

**An experiment to assess emotional and physiological arousal and personality correlates while imagining deceit**

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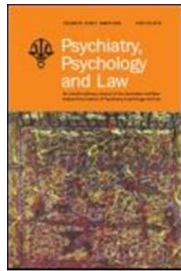
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An experiment to assess emotional and physiological arousal and personality correlates while imagining deceit.

**Running Head:** Arousal during deceit.

For Peer Review Only

## Abstract

In order to examine how personality traits, emotional arousal, and physiological arousal impact deception confidence, students (N = 102) completed the EPQ-R as well as stress and deception tasks while their Heart Rate Variability was measured. Findings indicated Psychoticism did not moderate how physiologically aroused participants were while viewing emotionally salient stimuli (video of a road traffic accident) or the thought of enacting deceit, although this came close to significance. However, participants (particularly males) higher in Psychoticism reported less subjective distress after imagining enacting deceit than those lower on Psychoticism. Extroversion had no impact on physiological arousal when viewing emotionally salient stimuli or thinking about enacting deceit. However, Extroverts reported more subjective distress after thinking about enacting deceit than Introverts. Also, deception confidence was not correlated to any of these variables. Future research could examine a sample higher in Psychoticism and how this trait impacts deception confidence.

*Keywords:* deception, emotional arousal, extroversion, psychoticism, physiological arousal, heart rate variability, lying.

## Introduction

Deception research has examined the ability to enact deceit with the aim of determining whether or not we are able to detect when people are being deceptive. However, a consensus as to what differentiates apt from inept deceivers has yet to be found. This is due to the multitude of factors that influence deceptive interactions, including the individual cognitive, emotional, and behavioural differences of deceivers. Yet while some attempts at deception fail, others are successful (Bond & DePaulo, 2006). Thus, we see the need to understand why some deceivers are able to appear credible while others are not. Through investigating the association of physiological and psychological characteristics of individuals (i.e., Extroversion / Introversion, Psychoticism, emotional and physiological arousal) with their confidence as deceivers, we hope to begin to determine the characteristics that impact on ones success at dissimulation.

First, we will provide definitions of deception, emotion, arousal, Introversion / Extroversion, and Psychoticism. Next, we will discuss deception related emotions and emotion management. Following this we will briefly discuss the personality traits of Introversion / Extroversion and Psychoticism as personality traits that may impact the ability to deceive. We will then provide an overview of the methodology of this study.

## Definitions

*Deception* is defined as intentionally misleading others through the act of deliberately providing, distorting, or omitting information, and is usually intended to benefit the deceiver (Bond & Robinson, 1988; Podlesney & Raskin, 1977; Vendemai, Buzan, & Simon-Dack, 2005). *Deception cues* encompass verbal and nonverbal behaviours that suggest deception is occurring but do not reveal which part of the message is false (Ekman & Friesen, 1974). While deception cues can betray the occurrence of deception, they do not leak the concealed emotion (Ekman, 1988). *Leakage* refers to signs of emotion (e.g., heightened arousal and positive or negative affect) that individuals have attempted to conceal from others (Burgoon & Buller, 1994; Ekman & Friesen, 1969, 1974) in order to appear convincing while enacting deceit.

Biologically, *emotion* has been conceptualized as a multifaceted set of interactions within the neural and hormonal systems that can generate affective experiences, such as feelings of arousal (Kleinginna & Kleinginna, 1981). Physiological changes in response to emotionally arousing conditions may lead to adaptive or goal directed changes in behaviour (Kleinginna & Kleinginna). *Arousal* refers to how calming or exciting individuals find the experience of specific emotions (Kensinger, 2004). This is important because emotional

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3 arousal can interfere with the successful production of verbal messages and nonverbal  
4 behaviours (DePaulo, Kirkendol, Tang, & O'Brien, 1988; Ekman, 1981).

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6 *Heart rate variability* (HRV) refers to the variation in the time interval between  
7 heartbeats and is measured by the variation in the beat-to-beat intervals.

8  
9 *Extroversion* is characterized by positive affect, being talkative, and prone to seeking  
10 stimulation; *Introversion* encompasses a reserved temperament characterized by a focus on  
11 internal thoughts, feelings, and moods; and *Psychoticism* encompasses a personality pattern  
12 typified by aggression, tough-mindedness, recklessness, and impulsivity (Eysenck &  
13 Eysenck, 1975).

### 14 15 16 17 **Deception-Related Emotions and Emotion Management**

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19 The ability to falsify or conceal the information component of a deceptive message,  
20 while simultaneously concealing any affect provoked by the information being conveyed or  
21 withheld is essential for the successful perpetration of deceit (Ekman, 1981). However,  
22 people vary in their ability to regulate deception-related emotions (e.g., guilt or detection  
23 apprehension; Bond & DePaulo, 2008). Additionally, when emotional reactions to enacting  
24 deceit are particularly strong, it is more challenging for deceivers to control their behaviour  
25 (DePaulo, 1992; Ekman, 1988). This can lead to leakage that may be incongruent with ones  
26 behaviour or verbal message (Ekman & Friesen, 1974). Behavioural inconsistencies such as  
27 this can be an indication of deception.

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33 **Emotional expression and Introversion / Extroversion.** Some people are naturally  
34 more spontaneously expressive than others. Thus, the degree to which felt emotions are  
35 readable from nonverbal facial expressions that individuals are not deliberately trying to  
36 convey will vary among individuals (DePaulo, 1992; DePaulo, Blank, Swaim, & Hairfield,  
37 1992; Kring, Smith, & Neale, 1994). In addition, spontaneously expressive individuals (i.e.,  
38 Extroverts) are more skilled at posing emotional expressions than individuals who are not  
39 spontaneously expressive (i.e., Introverts; DePaulo et al.; Tucker & Riggio, 1988). When  
40 enacting deceit that does not trigger strong emotions, expressive individuals have been found  
41 to be better deceivers than unexpressive individuals (DePaulo et al.). In essence, it has been  
42 argued that expressive individuals tend to appear no more deceptive when being dishonest  
43 than they do when they are being honest (DePaulo et al.). This may be due to their ability to  
44 control their facial expressions to both conceal and feign emotions. Thus, while less  
45 emotionally expressive individuals (i.e., Introverts) may naturally display less emotional  
46 leakage, spontaneously expressive individuals (i.e., Extroverts) are better able to control  
47 emotional leakage and feign emotions. Thus, the personality trait of Introversion /

