fouchè (2007) found a similar level of internal consistency ($\alpha = .89$).

Beck Depression Inventory-II (BDI-II). This self-report questionnaire of 21 items measures current depressive symptomatology (see Appendix E; Beck et al., 1996). Respondents chose a statement from a list, for each item, that best described their mood or behavior over the previous 2 weeks. In this study, scores on the BDI were used as a covariate measure. The BDI-II has high internal consistency and test-retest reliability ($\alpha = .91$ and $.93$, respectively), as well as adequate factorial and content validity (Beck et al., 1996; Dozois, Dobson, & Ahnberg, 1998). Furthermore, the BDI-II has been used in several South African studies and has been shown to have high internal consistency ($\alpha = .90$) (Henry, Wolf, Ross, & Thomas, 2015; Kagee, Nel, & Saal, 2014; Somhlaba & Wait, 2009).

The Maastricht Acute Stress Test (MAST). The MAST is a stress induction procedure that combines the Cold Pressor Test with mental arithmetic from the Trier Social Stress Test (Smeets et al., 2012). The test takes 15 minutes to administer. Participants

alternate between having their hand in cold water and doing an arithmetic task where they must count backwards in steps of 17 from 2043. Participants are stopped and told to start over if they make a mistake on the arithmetic task. Participants were informed that there would be multiple trials of these tasks and that trial length is randomly determined, while it is in fact fixed, but would never exceed 90s. The unpredictability of the task and social-evaluative nature of the negative feedback during the arithmetic task activate both the HPA and SAM axis, eliciting a comprehensive stress response (Smeets et al., 2012).

The MAST has been used in several studies alongside the placebo MAST and has been shown to reliably produce a stress response as measured by physiological measures and self-report (Shilton, Laycock, & Crewther, 2017). Measures of cortisol, pulse rate as well as systolic and diastolic blood pressure have been reported as being significantly different between participants completing the MAST and placebo MAST (Meyer, Smeets, Giesbrecht, Quaedflieg, & Merckelbach, 2013). Subjective scores of anxiety, stress and discomfort have also shown significant stress induction after MAST administration (Salam, Rainford, van Vugt, & Ronay, 2017). This procedure has been used in an eyewitness memory experiment similar to that proposed here (Sauerland et al., 2016).

The Vrije Universiteit Ambulatory Monitoring System, version 5fs (VU-AMS; Vrije Universiteit, Amsterdam, Holland). Heart rate (HR) and skin conductance (SC) were measured using the VU-AMS. This non-invasive and portable device measured physiological responses continuously throughout the study. These measures were analysed as part of the stress manipulation. Both HR and SC have been shown to increase when people experience stress (Lin, Lin, Lin, & Huang, 2011). Lin et al. (2011) also found no stress x depression interaction on these measures making them a suitable variable for the stress manipulation check in the presence of depression.

The Self-Administered Interview (SAI©). The SAI© is a standardized interview based on the cognitive interview. It asks generic questions applicable to various crimes and has been shown to enhance recall (Hope, Gabbert, & Fisher, 2011). The witness is asked to think back to the event and is then asked a series of non-leading questions to prompt recall. Questions ask about physical aspects of the event and the perpetrator as well as actions taken by the perpetrator and any other people involved (Sauerland et al., 2016). In this study the SAI was used as to test participants' memory of the mock crime through an online survey.

Line-ups. TA and TP line-ups were constructed for two confederates who volunteered to assist with the project. Both were female third year students in their early 20's. Line-ups were composed of two rows of three photographs, showing the neck and face,

presented simultaneously, 11 foils for each confederate were selected from a data base of photos. A short list of 16 foils was selected, based on a general description of each confederate, by the researcher, which was reduced to the 11 photos judged to look the most like the target by the confederate and the photographer. This was done to ensure a high similarity between the foils and the target which reduces line-up suggestibility (Fitzgerald, Oriet, & Price, 2014) Once constructed, the line-ups were shown to some of the researcher's classmates, who noted that the photographs of the confederates were of higher quality than those of the foils, and thus stood out. After a second round of editing, the line-ups were shown to the 9 members of the eyewitness lab at UCT, who were unable to distinguish the target from the foils. Two versions of each line up were constructed, with the target being in either position 3 or 5 to reduce the influence of a position effect (Wells, Steblay, & Dysart, 2015). In the TA lineup the 'target' was the foil who most resembled the perpetrator (see appendix F).

Procedure

Ethical clearance was obtained through the Department of psychology ethics committee at UCT (see Appendix G). Participants were first screened through an online survey to avoid possible negative outcomes from the stress induction. Eligible participants were directed to a sign-up sheet online.

Screening phase. The STAI-trait was used to screen for anxiety and the PC-PTSD for symptoms of PTSD. Participants with high levels of either may have experienced adverse reactions to stress induction and were screened out. Participants scoring above the respective cut-off scores were informed of this and advised on where to seek counselling if desired (see Appendix H).

Laboratory phase. Participants were given a consent form (see Appendix I) outlining the procedure of the experiment, which they were told aimed to test the effect of stress on problem-solving ability. Once the consent form had been signed, participants attached the VU-AMS device to themselves, the signal was checked, and it was set to record. They were not informed that a mock crime would take place to ensure natural reactions. Participants then completed the BDI-II. Participants in the experimental group were informed of the procedure for the MAST, or placebo-MAST for the controls, before commencing with the test. For the experimental group, the water was cooled with ice until it reached 5°C, as measured by a pool thermometer. The water for the control group was tap water warmed to 20°C. After the MAST procedure, participants completed the STAI-state form. Thereafter,

participants were given a vocabulary test as a distractor task but told that it was the main test (see Appendix J). At this point the experimenter excused himself to go to the bathroom, leaving a phone on a container which held spare cables for the VU-AMS. A confederate then knocked on the door, entered the room and asked the participant if the researcher was present. They told the participant that they had left their phone behind during a previous session. The confederate went to the table, took the researcher's phone, stating that it was theirs, and left the room. When the researcher reappeared, he asked about the distractor task while searching for the phone. If the participant mentioned that someone had come to fetch their phone the researcher asked what phone had been taken and stated that the phone was his. If the participant did not mention the theft the researcher asked what had happened to the phone he left on the container (see Appendix K for schematic of procedure). Once the participant had told the researcher what had happened they were informed that they had witnessed a mock crime and were debriefed (see Appendix L).

A recall task was sent to the participants the next day via email, ensuring that line-ups were double blind (Wells et al., 2015a). A period of 24 hours ensured that participants were only affected by stress during encoding (Sauerland et al., 2016). The task was comprised of the SAI as well as two line-ups comprised of 6 faces, labeled A-F. Each participant first saw a target absent (TA) lineup and then a target present (TP) line-up for the confederate they saw in the lab. The instructions above the line-up stated that 'the suspect may or may not be present'. Participants were asked to rate their confidence in their line-up selection and had the option to say the suspect was not present or that they didn't know who the suspect was. This is in line with best practice identification procedure which reduces the chance of false identifications (Malpass & Devine, 1981).

Data management and Statistical Analysis

Data was captured with Microsoft Excel which was used to calculate t-tests and related effect sizes. Participants' personal information was not captured to insure confidentiality. Inferential statistics were computed using SPSS version 25. Raw Excel and VU-AMS data as well as SPSS output and syntax are stored in an encrypted folder, available for inspection if requested. All assumptions for analysis were met unless otherwise stated.

