Meeting Strangers Online: Decision making under acute psychosocial stress

Dale C. Stephen

ACSENT Laboratory
Department of Psychology
University of Cape Town

Author's Note:

This study was funded by the National Research Foundation through the Freestanding Honours Scholarship. The study also received funding support from the University of Cape Town's University Research Committee.

Supervisor: Kevin Thomas

Co-supervisors: Robyn Human and Tarah Swanepoel

Word Count: 10920

Glossary

The following terms are used commonly in evolutionary psychology, experimental neuropsychology, and cognitive neuroscience, particularly in studies examining (either together or separately) stress and decision-making.

Evolutionary Psychology:

LHS: life history strategy

Measures and Procedures:

BDI-II: Beck Depression Inventory-II

CPT: Cold Pressor Test

FSST: Fear Factor Stress Test

IGT: Iowa Gambling Task

MSST: Mortality Salience Stress Test

STAI: State-Trait Anxiety Inventory

Neuroanatomical terms:

ACC: Anterior cingulate cortex

DLPFC: Dorsolateral prefrontal cortex

PFC: Prefrontal cortex

VMPFC: Ventromedial prefrontal cortex

Physiological terms:

BMI: body mass index

ECG: electrocardiography

HPA: Hypothalamic-pituitary-adrenal

SAM: Sympathetic adrenomedullary

Abstract

A growing body of research focuses on the intricate relationship between stress and decision-making. An important feature of the extant literature is that it describes male behaviour under stressful conditions as, exclusively, risk-taking and, in contrast, female behaviour under similar conditions as, predominantly, risk-aversive. Although these descriptions of sex differences may be accurate, they are only descriptions of risk-taking behaviour as it relates to proximal factors (neurobiological changes); they make no connection between that behaviour, those proximal factors, and distal determinants of human strategies in engaging the environment. The current study thus attempted to locate decision-making in a real-life context, where sex differences under stress may, at least partially, be a function of how men and women respond differently to environmental challenges because of different evolved psychological mechanisms. I hypothesised that firstly (a) the stress induction paradigm would produce both HPA-axis and ANS activity in males and females, and that under stress (b) men are more risk-taking than women, (c) women make more conservative decisions compared to relaxed women, (d) men become more risk-taking compared to relaxed men, and that (e) individuals with a fast LHS show more risk-taking behaviour than individuals with a slow LHS. The results suggested (a) the stressor used was effective in eliciting appropriate responses in males but not females, (b) men and women did not differ in their decision making, (c) stress had no influence on decision making behaviour and that (d) as the hypothesis stated individuals, regardless of sex, with a fast LHS presented with more risk-taking behaviour than individuals with a slow LHS. In summary this study provides an illustration of individual differences in decision-making under stress that are driven by distal determinants of behaviour, that being life history strategy.

Meeting Strangers Online: Decision-making under acute psychosocial stress

In everyday life, humans make many and varied decisions in social, academic, and occupational environments; often, they make these decisions under stressful conditions. Hence, a growing body of research focuses on the intricate relationship between stress and decision-making (Starcke & Brand, 2012). Frequently, making decisions involves choosing whether to take a risky action that has a larger potential reward, or a safer, more conservative course of action that might not reward as much. The implications of making these *risk decisions* are wide-ranging; they might involve relatively serious and rare events such as whether or not to trade a stock, or relatively trivial and common events such as whether to speed through a yellow traffic light. The current study investigates how stress influences these decision-making processes.

The primary neurobiological rationale driving investigations behind stress and decision-making is that increased levels of cortisol, a hormone released as part of the physiological stress response, have been associated with reward-like properties related to sensation-seeking behaviour (Putman, Antypa, Crysovergi, & van der Does, 2010). Furthermore, at a neural level, the brain regions associated with decision-making, particularly those that involve weighing probabilities, are sensitive to stress-induced changes in brain chemistry and physiology (Lighthall et al., 2012; Mather, Gorlick, & Lighthall, 2009). Additionally, Damasio's (1994) somatic marker theory, and empirical work supporting that theory, suggest that stress responses guide decision-making. Taken together, these separate bodies of literature indicate that acute stress and elevated levels of cortisol may promote risk-taking behaviour.

Although there are clear, specific, and species-wide neuroanatomical processes that are responsible for decision-making in humans (Brand, Labudda, & Markowitsch, 2006), the apparent unpredictability of human behaviour, especially under stressful circumstances, means there is still much to learn in this field. For the purposes of expanding current knowledge, the present study attempted to use evolutionary psychological theory to explore the nature of individual differences in decision-making under stress. At their core, evolutionary psychological theories posit that individual relational and sexual motives are evolved mechanisms that have proved successful in facing adaptive challenges over the course of human history. Yet, there are individual differences in how human beings decide to

allocate resources in their strategic approach toward satisfying these motives. Hence, an individual's *life history strategy* (LHS; Brumbach, Figueredo, & Ellis, 2009) helps predict how individuals may respond to environmental challenges.

Perhaps the major scientific contribution of this study, then, is that it examines how individuals with different life history strategies alter their decision making under stressful conditions.

Mechanisms of Stress and Decision Making

Neurobiological correlates of stress. The physiological stress response consists of two complementary systems. The fast-reacting sympathetic adrenomedullary (SAM) system responds immediately following stress exposure, triggering the release of adrenaline and noradrenaline from the adrenal medulla. A second, slower cognitive reaction involves increased activity in the hypothalamic-pituitary-adrenal (HPA) axis that, ultimately, stimulates the release of glucocorticoid hormones (Sapolsky, Romero, & Munck, 2000). The SAM system and the HPA axis are synchronous in their responses, enabling the body to adapt appropriately to a stressor (Joëls & Baram, 2009).

The HPA-axis response underlies, to a great degree and via neuromodulatory means, the impact of stress on cognition. Consecutive sequences of activity in the hypothalamus and pituitary gland lead to the synthesis of glucocorticoids (primarily cortisol, in humans) in the adrenal cortex. After crossing the blood-brain barrier, glucocorticoids bind to specific receptor sites in prefrontal and limbic areas of the brain. In young adults, specific processes of the prefrontal cortex (PFC) and limbic system are particularly vulnerable to such changes in glucocorticoid activity (Alderson & Novack, 2002)

Neuroimaging studies confirm that increases in cortisol levels lead to metabolic changes, particularly in regions marked by heavy concentrations of stress-hormone receptors (Pruessner et al., 2010). These regions include the dorsolateral prefrontal cortex (DLPFC), ventromedial prefrontal cortex (VMPFC), anterior cingulate cortex (ACC), hippocampus, and basal ganglia (including, specifically, the dorsal striatum).

The decision-making process. Dual-process theories of decision making (Epstein, Pacini, Denes-Raj, & Heier, 1996; Reyna & Brainerd, 2011) propose that decisions can be made using, concurrently, a rational-analytical system and an emotional-intuitive system.

Rational-analytical decision-making. Many decisions occur in situations where the individual experiences a conflict between initial automated responses and more considered, deliberate thinking. Decisions often require that alternative actions are balanced based on the

probability of gains and losses. Decisions made under such circumstances have been labelled *risk decisions* (Starcke & Brand, 2012).

Rational-analytic processes underlie these risk decisions. These processes are dependent on some of the more basic executive functions, such as planning, reasoning, and working memory (Brand et al., 2006). Features of the current decision situation (held in working memory) and information about previous problems and decisions (held in long-term memory) are integrated to initiate a decision (Brand et al., 2006). The neural regions involved in making such strategic decisions are the DLPFC, the VMPFC, and the ACC (Labudda et al., 2010). Patients with damage to these areas tend to make more risky decisions (Brand et al., 2005; Lie, Specht, Marshall, & Fink, 2006).

Emotional-intuitive decision-making. Humans do not always make strategic, calculated probabilistic decisions. Recent literature emphasises the role of an emotional-intuitive system that provides an integrative role for emotional processing in decision making (Bechara, 2004; Damasio, 1994). Hence, emotional feedback based on the memory of past decision situations can guide future decisions (Brand et al., 2006).

The emotional-intuitive decision-making system is centred on limbic areas and on the basal ganglia, particularly the striatum (Delgado, 2007; Labudda et al., 2010). Patients with lesions to the ventral striatum and to dorsal areas of the basal ganglia display pathological disturbances to reward-processing behaviour. For instance, the most common behavioural impairment following such lesions is the syndrome of abulia (i.e., an abnormal inability to perform voluntary actions or to make decisions; Bhatia & Marsden, 1994).

Effects of Stress on Decision Making

The decision-making process that balances a rational-analytical approach with an emotional-intuitive approach is particularly sensitive to stress-induced changes in the PFC and in the basal ganglia. For instance, Youssef et al. (2012) showed that stressed participants were less likely than controls to make rational, utilitarian decisions that could mediate strong emotional processes in response to choices regarding moral dilemmas.

Of particular interest to many researchers in this field is that there are sex differences in decision-making behaviour under conditions of stress (Lighthall et al., 2012; Porcelli & Delgado, 2009; Preston, Buchanan, Stansfield, & Bechara, 2007; van den Bos et al., 2009). In men, elevations in cortisol levels following stress exposure result in faster decision speeds (behaviour consistent with more automatic, and thus less deliberative and rational, processing) and more risky decisions (Porcelli & Delgado, 2009). Conversely, stressed

women exhibit slower decision speeds and make fewer risky decisions (Lighthall et al., 2012). Some researchers have also observed an inverted U-shaped relationship between stress/cortisol levels and decision-making behaviour in women: As cortisol increases, women are more conservative in their behaviour, yet the highest cortisol responders tend to make more risky decisions, in the same way that men do (Preston et al., 2007; van den Bos et al., 2009).

Neuroimaging investigations suggest that these behavioural differences are associated with sex differences in brain activation (Bolla, Elderth, Matochik, & Cadet, 2004; Lighthall et al., 2009; Preston et al., 2007). That is to say, exposure to an acute stressor appears to affect brain activity during risk decision-making differently in men and women. In men, right prefrontal areas, crucial for modulating risk-taking behaviour, are more active than left prefrontal areas during risk decision-making. This asymmetry is not present in women (Lueken et al., 2009; Tranel, Damasio, Denburg, & Bechara, 2005). This sex difference, and the fact that stress-regulatory systems impact more generally on right prefrontal areas, suggests that men are more susceptible to risk-taking behaviour under stress.

These sex differences in neural activation imply that, under conditions of acute psychological stress, men rely more heavily on an emotional-intuitive system than on a rational-analytic system during decision-making. In contrast, under the same conditions, women appear to prefer the rational-analytical system. Hence, under stress men are more likely than women to make risky decisions, and women are more likely than men to make conservative decisions.

Empirical studies of decision-making under stress have nevertheless failed to test participants under circumstances where the consequences of decisions in a particular direction vary depending on environmental contingencies. That is to say, the designs used in previously published studies feature a predictable response pattern that can be discerned by participants; they can deduce that choosing one response will always produce one kind of outcome (either positive or negative). Knowingly choosing a ‘long-term’ disadvantageous decision can thus be considered a ‘bad’ decision, as the probable outcomes have been learnt. Considering that healthy participants undertaking these tasks are able to familiarise themselves with a predictable pattern for success, any element of risk thus dissipates (Kaplan & Garrick, 1981). The ecological validity of the kinds of decision-making tasks used in published studies is, therefore, limited. Nevertheless, following the outcomes of studies using tasks such as these, men and women have been labelled, simply, as being risky and conservative under stress, respectively.

Importantly, however, one might argue that men and women do take different approaches to decision making, and that these different approaches emanate largely from the kinds of environmental contingencies faced by individuals over evolutionary and individual history. Human beings are able to monitor current and expected environmental pressures, and to adjust their LHS accordingly (Griskevicius, Delton, Robertson, & Tybur, 2011). Hence, an individual's LHS is determined by a set of behavioural and cultural life history traits. Collectively, these traits (i.e., the person's LHS) can predict rates of reproduction, patterns of growth, parental investment, and ageing. These traits are clustered on a continuum from slow to fast life history strategies (Brumbach et al., 2009; Ellis, Figueredo, Brumbach, & Schlomer, 2009). A *slow LHS* is commonly associated with, for instance, high levels of reproductive effort focused on parenting (Dunkel, Mathes, & Decker, 2010). Slow LHS individuals are more likely to dedicate their resources towards long-term relationships, and are less likely to pursue short-term relationships characterised by a high degree of mating effort. At the other end of the continuum lies a *fast LHS*, defined by a life trajectory favouring reproductive effort focused on mating (Dunkel et al., 2010). Individuals with a fast LHS usually find themselves in unpredictable environments; short-term relationships, with effort focused on mating rather than on parenting, are adaptive under these circumstances (Brumbach et al., 2009). Generally speaking, males are more oriented toward a faster LHS; they demonstrate an increased propensity for short-term mating strategies (Figueredo et al., 2006).

Thus, when interpreting sex differences in decision-making it is important to understand that these differences stem not simply from the biological sex of the individual, but also from each individual's developmental history. What this study aims to do is take the research on decision-making under stress a step further than it has gone before by describing how changes in decision strategies might be predicted by distal evolutionary mechanisms. Such an understanding may provide evidence for distal mechanisms underlying the presence of sex differences in decision-making under stress (i.e., for an understanding of how stress effects on risk-taking behaviour are evolutionarily adaptive). Hence, I hope to provide a precise and ecologically valid investigation of decision-making behaviour.

Rationale, Specific Aims, and Hypotheses

Proximally-focused investigations of decision-making under stress suggest that sex differences exist at both neural and behavioural levels (Lighthall et al., 2012; Starcke & Brand, 2012; van den Bos et al., 2009). These studies suggest that, as cortisol levels increase,

men tend to engage in more risk-taking behaviour; such behaviour is consistent with a preference for the automated intuitive-experiential system of decision-making. These studies also suggest that, in contrast, as cortisol levels increase, women tend to make more conservative decisions; such behaviour is consistent with a preference for a rational-analytical system for decision-making.

