CONSCIENTIOUSNESS AND CARDIOVASCULAR REACTIVITY TO RECURRENT ACUTE PSYCHOLOGICAL STRESS

Thesis submitted for the Degree of Doctor of Philosophy

Amanda A. Sesker, B. A. (Psychology; Women’s Studies)

School of Psychology
National University of Ireland, Galway
Galway
February 2019

Supervisor
Prof. Brian M. Hughes

Supervisor of Research:
Dr. Siobhán Howard
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ABSTRACT

Introduction. Conscientiousness is a personality construct encompassing the trait of being careful, vigilant, dutiful, and concerned about the implications of one’s actions. It is a core trait within the five-factor personality trait model, and is known for its stability and consistency across the lifespan, as well as its predictability for health behaviour choices that affect morbidity and longevity. Research has presented robust evidence for the influence of socio-behavioural models in moderating conscientiousness and stress appraisal. However, far less scrutiny has been given in addressing whether direct psychosomatic mechanisms might not also play a significant role in moderating this relationship. The central research of this thesis will examine the systematic associations between conscientiousness and acute cardiovascular stress responsivity, and will argue for the consideration of conscientiousness in future psychosomatic models of stress.

Methods. Four empirical studies were conducted. In a sample of 602 middle-aged adults drawn from the Midlife in the United States (MIDUS) cohort, Study 1 examined whether conscientiousness was associated with agentic stress coping strategies using multiple regression. In a sample of 37 female college students, Study 2 investigated whether conscientiousness affected a distinctly adaptive profile of CVR to recurrent acute psychological stress across a protocol of repeated stress exposures. Study 3, in a sample of 89 female college students, scrutinized the conscientiousness and cardiovascular response profiles to acute stress, with the incorporation of performance evaluation in the paradigm. In Study 4, a sample of 84 college students (42 females and 42 males from Study 2) was compared to establish whether these patterns were consistent across sex using a matched-subjects design.

Results. Findings from Study 1 supported previous research which suggested that persons higher in conscientiousness were more likely to engage in problem-focused coping behaviours, while persons lower in conscientiousness would tend to utilise emotion-focused coping behaviours. Furthermore, results suggested a propensity for conflation of Midlife in the United States (MIDUS) mindfulness scale items with conscientiousness scale items. In Study 2, significant findings for SBP and MAP indicated that higher-order level interaction effects were present for
conscientiousness across time. Study 3 showed significant higher-order effects across the entire protocol for SBP, DBP, and MAP, and HR. CO also demonstrated significance at the cubic level. Study 4 showed that sex exerted the main influence for reactivity effects across time for SBP, DBP, CO, MAP, and TPR in females, while CO and TPR were significant drivers of conscientiousness effects for responsivity in both males and females.

**Conclusions.** These findings indicate that conscientiousness has a critical influence on myocardial dynamics and may be a critical health marker for adaptive response profiles to recurrent acute stress. Conscientiousness was associated with significant cardiovascular response trajectories across repeated acute stressor tasks, sex, and a variety of cardiovascular parameters. High in conscientiousness was associated with problem-focused coping behaviours and lower trait anxiety, while low conscientiousness was associated with emotion-focused coping and higher trait anxiety. Men were more likely to report higher stress across the protocol than women. Overall, findings are consistent with established literature linking conscientiousness with morbidity risk and suggest that conscientiousness is a significant repeated measures variable for predicting haemodynamic reactivity across time. It is possible that rank order groups for conscientiousness may be associated with different stress response profiles and potentially adverse outcomes depending on the situational context. Further investigation is needed in this area. Future research could benefit from assessing between-group differences in conscientiousness and its overall role in reducing the impact of CVR on the development of future disease risk.
PREFACE

This research was funded in part by the Galway Doctoral Scholarship, Postgraduate International Merit Scholarship, and Research Travel Bursaries sponsored by the National University of Ireland, Galway and College of Arts, Social Sciences and Celtic Studies. All works presented in this thesis were conducted in the School of Psychology at NUI Galway. All projects and amendments were approved during annual review and compliance procedures were overseen by the NUI Galway Research Ethics Committee [research ethics reference: 14-Nov-02].

The data analysed in Chapter 2 was drawn from the National Survey of Midlife Development in the United States (MIDUS) II and the MIDUS Biomarker Project. MIDUS is funded under the United States Department of Health and Human Services, National Institutes of Health and National Institute on Aging [5-PO1-AG20166-04 and P01-AG020166]. This data is in the public domain; special permission is not required for its use in research or clinical purposes.

A version of Chapter 2 has been published [Sesker, A. A., Ó Súilleabháin, P., Howard, S., & Hughes, B. M. (2016). Conscientiousness and mindfulness in midlife coping: An assessment based on MIDUS II. Personality and Mental Health, 10(1), 29-42]. The author of this thesis was lead investigator, and Ó Súilleabháin contributed to manuscript edits. Howard and Hughes were supervisory authors and contributed to the manuscript formation and composition.
ACKNOWLEDGEMENTS

I would like to thank the Centre for Research on Occupational and Life Stress and School of Psychology for their clerical aid and resources to complete data collection, especially Declan Coogan for his technological savvy and Dr. Sinead Conneely for her assistance with academic resources and psychometric archives. I thank the postgraduate researchers in the School of Psychology, particularly to Dr. Corinna Stewart, Sophi Arndt, Dr. Milou Fredrix, and the rest of the G042 crew: your support, friendship, and tea breaks made the last four-odd years endurable and light-hearted. I also extend warm thanks and acknowledgment to my excellent friend and colleague Dr. Páraic Ó Súilleabháin, whose tenacity I admire, and whose enthusiasm, guidance, and Rory/Fiadh-time invariably strengthened both the quality of this research and my capacity to complete it.

I would also like to thank my parents; Scott and Katie Sesker, and Michelle Lemyre, for the years of support and well-timed care packages with which I ate my way through my research work. Also, to my grandparents Wayne and Sharon Sesker, and posthumously to Tom and Bernie Stark, for first inspiring my enthusiasm for discovery and the pursuit of knowledge, and for always supporting me to do so. To my lovely aunt and personal cheerleader, Teri Stark: thank you for the kind words of encouragement and pep talks you’ve given me throughout the last four years. Kudos is also extended to my good friend and fellow Sigma Tau Delta, Dr. Bridget Kapler, as well as Dr. Stephen Bonfilio, for kindly lending a keen eye to proofread the final draft of this thesis. I extend grateful thanks to the numerous friends and family present in my life, and for their love and support both near and afar; I’m lucky to have so many of you and wish I had the space (and the financial resources) to list all your names. I also want to especially thank the Miller family – Terry, Liz, Joe, Dan, and Chuck – for their hospitality, many laughs, and for always lending an unconditional open hand (or paw) whenever needed. I would also like to take a moment to acknowledge the brew crew working for Galway Bay Brewery and Bent Brewstillery: thanks, as always, for providing me with a haven for countless hours of ‘research,’ writing, and the opportunity to continuously perfect my ‘elevator pitch.’

Special gratitude is due to my co-supervisor, Dr. Siobhán Howard, for working across time zones and lunch breaks in helping compose a proposal for graduate study; thank you for seeing my potential and guiding me from those early
years during the application process all the way through to the final drafts. Sincere appreciation is also given to my supervisor Prof. Brian Hughes; your guidance and mentorship, at times both challenging and inspiring, shaped the development of this research into the calibre it is today. For this I am most grateful.

Last, but certainly not least, I express heartfelt gratitude to my loving partner Colin Miller. It’s been a long journey since I first met you in Galway that fateful autumn 2008, where we returned once again in 2013. In this very moment as I type, I am reminded that it has now been nearly years since you returned to the States. True enough to your favourite adage; no one said it was going to be easy. Indeed, academics are a particular breed and niche concerns may not seem like the easiest (or most obvious) things to assuage. Long distances also strain the heart. However, your humorous life outlook and unwavering support, oftentimes in the form of cat videos or beer, continuously reminds me that “…happiness can be found, even in the darkest of times, if only one remembers to turn on the light” (Columbus & Cuarón, 2004). A new road opens before us, and I can’t wait to see where it leads.

I dedicate this thesis to us and all future adventures.
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LIST OF ACRONYMS

AD: Alzheimer’s Disease
ANCOVA: Analysis of covariance
ANOVA: Analysis of variance
BH: Borderline hypertensive
bpm: Beats per minute
BMI: Body mass index
CHD: Coronary heart disease
CO: Cardiac output
CVD: Cardiovascular disease
CVR: Cardiovascular reactivity
DBP: Diastolic blood pressure
DV: Dependent variable
FFMQ: Five factor mindfulness questionnaire
HIV: Human immunodeficiency virus
HPA: Hypothalamic-pituitary-adrenal axis
HR: Heart rate
lpm: Litres per minute
LVM: Left ventricular matriculation
MA: Mental arithmetic
MAAS: Mindfulness attention awareness scale
MBSR: Mindfulness-Based Stress Reduction
MAP: Mean arterial pressure
MI: Myocardial infarction
MIDUS: The national survey of Midlife Development in the United States
mmHg: millimetres of mercury; a manometric unit of pressure
NEO-FFI-3: Neuroticism, Extraversion, Openness-Five Factor Model Inventory-3
NEO-PI-R: The Revised NEO Personality Inventory
OC: Oral contraceptive
PNS: Peripheral nervous system
pru: Peripheral resistance units
REC: Research ethics committee
SBP: Systolic blood pressure
SD: Standard deviation
SE: Standard error
SNS: Sympathetic nervous system
STAI: State-Trait Anxiety Inventory
TPR: Total peripheral resistance
CHAPTER I
INTRODUCTION

1. Conscientiousness

1.1. Identifying and Defining Conscientiousness

Conscientiousness is a personality construct encompassing the trait of being careful, vigilant, dutiful, and concerned about the implications of one’s actions. It is one of the five-factor personality traits described within the Costa Jr. and McCrae (1992) big five model of personality. The other dimensions in this model include agreeableness, extraversion, neuroticism, and openness to experience. Narratives describing trait conscientiousness can be found in the earliest surviving lexicon of trait terms describing human behaviour. Francis Galton (1884) was one of the earliest scientists to hypothesize a connection between personality characteristics, heredity, and individual differences. He attempted to inventory and measure human temperament and character by identifying characteristics from words indexed in Roget’s Dictionary. Allport and Odbert (1936) then expounded Galton’s work and created a taxonomy from these personality characteristics. This list of terms included a central trait initially referenced as conscientiousness. Cattell (1943) condensed these trait adjectives to the 16 distinct personality factors known today into the ‘self-control’ factor in his Sixteen Personality Factor Questionnaire, some of which first comprised the trait facets of conscientiousness. In similar fashion, those 16 components were further reduced to extraversion, agreeableness, conscientiousness, emotional stability, and culture (Norman, 1963). These broad dimensions soon became known as the “Big Five” factors (Goldberg, 1981). When Costa Jr. and McCrae (1983) expanded their Neuroticism, Extraversion, Openness–Five Factor Model Inventory (NEO) to include agreeableness and conscientiousness scale measures (John & Srivastava, 1999), they were met with public disagreement from Eysenck (1992b). However, Costa Jr. and McCrae countered that the trait was replicable across time in diverse instruments (1992c) and was to be considered a ‘real, pervasive, universal, and biologically based’ dimension that was an orthogonal, irreducible, and distinct measure (Costa Jr. & McCrae, 1992b; Heaven, Ciarrochi, Leeson, & Barkus, 2013). The scale items that comprise the NEO-FFI and NEO PI-R tests “measure traits that approximate normal, bell-shaped distributions… it is necessary to keep this distribution in mind when interpreting the meaning of any
individual’s scores” (Costa Jr. & McCrae, 1992a, p.13). The five-factor model is currently considered dominant within the modern framework of personality theory. Within this framework, conscientiousness is commonly identified as the extent to which an individual is organized, thorough, and reliable (Goldberg, 1993). It is a trait associated with determination, achievement, persistence, and systematically approaching problems and situations (Javaras et al., 2012).

A common theoretical assertion regarding conscientiousness has been an affiliation with moral righteousness, traditionalism, and justice (Hirsh, DeYoung, Xu, & Petersen, 2010). This conjecture follows Kantian ethics (Kant, 2003), which posits that morality and excellence require conscientious attention and obedience. Essentially, truly benevolent and sensitive persons are compelled to think of others in need (Noddings & Slote, 2003). However, views considered prejudiced by mainstream groups or societies can nonetheless also be considered highly conscientiousness. Indeed, highly conscientious individuals may be fully capable of committing themselves to orderly, diligent, deliberate, and competent behaviours in pursuit of their own particular (in this case, racist) aims (Ekehammar, Akrami, Gylje, & Zakrisson, 2004). Therefore, conscientiousness must be separated from culturally determined moral frames of reference, core cognition and behaviour. Since kind persons don’t worry whether their actions are kind and just persons explicitly worry whether their actions are just (Williams, 1985), logic follows that conscientiousness should be considered in terms of the extent to which persons are concerned over the outcomes and consequences of their actions.

1.2. Conscientiousness and Stress Appraisal

Conscientiousness is frequently dichotomized into either high or low scoring categories on the dimensional spectrum and consequently evaluated as a system of costs and benefits: high has been commonly inferred as a marker of ‘good’ citizenship, whilst low conscientiousness has been portrayed as ‘bad’ (Currall, 1988). People who score high for conscientiousness in personality inventories commonly demonstrate behavioural characteristics for industriousness and pragmatism, whereas persons attempt to troubleshoot, and this activity prepares them for stress. For example, highly conscientious persons tend to engage in primary appraisals when assessing stressful situations and subsequently attempt to control all possible outcomes (Penley & Tomaka, 2002). Using concepts described by Lovallo
Chapter 1: Introduction

(2015), stress will be used throughout this thesis to refer to an event that requires an individual to make major readjustments to successfully cope with its severity, or a challenge sustained so long that it significantly alters an individual’s psychophysiology.

Highly conscientious persons tend to engage with stressful situations head-on, and cope with stressors in an efficient and orderly manner (O’Brien & DeLongis, 1996; Bogg & Roberts, 2004; Carver & Connor-Smith, 2010). Conversely, persons scoring low in conscientiousness tend to be more impulsive, disorganized, careless and irresponsible. This can lead to poor health behaviour choices and a greater vulnerability to stress (Vollrath & Torgersen, 2000). Consequently, high conscientiousness might be considered an ideal trait prioritized and encouraged in students, citizens, military personnel and employees. Persons who willingly demonstrate a greater capacity for attentive and organised behaviours are frequently rewarded and reinforced for their hard work and overreaching accomplishments.

Trends demonstrating peak trait maturation in emerging adulthood are also frequently driven by societal roles which may emphasize orderliness, achievement and self-regulation (Soto, John, Gosling, & Potter, 2011). However, it is also possible that the success credited to significant behavioural trait changes in young adulthood may arise instead from learned behaviour patterns rather than trait-level changes in plasticity or physiology (Roberts & Jackson, 2008). There is methodological difficulty with questionnaires in ascertaining whether significant long-term behaviour change is involved with the trait.

Despite the extensive body of research promoting the benefits associated with high conscientiousness, highly conscientious individuals are not invariably protected from the potential fallouts related to unpreventable stressors. Lower life satisfaction and greater distress has been reported amongst long-term unemployed persons (Boyce, Wood, & Brown, 2010), as well as inter-competitive athletes (Cleveland et al., 2012) and students (Seery et al., 2010) with higher levels of conscientiousness than their lower functioning counterparts. This effect may be due to a tendency for high conscientiousness persons to equate success with personal achievement and ability. Greater self-imposed pressure to accomplish ambitious and difficult goals is itself a source of stress. Known as the ‘moral tinge,’ failure can exact debilitating negative emotions, such as guilt or shame, which can undermine the self and draw strong self-criticism (Costanzo, 2014). Thus, high conscientiousness may have
knock-on effects for comorbid perfectionist and obsessive-compulsive tendencies and behaviours, becoming detrimental during perceived failure (Stoeber, Otto, & Dalbert 2009; Shanahan et al., 2014; Carter, Guan, Maples, Williamson, & Miller, 2016). Persons who score low in conscientiousness may have an advantage in situations that require creativity and flexibility. However, this supposed advantage is also associated with a greater propensity for distraction and engagement in counterproductive behaviours (Ferguson et al., 2014).