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3 Extroversion may influence how well people can control the display of deception related  
4 emotions. So long as they are not experiencing strong emotions, Extroverts may actually be  
5 more successful deceivers than Introverts.  
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8 **Emotional expression and arousal.** There is a link between physiological arousal  
9 and the expression of facial displays of emotion (Buck, Miller, & Caul, 1974; Buck, Savin,  
10 Miller, & Caul, 1972). Naturally spontaneous expressers (i.e., Extroverts) have been found to  
11 exhibit weaker physiological reactions (i.e., skin conductance and HR) in response to  
12 emotionally arousing situations than natural inhibitors (i.e., Introverts; Buck et al., 1974;  
13 Buck et al., 1972; Notarius & Levenson, 1979). This supports the discharge model of  
14 emotion that states that physiological responding is negatively correlated with  
15 communication accuracy (Buck et al., 1974; Buck et al., 1972). However, some studies found  
16 a positive relationship between nonverbal displays of emotional affect and physiological  
17 indices of emotional states (Lanzetta, Cartwright-Smith, & Kleck, 1976; Zuckerman,  
18 Klorman, Larrance, & Spiegel, 1981). The conflicting findings may have stemmed from  
19 differences in the operationalization of emotional expressivity across studies. Active  
20 inhibition, or the posing of a feigned emotion, may lead to a positive relationship between  
21 facial expression and physiological reactivity (Lanzetta et al.). Conversely, the discharge  
22 model may account for natural expressions of emotion (Buck et al., 1974; Buck et al., 1972;  
23 Lanzetta et al.).  
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34 In the current study, we will examine physiological response (i.e., HRV) to  
35 emotionally arousing stimuli with the intention of identifying individuals who may be more  
36 or less facially expressive. In line with the discharge model and previous research findings  
37 (Buck et al., 1974; Buck et al., 1972), we propose that people who are more physiologically  
38 reactive (i.e., decrease in HRV) will be higher on the personality trait of Introversion.  
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#### 41 **Deception and Psychoticism**

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43 A significant correlation has been found between Psychopathy and the personality  
44 trait of Psychoticism and the lie scale on the Eysenck Personality Questionnaire (EPQ; Hare,  
45 1982). Specifically relevant to this study, significant correlations have also been found  
46 between a tendency towards deception and higher scores on the Psychoticism, and Lie scales  
47 of the EPQ (Gudjonsson & Sigurdsson, 2004). Superficial charm, manipulation, and  
48 deceptive behaviours are all features of a psychopathic personality (Edens, Buffington, &  
49 Tomicic, 2000; Hare, Forth, & Hart, 1989; Richendoller & Weaver, 1994). Thus,  
50 Psychopath's may be more confident in their ability to deceive and manipulate others.  
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60 However, there is paucity in the literature regarding whether this translates into actual

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3 success at deceiving others (Edens et al.; Kucharski, Duncan, Egan, & Falkenbach, 2006;  
4 Poythress, Edens, & Watkins, 2001). In this study, we will examine the association between  
5 Psychoticism and confidence in ones own ability to enact deceit. It is expected that people  
6 higher on the trait of Psychoticism will be more confident in their ability to successfully  
7 deceive others than those lower on this trait. We will also examine the relationship between  
8 Psychoticism and physiological arousal related to distressing images and the thought of  
9 enacting deception. It is expected that people higher in Psychoticism experience less  
10 physiological arousal (i.e., higher HRV) when stressed and during deception attempts than  
11 people lower in Psychoticism.  
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### 14 **Aims**

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16 In the current study, emotional and physiological responses to emotionally arousing  
17 stimuli and the thought of enacting deception will be measured along with personality traits  
18 (i.e., Introversion / Extroversion and Psychoticism) and deception confidence. We aim to  
19 examine how personality traits are related to ones physiological arousal (i.e., HRV)  
20 associated with stress and deception, as well as their confidence in their ability to enact  
21 deceit. Overall, we aim to identify the characteristics of confident deceivers.  
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### 24 **Hypotheses**

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26 By investigating three hypotheses we aim to examine the correlations between  
27 emotional and physiological arousal (i.e., HRV), Introversion / Extroversion, and  
28 Psychoticism and ultimately identify whether these characteristics impact on ones confidence  
29 in their ability to enact deceit. We predict that; (1) Individuals with lower HRV during the  
30 deception task will have lower HRV during the stress task and will also report more distress  
31 during both tasks; (2) Individuals who score higher on the personality trait of Psychoticism  
32 will report less distress and have higher HRV during the stress and deception tasks and will  
33 also be more confident deceivers than individuals who score lower on Psychoticism; and (3)  
34 Individuals who score higher on the personality trait of Introversion / Extraversion  
35 (Extroverts) will report less distress and have higher HRV during the stress and deception  
36 tasks.  
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## 55 **Method**

### 56 **Participants**



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3 First year psychology students (male  $n = 30$ , female  $n = 72$ ), with an average age of  
4 21.42 years ( $SD = 6.64$ ) volunteered for this research as partial fulfillment of a research  
5 requirement for a first year psychology course.  
6

