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Evaluating personality as a moderator of the association between life events stress and cardiovascular reactivity to acute stress

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ABSTRACT

The present study investigated the possible interaction between life events stress and personality in predicting cardiovascular stress responses. Participants ($N = 184$) completed psychometric measures of life event stress and personality styles and had cardiovascular responses monitored during a standardised stress testing protocol. In adjusted models, the observed blunted association between life event stress and SBP and DBP was moderated by openness; this was more evident at $-1SD$ below the mean openness value. Further, the association between life event stress and TPR vascular resistance was found to be moderated by conscientiousness. In particular, we found conscientiousness at both the mean and 1*SD* above the mean buffered against the negative impact of life stress on TPR reactivity. The findings are discussed in relation to theory and future directions.

1. Introduction

Coronary heart disease (CHD) is one of the leading causes of death among the general population, yearly claiming the lives of approximately 610,000 people in the U.S. alone (American Heart Association, 2017). In addition to the established risk factors including smoking, obesity, diabetes, family history of heart disease and low physical activity (Helfand et al., 2009; Hubert et al., 1983; Stamler et al., 1993), there is an increasing literature suggesting that psychological factors may significantly contribute to CHD. In particular, the reactivity hypothesis posits that exaggerated or prolonged cardiovascular reactivity (CVR) to psychological stress may promote the development of cardiovascular disease (Obrist, 1981; Phillips and Hughes, 2011). This hypothesis has received substantial support with prospective studies finding that heightened reactivity to stress is associated with adverse cardiovascular outcomes including hypertension (Carroll et al., 2012; Markovitz et al., 1998) and atherosclerosis (Barnett et al., 1997; Matthews et al., 1998). Further, although low CVR to acute stress is often assumed to be benign, blunted cardiovascular responses also have adverse health-related implications (Phillips and Hughes, 2011; Phillips, 2011), and have been associated with myriad negative health states (Phillips et al., 2013) including obesity (Carroll et al., 2008), poor cognitive functioning (Ginty et al., 2012), and increased intima-media thickness (Ginty et al., 2016).

Importantly, research examining maladaptive patterns of reactivity has identified stressful life events as correlates of blunted responses. In a 30-year review of the literature, individuals experiencing negative life stressors were found to display a blunted cardiovascular profile in response to acute psychological stress (Chida and Hamer, 2008), implying that everyday life stressors may contribute to a diminished cardiovascular response to acute stressors. More recently, young women who experienced negative life events in childhood displayed a blunted endocrine and cardiovascular response to the Montreal Imaging Stress Task (Voellmin et al., 2015). These findings are consistent with the theory of allostatic load whereby exposure to chronic stress disrupts the regulatory mind-body systems causing an increased vulnerability to disease (McEwen, 2005). Alongside this line of research are studies implicating individual differences in personality in maladaptive responding to stress.

Indeed, several studies have found that personality factors are associated with CVR to acute stress (see Chida and Hamer, 2008, for a review). A recent study found that those scoring higher on neuroticism and low on openness to experiences had smaller systolic (SBP), diastolic (DBP), and heart rate (HR) stress reactions (Bibbey et al., 2013), indicative of a blunted cardiovascular response. These findings are consistent with the cognitive model of stress (Lazarus and Folkman, 1984), which states that one's internal characteristics including personality influence how one copes and manages stress. In fact, in CVR studies, personality styles have been found to influence stress appraisals, coping appraisals, effort, motivation and engagement with the stressor (Harper et al., 2016; Kemper et al., 2008; Silvia et al., 2013). For example, a recent CVR study demonstrates that participants scoring high in

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neuroticism perceived stress tasks as more stressful and difficult, and also perceived themselves to be less in control (Bibbey et al., 2013). In contrast, those scoring high on extraversion and openness rated the task as less stressful, less difficult, and also felt they had greater control. Other studies have also linked negative life events, personality and health. For example, neuroticism in childhood has been found to be predictive of higher life event stress and poor health, in adulthood (van Os et al., 2001). Thus, given these associations between personality and life stress for health, it is possible that there would be a similar interaction on CVR to acute psychological stress.

In summary, it is plausible that negative personality traits are associated with diminished SBP, DBP, and HR responses. These blood pressure changes may further be underpinned by less variability in hemodynamic variables (i.e., cardiac output [CO], and total peripheral resistance [TPR]) associated with negative traits (such as Type D; Howard et al., 2011). However, based on the above research the interactive relationship between negative life events and personality and their impact on cardiovascular outcomes remain unclear. The present study aims to distinguish the extent to which these work in combination with one another and to what extent does personality, particularly neuroticism and openness to experience, moderate the association between negative life event stress and CVR to stress. In light of previous findings (Chida and Hamer, 2008; Bibbey et al., 2013), it is likely that both stressful life events and negative personality traits are associated with blunted reactivity. It is possible that these factors contribute additively to blunted reactivity; however, it is also plausible that stressful events and personality influence one another, and that their shared variance predicts diminished reactivity. Furthermore, the personality-reactivity literature is heavily weighted towards exploration of negative affect-related variables, meaning predictions regarding conscientiousness, for example, are difficult to generate. For this reason, and given a lack of research evaluating the interaction between these stressful life events and personality, an exploratory approach to hypothesis testing is adopted.