1.3. Evolution and Trait Heritability

Conscientiousness is cross-culturally universal, stable across the lifespan, and present across non-human animals (Gosling & John, 1999; Soldz & Vaillant, 1999; Yamagata et al., 2006; Weiss et al., 2015). This stability arises from a substantial underlying heritable component. As is proposed of all five factor dimensions, conscientiousness is considered a genetically-driven trait adaptation (McCrae & Costa Jr., 1999). It has a strong genetic component estimated at 43-52% heritability, which may shape health and morbidity outcomes across the lifespan (Jang, Livesley, & Vernon, 1996; Bouchard Jr., & McGue, 2003; Distel et al., 2009; South & Krueger, 2014). Reports have indicated that neither shared home environment nor sex heritability yield any significant effect on trait expression, whereas individual differences in non-shared environment will (Roberts, Wood, & Smith, 2005; Loehlin, McCrae, Costa Jr., & John, 1998; Bouchard Jr., 1994; Luciano, Wainwright, Wright, & Martin, 2006). In this way, genetic factors contribute to individual differences within conscientiousness, which may influence trait-characteristic behaviours. Trait-expressive behaviours associated with conscientiousness, especially those related to work performance and evaluation, can be distinguished by set conditions which may favour its use in different contexts (Tett & Burnett, 2003). Indeed, performance expectancy and goal choice have been shown to mediate conscientiousness and task performance. High conscientiousness is associated with negative stress and performance reactions when negative performance feedback is given (Cianci, Klein, & Seijts, 2010), although the strength of this relationship may be dependent on the context of the environment (Gellatly, 1996; Tett & Burnett, 2003).

Costa Jr. and McCrae (1992b) stated that trait levels of five factor elements are compartmentalized in distinct domains but hold the capacity to overlap across
more than one factor. When this occurs, conscientiousness may counteract risk factors that accompany other traits and act as a direct mechanism to regulate positive health behaviours; e.g., abstention from use of illicit substances (Turiano, Whiteman, Hampson, Roberts, & Mroczek, 2012). As such, heritable influences may impart a significant effect on orderly behaviour. For example, a tidy living or working space has the potential to significantly influence the impact of extraneous variables; e.g., environmental factors such as sanitation, and guide individual variations in epigenetics (Specht, 2017). In this way, trait heritability and individual differences in behaviour decisions can have a substantial influence on long-term health.

Genetic components seem to have a more substantial influence on trait expression that potential social influences constructed by home-environment interactions. Coping tendencies have been found to be associated with moderate levels of both specific and shared genetic heritability (Kendler et al., 1991; Busjahn, Faulhaber, Freier, & Luft, 1999). It is estimated that 20% of the accounted variance in coping style is accounted for by personality, and these effects may be indirectly affected by the genetic accountability for personality trait itself (Watson & Hubbard, 1996). However, this effect does not appear to be driven by shared environment (Busjahn et al., 1996). Much existing research focuses on socio-behaviour choices in health behaviours. The connection between these distinct focal points appeals for further research on the biological components of the trait that may be generating biopsychosocial responses to particular contexts or environments. It is possible that conscientiousness may be a direct phenotypic expression of an underlying psychobiological mechanism.

Trait consistencies may moderate actions that may reduce the effect of stressors and attenuate the resulting physiological responses. However, individual differences may also dictate natural variations that exist across populations exposed to similar social or environmental situations. For instance, differences in psychophysiological reactivity to stressors are normally distributed across populations. The largest group of reactors fall within the average range between the extremes of high and low reactivity. A basic principle of evolution asserts that mid-range traits are considered the most genetically adaptive and thus, most likely to be retained since they are a part of the large (and overwhelmingly major) portion of the average distribution (Darwin, 2009; MacDonald, 1995; Nettle, 2006). Pain sensitivity is a distinctive example for evidence of mid-range success. It is
considered maladaptive to disregard pain thresholds to the point of severe bodily
damage or injury. Likewise, it would not be adaptive to be incapacitated by the
slightest pain: too much or too little of one characteristic may lead to debilitating
effects. The mid-range group would conceivably neither over- or under-reacts to pain
in this scenario, and thus best adapted for survival and generational success.

Following this narrative, concern has been raised over whether dichotomizing
continuous variables like time and stress would result in idiosyncratic
misclassifications or unstable interaction effects (Veiel, 1988). Likewise, it is argued
that scores just above and below median splits become allocated into high and low
groups by arbitrary means (Schütz, Archer, & Garcia, 2015). Tertile split procedures
would require greater power than median splits, but they maximize the variance
explained within those distinct groups (Kerlinger, 1973). Since personality traits are
heritable and research implies that a mid-range advantage may be best suited for
daily life stress (Costa Jr. & Widiger, 1994), individual differences may be partially
responsible for moderating maladaptive responses in certain contexts.

1.4. Conscientiousness and Coping

Many research findings to date have commonly reported on the relationship
between conscientiousness and distinctive coping strategies, and how particular
coping styles mediate a variety of sociobehavioural stressors. Coping behaviours are
considered efforts which prevent or diminish threat, harm, and loss, or reduce the
association of stress. Distinct personality types seem to be associated with particular
coping styles, which may be dependent on environment and dispositional tendencies.
Most of the research available on coping strategies focuses on two distinct categories
which encapsulate a variety of behaviours: problem-focused coping and emotion-
focused coping (Penley & Tomaka, 2002). Problem-focused coping describes several
strategies utilized in reducing or eliminating stress, such as active coping, planning,
suppressing competing activities, increasing applied effort or seeking social support.
Emotion-focused coping regulates emotions accompanying interactions with stress
and describes strategies utilized towards emotional arousal and distress, such as
seeking emotional–social support seeking, venting emotions, self-blaming, wishful
thinking and humour (Kaiseler, Polman, & Nicholls, 2012). Both strategies are
known for proactively dealing directly with conditions triggering stress (Vollrath,
2001). For example, turning to others and problem solving have been shown to

High conscientiousness is closely associated with the use of problem-focused coping. This strategy has been reported in samples of highly conscientious athletes (Kaiseler et al., 2012), students (Bartley & Roesch, 2011), and police officers (Lau, Hem, Berg, Ekeberg, & Torgersen, 2006). Highly conscientious copers are known for facing stressors straight on, figuring out what needs to be done, and carrying out plans to completion (O’Brien & DeLongis, 1996). As such, it is reasonable but not discernible which mechanism, conscientiousness or problem-focused coping, is related to positive health outcomes. Conversely, people with low levels of conscientiousness demonstrate a greater vulnerability to stress (especially when paired with high neuroticism), and a tendency to engage in more emotion-focused coping behaviours (Vollrath & Torgersen, 2000). Specific emotions, such as anger and shame, are also associated with greater emotion-focused coping and physiological arousal (Herrald & Tomaka, 2002). These findings have been consistent across local and national studies, as well as consistently demonstrated across the lifespan (Weinstein, Brown, & Ryan, 2009).

1.5. Conscientiousness and Health

The literature thus far suggests that high conscientiousness confers a number of benefits. Regardless, high conscientiousness in and of itself does not inherently minimize distressful outcomes across all circumstances. Competitive, achievement-based situations might prove very stressful for these individuals because they may not directly control the subsequent outcomes. Independent of these attritions, conscientiousness is still by far the strongest predictor of longevity than any of the other five factor personality traits (Martin & Friedman, 2000). In a series of longitudinal studies following large cohorts of children and middle-aged adults across the lifespan, higher reported childhood scores for conscientiousness were significantly related to greater survival outcomes into middle and old age, suggesting the trait may moderate longevity and health (Friedman et al., 1993; Martin, Friedman, & Schwartz, 2007; Hampson, Edmonds, Goldberg, Dubanoski, & Hillier, 2013). These findings have been replicated in other studies of longevity. Research derived from the Whitehall II Cohort and the Midlife in the United States (MIDUS)
studies have reported a 10-13% decrease in mortality for each SD increase in conscientiousness (Hagger-Johnson et al., 2012; Turiano et al., 2015). In a study of old-age adults, high conscientiousness was related to fewer feelings of fear and anxiety, and fewer reported psychological concerns with aging (Harris & Dollinger, 2003). Higher reported scores for conscientiousness have also been attributed to a 40-50% lower overall cardiovascular mortality risk, which remained consistent after controlling for obesity, diabetes, smoking, hypertension, and physical inactivity (Jokela, Pulkki-Råback, Elovaonio, & Kivimäki, 2014). As such, high conscientiousness has been associated with greater longevity and healthful life outcomes, likely resulting from health-promoting behaviours associated with medication adherence, safe sex practices, nutritional choices, exercise, and sobriety (O’Cleirigh, Ironson, Weiss, & Costa Jr., 2007; Leahy, Treacy, & Molloy, 2015). Findings indicate that conscientiousness also reliably predicts morbidity outcomes for obesity (Hampson et al., 2013), Alzheimer’s disease (AD) (Duberstein et al., 2011), chronic renal insufficiency (Christensen et al., 2002), dementia (Sutin, Stephan, & Terracciano, 2017) high blood pressure (Hagger-Johnson et al., 2012), and HIV progression (O’Cleirigh et al., 2007).

Since low conscientiousness scorers tend to be disorganized, neglectful and careless, it comes as no surprise to find that they are highly vulnerable to stress (Vollrath & Torgersen, 2000), poor health and obesity (Hampson & Goldberg, 2006). Significantly low levels of conscientiousness have also been identified with particular mental disorders, such as major depression, panic attacks, general anxiety disorder and substance abuse (Goodwin & Friedman, 2006). Data collated from several large, publicly available datasets have demonstrated a relationship between low conscientiousness and poor sleep quality in middle and older aged adults over the course of a 10-year period (Stephan, Sutin, Bayard, Križan, & Terracciano, 2017). Low conscientiousness has also been associated with elevated levels of interleukin-6 and glucocorticoids, as well as smoking and obesity (Sutin et al., 2010; Chapman et al., 2011; Garcia-Banda et al., 2011). Additional reports in morbidity rates also correlate with tobacco consumption, car accidents and risky sexual behaviours (Bogg & Roberts, 2004). As such, a clear relationship between the mediating effects of conscientiousness has demonstrates reliable prediction of key health-related behaviours contributing to longevity. However, these influences may also be dependent on how much concern and control conscientious individuals have.
regarding certain situations and outcomes. Particular coping styles and methods of appraisals may also moderate physiological changes elicited by psychological stressors. In consideration of these individual differences, it is important to note purported sex differences in this narrative: where preferences in particular coping styles and gender have been reported (Matud, 2004), no significant sex effects have been found with linking levels of conscientiousness with mortality risk (Matud, 2004; Martin et al., 2007; Jokela et al., 2013). Indeed, key differences in individual variation may serve as more accurate predictors of future health outcomes.

2. Cardiovascular Stress Response

2.1. The Reactivity Hypothesis and Psychological Stress

It is widely accepted that the appraisals of outcomes are a critical factor in determining the impact of stress on individuals. Stress is a pattern of psychophysiological response to real or imagined events that might threaten goal achievement or well-being. One of the most important psychophysiology responders to stress appraisal is the cardiovascular system, which is engaged by the hypothalamus-pituitary-adrenal (HPA) axis response. The sympathetic nervous system (SNS) response serves to mediate the physiological response patterns in such a way that the body returns to homeostasis following exposure to stress. Known as the transactional model, the basic premise posits that individuals must psychologically perceive a context as stressful for a response to exist. Individuals must quickly assess whether the stressor is a challenge or a threat; then, whether they have the necessary resources and skills to deal with the situation (Kaplan, Manuck, Clarkson, Lusso, & Taub, 1982; Lazarus & Folkman, 1987). When resources meet or exceed the demand, the HPA feedback loop engages in a negative feedback cycle within the peripheral nervous system (PNS). When the PNS is engaged, vessel constriction, respiration, adrenaline, salivation, and heart rate all decrease and return to homeostasis. When the demands exceed the resources and become a threat, the concentration, severity, and magnitude of the SNS response can evoke changes consistent with an atherogenic lipid profile, contributing to biomarker inflammation responses (Black & Garbutt, 2002). This change in physiological response has become known as the ‘fight or flight’ response (Cannon, 1929).

In recent decades, researchers have called for expansion of this prototypical threat-response sequence to a more modern and accurate alternative: ‘freeze, flight,
fight, or fright’ (Gray, 1988; Bracha, Ralston, & Matsukawa, 2004; Lovallo, 2005). These efforts are meant to challenge internalized assumptions of biological determinism and sociocultural reinforcement brought on by the term, often manipulated to lay claim for biological bases for inherent socio-cultural roles. In updating the adage with current research findings, this challenge aids in raising awareness of the relevant advancements made in psychobiology (Bracha et al., 2004; Hughes, 2016). Overall, the SNS stress response is an autonomic, natural, and adaptive physiological process. Sustained response or a failure to cope adaptively to stress, however, could potentially lead to long-term physiological dysregulation.

Coping strategies serve as characteristic examples of how individuals appraise and engage with potentially challenging or threatening situations. Psychological stress tends to elicit active coping responses in the presence of sympathetic arousal in the form of emotion-focused or problem-focused behaviours (Obrist, 1976; Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). Some research has indicated positive relationships between active coping strategies and lower cardiovascular arousal (Malan et al., 2006), but this effect may be predictive in specific contexts (Folkman, 1984; Lazarus, 1993b). Conscientiousness and problem-focused coping are both associated with elements of self-discipline, order, and control over outcomes, so it stands to reason that highly conscientious persons who strive to systematically reduce and prevent the likelihood of daily stressful encounters frequently report lower perceived stress, fewer demands and threats, and higher satisfaction following stressful outcomes (Folkman & Lazarus, 1980; Folkman et al., 1986; Penley & Tomaka, 2002; Mazzella Ebstein et al., 2018).

While conscientiousness and problem-focused coping appear to consistently share a positive correlational relationship (Carver & Connor-Smith, 2010), further investigation is needed to demonstrate that a sustained linear relationship exists independently between coping behaviours and cardiovascular stress arousal (Lane Bagget, Saab, & Carver, 1996; Kato, 2017). Existing research does, however, indicate that higher levels of reported problem-focused coping are associated with lower HR and SBP during stressful tasks (Lee, Suchday, & Wilie-Rossett, 2012). In following the narrative of the transactional model of stress, it is logical to presume that stress appraisal and coping techniques play a substantial role in altering psychophysiology.
The reactivity hypothesis (CVR) proposes that persistent, exaggerated and excessive cardiovascular activity in response to stressor is a risk factor for long-term cardiovascular disease (CVD) development across the lifespan (Obrist, 1981; Blascovich & Katkin, 1993; Manuck, 1994; Lovallo, 2005). Specifically, exaggerated reactivity increases the magnitude of arterial blood pressure in the body, and the ability to withstand lengthier and more challenging exposures (Hughes, Howard, James, & Higgins, 2011; Lee & Hughes, 2014). Although similar, blood pressure responsivity and blood pressure reactivity are distinct measures of haemodynamic stress: blood pressure response is elicited by exposure to a single stimulus, while reactivity refers to characteristic patterns of response over time (Hughes & Lü, 2017). When compared to baseline, the magnitude and intensity demonstrated in individual patterns reveal unique haemodynamic response profiles implicated with cardiovascular disease risk across the lifespan.

There is a plethora of effects on CVR due to individual variations in environment, genetics, and situation. Although the central focus of the CVR hypothesis is to report exaggerated cardiovascular responses to stress, recent research now suggests that low responses, known as blunted reactivity, may also serve as an indicator of future cardiovascular health outcomes (Phillips, Ginty, & Hughes, 2013; O’Leary, Howard, Hughes, & James, 2013). Cardiovascular responding is considered healthful when an initial exaggerated response occurs a stressor following baseline, proceeded by progressively attenuated responses to consecutive exposures to the same stimulus (Obrist, 1981; Turner, 1994). Although individuals may start at different baseline resting blood pressure levels or show particularly extreme or underwhelming responses to each exposure, an overall pattern of higher response to the first exposure and lower responses at consecutive exposures still indicates healthful reactivity patterns. Myocardial, vascular, and bioassay markers are observable variables commonly used within this paradigm to quantifiably measure stress.

