The effects of stress on eyewitness memory and suspect identification in photographic lineups

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Abstract

Eyewitness memory refers to the information one retains after witnessing a crime or event of interest. Stress and arousal are two factors suggested to influence the accuracy of eyewitness memory and suspect identification when it is present during encoding. Although these two factors are suggested to have harmful effects on eyewitness memory and suspect identification, the literature reveals inconsistent findings. Knowledge in this area is crucial as it can assist in policy-making, legal cases and assessing the level of risk that is associated with the identification of perpetrators. Undergraduate psychology students served as participants (*n*=77). They were screened on anxiety and self-reported plagiarism history at the University of Cape Town. Participants were then randomly assigned to a control, medium-stress or high-stress group. Participants completed a writing task, three self-reported measures of affect, and were exposed to two different targets. One of the targets induced stress through a false plagiarism report, and the other debriefed the participants. A manipulation check indicated that stress was psychologically induced, but not physiologically induced. Results indicated that the medium-stress group performed more accurately when identifying the stress-inducing target in a lineup compared to control and high-stress groups. However, the same cannot be said for the neutral target as neither group performed significantly different from the others in suspect identification accuracy. Future research should focus on manufacturing realistic, stressful situations for participants in order to further our knowledge on the effects of stress on eyewitness memory and suspect identification.

Keywords: Eyewitness Memory; Suspect Identification; Face Recognition; Stress; VU-AMS; PANAS

An eyewitness is a bystander or victim who observes a crime or event of particular interest, which is a process that typically induces a level of stress (Aharonian & Bornstein, 2008; Hervé, Cooper & Yuille, 2012). Eyewitnesses may be called upon during a criminal investigation to identify the perpetrator of that crime in a lineup. Therefore, it is important to understand the influence that stress has on the accuracy of eyewitness memory and suspect identification. Stress is a factor of notable concern, as it may have potentially harmful effects on eyewitness memory and suspect identification accuracy. Mistaken eyewitnesses have been identified as the greatest contributor to false convictions, which highlights the importance of research on this topic (Garrett, 2011). Knowledge about eyewitness memory will not only assist in policy-making, legal cases and ensuring that innocent individuals are not falsely accused of criminal activity, but also in assessing the level of certainty associated with the identification of perpetrators. Therefore, the stress response and its impact on eyewitness memory and suspect identification when present during encoding will be critically discussed.

Stress refers to an adverse emotion that is accompanied by its subjective experience and a cascade of physiological changes (Aharonian & Bornstein, 2009). These changes include, but are not limited to: increased heartrate; increased muscle tone; increased arousal; increased skin conductance, and an increased respiratory rate (Charmandari, Tsigos & Chrousos, 2005; Deffenbacher, Bornstein, Penrod & McGorty, 2004). The psychological experience accompanying stress includes anxiety-related feelings and the perception that danger is imminent (Aharonian & Bornstein, 2009). The various cognitive and emotional changes that follow stress is known as the stress response. The stress response is suggested to fluctuate throughout the menstrual cycle, as changes in allopregnanolone influence the extent to which these alterations can occur (Ossewaarde et al., 2010). This response is triggered when an environmental or conditional demand surpasses the natural limits and regulatory capacity of an individual, which is almost always associated with the experience of a criminal event (Attwood, Penton-Voak, Burton & Munafo, 2013; Drexler & Wolf, 2017).

Although it may be intuitively assumed that memory is facilitated by greater levels of stress, it is possible that the inverse can occur. Attempts to understand the relationship between stress and eyewitness memory (i.e. the memory of felonious actions committed by perpetrators that are witnessed by bystanders and/or victims) have typically resulted in inconsistent findings (Hervé et al., 2012). Some research indicates that stress improves the accuracy of eyewitness memory and suspect identification, while others indicate that stress has no effect on the accuracy of eyewitness memory and suspect identification (Burke, Heuer & Reisburg, 1992; Christianson, Loftus, Hoffman & Loftus, 1991; Deffenbacher et al., 2004;

Heuer & Reisberg, 1990). However, there is a substantial portion of literature that suggests memory formation in eyewitnesses is negatively impacted by highly stressful events (Davis, Peterson, Wissman & Slater, 2019; Deffenbacher et al., 2004). The inconsistency of these findings may be partially explained by the varying degree of stress that each of the studies induced in their samples.

The Yerkes-Dodson law has been widely accepted as a model of the arousal-performance relationship (Yerkes & Dodson, 1908). This law illustrates how a stress hormone dose-response curve is useful in understanding how stress hormones impact memory (Teigan, 1994). Electrophysiological and behavioural studies have indicated that the shape of the curve is an inverted-U (see Figure 1), suggesting that exceptionally high and low levels of stress are detrimental to one's memory (Aharonian & Bornstein, 2008). The curve further suggests that memory performance improves as arousal increases until an optimal point (unknown, or hard to determine) is met, thereafter performance decreases considerably (Teigan, 1994). A moderate amount of stress would be considered conducive to an accurate eyewitness memory (Aharonian & Bornstein, 2008). Therefore, the effect that stress has on eyewitness memory will differ depending on the intensity of the stress and its positioning on the curve. This may partially explain the irregularity of the findings of the literature, as various studies are likely to induce different severities of stress.

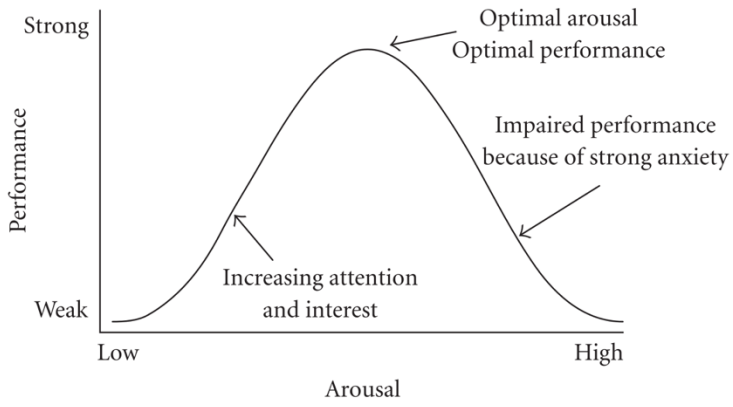

Figure 1. The Yerkes-Dodson Curve

Note. From "The temporal dynamics model of emotional memory processing: A synthesis on the neurobiological basis of stress-induced amnesia, flashbulb and traumatic memories, and the Yerkes-Dodson law," by D. M. Diamond, A. M. Campbell, C. R. Park, J. Halonen, & P. R. Zoladz, 2007, *Neural Plasticity, 33.* Copyright [2007] by David Diamond and colleagues. Reprinted with permission.

A meta-analysis conducted by Deffenbacher and colleagues (2004) focused on the effects of high stress levels on the eyewitness' encoding of a crime. Their investigation centered around high-stress levels being of particular interest to forensic fields, as witnessing a crime is thought to almost always induce a stress response. Their conclusion indicated that high stress levels negatively impact the eyewitness' performance at suspect identification. This conclusion is likely to remain intact for the foreseeable future, as its findings are robust (Deffenbacher et al., 2004). Deffenbacher and colleagues (2004) further suggested that greater levels of stress are consistent with a greater inaccuracy in eyewitness responses to identification procedures where the perpetrator is present. They argued that stress causes a reduction in the veridicality of the witness' memory for details of the crime and perpetrator. However, the Yerkes-Dodson curve is non-linear, and so the simple increasing function suggested here by Deffenbacher and colleagues (2004) cannot be correct.

The studies discussed up to this point are not free of limitations, and it is important that they are acknowledged. A study conducted by Sauerland and colleagues (2016) utilized the Maastricht Acute Stress Test (MAST) to induce stress. The stress group submerged their hand in cold water and performed a complicated mental arithmetic task. The control group did the same, but room-temperature water and a simple mental arithmetic task was used. A mock crime was staged after participants' exposure to the stressor. The perpetrator of that crime was to be identified in a target-absent (TA) or target-present (TP) lineup one week after exposure. Sauerland and colleagues (2016) found that stress did not impact identification accuracy, as both groups performed the same despite their different stress conditions. The overarching limitation in this study is that stress was induced prior to the encoding of the perpetrator. This highlights the importance of when stress induction occurs in relation to facial encoding, as this may influence eyewitness memory and suspect identification performance (Davis et al., 2019). Stress is typically induced during a crime, and not before. Therefore, research should focus on inducing stress at the same time as facial encoding in order for its findings to be directly relevant to the eyewitness field.

Davis and colleagues (2019) attempted to rectify the issue of when stress induction occurs in relation to facial encoding. In their experiment, they induced stress in their participants via the cold pressor test, where participants must submerge their hand in a bowl of cold water. Participants in the control group also submerge their hand, but the water is room temperature. While the cold pressor test was being done, participants were shown a random selection of 30 faces for one second with a 500-millisecond interval between each photo. After all of the 30 faces had been viewed, the participants removed their hand from the

bowl of water and then completed a sudoku puzzle. A self-paced old-new recognition task was completed. Davis and colleagues (2019) found a large effect between stress and control groups, and concluded that stress reduces the accuracy of eyewitness identification performance.