A key knowledge gap in this literature, however, is that under acute stress males have been described, exclusively, as risk-taking and females have been described, predominantly, as risk-aversive (Lighthall et al., 2009; Mather et al., 2009; Putman et al., 2010). These conclusions have, however, been drawn based on studies using computerised decision-making tasks that were developed for use in clinical populations; there are no descriptions of how individual life history strategies may account for these differences in decision making under stress. Research has yet to incorporate the possibility that sex differences in decision making under stress are, at least partially, a function of individual differences in LHS. In other words, there are only descriptions of behaviour as it relates to proximal factors (neurobiological changes), but no connection between that behaviour, those proximal factors, and distal determinants of human strategies in engaging the environment. By using both a widely-used experimental task and a novel method that mimics real-life interactions, I hope to provide an illustration of individual differences in decision-making under stress and how they are acted out in a more ecologically valid decision-making context.

In summary, the primary objective of this study was to show that decision-making strategies change under stress, and that these changes serve an adaptive function pertaining to an individual's LHS. This study will make an important contribution in its attempt to make a connection between behaviour in the laboratory and decision-making strategies under real-life circumstances. The ecological validity of this study is a step towards a more nuanced understanding of the relationship between stress and decision-making.

The following specific hypotheses are tested:

1. The stress induction paradigm would produce both HPA-axis and ANS activity in males and females
2. Men are more 'risk-taking' than women.
3. Stressed men are more 'risk-taking' than unstressed men.
4. Stressed women are more conservative than unstressed women.
5. Individuals with a fast LHS are more 'risk-taking' than individuals with a slow LHS.

Methods

Design and Setting

This quasi-experimental study used a repeated-measures factorial design. Between-subject variables were experimental condition (two levels: Stress, Control) and sex (two levels: male, female). Outcome variables were participant decision-making performance on the IGT and in an online chatroom task.

Each participant took part in one 2-hour session; due to diurnal variations in cortisol levels, the sessions took place between 14h00 and 18h00. Conducting the study between these times meant that baseline salivary cortisol levels should be similar for all participants (Kudielka, Schommer, Hellhammer, & Kirschbaum, 2004), thereby avoiding a confounding factor prevalent in other studies measuring cortisol response levels (Luethi, Meier, & Sandi, 2009).

The study setting was two venues in the Department of Psychology at the University of Cape Town (UCT). In the first venue, a research laboratory, participants completed all self-report, physiological, and decision-making measures. In the second venue, a nearby smaller room, participants were exposed to the experimental manipulation.

Participants

Subjects. Forty-eight volunteer undergraduate psychology students (27 females), aged between 18 and 26 years were used for data analysis. Subjects signed up for the study using the UCT Department of Psychology's Student Research Participation Programme (SRPP).

I employed a self-selected sampling method. Due to research suggesting that women respond differently to stress at different phases of their menstrual cycle, and that oral contraception may affect stress responses (Kirschbaum, Kudielka, Gaab, Schommer, & Hellhammer, 1999; Kirschbaum, Pirke, & Hellhammer, 1995), sign-up procedures for men and women differed. Women who wished to participate and who were not on any form of oral contraception were asked to contact the research team via email, and to include in that email their name, student number, and contact telephone number. This procedure ensured that female participants' privacy regarding their non-use of oral contraceptives was maintained.

Correspondence with female participants was crucial so as to determine the regularity of their menstrual cycle and to obtain an estimate of when the first day of their next period was due. This process ensured that a suitable date could be arranged for the testing of female participants in the luteal phase of their menstrual cycle (i.e., the 12 days preceding the start of

their menses; Kirschbaum, 1999); research indicates that women in this phase of their menstrual cycle experience similar baseline levels of cortisol to men (Kirschbaum et al., 1999). At the conclusion of the experimental procedures, all female participants were asked to contact the research team on the first day of their next period so as to verify the phase of the menstrual cycle in which they had been tested.

Male participants signed up for the study through the SRPP website; there, they were asked to supply their name, student number, email address, and contact telephone number. Potential male participants were then contacted with dates and times that could fit around the already-booked female participants.

This study followed the ethical guidelines for research with human subjects outlined by the Health Professions Council of South Africa (HPCSA) and the University of Cape Town (UCT) Codes for Research. Participation was voluntary and all participants provided written informed consent. The consent form described the study procedures clearly, assured the confidentiality of participation, outlined what would be expected, stated they could end their participation at any time without penalty or prejudice, and confirmed they would receive course credit as compensation (Appendix A). No participant took the option to withdraw, and none reported remaining in a subjectively distressed state at the end of the study. Had any been in such a state, a clinical psychologist was on stand-by, and contact details of other counselling services would have been provided. All participants were debriefed at the end of the 2-hour study session, and were provided with a debriefing information form (Appendix B) that they were asked to sign. The Research Ethics Committee of the University of Cape Town's Department of Psychology and the UCT Faculty of Health Sciences approved all study procedures.

Participants who were included in this study at this point and that survived the exclusion criteria ($N = 48$) were pseudorandomly assigned to one of four groups: Stress-Female (SF), Control-Female (CF), Stress-Male (SM), or Control-Male (CM).

Judges. 3rd-year undergraduates (RAs: 1 opposite sex as the participant, 1 same sex as the participant) served as judges. They were smartly dressed and seated behind a desk.

Confederates. 3rd-year undergraduates (RAs: 2 opposite sex as the participant, 1 same sex as the participant) served as confederates in the Chatroom task.

Exclusion criteria. These included: (a) smoking, (b) a Beck Depression Inventory-Second Edition (BDI-II; Beck, Steer, & Brown, 1996) score of greater than or equal to 29 (indicating current experience of severe depression), (c) the use of any prescription or steroid-

based medication, including oral contraceptives, and (d) a body mass index (BMI) of more than 31 or less than 18. Participants were further required to refrain from eating, drinking (except water), or doing physical exercise for 2 hours before testing. These criteria have been identified as being potential confounding variables in past research investigating the effects of psychosocial stress on cognitive performance (Fraser et al., 1999; Kudielka, Hellhammer, & Wüst, 2009; Kudielka & Kirschbaum, 2005); they are also consistent with those criteria used in previous research in this field (Lighthall et al., 2009; van den Bos et al., 2009).

Materials and Procedure

Participant self-report measurements

Beck Depression Inventory-II (BDI-II). This instrument (Beck et al., 1996) was developed to comply with the diagnostic criteria for major depression listed in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association [APA], 1994). It is a 21-item self-report questionnaire that measures levels of depressive symptomatology. Each item has four possible responses; the participant is required to choose the response that best suits how s/he has felt for the 2 weeks prior to reporting. Higher scores indicate greater levels of depression; scores greater than 29 (the cut-off in this study) indicate severe depression (Beck et al., 1996). This measure is highly internally consistent (α = .91; Dozois, Dobson, & Ahnberg, 1998), and has good test-retest reliability (α = .93; Beck et al., 1996).

The Mini-K Short Form. This instrument, a Likert-type scale, is a component of the Arizona Life History Battery (ALHB; Gladden, Figueredo, & Snyder, 2010). It is designed to measure the behavioural and cognitive aspects of an individual's life history strategy. It consists of 20 items, with responses to each ranging from -3 (*disagree strongly*) to +3 (*agree strongly*); a response selection of 0 indicates *not applicable*. A score of -60 is on the most extreme end of a fast LHS, whereas a score of +60 is on the most extreme end of a slow LHS.

Regarding reliability, the Mini-K is internally consistent, with alpha values ranging from .70 to .77 (Gladden et al., 2010). Furthermore, the Mini-K is a valid measure that correlates strongly with, and can be used interchangeably with, other measures of LHS, such as the High-K Strategy Scale (HKSS; Dunkel & Decker, 2010).

Figure 1 illustrates the temporal distribution of events during the experimental procedure. Test sessions occurred between 14h00 and 18h30.

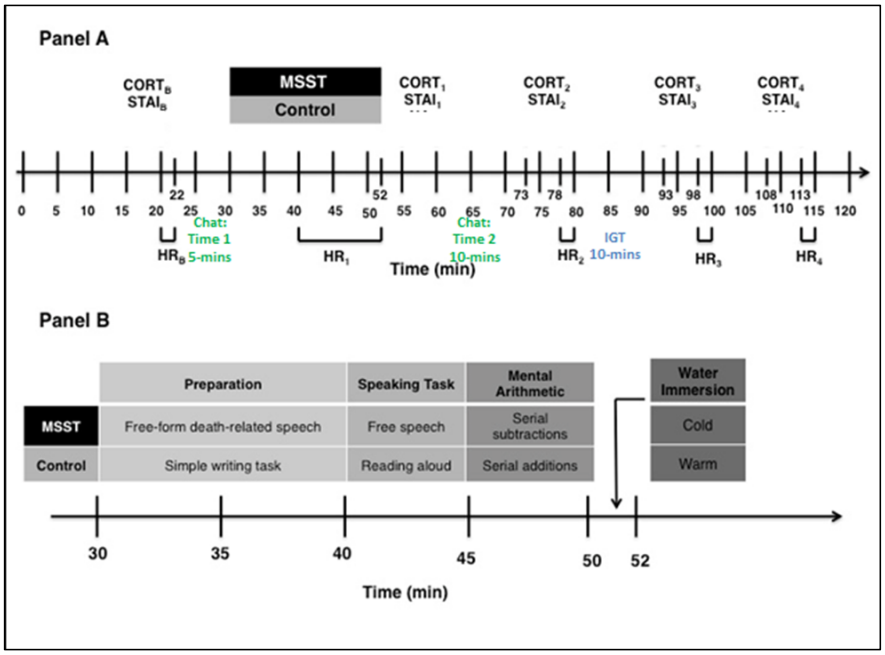


Figure 1. The procedure of the Mortality Salience Stress Test. Panel A indicates the temporal precedence of measures taken throughout the study. Panel B shows the procedure followed for the experimental manipulation. $CORT_B$ = Baseline cortisol measurement; $CORT_1$ = 2nd cortisol measurement; $CORT_2$ = 3rd cortisol measurement; $CORT_3$ = 4th cortisol measurement; $CORT_4$ = 5th cortisol measurement. $STAI_B$ = Baseline state anxiety; $STAI_1$ = 2nd state anxiety measurement; $STAI_2$ = 3rd state anxiety measurement; $STAI_3$ = 4th state anxiety measurement; $CORT_4$ = 5th state anxiety measurement. IGT = Iowa Gambling Task. Chat = Chatroom task.

The experimenter met participants at the research laboratory. Participants immediately read and signed an informed consent document, after which their height and weight were measured. Participants then completed BDI-II questionnaire and the Trait form of the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). On completion of the above-named questionnaires, and if the participant remained eligible following BMI calculation, s/he completed the Mini-K Short Form questionnaire. These measures ensured that, across groups, participants experienced similar levels of depression and general anxiety in their everyday lives, and that individuals who reported 'severe' levels of depression could be screened and excluded from further participation.

If these screening procedures established the participant's eligibility to continue in the study, the experimenter fitted a Vrije Universiteit Ambulatory Monitoring System (Version 5fs) to measure heart rate continuously. Average heart rate measurements, as well as self-report anxiety scores were recorded throughout the 2-hour study session (see Appendix C).

Physiological stress measure. I used the apparatus described below to collect information on participant physiological states before, during, and after the experimental manipulation.

Salivary cortisol. The experimenter collected saliva samples, using SARSTEDT Salivette® Cortisol swabs (Sarstedt, Nümbrecht, Germany), which is an easy and effective method that does not cause any distress for the participant (Garde & Hansen, 2005). Five saliva samples were collected: the first, a baseline, shortly after entering the research laboratory ($CORT_B$; minute 0), the second after the stress or control manipulation ended ($CORT_1$; minute 55), the third ($CORT_2$; minute 73), the fourth ($CORT_3$; minute 93), and the fifth ($CORT_4$; minute 108). After each collection, the RA immediately placed the cotton swab into a storage tube and placed the tube in a freezer where it remained until transported to a laboratory for salivary cortisol analyses.

Experimental Manipulations. I pseudo-randomly assigned each participant to one of two experimental groups Mortality Salience Stress Test (MSST; $n = 24$), and Control ($n = 23$).

MSST. The RA instructed each participant to imagine auditioning for a place on the reality television show *Fear Factor* and read standardized instructions detailing the process of the audition while escorting the participant through the audition (see Appendix D for full script used for this group).

Phase 1. The experimenter administered the MSST thirty minutes after the participant entered the laboratory (see Figure 1, Panel A). The experimenter began by instructing the participant to "Prepare a brief five-minute speech describing the circumstances of your death in detail, the emotions and the thoughts of that death arouses in you, and what you think happened to you as you physically die and after you were physically dead" (instructions patterned after Landau, Solomon, Pyszczynski, & Greenberg, 2007, p. 479). This, according to the instructions, was a test of the participant's ability to withstand the psychological pressures associated with an appearance on *Fear Factor*. Participants received a blank sheet of paper and 10 minutes to prepare the speech in private.

Phase 2. After preparation (see Figure 1, Panel B), the participant was escorted by the experimenter to a room illuminated by a halogen lamp; this room contained a video camera and a panel of two judges seated behind a desk. Upon entering the room, the experimenter unexpectedly removed the participant's notes. Once in the room, the experimenter stood behind the participant and the judges then instructed the participant to present the prepared speech extemporaneously. If the participant stopped speaking before 5 minutes elapsed, the

judge of the opposite sex to the participant asked a set of standard prompting questions (e.g., "You still have time left, please continue" or "What is your ultimate fear and how do you think you will be able to overcome it in front of the camera?"). The experimenter remained in the room during this phase of the experiment.

Phase 3: Upon completion of the 5-min speech, the judge of the sex opposite to the participant introduced the mental arithmetic task; participants were required to subtract 17 from 2043, continuously, until they were prompted to stop after 5-minutes had elapsed. If an incorrect answer occurred, the same judged asked the participant to restart the process from 2043. The judge told the participant this procedure tested their ability to thinking under pressure. The experimenter remained in the room during this phase of the experiment.

Phase 4: Upon completion of the arithmetic task, the RA of the same sex then instructed the participant to "Submerge your dominant arm up to your elbow into this bucket of water for as long as possible, up to a maximum of 2 minutes." The water was cold (between 0º and 4ºC). The RA told the participant this task served to measure pain resilience and the ability to withstand the physical demands of the show. The experimenter and the judges watched the participant closely during this phase of the experiment.