Individual differences in behavioural genetic influences on CVR have been well-documented in studies designed to assess the overall stability of these differences (and similarities) at a greater population level (Turner, 1994). When individual cases are modelled in experimental laboratory settings across time and key variables, distinct curvilinear patterns of reactivity appear, dividing subjects into different types of reactors. Until now most five-factor traits have been considered
successful on a linear continuum, wherein ‘low’ traits are viewed as maladaptive and ‘high’ traits are adaptive. However, burgeoning research now indicates that curvilinear, parabolic models also represent ‘successful’ trait distributions. Carter et al. (2014; 2017; 2018) have proposed that moderate conscientiousness is successful within work and performance contexts, as reported across multiple performance dimensions, self-reported negative affect, and subjective well-being. Parabolic models also appear relevant to clinical psychopathology, where successful trait distribution showed inverted U-shaped curvilinearity for OCPD (Carter et al., 2016). Similar models have been suggested for CVR and stress (Chatkoff, Maier, & Klein, 2010). Nonlinear characteristics of conscientiousness, namely distinctions for high, mid-range, and low traitedness and their fitness, should be considered within the CVR paradigm. For example, high conscientiousness may contribute to healthful behaviour choices (e.g., timeliness and achievement-orientation) which may reduce the likelihood of stressful encounters. However, high traitedness may also contribute to higher propensities of control and orderliness, which may exacerbate threat-associated stress appraisals in contexts where individuals have little or no control over specific contexts or outcomes (e.g., redundancies and layoffs).

Although very little research exists specifically on the relationship between conscientiousness and CVR, robust research related to specific CVD outcomes and conscientiousness are widely referenced; for example, longevity and twin studies have indicated relationships between higher levels of conscientiousness with lower blood pressure, hypertension, CHD, and stroke (Hagger-Johnson et al., 2012; Jokela et al., 2013; Jokela et al., 2014). Combined with the knowledge that conscientiousness is a universal and cross-culturally stable trait, it stands to reason that conscientious individuals within the same scoring group would share similar trait tendencies and preferences that would inform the way they prepare for and respond to stressors. There are no key examples present in the literature pertaining to conscientiousness and CVR, furthermore, specifically in Irish populations. However, similar structures have been posited for a variety of personality variables, notably neuroticism (Schallmayer & Hughes, 2010), openness to experience (Ó Súilleabháin, Howard, & Hughes, 2017), and Type D personality (O’Leary et al., 2013).

When conducting psychophysiological research, a variety of assessments can be utilised to elicit specific psychological stress responses. To be considered a successful psychological stress task, the stressor must require participants to be
actively engaged in the task, with continuous and focused mental effort, and the least amount of physical exertion possible to complete the task (Turner, 1994). Standardised mental arithmetic (MA) is particularly excellent for measuring psychological stress. Acute stressors, such as MA, can elicit the appropriate cardiovascular-hormonal arousal associated with the HPA axis while minimizing the direct physical exertion of participants. Such responses are evoked on a daily basis and can be replicated and studied in a laboratory setting; this demonstrates that stress affects cardiovascular function and gives definition to specific contexts that may provoke threat reactions (Steptoe & Vögele, 1991). Properties such as predictability, mental workload, and controllability are examined parametrically using experimental designs. A typical MA task introduces the participant to a standardised presentation of subtraction equations across regimented intervals of exposure and rests (Turner, 1994). However, participants within a population sample may not necessarily share the same skill capabilities as others in their cohort. In order to offset any massive differences in math skill within the population, interactive computer programmes have been designed to reflexively respond based on the accuracy (or lack thereof) of previous responses; continuous correct responses become more challenging, whilst incorrect responses lead to simpler equations (Turner et al., 1986). When tested in a controlled experimental laboratory setting, MA tasks demonstrate substantial reliability to not only distinguish high and low reactors, but also account for variations in response patterns (Frankish & Linden, 1991; Sherwood & Turner, 1992; Turner, 1994). However, this task is only considered moderately generalisable to non-lab stressors (Schwartz et al., 2003). MA tasks produce substantial myocardial arousal independent of physical activity (e.g., cold pressor task or exercise) with low risk for aversion and emotional distress (Lovallo, 2005).

There are several other psychological stress tasks that are useful in measuring and assessing psychophysiology. These include reaction time tasks, video game tasks, speech tasks, and the cold-pressor task. The reaction time task requires participants to sit still with their fingers near a button. Once a timed stimulus appears, participants are required to press the button as quickly as possible. Reaction tasks are usually better suited for implicit reactions, and don’t inherently reflect psychological stress unless a manipulation of the task occurs, which often manipulates the motivation of participants (e.g., Obrist et al., 1974). Videogames elicit strong cardiovascular responses, and embody elements of uncertainty, novelty,
and avoidance in addition to being flexible like MA (Turner, 1989). Although videogames and MA are both active coping tasks and have a relatively high intertest reliability (Turner et al., 1986), videogame tasks are considered non-aversive and often elicit physical activity. Speech tasks are also often employed as lab stressors and can range from script reading to general topic discussions and hypothetical situations for a set amount of time, usually three minutes (Girdler, Turner, Sherwood, & Light, 1990). Lastly, the cold pressor task, considered a passive stress measure, requires participants to insert a body part into icy water. This task does not measure psychological stress, so it will not be considered viable in this body of research (Pickering & Gerin, 1990). Additionally, speech and cold pressor tasks are not necessarily conditions that most people would encounter daily, so the clinical significance of cardiovascular responses recorded during these tasks may be questionable, and specific causes of cardiovascular arousal measured in real life (i.e., ambulatory monitoring) can be difficult to discern.

Acute psychological stressors, however briefly, can create lasting effects by which recurrent exposures in daily life lead to increased resting blood pressure, arterial stiffness, and hypertension in both normotensive and hypertensive individuals (Light & Obrist, 1980; Lovallo & Gerin, 2003; Nichols, O’Rourke, & Vlachopoulos, 2011). Chida and Steptoe (2010) also reviewed findings that greater reactivity and poorer recovery to acute psychological stress was associated with a greater risk for CVD morbidity and mortality. The research indicates that CVR to psychological stress is a critical marker for long-term cardiovascular health.

High reactivity plays a significant role in the prediction and development of hypertension (Obrist, 1981; Manuck et al., 1990; Gerin et al., 2000; Matthews et al., 2004). Research has shown that gradual increases in resting blood pressure levels are associated with a subsequent increased risk for essential hypertension, left ventricular matriculation (LVM), and coronary heart disease (CHD) (Treiber et al., 2003). Prolonged exposure to stress has been also been associated with high vascular resistance and endothelial tissue damage, leading to atherosclerosis, pulmonary hypertension, and CVD (Sherwood, Johnson, Blumenthal, & Hinderliter, 1999; Kensey, 2003; Tsai, Yucha, Nichols, & Yarandi, 2003). A number of studies suggest that CVR may be a key predictor of future CVD risk in youth (Light & Obrist, 1980; Manuck, Kasprowicz, & Muldoon, 1990; Phillips & Hughes, 2011); borderline hypertensive (BH) children and adults with heightened SBP and HR reactivity have
demonstrated significantly greater resting blood pressure at 5-year follow-ups (Carroll, Ring, Hunt, Ford, & Macintyre, 2003), and an increased risk for hypertension at 10 and 20-yr follow-ups (Borghi, Costa, Boschi, Mussi, & Ambrosioni, 1996; Wood, 1984). Youth with hypertensive parents were also twice as likely to develop hypertension or prehypertension as adolescents than youth with normotensive parents (Falkner, Kushner, Onesti, & Angelakos, 1981; Hunt et al., 1986; Turner, 1994; Falkner, 2010). Literature has well documented the relationship between conscientiousness and self-reported health measures across the lifespan; however, the paucity of research on conscientiousness and its relationship to CVR warrants further attention. Conscientiousness is potentially one of the most relevant five factor dimensions to influencing stress appraisal and response.

2.2. Habituation-Sensitization

Cardiovascular responses to repeated stressful stimuli should demonstrate adaptive patterns over time. This pattern has come to be known as the dual-process theory (Groves & Thompson, 1970). The process consists of two phases: habituation and sensitization. Kelsey (1993) would go on to describe these processes as specific types of cardiovascular response. In addition to habituation and sensitization he included a third stress response known as constant reactivity, which defined a pattern of moderate but gradually elevated response. These shifts in responses between a sensitized, initial response to an attenuated, habituated pattern of responsivity are considered the most adaptive, healthful pattern of reactivity (Dienstbier, 1989; Hughes et al., 2011; Hughes, Lü, & Howard, 2018).

Habituation is the process of decreasing reactivity to subsequent stimuli exposures. Habituated CVR consists of initial reactivity to a stressor which attenuates over time (Kelsey, 1993). It is typically considered a healthful response. For example, a series of studies conducted by Mason (as cited in Lovallo, 2015) tested challenge and threat demands in monkeys to determine the relationship between stress appraisal, stress exposure, and adaptation processes. Mason found that novel stressors elicited high cortisol responses, and repeated exposures to the same stimuli gradually lead to a habituated pattern of reactivity. Conversely, sensitization describes a pattern where an organism fails to adjust to the stressor and exhibits an incremental cardiovascular response to each consecutive exposure across time. An inability habituate to a recurrent or prolonged stressor is considered
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maladaptive. Sensitized responding to psychological stress has been documented in at-risk groups, such as smokers and Type D men. Additional studies of women who report higher levels of social support and general populations of Type D individuals have demonstrated habituated CVR patterns to psychological stressors (Hughes & Black, 2006; Hughes & Higgins, 2010; Howard & Hughes, 2013). Negative affect, social inhibition, and smoking are known to have robust associations with cardiovascular risk factors independent of CVR (Primatesta, Falaschetti, Gupta, Marmot, & Poulter, 2001; Williams et al., 2008; Nater, Hoppmann, & Klumb, 2010). As such, it is more likely that adaptive CVR is additionally moderated by both psychosocial and biological processes. Differences in stress appraisal and coping style are also known to have moderating effects on CVR (Hughes, 2007b; Howard, Hughes, & James, 2013; Howard & Hughes, 2013).

Within the habituation-sensitization model, key haemodynamic variables appear to exhibit specific cardiovascular responses to set physiological and psychological stressors. Myocardial reactivity and habituation have been demonstrated during recurrent acute psychological stress exposure in laboratory-based environments (Frankish & Linden, 1991; Kelsey et al., 1999; Carroll et al., 1990). In some contexts, acute recurrent stressors have been shown to sustain inflammatory activity and increase the risk of developing coronary vessel damage, especially if chronic stress exposure and activation occur (von Känel, Kudielka, Preckel, Hanebuth, & Fischer, 2006; Steptoe, Hamer, & Chida, 2007).

Current research supports that relevant contexts significantly affect trait conscientiousness and acute cardiovascular stress responses. Persons who score higher in conscientiousness tend to report increased feelings of psychological distress following perceived failure, and consequently may be at risk for physiological problems associated with acute stress. However, higher conscientiousness scorers also tend to exhibit lower baseline cortisol during non-stressful situations and enhanced cortical response during performance (Garcia-Banda et al., 2011). They also experience fewer self-dependent episodic stressors, fewer chronic stressors, and a greater resistance to glucocorticoids during chronic stress (Murphy, Miller, & Wrosch, 2013). This pattern of response reflects a better adaptation to stressors because such reactivity aids conscientious persons in anticipating, coping, and responding to salient contexts (McEwen, 1998). It is indicative of habituation and adaptation and appears to be context dependent;
avoidable stress is accounted for and managed by higher conscientiousness, and novel unavoidable stress may result in maladaptive response. Conscientiousness appears to be an important determinant of psychophysiological stress response. However, while some studies have recorded associations between conscientiousness and health behaviours, these are often subordinate to wider research objectives. Little research has directly investigated whether conscientiousness is a primary factor influencing physiological tolerance to recurrent stress, using standard psychosomatic methodological paradigms.

2.3. Haemodynamic Profiles of Stress

Mental stress can significantly alter the material deformation and flow of blood during the stress episode. To counteract the potential damage and any consequent long-term effects of stress on the cardiovascular system, the human body attempts to moderate these processes and return to homeostasis. The SNS autonomic response is elicited by mental stressors. The HPA axis activation circuit is engaged, causing an increase in blood pressure to pump oxygen-rich blood and hormones throughout the body. The magnitude and duration of the stressor effects is dependent on individual characteristics in behaviour and physiology that might contribute to either a positive or negative feedback response. One such response is known as the haemodynamic response profile, which describes a compensatory blood pressure regulation exchange between blood pressure markers CO and TPR. CO is the amount of blood pumped through the arterial system each minute, and TPR is the arterial blood flow resistance due to increases or decreases in a vessel’s diameter. Both biomarkers dictate the magnitude and relationships of blood pressure, flow and resistance. As CO increases blood flow into the arteries, the wall must accommodate an appropriate, corresponding amount of elasticity to propagate a necessary pressure-velocity relationship by decreasing the peripheral resistance. As such, TPR will typically decrease when CO increases. This is referred to as the haemodynamic profile-compensation deficit (HP–CD) model (Gregg, Matyas, & James, 2002).

Often described as myocardial (active) and vascular (passive), a robust haemodynamic profile is demonstrated when adrenergic receptor sites are stimulated by the SNS to vasoconstrict or vasodilate innervated blood vessels (Turner, 1994). This is known as a β-adrenergic activation response and has been associated with active coping strategies. When TPR increases to accommodate a loss in CO, α-
adrenergic activation occurs. α-adrenergic responses are usually associated with passive coping strategies (Obrist et al., 1978; Sherwood, Dolan, & Light, 1990). β-adrenergic tasks like MA typically elicit myocardial responses, whilst α-adrenergic tasks such as the cold pressor elicit predominantly vascular responses. Coping and appraisal behaviours directly affect type-specific reactivity and thus, the magnitude and duration of the stress response. This response could be more objectively described as one of ‘engage-or-evade,’ avoiding terminological stigmas associated with primitive aggression and gender distinction (Hughes, 2016). Personality traits distinctly influence the appraisal of contexts as either challenging or threatening. CO and TPR are excellent biomarkers for measuring these types of underlying physiological states, and often undetected by blood pressure measures alone. CO and TPR reactivity are useful in detecting psychophysiological changes in how individuals appraise contexts, particularly in association with performance and evaluation (Cleveland et al., 2012).

Acute stress, which arises from novel and unpredictable contexts, is often perceived as a ‘healthier’ stress compared to on-going chronic stressors. The most commonly reported measures of cardiovascular response are SBP (cardiac contraction), DBP (cardiac relaxation), and HR (number of contractions per unit of time). For a healthy resting adult, SBP is typically 80-120 mmHg, DBP is 60-80 mmHg, and HR is 60-75 bpm. SBP and DBP measures are regulated by underlying haemodynamic variables CO (volume of blood ejected by each ventricle per unit of time) and TPR (pressure drop required to drive blood flow through systemic circulation). CO is calculated by multiplying HR × SV. At rest CO is typically 5-6 lpm and TPR is calculated by dividing MAP/CO, where 1 pru is typical for a healthy resting adult (Levick, 2010).

In the CVR paradigm, myocardial responses tend to exhibit decline across exposures (Kelsey, 1991) while vascular responses typically increase, demonstrating a replicable, inverse relationship (Kelsey, 1993). This autoregulation of blood flow is a mechanism by which active changes in vascular adjustment hold vasodilation and vasoconstriction responses to pressure at a stable constant. During challenge, TPR will typically decrease with arterial dilation, as CO will consequently rise following increased blood flow. The opposite effect is usually demonstrated during perceived threat. When both rise or fall simultaneously, this is known as a mixed response and has been associated with CVD (Eliot, Buell, & Dembroski, 1982). Given that
myocardial SBP, DBP, or HR responses may not necessarily yield similar responses in CO or TPR, haemodynamic biomarkers may be better predictors of cardiovascular health risks than just blood pressure reactivity alone (James, Gregg, Matyas, Hughes, & Howard, 2012).