2. Materials and methods

2.1. Participants

One hundred and eighty-four healthy undergraduate students (62.3% female), from our local university participated in this study. Based on power calculations, a minimum sample size of 146 participants was needed to detect a significant effect ($p = .05$, $f^2 = 0.06$) at 80% power. However, in order to account for attrition and potential outliers a higher number were recruited. Participants were recruited by means of a course credit system within the university, by word of mouth, and the advertisement of the study throughout the campus. Participants ranged in age from 18 to 58 ($M = 21.65$, $SD = 5.33$) with a mean body mass index (BMI) of 23.65 kg/m^2 ($SD = 3.70$).

Participants with a diagnosis of cardiovascular disease or hypertension, an immune disorder, or women who were pregnant, were excluded in order to minimize the possibility of confounding variables. Participants who were ill or taking medication influencing cardiovascular measures (other than the oral contraceptive) were also excluded. In preparation for the testing session participants were asked to refrain from alcohol and vigorous exercise 12 h prior to testing, as well as smoking and consuming caffeine 2 h before testing. These precautionary instructions were provided as previous research has found a subsequent change in blood pressure following smoking (Cruickshank et al., 1989; James and Richardson, 1991), caffeine consumption (Hartley et al., 2000; Savoca et al., 2005), alcohol intake (Potter et al., 1986) and exercise (Somers et al., 1991). This study was approved by the university's research ethics committee. All participants provided written informed consent prior to participating and were debriefed following the testing session.

2.2. Design

The present study employed a within-subjects correlational design. The main predictor variables were life events stress and personality. The dependent variables were measures of CVR including SBP, DBP, HR, CO, and TPR. These included the primary variables assessed in CVR research (i.e., SBP, DBP, and HR), in addition to haemodynamic variables measured in previous CVR-personality research (e.g., Jonassaint et al., 2009; Ó Súilleabháin et al., in press). Reactivity scores were computed as the difference between mean baseline and mean task value for each cardiovascular parameter, in line with previous research (e.g., Gallagher et al., 2014; Phillips et al., 2009).

2.3. Materials and apparatus

2.3.1. Negative life events measure

The 36-item Life Events for Students Scale (LESS; Linden, 1984) was used as to measure negative life events stress. This scale is comprised of life events that students may have encountered over the past year. Examples of items on the scale include; 'Death of a Parent', 'Pregnancy', 'Major Car Accident', 'Failing a Course', etc. Participants were required to indicate, 1) the number of life events they had experienced over the past year from the list, and 2) their rating of perceived stressfulness of each event on a scale ranging from 1 (*Not At All*) to 4(*Very*). This scale was selected as a measure of negative life events as it is tailored to suit the needs of students within higher education rather than the general public.

2.3.2. Personality assessment

The 10-item Personality Inventory (TIPI) (Gosling et al., 2003) was used a measure of personality. The TIPI is a short-form measure of the big five personality traits and was used to assess extraversion, agreeableness, conscientiousness, openness to experience and emotional stability. Two items assess each type of personality, both of which are averaged. Examples of items include for extraversion, 'I see myself as extraverted/enthusiastic' and 'I see myself as reserved/quiet'. Participants were required to rate the degree to which each items described themselves on a 7-point Likert scale ranging from 1 (*disagree strongly*) to 7 (*agree strongly*). Several of the items are reversed coded (i.e., 2, 4, 6, 8, & 10). Scores range from 2 to 14 with higher scores implying a stronger identification with this personality style. Gosling et al. (2003) found the TIPI to display a strong test-retest reliability over a 6-week period ($r = 0.72$) and close convergence with the well-established Big-Five Inventory (mean $r = 0.77$). Furnham (2008) also found the TIPI to have close convergence with the NEO-FFI (mean $r = 0.53$), and suggested that in comparison to two other brief personality measures the TIPI displayed slightly better validity.

2.3.3. Stress task measures

Immediately before and after the battery of stress tasks, participants were asked to indicate how stressful they expected to find each task and how stressful they found each task. These items were scored on a 7-point Likert scale 0 (*Not at all*) to 6 (*Extremely*) and were used to confirm that the task was psychologically stressful.

2.3.4. Cardiovascular assessment

Beat-to-beat measures were recorded using a Finometer Pro hemodynamic cardiovascular monitor (Finapres Medical Systems BV, BT Arnhem, The Netherlands). The Finometer is well-validated (e.g., Schutte et al., 2004) and takes continuous non-invasive measurements from one's finger arterial pressure attached to the middle finger of the participant's non-dominant hand. A second cuff is attached to the participant's upper arm and is used to calibrate reconstructions of the intrabrachial pressure derived from the finger cuff. A hydrostatic height correction system is used to correct hand height to heart level.