HR and SC were sampled between minutes two and three after obtaining informed consent, to obtain a baseline, using VU-DAMS version 4.0. The second period sampled was between minute 16 and 17 of the recording, by which time the MAST had been completed. A repeated measure analysis of variance (ANOVA) was conducted within groups to compare

HR and SC over time. A mixed methods ANOVA was also conducted to see if there was a significant time x condition interaction between groups.

A list of verifiable details was coded for descriptions of the location of the experiment, details of the mock crime, from when the researcher left the room to when he returned, and for descriptions of the perpetrator (see Appendix M). These were determined top-down based on a script for the confederates' actions, set clothing consistently worn, and a fixed location for the participant and items in the lab. Interrater reliability was obtained for the 28 coded statements on details of location, events and perpetrator descriptions. For the quantity of details reported the single-measure inter-class coefficients (requiring absolute agreement) were 0.89, 0.93 and 0.82 for location, events and perpetrator details respectively (Landis, & Koch, 1977). An analysis of covariance (ANCOVA) was conducted for each category of recall, and on total details recalled, to analyse the effect of condition (stress vs control) on recall memory, using BDI-II a covariate.

For face identification, an ANCOVA was conducted to compare the results from each group using BDI-II scores as a covariate. Results from both line-ups and confederates were collapsed to create a single score for each participant. A correct rejection on the TA and a correct identification on the TP line-up counted one point each. Thus, scores were analysed as continuous variables that ranged from zero to two.

Results

Manipulation check

Physiological measures. HR and SC were analysed for 35 participants (17 of whom underwent the stress inducing procedure) using a repeated measures ANOVA to compare the change between groups. There was a significant time x condition interaction for HR, $F(1, 33) = 5.12, p=0.03, d = 0.84$, shown in figure 1, and for SC, $F(1, 33) = 5.77, p = 0.022, d = 0.92$, shown in figure 2. Both interactions were disordinal with average HR and SC changing in opposite direction for the experimental and control groups over time. For the experimental group SC increased significantly $F(1, 15) = 5.78, p = 0.019, d = 1.30$ but HR did not change significantly while for the control group HR decreased significantly $F(1, 16) = 15.02, p = 0.001, d = 1.88$ but SC remained the same.

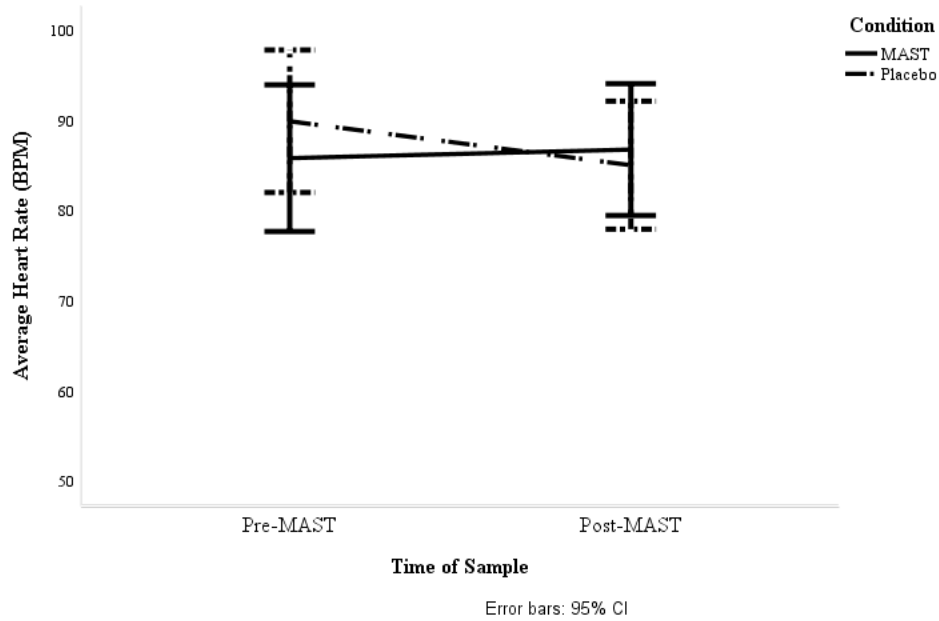


Figure 1 Disordinal Heart Rate x time Interaction for Stress vs Control groups. Y-axis starts at minimum recorded heart rate.

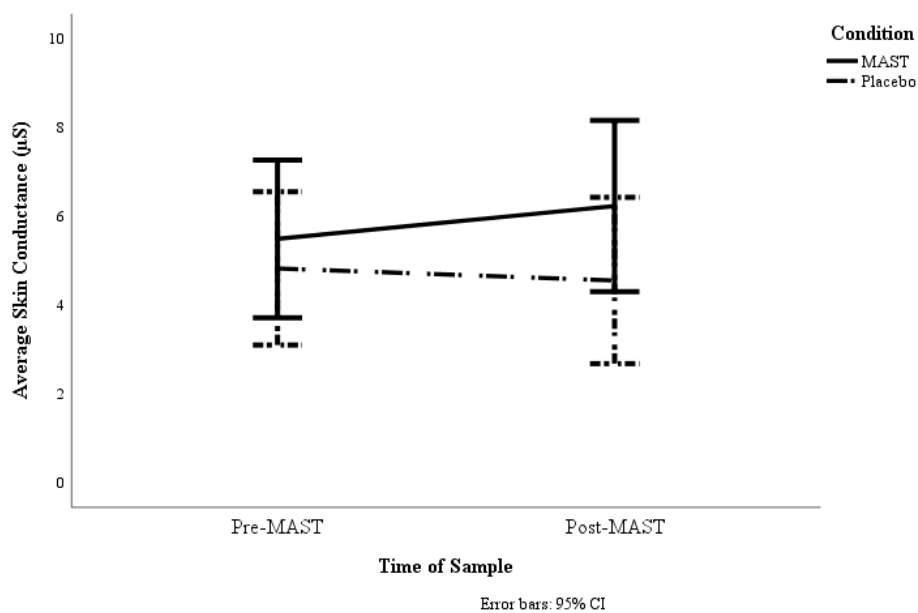


Figure 2 Disordinal Skin Conductance x time Interaction for Stress vs Control groups.

Self-Report Measure. The STAI-Y1 scores of 40 participants (Stress = 20) were used as a self-report measure of stress. Both groups completed the STAI-Y1 after doing the MAST or placebo MAST. Means and standard deviations are reported in Table 1 for both groups along with BDI-II scores. An independent samples t-test was conducted to see if there was a significant difference between self-reported stress post-MAST. There was a significant

difference between scores $t(38) = 3.40, p < 0.001, d = 0.95$. A T-Test was also used to compare depression scores across the groups. There was no significant difference $t(38) = 1.36, p = 0.181$ and as such differences between groups cannot be attributed to depression.