3. Conscientiousness and CVR

3.1. Conscientiousness and CVR: Mechanisms of Effect

Definitions of conscientiousness include thoroughness, attention to detail, efficiency, and orderliness. Conscientiousness may be usefully considered a continuous variable ranging from “extremely concerned about consequences” (high conscientiousness) to “extremely unconcerned about consequences” (low conscientiousness). This narrative is coherent with past research linking people who score high for conscientiousness with self-imposed pressure to achieve goals and challenges, appraising failures as a personal lack in capability, and a greater likelihood to develop perfectionist-type behaviours (Stoeber et al., 2009). As such, tenacious perseverance, rigidly striving for order and over-achievement may be considered counterproductive in some contexts. This may be especially true in situations that are characterised by ambiguity, novelty, or a lack of control. These situations and environments might be especially characteristic of some occupational sectors. Work stress independently predicts both psychological distress and their resulting cardiovascular events (Boyce et al., 2010). In a cross-sectional study conducted by Utsugi et al. (2009), female workers who reported high stress jobs defined by greater work demands combined with less perceived control demonstrated higher levels of arterial stiffness than male workers, further demonstrating that this effect appears to be contextual rather than entirely biological (Mathews, Davis, Stoney, Owens, and Caggiula, 1991).

Challenge/threat behaviours and self-reported stress response studies are abundant. Despite the significant role that conscientiousness plays in organisation, competitiveness and problem-focused stress prevention strategies, research on the relationship between stress-response states and conscientiousness remains sparse. In one assessment of five-factor traits and self-reported occupational stress, conscientiousness was the only trait found to modify SBP during CVR in bank clerks. Amongst clerks who had high levels of conscientiousness, low SBP reactivity was reported amongst clerks who evaluated their work as stressful, while clerks who
evaluated their work as less stressful reported higher SBP reactivity (Merecz, Makowska, & Makowiec-Dabrowska, 1999). In studies conducted by Cleveland et al. (2012) & Allen et al. (2012), student-athletes with high levels of conscientiousness demonstrated lower CO, lower HR, and higher TPR responsivity to speech and anagram tasks than athletes with low levels of conscientiousness. Highly conscientious athletes also tended to report engaging in problem-focused coping behaviours; such findings corroborate previous research reporting attenuated SBP and DBP responding in individuals who engage in problem-focused coping strategies during high stress conditions, of which highly conscientious persons typically utilise (Clark, 2003; Nykliček, & Vingerhoets, 2009). Overall, the association between conscientiousness, coping, and behaviour has been well documented but a definitive, biopsychological relationship isn’t clear.

While research relevant to some aspects of low conscientiousness, like sensation-seeking, has reported on greater blood pressure and HR reactivity to mental arithmetic (MA) and speech task stressors (Heponiemi, Keltikangas-Järvinen, Kettunen, Puttonen, & Ravaja, 2004; Allen, Hogan, & Laird, 2009), further investigation is required to definitively determine the relationship underlying the psychophysiological mechanisms present between trait effects and reactivity patterns. Since conscientiousness is a stable, universal, biologically-grounded trait, it is reasonable to suggest that distinct neurophysiological differences may exist between persons who are high in conscientiousness and low in conscientiousness. Individuals scoring high in conscientiousness may attempt to systematically plan for predictable stressors and engage in problem-focused coping behaviours (Carver & Connor-Smith, 2010). These combined tactics allow for minimal stress exposure and a greater control over stressful encounters (Vollrath, 2000; Penley & Tomaka, 2002). However, situations and stressors beyond the reach of this control may result in significant alterations in haemodynamic response profiles to threatening stressors. High conscientiousness may not necessarily be adaptive across all individual differences in blood pressure reactivity and may only partially moderate stress effects on the development of hypertension (Sherwood et al., 1990).

3.2. Focus of Research

There is much evidence to support the theory associated with conscientiousness, problem-focused coping behaviours, and health outcomes.
Furthermore, there is evidence which suggests a predictive value of conscientiousness within the CVR paradigm. Conscientiousness is biologically-tailed, independent of environmental influences, and has been identified as a psychosocial marker of behavioural health. When dichotomized, high conscientiousness has been shown to be strongly and significantly predict a number of positive health outcomes, while low conscientiousness is related to negative outcomes in a variety of populations. The relationship between conscientiousness, perceived stress, and coping behaviours has also been demonstrated. Highly conscientious individuals appear to successfully engage with psychological stress, especially in situations where the environment is perceived as challenging or controllable. Given the predictive power of conscientiousness biologically and behaviourally, this trait must be discriminated further: The central focus of this research is to examine how conscientiousness affects cardiovascular health through psychophysiological pathways, specifically the CVR paradigm.

This thesis will highlight the important differences in CVR to acute, recurrent psychological stressors in a healthy young adult population. The CVR paradigm will be modelled (Turner, 1994), starting with a 20-minute vanilla baseline, and proceeding to complete an interactive digital math task in three sets of five-minute exposures and five-minute recovery stages. Participants are allotted five seconds before the equation times out and proceeds to the next one. Instructions will be administered accordingly to this fashion, where participants are informed to complete the tasks as quickly and correctly as possible and read neutral stimuli (e.g., pre-screened magazines) during the recovery stages. 3-5-minute exposure intervals are considered customary for the psychological stress tasks. Although blood pressure levels typically return to baseline levels within 2 minutes, healthy persons can sustain cardiovascular arousal effects for up to 90 minutes (Schwartz et al., 2003; Ghiadoni et al., 2000). In this thesis, three sets were incorporated. This adjustment serves to expand the current model and capture the adjustments (or lack thereof) in reactivity to the MA task across a longer period and demonstrate any true habituation or sensitization that may occur across the whole paradigm. Likewise, the unorthodox inclusion of a third recovery stage seeks to elucidate a clearer and more accurate portrayal of recovery following multiple exposures. Since individual differences in CVR only capture response magnitude, recovery measures may indicate a more useful perspective of the stress-disease relationship (Schwartz et al., 2003).
In addition to elucidating the role of conscientiousness, each chapter will compare conscientiousness across a variety of contexts (namely, repeated exposure, singular exposure, evaluation) and variables (coping behaviours, secondary arterial biomarkers, sex). In efforts to assess the consistency of how conscientious individuals respond when the context of the environment shifts, Study 3 sought to replicate the design in Study 2 and extend the design by introducing an evaluative factor: participants were informed during the introduction that their performance would be recorded by a visible video camera sitting on top of their computer monitor and reviewed later by the investigator. This was done to induce potential changes in performance motivation and control. By altering the control environment, differences can be compared between Study 2 and Study 3 and elucidate the potential influence this may cause in altering psychophysiological stress reactivity.

Findings are reported in in four parts: first, by highlighting and reaffirming coping behaviours in high versus low conscientiousness in a large, multi-year national cohort (Chapter 2); second, by establishing the distinction of conscientiousness in myocardial response to repeated stress (Chapter 3); third, by investigating the continuity of these discrepancies and similarities in CVR when performance evaluation is introduced (Chapter 4); and finally, by highlighting similarities and differences in cardiovascular responding between men and women in a matched-pairs sample, derived from the sample pool described in Study 2 (see Chapter 5, p. 76). All chapters provide protracted introductions and discussions for each empirical study.

3.3. A Conceptual Model

To explain and outline the basis of the research in this thesis, a concept model of studies 1, 2, 3, and 4 was developed to visually and coherently outline the central investigations in this dissertation (see Figure 1.1). The model highlights the linear relationship conscientiousness and coping behaviour in Study 1, the relationships between conscientiousness and CVR in Study 2, the additional effects of performance evaluation in Study 3, and the incorporation of sex effects in Study 4, by which hypotheses contested that personality effects would be stronger and more independent.

This model represents the important component and concepts with represent the role that conscientiousness plays in part of stress appraisal and CVR, and
combines elements depicted in Lazarus and Folkman’s Transactional Model of Stress (1987) and the CVR paradigm (Obrist, 1981). The proposed model depicts a relationship wherein conscientiousness is an independent factor which influences stress appraisal and response within CVR paradigm: acute stressors that are encountered by an individual elicit response-recovery patterns of reactivity and it is predicted that conscientiousness wields a distinct direct influence stress appraisal, coping, and response. When stressors (e.g. MA) are presented, conscientiousness affects whether the stressor is challenging or threatening. Withstanding situational influences (e.g. performance evaluation) that may doctor this evaluation, conscientious persons, according to theoretical and empirical findings, appraise acute stressors as challenges and engage in problem-focused coping behaviours which determine arousal (e.g. magnitude of cardiovascular response). Consistent maladaptive responding may contribute to future health consequences (e.g. CVD).
Figure 1.1. Conceptual model of how conscientiousness and situational context directly and indirectly influences stress evaluation and coping behaviours during CVR.
Introduction

Conscientious people appear to have better physical and mental health, although it is unclear precisely why this is the case. As a higher-order personality trait, conscientiousness is commonly said to comprise sub-trait such as competence, achievement-striving, orderliness, self-control, and deliberation (Javaras et al., 2012), all of which may contribute to better health. Research suggests that persons scoring high for conscientiousness experience less stress and better health than others because they were more likely to engage in positive health behaviours and had greater longevity (Friedman et al., 1993; Bogg & Roberts, 2004; Grant & Langan-Fox, 2006; Murphy et al., 2013). While it is tempting to attribute the health benefits of conscientiousness to self-preserving behaviour and wise health choices, researchers have been unable to precisely account for the intervening mechanisms (Friedman, 2000). Most studies have suggested that conscientiousness may predict low stress exposure because conscientious persons plan for predictable stressors and avoid impulsive reactions by engaging in planful problem solving to cope with agentic stressors, and use significantly less escape-avoidance and self-blaming in coping across stressful situations than low conscientiousness persons (O’Brien & DeLongis, 1996). Conscientious individuals also experience less stress (Bartley & Roesch, 2011; Murphy et al., 2013), suggesting greater task organisation and successful prediction and avoidance of stressors.

Since coping style may be crucial to selecting and shaping stressful situations; individuals with distinct personality types may engage in different coping styles depending on environment and dispositional tendencies (Vollrath, 2001). Some studies have reported mixed associations between conscientiousness and stress outcomes. Boyce, Wood and Brown (2010) found that unemployed persons with high conscientiousness experienced greater distress than persons with low conscientiousness, and highly conscientious persons tended to report higher well-being from increased income and associated unemployment with the lack of ability to utilise their unique strengths in the workplace. The same relationship was observed in challenge states during athletic performance goals (Cleveland, Finez, Blascovich, & Ginther, 2012) and in lower clinical knowledge acquisition in medical students, despite
initial documented enhancement in preclinical knowledge (Ferguson et al., 2014). It appears that conscientiousness enhances performance across tasks when the context requires methodical and ordered thinking. However, conscientiousness may also reduce performance across tasks when creativity is required instead. Combined sub-traits like deliberation, responsibility, self-discipline and self-control might decrease stress exposure, and facets such as orderliness, perseverance and achievement-striving might be counterproductive in situations with greater ambiguity or require flexibility for success (Shanahan, Eccles, Hill, Roberts, & Friedman, 2012).

Some studies examining task performance have found that higher levels of reported conscientiousness reflected greater feelings of tension during performance goals following negative feedback; conscientiousness could relate positively to performance through effort, and it could also relate negatively through tension (Cianci et al., 2010). This is because highly conscientious individuals tend to set greater personal goals than their low conscientious counterparts, believing they could succeed at higher levels (Gellatly, 1996). Murphy et al. (2013) also concluded that higher conscientiousness may be harmful when a person faces failure. It may be that conscientious individuals sometimes experience greater pressure to achieve higher-set challenges and goals. Therefore, conscientiousness may be detrimental during times of failure, in addition to being beneficial to wellness and longevity (Turiano, Chapman, Gruenewald, & Mroczek, 2015). Inhibitions arising from conscientiousness may not be so much a failure of personality then, but more an inability to cope with life stress.

Definitions of coping emphasize efforts to prevent or diminish threat, harm and loss, or reduce associations with stress. These efforts include behavioural engagement (e.g., problem-solving), behavioural disengagement (e.g., substance use), emotional expression, and ‘emotion-focused’ activities such as exercise and relaxation (Carver & Connor-Smith, 2010; Weinstein, Brown, & Ryan, 2009). Since highly conscientious persons plan for predictable stressors and tend to avoid impulsivities that lead to problems, it is plausible to suppose that particular coping behaviours may affect longevity via negative relation to stress (Carver & Connor-Smith (2010).

Most of the research available on coping strategies tends to focus on two distinct categories in particular, which encapsulate a variety of behaviours: problem-focused coping and emotion-focused coping (Penley & Tomaka, 2002). Problem-focused coping describes any strategies utilised in reducing or eliminating stress, such as active coping, planning, supressing competing activities, increasing applied effort or seeking social support (Kaiseler, Polman, & Nicholls, 2012). These strategies are known for proactively dealing directly with
High conscientiousness have been often associated with use of problem-focused coping strategies in athletes (Kaiseler et al., 2012) and police officers (Lau, Hem, Berg, Ekeberg, & Torgersen, 2006), since highly conscientious copers are known for facing stressors straight on, figuring out what needs to be done, and carrying out plans to completion (O’Brien & DeLongis, 1996). Both conscientiousness and problem-focused coping behaviour are related to overall positive health outcomes (Penley, Tomaka, & Wiebe, 2002).

Emotion-focused coping regulates emotions accompanying interactions with stress (Vollrath, 2001) and describes strategies utilised towards emotional arousal and distress, such as seeking emotional social support-seeking, venting emotions, self-blaming, wishful thinking, and humour (Kaiseler et al., 2012). Studies of emotion-centred coping concluded that writing about emotional responses to stress in evaluative ways leads to less efficient heart rate habituation and recovery than from processing emotions in accepting manners (Low, Stanton, & Bower, 2008). Although it is evident that high conscientiousness is associated with a favourable stress and coping profile, lower conscientiousness, paired with higher neuroticism, reveals higher vulnerability to stress and has been associated with emotion-focused behaviour (Vollrath & Torgersen, 2000). Specific emotions such as anger and shame are also associated with greater emotion-focused coping and physiological arousal (Herrald & Tomaka, 2002).

Mindfulness has been defined as a process of drawing novel distinctions that lead to experiences of environmental sensitivity and enhanced awareness of perspectives while problem solving (Langer & Moldoveanu, 2000). In academic research, mindfulness has been divided into two general cohorts that appear to focus on either cognitive-trait mindfulness or therapeutic and meditative mindfulness. Dispositional mindfulness attributes trait-like proclivities to experience and expresses mindful qualities, such as non-judgment and equanimity, as well as behavioural tendencies like awareness (Vago & Silbersweig, 2012) and mindfulness-based meditation focuses on mindfulness as a primary or ancillary behavioural practice or treatment for medical conditions like CVD, diabetes, cancer and other chronic illnesses, which have been caused or exacerbated by lifestyle factors utilise Mindfulness-Based Stress Reduction (MBSR) (Thompson & Waltz, 2007). However, such practices have yielded mixed results (van den Hurk et al., 2011). Although mindfulness is often acknowledged in eastern religious practices like Buddhism and zazen, this is more or less another ‘brand’ of mindfulness and mindfulness as a cognitive process is still studied separately from this context.
It has also been suggested that mindfulness is an adaptive coping strategy; the ability to separate one’s self from the experience at hand by reducing emotional reactivity, predictive of enhanced parasympathetic influences by individuals who may utilise maladaptive strategies (Brown, Ryan, & Creswell, 2007; Mankus, Aldao, Kerns, Wright Mayville, & Mennin, 2013). Although improved well-being seems to be a recurrent theme, reports of higher levels of well-being by mindful individuals may be due to a tendency to appraise situations in non-threatening ways (Weinstein et. al, 2013). Strong positive associations have been found between mindfulness and conscientiousness (Giluk, 2009; Latzman & Masuda, 2013), especially in context of dispositional or trait mindfulness. It has also been suggested that mindfulness may prevent psychopathological symptoms arising from personal disappointments and perceived failures associated with conscientiousness (Bergomi, Ströhle, Michalak, Funke, & Berking, 2013).