Control group. Participants assigned to this condition experienced a procedure that mimicked elements of the MSST (see Figure 1, Panel B), but that was devoid of its purported stress-inducing components. The experimenter administered the Control procedure thirty minutes after the participant entered the laboratory (see Figure 1, Panel A). Rather than having to prepare a speech describing the circumstances of their own death, the researcher instructed participants to write a summary of everything that they had done that day; they were given 10 minutes to do so. The researcher then escorted participants to the same room used for the experimental condition. This time, however, the room was well lit, there was no bright lamp and no video camera, and there was no one else present in the room. Participants were asked to first stand and read aloud from a general interest magazine; they did so for 5 minutes. Thereafter, they were asked to count upwards in multiples of 5, starting from 0; they did so for 5 minutes. The final task was similar to the hand submersion task described above; this time, however, the water was warm (34-38 ºC).

Dependent variables.

Decision-making measures. The tasks described below captured data on participant decision-making performance.

*Iowa Gambling Task (IGT).*The IGT was administered to participants after the experimental manipulation, 52 minutes from the time the session had begun. The task is a

standardised, computerised version of the IGT (Bechara, 2007) whereby participants are required to develop a profitable monetary strategy in a presumable situation of uncertainty. In the task, there is a conflict between the probability of gaining an immediate large reward in two, long-term disadvantageous decks of cards (A and B) and the probability of gaining an immediate small reward in two, long-term advantageous decks of cards (C and D). Participants are not given any information regarding the relative advantages/disadvantages associated with each deck.

I measured IGT performance by subtracting the total number of AB cards from the total number of CD cards per 20 trials. I also calculated the total number of AB cards per 20 trials. The selection of more AB than CD cards indicated the kind of performance that is labelled as risk-taking behaviour in some studies (Lighthall et al., 2012; Preston et al., 2007).

Research into the reliability of the IGT has yet to be conducted (Buelow & Suhr, 2009) and was not discussed in the professional manual for the computerised IGT (Bechara, 2007). There is also limited evidence for the ecological validity of the IGT, as it is unclear what the relationship is between performance on the task and performance in a real-world assessment of decision making (Buelow & Suhr, 2009)

Online chatroom. Participants were also required to engage in a novel online decision-making environment, prior to and following the experimental manipulation (see Figure 1, Panel A). The task was designed to investigate whether participants, when anonymous, develop more risk-taking behaviours when under stress. A chatroom platform was modified specifically for this study to allow me to create a private chatroom for each participant. I constructed standardised chatroom scripts that could be loaded into the chatroom interface (Appendix E). The platform also allowed me to save chatroom conversations for later coding. Three confederates (2 of the opposite sex, and 1 of the same sex as the participant) were logged in to the chatroom at the same time as the participant. Although the confederates received no exact script for what they should say to each other and to the participant, each was each instructed to play the role of a specific type of personality; the same roles were enacted for each participant (Appendix F). There was no face-to-face contact between the three confederates and the participant.

Time 1. Before the stress-induction procedure, participants were instructed to 'kill time' in an online chatroom while allowing for the VU-AMS devise to normalise. The pre-manipulation script that had been loaded into the chatroom initiated an introductory tone: The participant could see, by reading the screen, that prior to his/her entry into the room there had been exchanges regarding biographical information, hobbies, year and course of study, and so

forth. In this way, the participant could get to know the personality of each of the others (i.e., the confederates) in the chatroom, and to become more comfortable with the nature and operation of the chatroom.

Time 2. After the stress-induction procedure, participants were again instructed to 'kill time' in the same chatroom. Although the same confederates were present in this chatroom, this time a post-manipulation script had been loaded into the chatroom platform. This script initiated a more racy and sexual tone than before. To set this tone, I constructed a script wherein the characters discussed their willingness to take a girl/boy home after meeting her/him for the first time at a party. While this topic was the centre of attention, the characters in the chatroom assumed different opinions on the matter. The participant was led to believe that s/he was joining this conversation in progress. Hence, this frank and sexual conversation allowed the participants to engage with different character personalities in a more personal manner than pre-manipulation. Importantly, this chatroom environment provided the participant with a context within which s/he could engage in a sexual tone, and display risk tendencies if so desired. Because the chatroom was a live, online platform that was not computer-generated according to specific odds, the outcomes of the participant's actions were uncertain, and constantly changing, depending on the character(s) with whom s/he chose to engage and the tone in which s/he chose to engage.

Data Management and Statistical Analyses

All analyses were completed using IBM® SPSS® Statistics Version 21. The study's design allowed for both within- and between-groups analyses. The threshold for statistical significance was set at $\alpha = .05$.

Before the inferential analyses, I made the appropriate steps toward ensuring that the data met all assumptions for each of the parametric tests used. Unless otherwise stated, all of the required assumptions were upheld for each statistical analysis.

Sample characteristics. Analysis of these characteristics sought to ensure that all participants, regardless of group assignment, were drawn from similar populations. Hence, 2 x 2 (Experimental Condition [stress/control] x Sex [male/female]) between-groups factorial ANOVAs were conducted on the data for participant age, BMI, and BDI-II, STAI-Trait, and Mini-K Short Form scores.

Experimental manipulation check. The following analysis examined the effectiveness of the experimental manipulation. For the outcome variable salivary cortisol, I conducted a 2 x 2 x 5 (Experimental Condition [stress/control] x Sex [male/female] x Time

[$CORT_B$/$CORT_1$/$CORT_2$/$CORT_3$/$CORT_4$) repeated-measures ANOVA. I followed up the ANOVA with planned comparisons testing pre-existing hypotheses about where exactly between- and within-group differences would exist.

Due to violations of the assumptions of normality, homogeneity of variance, and sphericity required for a repeated-measures ANOVA, it was necessary for me to perform log10 transformations on salivary cortisol data sets. Log transformations improved homogeneity of variance, and distributed the data somewhat more normally. In terms of sphericity, Mauchley's test remained significant salivary cortisol ($p < .001$). Hence, I used the Greenhouse-Geisser degrees of freedom correction in analyses of those data.

Performance on decision-making tasks. Separate sets of analyses examined performance on the IGT and in the chatroom.

IGT. I used 2 x 2 x 5 (Experimental Condition [stress/control] x Sex [male/female] x Trial Interval [20/40/60/80/100]) repeated-measures ANOVA to compare performance for (1) CD-AB cards, and (2) AB cards. These analyses replicate those of previous studies investigating the effect of stress on decision-making using the Iowa Gambling Task as a outcome measure (Preston et al., 2007; van den Bos et al., 2009).

I also used General Linear Modelling (GLM) to investigate predictors of IGT performance. I created a GLM, with interactions, to describe the influence of the stress hormone cortisol, as well as an individual's sex and life history strategy, on IGT performance. The model-creation process involved testing pre-existing hypotheses derived from (a) previous research on decision making under stress, and (b) evolutionary psychology, specifically theories pertaining to life history traits. Specifically, I removed one variable at a time, in order of decreasing complexity (i.e. I removed three-way interactions before two-way interactions), to make the parameter estimates more efficient. The set of predictors entered into the model were the dichotomous categorical variables sex and experimental condition, and the continuous variables Mini-K score (as a measure of LHS), and the third cortisol measurement ($CORT_2$; as a measure of stress). The outcome variable here was the overall difference between CD and AB cards selected over the course of the entire 100-trial run.

The model is unique in this literature in that it aims to predict the interaction of proximal and ultimate factors that influence an individual's decision-making, under stress, in a real-world context.

Chatroom task. The raw textual data from the chatroom was first coded into quantifiable data at Time 1: by (1) counting the number of conversation initiations made by

the participant, and (2) by counting the amount of personal information which the participant chose to divulge in the chatroom, and at Time 2: by rating participants risk; willingness to meet one of the strangers (confederates) in the chatroom. A coding manual is provided in Appendix G that illustrates how these outcome variables were derived from the chatroom text.

I used 2 x 2 (Experimental Condition [stress/control] x Sex [male/female]) factorial ANOVAs to analyse the data pertaining to the number of conversation initiations and amount of personal information divulged in the chatroom. The main analysis of the chatroom data, however, pertained to an individual's willingness to meet, in real-life, someone from the chatroom; this behaviour is a proxy for risk-taking behaviour in real-world circumstances. An ordinal scale between 0 *(no risk)* and 3 *(high risk)* was used as the outcome variable. The means by which participants were placed on this scale are described further in Appendix G. I used an ordinal Logistic Regression to investigate predictors of an individual's willingness (or not) to make this risky decision. The set of predictors entered into the model were the dichotomous categorical variables Sex and Experimental Condition, and the continuous variables Mini-K score (as a measure of LHS), and the second cortisol measurement ($CORT_1$). The outcome variable for the regression was 'risk'.

Results

Sample Characteristics

The data from one female participant (assigned to Stress-Female group) were excluded from all analyses because she opted withdraw from the study before completing the MSST. Hence, the final sample ($N = 47$) was constituted as follows: Stress-Female $n = 12$; Stress-Male $n = 12$; Relax-Female $n = 12$; and Relax-Male $n = 11$. Table 1 presents descriptive statistics for key characteristics of this sample.

Table 1
Sample Characteristics: Descriptive statistics (N = 47)

	Group			
Measure	Stress-Female (n = 12)	Stress-Male (n = 12)	Relax-Female (n = 12)	Relax-Male (n = 11)
Age	20.08 (2.19)	20.00 (0.85)	19.92 (1.16)	19.91 (1.30)
BDI-II	9.75 (6.52)	8.08 (6.44)	8.92 (7.24)	10.09 (9.15)
BMI	23.70 (3.31)	23.60 (2.71)	24.96 (3.75)	21.99 (1.81)
STAI-Trait	41.25 (9.67)	38.08 (10.09)	37.17 (8.42)	39.55 (12.05)
Mini-K Short Form	28.25 (13.47)	19.92 (10.02)	31.92 (14.03)	25.36 (9.92)

Note. Data presented are means, with standard deviations in parentheses. BDI-II = Beck Depression Inventory-Second Edition; BMI = body mass index; STAI = State-Trait Anxiety Inventory.

Age. Overall, the participant age range was 18-26 years (M = 19.98, SD = 1.42). The factorial ANOVA did not detect a significant (a) main effect for Experimental Condition, $F(1, 43) = 0.09$, $p = .765$, $\eta_p^2 = .002$, (b) main effect for Sex, $F(1, 43) = 0.01$, $p = .916$, $\eta_p^2 < .001$, and (c) interaction effect for Experimental Condition x Sex, $F(1, 43) = 0.01$, $p = .930$, $\eta_p^2 < .001$. Hence, it is evident that the average age for each of the groups did not differ significantly, and therefore one can assume that the results of the study were not confounded by between-group differences in age.

BDI-II scores. The mean BDI-II score for each of the four groups all fell in the 'minimal' depression range, thus indicating low levels of depressive symptomology across the sample (Beck et al., 1996). The factorial ANOVA detected no significant (a) main effect for Experimental Condition, $F(1, 43) = 0.07$, $p = .786$, $\eta_p^2 = .002$, (b) main effect for Sex, $F(1, 43) = 0.01$, $p = 0.909$, $\eta_p^2 < .001$, and (c) interaction effect for Experimental Condition x Sex, $F(1, 43) = 0.44$, $p = .513$, $\eta_p^2 = .010$. These data suggest there were no significant between-group differences in terms of depressive symptomology, and one can therefore assume that the results of the study were not confounded by pre-existing differences in mood states.

BMI. Although visual inspection suggested these data were distributed normally, Levene's test was significant ($p = .043$), indicating that variances were not equal across groups. Given that the test was barely significant, and that ANOVA is a robust statistical test, I continued with the factorial ANOVA in the conventional manner and without undue concern that the minor violation of the homogeneity of variance assumption would have a great impact on the results.

The factorial ANOVA detected no significant (a) main effect for Experimental Condition, $F(1, 43) = 0.04$, $p = .845$, $\eta_p^2 = .001$, (b) main effect for Sex, $F(1, 43) = 3.05$, $p =$

.088, η_p^2 = .066, and (c) interaction effect for Experimental Condition x Sex, $F(1, 43) = 2.67$, $p = .110$, $\eta_p^2 = .058$. These data suggest that the results of the study were not confounded by pre-existing differences in participants' physiology.

STAI-Trait scores. The factorial ANOVA detected no significant (a) main effect for Experimental Condition, $F(1, 43) = 0.20$, $p = .659$, $\eta_p^2 = .005$, (b) main effect for Sex, $F(1, 43) = 0.18$, $p = .894$, $\eta_p^2 < .001$, and (c) interaction effect for Experimental Condition x Sex, $F(1, 43) = 0.89$, $p = .352$, $\eta_p^2 = .020$. These data suggest that there were no between-group differences in pre-existing general levels of anxiety. Hence, the results of the study were not confounded by such differences.

Mini-K Short Form scores. The factorial ANOVA detected no significant (a) main effect for Experimental Condition, $F(1, 43) = 1.68$, $p = .202$, $\eta_p^2 = .038$, and (b) no interaction effect for Experimental Condition x Sex, $F(1, 43) = 0.06$, $p = .802$, $\eta_p^2 = .001$. It did, however, detect a significant main effect for Sex, $F(1, 43) = 4.47$, $p = 0.040$, $\eta_p^2 = .094$. The suggestion here, then, is that men and women, regardless of experimental condition assignment, differed in their individual relational and sexual motives when confronting and responding to environmental challenges. Individual differences that are related to sets of behavioural strategies that increase individual reproductive success within a given environmental context are well noted in the literature; generally, women are measured as having a slower LHS than men (MacDonald, 1998; Figueredo et al., 2005; Griskevicius, Tybur, Delton, & Robertson, 2011).

Experimental Manipulation Check

Table 2 provides descriptive statistics for cortisol as a physiological measure of stress. The statistics for heart rate measurements and state anxiety levels for participants can be found in Appendix C.