As not all participants completed the recall task, a second manipulation check was conducted on for those participants who did. The pattern in the data remained the same with a significant difference on the self-report scores of those participants $t(26) = 2.33, p = 0.014, d = 0.88$. For the 25 participants for whom there was physiological and recall data (Stress = 13), the time x condition interaction for HR $F(1, 22) = 7.37, p = 0.013, d = 1.16$ and SC $F(1, 22) = 6.15, p = 0.021, d = 1.03$ were both significant. There was a significant decrease in HR $F(1, 10) = 8.97, p = 0.012, d = 1.81$ for the control group and no significant change in SC. For the experimental group there was no significant change in HR but a significant increase in SC $F(1, 11) = 7.44, p = 0.018, d = 1.58$.

Table 1

Self-Reported Stress and Depression scores by Condition

	STAI-Y1		BDI(II)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
MAST	24.35	9.97	13.90	9.70
Placebo	14.30	8.94	10.35	6.45

Note: Means and standard deviations for self-report measures.

Effect of Stress on Recall

Recall data was collected from 28 participants (stress = 14). The data was collapsed across confederates, owing to the small sample size. Means and Standard Deviations are reported in Table 2 for each category of recall as well as a total score for each group. Comparing the results for total recall across conditions, suggests that the MAST group performed slightly worse than the control group. However, the higher Standard Deviation also suggests that the results had a greater spread.

Separate ANCOVAs were conducted for memory of location, events and descriptions using. The memory of location analysis showed no difference between groups $F(1, 26) = 1.85, p = 0.19, d = 0.54$, and no effect of the covariate $F(1, 26) < 0.01, p = 0.909, d = 0.04$. For the analysis for memory of events the assumption of homogeneity of variance was violated with Lavene's test significant $F(1, 26) = 11.35, p = 0.002$. The more robust Welch test was run which was non-significant $F(1, 18.07) < 0.01, p = 0.934, d = 0.03$ and the effect

of the covariate was also non-significant $F(1, 26) = 0.22, p = 0.646, d = 0.18$. The descriptions of perpetrator did not differ between groups $F(1, 26) = 0.12, p = 0.727, d = 0.14$ with the covariate similarly non-significant $F(1, 26) < 0.01, p = 0.911, d = 0.04$. A fourth ANCOVA was conducted using a sum of all information recalled forming a single recall score for each participant. Levene's test was significant $F(1, 26) = 10.96, p = 0.003$ so the Welch test which is more robust to unequal variance is reported. The difference between groups was similarly non-significant $F(1, 22.08) = 0.71, p = 0.441, d = 0.29$ as was the effect of the covariate $F(1, 26) = 0.19, p = 0.666, d = 0.08$.

Table 2

Means and Standard Deviations for Recall Type by Condition

	MAST		Placebo	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Location details	4.86	3.08	6.50	2.98
Event details	5.21	2.63	5.21	1.19
Perpetrator description	3.93	2.37	4.36	2.92
Total	14.00	5.94	16.07	3.87

Note: Means and Standard deviations for each recall type for the stress and control group.

Effect of Stress on Face Identification

Face identification data was collected from 28 participants (stress = 14). From Table 3, which shows the response data for the face identifications, we can see that a large proportion of participants in both groups made a false identification on the TA line-up. The stress group had more correct rejections but also more false alarms, while more participants in the control group were not confident enough to either reject the TA line-up or to make an identification. For the TP line-up, both groups made the same number of correct identifications, but the controls identified a foil or rejected the line-up more often. However, these differences were small.

Of the 28 participants, 15 made identification attempts in the TP line-up, across the groups, eight were successful. Using a binomial distribution where that probability of a correct identification by chance, or base rate, is $p = 0.167$, the probability that that eight of the 28 participants would make a correct identification by chance is $p = 0.049$ which is less than alpha. When one only considers the 15 participants who attempted to make an identification, the probability of making eight identifications by chance drops to $p = 0.001$. This is worth noting as an identification rate close to chance would render any conclusions drawn meaningless (Wells, Yang, & Smalarz, 2015). From the above we can conclude that

the low hit rate on the TP line-up is still significantly above the base rate. The results of the ANCOVA showed no significant difference between groups $F(1, 26) = 0.47, p = 0.499, d = 0.20$ and the effect of the covariate was also non-significant with $F(1, 26) = 0.39, p = 0.536, d = 0.19$. Thus, we can conclude that there were no meaningful differences in identification rate between the groups.

Table 3
Line-up Responses by Stress Condition for TA and TP Line-ups

	MAST	Placebo
TA	<i>n</i> =14	<i>n</i> =14
Correct reject	3	2
False alarm	10	9
Don't know responses	1	3
TP	<i>n</i> =14	<i>n</i> =14
Correct identification	4	4
Foil identification	3	4
False reject	5	6
Don't know responses	2	0

Note: for a Target-Absent (TA) line-up rejecting the line-up is the best response, equivalent to a correct identification in the Target-Present (TP) line-up. False alarm in TA and Foil identification are also equivalent

Power Analysis

The power achieved for the main variables recall and identification were both low at 0.11 and 0.08 respectively due to the small sample size. As such conclusions drawn can only be tentative and this should be considered a pilot study. To achieve power of .5. Sauerland et al. (2016) required 123 participants.

Discussion

The present study investigated the effect of stress at encoding on eyewitness memory. As witnessing crimes often induces stress, it is important to understand how reliable witness memory is under these conditions. The MAST, a standardized stress induction procedure, was used to induce stress in the experimental group (Smeets et al., 2012). A live, scripted mock crime was staged, increasing the ecological validity of this study without sacrificing control. Importantly, this event controlled for participants attention by having the confederate engage them. By allowing a full day to pass between the experimental session and the recall test, this study ensured that participants were only acutely stressed during encoding and not recall or recognition. This delay further increases the ecological validity of the study as police are typically not able to arrange a line-up on the same day as the crime (Sauerland et al.,

2016). Furthermore, as previous research using the SAI has not separated the effect of stress at encoding and recall, this study expands on the current literature on the SAI.

The results of both self-report and physiological measures allow us to conclude that the stress manipulation was effective, resulting in differences of approximately one standard deviation between groups. Participants in the experimental group reported higher STAI Y-1 scores than those in the control group. Although no baseline STAI scores were recorded, differences between groups show that the experimental condition was more stressful than the control condition. SC increased significantly after completing the MAST procedure and decreased for controls completing the placebo MAST resulting in significantly higher scores in the experimental group post-procedure. The HR of participants in the experimental group did not increase significantly, but that of the controls decreased, resulting in a significant difference between groups. While an increase in HR was expected this result can be explained as all participants were told that they were taking part in a stress experiment and given the instruction of the MAST before the VU-AMS was set to record. Shilton et al. (2017) found that participants' HR increased after having the instructions of the MAST explained to them in anticipation of the procedure. Thus, the high baseline HR found in this study were likely an anticipatory stress response. This high HR was sustained for the experimental but not the control group, resulting in a significant difference between the groups. These results were found with the full sample as well as the subset who completed the whole experiment. Together, these results suggest that the MAST produced a significant stress response, in line with previous research (Sauerland et al., 2016; Smeets et al., 2012). Previous studies used the Positive and Negative Affect Scale (PANAS) and the STAI Y-1 as a self-report measures and reliably showed increases in subjective stress (Shilton et al., 2017; Smeets et al., 2012). Cortisol levels, heart rate, systolic and diastolic blood pressure have previously been shown to increase significantly after administering the MAST (Shilton et al., 2017; Smeets et al., 2012). The results of this study are the first to show the effectiveness of the MAST using SC.