This study sought to examine whether conscientiousness and mindfulness determined agentic coping behaviour (i.e., problem-focused coping) as distinct from other types of coping (such as emotion-focused coping). Given that the construct of conscientiousness appears to have similar trait facets with that of mindfulness (Sternberg, 2000), and given the abundance of evidence links personality and coping and to lower stress, it seems plausible to hypothesize: 1.) that conscientiousness would predict problem-focused coping while inversely predicting emotion-focused coping; and 2.) due to the mutual trait similarities between conscientiousness and mindfulness, that mindfulness would be predictive of problem-focused coping. The personality measures used in the current study elucidate the key aspects of conscientiousness, which were closely aligned with those drawn from Costa Jr. and McCrae’s (1992a) Big Five inventory.

**Methodology**

**Participants**

Data was used from 602 English-speaking American adults drawn a sample pool of 4,963 respondents, aged 25 to 74, drawn from the National Survey of Midlife Development in the United States (MIDUS) Study II, conducted from 2004-2006, and from the 1,255 respondents drawn from the MIDUS II Biomarker Project. MIDUS II (total response rate: 75%) was a follow-up of the original MIDUS study, conducted from 1995 to 1996, which yielded a sample of 7,108 respondents. The participants of MIDUS II were invited to attend for an additional element, the Biomarker Project, which they attended for biological assessments. The Biomarker Project contains data from 1,225 participants; 1,054 from the
longitudinal survey sample, and 201 from the Milwaukee sample (Ryff, Seeman, & Weinstein, 2010; Ryff et al., 2012). Participants were recruited and data collected for MIDUS via telephone interviews and self-administered questionnaires.

Participants ranged in age from 34 to 84 years \((N = 602; M = 55.30 \text{ years}, SD = 11.85)\) and was comprised of 45.5% males \((n = 274)\) and 54.5% females \((n = 328)\). Height (meters) and weight (kilograms) of each participant was measured by clinical staff, with continuous measure of body mass index (BMI) computed by dividing weight by height squared \((M = 29.29 \text{ kg/m}^2, SD = 5.98)\). A number ranging from 1 (no school/some grade school) to 12 (graduate or professional degree) was used to measure the educational attainment of each participant, in which the mean level of education was “3 or more years of college, no degree yet.” 84% of the sample surveyed identified as Christian and 11.6% identified as non-religious. Response refusals and missing and incomplete data were removed from sample analysis.

**Personality**

All personality predictor variables were derived via the adjectival measures of the Five Factor Inventory assessed at MIDUS II (Zimprich, Allemand, & Lachman, 2012). Each participant was asked to rate what extent each of the adjectives described them on a scale from 1 (not at all) to 4 (a lot). The measures consisted of the: Agreeableness (helpful, warm, caring, soft-hearted, sympathetic) five-item scale; Openness to experience (creative, imaginative, intelligent, curious, sophisticated, adventurous) seven-item scale; Conscientiousness (organized, responsible, hardworking, (not) careless) four-item scale; Extroversion (outgoing, friendly, lively, active, talkative) five-item scale; and Neuroticism (moody, worrying, nervous, (not) calm) four-item scale. The conscientiousness scale used in MIDUS II was utilised in this study via the (organized, responsible, hardworking, [not] careless, thorough) five-item scale (Ryff et al., 2012). These Big Five scale have been used previously and have been shown to possess validity due to strong correlations with the NEO trait measures (Mroczek & Kolarz, 1998; Prenda & Lachman, 2001). Current reliability \(\alpha\) (Cronbach’s) in the present study sample, after controlling for additional variables, was 0.67 (conscientiousness), 0.80 (agreeableness), 0.75 (openness to experience), 0.75 (extraversion), and 0.75 (neuroticism).
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Coping

The Problem-Focused Coping predictor variable was assessed via a 12-item scale combining “Positive Reinterpretation and Growth,” “Active Coping,” and “Planning” (α = 0.90). Current reliability α (Cronbach’s) in the present sample was 0.84. The Emotion-Focused Coping predictor variable was assessed via a 12-item scale combining “Focus on and venting of emotion,” “Denial,” and “Behavioral disengagement” (α = 0.83). Current reliability α (Cronbach’s) in the present sample was 0.63. Table 1 presents the means and standard deviations of conscientiousness by coping style.

Mindfulness

Mindfulness was a new variable added to MIDUS II, and was assessed via a bespoke self-administered questionnaire, developed by the MIDUS authors. Each participant was asked to rate to what extent he or she agreed to each of the statements described on a scale from 1 (strongly agree) to 5 (strongly disagree): ‘Because of your religion or spirituality, do you try to be...’: “more engaged in the present moment;” “more sensitive to the feelings of others;” “more receptive to new ideas;” “a better listener;” “a more patient person;” “more aware of small changes in my environment;” “more tolerant of differences;” “more aware of different ways to solve problems;” and “more likely to perceive things in new ways” (α = 0.94). Current reliability α (Cronbach’s) in the present sample was 0.93. Table 2 presents the means and standard deviations of mindfulness by coping style.

Table 2.1. Descriptive results of coping behaviours and conscientiousness

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 602</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem-Focused Coping</td>
<td>37.56</td>
<td>6.09</td>
</tr>
<tr>
<td>Emotion-Focused Coping</td>
<td>22.55</td>
<td>5.51</td>
</tr>
<tr>
<td>Age in Years</td>
<td>55.54</td>
<td>11.78</td>
</tr>
<tr>
<td>Education</td>
<td>7.73</td>
<td>2.51</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>29.30</td>
<td>6.11</td>
</tr>
<tr>
<td>Self-Evaluated Physical Health</td>
<td>2.47</td>
<td>1.00</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>33.94</td>
<td>6.03</td>
</tr>
<tr>
<td>Extraversion</td>
<td>3.08</td>
<td>0.58</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>3.42</td>
<td>0.51</td>
</tr>
<tr>
<td>Open to Experience</td>
<td>2.86</td>
<td>0.56</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>2.05</td>
<td>0.61</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>3.40</td>
<td>0.47</td>
</tr>
</tbody>
</table>
Table 2.2. *Descriptive results of coping behaviours and mindfulness*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
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<tbody>
<tr>
<td>Problem-Focused Coping</td>
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</tr>
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**Statistical analyses**

The data were analysed using SPSS (IBM, version 21). Both conscientiousness and mindfulness were computed in separate analyses. Hierarchical linear regression analyses were used to measure any associations between conscientiousness and/or mindfulness with both emotion-focused and problem-focused coping responses. For both coping responses, each model adjusted for a number of variables; sex, age, education level, religious preference, body mass index (BMI), self-evaluated physical health, and mindfulness were entered into the first step of the model, followed by the Five Factor Model Personality types Extraversion, Agreeableness, Openness to Experience, and Neuroticism. Conscientiousness was entered into the third step of the model. Effects sizes were presented as Cohen’s $f^2$; the partial values for multiple regression effects with values of .02, .15, and .35 being taken to represent small, medium, and large effect sizes respectively (Cohen, 1988; Cohen, 1992).

**Results**

*In order to examine if conscientiousness predicted problem-focused coping*

For the regression analyses examining the association between conscientiousness and problem-focused coping, the control variables entered in the first block explained 14% of the variance in problem-focused coping, $F(6, 595) = 6.50, p < .001$, adjusted $R^2 = .144$. The addition of the personality variables in the second block lead to a significant $F$ change ($p < .001$), with the model now explaining 31% of the variance in problem-focused coping.
(adjusted \( R^2 = .31 \)), \( F(11, 590) = 25.79, p < .001 \); an increase of 17% in explained variance. Finally, the addition of conscientiousness in the final step also lead to a significant \( F \) change \((p < .001)\), where conscientiousness explained a further 4% of the variance in problem-focused coping, \( F(12, 589) = 28.17, p < .001 \), adjusted \( R^2 = .35 \). Overall, in the final model, as can be seen in Table 3, mindfulness (\( \beta = +.21 \)), openness to experience (\( \beta = +.27 \)), and conscientiousness (\( \beta = +.23 \)) were the strongest predictors of problem-focused coping with all three measures positively correlated with problem-focused coping. Analyses for problem-focused coping yielded a large effect size (\( f^2 = 0.33 \)).

In order to examine if conscientiousness predicted emotion-focused coping

For the regression analyses examining the association between conscientiousness and emotion-focused coping, the control variables entered in the first block explained 5.1% of the variance in problem-focused coping, \( F(7, 594) = 5.57, p < .001 \), adjusted \( R^2 = .051 \). The addition of the personality variables in the second block lead to a significant \( F \) change \((p < .001)\), with the model now explaining 23.7% of the variance in emotion-focused coping (adjusted \( R^2 = .24 \)), \( F(11, 590) = 18.02, p < .001 \); an increase of 18.6% in explained variance. Finally, the addition of conscientiousness in the final step also lead to a significant \( F \) change \((p < .001)\), where conscientiousness explained a further 1.4% of the variance in emotion-focused coping, \( F(12, 589) = 17.76, p < .01 \), adjusted \( R^2 = .25 \). Overall, in the final model, as can be seen in Table 3, neuroticism (\( \beta = +.17 \)) was the strongest predictor of emotion-focused coping, along with extraversion (\( \beta = +.38 \)) and self-evaluated physical health (\( \beta = +.11 \)), as three measures correlated positively with emotion-focused coping while conscientiousness (\( \beta = -.14 \)) had a negative correlation. Analyses for emotion-focused coping yielded a medium to large effect size (\( f^2 = 0.28 \)).

In order to examine if mindfulness predicted problem-focused coping

For the regression analyses examining the association between conscientiousness and emotion-focused coping, the control variables entered in the first block explained 5.1% of the variance in problem-focused coping, \( F(7, 594) = 5.57, p < .001 \), adjusted \( R^2 = .051 \). The addition of the personality variables in the second block lead to a significant \( F \) change \((p < .001)\), with the model now explaining 23.7% of the variance in emotion-focused coping (adjusted \( R^2 = .24 \)), \( F(11, 590) = 18.02, p < .001 \); an increase of 18.6% in explained variance. Finally, the addition of conscientiousness in the final step also lead to a significant \( F \) change \((p < .001)\), where conscientiousness explained a further 1.4% of the variance in emotion-
focused coping, $F(12, 589) = 17.76, p < .01$, adjusted $R^2 = .25$. Overall, in the final model, as can be seen in Table 3, neuroticism ($\beta = +.17$) was the strongest predictor of emotion-focused coping, along with extraversion ($\beta = +.38$) and self-evaluated physical health ($\beta = +.11$), as three measures correlated positively with emotion-focused coping while conscientiousness ($\beta = -.14$) had a negative correlation. Analyses for emotion-focused coping yielded a medium to large effect size ($f^2 = 0.28$) (Figure 2.1).

In order to examine if mindfulness predicted emotion-focused coping

For the regression analyses examining the association between mindfulness and emotion-focused coping, the control variables entered in the first block explained 4.8% of the variance in problem-focused coping, $F(6, 595) = 6.10, p < 0.001$, adjusted $R^2 = 0.06$. The addition of the personality variables in the second block leads to a significant $F$ change ($p<0.001$), with the model explaining 25.1% of the variance in emotion-focused coping (adjusted $R^2 = 0.25$), $F(11, 590) = 19.28, p < 0.001$, an increase of 20.6% in explained variance. Finally, the addition of mindfulness in the final step also leads to no significant $F$ change ($p > 0.05$), where mindfulness explained 0% of the variance in emotion-focused coping, $F(12, 589) = 17.76, p > 0.05$, adjusted $R^2 = 0.25$. Overall, in the final model, as can be seen in Table 2.4, neuroticism ($\beta = +0.38$) was the strongest predictors of problem-focused coping, along with extraversion ($\beta = +0.17$) and self-evaluated physical health ($\beta = +0.11$), as three measures positively correlated with emotion-focused coping, while conscientiousness ($\beta = -0.14$) had a negative correlation. Analyses yielded a medium to large effect size ($f^2 = 0.28$) (Figure 2.2).

In order to examine if conscientiousness predicted problem-focused coping without mindfulness

In order to confirm these results, a separate set of hierarchical linear regressions was conducted without mindfulness as a model variable. Descriptive statistics yielded the same set of means and SDs as the original regression sets, with the exception of the mindfulness variable (Table 2.1). For the regression analyses examining the association between conscientiousness and problem-focused coping, the control variables entered in the first block explained 5.2% of the variance in problem-focused coping, $F(6, 595) = 6.50, p < 0.001$, adjusted $R^2 = 0.052$. The addition of the personality variables in the second block leads to a significant $F$ change ($p < 0.001$), with the model now explaining 27.9% of the variance in problem-focused coping (adjusted $R2 = 0.28$), $F(10,591) = 24.31, p < 0.001$, an increase of
22.7% in explained variance. Finally, the addition of conscientiousness in the final step also leads to a significant $F$ change ($p < 0.001$), where conscientiousness explained a further 3.5% of the variance in problem-focused coping, $F(11, 590) = 25.96, \ p < 0.001$, adjusted $R^2 = 0.31$. Overall, in the final model, as can be seen in Table 2.5, conscientiousness ($\beta = +0.21$), openness to experience ($\beta = +0.30$) and extraversion ($\beta = +0.11$) were the strongest predictors of problem-focused coping with all three measures positively associated with problem-focused coping. Analyses yielded a large effect size ($f^2 = 0.39$).

In order to examine if conscientiousness predicted emotion-focused coping without mindfulness

For the regression analyses examining the association between conscientiousness and emotion-focused coping, the control variables entered in the first block explained 4.8% of the variance in emotion-focused coping, $F(6, 595) = 6.10, \ p < 0.001$, adjusted $R^2 = 0.048$. The addition of the personality variables in the second block leads to a significant $F$ change ($p<0.001$), with the model now explaining 23.7% of the variance in emotion-focused coping (adjusted $R^2= 0.24$), $F(10, 591) = 19.64, \ p < 0.001$, an increase of 18.9% in explained variance. Finally, the addition of conscientiousness in the final step also leads to a significant $F$ change ($p < 0.001$), where conscientiousness explained a further 1.4% of the variance in emotion-focused coping, $F(11, 590) = 19.28, \ p < 0.001$, adjusted $R^2=0.25$. Overall, in the final model, as can be seen in Table 5, neuroticism ($\beta = +0.38$) was the strongest predictor of emotion-focused coping, along with extraversion ($\beta = +0.17$) and self-evaluated physical health ($\beta = +0.11$), as three measures positively correlated with emotion-focused coping, while conscientiousness ($\beta = -0.14$) had a negative correlation. Analyses yielded a medium to large effect size ($f^2=0.28$).
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Figure 2.1. Illustration of mean coping responses by tertiles of conscientiousness. Error bars denote standard errors of the mean. Figure 2.2. Illustration of mean coping responses by tertiles of mindfulness. Error bars denote standard errors of the mean.
### Table 2.3. Descriptive results table of coping behaviours and personality