## 7 **Measures**

8  
9 **Demographic and general information questionnaire.** A demographic questionnaire  
10 gathered information related to participants' gender, age, any prescription medication they  
11 were taking that may impact their heart rate (HR), history of prior traumatic events, as well as  
12 their thoughts, beliefs, and opinions related to deception.  
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16 **Eysenck Personality Questionnaire Revised (EPQ-R; Eysenck & Eysenck, 1975).**  
17 Personality traits were measured using the Eysenck Personality Questionnaire Revised (EPQ-  
18 R; Eysenck & Eysenck, 1975). This 48-item inventory measures four dimensions of  
19 personality; Extroversion, Neuroticism, Psychoticism, and Dissimulation. The EPQ-R has  
20 been used in previous research (Gudjonsson & Sigurdsson, 2004; Hare, 1982; Perkins,  
21 Kemp, & Corr, 2007), and in a study by Perkins, Kemp, and Corr (2007) the Cronbach's  
22 alpha coefficients for the Extroversion, Neuroticism, and Dissimulation scales ranged from  
23 .73 to .88, indicating a good internal consistency range. However, the psychoticism scale has  
24 been found to have an internal consistency of approximately .6 (Perkins et al.).  
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31 **Polar RS800CX heart rate monitor.** A Polar RS800CX heart rate monitor (HRM)  
32 comprised of a wrist and chest band was used to measure HRV during the deception and  
33 stress tasks. The Polar RS800CX, has been found to possess sound validity, accuracy, and  
34 instrument reliability for assessment of HR variability in clinical studies (Williams et al.,  
35 2016; Quintana, Guastella, Outhred, Hickie, & Kemp, 2012; Quintana, Heathers, & Kemp,  
36 2012). Measures of HR have been used in previous research as an indicator of emotional  
37 responding (Buck et al., 1974; Buck et al., 1972). Physiological responding associated with  
38 deception has also been investigated using measures of HR (Grubin & Madsen, 2005; Meijer,  
39 Verschuere, Gamer, Merckelbach, & Ben-Shakhar, 2016; Podlesny & Raskin, 1977), most  
40 notably in polygraph testing.  
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47 The HRV for the deception task (HRV Deception) was calculated by subtracting the  
48 participants' baseline HRV while telling the truth from their HRV while enacting deceit. This  
49 indicates the difference in HRV when telling the truth and being deceptive. Similarly, the  
50 HRV for the stress task (HRV Stress) was calculated by subtracting the participants' baseline  
51 HRV while viewing stimuli that was not emotionally arousing (a turtle swimming  
52 underwater) from their HRV while viewing emotionally salient stimuli (video recording of a  
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3 road traffic accident). Again, this indicates the difference in HRV when relaxed and when  
4 distressed.  
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6 **Deception task.** Participants were first required to imagine themselves in a scenario  
7 telling the truth (failing to attend a meeting due to illness) for two minutes while their HRV  
8 was measured in order to get a baseline measure. Participants were then required to imagine  
9 themselves in a similar scenario enacting deceit (lying about being sick to get out of a  
10 meeting) for an additional two minutes. Their HRV was again measured in order to gauge  
11 whether the thought of enacting deceit was emotionally and physiologically arousing for  
12 them. This methodology was tested in order to determine whether the thought of enacting  
13 deceit is emotionally and physiologically arousing.  
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19 **Stress task.** Two minutes of video footage depicting a pleasant underwater scene of a  
20 turtle swimming was used to gather baseline HRV. A second 9 minutes and 20 seconds of  
21 video footage depicting the results of a road traffic accident (Deville & Annab, 2006) was  
22 used to determine, by again measuring HRV, if this stimuli was emotionally and  
23 physiologically arousing.  
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27 **Deception questionnaire.** A questionnaire was used to gather information pertaining  
28 to how distressing the participants found the stress and deception tasks ranging from 1 (not at  
29 all distressing) through to 5 (extremely distressing) as well as their confidence in their ability  
30 to deceive on a rating scale ranging from 1 (not at all confident) through to 5 (extremely  
31 confident). Participants were asked to rate how distressing they found the video of the turtle  
32 swimming underwater (incase anybody had a fear of the ocean or turtles), the road traffic  
33 accident video, as well as the thought of enacting deceit. However, the participants were not  
34 asked to rate how distressing they found the thought of telling the truth, as we did not believe  
35 this would cause any distress. Thus, unfortunately, we did not have a baseline measure for  
36 subjective distress during the deception task.  
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### 43 **Procedure**

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45 Ethical approval was obtained from the Griffith University Human Ethics Research  
46 Committee (GU Ref No: PSY/70/14/HREC). Participants completed the experiment in  
47 groups of one to three while on campus. Participants were briefed concerning the background  
48 and relevance of the study prior to participation and informed consent was obtained from all  
49 participants. Participants first completed a demographic questionnaire and the EPQ-R  
50 (Eysenck & Eysenck, 1975). Next, while wearing the HR monitor, participants first viewed  
51 two minutes of emotionally neutral video footage of an underwater scene followed by 9  
52 minutes and 20 seconds of emotionally salient video footage of paramedics attending the  
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3 scene of a road traffic accident. Heart rate variability was recorded at the end of each stimuli  
4 presentation. Next, participants completed a deception task while wearing the HR monitor.  
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6 This task required the participants to first read a scenario depicting a truthful situation for two  
7 minutes and then read a scenario that involved an element of deception and imagine themselves  
8 in this scenario enacting deceit for two minutes. Heart rate variability was again recorded at  
9 the end of each stimuli presentation. Finally, participants completed a questionnaire asking  
10 how distressing they found the tasks and how confident they were in their ability to deceive.  
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## 14 **Results**

### 15 **Approach to Data Analysis**

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17 There was no missing data. Data screening was conducted by examining the  
18 descriptive statistics and plots for each of the seven variables (i.e., Introversion /  
19 Extroversion, Psychoticism, distress during the stress task, distress during the deception task,  
20 HRV during the stress task, HRV during the deception task, and deception confidence)  
21 separately. The means and standard deviations (see Table 1) were calculated for each of the  
22 aforementioned variables. Correlational analyses and regression analyses were conducted to  
23 examine relationships between the seven variables. Statistica 13.3 was used for the  
24 correlational statistical analyses. An alpha level of .05 was used for all analyses.  
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30 Consistent with previous research (Aluja, Garcia, & Garcia, 2003; Perkins et al., 2007),  
31 there was a significant difference between male and female scores on the Psychoticism scale  
32 of the EPQ-R (Eysenck & Eysenck, 1975). There was also a significant difference between  
33 males and females on self-reported distress after the stress task. Therefore, we also analysed  
34 these variables by gender.  
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### 38 **Methodology Check**