As in the study by Krix et al. (2016) stress was induced directly before a mock crime. Although stress levels differed significantly between the groups at encoding, no difference in memory performance was found. Hypothesis one, that stress would improve recall can thus be rejected while hypothesis two, that stress would not affect recognition was supported. This contradicts findings that show either increased or decreased memory performance as a result of stress during encoding (Deffenbacher et al., 2004). As these results did not show a difference in the effect of stress at encoding on either recall or recognition tasks, it does not

support findings which show that stress is more beneficial to recall performance than recognition (Het et al., 2005). However, it supports findings by Krix et al. (2016) using the SAI that found no effect of stress on recall memory. They found significantly elevated levels of cortisol in the experimental groups using the MAST, an effect size $d = 1$, suggesting that cortisol was elevated during encoding. It was suggested that, as recall was performed directly after encoding, the lack of significant difference was a result of the same level of stress being present at both encoding and recall. However, as participants in this study all performed the recall task under conditions of no stress, other explanations are needed. In both studies, stress cannot be directly attributed to the crime. It has been considered that this could reduce the effect of stress on memory of the event. However, as basic research in neuropsychology has found a stress effect on list learning tasks, the lack of association between the to be remembered event and stress induction is not a sufficient explanation (Krix et al., 2016).

Research on the effect of stress on recognition has found a range of results. While Het et al. (2005) found stress to benefit recall but not recognition and Morgan et al., (2004) found stress to impair recognition. Methodological differences between studies accounts for these discrepancies. The present study supports finding by Sauerland et al. (2016) which found no effect of stress on eyewitness identification accuracy in either target absent or target present line-ups. An important distinction in the present study is that participants completed both the recall and recognition task the day after the stress induction. Replicating the findings of Sauerland et al. (2016) with a different, yet meaningful, delay between encoding and recognition also suggests that stress does not change the rate of decay of memory traces (Levine & Edelstein, 2009). As such these findings show that stress at encoding has no effect on subsequent recall or recognition.

The procedure used in both studies does several things to increase rigour (Sauerland et al., 2016). By seeing participants in individual sessions, it controls for attention as the confederate always engages the participant directly. The live crime provides a more realistic scenario than the video clips often used in eyewitness research. In this way participants are physically and mentally present in the event, as opposed to a video which may not fully, or consistently capture their attention. The individual sessions also allow for a careful stress manipulation as well as simplified physiological data collection. This allows for methodological rigour in data collection while increasing the ecological validity of the event (Sauerland et al., 2016). Such a standardized procedure allows for the systematic addition or manipulation of conditions which is crucial in making meaningful observations. It may also allow for differences in basic neuropsychology and forensic psychology stress research to be

understood. As the materials and type of memory tested are so different between these fields, consistency within forensic psychology, where there is currently less rigour, is needed to establish the cause of these different findings (Sauerland et al., 2016).

An important consideration when comparing findings on the effect of stress, other than the recall or recognition task, is the level of stress induced (Sauerland et al., 2016). As methods of stress induction vary, it is plausible that different studies have induced significant but heterogenous degrees of stress. As the theoretical stress model suggests that the effect of stress on learning and memory fits a negative parabolic curve, different stress induction methods may have differing effects (Drexler & Wolf, 2017). By only having two stress groups it is possible that an affect will be missed as the relationship between stress and performance is non-linear (Nixon, 1982). As such the present study may have looked at points on either side of the optimal performance peak, missing the point where stress benefits performance. performance caused by stress. Methodological differences in stress induction within eyewitness studies may also explain the confusion as to the effect of stress on both recall and recognition (Sauerland et al., 2016). Future research should use this procedure with a different stress induction method to investigate this effect. By using a standard, ecologically valid live event but altering the stress induction technique, the effects of stress on eyewitness memory will become clearer.

A notable difference in the results of this study and that by Sauerland et al. (2016), is the difference in TA rejections and TP hits. While in both studies the rates were similar between groups, Sauerland et al. (2016) report more correct rejections in the TA line-ups as well as hits in the TP line-ups. This result was surprising as the face recognition task conducted by Sauerland et al. (2016) was conducted a week after encoding while in the current it was conducted 24 hours later. As memory performance tends to decrease with time, one would expect that identification rates would be higher in this experiment, which used the same procedure (Shields et al., 2016). This is likely the result of the repeated measures line-up design. As many participants identified a foil on the target absent line-up, they subsequently rejected the target present line-up. However, as the successful identification rate was significantly greater than chance and consistent across the experimental conditions, this difference did not affect the results.

The non-significance of depression scores as a covariate is a finding which should be investigated further. It was hypothesised that depression would impair recall memory, yet this was not the case in either group. While it did not affect recognition, as hypothesised, conclusions drawn remain tentative. The procedure used ensured that the confederate

engaged the participant, drawing their attention to the event. As such the procedure controlled for attentional bias and this may explain the non-significant effect of depression (Everaert et al., 2015). However, as the average depression score was low for both groups, the sample may not have had sufficient variation in depression scores for an effect to be found.

Increasing the sample size should provide suitable variation in depression scores to clarify this. Future research should also measure depression at recall as acute stress is associated with the onset of depression (Hammen, Kim, Eberhart, & Brennan, 2009). A study using mood induction found that negative mood at recall but not encoding negatively impacted memory (Thorley, Dewhurst, Abel, & Knott, 2015). As such, depression may be more relevant at recall than encoding.

The primary limitation of this study is the small sample size and its ramifications for statistical power. As a result of one of the confederates having to leave the country during data collection, unanticipatedly, not all of the 40 participants witnessed the mock crime, and some could thus not provide a full set of data. As the effect sizes for the effect of stress and depression on recall memory were small, more participants are required to check the non-significance of these findings. Another possible limitation was the use of repeated measures design for the line-ups. This design was used, as opposed to a between group design, to increase the power of what was expected to be a small sample. This contributed to an increase of rejections of the TP line-up, as many participants made a confident false identification on the TA line-up. As all participants first saw the TA line-up, this effect was not counterbalanced, because seeing the TP line-up first would confound the decisions on a subsequent TA line-up. Regarding the stress manipulation check, although the results were consistent across physiological and self-report measures, the manipulation check could be improved. Self-report analysis was done between groups to show differences between experimental conditions, yet future research should take baseline measurements for the self-report scores as with the physiological measures. Physiological measures were sampled at two points, which while sufficient is not optimal. All measures could have been taken once more to establish whether the stress effect was lasting or transient. Finally, participants ages were not recorded. While age can affect cognitive processes, these effects are most pronounced at either end of lifespan development (Fitzgerald & Price, 2015). As all participants were younger adults enrolled for undergraduate degrees, age is unlikely to have affected the results.

Conclusion

The results of this study support previous findings using the same experimental design. The experimental stress induction resulted in significant differences between the groups on both self-report and physiological measures, including SC which had not previously been used to evaluate the MAST. Such stress manipulation checks are rare in the eyewitness literature yet increase methodological rigour and allow more robust conclusion to be drawn. This induced stress at encoding did not affect either recall or recognition. As such, stress at other time points should be considered. Discrepancies in the forensic psychology literature make a strong case for the need to increase methodological consistency in stress research to ensure that studies are directly comparable. By using this same procedure but inducing stress at recall or during consolidation, future research may systematically explore the effects of stress on eyewitnesses. It may also be important to have more than two groups when conducting experiments with stress owing to the non-linear relationship between stress and performance. This project will be expanded to increase the power of current findings and introduce a second experiment with 3 groups, to better understand the effects of varied levels of stress on eyewitness memory. This project demonstrates that ecological validity and methodological rigour are not mutually exclusive and should become a staple in the eyewitness literature.