Table 2
Self-Report and Physiological Measures of Stress: Descriptive statistics (N = 47)

Measure	Group			
	Stress-Female (n = 12)	Stress-Male (n = 12)	Relax-Female (n = 12)	Relax-Male (n = 11)
Cortisol Level				
$CORT_B$	7.87 (1.38)[a]	15.84 (1.32)	10.11 (1.32)	11.78 (1.38)
$CORT_1$	9.88 (4.98)[a]	22.84 (8.28)	8.58 (2.16)	8.58 (2.56)
$CORT_2$	10.46 (1.48)[a]	23.26 (1.42)	8.90 (1.42)	8.93 (1.48)
$CORT_3$	9.21 (4.15)[a]	18.07 (5.31)	8.11 (1.86)	9.18 (1.86)
$CORT_4$	7.68 (0.81)[a]	15.00 (0.78)	7.98 (0.78)	8.68 (0.81)
Cortisol Change				
$CORT_{\Delta 1}$	2.01[a]	7.00	-1.53	-3.20
$CORT_{\Delta 2}$	2.58[a]	7.42	-1.20	-2.85
$CORT_{\Delta 3}$	1.34[a]	2.23	-2.00	-2.60
$CORT_{\Delta 4}$	-0.2[a]	-0.84	-2.13	-3.10

Note. Data presented are means, with standard deviations in parentheses. Cortisol levels are measured in nanomoles per litre (nmol/l). $CORT_B$ = Baseline cortisol measurement; $CORT_1$ = 2nd cortisol measurement; $CORT_2$ = 3rd cortisol measurement; $CORT_3$ = 4th cortisol measurement; $CORT_4$ = 5th cortisol measurement.[a]n = 11. $CORT\Delta_1 = CORT_1 - CORT_B$; $CORT\Delta_2 = CORT_2 - CORT_B$; $CORT\Delta_3 = CORT_3 - CORT_B$; $CORT\Delta_4 = CORT_4 - CORT_B$.

Physiological stress measures. Here, I report on the salivary cortisol data.

Salivary cortisol. Data for one participant in the SF group were excluded from all analyses using cortisol as an output variable because her cortisol levels were unusually higher than the rest of the sample. Her baseline cortisol level (394.10 nmol/l) was 165 standard deviations above the mean of the group to which she had been assigned (M = 7.87, SD = 1.38). Her final (Time 4) cortisol sample (267.10 nmol/l) was 93 standard deviations above the mean of the SF group at Time 4 (M = 7.68, SD = 0.81). Hence, it is possible that there were errors in data collection and/or cortisol analysis for this participant's saliva samples.

Dale Stephen 13/10/23 9:52 AM
Deleted:

Figure 3 shows the fluctuations in participants' cortisol levels across the 2-hour experimental session. Visual inspection of the figure suggests that participants in the Stress Male group experienced marked elevations of cortisol post-manipulation, but that participants in the Stress-Female group experienced only mild elevations. There was little to distinguish participants in the two Relax groups; both sets of participants appeared to maintain relatively low cortisol levels throughout.

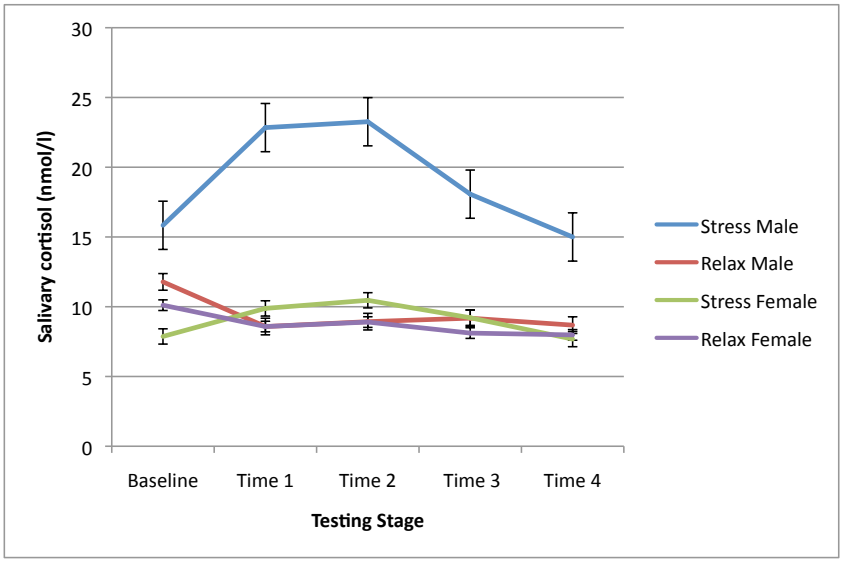


Figure 3. Salivary cortisol levels across the experimental session for the four groups separately. Error bars indicate standard error of means, with 95% confidence interval.

Results from the factorial ANOVA supported this impression. The analysis detected statistically significant main effects for Experimental Condition, $F(1, 42) = 16.10$, $p < .001$, $\eta_p^2 = .277$, for Sex, $F(1, 42) = 25.55$, $p < .001$, $\eta_p^2 = .378$, and for Testing Stage, $F(2.56, 94.85) = 11.63$, $p < .001$, $\eta_p^2 = .217$. It also detected the following significant interaction effects: Experimental Condition x Testing Stage, $F(2.26, 94.85) = 22.28$, $p < .001$, $\eta_p^2 = .347$, Experimental Condition x Sex, $F(1, 42) = 17.96$, $p < .001$, $\eta_p^2 = .300$, and Experimental Condition x Sex x Testing Stage, $F(2.26, 94.85) = 3.42$, $p = .031$, $\eta_p^2 = .075$. The interaction between Sex and Testing Stage was not significant, $F(2.25, 94.85) = 0.14$, $p = .889$, $\eta_p^2 = .003$.

Planned contrasts revealed significant differences at baseline between SM and SF groups, $F(2, 155) = 11.11$, $p < .001$, and between the SM and CM groups, $F(1, 105) = 4.61$, $p = .034$. In the light of this between-group difference in baseline cortisol, it was important to focus on the change in cortisol levels in the Stress-Male and Stress-Female groups. Therefore, I used difference scores as outcome data in the subsequent analysis of cortisol levels. To obtain these scores I subtracted the baseline measure from those at the second, third, fourth and fifth measurement points as follows:

$$CORT_{\Delta 1} = CORT_1 - CORT_B$$

$$CORT_{\Delta 2} = CORT_2 - CORT_B$$

$CORT_{\Delta 3} = CORT_3 - CORT_B$

$CORT_{\Delta 4} = CORT_4 - CORT_B$

The repeated-measures ANOVA run on these difference-score data detected a significant main effect for Time, $F(3, 126) = 9.47$, $p < .001$, $\eta_p^2 = .184$, and a significant main effect for Experimental Condition, $F(1, 42) = 4.03$, $p = .050$, $\eta_p^2 = .09$. It did not, however, detect a significant main effect for Sex, $F(1, 42) = 0.60$, $p = .444$, $\eta_p^2 = .01$.

Regarding interaction effects, the analysis detected no significant Experimental Condition x Sex interaction, $F(1, 42) = 0.02$, $p = .877$, $\eta_p^2 = .01$. It did, however, detect the following significant interaction effects: Time x Experimental Condition, $F(1, 42) = 79.68$, $p < .001$, $\eta_p^2 = .66$, Time x Sex, $F(1, 42) = 7.76$, $p = .008$, $\eta_p^2 = .156$; and Time x Experimental Condition x Sex, $F(1, 42) = 18.13$, $p < .001$, $\eta_p^2 = .30$. Figure 4 illustrates these significant differences between the Stress and Control condition, but also shows that these significant differences in cortisol levels occur at particular time points only.

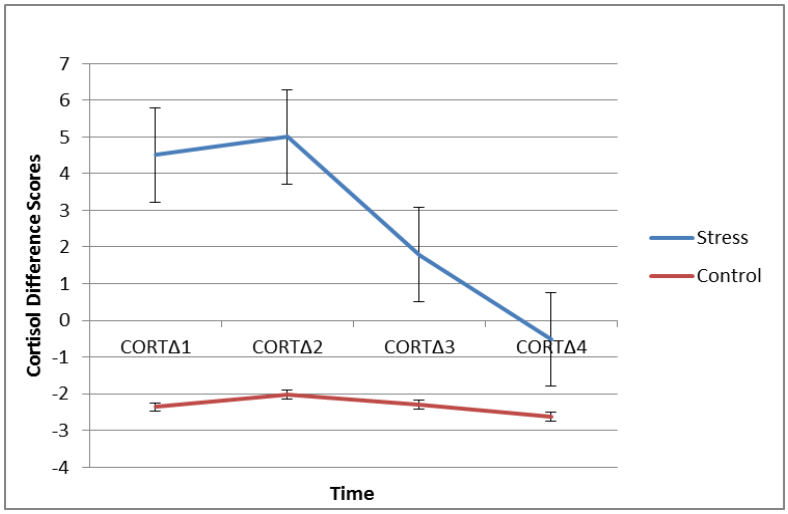


Figure 4. Changes in cortisol levels (measured in nmol/l) for the combined Stress and Control groups. Error bars indicate standard error of means.

I investigated the Time x Experimental Condition interaction further using planned contrasts. These analyses revealed significant differences in mean cortisol levels between the combined Stress and Control groups at the first three measurement points: $CORT_{\Delta 1}$, $F(1, 175) = 39.46$, $p < .001$; $CORT_{\Delta 2}$, $F(1, 175) = 41.27$, $p < .001$; and $CORT_{\Delta 3}$, $F(1, 175) = 13.64$, $p < .001$. There was no significant difference between the Stress and Control condition at

$CORT_{\Delta 4}$, $F(1, 175) = 0.57$, $p = .452$. Hence, results indicated that Stress-group participants showed elevated cortisol responses in comparison to Control participants at all points in the study, except for the last measurement.

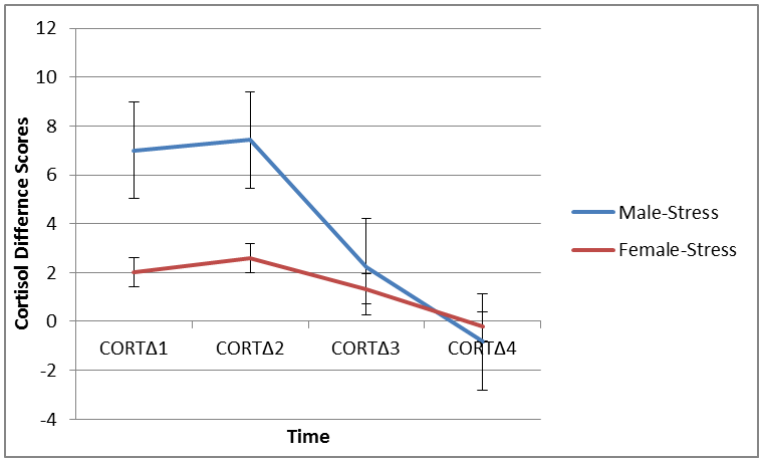


Figure 5. Changes in cortisol levels for the SM and SF groups. Error bars indicate standard error of means.

Figure 5 shows the differences in cortisol responses across time for the SM and SF groups. I conducted a set of planned contrasts on these data to investigate our hypothesis regarding sex differences in cortisol responses. At $CORT_{\Delta 1}$, $CORT_{\Delta 2}$, and at $CORT_{\Delta 3}$ the SM group demonstrated significantly higher average values than the SF group, $F(2, 124) = 18.85$, $p < .001$, $F(2, 124) = 19.24$, $p < .001$, and $F(2, 124) = 73.37$, $p = .013$ respectively. There were no significant differences at $CORT_{\Delta 4}$, however; $F(2, 124) = 0.43$, $p = .649$.

What these data suggest is that men in the Stress group demonstrated, immediately following and at 40 minutes after the manipulation, significantly higher elevations in their cortisol responses to the MSST than women. However, they were not able to sustain this elevated response until the conclusion of the measurements at 55 minutes post-manipulation.

Performance on Decision-Making Tasks

Here, I report first on the analyses of data from the IGT, and then on analyses of data from the chatroom.

IGT. As noted earlier, there were two major outcome variables here. The first was the total number of AB cards selected subtracted from the total number of CD cards selected,

measured at five equally-spaced intervals (20, 40, 60, 80, and 100 trials). The second was the total number of AB cards selected, measured at the same five intervals.

CD-AB cards. Figure 4 shows the data for this outcome measure in the combined Stress and Relax groups. Visual inspection of the figure suggests that there was little to distinguish the groups: Participants in both Stress and Relax condition gradually chose more conservative than risk cards. At the fifth interval, it appears as if participants in both conditions chose the same amount of conservative over risk cards.

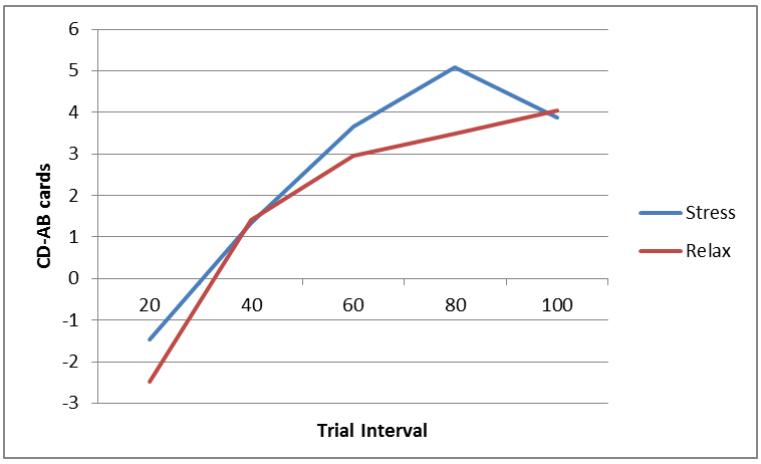


Figure 4. Iowa Gambling Task performance. The selection of conservative (decks C and D) over risk (decks A and B) cards for participants in the combined Stress and Relax groups. Error bars indicate standard error of means, with 95% confidence interval.

Results from the factorial supported, generally, those impressions. The analysis did not detect a significant main effect for Sex, $F(1, 43) = 0.99$, $p = .325$, $\eta_p^2 = .023$, or for Experimental Condition, $F(1, 43) = 0.13$, $p = .726$, $\eta_p^2 = .003$. It also did not detect any significant interaction effects: Sex x Experimental Condition, $F(1, 43) = 0.13$, $p = .719$, $\eta_p^2 = .003$, Trial Interval x Sex, $F(3.25, 139.59) = 0.35$, $p = .807$, $\eta_p^2 = .008$, Trial Interval x Experimental Condition, $F(3.25, 139.59) = 0.19$, $p = .918$, $\eta_p^2 = .004$, Trial Interval x Sex x Experimental Condition, $F(3.25, 139.59) = 0.62$, $p = .613$, $\eta_p^2 = .014$. It did, however, detect a significant main effect for Trial Interval, $F(3.25, 139.59) = 9.038$, $p < .001$, $\eta_p^2 = .174$.