<table>
<thead>
<tr>
<th></th>
<th>Problem-Focused Coping ((N = 605))</th>
<th>Emotion-Focused Coping ((N = 602))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>(B = .580, \beta = .047, t = 1.419, p = .156)</td>
<td>(B = -.541, \beta = -.049, t = -1.362, p = .174)</td>
</tr>
<tr>
<td>Age in Years</td>
<td>(B = .030, \beta = .057, t = 1.705, p = .089)</td>
<td>(B = -.022, \beta = -.047, t = -1.307, p = .192)</td>
</tr>
<tr>
<td>Education</td>
<td>(B = .019, \beta = .008, t = .235, p = .814)</td>
<td>(B = -.037, \beta = -.017, t = -1.470, p = .639)</td>
</tr>
<tr>
<td>Religion</td>
<td>(B = .021, \beta = .044, t = 1.344, p = .180)</td>
<td>(B = -.019, \beta = -.044, t = -1.230, p = .219)</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>(B = .028, \beta = .028, t = .849, p = .396)</td>
<td>(B = .040, \beta = .045, t = 1.247, p = .213)</td>
</tr>
<tr>
<td>Self-Evaluated Physical Health</td>
<td>(B = -.497, \beta = -.082, t = 2.328, p = .020)</td>
<td>(B = .621, \beta = .113, t = 2.990, p = .003)</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>(B = .215, \beta = .212, t = 5.944, p = .000)</td>
<td>(B = .036, \beta = .039, t = 1.014, p = .311)</td>
</tr>
<tr>
<td>Extraversion</td>
<td>(B = 1.132, \beta = .108, t = 2.529, p = .012)</td>
<td>(B = 1.601, \beta = .168, t = 3.677, p = .000)</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>(B = -.239, \beta = -.020, t = -.482, p = .630)</td>
<td>(B = 1.073, \beta = .099, t = 2.224, p = .027)</td>
</tr>
<tr>
<td>Open to Experience</td>
<td>(B = 2.877, \beta = .267, t = 6.479, p = .000)</td>
<td>(B = -1.723, \beta = -1.176, t = -3.974, p = .000)</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>(B = -.862, \beta = -0.86, t = 2.479, p = .013)</td>
<td>(B = 3.451, \beta = .380, t = 10.219, p = .000)</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>(B = 2.957, \beta = .230, t = 6.102, p = .000)</td>
<td>(B = -1.593, \beta = -1.137, t = -3.383, p = .001)</td>
</tr>
</tbody>
</table>

*p < 0.05

**p < 0.01

***p < 0.001

### Table 2.4. Descriptive results table of coping behaviours and mindfulness

<table>
<thead>
<tr>
<th></th>
<th>Problem-Focused Coping ((N = 602))</th>
<th>Emotion-Focused Coping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>(B = .565, \beta = .046, t = 1.382, p = .167)</td>
<td>(B = -.541, \beta = -.049, t = -1.362, p = .174)</td>
</tr>
<tr>
<td>Age in Years</td>
<td>(B = .029, \beta = .055, t = 1.651, p = .099)</td>
<td>(B = -.022, \beta = -.047, t = -1.307, p = .192)</td>
</tr>
<tr>
<td>Education</td>
<td>(B = .015, \beta = .006, t = .184, p = .854)</td>
<td>(B = -.037, \beta = -.017, t = -1.470, p = .639)</td>
</tr>
<tr>
<td>Religion</td>
<td>(B = .019, \beta = .040, t = 1.219, p = .223)</td>
<td>(B = -.019, \beta = -.044, t = -1.230, p = .219)</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>(B = .027, \beta = .027, t = .819, p = .413)</td>
<td>(B = .040, \beta = .045, t = 1.247, p = .213)</td>
</tr>
<tr>
<td>Self-Evaluated Physical Health</td>
<td>(B = -.510, \beta = -.084, t = -2.385, p = .017)</td>
<td>(B = .621, \beta = .113, t = 2.990, p = .003)</td>
</tr>
<tr>
<td>Extraversion</td>
<td>(B = 1.170, \beta = .111, t = 2.612, p = .009)</td>
<td>(B = 1.601, \beta = .168, t = 3.677, p = .000)</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>(B = -.212, \beta = -.018, t = -.428, p = .669)</td>
<td>(B = 1.073, \beta = .099, t = 2.224, p = .027)</td>
</tr>
<tr>
<td>Open to Experience</td>
<td>(B = 2.847, \beta = .263, t = 6.382, p = .000)</td>
<td>(B = -1.723, \beta = -1.176, t = -3.974, p = .000)</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>(B = -.845, \beta = -.084, t = -2.431, p = .015)</td>
<td>(B = 3.451, \beta = .380, t = 10.219, p = .000)</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>(B = 2.949, \beta = .230, t = 6.086, p = .000)</td>
<td>(B = -1.593, \beta = -1.137, t = -3.383, p = .001)</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>(B = .216, \beta = .214, t = 5.978, p = .000)</td>
<td>(B = .036, \beta = .039, t = 1.014, p = .311)</td>
</tr>
</tbody>
</table>

*p < 0.05

**p < 0.01

***p < 0.001
### Table 2.5. Descriptive results table of coping behaviours and personality (controlled for Mindfulness)

<table>
<thead>
<tr>
<th></th>
<th>N = 602</th>
<th></th>
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<tr>
<td></td>
<td></td>
<td>B</td>
<td>β</td>
<td>t</td>
<td>p</td>
<td>B</td>
<td>β</td>
<td>t</td>
<td>p</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>.533</td>
<td>.044</td>
<td>1.266</td>
<td>.206</td>
<td>-.574</td>
<td>-.049</td>
<td>-1.376</td>
<td>.169</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Age in Years</td>
<td>.027</td>
<td>.053</td>
<td>1.537</td>
<td>.125</td>
<td>-.022</td>
<td>-.048</td>
<td>-1.319</td>
<td>.188</td>
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</tr>
<tr>
<td>Education</td>
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<td>.001</td>
<td>.031</td>
<td>.975</td>
<td>-.039</td>
<td>-.018</td>
<td>-.495</td>
<td>.620</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religion</td>
<td>.015</td>
<td>.033</td>
<td>.955</td>
<td>.340</td>
<td>-.019</td>
<td>-.045</td>
<td>-1.271</td>
<td>.204</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>.014</td>
<td>.014</td>
<td>.397</td>
<td>.691</td>
<td>.038</td>
<td>.042</td>
<td>1.180</td>
<td>.238</td>
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<tr>
<td>Self-Evaluated Physical Health</td>
<td>-.526</td>
<td>-.087</td>
<td>-2.392</td>
<td>.017*</td>
<td>.618</td>
<td>.113</td>
<td>2.977</td>
<td>.003**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraversion</td>
<td>1.189</td>
<td>.113</td>
<td>2.579</td>
<td>.010*</td>
<td>1.604</td>
<td>.169</td>
<td>3.684</td>
<td>.000***</td>
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<td></td>
<td></td>
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<tr>
<td>Agreeableness</td>
<td>.629</td>
<td>.052</td>
<td>1.285</td>
<td>.199</td>
<td>1.211</td>
<td>.111</td>
<td>2.619</td>
<td>.009**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open to Experience</td>
<td>3.206</td>
<td>.296</td>
<td>7.048</td>
<td>.000***</td>
<td>-1.664</td>
<td>-.170</td>
<td>-3.873</td>
<td>.000***</td>
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<tr>
<td>Neuroticism</td>
<td>-.716</td>
<td>-.071</td>
<td>-2.006</td>
<td>.045*</td>
<td>3.473</td>
<td>.383</td>
<td>10.302</td>
<td>.000***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>2.739</td>
<td>.213</td>
<td>5.507</td>
<td>.000***</td>
<td>-1.628</td>
<td>-.140</td>
<td>-3.465</td>
<td>.001**</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* p < .05
** p < .01
*** p < .001
Discussion

The present study reaffirms the available research on the relationship between conscientiousness and coping behaviour. Results revealed that conscientiousness predicted problem-focused coping and inversely predicted emotion-focused coping respectively, even after controlling for remaining Big Five and confounding variables. Conscientiousness has long been positively predictive of problem-focused coping (Penley & Tomaka, 2002; Connor-Smith & Flachsbart, 2007), and these findings are consistent with past research on conscientiousness, problem-focused coping behaviour and encountering stress (Kaiseler et al., 2012). The results observed in the present findings extend upon previous research; the behaviour patterns between conscientiousness and coping behaviours have been observed already in university level students in singular university populations (Watson & Hubbard, 1996; Penley & Tomaka, 2002; Bartley & Roesch, 2011), while the current analysis utilised a large, multi-year national population comprised of mid-aged American adults. This study also highlights conscientiousness in health-relevant ways; positing the notion that highly conscientious people may be well placed to deal with stress. McEwen (1998) suggests that conscientious persons live longer and have better health because their basal cortisol is lower during non-stressful situations and greater cortisol reactivity may aid in anticipation, coping and responses – better adaptation – to stressful situations. Since the present study had no biometric data with which to compare with the personality and coping variables, no associations with cortisol could be elucidated. While higher conscientiousness may be connected with greater stress resilience, further methodologically rigorous research is required to expand upon the present findings.

This study also provided new research on the relationship between mindfulness and coping behaviour. Consistent with previous research (Weinstein et al., 2009), mindfulness was found to be predictive of problem-focused coping behaviour. Given these findings and past research highlighting the healthful benefits of problem-focused coping behaviour, mindfulness may be preventive of psychopathological symptoms when perceived failure and disappointment occurs (Bergomi et al., 2013). Past research has also shown that mindfulness-focused activities, such as breathing exercises and meditation, have been associated with stress reduction and decreased resting heart rate, cortisol and serum cholesterol levels, and less alcohol and tobacco use (Barnes & Orme-Johnson, 2006). However, some researchers contest that such evidence, if any, would be relegated to dispositional mindfulness rather than the practice of mindfulness-based meditation activity (Díaz & Lopes, 2014). Additionally, MIDUS research has also drawn associations between the present mindfulness variable and
with persistence in goal-striving, which is a trait quality of conscientiousness and problem-focused coping (Davis, 2013). However, this study was conducted in the context of social well-being and the development of self-regulatory attention skills. The present findings suggest that conscientiousness and mindfulness may contribute to coping responses in potentially healthful ways, and highlight potentially new evidence for the protective role of mindfulness in stressful situations.

In conducting this analysis, new questions arose in regards to the definition of the mindfulness variable. As this was a new variable added to the MIDUS II survey, there is no previous data with which to compare it to in MIDUS I. Survey questions regarding meditative practices, for both therapeutic and religious contexts, existed in both datasets. However, in MIDUS II, the measure of mindfulness was explicitly contextualized in terms of religion and spirituality. Specifically, the items on mindfulness invited participants to respond to questions beginning with the phrase, “Because of your religion or spirituality...” This phrasing served to restrict the measure to that of religious and/or spiritual mindfulness, and respondents who practiced mindfulness for other reasons should not logically have reported doing so in response to such questioning. Not only was the measure restrictive, it was also highly idiosyncratic. Little previous academic research into mindfulness and health has embedded a spiritual definition of mindfulness into their measures. Most, in fact, refer to the general definitions involving focus on the present moment and acuity to one’s surroundings. For this reason, it is now difficult to deduce whether or not the MIDUS dataset is an externally valid representation of true mindful behaviour, insofar as it is unclear whether this measure of mindfulness is at all comparable to those used in other studies. Therefore, it is difficult to interpret the true measure of mindfulness in this study, and consequently these results cannot easily be generalised.

Limitations

The present study had several limitations and suggestions for further directions of research. While the personality measure used in MIDUS is considered reliable, it has been unable to measure the individual sub-facets that comprise trait conscientiousness. Therefore, the findings in this study cannot be further examined in terms of their individual contributions to the results. Previous research has posited that certain characteristics of conscientiousness may be more influential on preferred coping behaviours than others and vary the overall impact (LePine, Colquitt, & Erez, 2000; Shanahan et al., 2012). Although a number of variables were controlled for in this analysis to eliminate any confounding influences, future
Research would benefit by the inclusion of a stress task. After controlling for demography and personality influences, a small sample size remained with no haemodynamic data (i.e., blood pressure) to cross-analyse. Research has established that persons high in conscientiousness exhibit exaggerated haemodynamic responses in certain situations by examining the stress hormone cortisol (Garcia-Banda et al., 2011; Savic, Knezevic, Damjanovic, Spiric, & Matic, 2012) rather than blood pressure or other functions of the cardiovascular system, so further inquiry, in addition to a larger complete sample, would be beneficial.

Additionally, it is unknown whether the religio-spiritual context of the mindfulness measure used by MIDUS may have delineated the validity of the measure within the sample. Mindfulness can be a cognitive construct by which a person can, by awareness and observation, contextualize their environment. Different results may have arisen due the objective wording of the mindfulness questions chosen by MIDUS. A study utilising an inventory specifically for dispositional mindfulness may be more reflective of a psychological and health context; perhaps a trait-based inventory like the Five Facet Mindfulness Questionnaire (FFMQ), a 39-point inventory based off a factor analytic study of five mindfulness questionnaires (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), would prove a more accurate measure. The Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003) is another trait measure scale developed for this purpose. Use of these types of instruments would not only more accurately reflect trait mindfulness, but would also be a fairer representation of mindfulness, and more evaluative of participants who do not contextualise these behaviours through a spiritual lens, or even identify as religious or spiritual at all.

Finally, several questions from the FFMQ and MAAS draw parallels with the conscientiousness inventory of the NEO-PI-R (Costa Jr. & McCrae, 1992a). However, this may be an indication that mindfulness, as a measure, is in reality just an alternative, attenuated measure for conscientiousness and the two have become conflated. In a study conducted by Brown and Ryan regarding the role of mindfulness in psychological well-being using the MAAS, neuroticism was found to be inversely correlated with trait mindfulness (2003). Such results, however, were not replicated in this study population. Further investigation of the validity of these measures, as well as a scale in MIDUS measuring dispositional rather than spiritual mindfulness, would be helpful.
Limitations withstanding, the present findings add to and reaffirm the current available literature on personality and coping behaviour. This study conclusively suggests that conscientiousness (and, possibly, mindfulness) may predict problem-focused coping behaviour. However, given the narrow (spiritual) definition of mindfulness as is constituted by MIDUS, its construct validity is unclear. If mindfulness plays a role in the association between conscientiousness and good health, then further research with a more rigorous measure will be needed to elucidate the relevant processes.

These findings are further confirmed by an inverse relationship between conscientiousness and emotion-focused coping behaviour. In addition to the positive relationship between neuroticism and emotion-focused coping behaviour, such findings have confirmed previous research and strengthened the notion that conscientiousness and neuroticism may be the biggest predictors of coping behaviour (Watson & Hubbard, 1996). This study also offers potential importance to healthfulness and healthful behaviours, of which conscientiousness seems to be a central predictor and possible moderator (Turiano, Whiteman, Hampson, Roberts & Mroczak, 2012). Lastly, this study highlights the potential importance of coping in healthful behaviours and stress adaptation. The replication of these findings in a large national cohort of middle-aged, non-academic adults contributes to the current literature on the relationship between conscientiousness and problem-focused coping, and strengthens the argument that personality is predictive of coping behaviour and raises a need for further exploration of the role of mindfulness within this interaction.

Conflicts of interest statement

There are no reported potential or actual conflicting interests involved in this research. Limitations withstanding, the present findings add to and reaffirm the current available literature on personality and coping behaviour. This study conclusively suggests that conscientiousness (and, possibly, mindfulness) may predict problem-focused coping behaviour. However, given the narrow (spiritual) definition of mindfulness as is constituted by MIDUS, its construct validity is unclear. If mindfulness plays a role in the association between conscientiousness and good health, then further research with a more rigorous measure will be needed to elucidate the relevant processes.

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Overall Conclusions

These findings corroborate previous research establishing low conscientiousness as a maladaptive for healthful stress management, and high conscientiousness as beneficial. Although this research contributes to a wider body of research showcasing the relationship between conscientiousness and the stress experience (see Figure 1.1), the outcome variables measured were restricted to qualitative psychosocial factors and self-reported health-relevant behaviours and do not capture the type of stress experiences, their frequency of exposure, nor the associated physiological responses which may accompany them. As persons higher in conscientiousness were shown to actively engage in problem-solving behaviours when encountering stress, it follows suit that physiology would reflect an adaptive pattern of stress response, whilst low conscientiousness would likewise reflect in maladaptive patterns of responsivity. This pattern of reactivity would therefore contribute to the negative health outcomes and behaviours consistently reported for this group. Further research investigating cardiovascular stress reactivity to psychosomatic stress, and the moderating effect of conscientiousness on this pattern responsivity, will be examined in Chapter 3.
CHAPTER III
CONSCIENTIOUSNESS IS ASSOCIATED WITH OPTIMAL CARDIOVASCULAR FUNCTIONING DURING ACUTE STRESS EXPOSURE

Introduction

The trait theory of personality currently dominant in psychology presents conscientiousness as one of the five factor over-arching human personality traits (Costa Jr. & McCrae, 1992a). Within this framework, conscientiousness is understood as a trait that is most associated with determination, achievement, persistence, and a propensity for systematically approaching problems and situations (Javaras et al., 2012). Research has shown conscientiousness to be predictive of healthy behaviours and habits (Bogg & Roberts, 2004), coping behaviours (Penley & Tomaka, 2002), and longevity (Friedman et al., 1993). Persons considered high in conscientiousness are often depicted as industrious and likely to complete tasks in an orderly manner. Persons who score high in conscientiousness are considered more efficient at completing tasks, work harder, and suffer less from poor health due to better health choices (Bogg & Roberts, 2004). Altogether, these qualities comprise the image of an ideal student, citizen, or corporate employee.