An overarching limitation in their study presents a challenge to the field of research itself. The manipulation of stress in the two previously mentioned studies have no relation to the face that is encoded. Whereas in a real crime, the perpetrator becomes the source of stress and arousal to the witness. Stress induction and facial encoding are intricately linked in real-world circumstances, which should be central to research in the eyewitness field. However, this challenge is further compounded by how much stress a researcher can ethically induce in an experiment. Therefore, one observes how different induction techniques (i.e. the MAST, or cold pressor test) are being utilized in eyewitness research because they are effective and highly arousing. However, many of these techniques lack personal-relevance to its participants, which influences the attention, behaviour and stress response the technique triggers in them (Aharonian & Bornstein, 2008). All of these factors impact performance in eyewitness memory and suspect identification, which should encourage researchers to create personally-relevant stress induction techniques.

Morgan III and colleagues (2007) conducted a study that overcame both of these obstacles. The participants used were already enrolled in a military survival school and they role-played as a prisoner of war in a camp site, and were also exposed to sleep and partial food deprivation. After hours of isolation, the participants were then interrogated for 30 minutes in a well-lit room by an unfamiliar survival school instructor. The interrogation scenario served as an opportunity for (a) the participants to encode the instructor's face, (b) a personally relevant and highly arousing stress to be induced by the person-to-be-remembered, that is, the instructor after leaving the camp. Participants completed the Weschler Face Test and a TA or TP lineup after leaving the camp. The primary finding of their study was that stress does impact human facial recognition abilities. However, Morgan III and colleagues (2007) found a significant relationship present between the ability to recognize faces on standardized tests with the ability to perform in eyewitness identification processes. The findings of this study suggest that some people may possess an underlying trait for remembering faces, which allows them to accurately identify faces encoded under personally relevant, stressful circumstances (Morgan III et al., 2007). This study is limited in its reliability. A part of the procedure is classified, which prevents other researchers from

following Morgan III and colleagues' (2007) methodology to potentially replicate their findings.

Morgan III and colleagues' (2007) study provides an exaggerated example of what research in this field needs to aspire to. The stress should be induced by the perpetrator who will be encoded and later recalled by participants via lineups. The stress induced should further be personally-relevant and highly arousing for the participant. The Yerkes-Dodson law indicates that very low and very high levels of stress are detrimental to one's memory, but there is an unknown optimal level for accurate encoding and recall in-between these points (see Figure 1 above). Deffenbacher and colleagues' (2004) meta-analysis confirms the hypothesis that high stress levels are detrimental to the accuracy of eyewitness' performance, with specific reference to suspect identification. The Innocence Project (2019) indicated that 70% of their exonerated cases were convicted on the basis of false eyewitness identifications. Therefore, research in this field is imperative, as it may assist in amending the courts' reliance on eyewitness testimonies. This study will contribute to the literature currently present on this topic and will assist in replicating previous findings to strengthen the knowledge we possess on the relationship between stress, eyewitness memory and suspect identification.

Rationale, Research Aims, and Hypotheses

The current literature on the effects of stress on eyewitness memory has proven difficult to navigate, as conflicting evidence leaves one uncertain over how the stress response influences memory and suspect identification performance. Previous studies have tended towards inducing two levels of stress (i.e. presence and absence), inducing personally irrelevant stress, and separating the source of stress from the face being encoded. Therefore, this study aims to induce varying levels of stress in participants to determine what effect stress has on eyewitness memory and lineup accuracy. Although this research is centered within the eyewitness discipline, this study will not include a criminal element: instead, this study aims to manufacture a stressful situation with three varying levels of intensity that is personally-relevant to its participants, which is something not typically done in the eyewitness field. This study further aims to ensure that the source of stress is linked to the face that is being encoded in an attempt to replicate a real-life situation. Additionally, participants will be exposed to two different targets whom they must recognize at a later stage: the first target will induce a varying level of stress on participants, while the second

target will perform a neutral role. The difference in the targets' role will provide insight into the effects that stress has on the eyewitness' accuracy in suspect identification for a stress-inducing and a neutral face. Knowledge in this area may assist in assessing the level of risk associated with eyewitness identifications, as well as the credibility that is placed on this during legal proceedings. Based on the literature reviewed, the following hypotheses were formulated:

1) The target inducing the stress will be less likely to be accurately identified in lineups compared to the target not inducing the stress.
2) Participants that are exposed to moderate levels of stress will be more likely to accurately respond to lineups than participants exposed to low- or high- levels of stress.
3) The high-stress group is expected to achieve lower lineup accuracy responses compared to control and medium-stress groups.

Method

Design, Variables, and Setting

This study utilized an experimental design to explore the effect that induced stress has on suspect identification accuracy. The independent variable was stress, which had three different levels: a control group with no intentional stress induction; one experimental group with a moderate stress induction; and a second experimental group with a high stress induction. The dependent variable was accuracy in responses to TA and TP photographic lineups: one for the stress-inducing target, and one for the neutral target. The study was conducted in the ACSENT laboratory in the Department of Psychology at the University of Cape Town (UCT).

Participants

Recruitment. Participants were recruited from the Student Research Participation Program (SRPP) overseen by UCT's Department of Psychology. This is a form of convenience sampling that allows the departments' researchers to connect with undergraduate students. Prior to participation, an announcement posted to the program's online portal, Vula, invited students to participate in a short online survey (see Appendix A). Of the participants who responded to the survey (n = 266), 190 participants were invited to take part in the laboratory phase of the study after screening the survey responses.

Exclusion criteria. Students were excluded if they had a diagnosed psychiatric condition relating to stress, trauma, anxiety or depression. This was done to prevent any severe stress response that may have been induced during the study, such as panic or anxiety attacks. Students who had recently sustained a head injury that resulted in a loss of consciousness were also excluded, as to avoid the difficulty in concentration, apathy and anxiety that may subsequently follow this injury (Ryan & Warden, 2003). The survey completed online assessed the students' anxiety level using the Beck Anxiety Inventory (BAI, see Appendix B) as well as their experience in a list of varied stress-related scenarios (see Appendix C). Students with a score of 36 or above on the BAI were excluded from the study, as this level of anxiety might be considered potentially concerning (Beck, Brown, Epstein & Steer, 1988). Since the experiment employed a false plagiarism report as the stressor, students who had a history of plagiarism at UCT were excluded from the study. Question four in the list of varied stress-related scenarios asked whether participants had received an informal and/or formal warning for plagiarism at UCT. Students answering 'yes' to this question were screened out of the study. Students not meeting the study's criteria were notified via email (see Appendix D).

Final sample. Undergraduates enrolled in a psychology course at UCT completed the laboratory phase of this study (n = 89). However, only 77 participants were included in the analysis. Participants were excluded from the analysis if they knew a target or reported having trouble recognizing faces.

Measures and Materials

Beck Anxiety Inventory (BAI). The BAI is a self-reported measure that determines whether anxiety-related symptoms experienced within the past month of the respondent's life is possibly indicative of a clinical condition (see Appendix B). The 21-item measure has a high internal consistency (a = .92) and test-retest reliability (a = .75) (Beck et al., 1988). The BAI has been used extensively in published studies to measure anxiety in South African populations (LeRoux & Kemp, 2009; Banjies, Kagee, McGowan & Steel, 2016; Casale, Wild, Cluver & Kuo, 2014).

Questionnaire relating to previous stress-related experiences. The stress induction technique employed in this study centered around a false plagiarism report. Therefore, knowledge on potential participants' plagiarism history at UCT needed to be gained. The stress manipulation would not be as effective if participants had already been notified of their plagiarism offence or were asked about it directly. Therefore, a list of varied questions relating to previous exposure to potentially stressful situations was constructed (see Appendix

C). Question four acted as a hidden exclusionary criterion, as it asked whether students had a formal and/or informal warning for plagiarism at UCT. If the student answered 'yes' to this question, they were excluded from participating in the study's laboratory session. None of the other questions asked were relevant to the study.

The Vrije Universiteit Ambulatory Monitoring System, version 5fs (VU-AMS; Vrije Universiteit, Amsterdam, Holland). The VU-AMS measures heart rate and skin conductance, which are some of the physiological responses involved in stress. Both of these factors have been found to change in a particular direction after the release of stress hormones (Charmandari et al., 2005; Dickerson & Kemeny, 2004; Lin, Lin, Lin & Huang, 2011). The VU-AMS device is portable, easy to administer and non-invasive. One participant per session was attached to the VU-AMS device, and their heart rate was continuously recorded throughout this session. Skin conductance recordings were not taken, as the monitors interfered with the participants' ability to complete one of the study's tasks (i.e. typing on a computer keyboard for 10 minutes).

The Positive and Negative Affect Schedule (PANAS). This self-report schedule allowed participants to rate how they felt on 20 different positive and negative emotions (see Appendix E). Participants were instructed to rate each of the questionnaire measures according to how they felt in that moment. The scale ranges from one to five, and the emotion intensity increases as the numbers do. The PANAS has a high internal consistency for positive affect (a = .89) and negative affect (a = .85) (Watson, Clark & Tellegen, 1988). The correlation between these two scales is relatively low, as positive and negative affect account for about 1-5% of variance in each other (Watson et al., 1988). Van Zyl and Rothmann (2012) administered the PANAS in South African tertiary institutions and found it produced high reliability scores in both positive (a = .89) and negative affect (a = .83).