AB cards. Figure 5 shows the data for this outcome measure in the combined Stress and Relax groups. Again, visual inspection of the figure suggests that there was little to distinguish the groups: Participants in both the Stress and Relax condition gradually chose less risk cards.

Results from the factorial ANOVA supported this impression. The analysis did not detect a significant main effect for Sex, $F(1, 43) = 2.23$, $p = .142$, $\eta_p^2 = .049$, or for Experimental Condition, $F(1, 43) = 0.025$, $p = .874$, $\eta_p^2 = .001$. It also did not detect any significant interaction effects: Sex x Experimental Condition, $F(1, 43) = 0.03$, $p = .874$, $\eta_p^2 = .00$, Trial Interval x Sex, $F(3.18, 136.84) = 0.35$, $p = .803$, $\eta_p^2 = .008$, Trial Interval x Experimental Condition, $F(3.18, 136.84) = 0.38$, $p = .782$, $\eta_p^2 = .009$, Trial Interval x Sex x Experimental Condition, $F(3.18, 136.84) = 0.69$, $p = .568$, $\eta_p^2 = .016$. It did, however, detect a significant main effect for Trial Interval, $F(3.18, 136.84) = 9.884$, $p < .001$, $\eta_p^2 = .187$.

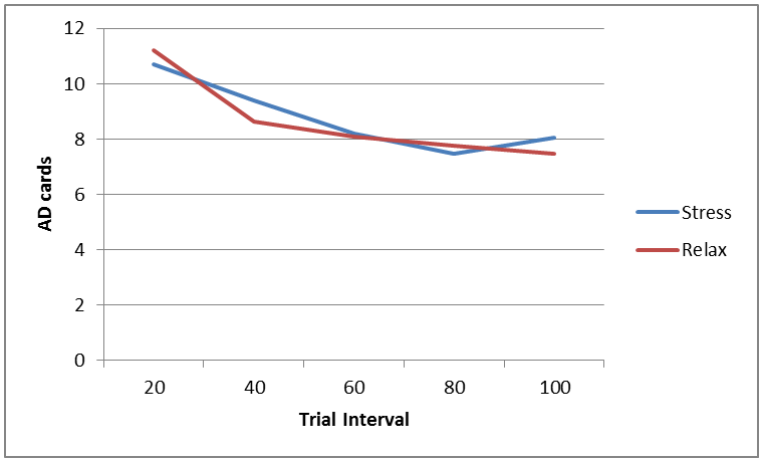


Figure 5. Iowa Gambling Task performance. The selection of risk cards (decks A and B) for participants in the combined Stress and Relax groups. Error bars indicate standard error of means, with 95% confidence interval.

General Linear Model (GLM). I used a GLM to construct a model that could best predict decision-making performance on the IGT. The outcome variable here was (CD-AB cards). The model is unique in this literature in that it aims to predict the interaction of proximal and ultimate factors that influence an individual's decision-making, under stress, in a real-world context.

Table 3
IGT Performance (CD-AB): General linear model (N = 46)

Predictor	Parameter Estimates	Type I Sum of Squares	*p*
Sex	81.22	768.3	.322
$CORT_2$	-4.71	559.6	.397
LHS	-1.08	20.8	.870
$CORT_2$*LHS	0.18	818.8	.307
Sex*LHS	-2.63	6309.1	.006

Note. $CORT_2$ = third cortisol measurement; LHS = life history strategy, as measured by Mini-K Short Form. For the model, $R^2 = .22$, and adjusted $R^2 = .12$. Degrees of freedom were (5, 40) in each case. For the entire model, $F(5, 40) = 2.22$, $p = .071$.

The best-fitting model (see Table 3) accounted for only 11.92% of the variance in the outcome. Although the interaction between Sex and LHS was a statistically significant predictor, the overall model itself did account for significant portion of the variance in the outcome. The interaction is unable to predict the outcome on its own, and its significance dissipates when the other factors are removed. Nevertheless, one might argue that there is a trend toward sex and LHS having an interactive effect on decision-making behaviour, as measured by the IGT. The discussion presents a more in-depth examination of this potential trend. Overall, however, the conclusion one must draw from this model is that neither sex, nor stress, nor LHS, nor any interaction between them, is able to predict decision-making performance on the IGT significantly. This result perhaps indicates that this task is not sensitive enough to capture stress-related sex differences in risk-taking behaviour.

Chatroom Task. As noted earlier, there were three major outcome variables here. The first was the total amount of conversation initiations, measured in the chartroom at Time 1. The second was the total amount of personal information given by the participant in the chatroom at Time 1; personal information that was coded for was age, sex, race, year and course of study, and place of residence. The third outcome variable was *risk*, measured on a scale ranging from 0 *(no risk)* to 3 *(high risk).* This information was coded at Time 2.

Time 1 Initiations. The factorial ANOVA detected no significant (a) main effect for Sex, $F(1, 43) = 1.86$, $p = .180$, $\eta_p^2 = .041$, (b) main effect for Experimental Condition, $F(1, 43) = 0.07$, $p = .789$, $\eta_p^2 = .002$, or (c) interaction effect for Sex x Experimental Condition, $F(1, 43) = 0.57$, $p = .457$, $\eta_p^2 = .013$.

Time 1 Personal Information. The factorial ANOVA detected no significant (a) main effect for Sex, $F(1, 43) = 0.21$, $p = .653$, $\eta_p^2 = .005$, (b) main effect for Experimental Condition, $F(1, 43) = 0.86$, $p = .358$, $\eta_p^2 = .020$. or (c) interaction effect for Sex x Experimental Condition, $F(1, 43) = 0.66$, $p = .421$, $\eta_p^2 = .015$.

Taken together, these data suggest that there were no pre-existing between-group differences in terms of willingness to participate in the chatroom.

Time 2 Risk: Ordinal logistic regression. The outcome variable modelled here is the willingness to take a risk (i.e., high risk is to make a proposition to someone in the chatroom, and to make plans to meet that individual in person) in the chatroom. The second measurement of cortisol ($CORT_1$) was used as the predictor, as this this was measurement was taken immediately prior to the chatroom task. The predictor variables were (in order of entry) Sex, $CORT_1$, LHS, $CORT_1$*LHS, Sex*LHS.

Table 4
Chatroom performance (Risk): Ordinal Logistic Regression (N = 46)

Variable	Variables in the Equation			
	B	SE	d*f*	Sig.
0 / 1	-0.962	.728	1	
1 / 2	-0.547	.721	1	
2 / 3	-0.314	.720	1	
LHS	-0.054	.026	1	.036

Score Test of Proportional Odds Assumption
Chi-square = .028 with 1 d*f* (*p* = .947)

The model suggests that, for every 1 unit increase in LHS, participants are less likely to be willing to make a 'risk' decision in the chatroom. The table illustrates that the lower an individual scores on LHS the more likely they are going to have a risk score of 3 and less likely to have a risk score of 0, the opposite is true for someone scoring high on LHS.

The overall model, using LHS as a predictor, is significant in predicting willingness to make 'risk' decisions in the chatroom ($p = .036$).

Discussion

Summary and Implications of Results

A growing body of research focuses on the intricate relationship between stress and decision-making (Lighthall et al., 2009; Mather et al., 2009, Preston et al., 2007; van den Bos

et al., 2009). To this point, the primary rationale driving such investigations has been neurobiological: increased levels of cortisol, a hormone released as part of the physiological stress response, are associated with reward-like properties related to sensation-seeking behaviour (Lighthall et al., 2012; Starcke & Brand, 2012). Hence, the experience of acute stress (the biological effects of which are indicated by elevated cortisol levels) has been proposed as a predictor of risk-taking behaviour. An important feature of the extant literature is that it describes male behaviour under stressful conditions as, exclusively, risk-taking; in contrast, it describes female behaviour under similar conditions as, predominantly, risk-aversive. These descriptions are, however, only of risk-taking behaviour as it relates to proximal factors (neurobiological changes); they make no connection between that behaviour, those proximal factors, and distal (or ultimate) determinants of human strategies in engaging the environment.

In this study, I described and tested an approach to investigating these sex differences as they occur in a real-world context; in doing so, I hoped to capture the contribution of ultimate determinants of decision-making behaviour. Sex differences in behaviour, cognition, of affect following stress exposure may, at least partially, be a function of how men and women respond differently to environmental challenges because of different evolved psychological mechanisms. The chatroom task provides a platform by which decision making under stress can be interpreted in light of adaptive functions pertaining to an individual's life history strategy (LHS; Brumbach et al., 2009).

I hypothesised that firstly (a) the stress induction paradigm would produce both HPA-axis and ANS activity in males and females, and that under stress (b) men are more risk-taking than women, (c) women make more conservative decisions compared to relaxed women, (d) men become more risk-taking compared to relaxed men, and that (e) individuals with a fast LHS show more risk-taking behaviour than individuals with a slow LHS. Below, I discuss the results of the tests of these hypotheses, and the implications for the field and for theory given (dis)confirmation of the hypotheses.

Before I address these hypotheses, however, it is important to note that that the Mortality Salience Stress Test (MSST) proved a successful stress-induction procedure. Analyses indicated that exposure to the MSST raised self-reported anxiety and autonomic activity (as measured by heart rate) significantly and successfully in both men and women. In terms of salivary cortisol response, the same pattern was evident for men; women, on the other hand, exhibited only mild elevations in salivary cortisol levels after exposure to the MSST.

This sex difference in cortisol response is consistent with previous observations (Lighthall et al., 2009; Lighthall et al., 2012; van den Bos et al., 2009), and is one reason why many studies in this field (e.g., Putman et al., 2010) have used all-male samples. In general, sex differences in cortisol response can be attributed to fluctuations in responsivity across the menstrual cycle (the responses of women are only similar to those of men when they are in the luteal phase of the cycle), or to the effects of oral contraceptives. I controlled, via recruitment, for both of these modulating effects, however. Hence, there are perhaps only two viable explanations for the observed sex differences. One is that the MSST is too much of an achievement challenge (i.e., whereas women perceive social rejection challenges to be more stressful, men perceive achievement challenges as more stressful) and does not have enough aspects of a social rejection challenge (i.e., that elicits greater cortisol responses in women). Previous studies suggest that women have significantly elevated cortisol responses when faced with social rejection challenges, but not when faced with an achievement challenge (Stroud, Salovey, & Epel, 2002). A second explanation, not necessarily inconsistent with the first, is that there might be an evolutionary, adaptive mechanism that inhibits, in social situations, the HPA-axis response in women. One implication of such inhibition is that, in women, the rational-analytical system for making decisions is not compromised by stress exposure; in theory, then, women are able to make more calculated decisions under stress, whereas men make faster and more risky decisions (behaviour consistent with more automatic, and thus less deliberative and rational, processing; Porcelli & Delgado, 2009). This proposal is, in fact, supported by empirical data (Lighthall et al., 2009; Preston et al., 2007).

Those empirical data emerge, however, from proximally-focused investigations of decision-making under stress. The assumptions that emerge from this literature ignore the context in which decisions are made in real-life circumstances. The data presented here provide evidence that studying the effects of stress on cognitive performance in healthy individuals must be contextualised to behaviour in the real-world. A comprehensive review regarding the construct validity of the IGT has yet to be formed; the assessment of whether a test actually measures the construct it claims to measure, in this case, risky decision making. The developers of the IGT did not define the construct of decision-making beyond this construct, and so there is the need to capture these using more ecological valid measures of decision making.

Analyses of IGT performance in my study showed that participants, regardless of Sex in both the Stress and Relax conditions, were able to learn a pattern for choosing cards that

would ensure a long-term advantageous outcome; participants were less likely to choose from the 'risky decks', as the long-term outcome of such selection was always disadvantageous. These results disconfirm the first three hypotheses made; there are in fact no sex differences in risk-taking behaviour, and that stress does not affect risk-taking propensities in males and females. One might argue, then, that the IGT was not a sensitive enough measure to elicit stress-related impairment in decision-making. Such differences are more likely to be observed in more subtle interactions that exist in the daily functioning of healthy participants.

Notably though, there has been literature to suggest that, using the IGT as a measure of decision making, stress-related impairment does exist, and that there are sex differences in such behaviours (Preston et al., 2007; van den Bos et al., 2009). In my study the task was used in the same manner as in this literature, and so my only plausible explanation for these differences could possibly be related to having sampled from a different population or that my sample size ($N = 47$) was not large enough to detect statistically significant differences. However, there has been literature to suggest that sex differences in decision making under stress are only observed in older adults. As the average age of my sample is 20, there is an argument that these different adaptive behaviours between men and women only emerge in older individuals, as they become more vulnerable to adaptive challenges.

Nevertheless, my results, while in contrast to the abovementioned studies on stress and decision making may reflect the correct pattern of behaviour on the IGT, when under acute psychosocial stress. I emphasise that risk decisions are not made when outcome probabilities are specified (as happens in the IGT), but instead arise when there is variation to outcomes, their likelihoods, and their subjective values (Pratt, 1964; Arrow, 1965). If risk decisions were merely a probabilistic calculation as some (e.g., Starke & Brand, 2009) suggest they are, I then argue that there would be no 'risk' involved considering the desired outcome could knowingly be achieved without the potential for loss. Researchers have nevertheless continued to investigate risk-taking behaviour, without fully understanding the nuances of decision-making under risk. Appropriate comments on risk-taking behaviour can only be deduced provided its assessment and theoretical assumptions match the operationalization of making risk decisions in real-life interactions.

The present study described a framework by which differences in decision-making behaviour are viewed as a function of individual differences in LHS. I attempted to construct a model that could predict decision-making behaviour on this task. Although I did find that the interaction between Sex and LHS was a significant predictor, the overall model was not significant. Further, building a model with only this interaction proved unsuccessful, as its

effect dissipated when all other variables were removed from the model. Hence, I was unable to predict performance on the IGT using cortisol, LHS, and sex as predictor variables, and for the time being my final hypothesis had been disconfirmed.