39  
40 The validity of the deception task and the stress task are assessed via a self-report  
41 indication of distress and a physiological measure of HRV to determine whether thinking  
42 about enacting deception is emotionally and physiologically arousing enough to provide a  
43 measureable change.  
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46 Subjective Distress ratings for imagining lying showed an almost perfect linear trend  
47 (positive skew), as one would expect. Therefore, non-parametric analyses will be used for  
48 self-report indicators of distress. A Wilcoxon Matched Pairs Test was conducted on distress  
49 ratings while watching a relaxing video (turtle swimming underwater) and when imagining  
50 telling a lie (sending an email lying about being sick to avoid a meeting). This showed a  
51 highly significant difference in distress rating ( $z(n = 59) = 5.79, p < .001$ ). Likewise, there  
52 was a very significant difference on Subjective Distress, between when watching a relaxing  
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3 video (turtle swimming underwater) and watching a stressful video (road traffic accident)  
4 ( $z(n = 98) = 8.60, p < .001$ ).

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6 Visual inspection of HRV histograms suggested the data was near normally  
7 distributed for most variables. One outlier was removed from HRV Stress and four outliers  
8 were removed from HRV Deception. Review of the skew and kurtosis suggested normality  
9 was a reasonable assumption for all other variables. Means and standard deviations for the  
10 seven variables (Introversion / Extroversion, Psychoticism, HRV Stress, HRV Deception,  
11 Subjective Distress Stress, Subjective Distress Deception, and Deception Confidence) being  
12 investigated are presented in Table 1.  
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17 A repeated measures ANOVA on HRV while imagining telling the truth versus when  
18 imagining telling a lie, did not show any significant differences ( $F(1,101) = .036, p = .85$ ).  
19 However, HRV when lying compared to when watching the video of the turtle swimming did  
20 show significant differences in line with subjective distress ratings as above ( $F(1,101) =$   
21  $59.58, p < .001$ ).

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25 Our interpretation of these results is that imagining lying and imagining telling the  
26 truth both reduced HRV (i.e., increasing HR) and increased subjective distress compared to  
27 watching a relaxing video. It seems that this methodology does not differentially evoke  
28 enough emotional or physiological arousal between imagining lying and imagining truth  
29 telling to provide a measurable change in HRV.  
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35 Insert Table 1 About Here  
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### 38 **Testing Relationships: Subjective Distress and HRV during The Stress and Deception** 39 **Tasks**

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42 The first aim of this study was to investigate the relationships between subjective  
43 distress reported after the stress and deception tasks, HRV during the stress and deception  
44 tasks, and the association between reported distress and HRV after the stress and deception  
45 tasks. To assess these relationships correlations were performed.  
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49 **Subjective distress reported after the stress and deception tasks.** Reported levels  
50 of distress after the stress task and reported levels of distress after the deception task were  
51 significantly correlated  $r(n = 102) = .40, p < .001$ . This indicates that participants in this  
52 sample who reported distress after watching the emotionally salient stimuli in the stress task  
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3 also reported distress after imagining themselves enacting deceit in the deception task. These  
4 participants are more reactive during emotionally arousing situations.  
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6 There was an interaction effect for gender on stress levels between the deception task  
7 and the stress task. A repeated measures ANOVA found a significant effect for gender  
8 overall ( $F(1,100) = 5.87, p < .017$ ) and an effect for stress ratings between the two conditions  
9 of watching a video of a road traffic accident and imagining lying ( $F(1,100) = 201.61, p <$   
10  $.001$ ). The interaction effect between genders and condition was quite marked ( $F(1,100) =$   
11  $10.34, p = .002$ ). In effect, females scored higher on stress ratings for both conditions, but  
12 differentially more for the video of the car accident.  
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17 **Heart rate variability during the stress and deception tasks.** Heart rate variability  
18 during the stress task (HRV for car accident minus HRV for turtle video) and HRV during  
19 the deception task (HRV for lying minus HRV for telling the truth) were significantly  
20 correlated  $r(n = 102) = .25, p = .01$ .  
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24 This indicates that individuals who have lower HRV during times of stress also had  
25 lower HRV while thinking about enacting deceit.  
26

27 **Subjective distress and HRV after the stress and deception tasks.** Reported levels  
28 of distress after the deception task and HRV during the deception task were not significantly  
29 correlated  $r(n = 102) = -.05, p = .63$ . This indicates that participants who reported distress  
30 after the deception task did not respond in a physiologically consistent way during the  
31 deception task, if one accepts that we should expect lower HRV when stressed.  
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35 Reported levels of distress after the stress task (car accident) and HRV during the  
36 stress task was also not significantly correlated  $r(n = 102) = -.12, p = .22$ . This indicates that  
37 participants who reported distress after the stress task did not respond physiologically during  
38 the stress task in a way that indicated they were physiologically aroused. Gender was not a  
39 factor in this lack of relationship (males  $r(n = 102) = -.05, p = .81$ ; females  $r(n = 102) = -.11,$   
40  $p = .35$ ).  
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#### 45 **Testing Relationships: Subjective Distress Deception, HRV Deception, Psychoticism,** 46 **and Deception Confidence** 47 48

49 The second aim of this study was to investigate the association between the  
50 personality dimension of Psychoticism, self-reported level of distress associated with  
51 deception, HRV during the deception task, and confidence in ability to deceive others. To  
52 assess these relationships correlations were performed (see Table 2).  
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Insert Table 2 About Here  
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No significant correlation was found between participants' level of Psychoticism and deception confidence (see Table 2). This indicates that Psychoticism did not mediate how confident the participants were in their own ability to enact deception.

No significant correlation was found between ones HRV when thinking about enacting deceit and their deception confidence (see Table 2). This indicates that people's confidence in their own ability to deceive others had no impact on how they responded physiologically (i.e., via change in HRV) when thinking about enacting deceit.

Deception confidence and subjective distress associated with deception were significantly negatively correlated (see Table 2). This indicates that participants who were more confident in their ability to enact deceit reported less distress after imagining enacting deceit.