Lineups. TA and TP lineups were constructed for each target (see Appendix F). All of the lineups consisted of six different faces photographed from the neck upwards against a pale grey background. Each individual in the lineup was wearing a black t-shirt. The photographs were assembled into two rows of three faces each, where each face was labelled from one to six. 11 Innocent individuals placed in the lineup (i.e. foils) were obtained from a database of photographs curated by Professor Colin Tredoux (Lindsay & Wells, 1985). Description-matched lineups were constructed to ensure that each targets' general physical features varied somewhat (Wells, Seelau, Rydell & Luus, 1994 as cited in McQuiston-Surrett, Malpass & Tredoux, 2006). The targets' photographs were placed in either position

two or six on the TP lineup, as to control for order and position effects (McQuiston-Surrett et al., 2006). The lineups provided to participants were in colour.

Procedure

Ethical clearance was obtained from the Ethics Committee through the Department of Psychology at UCT (see Appendix G).

Screening phase. Students were screened out of laboratory participation depending on their responses to an online survey. The survey consisted of the BAI and a questionnaire concerning past stress-related situations participants may have experienced (see Appendix B and C). Students received one SRPP point for completing this phase. Individuals who received a high score on the BAI (i.e. 36 or above) or answered 'yes' to having a history of plagiarism at UCT on the random questionnaire were excluded from laboratory participation. These students received an email to inform them of this exclusion (see Appendix D).

Laboratory phase. Each participant chose a convenient group session to complete this phase of the study via an online booking platform called Doodle (https://doodle.com/poll/5ezzrwxiw5mx3ivm). Each group contained a maximum of 10 participants. One of them would volunteer to wear the VU-AMS. Each group had a different level of stress: one without stress, one with moderate stress, and one with high stress.

Upon arrival at the laboratory, participants were seated in front of a computer with three different forms: a consent form (see Appendix H), a demographic information sheet (see Appendix I), and a PANAS (see Appendix E). Each participant was randomly assigned a participant number and was instructed to put this on all the forms received throughout the session. Once the forms were completed, the volunteer participant attached themselves to the VU-AMS device according to the researcher's instructions. The researcher restated the consent form and mentioned to participants that the study concerned the effects of stress on academic writing. Each participant then wrote their name, surname, and student number on a small blank sheet and handed it to the researcher.

Participants were told that while they completed task one, a research assistant would be checking their plagiarism history at UCT according to the details provided on the small sheet they had just handed to the researcher. Participants were briefed on task one: a reading extract (see Appendix J) on which the writing task was based. The task was to be completed in a Word document on the computer in front of them. Each stress group received different instructions on task one: group one directly copied the extract, group two summarized it, and group three summarized the extract but were told that it would be marked and compared to the rest of the group in that session. Task one was completed in 10 minutes.

The first target was then introduced by the researcher. The target came out of a curtained area in the room and delivered a false plagiarism report: group one was told their submissions were plagiarism-free; group two was sternly told that plagiarism was present in some of the submissions but no further action was to be taken; and group three was sternly told that plagiarism was present, that participants would be identified on their way out of the session, and that they were to appear in the disciplinary tribunal to plead their case at a later date. Target one then went back into the curtained area after one minute and 30 seconds of exposure and interaction with participants.

Participants then completed a second PANAS. The 20 PANAS items had been ordered differently in all of the forms to reduce the practice effect. The researcher then informed participants that the plagiarism report was false before giving them a distractor task. Task two asked participants to write down as many words from the PANAS that they could remember in two minutes.

The second target was then introduced by the researcher. The target came out of a curtained area in the room and debriefed the participants on what they had done, the risks, the benefits and the point of research in the eyewitness field. The target then went back into the curtained area after one minute and 30 seconds of exposure and interaction with participants. The roles of the targets were counter-balanced across all groups and sessions to prevent the possibility of certain facial characteristics making one target more memorable than the other. The researcher further debriefed participants and elaborated on the deceptive element of the study. Participants were told they would be required to identify the two targets in a photographic lineup the following day. Participants completed a debriefing form (see Appendix K), a third PANAS, and were encouraged to ask any questions they might have had before leaving the study.

Each group was emailed a copy of the debriefing form and a link to two photographic lineups 24-hours after laboratory participation. Participants were instructed to identify the two targets they were exposed to the previous day by indicating their number on the lineup. Participants were further given the option to indicate if they did not know if the target was present, or to indicate that the target was not present in the lineup. The link contained a TA lineup for one of the targets, and a TP lineup for the second target. Participants always saw a TA and TP lineup, but never two TP lineups or two TA lineups. There were four different versions of lineup combinations that participants could receive, as each target had a TA, TP in position two, and TP in position six lineup (see Appendix F). Students received two SRPP points for completing this phase.

Data Management and Statistical Analysis

Participants' data was captured according to their randomly assigned participant number, so that their personal information remained confidential. Data was captured using Microsoft Excel, and analysed in both SPSS (Version 25) and R (Version 3.6.1). Data is available upon request, and is being stored in an encrypted folder.

Heart rate (HR) measurements were sampled at three different points: five minutes before stress induction to establish a baseline; two minutes during stress exposure; and five minutes after stress induction to observe a return to baseline. The VU-AMS data for HR was obtained via VU-DAMS (Version 4.0). Two separate one-way analyses of variance (ANOVA) were conducted on HR. The first ANOVA aimed to determine whether stress was physiologically induced, and compared the change in HR in the first and second measurement between groups. The second ANOVA aimed to determine whether HR was relatively similar in the first and last measurement between groups, which would indicate that participants' HR returned to baseline.

The scores assigned to 10 negative affect measures (i.e. distress, guilty, hostile, irritable, ashamed, upset, scared, nervous, jittery, and afraid) were totalled for each PANAS completed. Therefore, each participant had a total negative affect score for three different intervals: one prior to stress exposure, one directly after stress exposure, and one a while after stress exposure. A 3 x 3 mixed designs ANOVA was conducted in SPSS to ascertain whether a significant interaction occurred between the three stress groups at the different time intervals in self-report measures of negative affect. Furthermore, pairwise comparisons were run for negative affect measurements taken directly after the stressor.

Four different chi-square tests were run: each target had a test run on their TA and TP lineup responses. Once the raw data for lineup responses had been tabulated, the variables for each target lineup were reduced and coded as dichotomous variables. Therefore, TA and TP lineup responses were either coded as 'accurate' or 'inaccurate' (i.e. correct rejections in TA lineups and correct identifications in TP lineups were coded as accurate). It is important to note that 'don't know' responses were coded as 'inaccurate' for lineups. A separate logistic regression was then run for each target in SPSS and R to ascertain whether group status predicted accuracy in suspect identification.

Results

Manipulation check

Physiological measures. HR was obtained and analysed from 10 participants: three in the control group; three in the medium-stress group; and four in the high-stress group. The mean values (see Table 1) seem to indicate that HR was higher at baseline level than during stress exposure. The mean values further indicate that HR was higher during stress exposure than during post-stress. The first one-way ANOVA that compared the change in HR from baseline to stress induction between the three stress groups was not significant, F (2,7) = .63, p = .63, d = .15. This suggests that there was no significant increase or decrease in HR between these two measurements for all of the stress groups. The second one-way ANOVA that compared the change in HR from baseline to post-stress between the groups was not significant, F (2,7) = .09, p = .918, d = .02. This suggests that HR remained relatively similar in pre-stress and post-stress measurements.

Table 1

Descriptive statistics for HR

HR change	Group	Mean	Std. Deviation	n
Baseline to stress induction	Control	3.75	.22	3
	Medium-stress	4.38	1.02	3
	High-stress	2.73	2.88	4
	Total	3.53	1.89	10
Stress induction to post-stress	Control	1.31	1.86	3
	Medium-stress	.34	3.93	3
	High-stress	1.23	4.78	4
	Total	.99	3.47	10

Self-report measures. The PANAS was administered at three different points throughout the session: one prior to stress induction; one directly after stress induction; and one about 10 minutes after stress induction. The total negative affect score for each PANAS was captured for 77 participants: 31 in the control group, 25 in the medium-stress group, and 21 in the high-stress group. The descriptive statistics revealed that mean negative affect

scores increased as stress induction increased during the second PANAS measurement (see Table 2).

All assumptions for the 3 x 3 mixed designs ANOVA were met. The second PANAS measurement is bordering on violating the homogeneity of variance assumption according to Levene's test, $F = 3.09$, $p = .051$. However, no adjustments were made to the degrees of freedom, as the statistic was considered non-significant. A main effect for time was observed, F (2,148) = 28.08, $p < .001$, $d = .28$, but not for group, F (2,74) = .49, $p = .617$, $d = .01$. A significant interaction between time x group was observed (see Figure 2), as F (4,148) = 6.27, $p < .001$, $d = .15$. Post-hoc comparisons revealed that there was no statistically significant difference between the three stress groups at 'pre-stress' and 'post-stress' time points, indicating that the groups performed equivalently. However, at the stress induction time-point the high-stress group ($M = 19.81$; $SD = 7.97$) a significantly greater negative affect compared to the control group ($M = 14.58$; $SD = 6.14$). The difference in negative affect reports between the medium-stress and high-stress group ($p = .263$), and between the control and medium-stress group ($p = .841$) were not significantly different.