In summary, the IGT results suggest that healthy participants, whether under stress or not, show similar decision-making tendencies. I suggest that this is most likely because the IGT is not sensitive to individual differences in risk-taking behaviour in a healthy population; it does not reflect differences in behaviour as it is enacted under real-life circumstances. Typically the task has, primarily, been used in clinical populations, where it is able to distinguish, for instance, between impaired decision-making capabilities in brain-damaged patients compared to healthy controls (Bechara, Damasio, & Anderson, 1994). Despite this fact, at least three recent studies have related IGT performance of healthy individuals to risk-taking propensities (Lighthall et al., 2009; Mather et al., 2009; Preston et al., 2007; van den Bos et al., 2009). What these studies fail to account for is that risk-taking behaviour does not only refer to one's ability to make a decision; it also reflects individual differences in responding to differing environmental contingencies. Hence, the novelty of this study is that it attempts to provide a methodological and theoretical framework within which one can capture and interpret these more subtle individual differences in decision-making behaviour. Specifically, it demonstrated how these differences might serve as adaptive functions pertaining to an individual's LHS.

The chatroom task has, unlike the IGT, been designed to investigate decision-making during real-life interactions among healthy subjects. The chatroom task is a useful means by which to do this considering that the majority of human interaction is now performed through the 21st century hub that is social media (Qualman, 2012). As the chatroom is representative of more real-life interactions, it was thus possible to interpret subtle behavioural differences in decision-making and how these may represent risk-taking propensities.

Importantly, while the analysis was successful in constructing a model to predict an individual's willingness to take risks in the chatroom, cortisol did not act as a significant predictor. Thus, like in the IGT, participants were just as likely to take risks if they were in the stress or relax groups. However, the primary objective of this study was nevertheless to present an alternative framework by which to consider individual differences in decision-making. As such, the logistic regression was hugely successful in that it found LHS to (a) be a significant predictor while (b) being the sole contributor to a statistically significant model predicting an individual's willingness to take a risk on the chatroom task. The results from the logistic regression suggest that, regardless of Sex or elevated stress levels, an individual

with a fast life history strategy is more likely to be willing to take risks, as opposed to a slow life history strategist, who is more likely to display conservative tendencies.

With regards to the hypotheses outlined earlier, the results suggested (a) the stressor used was effective in eliciting appropriate responses in males but not females, (b) men and women did not differ in their decision making, (c) stress had no influence on decision making behaviour and that (d) as the hypothesis stated individuals, regardless of sex, with a fast LHS presented with more risk-taking behaviour than individuals with a slow LHS. In summary this study provides an illustration of individual differences in decision-making under stress that are driven by distal determinants of behaviour, that being life history strategy.

Limitations and Directions for Future Research

Sex differences in cortisol response. Although the acute psychosocial stressor increased cortisol levels from baseline, the effects were only significant for men. In the Stress-Male group, the average cortisol increase from baseline to the time of highest cortisol response ($CORT_3$) was 7.42 nmol/l. Based on values reported elsewhere (Mather et al., 2009; van den Bos et al., 2009, Youssef et al., 2012), this increase appears to be of moderate-to-high magnitude. In the Stress-Female group, the (non-significant) average increase in cortisol from baseline to the time of highest cortisol response ($CORT_3$) was 2.58 nmol/l. This sex difference is important to note, as it might have affected participants' decision-making performance.

To handle such sex differences, some studies designate participants as cortisol responders and cortisol non-responders, and then further analyse the data from there. For instance, having noted that men and women subjects differed in the absolute levels of elevated salivary cortisol following exposure to the TSST, van den Bos et al. (2009) compared control participants, women with small responses, men with small responses, women with large responses, and men with large responses. They then found between-group differences in decision-making performance on the IGT. The current sample was too small to conduct such an analysis, and this might be one reason why I did not observe such stress-related performance differences on that task. Hence, I suggest that future research employ such designs and comparisons when testing cognitive performance under stress.

Chatroom task. Although the task measure was largely successful in fulfilling its purpose, there are many improvements that can be made in an attempt to provide more ecologically valid measures of decision making under stress.

Life History Strategy. The current study measured the construct of LHS in men and women from a sample of undergraduate university students. Work on life history traits suggests that individuals who attend university are currently investing in somatic effort (Brumbach et al., 2009), and so are more likely oriented toward a slow LHS. Although the current sample likely drew from a diverse set of backgrounds, the range of Mini-K scores were positively skewed. This limitation can be addressed in future research by obtaining data from a larger and more diverse sample of individuals, and by not limiting sampling to a tertiary education institution.

Summary, Conclusion and Significance

The results from the chatroom task suggest that individual differences in responding to differing environmental contingencies have a significant impact on cognitive performance. Particularly, I have shown that for healthy participants, the effects of stress do not emerge in individual differences for decision-making behaviour. Instead, people, in everyday circumstances, differ in their decisions in a response that best suits their LHS. Furthermore, these subtle differences in decision-making have been shown to manifest as risk-taking behaviour. The results presented thus reject all alternate hypotheses, bar the last; individuals with a fast LHS have been shown to be more 'risk-taking' than individuals with a slow LHS. It is evident that individuals make different kinds of decisions according to more distal determinants, more specifically according to differences in life history strategy.

The novelty of the study has been to describe decision making under stress from a more holistic perspective than has been done in previous research; the chatroom task provided a methodological and theoretical framework by to do so. The research presented makes an important contribution to research on cognitive functioning and specifically decision making, by illustrating that individual differences in decision making serve as an adaptive function pertaining to an individual's life history research. The integration of laboratory work within a distal framework by which we coexist is an important consideration that this study has demonstrated.

References

Alderson, A. L. & Novack, T. A. (2002). Neurophysiological and clinical aspects of glucocorticoids and memory: A review. *Journal of Clinical and Experimental Neuropsychology, 24,* 335-355.

Balleine, B. W. (2007). The neural basis of choice and decision making. *The Journal of neuroscience, 27*, 8159-8160.

Bechara, A. (2007). Iowa Gambling Task professional manual. Lutz, FL: Psychological Assessment Resources.

Bechara, A., (2004). The role of emotion in decision-making: Evidence from neurological patients with orbitofrontal damage. Brain and Cognition, 55, 30-40.

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50,* 7–15.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory manual (2nd ed.)*. San Antonio, TX: Psychological Corporation.

Bhatia, K. & Marsden, C. (1994). The behavioral and motor consequences of focal lesions of the basal ganglia in man. *Brain, 117,* 859-876.

Bolla, K., Elderth, D., Matochik, J., & Cadet, J. (2004). Sex-related differences in a gambling task and its neurological correlates. *Cerebral Cortex, 14,* 1226-1232.

Brand, M., Fujiwara, E., Borsutzky, S., Kalbe, E., Kessler, J., & Markowitsch, H. J. (2005). Decision-making deficits of Korsakoff patients in a new gambling task with explicit rules: associations with executive functions. *Neuropsychology, 19,* 267-277.

Brand, M., Labudda, K., & Markowitsch, H. J. (2006). Neuropsychological correlates of decision-making in ambiguous and risky situations. *Neural Networks, 19*, 1266-1276.

Brumbach, B. H., Figueredo, A. J., & Ellis, B. J. (2009). Effects of harsh and unpredictable environments in adolescence on development of life history strategies. *Human Nature, 20,* 25–51.

Buelow, M.T., & Suhr, J. A. (2009). Construct validity of the Iowa Gambling Task. *Neuropsychologcial Review, 19*, 102-114.

Damasio, A. R. (1994). *Descartes' error: Emotion, reason, and the human brain.* New York, NY: Putnam.

Delgado, M. (2007). Reward-related responses in the human striatum. In B. Balleine (ed.), *Reward and decision making in corticobasal ganglia networks* (pp. 70-88). Boston, MA: Blackwell.

Dozois, D. J. A., Dobson, K. S., & Ahnberg, J. L. (1998). A psychometric evaluation of the Beck Depression Inventory-II. *Psychological Assessment, 10*, 83-89.

Dunkel, C. S., & Decker, M. (2010). Convergent validity of measures of life-history strategy. *Personality and Individual Differences, 48,* 681-684.

Dunkel, C. S., Mathes, E., & Decker, M. (2010). Behavioral flexibility in life history strategies: The role of life expectancy. *Journal of Social, Evolutionary and Cultural Psychology, 4*, 51–61.

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk. *Human Nature, 20,* 204–268.

Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in intuitive-experiential and analytical-rational thinking styles. *Journal of Personality and Social Psychology, 71,* 390-405.

Figueredo, A. J., Vásquez, G., Brumbach, B. H., Schneider, S. M. R., Sefcek, J. A., Tal, I. R., … Jacobs, W. J. (2006). Consilience and life history theory: From genes to brain to reproductive strategy. *Developmental Review, 26,* 243–275.

Fraser, R., Ingram, M.C., Anderson, N.H., Morrison, C., Davies, E. & Connell, J.M.C. (1999). Cortisol effects on body mass, blood pressure and cholesterol in the general population. *Hypertension, 33*, 1364-1368.

Garde, A. H., & Hansen, Å, M. (2005). Long-term stability of salivary cortisol. *Scandinavian Journal of Clinical & Laboratory Investigation*, 65, 433-436.

Gladden, P. R., Figueredo, A. J., & Snyder, B. (2010). Life History strategy and Evaluative Self-Assessment*. Personality and Individual Differences, 48*, 731–735.

Griskevicius, V., Delton, A. W., Robertson, T. E., & Tybur, J. M. (2011). Environmental contingency in life history strategies: The influence of mortality and socioeconomic status on reproductive timing. *Journal of Personality and Social Psychology, 100*, 241.

Kirschbaum, C., Pirke, K-M., & Hellhamer, D. H. (1993). The 'Trier Social Stress Test' – a tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology, 28,* 76-81.

Kudielka, B., Hellhammer, D., & Wüst, S. (2009). Why do we respond so differently? Reviewing determinants of human salivary cortisol responses to challenge. *Psychoneuroendocrinology, 34*, 2-18.

Kudielka, B., & Kirschbaum, C. (2005). Sex differences in HPA axis responses to stress: a review. *Biological Psychology*, *69,* 113-132.

Kudielka, B. M., Schommer, N. C., Hellhammer, D. H., & Kirschbaum, C. (2004). Acute HPA axis responses, heart rate, and mood changes, to psychosocial stress (TSST) in humans at different times of day. *Psychoneuroendocrinology, 29,* 983-992.

Labudda, K., Brand, M., Mertens, M., Ollech, I., Markowitsch, H., & Woermann, F. (2010). Decision making under risk condition in patients with Parkinson's disease: a behavioural and fMRI study. *Behavioural Neurology*, *23*, 131-143.

Lueken, U., Leisse, M., Mattes, K., Naumann, D., Wittling, W., & Schweiger, E. (2009). Altered tonic and phasic cortisol secretion following unilateral stroke. *Psychoneuroendocrinology, 34,* 402-412.

Lie, C., Specht, K., Marshall, J. C., & Fink, G. R. (2006). Using fMRI to decompose the neural processes underlying the Wisconsin Card Sorting Test. *Neuroimage, 30*, 1038-1049.

Lighthall, N., Mather, M., & Gorlick, M. (2009). Acute stress increases sex differences in risk seeking in the Balloon Analogue Risk Task. *Plos One, 4,* 1-6.

Lighthall, N., Sakaki, M., Vasunilashorn, S., Nga, L., Somayajula, S., Chen, …Mather, M. (2012). Gender differences in reward-related decision processing under stress. *Social Cognitive and Affective Neuroscience, 7,* 476-484.

Mather, M., Gorlick, M. A., & Lighthall, N. R. (2009). To brake or accelerate when the light turns yellow? Stress reduces older adults' risk taking in a driving game. *Psychological Science, 20*, 174-176.

Platt, M. L., & Huettel, S. A. (2008). Risky business: The neuroeconomics of decision making under uncertainty. *Nature Neuroscience, 11*, 398-403.

Porcelli, A., & Delgado, M. (2009). Acute stress modulates risk taking in financial decision making. *Psychological Science, 20*, 278-283.

Preston, S. D., Buchanan, T. W., Stansfield, R. B., & Bechara, A. (2007). Effects of anticipatory stress on decision making in a gambling task. *Behavioral Neuroscience, 121*, 257-263.

Pruessner, J., Dedovic, K., Pruessner, M., Lord, C., Buss, C., Collins, …Lupien, S. (2010). Stress regulation in the central nervous system: Evidence from structural and functional neuroimaging studies in human populations. *Psychoneuroendocrinology, 35*, 179-191.

Putman, P., Antypa, N., Crysovergi, P., & van der Does, W. A. (2010). Exogenous cortisol acutely influences motivated decision making in healthy young men. *Psychopharmacology, 208,* 257-263.

Qualman, E. (2012). *Socialnomics: How social media transforms the way we live and do business.* John Wiley & Sons.

Reyna, V. F., & Brainerd, C. J. (2011). Dual processes in decision making and developmental neuroscience: A fuzzy-trace model. *Developmental Review,31*, 180-206.

Sapolsky, R., Romero, L. M., & Munck, A. (2000). How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. *Endocrine Reviews, 21*, 55-89.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State–Trait Anxiety Inventory*. Palo Alto, California: Consulting Psychologists Press.

Starcke, K., & Brand, M. (2012). Decision making under stress: A selective review. *Neuroscience and Biobehavioral Reviews, 36*, 1228-1248.

Stroud, L. R., Salovey, P., & Epel, E. S. (2002). Sex differences in stress responses: social rejection versus achievement stress. *Biological psychiatry, 52*, 318-327.

Tranel, D., Damasio, H., Denburg, N. L., Bechara, A. (2005). Does gender play a role in functional asymmetry of ventromedial prefrontal cortex? *Brain, 128,* 2872-2881.

Tritt, S., & Inzlicht, M. (2012). Toward a biological understanding of mortality salience (and other threat compensation processes). *Social Cognition, 30,* 715-733.

van den Bos, R., Harteveld, M., & Stoop, H. (2009). Stress and decision-making in humans: Performance is related to cortisol reactivity, albeit differently in men and women. *Psychoneuroendocrinology, 34*, 1449-1458.

Youssef, F., Dookeeram, K., Basdeo, V., Francis, E., Doman, M., Mamed, D, …Legall, G. (2012). Stress alters personal moral decision making. *Psychoneuroendocrinology, 37,* 491-498.

University of Cape Town
Psychology Department
Telephone: +27 21 650-3430
Fax: +27 21 650-4104

Appendix A

Informed Consent Form

Informed Consent to Participate in Research and Authorisation for Collection, Use, and Disclosure of Protected Health Information

This form provides you with information about the study and seeks your authorization for the collection, use and disclosure of your protected health information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your participation is entirely voluntary. Before you decide whether or not to take part, read the information below and ask questions about anything you do not understand. By participating in this study you will not be penalized or lose any benefits to which you would otherwise be entitled.