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Appendix A
SRPP Recruitment Advert

The Effect of Stress on Problem Solving

I am running a study which aims to examine the effects of acute stress on problem solving. To participate in this study, you will first need to complete an online survey to see if you are eligible (you will be awarded 1 SRPP point for this). If you are eligible, you will be invited to the laboratory phase where you will complete some questionnaires, take a short stress inducing procedure followed by a problem-solving test which should take less than an hour. You will also be required to complete feedback on the experiment the next day via email. You will receive a further 2 SRPP points for the laboratory phase of the experiment (that makes 3 for the whole study).

The First step is to complete [this survey](#) to see if you are eligible for the laboratory phase. You will receive an email once you have done this letting you know what the next step is if you are eligible.

Thank you for taking the time to read this and complete the questionnaire

Sincerely, Milton Gering

grnmil001@myuct.ac.za

Appendix B**PC-PTSD**

In your life, have you ever had any experience that was so frightening, horrible, or upsetting, that in the past month you:

Question	Yes	No
Have had nightmares or thought about it when you didn't want to?		
Tried hard not to think about it or went out of your way to avoid situations that reminded you of it?		
Were constantly on guard, watchful, or easily startled?		
Felt numb or detached from others, activities, or your surroundings?		

Appendix C

State-Trait Anxiety Inventory – Trait Form

SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-2

Name _____ Date _____

DIRECTIONS

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

ALMOST NEVER
SOMETIMES
OFTEN
ALMOST ALWAYS

- | | | | | |
|--|---|---|---|---|
| 21. I feel pleasant..... | 1 | 2 | 3 | 4 |
| 22. I feel nervous and restless | 1 | 2 | 3 | 4 |
| 23. I feel satisfied with myself..... | 1 | 2 | 3 | 4 |
| 24. I wish I could be as happy as others seem to be | 1 | 2 | 3 | 4 |
| 25. I feel like a failure | 1 | 2 | 3 | 4 |
| 26. I feel rested | 1 | 2 | 3 | 4 |
| 27. I am "calm, cool, and collected"..... | 1 | 2 | 3 | 4 |
| 28. I feel that difficulties are piling up so that I cannot overcome them..... | 1 | 2 | 3 | 4 |
| 29. I worry too much over something that really doesn't matter..... | 1 | 2 | 3 | 4 |
| 30. I am happy | 1 | 2 | 3 | 4 |
| 31. I have disturbing thoughts | 1 | 2 | 3 | 4 |
| 32. I lack self-confidence..... | 1 | 2 | 3 | 4 |
| 33. I feel secure | 1 | 2 | 3 | 4 |
| 34. I make decisions easily | 1 | 2 | 3 | 4 |
| 35. I feel inadequate..... | 1 | 2 | 3 | 4 |
| 36. I am content | 1 | 2 | 3 | 4 |
| 37. Some unimportant thought runs through my mind and bothers me | 1 | 2 | 3 | 4 |
| 38. I take disappointments so keenly that I can't put them out of my mind..... | 1 | 2 | 3 | 4 |
| 39. I am a steady person..... | 1 | 2 | 3 | 4 |
| 40. I get in a state of tension or turmoil as I think over my recent concerns
and interests | 1 | 2 | 3 | 4 |

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Published by Mind Garden, Inc., 1690 Woodside Rd, Suite 202, Redwood City, CA 94061

STAIP-AD Test Form Y
www.mindgarden.com

Appendix D

STAI-State Questionnaire

SELF-EVALUATION QUESTIONNAIRE STAI Form Y-1

Please provide the following information:

Name _____ Date _____ S _____
 Age _____ Gender (Circle) **M** **F** T _____

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right now*, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

NOT AT ALL
 SOMEWHAT
 MODERATELY SO
 VERY MUCH SO

- | | | | | |
|--|---|---|---|---|
| 1. I feel calm..... | 1 | 2 | 3 | 4 |
| 2. I feel secure | 1 | 2 | 3 | 4 |
| 3. I am tense | 1 | 2 | 3 | 4 |
| 4. I feel strained | 1 | 2 | 3 | 4 |
| 5. I feel at ease | 1 | 2 | 3 | 4 |
| 6. I feel upset | 1 | 2 | 3 | 4 |
| 7. I am presently worrying over possible misfortunes | 1 | 2 | 3 | 4 |
| 8. I feel satisfied | 1 | 2 | 3 | 4 |
| 9. I feel frightened | 1 | 2 | 3 | 4 |
| 10. I feel comfortable | 1 | 2 | 3 | 4 |
| 11. I feel self-confident..... | 1 | 2 | 3 | 4 |
| 12. I feel nervous | 1 | 2 | 3 | 4 |
| 13. I am jittery | 1 | 2 | 3 | 4 |
| 14. I feel indecisive..... | 1 | 2 | 3 | 4 |
| 15. I am relaxed | 1 | 2 | 3 | 4 |
| 16. I feel content | 1 | 2 | 3 | 4 |
| 17. I am worried | 1 | 2 | 3 | 4 |
| 18. I feel confused..... | 1 | 2 | 3 | 4 |
| 19. I feel steady..... | 1 | 2 | 3 | 4 |
| 20. I feel pleasant..... | 1 | 2 | 3 | 4 |

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Appendix E

Beck Depression Inventory-II

Name: _____ Student number: _____

Gender: _____

Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully, and then pick out the one statement in each group that best describes the way you have been feeling during the past two weeks, including today. Circle the number beside the statement that you have picked. If several statements in the group seem to apply equally well, circle the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleep Pattern) and Item 18 (Changes in Appetite).

<p>1. Sadness</p> <p>0 I do not feel sad.</p> <p>1 I feel sad much of the time.</p> <p>2 I am sad all of the time.</p> <p>3 I am so sad or unhappy that I can't stand it.</p> <p>2. Pessimism</p> <p>0 I am not discouraged about my future.</p> <p>1 I feel more discouraged about my future than I used to be.</p> <p>2 I do not expect things to work out for me.</p>	<p>6. Punishment Feelings</p> <p>0 I don't feel I am being punished.</p> <p>1 I feel I may be punished.</p> <p>2 I expect to be punished.</p> <p>3 I feel I am being punished.</p> <p>7. Self-Dislike</p> <p>0 I feel the same about myself as ever.</p> <p>1 I have lost confidence in myself.</p> <p>2 I am disappointed in myself.</p> <p>3 I dislike myself.</p> <p>8. Self-Criticalness</p>
--	---