Many indirect mechanisms have been proposed to explain how conscientiousness affects long-term health, such as better stress management, greater self-regulation and discipline, and engagement in pro-health behaviours (Hampson, 2008). Longevity and twin studies show stability for conscientiousness across the lifespan, replicable upon multiple assessments, and genetically heritable (Bouchard Jr. & McGue, 2003). Higher conscientiousness also reduces mortality risk in middle and old age (Turiano et al., 2015), regardless of environmental influences. Persons high in conscientiousness are also believed to ruminate more, which may confer its own disadvantages. On the other end of the spectrum, persons low in conscientiousness are typically depicted as relatively careless and impulsive. Persons low in conscientiousness seldom plan and prepare for situations and tasks in advance, and thus vulnerable to high-stress situations, subject to poorer health, and have lower longevity. The flexibility seen in persons low in conscientiousness is believed to increase their risk of engaging in counterproductive behaviour (Ferguson et al., 2014).

As with other five factor personality traits, links between conscientiousness and health are likely to be mediated by direct physiological mechanisms. As such, conscientiousness may affect health by influencing the extent to which individuals encounter stress-provoking situations, or in which they perceive or cope with stressful situations (Bartley & Roesch,
2011; Murphy et al., 2013). Some research suggests that persons high in conscientiousness exhibit exaggerated stress responses in certain situations, such as during periods of unemployment (Boyce et al., 2010), competitive performance tasks (Cleveland et al., 2012), and challenging educational contexts (Ferguson et al., 2014). These contexts highlight the possibility that high conscientiousness may at times prove to be unhealthy, perhaps leading an individual to become overly concerned by outcomes they cannot control. Conscientiousness may be detrimental during times of uncontrollable stress or perceived imminent failure.

In popular discourse, conscientiousness is oftentimes associated with morality. However, it is possible to be considered conscientiousness and yet still amoral (Ekehammar et al., 2004). As such, conscientiousness is perhaps best considered the extent to which persons concern themselves with the consequences of their actions. This view is consistent with the posited assumption that traits are evolved adaptations shaped by processes of natural selection. As an evolved trait, conscientiousness is similar to other adaptations such as pain sensitivity or anxiety. Exaggerated pain sensitivity and exaggerated anxiety are maladaptive; equally however, exaggerated insensitivity to pain or exaggerated inabilities to experience anxiety are also maladaptive in typical human environments. This observation is reflected in both the normal distribution of pain sensitivity and anxiety reflected in the most effectively thriving in human populations. If conscientiousness is an adaption of human tendencies towards vigilance and scenario-planning revolving around the degree to which one is concerned about outcomes, then it is expected that individuals exaggeratedly worried about outcomes, or those who are exaggeratedly unworried about outcomes, are less likely to thrive.

It is widely accepted that the appraisals of outcomes represent a critical factor in determining the impact of stressful situations on individuals (Lazarus & Folkman, 1987). Of all the five factor traits, conscientiousness is perhaps the most relevant to influencing appraisal. Perhaps the most salient psychophysiological system involved in stress appraisal and responding is the cardiovascular system. Individual patterns of CVR are known predictors of CVD risk (Light & Obrist, 1980; Treiber et al., 2003; Phillips & Hughes, 2011). CVR varies across the population, and high blood pressure runs in families in ways that imply a genetically-inherited component (Turner, 1994). Exaggerated reactivity profiles have been implicated as disease risk factors (Phillips et al., 2013), and many studies have shown CVR to be significantly associated with psychometrically-assessed traits (Hughes, 2013).

The present study sought to test the proposition that conscientiousness is a significant impactor in affecting psychophysiological response to acute stress. Specifically, this research
Chapter 3: Mid-range trait conscientiousness

...theorizes that conscientiousness has a healthful association with CVR. Conscientiousness and cardiovascular stress responses during a standardised laboratory-based stressor task were examined. It was predicted that, when presented with unavoidable mental stress in a laboratory setting, conscientiousness would be associated with a more adaptive profile of cardiovascular response to recurrent acute stress exposures.

Materials and Methods

Participants

Participants consisted of a sample of 37 undergraduate students, ranging in age from 17 to 23 years (19.19 ± 1.39 yrs.), with an average BMI of 23.49 kg/m² (± 3.73). Participants who were hypertensive ($n = 7$), consumed caffeine ($n = 111$), and missing cases ($n = 19$) were excluded from the sample. Smokers, participants with a BMI exceeding 30 kg/m² and participants taking medications were included in the study because the inclusion did not statistically alter analyses. Participants were included if they were under the age of 26 and were selectively female due to a predominant sex imbalance within the sample population. Procedures and methods were approved by an institutional research ethics committee (REC).

Design

The study measured SBP, DBP, mean arterial pressure (MAP), heart rate (HR), cardiac output (CO), and total peripheral resistance (TPR) across seven consecutive phases, namely: baseline, exposure 1, recovery 1, exposure 2, recovery 2, exposure 3, and recovery 3. Conscientiousness was treated as a covariate. Effects were assessed using a series of 7 x 1 (time x conscientiousness) repeated measures factorial design ANCOVAs, with a separate ANCOVA for each physiological dependent variable (DV). ANCOVA tests were used for these multivariate analyses due to their robustness, optimal use for repeated measures and time-series analyses, and their capability of testing numerous explanatory factors in a model. MANCOVA (multivariate analyses of covariance) were not employed because a singular DV was used (i.e., cardiovascular response), rather than multiple DV’s (i.e., cardiovascular response or cortisol), across time; bivariate analyses are better suited for random selection and cross-sectional studies, such as this one (Barton & Peat, 2014). In considering effects for time across the seven phases, non-linear main effects and interactions were scrutinized. This was done in light of a priori predictions of curvilinear (namely, inverted U-shaped) effects for physiological arousal across time. In addition to ANCOVA for time phase, $2 \times 3$ repeated measures analyses of variance (ANOVA) were also used to examine significant interactions...
of change from exposure to recovery at each time point. Linear regressions were used to assess the relationship between conscientiousness and state-trait anxiety.

**Measurement apparatus and materials**

**Psychometric assessment**

Scores for conscientiousness were derived from a post-test questionnaire given to participants after cardiovascular monitoring. Personality was assessed using the Revised NEO Personality Inventory (NEO-PI-R), which has been validated on young, healthy populations (Costa Jr. & McCrae, 1992a). The NEO-PI-R has been designed to approximate bell-curve-shaped distributions and consists of 240 scaled items. Each personality domain consists of 48 items scored on a 5-point Likert scale (0–4) with total scores ranging from 0 to 192, derived from the selections “Strongly disagree,” “Disagree,” “Neutral,” “Agree,” and “Strongly agree.” Scores for conscientiousness were totalled and converted into T-Scores; estimated scores of approximations can be found below in Table 3.1 (Costa Jr. & McCrae, 1992a). The conscientiousness subscale of the NEO-PI-R is considered an internally consistent and valid measure (Costa Jr., McCrae, & Dye, 1991). The average score for conscientiousness was 45.95 ± 11.09, which is within bounds of reported national average scores from 42 nations (Mõttus, Allik, & Realo, 2010). Reliability analyses for conscientiousness in this study also demonstrated strong internal consistency reliability (Cronbach’s α = 0.919), which are with findings derived from cross-national and cross-instrumental populations (McCrae, Kurtz, Yamagata, & Terracciano, 2011).

Table 3.1. Approximations of population sample distributions of FFM traits; data from Costa Jr. & McCrae (1992a)

<table>
<thead>
<tr>
<th>Five-Point Scale Item</th>
<th>Range (total)</th>
<th>Distribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>20 – 34</td>
<td>7%</td>
</tr>
<tr>
<td>Low</td>
<td>35 – 44</td>
<td>24%</td>
</tr>
<tr>
<td>Average</td>
<td>45 – 55</td>
<td>38%</td>
</tr>
<tr>
<td>High</td>
<td>56 – 65</td>
<td>24%</td>
</tr>
<tr>
<td>Very High</td>
<td>66 – 80</td>
<td>7%</td>
</tr>
</tbody>
</table>

To examine subjective measures of perceived stress, participants were asked to answer brief Likert scale questions prior to and following the laboratory session, as well as items. Scores ranged from 0 (not at all) to 10 (extremely). Questions included “how stressed do you feel right now,” and “how calm do you feel right now,” which were asked at the beginning of the lab session. Following the experiment, participants were asked these first...
two questions again, along with the additional questions: “How stressful did you find this study?,” and “Should I repeat these tasks again, how stressed would I feel?” Participants were also administered the State-Trait Anxiety Inventory (STAI; Spielberg, Gorsuch, Lushene, Vagg, & Jacobs, 1970), which asks participants to self-evaluate current states of anxiety, i.e. "I am tense," and general traits associated with stressful or anxious situations, i.e. "I have disturbing thoughts." Each domain consisted of 20 items (40 total) scored on a 4-point scale (1-4) with total scores ranging from 20 to 80, derived from the selections “Not at all,” “Somewhat,” “Moderately so,” and “Very much so.”

**Physiological assessment**

Continuous (beat-to-beat) cardiovascular assessment was conducting using a Finapres Finometer device (Finapres Medical Systems BV, BT Arnhem, The Netherlands), which has demonstrated accuracy across young and robust populations (Schutte, Huisman, van Rooyen, Oosthuizen & Jerling, 2003). The Finometer measures cardiovascular parameters using photoplethysmography via a finger cuff attached onto the middle finger and an arm cuff on the non-dominant arm. Participants sat at a table with their non-dominant arm resting on a table during the procedure, while a researcher operated and monitored the equipment from behind an opaque screen. In order to maintain consistency across participants, all testing was conducted in the same laboratory. Reliability analyses of the combined minute-by-minute beat phase intervals demonstrated strong internal reliability with SBP (Cronbach’s α = 0.978), DBP (Cronbach’s α = 0.986), MAP (Cronbach’s α = 0.983), HR (Cronbach’s α = 0.995), CO (Cronbach’s α = 0.990), and TPR (Cronbach’s α = 0.975).

**Mental arithmetic task**

Following the baseline period, participants were instructed to complete a MA task on a simple math computer programme for three separate five-minute periods. Participants were instructed to begin the task upon a prompt by the investigator and solve the timed subtraction equations on the computer screen. The programme was designed to reflexively challenge participants by adjusting the level of difficulty based on personal performance; after three equations were correctly solved, the programme became more difficult. This procedure was chosen because it has shown reliability as a myocardial active stress task across populations (Frankish & Linden, 1991; Kelsey et al., 1999), and relies on a mathematical probability of standardized flexibility, which is considered the most suitable procedure for measuring CVR (Turner, 1994).
Chapter 3: Mid-range trait conscientiousness

Procedure

All testing took place in a cardiovascular psychophysiology laboratory at a university psychology department. Height and weight were measured, and participants were asked to sit at a table with a computer. Informed consent was obtained prior to participation in the study, and then participants were connected to the blood pressure cuffs while completing a questionnaire packet. Pre-screened travel magazines were offered to participants to read for a 20-minute baseline period. The researcher and testing equipment were situated behind a blind screen, so the participants would not be able to see or interact with them. Participants completed three alternating sets of 5-minute MA tasks, each followed by a corresponding 5-minute rest phase. On completion of these tasks, participants completed a small feedback scale and were given a questionnaire pack containing additional psychometric measures to be completed outside the laboratory and returned to the experimenter.

Statistical Analyses

Mean levels of each cardiovascular parameter were computed for each phase. For each cardiovascular variable, a series of 7 x 1 (time x conscientiousness) repeated measures ANCOVA were conducted. Mauchly’s test of sphericity revealed violations of assumptions, so Greenhouse-Geisser corrections were reported. In addition to ANCOVA, 2 x 3 repeated measures ANOVA were used to assess time effects for each time point. Paired-sample t-tests were also conducted to investigate between-subjects differences that may have occurred in self-reported perceived stress from baseline to the end of recovery phase 3. Since multiple comparisons were conducted, Bonferroni corrections were utilised to offset false positive and adjust for confidence. Effect sizes are presented as partial-eta (η²) for small (.1), medium (.25), and large (.4) effect sizes (Cohen, 1988; Cohen, 1992). Additional post hoc power analyses were conducted using G*Power (Faul & Erdfelder, 1992) to confirm results.

Results

Given the anticipated cyclical profile of physiological responses to three repeated stress exposures interspersed with resting periods, special attention was paid to the nonlinear trends of each parameter when scrutinizing the results of each ANCOVA. 60-second periods were included in the model as a set of linear through order 6 effects. Significant non-linear interactions (e.g. quadratic and cubic effects) were taken to represent significant effects for phases across the paradigm. Participants in the field study were consistent with the general population norms (Costa Jr. & McCrae, 1992; Möttus et al., 2010).
Perceived Stress

Pair-wise and independent sample t-tests were conducted to test for differences in perceived stress reporting before and after the experiment (see Table 3.2). Paired-sample t-tests demonstrated that there was no statistically significant change within the overall sample in mean stress, $t(35) = -0.982, p = .333$, or mean calmness, $t(32) = 1.628, p = .113$. Statistically significant results from the one-sample t-tests showed that participants reported that the overall experiment was stressful, $t(34) = 13.348, p < .001$, and they perceived that their stress would be high if the study was repeated again, $t(32) = 9.251, p < .001$.

Table 3.2. Means and standard deviations for perceived stress and state-trait anxiety

<table>
<thead>
<tr>
<th>Scale</th>
<th>Question</th>
<th>Total M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-stress exposure</strong></td>
<td>How stressed now</td>
<td>2.86(1.87)</td>
</tr>
<tr>
<td></td>
<td>How calm now</td>
<td>6.91(2.23)</td>
</tr>
<tr>
<td><strong>Post-stress exposure</strong></td>
<td>How stressed now</td>
<td>3.28(2.02)</td>
</tr>
<tr>
<td></td>
<td>How calm now</td>
<td>6.33(2.34)</td>
</tr>
<tr>
<td></td>
<td>How stressful overall</td>
<td>5.09(2.25)</td>
</tr>
<tr>
<td></td>
<td>How stressed if repeated</td>
<td>4.24(2.63)</td>
</tr>
<tr>
<td><strong>STAI</strong></td>
<td>State Anxiety</td>
<td>31.70(7.22)</td>
</tr>
<tr>
<td></td>
<td>Trait Anxiety</td>
<td>39.86(8.82)</td>
</tr>
</tbody>
</table>

State-Trait Anxiety

Linear enter regressions were conducted to investigate the degree to which conscientiousness predicted state- and trait-level anxiety. Conscientiousness was a significant predictor of trait-level anxiety, $F(1, 35) = 6.118, p = .018$, $R^2 = .149$, but not state-level anxiety, $F(1, 35) = .016, p = .900$, $R^2 = .000$. Participants’ predicted scores for trait anxiety were equal to 53.959 - .307 (conscientiousness). Participants’ scores for trait-level anxiety decreased -.307 points for every one T-score increase in conscientiousness (see Figure 3.1).
Figure 3.1. Linear regression of trait anxiety and conscientiousness scores.