### **Testing Relationships: Subjective Distress and HRV Stress, Subjective Distress and HRV Deception, and Psychoticism**

The second aim of this study was also to investigate the association between the personality trait of Psychoticism and participants' distress and HRV during the stress and deception tasks. To assess these relationships a correlation matrix is presented below (see Table 3).

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Insert Table 3 About Here  
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No significant correlation was found between HRV during the stress or deception tasks and the trait of Psychoticism for the whole sample or when males and females were assessed separately. This indicates that participant's level of Psychoticism did not impact their physiological reaction (i.e., via change in HRV) to either the stress or deception tasks.

The level of distress reported after the stress task and the trait of Psychoticism were significantly correlated, however, the level of distress reported after the deception task and the trait of Psychoticism were not significantly correlated (see Table 3). This indicates that a participants' level of Psychoticism did not influence how distressing participants found the deception task, however, it did influence how distressing they found the stress task. People

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3 higher in the trait of Psychoticism reported significantly less distress after the stress task than  
4 people lower on this trait.  
5

6 For males, the level of distress reported after the stress and deception tasks and the  
7 trait of Psychoticism were significantly correlated (see Table 3). This indicates that males  
8 level of Psychoticism did influence how distressing they found the stress and deception tasks.  
9 Males higher in the trait of Psychoticism reported significantly less distress after the stress  
10 and deception tasks than males lower on this trait.  
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14 For females, the level of distress reported after the stress and deception tasks and the  
15 trait of Psychoticism were not significantly correlated (see Table 3). This indicates that  
16 females level of Psychoticism did not influence how distressing they found the stress and  
17 deception tasks.  
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### 20 **Testing Relationships: Introversion / Extraversion and Subjective Distress and HRV**

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22 The third aim of this study was to investigate the association between Introversion /  
23 Extraversion and distress and HRV during the stress and deception tasks. To assess these  
24 relationships correlations were performed (see Table 4).  
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32 No significant correlation was found between ones HRV during the stress or  
33 deception tasks and the trait of Introversion / Extroversion (see Table 4). This indicates that  
34 ones level of Introversion / Extroversion did not impact on how the participants in this sample  
35 responded physiologically (i.e., via change in HRV) to the stress or deception tasks.  
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39 The personality trait of Introversion / Extroversion and subjective distress associated  
40 with the stress task were not significantly correlated (when analysed as a whole group or  
41 males and females separately), however, the personality trait of Introversion / Extroversion  
42 and subjective distress associated with deception were significantly correlated. This indicates  
43 that ones level of Introversion / Extroversion did not influence how distressing participants  
44 found the stress task, however, it did influence how distressing they found the deception task.  
45 Extroverts reported significantly more distress after the deception task than Introverts.  
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## 50 **Discussion**

### 51 **Overview of Main Findings**

52 The aim of this study was to identify emotional, physiological, and psychological  
53 characteristics of confident deceivers. To do this we examined correlations between  
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3 personality traits of Introversion / Extroversion and Psychoticism; HRV and subjective  
4 distress when stressed; and HRV and subjective distress associated with imagining enacting  
5 deceit.  
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### 7 **Hypothesis 1**

9 The first aim of this study was to investigate the associations between subjective  
10 distress and HRV while viewing distressing images of a road traffic accident and when  
11 thinking about enacting deceit.  
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14 **Subjective distress after the stress and deception tasks.** As predicted, the  
15 participants, particularly the female participants, who reported distress after watching  
16 emotionally salient stimuli that has been found to evoke stress in past studies (Deville &  
17 Annab, 2006), also reported distress after imagining themselves enacting deceit. This  
18 indicates that the majority of people, in particular the females, who were distressed by  
19 watching emotionally salient stimuli in the stress task also found the thought of enacting  
20 deceit to be distressing, and that these people are more reactive during emotionally arousing  
21 situations. However, when analysing the male participants, we found that those who reported  
22 distress after watching the emotionally salient stimuli in the stress task did not necessarily  
23 report distress after imagining themselves enacting deceit in the deception task or vice versa.  
24 Thus, males who are more reactive to distressing video footage, seem to be less distressed by  
25 the thought of enacting deceit.  
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33 **Heart rate variability during the stress and deception tasks.** In addition to the  
34 positive correlation between subjective distress while viewing emotionally arousing stimuli  
35 (road traffic accident video) and while thinking about enacting deceit, findings also indicated  
36 that individuals who have lower HRV during times of stress also have lower HRV while  
37 deceiving - and vice versa. From this we can see that people physiologically react in the same  
38 way when emotionally aroused as they do while they are thinking about enacting deceit.  
39 Thus, we can conclude that the people who react physiologically (i.e., lower HRV) when  
40 viewing emotionally arousing stimuli also react physiologically (i.e., lower HRV) to thinking  
41 about enacting deceit. As both the HRV during the stress task and the HRV during the  
42 deception task decreased from the participants baseline HRV (relaxed), we see this finding as  
43 evidence that some individuals are more physiologically reactive during times of stress than  
44 others.  
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53 **Subjective distress and HRV after the stress and deception tasks.** We found both  
54 a positive correlation between subjective distress while viewing emotionally arousing stimuli  
55 (road traffic accident video) and while thinking about enacting deceit and a positive  
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3 correlation between HRV during the stress task and HRV during the deception task.  
4 However, findings also indicated that participants reported levels of distress after both the  
5 stress and deception tasks did not significantly correlate with their HRV during the stress or  
6 deception tasks respectively. Thus, participants who reported lower levels of distress after the  
7 stress or deception tasks did not necessarily have higher HRV (i.e., lower HR indicating  
8 resilience during times of stress) than those who reported higher levels of distress after the  
9 stress or deception tasks. Nor did participants who reported higher levels of distress after the  
10 stress or deception tasks necessarily have lower HRV (i.e., higher HR indicating emotional  
11 arousal) during the stress or deception tasks. Thus, while some people reacted emotionally  
12 (i.e., self-reports of distress) other people reacted physiologically (i.e., through a decrease in  
13 HRV) to the thought of enacting deceit.