Table 2

Descriptive statistics for negative affect self-report measures

	Group	Mean	Std. Deviation	*n*
Pre-stress	Control	14.87	6.09	31
	Medium-stress	14.96	4.33	25
	High-stress	13.67	3.69	21
	Total	14.57	4.94	77
Stress	Control	14.58	6.14	31
	Medium-stress	16.48	5.47	25
	High-stress	19.81	7.97	21
	Total	16.62	6.75	77
Post-stress	Control	12.84	5.11	31
	Medium-stress	12.64	4.14	25
	High-stress	12.57	2.99	21
	Total	12.70	4.25	77

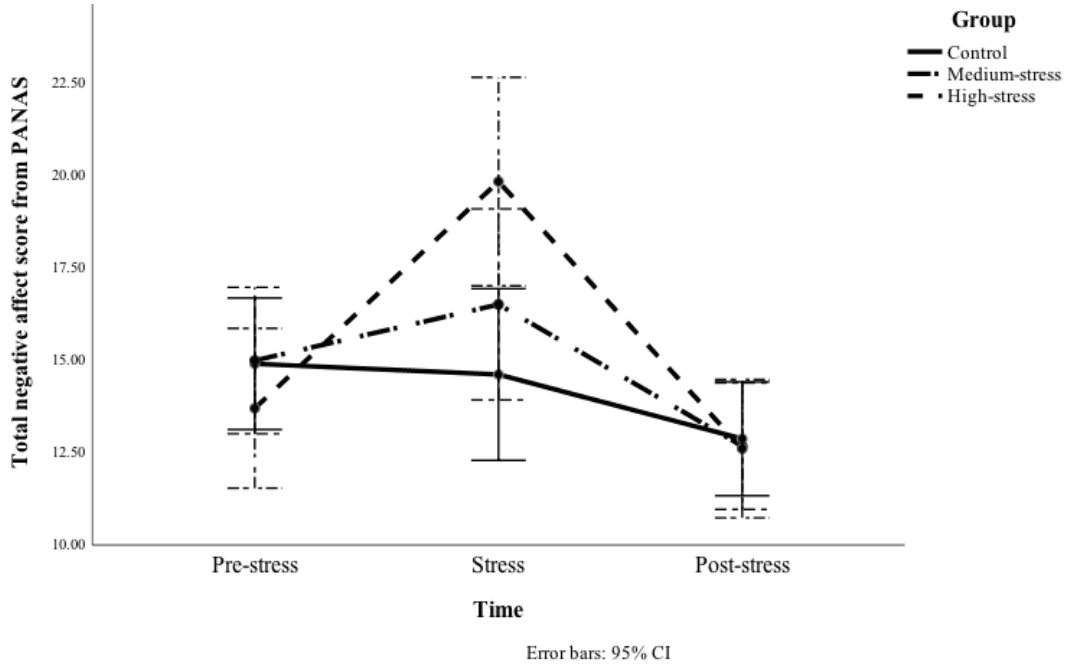

Figure 2. Time x group interaction of total negative affect scores from the PANAS

Raw Data Summary

None of the chi-square tests reveal significant findings. However, the performance of each group can still be understood through its results. The difference in stress group performance is most notable in TA lineups: the majority of the control group either correctly rejected the stress-inducing target or identified an innocent foil (i.e. false alarm), the majority of the medium-stress group correctly rejected the stress-inducing target, and the majority of the high-stress group identified an innocent foil instead of the stress-inducing target. Furthermore, the majority of the control group identified an innocent foil instead of the neutral target, the majority of the medium-stress group correctly rejected the neutral target, and the majority of the high-stress group either correctly rejected the neutral target or identified an innocent foil. However, the majority of all stress groups hit the stress-inducing and neutral target in TP lineups.

Table 3

Chi-square results for TA and TP lineup responses for the stress-inducing and neutral target

Variable	Group			*t*	*p*
	Control (*n* = 36)	Medium Stress (*n* = 28)	High Stress (*n* = 24)		
Target (stress)					
TP				7.64	.265
Hit	71.4%	76.5%	50.0%		
Miss	14.3%	17.6%	33.3%		
False rejection	.0	5.9%	16.7%		
Don't know	14.3%	.0	.0		
TA				6.19	.186
Correct rejection	43.5%	85.7%	33.3%		
False alarm	43.5%	14.3%	66.7%		
Don't know	13.0%	.0	.0		
Target (no stress)					
TP				4.33	.363
Hit	65.7%	85.7%	66.7%		
Miss	13.0%	0.0	33.3%		
False rejection	21.7%	14.3%	.0		
Don't know	.0	.0	.0		
TA				6.89	.142
Correct rejection	28.6%	64.7%	41.7%		
False alarm	71.4%	17.6%	41.7%		
Don't know	.0	17.6%	16.7%		

Hypothesis 1: The target inducing the stress will be less likely to be accurately identified in lineups compared to the target not inducing the stress.

I hypothesized that the accuracy in lineup response for the target inducing the stress would be worse than for the neutral target. Data from 72 participants was used: 30 in the control group; 24 in the medium-stress group; and 18 in the high-stress group. A chi-square test was run to determine if the stress-inducing target received a greater inaccuracy in lineup responses compared to the neutral target. All assumptions for the analysis was met. The test

indicated that there was no significant difference in lineup accuracy between the targets (see Figure 3), as t (1) = .029, p = .433. Therefore, the hypothesis was not confirmed in this study.

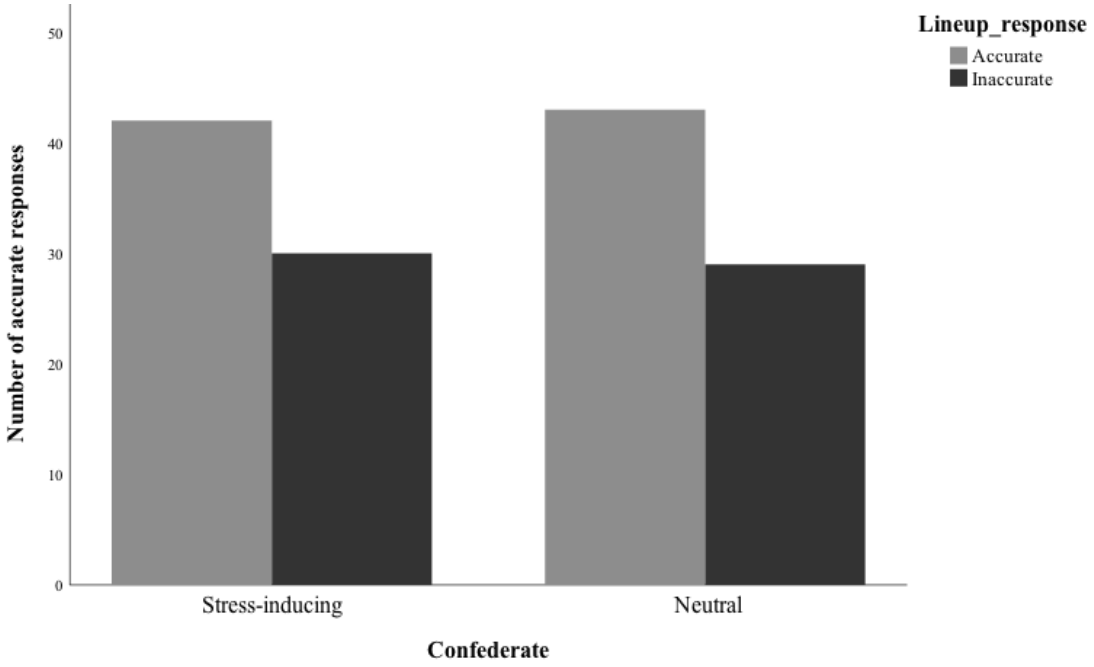

Figure 3. A bar chart indicating the number of accurate and inaccurate responses for both targets

Hypothesis 2: Participants that are exposed to moderate levels of stress will be more likely to accurately respond to lineups than participants exposed to low- or high- levels of stress.

Participants who were exposed to moderate levels of stress were hypothesized to be more accurate in lineup responses compared to participants in control or high-stress groups. A logistic regression was run for each target. Data from 72 participants was used to determine which group performed more accurately for target one and two: 30 in the control group; 24 in the medium-stress group; and 18 in the high-stress group. All assumptions for the analyses were met.

Target one's model found the group covariate to explain 12% of the variance in lineup accuracy. However, this percentage should be interpreted with caution, as it represents a Cragg-Uhler value. The logistic regression, t (2) = 6.92, p = .032, indicated that the medium-stress group (p = .032) performed significantly better than the control group in suspect identification. The regression further indicated that the high-stress group (p = .709) performed similarly to the control group, and thus performed significantly worse than the medium-stress group in suspect identification. The Yerkes-Dodson law (Teigan, 1994)

suggests the relationship between stress and memory performance is not linear, therefore a second analysis was run to observe how the data would respond to a polynomial logistic regression. This regression coded 'group' as a parabolic parameter, which indicated a greater difference in statistical significance between the three stress groups than the previous model, t (2) = 6.92, p = .032. The medium-stress group (p = .013) was significantly more accurate in lineup responses compared to the high-stress group. The high-stress group (p = .094) performed similarly in lineup accuracy to the control group. Furthermore, the medium-stress group is about six times more likely to accurately identify a perpetrator in suspect identification procedures compared to control or high-stress groups (see Table 4).