1. **Name of Participant ("Study Subject")**

_____

2. **Title of Research Study**

Meeting Strangers Online: Decision-making under acute psychosocial stress

3. **Principal Investigators, Ethics Committee, and Telephone Numbers**

Kevin G. F. Thomas, Ph.D.
Department of Psychology
University of Cape Town
021-650-4608
021-788-5536

Robyn Human, MA
PhD Candidate
Department of Psychology
University of Cape Town

Dale Stephen
Honours student

Faculty of Health Sciences
Research Ethics Committee
Room E52-24, Groote Schuur Hospital, Old Main Building
Observatory 7925
Tel: 021-406-6338
Fax: 021-406-6411
Email: lamees.emjedi@uct.ac.za

4. **What is the purpose of this research study?**

The purpose of this research study is to better understand how exposure to acute psychological stress affects cognitive performance. More specifically, we are interested in how the acute psychosocial stressor affects decision-making performance.

5. **What will be done if you take part in this research study?**

During this study, you will be required to complete a number of decision-making based tasks and may be required to complete a 20-minute presentation. Your levels of stress will be assessed through the collection of self-report data, heart rate measurements, and saliva samples with the aid of a cotton swab. These saliva samples will be used to analyse levels of cortisol, a stress hormone.

6. **What are the possible discomforts and risks?**

If you are one of the participants selected to complete the 20-minute presentation, you may be placed in a mildly stressful situation involving public speaking. Furthermore, you may be asked to place your hand in very cold water. There are no other discomforts and risks associated with participation in the study.

7. **What are the possible benefits of this study?**

One major benefit of this study is that scientists and society in general, will have better understanding of the effects of acute psychological stress on cognitive performance, and how individual differences may account for this relationship to some extent. This knowledge can then be applied to many different individuals and situations, including students who are taking exams, business managers who have to present to their boards, and so on.

8. **Can you withdraw from this research study and if you withdraw, can information about you still be used and/or collected?**

You may withdraw your consent and stop participation in this study at any time. Information already collected may be used.

9. **Once personal information is collected, how will it be kept confidential in order to protect your privacy and what protected health information about you may be collected, used and shared with others?**

Information collected will be stored in locked filing cabinets or in computers with security passwords. Only certain people - the researchers for this study and certain University of Cape Town officials - have the legal right to review these research records. Your research records will not be released without your permission unless required by law or a court order.

If you agree to be in this research study, it is possible that some of the information collected might be copied into a "limited data set" to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you.

Signatures

As a representative of this study, I have explained to the participant the purpose, the procedures, the possible benefits, and the risks of this research study; the alternatives to being in the study; and how the participant's protected health information will be collected, used, and shared with others:

_____ _____

Signature of Person Obtaining Consent and Authorization Date

You have been informed about this study's purpose, procedures, and risks; how your protected health information will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree to participate in this study. You hereby authorize the collection, use and sharing of your protected health information. By signing this form, you are not waiving any of your legal rights.

_____ _____

Signature of Person Consenting and Authorizing Date

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

Method of contact:

Phone number: _____

E-mail address: _____

Mailing address: _____

University of Cape Town
Psychology Department
Telephone: +27 21 650-3430
Fax: +27 21 650-4104

Appendix B

Debriefing Form

Study Debriefing Form

Thank you for participating in the 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 Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also explain this study to you in full and answer all of your questions.

1. Name of Participant ("Study Subject")

_____

2. Title of Research Study

Meeting Strangers Online: Decision-making under acute psychosocial stress

3. Principal Investigators, Ethics Committee, and Telephone Numbers

Kevin G. F. Thomas, Ph.D.
Department of Psychology
University of Cape Town
021-650-4608

Robyn Human, MA
PhD Candidate
Department of Psychology
University of Cape Town
021-671-3273

Dale Stephen, BSocSc

BSocSc (Hons) Candidates

Department of Psychology

University of Cape Town

072-235-2009

Faculty of Health Sciences

Research Ethics Committee

Room E52-24, Groote Schuur Hospital, Old Main Building

Observatory 7925

Tel: 021-406-6338

Fax: 021-406-6411

Email: lamees.emjedi@uct.ac.za

4. What is the purpose of this research study?

The purpose of this research study is to better understand how exposure to acute psychological stress affects cognitive performance. More specifically, we are interested in what variables may moderate this relationship.

5. What was done during this research study?

During this study, you were required to complete a number of decision-making and risk-taking tasks and may have been required to complete a 12-minute presentation. Your levels of stress were assessed through the collection of self-report data, heart rate measurements, skin conductance measurements and saliva samples with the aid of a cotton swab. These saliva samples will be used to analyse levels of cortisol, a stress hormone.

6. Was any deception used in this research study?

If you were one of the participants selected to complete the 12-minute presentation, you will have been told that your verbal and non-verbal behaviour was being judged by a panel, and that you were being filmed in order to facilitate this evaluation. However, the panel was not judging you in any way, nor was the video camera actually recording your behaviour. Anything that you said or did in the "interview" will be kept completely confidential. In the study you were also asked to join a chatroom. Although you were led to believe that this was a live chatroom, it was in fact an artificial space that was facilitated by chatroom confederates.

7. Is anything further required of you?

Please do not disclose anything that happened during this research session 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 contact us and we will provide you with the contact details of a clinical psychologist who could provide you with post-session counselling.

If you are a female participant, you have been asked to let us know when your next menstrual cycle begins (i.e., to contact us on the first day of your next period).

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 and Authorization 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 and Authorizing Date

Appendix C

Self-report anxiety data and heart-rate measurements

I used the following instrument to collect information on participant affective state and physiological state before, during, and after the experimental manipulation.

State-Trait Anxiety Inventory (STAI). This instrument (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) features two separate sections: (1) the STAI-State, which measures an individual's anxiety at a specific point in time (state anxiety), and (2) the STAI-Trait, which measures general levels of anxiety (trait anxiety). Each form contains 20 statements that people have used to describe themselves. Participants are asked to indicate to what extent they can relate to each statement, with a required response range from 1 *(not at all)* to 4 *(very much so)*. The STAI-State measured subjective levels of anxiety at three time points during the study.

Heart rate. Heart rate measurements were taken throughout the 2-hour experimental session using a Vrije Universiteit Ambulatory Monitoring System, version 5fs (VU-AMS; Vrije Universiteit, Amsterdam, Holland). The VU-AMS is a portable, non-invasive device that is attached via electrodes to the participants' chest and abdominal region. Participants were thus able to move around and walk freely between the two study venues. The device measured heart rate continuously until it was removed at the end of the study.

Table
Self-Report and Physiological Measures of Stress: Descriptive statistics (N = 47)

	Group			
Measure	Stress-Female (n = 12)	Stress-Male (n = 12)	Relax-Female (n = 12)	Relax-Male (n = 11)
STAI-State				
Baseline	35.00 (8.46)	31.58 (5.99)	32.67 (7.64)	33.36 (7.38)
Post-condition	52.42 (12.49)	41.50 (9.66)	30.92 (4.23)	34.63 (9.58)
End	36.67 (9.36)	30.67 (9.23)	29.25 (4.29)	35.73 (11.26)
Heart Rate				
Baseline	73.74 (8.06)	77.27 (15.17)[a]	75.55 (8.58)	74.62 (12.25)
Post-condition	101.30 (11.54)	103.57(24.04)[a]	87.03 (9.69)	88.37 (14.88)
End	78.45 (7.11)	80.17 (17.70)[a]	75.44 (8.98)	75.38 (13.08)

Note. Data presented are means, with standard deviations in parentheses. Heart rate levels are measured in beats per minute (bpm). STAI = State-Trait Anxiety Inventory. [a]*n* = 10.

STAI-State scores. Figure 1 shows the fluctuations in the participants' self-reported state anxiety levels across the 2-hour experimental session. Visual inspection of the figure suggests that, at the Baseline and End measurement points, there was little to differentiate the combined Stress and Relax groups; at the Post-manipulation measurement point, however, participants in the Stress condition reported a spike in anxiety, whereas those in the Relax condition did not.

Results from the factorial ANOVA supported this impression. It detected significant main effects for Experimental Condition, $F(1, 43) = 6.42$, $p = .015$, $\eta_p^2 = .130$, and for Testing Stage, $F(2, 86) = 19.18$, $p < .001$, $\eta_p^2 = .308$, in the absence of a significant main effect for Sex, $F(1, 43) = 0.59$, $p = .448$, $\eta_p^2 = .013$. As expected, the analysis detected a significant Experimental Condition x Testing Stage interaction effect, $F(2, 86) = 19.10$, $p < .001$, $\eta_p^2 = .308$, but no other significant interaction effects: Experimental Condition x Sex, $F(1, 43) = 6.41$, $p = .015$, $\eta_p^2 = .130$; Sex x Testing Stage, $F(2, 86) = 1.17$, $p = .315$, $\eta_p^2 = .027$; Experimental Condition x Sex x Testing Stage, $F(2, 86) = 2.44$, $p = .093$, $\eta_p^2 = .054$.

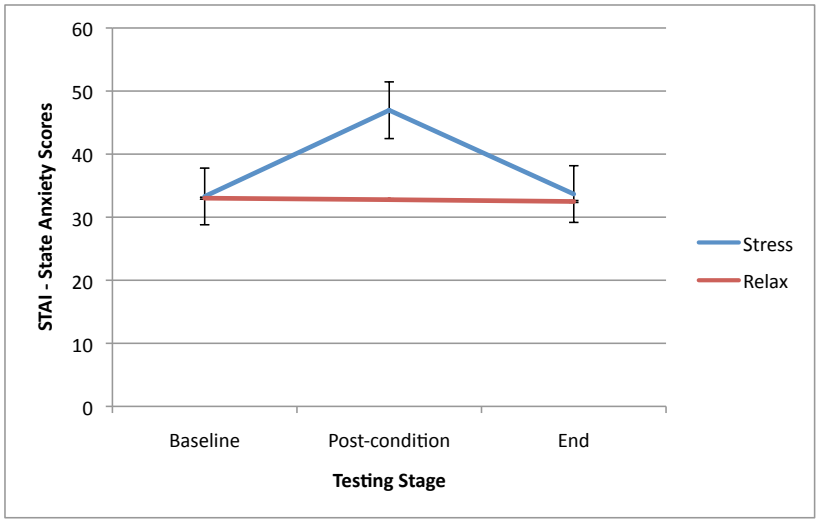


Figure. STAI-State scores showing a main effect for Experimental Condition. Error bars indicate standard error of means, with 95% confidence interval.

I used a set of planned pairwise comparisons to explore the nature of the Experimental Condition x Testing Stage interaction so as to identify exactly where between- and within-

group differences existed. Given that the factorial ANOVA indicated that sex was not a significant factor determining STAI-State scores, for each of these comparisons I collapsed the Stress-Female and Stress-Male groups into the Stress group, and the Relax-Female and Relax-Male groups into the Relax group. The first planned comparison showed that, at Baseline, there were no significant differences between the Stress and Relax groups, $F(1, 135) = 0.01$, $p = .940$. This result suggests that participants in both conditions entered the study with similar levels of state anxiety, and that any subsequent changes in these levels would therefore be likely due to in-experiment experiences.

A second planned comparison indicated that Stress-group participants showed a statistically significant increase in self-reported anxiety from Baseline to Post-manipulation; SM: $F(1, 86) = 8.15$, $p = .005$, SF: $F(1, 86) = 25.13$, $p < .001$. In contrast, a third planned comparison indicated that Relax-group participants did not show such a change, RM: $F(1, 86) = 8.91$, $p = .727$, RF: $F(1, 86) = 0.25$, $p = .616$. These data suggest that the MSST was successful in increased subjective levels of anxiety relative to a control condition.

A fourth planned comparison indicated that, at the Post-manipulation measure, participants in the Stress and Relax groups differed significantly from each other, $F(1, 135) = 30.33$, $p < .001$. Stress-group participants reported significantly more state anxiety than Relax-group participants.

Ethically, it was important to establish that exposure to the MSST did not have lasting effects on participants' subjective levels of anxiety. An examination of the baseline and end-of-session mean scores for the participants in the SF and SM groups makes it clear that these participants left the study with similar levels of self-reported state anxiety as when they arrived, $t(23) = 0.19$, $p = .849$.

Taken together, these results the a priori hypotheses that exposure to the MSST raised subjective levels of anxiety, whereas exposure to the MSST-Control condition did not. Furthermore, sex was not a contributing factor to the changes in those levels.

Heart rate. Due to intermittent VU-AMS hardware malfunctions, heart rate data were lost for two participants in the Stress-Male group.

Figure 2 shows the fluctuations in participants' heart rate across the 2-hour experimental session. Visual inspection of the figure suggests that, at the Baseline and End measurement points, there was little to differentiate the combined Stress and Relax groups; at the Post-manipulation measurement point, however, participants in the Stress condition reported a spike in anxiety, whereas those in the Relax condition did not.

Results from the factorial ANOVA supported this impression. Although it did not detect significant main effects for Experimental Condition, $F(1, 41) = 2.51$, $p = .121$, $\eta_p^2 = .058$, or for Sex, $F(1, 41) = 0.010$, $p = .920$, $\eta_p^2 < .001$, it did detect a significant main effect for Testing Stage, $F(1.64, 67.21) = 157.28$, $p < .001$, $\eta_p^2 = .793$, and a significant interaction between Experimental Condition and Testing Stage, $F(1.64, 67.21) = 14.16$, $p < .001$, $\eta_p^2 = .257$. The analysis did not detect significant effects for Sex x Experimental Condition, $F(1, 41) = 0.07$, $p = .787$, $\eta_p^2 = .002$, for Sex x Testing Stage, $F(1.64, 67.21) = 0.07$, $p = .896$, $\eta_p^2 = .002$, or for Sex x Experimental Condition x Testing Stage, $F(1.64, 67.21) = 0.56$, $p = .539$, $\eta_p^2 = .014$.