## 21 **Hypothesis 2**

22 The second aim of this study was to investigate the association between participant's  
23 subjective distress and HRV while considering enacting deceit and their confidence in their  
24 own ability to deceive; the association between the personality trait of Psychoticism and  
25 confidence in ones own ability to deceive was also assessed and; the association between the  
26 personality trait of Psychoticism and participants level of reported distress and HRV during  
27 times of stress and when considering enacting deception.

28 **Subjective distress, HRV, and deception confidence.** Findings indicated that  
29 participant's confidence in their own ability to enact deceit did not impact on how they  
30 responded physiologically (i.e., via changes HRV) while thinking about enacting deceit or  
31 vice versa. Thus, people who had lower HRV during the deception task, indicating they were  
32 physiologically aroused while thinking about enacting deceit, were not necessarily less  
33 confident in their own ability to enact deceit, as predicted. Nor were people who had higher  
34 HRV when thinking about enacting deception, indicating they were not emotionally aroused  
35 while thinking about enacting deceit, more confident in their own ability to enact deceit.  
36 Again, perhaps the deception task was not able to evoke strong enough deception related  
37 emotions to produce a measurable physiological change in this sample. However,  
38 participants' level of self-reported distress after imagining themselves enacting deceit was  
39 negatively correlated to their confidence in their ability to enact deceit. This indicates that, as  
40 predicted, the more confident people are in their ability to deceive others the less distressing  
41 they find the idea of enacting deceit.

42 **Psychoticism and deception confidence.** Findings indicated that when assessed as a  
43 whole group, or when analysed by gender, Psychoticism had no impact on people's  
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3 confidence in their ability to enact deceit. Thus, contrary to our prediction, people who were  
4 higher in the trait of Psychoticism were not necessarily more confident in their own ability to  
5 deceive others. People with a Psychopathic personality possess traits of superficial charm and  
6 manipulation (Edens et al., 2000; Hare et al., 1989; Richendoller & Weaver, 1994) that could  
7 contribute to a tendency towards deception. In addition, Psychopaths are unlikely to  
8 experience deception related emotions such as guilt or anxiety, and as a result are usually  
9 confident deceivers (Ekman, 1981). It may be the case that people who are true Psychopaths  
10 may be more confident in their own ability to enact deceit, however, this sample did not  
11 include enough people who scored really high on the scale of Psychoticism, which would  
12 give greater chance of them also scoring high on Psychopathy. People who are confident in  
13 their ability to deceive others may experience less deception related emotions. Therefore,  
14 deception confidence could result in less emotional leakage and cues to deception. We,  
15 therefore, see a need to investigate whether true Psychopaths are more confident in their  
16 ability to enact deceit and whether this impacts on their credibility as deceivers.

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26 **Subjective distress and HRV stress, subjective distress and HRV deception, and**  
27 **psychoticism.** It was expected that people higher in Psychoticism (which has been found to  
28 relate to psychopathy; Hare, 1982) would have higher HRV during both the stress and  
29 deception tasks, indicating they are more resilient during times of stress. Contrary to our  
30 prediction, findings indicated that for the whole sample or when analysing males and females  
31 separately, Psychoticism had no impact on how people responded physiologically (i.e., via  
32 change in HRV) when viewing emotionally salient stimuli (road traffic accident) or when  
33 considering enacting deception. Thus, people who exhibited higher HRV (i.e., less emotional  
34 arousal) during the stress and deception tasks were not necessarily higher in Psychoticism, as  
35 predicted. However, Psychoticism and HRV during the stress task (watching a video of a  
36 road traffic accident) were nonsignificantly positively correlated ( $p = .06$ ). This indicates that  
37 with a larger sample of participants who score high in Psychoticism we would see a  
38 significant correlation here.

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The trait of Psychoticism had no impact on how distressing the whole group of  
participants or the female participants found the idea of enacting deceit. However, males who  
were higher in Psychoticism reported less distress after the deception task than males lower  
on this trait. As previously mentioned, the deception task may not have aroused strong  
enough deception related emotions to enable us to assess emotional arousal related to  
deception. Additionally, we did not have a substantial number of participants who scored  
high on the trait of Psychoticism.

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3 In addition, female' level of Psychoticism had no impact on how distressing they  
4 found the road traffic accident video. Conversely, as expected, the whole group of  
5 participants and the male participants higher on the trait of Psychoticism did report feeling  
6 less distressed by viewing the emotionally salient stimuli (i.e., paramedics attending the scene  
7 of a road traffic accident) than people who scored lower on this trait. A callous disregard for  
8 others is a central feature of a psychopathic personality. In this sample, males scored higher  
9 on Psychoticism than females. This could account for the difference in these findings.  
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### 14 **Hypothesis 3**

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16 The third aim of this study was to investigate the association between the personality  
17 trait of Introversion / Extraversion and self-reported distress and HRV during the stress task  
18 and when considering enacting deceit.  
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21 **Subjective distress and HRV stress, subjective distress and HRV deception, and**  
22 **introversion / extraversion.** Contrary to our hypothesis, findings indicated that the tendency  
23 to be either Introverted or Extraverted did not impact on how people responded  
24 physiologically (i.e., via change in HRV) to a stressful situation or an imagined deceptive  
25 interaction that may have evoked deception related emotions (e.g., fear, guilt, delight). We  
26 predicted that, in line with previous findings (Buck et al., 1974; Buck et al., 1972; Notarius &  
27 Levenson, 1979), naturally spontaneous expressers (i.e., Extroverts) would exhibit weaker  
28 physiological reactions (i.e., skin conductance and HR) in response to emotionally arousing  
29 stimuli than natural inhibitors (i.e., Introverts). While the video footage of paramedics  
30 attending the scene of a road traffic accident used in the stress task has been found to evoke  
31 stress in past studies (e.g., Devilly & Annab, 2006; Cheung, Garber & Bryant, 2015), as  
32 previously mentioned, the deception task (imagining enacting deceit) may not have evoked  
33 strong emotions in this sample. Therefore, a task that involves enacting deception is needed  
34 to further examine physiological arousal associated with deception.  
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43 In addition, when analysing the participants as a whole group or males and females  
44 separately, the level of Introversion / Extroversion did not influence how distressing  
45 participants found the stress task. Therefore, neither Introverts nor Extroverts were more  
46 likely to report feeling distressed after viewing the scene of a road traffic accident. However,  
47 the trait of Introversion / Extroversion did influence how distressing participants as a whole  
48 found the deception task. Extroverts reported significantly more distress after the deception  
49 task than Introverts. This is contrary to our initial prediction. We believed Introverts, with  
50 their typically more timid natures, would be more distressed by the thought of enacting  
51 deceit. It is also possible that the extremely distressing nature of the car accident may have  
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3 washed-out any effects, it being exceptionally distressing for most people to watch (Cheung  
4 et al., 2015).  
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### 6 **Applications of Main Findings**