<p>3 I feel my future is hopeless and will only get worse.</p> <p>3. Past Failure</p> <p>0 I do not feel like a failure</p> <p>1 I have failed more than I should have.</p> <p>2 As I look back, I see a lot of failures.</p> <p>3 I feel I am a total failure as a person.</p> <p>4. Loss of Pleasure</p> <p>0 I get as much pleasure as I ever did from the things I enjoy.</p> <p>1 I don't enjoy things as much as I used to.</p> <p>2 I get very little pleasure from the things I used to enjoy.</p> <p>3 I can't get any pleasure from the things I used to enjoy.</p> <p>5. Guilty Feelings</p> <p>0 I don't feel particularly guilty.</p> <p>1 I feel guilty over many things I have done or should have done</p> <p>2 I feel quite most of the time.</p> <p>3 I feel guilty all of the time.</p>	<p>0 I don't criticise or blame myself more than usual.</p> <p>1 I am more critical of myself than I used to be.</p> <p>2 I criticise myself for all my faults.</p> <p>3 I blame myself for everything bad that happens.</p> <p>9. Suicidal Thoughts or Wishes</p> <p>0 I don't have any thoughts of killing myself.</p> <p>1 I have thoughts of killing myself, but I would not carry them out.</p> <p>2 I would like to kill myself.</p> <p>3 I would kill myself if I had the chance</p> <p>10. Crying</p> <p>0 I don't cry any more than I used to.</p> <p>1 I cry more than I used to.</p> <p>2 I cry over every little thing.</p> <p>3 I feel like crying, but I can't.</p>
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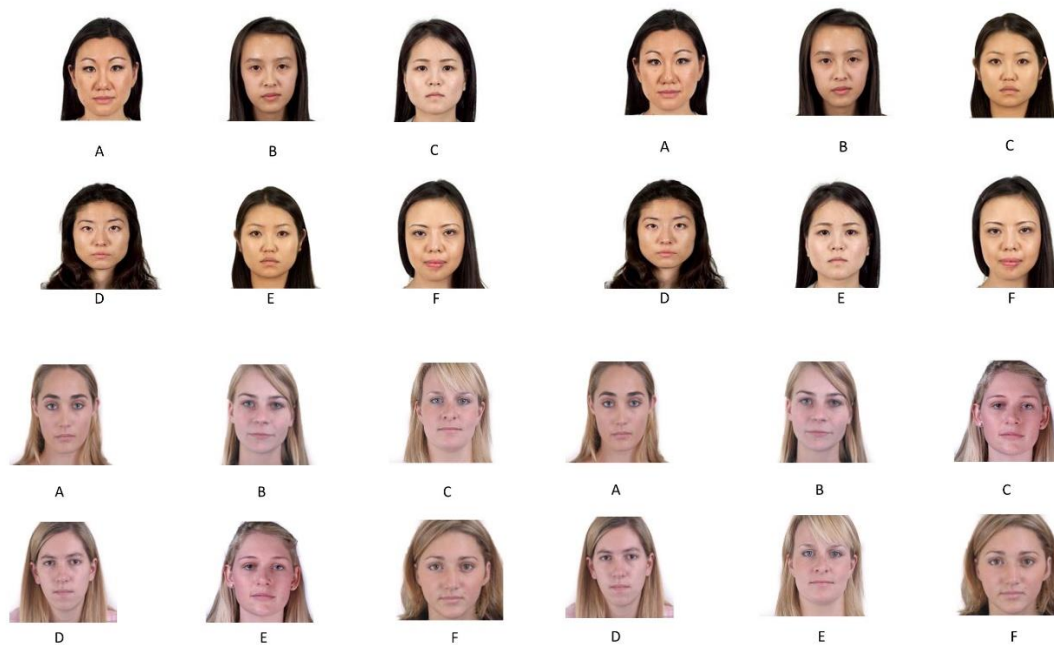
<p>11. Agitation</p> <p>0 I am no more restless or wound up than usual.</p> <p>1 I feel more restless or wound up than usual.</p> <p>2 I am so restless or agitated that it's hard to stay still.</p> <p>3 I am so restless or agitated that I have to keep moving or doing something.</p> <p>12. Loss of Interest</p> <p>0 I have not lost interest in other people or activities.</p> <p>1 I am less interested in other people or things than before.</p> <p>2 I have lost most of my interest in other people or things.</p> <p>3 It's hard to get interested in anything.</p> <p>13. Indecisiveness</p> <p>0 I make decisions as well as ever.</p> <p>1 I find it more difficult to make decisions than usual.</p> <p>2 I have much greater difficulty in making decisions than I used to.</p> <p>3 I have trouble making any decisions.</p> <p>14. Worthlessness</p>	<p>17. Irritability</p> <p>0 I am no more irritable than usual.</p> <p>1 I am more irritable than usual.</p> <p>2 I am much more irritable than usual.</p> <p>3 I am irritable all the time.</p> <p>18. Changes in Appetite</p> <p>0 I have not experienced any changes in my appetite</p> <p>1a My appetite is somewhat less than usual.</p> <p>1b My appetite is somewhat more than usual.</p> <p>2a My appetite is much less than usual.</p> <p>2b My appetite is much more than usual.</p> <p>3a I have no appetite at all.</p> <p>3b I crave food all the time.</p> <p>19. Concentration Difficulty</p> <p>0 I can concentrate as well as ever.</p> <p>1 I can't concentrate as well as usual.</p> <p>2 It's hard to keep my mind on anything for very long.</p> <p>3 I find I can't concentrate on anything.</p> <p>20. Tiredness or Fatigue</p>
--	--

<p>0 I do not feel I am worthless.</p> <p>1 I don't consider myself as worthwhile and useful as I used to be.</p> <p>2 I feel more worthless as compared to other people.</p> <p>3 I feel utterly worthless.</p>	<p>0 I am no more tired or fatigued than usual.</p> <p>1 I get more tired or fatigued more easily than usual.</p> <p>2 I am too tired or fatigued to do a lot of the things I used to do.</p> <p>3 I am too tired or fatigued to do most things I used to do.</p>
<p>15. Loss of Energy</p> <p>0 I have as much energy as ever.</p> <p>1 I have less energy than I used to have.</p> <p>2 I don't have enough energy to do very much.</p> <p>3 I don't have enough energy to do anything.</p>	<p>21. Loss of Interest in Sex</p> <p>0 I have not noticed any recent change in my interest in sex.</p> <p>1 I am less interested in sex than I used to be.</p> <p>2 I am much less interested in sex now.</p> <p>3 I have lost interest in sex completely.</p>
<p>16. Changes in Sleep Pattern</p> <p>0 I have not experienced any change in my sleeping pattern.</p> <p>1a I sleep somewhat more than usual.</p> <p>1b I sleep somewhat less than usual.</p> <p>2a I sleep a lot more than usual.</p> <p>2b I sleep a lot less than usual.</p> <p>3a I sleep most of the day.</p> <p>3b I wake up 1-2 hours early and can't get back to sleep.</p>	