Target two's model found group, age and sex to explain 8% of the variance in lineup accuracy. However, we are again reminded to interpret this with caution, as it represents a Cragg-Uhler value. The logistic regression, t (3) = 4.15, p = .25, indicated that none of the covariates were significant contributors to the model (see Table 5). Furthermore, neither group performed significantly better than any of the others in suspect identification accuracy.

The medium-stress group did perform more accurately in suspect identification compared to control and high-stress groups for the stress-inducing target. However, no difference in group performance was observed for the neutral target. Therefore, the hypothesis is confirmed in this study.

Table 4

Polynomial logistic regression output for accuracy in lineup responses for the stress-inducing target

Group	Est.	Confidence intervals		p
		2.5%	97.5%	
Control	.13	-4.01	4.28	.95
Medium-stress	5.91	1.23	10.59	.01

Note. Control and medium-stress groups are being compared to the high-stress group in the model. In other words, the coefficient for control is in fact identification accuracy for the control group compared to the high-stress group.

Table 5

Logistic regression output for accuracy in lineup response for the neutral target

Covariate	Est.	Confidence intervals		p
		2.5%	97.5%	
Group	.04	-.56	.65	1.00
Age	-.30	-.69	.08	.13
Sex	-.52	-1.83	.78	.43

Hypothesis 3: The high-stress group is expected to achieve lower lineup accuracy responses compared to the control or medium-stress group.

Participants in the high-stress group were expected to perform worse in suspect identification accuracy compared to the control and medium-stress group. The logistic regression for target one, t (2) = 6.92, p = .032, previously discussed indicates that there was no significant difference in performance accuracy between the control and high-stress group (p = .709). However, the high-stress group did perform significantly worse than the medium-stress group in suspect identification (p = .032)

Therefore, the hypothesis is partly confirmed, as the high-stress group did perform more inaccurately in suspect identification compared to the medium-stress group. However, the high-stress group did not perform more inaccurately in suspect identification compared to the control group.

Discussion

This study sought to investigate the effects of stress on eyewitness accuracy in suspect identification. Overall, the findings of this study seem promising as they support the century-old claim of a negative parabolic relationship between stress and accuracy. Furthermore, this relationship is only observed for the stress-inducing target, and not for the neutral target.

Studies of this kind generally rely on standardized tests to induce stress, such as the MAST or cold-pressor test (Davis et al., 2019; Sauerland et al., 2016). However, the present study adopted a novel approach of manufacturing a real-life situation where stress was induced. This decision sought to combine the face that participants encoded as the source of stress, as it seems to present a more logical approach to combining stress and eyewitness memory in research. Although standardized tests are effective, they do not seem to capture

the complex interactions that occur internally when a person feels threatened or stressed by another. However, a limitation in the manufacturing approach was revealed in the physiological data, as the manipulation check showed HR to have no significant difference between the groups. In contrast, the self-reports of negative affect indicated that significant differences occurred between the control and high-stress group, but not between medium and high stress group.

The lack of physiological response to the stressor combined with a self-reported response may be interpreted in two different ways. The first explanation is that there was simply an insufficient amount of physiological data recorded. This limits the study because it may have caused the lack of significant differences observed between the stress groups. Therefore, the study would have benefitted from increasing the number of physiological recordings taken. The second explanation is to be interpreted with caution: it suggests an activation of the sympathetic-adrenal-medullary (SAM) system occurred, but an activation of the hypothalamus-pituitary-adrenal (HPA) system did not. There are typically two responses involved in stress: the SAM axis which produces fast, fleeting changes, and the HPA axis which produces delayed, enduring effects (Cohen, Janicki-Deverts & Miller, 2007; Pietromonaco & Powers, 2015). The stress manipulation in this study may have induced a short-term SAM response, but not a long-term HPA response. The activation of the latter is dependent on the type of stressor, its duration and severity (Drexler & Wolf, 2017). Therefore, the stress manipulation in this study may have benefitted from a greater intensity and strength, as this may have triggered a response in the HPA axis. It is possible that some participants did not feel personally threatened by the plagiarism commentary, that some participants knew they had a plagiarism-free record, or that some participants were simply not paying enough attention. This may pose a challenge to research conducted in stress and eyewitness memory, as it proves difficult to ethically induce a realistic stressor that triggers a SAM- and HPA-axis response.

The first prediction of the study was that the target inducing the stress was less likely to be accurately identified in lineups compared to the neutral target. This hypothesis was formulated on the premise that stressful encoding conditions generally impair recognition performance (Davis et al., 2019; Morgan III et al., 2004; Sauerland et al., 2016). However, the chi-square test indicated that there was no significant difference in lineup accuracy between the targets. In part, this may have occurred due to the short time in-between participants' exposure to each target. There was a brief period of about 3-4 minutes separating exposure to the targets. However, this is not to be interpreted as a limitation in the

study. The logistic regression for the stress-inducing target revealed a negative parabolic relationship between stress and suspect identification accuracy, but the same was not observed for the neutral target. This suggests that although there was no significant difference in lineup accuracy between the targets overall, the contributions of each stress group to each target differ. The short delay between exposure to the targets suggests that stress was relatively similar in both observations. However, the target paired with the stressor shows a difference in lineup performance between the stress groups, but the neutral target does not.

The second prediction of the study was that participants exposed to moderate levels of stress were hypothesized to have a greater accuracy in lineup responses compared to control and high-stress groups. This was based on the premise of the Yerkes-Dodson law, as its curve suggests that exceptionally high and low levels of stress are detrimental to one's memory (Aharonian & Bornstein, 2008). The curve further suggests that an optimal level, or levels, of stress exist in between these two points that enhance one's memory performance (Teigan, 1994). Therefore, it is promising that this study found the medium-stress group to perform more accurately in suspect identification compared to control and high-stress groups. This indicates that a certain level of stress or arousal is required for optimal memory performance, and that a dearth or excess of this factor may impair it.

The third prediction of the study was that participants in the high-stress group were hypothesized to perform worse in suspect identifications compared to control and medium-stress groups. The results of this study did not confirm this. The lack of significance in performance differences between control and high-stress groups indicates that these two groups are associated with the same level of risk. However, the cause of that risk is what differs. This may be explained through the role of attention: the high-stress group's attention control was possibly activated by the stressor and this caused the memory to be reduced; the medium-stress group's attention control was possibly aroused by the stressor and this caused the memory to be enhanced; and the control group's attention control may not have been stimulated by the stressor at all and this caused the memory to be reduced (Deffenbacher, 1994). Although low- and high-stress levels appear to be equally detrimental to memory performance, it is important to note that these may be caused by different factors.

Although these findings are in line with the Yerkes-Dodson law and the majority of the literature in this field, the implications of this in the real world are conflicting. This study has categorized stress beyond its mere absence or presence and has illustrated a ranking in stress severity. As the intensity of stress seems to influence eyewitness memory and suspect identification accuracy differently, this knowledge seeks to influence the ways in which

eyewitness testimonies are interpreted during legal proceedings. If an individual was thought to experience a large amount of stress while a crime was taking place, then the courts and law enforcement would be encouraged to handle this testimony with great caution. However, how can it be ascertained what level of stress an eyewitness experienced during a crime?

The problem in applying this knowledge is identifying where the eyewitness' stress endured during a crime falls along the curve. However, in doing so, one is in danger of ranking crime severity according to the amount of stress it is suggested to induce in an eyewitness. A simple conclusion to this issue would be to include a stress scale in the eyewitness' initial written testimony. This scale could range from 1 to 100 and would provide a self-reported indication of the eyewitness' level of stress experienced throughout the crime's duration. This percentage may then be located along the Yerkes-Dodson curve to determine whether the eyewitness' memory of the crime or perpetrator is associated with a low or high level of risk in accuracy. This self-categorization of stress and associated risk needs to be acknowledged in legal settings, as false eyewitness identifications are the leading contributors to wrongful imprisonments (The Innocence Project, 2019). Therefore, courts and law enforcement are encouraged to call upon expert witnesses on the effects of stress on eyewitness memory and suspect identification in the relevant legal cases, and to reduce their reliance on suspect identifications made through testimonies.

The implications of this research are not solely based on the findings of this study, as its sample was not large enough and its conclusions should be drawn tentatively. A power analysis conducted in G*Power indicated a sample of 120 participants was recommended, however this study only contained 77. Cohen's d reported an effect size valued at about 0.31 in a meta-analysis conducted on the effects of stress of eyewitness memory (Deffenbacher et al., 2004). The effect size suggested in the literature on identification performances is 0.50 (Sauerland et al., 2016). Therefore, the average of these effect sizes, an alpha value of 0.05, and a minimum power of 0.8 was used to conduct this power analysis. The findings of this study remain promising despite its small sample, as the expected trend in suspect identification performance accuracy was observed in the stress groups. The implications of this research are based on the findings in the stress and eyewitness field, not only this study.

This study alone is not capable of arguing for a change in policy around the interpretation of eyewitness identifications made in legal cases. However, this study along with others reveal the detrimental impact that stress has on eyewitness memory is capable of doing so. It is no longer possible to continue legally approaching suspect identifications in the same manner. The criminal justice system cannot continue placing innocent individuals in

prison on the basis of a single eyewitness testimony without alternative supporting evidence. The majority of research indicates that eyewitness memory and performance in suspect identification is largely inaccurate when high levels of stress are induced during the encoding of the crime (Aharonian & Bornstein, 2008; Davis et al., 2019; Deffenbacher et al., 2004). Therefore, the courts and legal magistrates are urged to reduce the influence that an eyewitness identification has on a case. Memory is malleable and should not be relied upon so heavily in legal proceedings (Wixted, Mickes & Fisher, 2018).