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8 This study was designed to differentiate individuals who may be good and bad at  
9 enacting deceit. This was done with the aim of identifying participants to be utilised in future  
10 research that will further examine the ability of people to enact deceit. In this study we aimed  
11 to identify personality traits and patterns of emotional and physiological arousal that may  
12 impact on individuals' confidence as deceivers. We further considered how these traits may  
13 influence the ability of people to enact deception. Identifying personal characteristics that  
14 may make for confident, credible deceivers could be beneficial when trying to identify  
15 deception cues and leakage in order to train people to detect deception.  
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### 21 **Strengths and Limitations of the Study**

22 The research observations in this study reflect the true effects in this population and  
23 are considered to be sound due to the sizable student sample that is representative of both  
24 genders. In this study we ultimately aimed to identify an emotional, physiological, and  
25 behavioural profile that may be an indication of deception ability. These findings put us one  
26 step closer to identifying optimal personal characteristics of credible deceivers.  
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30 It is a limitation to this study that within this sample (undergraduate students) we did  
31 not have many participants with truly high scores on the measure of Psychoticism, with the  
32 majority of the participants not scoring over the population mean for their gender on this trait  
33 (males [M = 3.69, SD = 2.48] and females [M = 2.97, SD = 2.22]; Aluja et al., 2003).  
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37 Further, the deception task did not seem sufficient to evoke strong deception related  
38 emotions (i.e., distress, apprehension, guilt, delight), with no real change in HRV being  
39 observed between imagining a truthful scenario and imagining enacting deception. This may  
40 be due to participants not completing the task properly or the fact that merely imagining  
41 enacting deceit does not arouse strong enough emotions to cause measureable physiological  
42 change via HRV.  
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### 46 **Future Research Directions**

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48 Future studies could investigate different psychological characteristics and attempt to  
49 determine whether or not they impact on deception confidence. The psychological  
50 characteristics investigated in the current study could also be examined among forensic  
51 populations. People who are higher in Psychoticism and high in Psychopathy may have a  
52 unique physiological profile associated with emotional arousal while enacting deception that  
53 could influence their confidence in their ability to deceive or their credibility as deceivers. As  
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3 Psychoticism and HRV while watching emotionally salient stimuli (video of a road traffic  
4 accident) came close to significance, we believe that with a larger sample of participants who  
5 score high in Psychoticism we would see a significant correlation here. This needs to be  
6 tested as it is unknown whether Psychopaths are emotionally or physiologically aroused  
7 during deceptive interactions in the same way as others. People higher in Psychoticism and  
8 Psychopathy may not experience as much physiological arousal (i.e., change in HRV) during  
9 deceptive communication as people lower in these traits, as they may not experience  
10 deception apprehension or guilt. As a result, Psychopaths may display minimal leakage or  
11 behavioural cues to deception. However, Psychopaths may experience duping delight  
12 (excitement caused by duping others), which could cause physiological arousal. The  
13 deception task would need to be altered in order to ensure it evoked strong enough deception  
14 related emotions to cause changes in physiological arousal.

## 22 **Conclusion**

23  
24 Overall, this study has shown that while some people have a tendency to react  
25 emotionally (i.e., self-reports of distress) other people are more likely to react physiologically  
26 (i.e., through a decrease in HRV) to emotionally arousing stimuli and to the thought of  
27 enacting deceit. While we initially predicted this style of responding would coincide with a  
28 level of Introversion and Extroversion, this personality trait did not seem to moderate the  
29 tendency to react emotionally or physiologically to the tasks in this study.