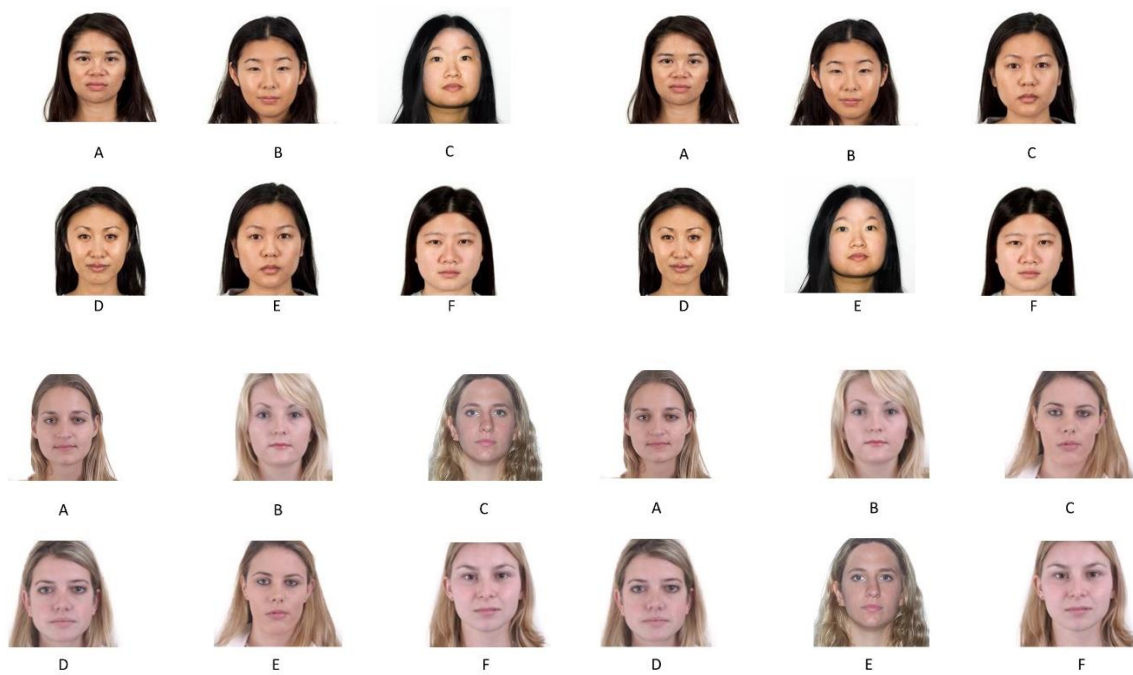
Appendix F

Line ups

TA Line ups for confederate 1 and 2



TP Line-ups for confederate 1 and 2 (Target in position C then E)



Appendix G
Ethical Clearance Form

UNIVERSITY OF CAPE TOWN



Department of Psychology

University of Cape Town Rondebosch 7701 South Africa
Telephone (021) 650 3417
Fax No. (021) 650 4104

25 July 2018

Milton Gering
Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Milton

I am pleased to inform you that ethical clearance has been given by an Ethics Review Committee of the Faculty of Humanities for your study, *The Effects of Stress and Depression on Eyewitness Memory*. The reference number is PSY2018-052.

I wish you all the best for your study.

Yours sincerely

A handwritten signature in cursive script, appearing to read 'Lauren Wild'.

Lauren Wild (PhD)
Associate Professor
Chair: Ethics Review Committee

University of Cape Town
PSYCHOLOGY DEPARTMENT
Upper Campus
Rondebosch

Appendix H
Email Template for Non-Eligible Students

Dear _____

Thank you so much for completing this questionnaire. I really appreciate you taking the time to try help me with my research. Unfortunately, you do not suit the study eligibility criteria at present.

According to your screening questionnaire you have scored highly on symptoms of anxiety, trauma or depression (this does not necessarily mean you have PTSD, anxiety or depression) but if you have often felt anxious or sad over the past 2 weeks or are feeling concerned recently or are concerned about an event that has occurred I recommend speaking to someone. Below is a list of free centres you can attend.

I hope you have a great evening

Kindest regards,

Milton Gering

Counselling Centres

UCT Student Wellness Counseling Services

Address

The Student Wellness Service

28 Rhodes Ave

Mowbray 7700

Tel: 021 650 1017 / 1020

Lifeline

Address

Telephone Counselling service

Tel: 021 461 1111

WhatsApp Call: 063 709 2620

FamSA (For Family, relationship or bereavement counselling)

9 Bowden Road, Observatory

Tel: +27 21 447 7951 / 082 231 0373

Appointments: +27 21 447 0170 / 082 231 4470

Fax: +27 21 447 0174

E-mail: famsa@famsawc.org.za

UCT 24 hour Student Careline

Tel: 0800 24 25 26 (Free from a Telkom line)

or SMS 31393 for a “call-me-back”

Appendix I
Informed Consent Document

University of Cape Town

Stress and Eyewitness Memory Study

Purpose

I am a UCT Psychology Honours student investigating the effect of stress on abstract problem solving.

Procedure

If you decide to participate in this study, you will be asked to complete questionnaires with some demographic and other information about yourself. You will then complete, stress induction technique, which may involve holding your hand in some cold water for no longer than 90 seconds at a time. After this you will be asked to complete another questionnaire and a cognitive test.

Possible Risks

This study will induce moderate acute stress. The risks of such acute stress are minimal and temporary. If you feel stress or discomfort after the experiment, please alert the researcher who will provide assistance.

Possible Benefits

If you complete the online questionnaires, you will receive 1 SRPP point. If you attend the lab session, you will receive a further 2 SRPP points.

Voluntary Participation

Participation in this study is completely voluntary. You are free to refuse to answer any question without giving reasons for your refusal. Your decision regarding participation in this study will not affect your grades or academic career. If you decide to participate, you are free to change your mind and stop

participation at any time without any negative consequences. You will still receive 1 SRPP point for every 30 minutes of participation.

Confidentiality

Information about you obtained for this study will be kept confidential. Your name, consent form and other identifying information will be kept in separate, locked file cabinet, and there will be no link between the consent form, questionnaires and cognitive tests. The results of the cognitive tests will not be available to your university or any current or future employers, nor will it be made available to anyone else. Any reports or publications about the study will not identify you or any other study participant.

Questions

If you have any study-related questions, problems or emergencies you can contact Milton Gering via email sent to grnmil001@myuct.ac.za or his supervisor on Colin.Tredoux@uct.ac.za

If you have questions about your rights as a study participant, or any comments or complaints about the study, please contact:

Rosalind Adams at the UCT Department of Psychology.

Phone:021 650 3417

Email: rosalind.adams@uct.ac.za

I have read the above and am satisfied with my understanding of the study and its possible benefits and risks. My questions about the study have been answered. I hereby voluntarily consent to participation in the research study as described.

Name of Participant

Signature of Participant

Date

Appendix J

Shibley-2

Instructions

Circle the word that has the same meaning as the one written in capital letters. If you want to change an answer, draw an X through your first answer and then circle your new choice. Please press hard when marking your responses.

Shibley-2

Vocabulary AutoScore™ Form

Walter C. Shibley, Ph.D., and
Christian P. Gruber, Ph.D.

Name: _____

Age: _____

Date: _____

Additional copies of this form (W-476A) may be purchased from WPS. Please contact us at 800-648-8857, Fax 310-478-7838, or www.wpspublish.com.