Future research in this field should aim to induce varying levels of stress in participants to determine how each of these impact eyewitness memory and suspect identification. These levels may extend beyond the three presented in this study in an attempt to gain greater insight into what this relationship looks like. Stress within the eyewitness field needs to move away from being viewed as a binary concept (i.e. stress and no stress), and rather towards being viewed along a spectrum. Physiologically, stress is either absent or present, but psychologically this does not seem to be the case. Future research should further ensure that the source of stress and the face being encoded are linked, and that the stressor is personally relevant and realistic. It would be interesting to follow the example set by Morgan III and colleagues (2007), which inserts research into stressful, real-life circumstances that innately include the effects of stress on aspects of eyewitness memory.

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Thank you to Professor Colin Tredoux and Dr. Alicia Nortje for their continued support, guidance, time, and expertise given to me and this project. It has been an honour to work with both of them. Thank you to Milton Gering for inspiring the path of my research topic, for providing endless support and assistance. Thank you to Michelle Henry for her comments and advice, and to Associate Professor Kevin Thomas for providing weekly encouragement and guidance during ACSENT meetings. Lastly, a massive thank you to my close friends and family: to Kennedi Vermaak and Gabrielle Sauzier for acting as this study's targets and giving up hours of your time; to my family for constantly motivating me, encouraging me and providing me with this opportunity; and to Nikelo Maponya for his support throughout this year.

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Appendix A: Recruitment Advertisement

The Physiological Effects of Stress on Academic Writing

I am conducting a study that aims to investigate the physiological effects of stress on academic writing. All you need to do is follow the link and complete the online survey to see if you are eligible to participate in this study (1 SRPP will be awarded for this step). You will receive an invitation to the laboratory phase of the study if you meet the criteria for participation. During the session, you will be asked to complete a few forms and you will be given a broad topic that you are expected to write a short academic piece on for about 10 minutes. The full session should take about 1 hour. Before you are awarded a further 2 SRPP points for participation in the study, you will need to complete a feedback report on your experience of the experiment the day after your laboratory session. If you meet the criteria below, you are encouraged to follow the link and complete the survey to see if you are eligible for participation in this study:

i. You do not have a severe diagnosed psychiatric condition relating to stress, trauma, anxiety or depression.
ii. You have not recently sustained a head injury that led to a loss of consciousness.

https://www.surveymonkey.com/r/BPTGQWZ

Kind regards,
Tayla Johnson
JHNTAY004@myuct.ac.za

Appendix B: Beck Anxiety Inventory (BAI)

The statements below represent symptoms that are common in anxiety. Please read each item thoroughly and indicate how much the symptom has bothered you in the past month until today.

	Not at all	Mildly, but it didn't bother me much	Moderately, it wasn't pleasant at times	Severely, it bothered me a lot
Numbness or tingling	0	1	2	3
Feeling hot	0	1	2	3
Wobbliness in legs	0	1	2	3
Unable to relax	0	1	2	3
Fear of worst happening	0	1	2	3
Dizzy or lightheaded	0	1	2	3
Heart pounding/racing	0	1	2	3
Unsteady	0	1	2	3
Terrified or afraid	0	1	2	3
Nervous	0	1	2	3
Feeling of choking	0	1	2	3
Hands trembling	0	1	2	3
Shaky/unsteady	0	1	2	3
Fear of losing control	0	1	2	3
Difficulty in breathing	0	1	2	3
Fear of dying	0	1	2	3
Scared	0	1	2	3
Indigestion	0	1	2	3

Faint/lightheaded	0	1	2	3
Face flushed	0	1	2	3
Hot/cold sweats	0	1	2	3

Appendix C: Random Stress-Related Experiences Questionnaire

Please carefully read each of the following questions and answer them truthfully. If you have experienced what the question is asking, indicate ‘yes’, and if you have not experienced what the question is asking, indicate ‘no’.

1. A significant other has ended a romantic relationship with me before.
2. I have failed at least one of the following at an academic institution: assignment, test, or examination.
3. I have lost a pet that lived in the same house as me.
4. I have received an informal and/or formal warning for plagiarism at UCT.
5. I have lost a significant belonging before (including, but not limited to: a cellphone, an item of jewelry, a letter).
6. I have submitted an assignment after it was due.
7. I have been blatantly ignored by somebody in the past week.
8. I have been rejected for a job or position that I have applied for.

Appendix D: Exclusion Email

Good morning/afternoon,

I regret to inform you that you have not been chosen to participate in the study 'The Physiological Effects of Stress on Academic Writing'. If you wish to enquire on the reasoning, please do not hesitate to contact me personally via email.

I appreciate you taking the time to complete and answer the questionnaires for my research study!

If you are feeling uneasy about the results of any of these questionnaires, please do not hesitate to make use of any of the services offered at our Student Wellness Center. The center is situated on 28 Rhodes Avenue, Mowbray 7700, or you can contact them on 021 650 1017 / 021 650 1020. You may also contact the SADAG UCT student careline for advice, counselling or referrals concerning these results, or for any other reason, on 0800 24 25 26 free of charge from a Telkom line. Alternatively, you can SMS 31393 and the center will call you back.

Kind regards,
Tayla Johnson
JHNTAY004@myuct.ac.za

Appendix E: Positive and Negative Affect Scale (PANAS)

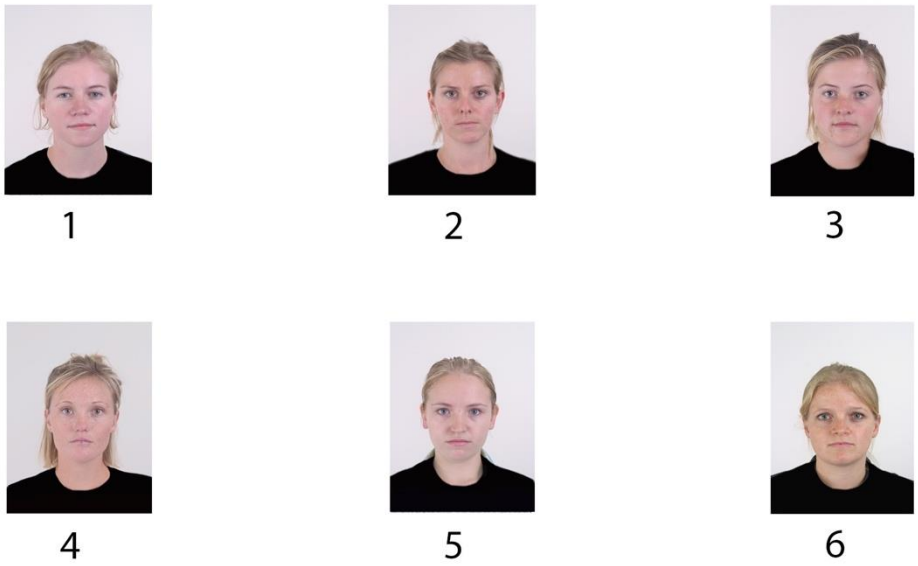
Please read the following feeling or emotion words carefully. Next to each item, indicate on a scale of 1 to 5 the extent to which you are feeling it in this exact moment.

1	**2**	**3**	**4**	**5**
Very slightly or not at all	**A little**	**Moderately**	**Quite a bit**	**Extremely**

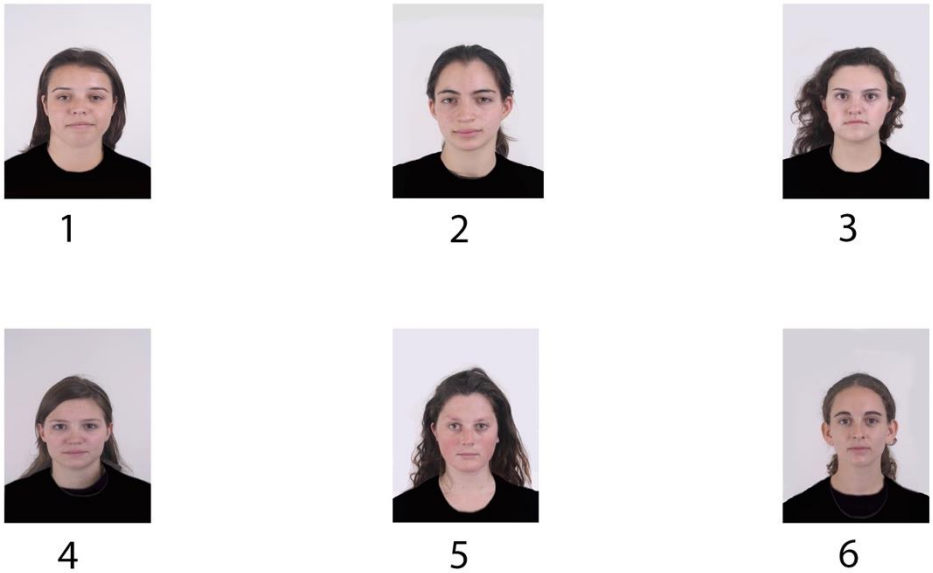
Interested		Irritable	
Distressed		Alert	
Excited		Ashamed	
Upset		Inspired	
Strong		Nervous	
Guilty		Determined	
Scared		Attentive	
Hostile		Jittery	
Enthusiastic		Active	
Proud		Afraid	

Appendix F: Lineups

TA lineup for target 1.