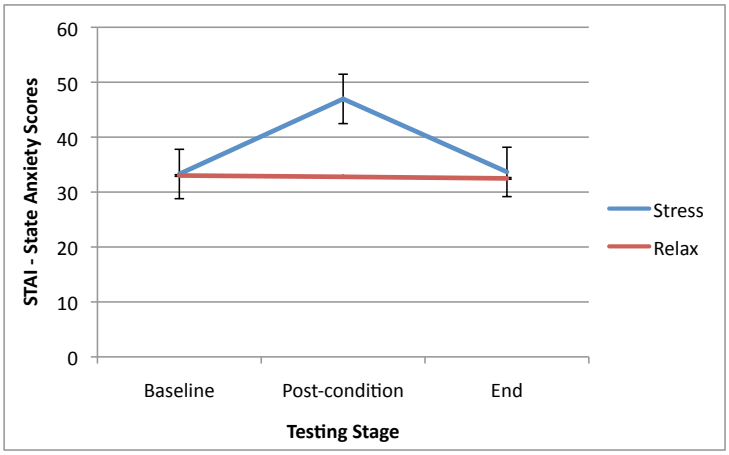


Figure 2. Heart rate measurements showing a significant interaction between Experimental Condition and Testing Stage. Error bars indicate standard error of means, with 95% confidence interval.

As was the case for STAI-State data above, I used a set of planned pairwise comparisons to explore the nature of the Experimental Condition x Testing Stage interaction so as to identify exactly where between- and within-group differences existed. Again, given that the factorial ANOVA indicated that sex was not a significant factor in determining heart rate, the planned comparisons analysed data from the combined Stress and combined Relax groups. The first planned comparison indicated that participants in the four groups did not differ statistically significantly in terms of their baseline heart rate levels, $F(3, 123) = 0.26$, $p = .851$. Further comparisons showed that while both Stress and Control conditions showed a statistically significant increase from baseline to post-manipulation, participants in the Stress condition still experienced significantly higher heart rate levels than participants in the Relax condition $F(1, 128) = 13.58$, $p < .001$.

Taken together, the a priori hypothesis that exposure to the MSST raised heart rate levels significantly, whereas exposure to the MSST-Control condition did not. Furthermore, sex was not a contributing factor to the changes in those levels

Appendix D

Research Assistants' Script for Mortality Salience Fear Factor Stress Test

Remember not to be engaging with the participant (i.e., no positive or negative reinforcement / no sign of social support). The participant must not know how well or badly they are doing.

Part 1: Free-Form Speech (5 min)

[Participant of the Opposite Sex]

Say, *"Good afternoon (Participant's name). As (Experimenter's name) has already explained to you this audition for Fear-Factor will comprise of 3 parts. Firstly, could you please describe the circumstances of your death, the emotions and the thoughts that death arouses in you, and what you think will happen as you physically die and after you are physically dead"*.

If the participant stops talking before 5 minutes are up,

1) Wait 10 seconds and say: "*You still have time left, please continue*."

2) Wait 10 seconds and say: *"In your opinion, what is the worst way to die?*

If participant responds with a short answer, wait 10 seconds and ask: *Why?*

3) Wait 10 seconds and say: "*What scares you the most about the process of dying?"*

4) Wait 10 seconds and say: *"How many people do you think would be at your funeral?"*

If participant responds with a short answer, wait 10 seconds and ask: *"Why?"*

5) Wait 10 seconds and say: *When you die would you rather be cremated or buried?"*

If participant responds with a short answer, wait 10 seconds and ask: *"Why?"*

6) Wait 10 seconds and say: "*What do you think will happen to your body after your death?"*

After 5 minutes are up or the participant has nothing more to say (refuses to carry on talking), say, "*Thank you, that is fine. We are now going to proceed with the second part of the audition, which is a test of mental agility*."

Part 2: Test of mental agility (5 min)

[Participant of the Opposite Sex]

Say, "*We are now going to ask you to subtract 17 from 2043 continuously until we tell you to stop. If you make a mistake you will be asked to start from 2043 again. Please begin."*

If the participant stops at a number say, *"Please carry on subtracting 17*."

If an error is made say: "*That is incorrect, please start again from 2043*."

Start: 2043 → 2026 → 2009 → 1992 → 1975→ 1958 → 1941 → 1924 → 1907 → 1890 → 1873 → 1856 → 1839 → 1822 → 1805 → 1788 → 1771 → 1754 → 1737 → 1720 → 1703 → 1686 → 1669 → 1652 → 1635 → 1618 → 1601 → 1584 → 1567 → 1550 → 1533 → 1516 → 1499 → 1482 → 1465 → 1448 → 1431 → 1414 → 1397 → 1380 → 1363 → 1346 → 1329 → 1312 → 1295 → 1278 → 1261 → 1244 → 1227 → 1210 → 1193 → 1176 → 1159 → 1142 → 1125 → 1108 → 1091 → 1074 → 1057 → 1040 → 1023 → 1006 → 989 → 972 → 955 → 938 → 921 → 904 → 887 → 870 → 853 → 836 → 819 → 802 → 785 → 768 → 751 → 734 → 717 → 700 → 683 → 666 → 649 → 632 → 615 → 598 → 581 → 564 → 547 → 530 → 513 → 496 → 479 → 462 → 445 → 428 → 411→ 394 → 377 → 360 → 343 → 326 → 309 → 292 → 275 → 258 → 241 → 224 → 207 → 190 → 173 → 156 → 139 → 122 → 105 → 88 → 71 → 54 → 37 → 20 → 3 → -14

[Participant of the SAME Sex]

After 5 minutes are up or a participant has completed the serial subtraction task say, "*Thank you, that is fine. We will now proceed onto the final part of the audition, which is a test of pain tolerance*."

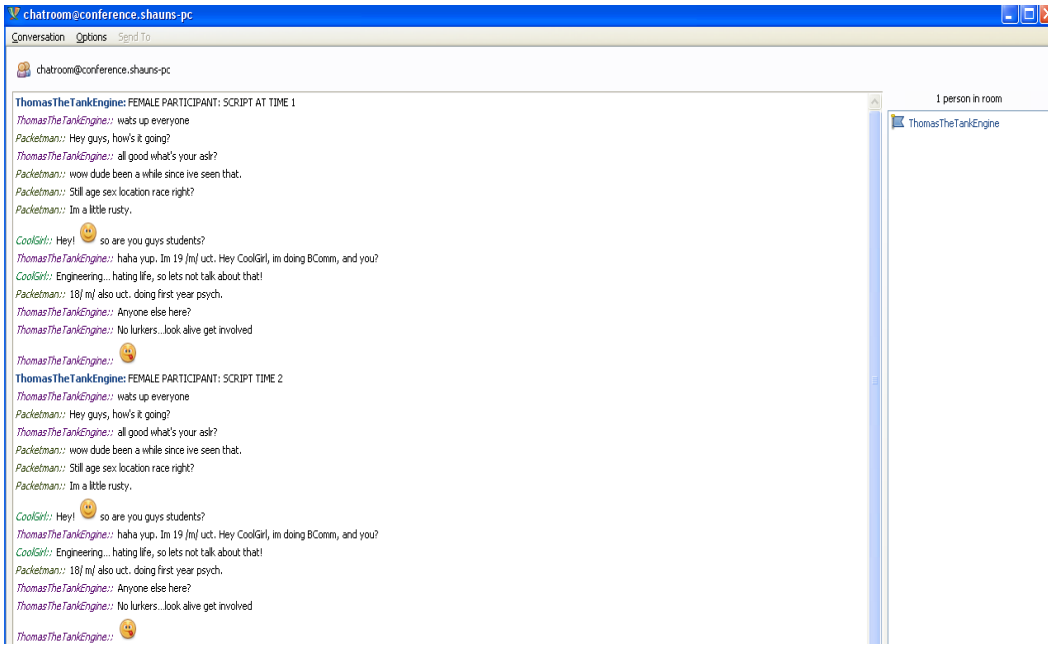
Part 3: Test of pain tolerance (2 min)

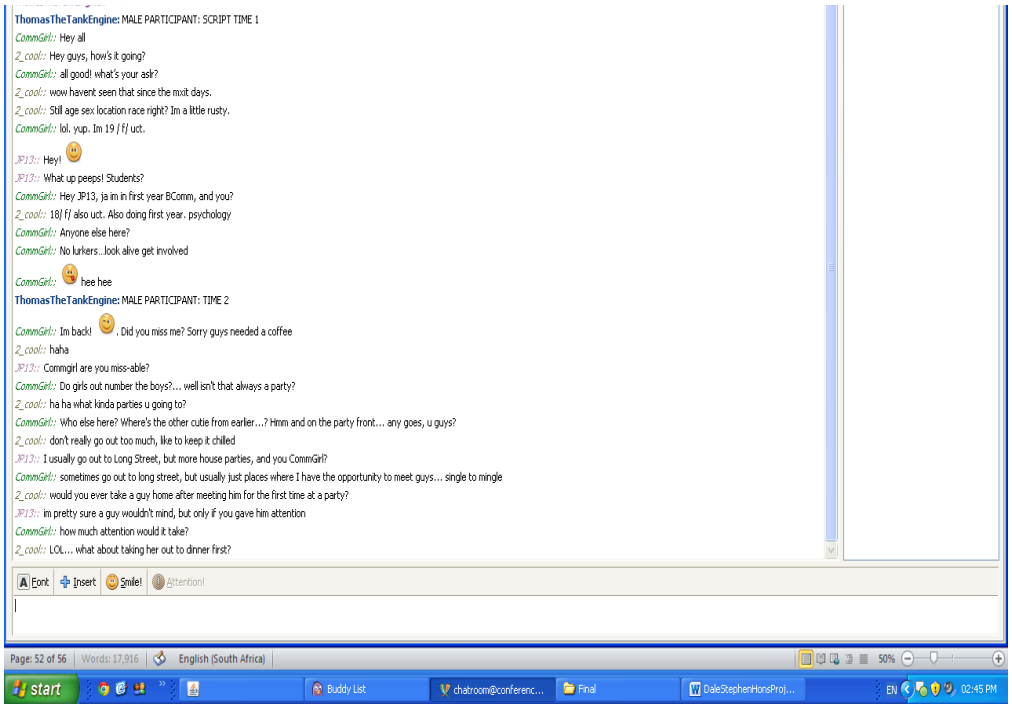
Say, "*We are now going to ask you to place your arm into the bucket of water. Please submerge your arm so that the palm of your hand is touching the bottom of the bucket. Please keep your arm submerged until we tell you to remove it or until you find it too painful to keep it there any long*er."

After 2 minutes say, "*Thank you, that is fine. That concludes the final part of the audition. Thank you for your participation*."

Appendix E

Time 1 and Time 2 chatroom scripts for male and female participants





Appendix F

Personality types for chatroom confederates

FEMALE PARTICIPANT

1. **ThomasTheTank Engine**

Chatter is forward and engaging if the participant is not. If the participant plays a passive role – feel free to lead the conversation:

- Looks: initially be vague but a little flirty.
    - Muscle build, tall, blonde hair, blue eyes
- Basic interests:
    - Sports, gym, partying, hobbies, - this individual is a popular, good looking male. He likes to party and socialise.
    - Studying BComm

2. **Packetman**

Chatter is equally engaging but not as flirty. More of the guy next door – but also knows how to have fun. Sporty, athletic, out-doors type.

- Looks: tanned and athletic, all about being able to get out in nature. Possible leading sports – hiking, running, mountain biking
- Basic interests: wanting to be a clinical psychologist, interest in helping people – good and wholesome.
- Studying Psychology

3. **CoolGirl**

Passive role in the chat – takes a back seat and pips in occasionally to remind the participant she is not the only female.

- Quite academic and hardworking, studying Science
- Not too sure about her plans for the future, just studying for now
- Doesn't go out much or socialise, doesn't really like going to the beach or being outdoors much
- Sexist or inappropriate remarks at times. An example being: No need to compensate for a lack of size in the pants.

MALE PARTICIPANT

1. **Commgirl**

Chatter is forward and engaging if the participant is not. If the participant plays a passive role – feel free to lead the conversation:

- Looks: initially be vague but a little flirty.
    - Slim, tall, blonde, blue eyes
- Basic interests:
    - Sports, partying, hobbies, - this individual is a little more of a party girl, likes to let her hair down and go out on the weekends
    - Studying a BComm

2. **2_cool**

Chatter is equally engaging but not as flirty. More of the girl next door – but also knows how to have fun. Sporty, athletic, outdoors type.

- Looks: tanned and athletic, all about being able to get out in nature. Possible leading sports – horse riding, gymnastics
- Basic interests: wanting to be a clinical psychologist, interest in helping people – good and wholesome. Studying Psychology

3. **JP13**

Passive role in the chat – takes a back seat and pipes in occasionally to remind the participant he is not the only male.

- Quite academic and hardworking, studying engineering
- Enjoys engineering, but is not sure about his plans for the future
- Doesn't go out much or socialise, enjoys computer games, doesn't really like going to the beach or being outdoors much
- Sexist or inappropriate remarks at times. An example being: love the shirt skirts and tight jeans girls are wearing on campus these days. Gets me excited.

Appendix G

Coding system for Chatroom task

Variable	Definition
Initiations	The visibility of a participant was measured by tallying the total number of times the participants initiated a conversation in the chat (regardless of content), and then converting this number into a percentage out of the total comments or posts in their chat
Personal Information	The amount of personal information given out by the participant was scored by tallying the total number of times the participant divulged information pertaining to their age, sex, race, sexuality, year/course of study or place of residence.
Risk	The amount of risk taken by a participant in the chatroom was measured based on their response to a one of the confederates (opposite sex to participant) asking the participant to meet up in real life; this was referred to as a proposition. Responses were coded for using the following scale: 0; the participant rejected the proposition +1; the participant accepted or made a proposition themselves, but no precise details regarding a meeting date, time, and place were given. +2; the participant accepted a proposition from one of the chatroom confederates, and no precise details regarding a meeting date, time, and place were given. +3; the participant made a proposition themselves toward one of the chatroom confederates, and precise details regarding a meeting date, time, and place were given.

PLAGIARISM DECLARATION

PLAGIARISM

This means that you present substantial portions or elements of another's work, ideas or data as your own, even if the original author is cited occasionally. A signed photocopy or other copy of the Declaration below must accompany every piece of work that you hand in.

DECLARATION

1. I know that Plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.

2. I have used the American Psychological Association formatting for citation and referencing. Each significant contribution to, and quotation in, this essay/report/project from the work or works, of other people has been attributed, cited and referenced.

3. This essay is my own work.

4. I have not allowed, and will not allow anyone to copy my work with the intention of passing it off as his or her own work.

NAME: Dale Stephen

STUDENT NUMBER: STPDAL001