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Publishers and Distributors

- Example: LARGE red **big** silent wet
1. TALK draw eat speak sleep
 2. COUCH pin eraser sofa glass
 3. REMEMBER swim recall number plan
 4. PARDON forgive pound divide crash
 5. HIDEOUS silvery tilted young dreadful

 6. MASSIVE bright large speedy low
 7. PROBABLE likely portable friendly comprehensive
 8. IMPOSTOR conductor officer book pretender
 9. FASCINATE welcome fix stir enchant
 10. EVIDENT green obvious skeptical afraid

 11. NARRATE yield buy associate tell
 12. HAUL respond twist pull realize
 13. HILARITY laughter speed grace malice
 14. IGNORANT red sharp uninformed precise
 15. CAPTION drum ballast heading ape

 16. INDICATE defy excite signify bicker
 17. SOLEMN serious satisfying rough tremendous
 18. FORTIFY submerge strengthen vent deaden
 19. MERIT deserve distrust fight separate
 20. RENOWN length head fame loyalty

 21. FACILITATE turn help strip bewilder
 22. AMULET charm orphan dingo pond
 23. STERILE barren illegal helpless tart
 24. CORDIAL swift muddy leafy affable
 25. SQUANDER tease belittle slice waste

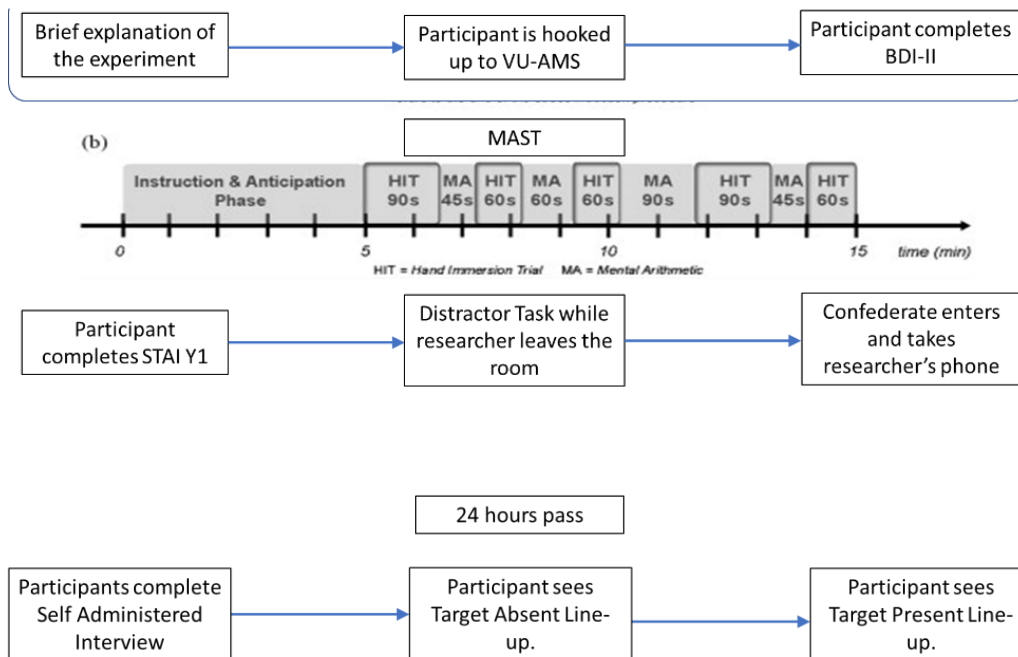
 26. SERRATED dried notched armed blunt
 27. PLAGIARIZE maintain intend revoke pilfer
 28. ORIFICE brush hole building lute
 29. PRISTINE vain sound unspoiled level
 30. INNOCUOUS powerful pure medicinal harmless

 31. JOCOSE humorous paltry fervid plain
 32. RUE deal lament dominate cure
 33. INEXORABLE untidy inviolable relentless sparse
 34. DIVEST dispossess intrude rally pledge
 35. MOLLIFY mitigate direct pertain abuse

 36. QUERULOUS maniacal curious devout complaining
 37. ABET waken ensue incite placate
 38. DESUETUDE disuse remonstrance corruption inanity
 39. PEREGRINATE contemplate mince solidify traverse
 40. QUOTIDIAN travesty everyday calculation promise

Appendix K

Schematic of Procedure



Appendix L

Debriefing Form

The physiological Effects of Stress and Depression

Debriefing Form

Thank you for participating in this research study.

This form provides you with information about the study in which you have just participated, and explains in full the methods of collection of data for this research study. The Principle Investigator (the person in charge of this research) or a representative of the Principle Investigator will also explain this study to you in full and answer your questions.

1. Name of Participant

2. Title of Research Study

The physiological Effects of Stress and Depression.

3. Principal Investigator and supervisor

Milton Gering, B.A. - Investigator

Colin Tredoux, Ph.D - Supervisor

Department of Psychology

Department of Psychology

University of Cape Town

University of Cape Town

grnmil001@myuct.ac.za

colin.tredoux@uct.ac.za

4. What is the purpose of this research study?

The purpose of this research study is to better understand how stress and depression interact in affecting eyewitness memory.

5. What was done during this research study?

During this study, you were required to complete an online questionnaire about your levels of anxiety and symptoms of past trauma. This should have taken 30 minutes and you will receive **1 SRPP** point. During the experiment you gave us some information about yourself, including current symptoms of depression. You then witnessed a mock crime and have been asked to give a statement, testing your memory of the event.

6. Was there any deception used in this research study?

Yes. You were not informed of the mock crime that took place. This was done to increase the ecological validity of the experiment as crimes tend to be unexpected. This experiment was investigating the effects of stress and depression on witness memory.

7. Is there anything further required of you?

Please do not disclose anything that happened during these research sessions to anyone else, as this may bias future participants and their performance. If you are still feeling stressed at the end of the research study, please inform me so that I can assist you. Tomorrow you will receive an email with the link to a feedback survey which you must complete to receive your SRPP points. Below are the details of some counselling services.

Counselling Centres

UCT Student Wellness

Address

The Student Wellness Service

28 Rhodes Ave

Mowbray 7700

Tel: 021 650 1017 / 1020

Lifeline

Address

Telephone Counselling service

Tel: 021 461 1111

WhatsApp Call: 063 709 2620

FamSA (For Family, relationship or bereavement counselling)

9 Bowden Road, Observatory

Tel: +27 21 447 7951 / 082 231 0373

Appointments: +27 21 447 0170 / 082 231 4470

Fax: +27 21 447 0174

E-mail: famsa@famsawc.org.za

Signatures

As a representative of this study, I have explained to the participant, in detail, the purpose, the procedures, and any deception used in this research study.

Signature of Person Obtaining Consent

Date

I have been informed, in detail, about this study's purpose, procedures, and deceptions. I have been given the opportunity to ask questions before I sign. By signing this form, I am not waiving any of my legal rights.

 Signature of Person Consenting

Date

Appendix M

Coding scheme

Events/10

Researcher excused himself to the bathroom and left	2 points
Confederate knocked on door	1 point
Entered and asked where the researcher was	2 points
Said she was a previous participant and that she left her phone behind	2 points
Picked up phone from Tupperware, stating it was hers	2 points
Left with phone or left phone on cooler	1 point

Location /10

Psychology building	1 point
Room name	1 point
Seated facing the door, researcher on the right	2 points
Room had a screen to the participants right	1 point
Equipment: VU-AMS, laptop, green cooler, blue Tupperware, note book	5 points

Description of confederate 1 /10

Female early 20's	2 points
Dark pants, dark shirt, dark jacket	2 points
Asian, dark hair, dark eyes	3 points
Small stature, average build	2 points
Standard South African accent	1 point

Description of Confederate 2 /10

Female early 20's	2 points
Dark pants, dark shirt, dark jacket	2 points
White, blond hair, blue eyes	3 points
Average height, slight build	2 points

English accent

1 point