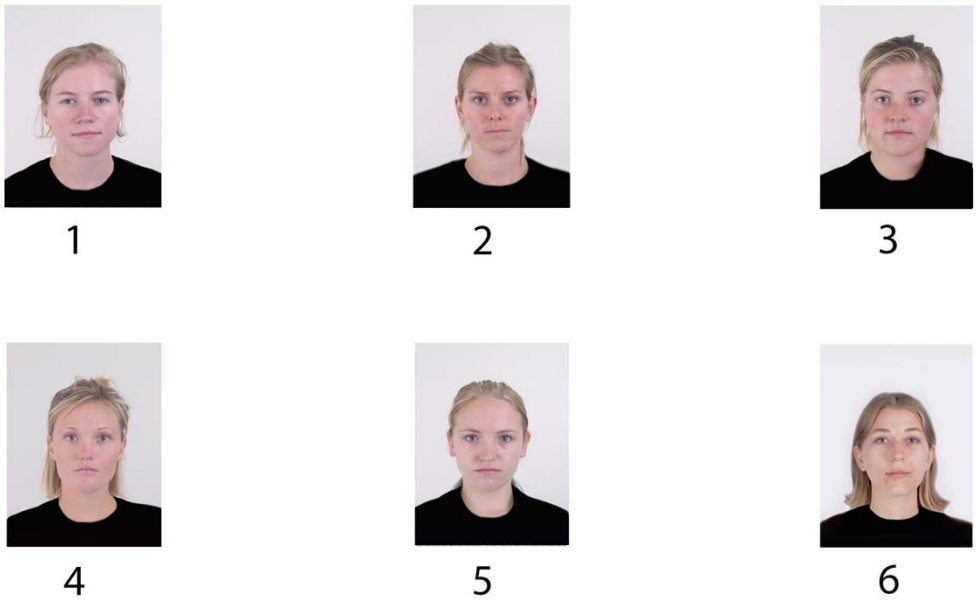


TA lineup for target 2.

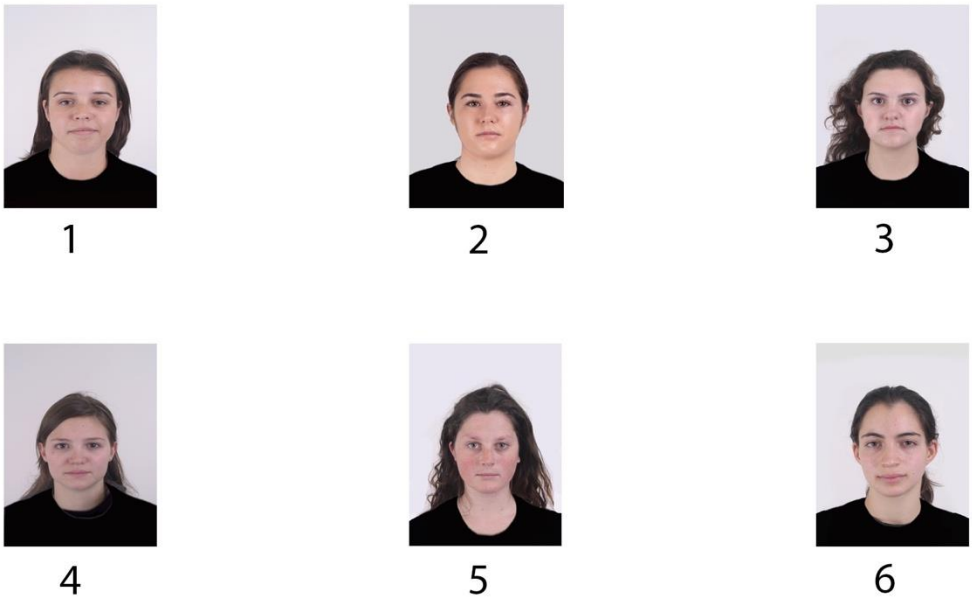


TP lineup for target 1 (Target placed in position 2)

TP lineup for target 1 (Target placed in position 6)

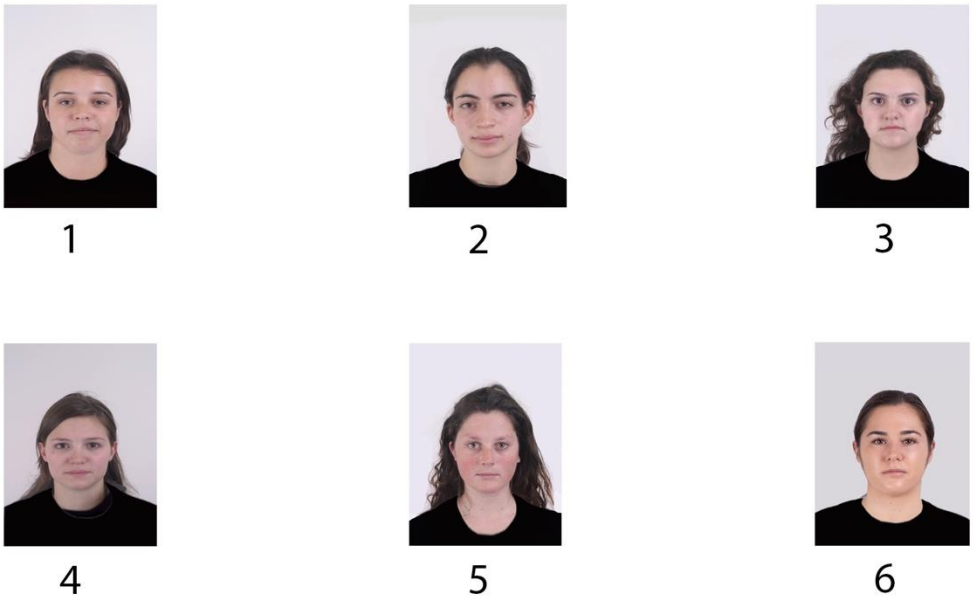


TP lineup for target 2 (Target placed in position 2)

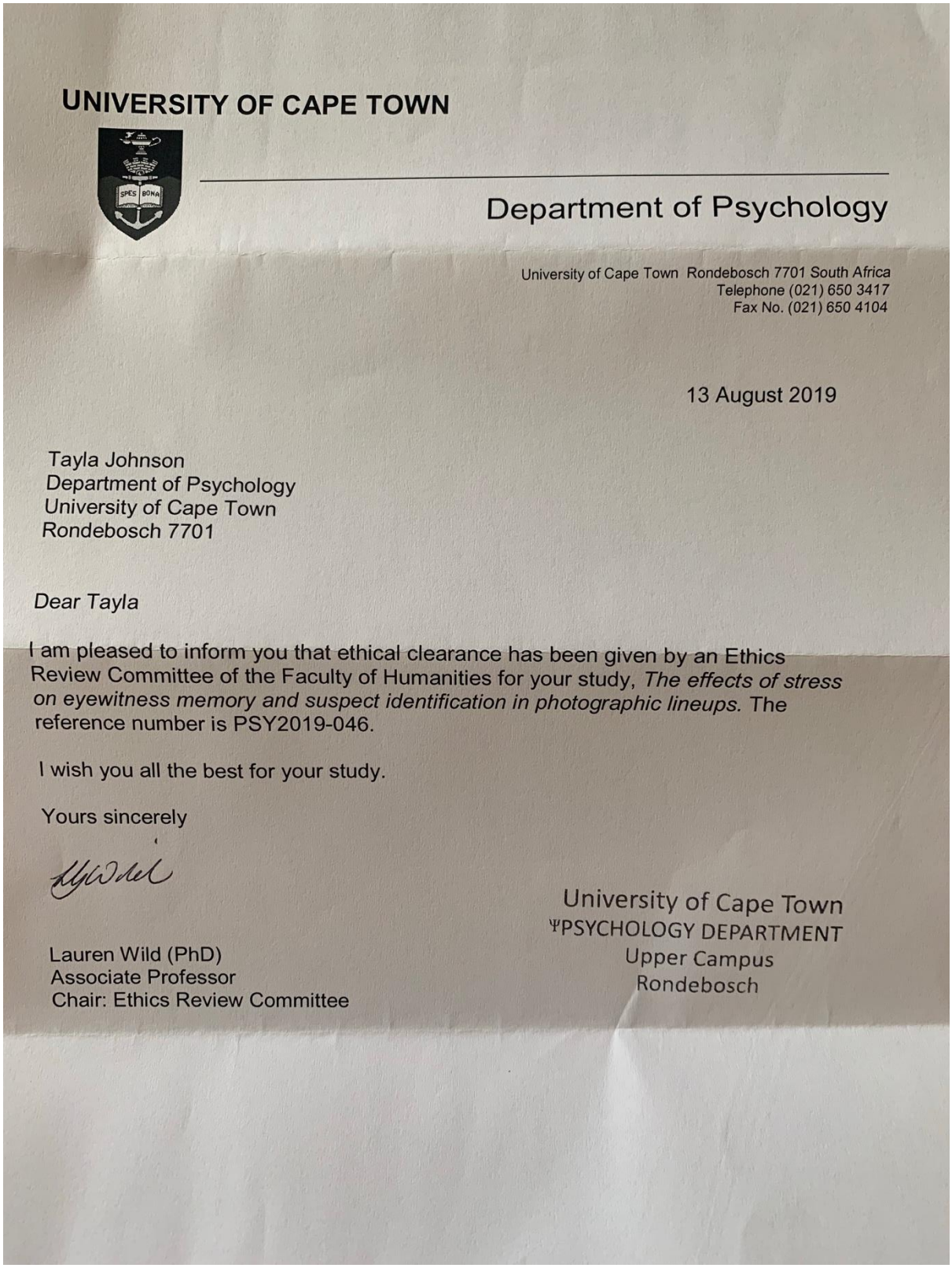


TP lineup for target 2 (Target placed in position 6)

`



Appendix G: Ethics Approval



UNIVERSITY OF CAPE TOWN

Department of Psychology

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

13 August 2019

Tayla Johnson
Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Tayla

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 on eyewitness memory and suspect identification in photographic lineups.* The reference number is PSY2019-046.