30  
31 We examined the difference in physiological response to emotionally salient stimuli  
32 and the thought of enacting deceit between Introverts and Extroverts with the intention of  
33 identifying individuals who may be more or less facially expressive. While previous studies  
34 have suggested that Extroverts exhibited weaker physiological reactions in response to  
35 emotionally arousing situations than Introverts (Buck et al., 1974; Buck et al., 1972; Notarius  
36 & Levenson, 1979) conflicting research findings suggest that Extroverts exhibit stronger  
37 physiological reactions in response to emotionally arousing situations than Introverts  
38 (Lanzetta et al. 1976; Zuckerman, et al., 1981). In line with the discharge model and previous  
39 research findings (Buck et al., 1974; Buck et al., 1972), we proposed that people who are  
40 more physiologically reactive would be higher on the personality trait of Introversion (less  
41 facially expressive). However, contrary to our prediction our findings indicated that one's  
42 tendency to be either Introverted or Extroverted had no impact on physiological arousal when  
43 viewing emotionally salient stimuli (road traffic accident) or when considering enacting  
44 deceit. While we have determined that our deception task (thinking about enacting deceit)  
45 may not have been sufficient to evoke physiological arousal, the video footage of paramedics  
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3 attending the scene of a road traffic accident has been found to evoke stress in past studies.  
4 Thus our findings do not provide support the previous research findings. However, Extroverts  
5 did report that they felt more emotionally aroused (distressed) by the thought of enacting  
6 deception than Introverts. Thus, in conjunction with desynchrony (emotional arousal and  
7 physiological arousal varying inversely or out of synchronicity), while the Extroverts were  
8 not physiologically aroused during the deception task, they did report feeling emotionally  
9 aroused after the task.  
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14 Contrary to our initial prediction, the personality trait of Psychoticism did not  
15 moderate how physiologically aroused the participants were in response to viewing  
16 emotionally salient stimuli (i.e., road traffic accident) or the thought of enacting deceit. Also  
17 contrary to our prediction, the personality trait of Psychoticism was not related to how  
18 emotionally arousing the group as a whole or the female participants found the thought of  
19 enacting deceit. However, in line with our hypothesis, males who were higher in  
20 Psychoticism reported less subjective distress after thinking about enacting deceit than males  
21 lower on this trait. In addition, female's level of Psychoticism had no impact on how  
22 distressing they found the road traffic accident video. Conversely, as expected, the whole  
23 group of participants and the male participants higher on the trait of Psychoticism were less  
24 emotionally aroused (self-reported distress) after viewing stimuli depicting others in distress  
25 (i.e., paramedics attending the scene of a road traffic accident) than people who scored lower  
26 on this trait.  
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35 Due to the characteristics associated with Psychoticism (typical high scorers are  
36 characterised as aggressive, nonconformist, tough-minded, inconsiderate, reckless, and  
37 impulsive), we expected people who were higher in the trait of Psychoticism to be more  
38 confident in their ability to deceive others. However, contrary to our prediction, the  
39 personality trait of Psychoticism had no impact on people's confidence in their ability to  
40 enact deceit. Further investigation into how Psychoticism impacts on deception confidence  
41 utilising a sample that score higher on this trait is warranted. We also expected that deception  
42 confidence would decrease the experience of emotional arousal and in turn physiological  
43 arousal while thinking about enacting deception. However, participants' confidence in their  
44 ability to enact deceit had no impact on how they responded physiologically (i.e., via changes  
45 HRV) while thinking about enacting deceit or vice versa. However, participants' level of self-  
46 reported distress after imagining themselves enacting deceit was negatively correlated to their  
47 confidence in their ability to enact deceit. This indicates that, as predicted, the more confident  
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3 people are in their ability to deceive others, the less distressing they find the idea of enacting  
4 deceit.  
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6 This investigation into psychological characteristics that may impact on the ability to  
7 successfully enact deceit has identified personal characteristics (i.e., Psychoticism and  
8 emotional and physiological arousal) for further investigation, ideally using a different  
9 sample population (i.e., forensic population).  
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Table 1

*Descriptive Statistics for Introversion / Extraversion, Psychoticism, HRV Stress, HRV Deception, Subjective Distress When Stressed, Subjective Distress During Deception, and Deception Confidence (N = 102)*

<b>Variables</b>	<b>Mean (SD)</b>
<b>Introversion / Extroversion</b>	7.49 (3.41)
<b>Psychoticism</b>	2.38 (1.71)
<b>HRV Relaxing Stimuli</b>	748.01 (110.99)
<b>HRV Stressful Stimuli</b>	728.15 (103.39)
<b>HRV Imagining Truth</b>	729.04 (115.25)
<b>HRV Imagining Deception</b>	730.06 (108.96)
<b>HRV Stress</b>	-16.33 (32.05)
<b>HRV Deception</b>	.44 (23.71)
<b>Subjective Distress Relaxing</b>	1.16 (.52)
<b>Subjective Distress Stress</b>	3.57 (1.01)
<b>Subjective Distress Deception</b>	1.87 (.89)
<b>Deception Confidence</b>	3.03 (1.00)

Table 2

*Correlation Between Deception Confidence, Psychoticism, and Subjective Distress and HRV Associated with Deception*

	<b>Psychoticism (N = 102)</b>	<b>Male Psychoticism (n = 30)</b>	<b>Female Psychoticism (n = 72)</b>	<b>HRV Deception (N = 102)</b>	<b>Subjective Distress Deception (N = 102)</b>
<b>Deception</b>	$r = .14$	$r = .26$	$r = .09$	$r = .06$	$r = -.23$
<b>Confidence</b>	$p = .15$	$p = .17$	$p = .45$	$p = .54$	$p = .02^*$

Table 3

*Correlation Between Psychoticism and Subjective Distress and HRV During The Stress and Deception Tasks*

	HRV Stress	Subjective Distress Stress	HRV Deception	Subjective Distress Deception
<b>Psychoticism</b>	$r = .19$	$r = -.26$	$r = .09$	$r = -.09$
<b>(N=102)</b>	$p = .06$	$p = .01^*$	$p = .40$	$p = .36$
<b>Male</b>	$r = .27$	$r = -.38$	$r = -.05$	$r = -.44$
<b>Psychoticism</b>	$p = .15$	$p = .04^*$	$p = .77$	$p = .01^*$
<b>(n = 30)</b>				
<b>Female</b>	$r = .12$	$r = -.11$	$r = .09$	$r = .08$
<b>Psychoticism</b>	$p = .33$	$p = .36$	$p = .48$	$p = .49$
<b>(n = 72)</b>				

Table 4

*Correlation between Introversion / Extraversion and Subjective Distress and HRV During the Stress and Deception Tasks*

	<b>HRV</b>	<b>Subjective</b>	<b>Males</b>	<b>Females</b>	<b>HRV</b>	<b>Subjective</b>
	<b>Stress</b>	<b>Distress</b>	<b>Subjective</b>	<b>Subjective</b>	<b>Deception</b>	<b>Distress</b>
	<b>(n = 102)</b>	<b>Stress</b>	<b>Distress</b>	<b>Distress</b>	<b>(n = 102)</b>	<b>Deception</b>
		<b>(n = 102)</b>	<b>Stress</b>	<b>Stress</b>		<b>(n = 102)</b>
			<b>(n = 30)</b>	<b>(n = 72)</b>		
<b>Introversion /</b>	$r = -.01$	$r = .01$	$r = .14$	$r = -.002$	$r = -.12$	$r = .22$
<b>Extraversion</b>	$p = .95$	$p = .92$	$p = .45$	$p = .98$	$p = .22$	$p = .03^*$