I wish you all the best for your study.

Yours sincerely

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

University of Cape Town
ΨPSYCHOLOGY DEPARTMENT
Upper Campus
Rondebosch

Appendix H: Consent Form

The effects of stress on academic writing

Purpose

I am a Psychology Honours student at the University of Cape Town aiming to investigate the effects of stress on academic writing.

Procedure

In this study you will be required to complete a form that asks you about some demographic and general information on you as a person. You will be given a few simple tasks that you are required to complete: such as reading an academic extract, a writing task on the extract and some filler tasks. This study will require a background check into your plagiarism reports submitted to the university to ensure that your results are meaningful to the study. Due to the nature of this study concerning stress, you may be required to wear a VU-AMS device that will monitor this response physiologically throughout the session. This device will monitor your heart-rate.

Possible Risks

Participation in this study may possibly induce a moderate level of stress, however, the risk associated with this is mild and temporary. If the stress does not subside, please inform the researcher so that they can assist you.

Possible Benefits

If you decide to participate in this study, you will receive 1 SRPP point for completing the online questionnaire, and a further 2 SRPP points for completing the laboratory phase of this study.

Voluntary Participation

Participation in this study is entirely voluntary and depends on your decision to, or not to, take part in this laboratory session. You may refuse to answer particular questions or tasks asked of you at any point in this study without reason. 2 SRPP points will be awarded for complete participation in the study, whereas partial participation will result in 1 SRPP point.

Confidentiality

Any information that I obtain from you throughout the duration of this study will be kept entirely confidential. Any identifying information concerning you as an individual will be kept in a locked and private location. Your information will be assigned to a random number during the data processing part of this study so that none of your results are tied to your name. The final write-up of this study will not include any identifiable information of you or any other participants that choose to participate in the laboratory session.

Questions

If you have any questions at this moment, please feel free to ask the researcher anything. If you have any questions, comments or suggestions in the future, please contact Tayla Johnson via email on JHNTAY004@myuct.ac.za. Furthermore, please feel free to contact Rosalind Adams (the post-graduate administrator) via email on Rosalind.adams@uct.ac.za for questions, comments, or suggestions concerning the research study.

To be completed by the participant:

I, _____ , have thoroughly read the above and understand the study, what is expected of me as a participant, and what risks or benefits may be involved through my participation. I understand that by signing this form, I am providing my voluntary consent for participation in this research study.

_____ _____

Signature Date

To be completed by a representative of the study:

I, _____, acknowledge that the participant has read and thoroughly understood this document. I understand that by signing this form, I am acknowledging the student's voluntary consent to participate in this research study.

_____ _____

Signature Date

Appendix I: Demographic Information Sheet

Please fill out the following questions concerning yourself. If you do not wish to answer a question, or it does not apply to you, please write 'N/A' on the line provided.

General Information:

Sex: _____

Age: _____

Chronic/current medication being used: _____

To your knowledge, do you struggle to recognize faces? _____

Menstrual Cycle Information:

1. Are you on birth control?

   _____

2. If you answered yes to the previous question, what form of birth control are you on?

   _____

3. Are you currently menstruating?

   _____

4. If you answered no to the previous question, when was the last day of your last menstruation?

   _____

Appendix J: Reading Extract

Rayle, A. D., & Chung, K. (2007). Revisiting first-year college students' mattering: Social support, academic stress, and the mattering experience. *Journal of College Student Retention, 9*(1), 22.

Schlossberg (1989) found that first-year college students in transition often feel marginal, that they do not make a difference, and do not matter to their colleges. In addition, first-year college students' feelings of marginality may equate to not fitting in academically and/or socially at their colleges, and can result in feelings of worthlessness and increased self-consciousness (Schlossberg, 1989). Further, the resulting self-consciousness may directly affect students' abilities to perform up to their academic capabilities, thus resulting in lower academic success and greater academic stress (Sand, Robinson Kurpius, & Dixon Rayle, 2005). Schlossberg (1989) noted that when college students believe that they matter to others, their feelings of marginality diminish; college students succeed in a multitude of ways when they perceive that they are appreciated by others and receive positive affirmation. Schlossberg's (1989) theory of mattering and marginality provided new ways to explore transitioning college students' involvement and perceptions of their experiences in higher education in the 20th century; however, no recent studies have explored this construct with transitioning college students within the past 15 years. In the 21st century, college counselors continue to report meeting with first-year students who are experiencing unique and demanding academic, financial, and relational challenges during their transitions to college (Cretzmeyer, 2003; Feldman, 2005) and Schlossberg (1989) suggested that it is during such transitions that individuals need to perceive that they matter to others. The transition from high school to college is often a double-edged occurrence for traditional students who encounter many challenges and opportunities for growth, and who experience the loss of the familiar and a fear of the unknown (Paul & Kelleher, 1995). The challenges first-year college students may face include a variety of life adjustments such as being away from loved ones, depression, isolation, searching for independence, building a new social support network, making life-altering decisions, and academic stress (Feldman, 2005; MacLennan & Dies, 1992; Reischl & Hirsch, 1989; Sand et al., 2005). Many students are able to rise to the challenges they face; however, one-fourth of all students, regardless of gender, do not return to school after the first year of college (Arizona State University, 2005), with the majority of non- persisters leaving at the end of their first semester (Cretzmeyer, 2003; Sand et al., 2005).

Appendix K: Debriefing Form

Thank you for your participation in this research study, your contribution is greatly appreciated.

This form will provide you with all of the necessary information that is relevant to the study that you have just completed participation in. The principle investigator (the researcher behind this study) or a representative of them will verbally debrief you on this study. You are however encouraged to further read and sign this document.

Title of the Research Study

The effects of stress on eyewitness memory and suspect identification in photographic lineups.

Principle Investigator and Supervisors

Tayla Johnson	Colin Tredoux, Ph.D	Alicia Nortje, Ph.D
Investigator	Supervisor	Co-supervisor
Department of Psychology	Department of Psychology	Department of Psychology
University of Cape Town	University of Cape Town	University of Cape Town
JHNTAY004@myuct.ac.za	colin.tredoux@uct.ac.za	alicia.nortje@gmail.com

Milton Gering
Co-supervisor
Department of Psychology
University of Cape Town
GRNMIL001@myuct.ac.za

The Purpose of the Study

This research study aims to investigate the effect that the stress response has on eyewitness memory, with specific reference to facial recognition. This is an important field of research as the victim's accuracy of the eyewitness identification process may alter depending on the

level of stress experienced during the criminal event. Gaining knowledge on this topic may assist in policy-making, legal cases and perpetrator identification systems currently used in the criminal justice system.

The Procedure of the Study

Initially, participants were screened on symptoms relating to anxiety and random stress-related experiences. Individuals that received low scores on these tests were invited to participate in the laboratory phase of this study. During the session that you have just completed, demographic and general information was obtained from you, a varying level of stress was induced, and you were exposed to two different individuals that entered and exited the room at different points. You will be asked to identify these individuals in a series of photographic lineups in a follow-up email. You will obtain 3 SRPP points in total for completing all the above-mentioned factors.

Deception

Deception was present in this study. You were informed that this research study focused on the effects of stress on academic writing, whereas it actually focused on the effects of stress on eyewitness memory and facial recognition in photographic lineups. You were not informed that you would need to remember the faces of the two individuals that entered and exited the laboratory session at different points. The first individual presented the plagiarism report feedback and the second individual presented the verbal debriefing session. Varying levels of stress were induced in order to see their individual effects on eyewitness memory and facial recognition abilities. This varying level of stress was induced by a staged plagiarism feedback report that was entirely false and has no real-life consequences to it. This element of deception was necessary in order to increase the study's ecological validity and to reduce rehearsing effects of the faces exposed to you.

It would be encouraged and appreciated that you do not disclose the true nature of this study to any possible participants, as this may bias their performance and the results obtained. If you are still feeling distressed, please alert me to this so that I can assist you further. UCT's Student Wellness details will follow if you require any counselling services.

UCT Student Wellness Center
28 Rhodes Avenue
Mowbray
7700
Tel: 021 650 1017 / 021 650 1020

Research Investigator

I, _____, on _____, acknowledge that I have provided the participant with a detailed explanation of the study (as seen above).

Participant

I, _____, on _____, acknowledge that I have been provided with sufficient information about the study's purpose, procedure and deceptions by a representative of the study.