SBP, DBP, and HR

Data were analysed using a mixed-design ANCOVA with a within-subjects factor of SBP (baseline, exposure 1, recovery 2, exposure 2, recovery 2, exposure 3, recovery 3) and conscientiousness was treated as a continuous covariate. Mauchly's test of sphericity revealed that the assumption of sphericity had been violated and therefore, degrees of freedom for repeated measure effects were corrected using Greenhouse-Geisser estimates ($\epsilon = .586, p < .001$). No significant within-subjects main effects for time were observed ($p = .415$), nor were any significant main effects for within-subjects contrasts ($p > .20$). However, a significant order 4 conscientiousness × time interaction was observed, $F(1, 31) = 5.671, p = .024$, $\eta^2_p = .155$. Between-subjects factors revealed no main effects of conscientiousness, $F(1, 31) = .939, p = .353$, $\eta^2_p = .028$. The significance of this interaction at the order 4 level indicates that patterns of responding across multiple phases differed depending on the conscientiousness score. Analyses showed a significant effect for conscientiousness in determining the entire increase-decrease-increase-decrease sequence of SBP, thus encompassing changes in SBP across all phases (see Figure 3.2).

In order to estimate the average effects for time and change for each exposure and recovery set at time 1 (exposure 1 vs. recovery 1), time 2 (exposure 2 vs. recovery 2), and time 3 (exposure 3 vs. recovery 3), $2 \times 3$ repeated measures ANOVA were conducted for each cardiovascular parameter. Mauchly’s test of sphericity indicated that equal variances were not assumed so Huynh-Feldt corrections were applied ($\epsilon = .896; \epsilon = .864$). Tests of
within-subjects effects indicated that no main effects were present for any groups or interactions \((p > .05)\), nor did tests of within-subjects contrasts show any significant effects \((p > .05)\). Pairwise comparisons did not demonstrate significance between groups \((p < .001)\).

![Figure 3.2. SBP function across phases for low \((n = 14)\), mid \((n = 16)\), and high \((n = 7)\) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.]

For DBP, the assumption of sphericity had been violated as well, so the Greenhouse-Geisser correction was used \((\epsilon = .661, p < .001)\). No significant main within-subjects effects were found for time \((p = .801)\), nor any significant main effects or time × conscientiousness interactions for within-subjects contrasts. No between-subjects effects were present \((p > .50)\). For ANOVA for DBP, sphericity was assumed for time points \((p = .068)\), but not for phase × time point \((p = .014)\) so Huynh-Feldt corrections were applied. Tests of within-subjects effects demonstrated significant main effects for phase, \(F(1, 33) = 10.903, p = .002, \eta_p^2 = .248\), and time point, \(F(2, 66) = 3.626, p = .032, \eta_p^2 = .099\). Tests of within-subjects contrasts showed a significant linear trend for time point, \(F(1, 33) = 5.856, p = .021, \eta_p^2 = .151\). Pairwise comparisons test showed significant differences between exposure and recovery pairs \((p = .002)\), but not between time points \((p > .05)\).

For HR, degrees of freedom were once again corrected where appropriate using the Greenhouse-Geisser method \((\epsilon = 0.549, p < .001)\). A significant main within-subjects effect for time was observed, \(F(3.295, 102.135) = 4.106, p = .007, \eta_p^2 = .117\). At the linear level a
significant within-subjects contrast effect was present for time, $F(1, 31) = 9.706, p = .004, \eta^2_p = .238$, but not for conscientiousness $\times$ time ($p > .05$). There was a near-significant between-subjects effect for conscientiousness, $F(1, 31) = 4.062, p = .053, \eta^2_p = .116$ (see Figure 3.3).

For ANOVA for HR, sphericity was violated so Greenhouse-Geisser corrections were used ($\varepsilon = 0.762$; $\varepsilon = .760$). Tests of within-subjects effects showed significant main effects for phase ($F(1, 33) = 50.633, p < .001, \eta^2_p = .605$), time point ($F(1.471, 48.554) = 35.108, p < .001, \eta^2_p = .515$), and phase $\times$ time point ($F(1.468, 48.458) = 5.707, p = .011, \eta^2_p = .147$). Tests of within-subjects contrasts also showed significant linear trends for time point ($F(1, 33) = 43.267, p < .001, \eta^2_p = .567$) and phase $\times$ time at the quadratic level ($F(1, 33) = 5.687, p = .022, \eta^2_p = .149$). Pair-wise comparisons test showed significant differences for both phases ($p < .001$), and between all time points ($p < .005$).

![Figure 3.3. HR response across phases for low (n = 14), mid (n = 16), and high (n = 7) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.](image)

**MAP**

For MAP, Mauchly's test of sphericity revealed that the assumption of sphericity was violated. Degrees of freedom were then corrected using Greenhouse-Geisser correction ($\varepsilon = .635, p < .001$), showing no significant within-subjects main effects were present ($p = .627$). No significant within-subjects contrasts were present for time ($p > .05$), but a significant time $\times$ conscientiousness interaction was present at the order 4 level, $F(1, 31) = 4.591, p = .040, \eta^2_p = .129$, observed power = .546. MAP did not show between-subjects effects ($p > .35$).
ANOVA for MAP indicated that sphericity was violated for phase × time point, so the Huynh-Feldt was applied (ε = .811). Tests of within-subjects effects showed significant main interaction effects for phase (F(1, 33) = 10.348, p = .003, ηp² = .239), while tests of within-subjects contrasts only showed no significant effects present (p > .05). Pair-wise comparisons test showed significant differences between phases (p = .003) but not between time points (p > .05).

Figure 3.4. MAP response across phases for low (n = 14), mid (n = 16), and high (n = 7) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.

TPR and CO

For TPR and CO, sphericity was violated so degrees of freedom were modified (ε = .318, p < .001 for TPR; ε = .537, p < .001 for CO). No significant main within-subjects effects for phase emerged (p > .40). In addition, there were no significant interaction effects, within-subjects contrasts, or between-subjects effects (all p’s > .10). ANOVA were also conducted for CO and TPR. Results for CO indicated that sphericity was violated for phase × time point, so Greenhouse-Geisser corrections were used (ε = .766, p = .003). Tests of within-subjects effects showed significant main effects across all measures for phase (F(1, 33) = 27.548, p < .001, ηp² = .455), time point (F(2, 66) = 15.791, p < .001, ηp² = .324), and phase × time point (F(1.533, 50.589) = 8.392, p = .002, ηp² = .203). Tests of within-subjects contrasts showed significant linear effects for time point (F(1, 33) = 24.283, p < .001, ηp² = .424) and phase × time (F(1, 33) = 16.360, p < .001, ηp² = .331). Pair-wise comparisons test showed significant
differences for both phases \((p < .001)\), as well as between time point 1 and time point 2 \((p = .001)\) and between time point 1 and time point 3 \((p < .001)\).

For TPR, ANOVA demonstrated that Mauchly’s test of sphericity was violated for both time point and phase × time point, so the Greenhouse-Geisser correction was used \((\varepsilon = .622; \varepsilon = .721)\). Tests of within-subjects effects showed significant main effects for phase, \(F(1, 33) = 29.616, p < .001, \eta^2_p = .473\), and time point, \(F(2, 66) = 18.293, p < .001, \eta^2_p = .357\). Tests of within-subjects contrasts only revealed significant linear effects for time point, \(F(1, 33) = 45.555, p < .001, \eta^2_p = .580\). Pair-wise comparisons test indicated significant differences existed between all phases \((p < .001)\) and between time points 1 and 2 \((p < .001)\), as well as time points 1 and 3 \((p < .001)\).

ANOVA results corroborated ANCOVA findings by establishing time point significant effects for each exposure-recovery set at time 1, time 2, and time 3. HR and CO were significant at phase, time point, and also at phase × time point. Results for SBP and MAP indicated marginal insignificance compared to other parameters. SBP, DBP, MAP, and TPR did not demonstrate significant phase × time point interaction effects. Pairwise comparisons further distinguished significant group differences amongst phases and time points for HR and CO, indicating that strong phase by time point interaction effects for HR and CO during reactivity in this sample.
### Table 3.3. Mean (SD) for cardiovascular measures across all phases of the experiment

<table>
<thead>
<tr>
<th>Phase</th>
<th>Baseline</th>
<th>Exposure 1</th>
<th>Rest 1</th>
<th>Exposure 2</th>
<th>Rest 2</th>
<th>Exposure 3</th>
<th>Rest 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>114.90 (7.69)</td>
<td>123.49 (11.44)</td>
<td>120.60 (10.78)</td>
<td>123.92 (12.47)</td>
<td>122.47 (13.82)</td>
<td>124.07 (11.79)</td>
<td>123.37 (16.31)</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>69.14 (8.59)</td>
<td>74.97 (10.67)</td>
<td>72.34 (10.41)</td>
<td>74.97 (10.77)</td>
<td>73.42 (11.83)</td>
<td>75.77 (10.16)</td>
<td>74.21 (11.17)</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>81.03 (10.71)</td>
<td>84.59 (11.98)</td>
<td>78.59 (9.89)</td>
<td>80.98 (11.08)</td>
<td>77.15 (9.91)</td>
<td>79.52 (10.54)</td>
<td>75.83 (10.12)</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>87.68 (7.87)</td>
<td>94.98 (10.73)</td>
<td>91.65 (10.26)</td>
<td>94.70 (11.32)</td>
<td>92.94 (12.42)</td>
<td>95.28 (10.38)</td>
<td>93.64 (12.45)</td>
</tr>
<tr>
<td>TPR (pru)</td>
<td>1.10 (0.34)</td>
<td>0.98 (0.47)</td>
<td>1.13 (0.36)</td>
<td>1.11 (0.35)</td>
<td>1.18 (0.41)</td>
<td>1.19 (0.40)</td>
<td>1.26 (0.56)</td>
</tr>
<tr>
<td>CO (lpm)</td>
<td>5.45 (1.37)</td>
<td>6.03 (1.51)</td>
<td>5.50 (1.34)</td>
<td>5.70 (1.37)</td>
<td>5.43 (1.34)</td>
<td>5.52 (1.34)</td>
<td>5.34 (1.42)</td>
</tr>
</tbody>
</table>
Discussion

In the present study, conscientiousness appeared to be associated with CVR during and after recurrent acute psychological stress. Conscientiousness was found to be specifically associated with higher order effects for SBP and MAP. Results derived for ANOVA seeking to establish any significant influences directly from phase and time point interactions suggest that conscientiousness was a more significant influence on the CVR paradigm. Findings indicated that the interaction effects demonstrated for HR and CO were indicative of significant changes from each exposure and recovery time point across the paradigm; however, this did not alter the parameters that were significant for conscientiousness effects in the ANCOVA. This suggests a plausible influence of conscientiousness on CVR for some parameters. While significant phase × time effects did exist for HR and CO, so did equally robust time × conscientiousness effects. Conscientiousness appeared to be associated with cardiovascular responding across the recurrent exposure paradigm.

Visual demonstrations for mid-range and high conscientiousness exhibited similar response stable trajectories for SBP and MAP responsivity compared to the low scoring group, whom exhibited irregular response trajectories across the paradigm. The lowest group maintained the highest elevation in blood pressure response, while the mid-range group maintained the lowest. However, these effects were visual and do not necessarily infer statistical significance between groups. In regard to the CVR hypothesis (e.g., Hughes, 2013), the findings in this study imply an existing link between personality and direct CVD outcomes (see Figure 1.1) and complement past research regarding the relationship between conscientiousness and health-relevant behaviours, such as longevity and morbidity (Friedman et al., 1993). These results suggest that recurrent acute stress demands may elicit different responses for different groups.

Achievement-orientation and competence are aspects of conscientiousness which guide individuals to diligently work at tasks efficiently, correctly, and to completion, which helps to control stressful encounters (McCrae & Costa, 1992; Penley & Tomaka, 2002). Thus, the present findings are perhaps unsurprising; persons scoring high in conscientiousness would be more adept at engaging with active stressors. This is reflected in the stress and STAI results; no significant differences were found between pre- and post-stress task reports, and no significant relationship was found between conscientiousness and (current) state anxiety. The only significant relationship that existed was trait-anxiety and conscientiousness, corroborating previous findings (Goodwin & Friedman, 2006).
Chapter 3: Mid-range trait conscientiousness

According to the CVR hypothesis, prolonged and recurrent psychological stress exposure is known to contribute to heart disease and hypertension (Light & Obrist, 1980; Lovallo & Gerin, 2003) and impacts how potential stressors are influenced by predictability control and habituation across repeated exposures (Hjemdahl et al., 2012). The results seen across all phases may denote poor cardiovascular response patterns and a failure to adapt to the stressor in low conscientiousness. This marks a potential vulnerability to not just recurrent acute novel stress, but also a trait vulnerability which may contribute to future heart disease. Past research has focused on the role of indirect mechanisms affecting conscientiousness, such as teamwork and stress (Allen, Frings, & Hunter, 2012) or processes concerning the way people think about their occupational circumstances (Boyce et al., 2010). Other works have examined associations between conscientiousness and cortisol (Hamer, Gibson, Vuononvirta, Williams, & Steptoe, 2006), but often with inconsistent findings (Nater et al., 2010). CVR may offer an alternative, perhaps refined, biological paradigm for considering stress response. However, it must be noted that no groups exceeded normal bounds of blood pressure response. Further study is needed to draw concrete conclusions.

Statistical analyses for conscientiousness yielded no discernible effects on DBP, TPR, or CO across time, reflecting the absence of non-linear differences for SBP and indicating a myocardial sympathetic response. Trends in myocardial β-adrenergic response suggested by SBP (and to some extent, HR) across tasks were noted, as well as more vascular α-adrenergic responding (suggested by MAP) across tasks were noted. Results for MAP indicate a disproportionately greater rise in CO than decrease in TPR across exposures, although no direct effects for either CO or TPR were found in the present data. Statistical significance for both SBP and HR suggests a strong α-adrenergic response while vascular resistance remained at a near constant. ANOVA findings for HR and CO parameters were indicative of clear phase by time point interaction effects across all group comparisons.

While findings succeeded in demonstrating a systematic and conceptually relevant pattern of associations between conscientiousness and cardiovascular stress responding, there are suggested directions for future research. The sample consisted of a demographically homogenous group of young female students and thus, results may not be reflective across age and sex. Limited statistical power may also be a concern because the modest sample size \( (n = 37) \) may have limited the significance of some statistical comparisons conducted. A post hoc power analysis using \( G^* \text{Power} \) (Erdfelder, Faul, & Buchner, 1996) revealed that sample sizes and effect sizes were slightly lower \( (n = 37, \eta^2 = .155) \) than the recommended \( (n = 42, \eta^2 = .165) \) to achieve a statistical power of .80 (Cohen, 1988).
Due to a large proportion of participants who consumed caffeine, many cases were removed and conscientiousness groups in the visual figures were under-allocated. However, caffeine is known to alter hemodynamic function, increase vascular resistance during psychosocial stress tasks, and is a well-known risk factor for hypertension (Hartley, Lovallo, & Whitsett, 2004; James, Baldursdottir, Johannsdottir, Valdimarsdottir, & Sigfusdottir, 2018). Also, the research variable in this study asked participants if they consumed caffeine within 24 hours; this didn’t assess potential differences in caffeine consumers who imbibed 1-2 hours before the experiment versus 23 hours, etc. As such, further study concerning the extent of caffeine on CVR should be considered in future research.

These findings may also be context dependent, and similar responses may not arise if the stressor or environment changes. Indeed, the novelty of any given situation may be a significant determinant for stress outcomes, just as psychophysiological responses are important to the events themselves (Lovallo, 2005). It would be beneficial to include other measurement scales to determine the possible roles of perceived threat and challenge to the participants; reactivity alone does not necessarily predict future hypertension (Falkner et al., 1981). The biological basis of the five factor traits, as well as the asocial stressor task utilised in this study, may considerably alter individual differences in cardiovascular response patterns. This subject will be the focus of investigation in Chapter 4.
CHAPTER IV
CONSCIENTIOUSNESS AND PERFORMANCE EVALUATION: EFFECTS ON ACUTE CARDIOVASCULAR REACTIVITY IN WOMEN

Introduction

Persons who score low in conscientiousness tend to be disorganized, neglectful, and careless. They are also less likely to engage in health-beneficial behaviours which leave them prone to greater stress, poorer health, and a higher risk for obesity (Vollrath & Torgersen, 2000; Hampson & Goldberg, 2013). On the other hand, high conscientiousness is associated with lower rates of morbidity and mortality. This likely arises from a greater propensity towards health-promoting behaviours like medication adherence, safe sex practices, nutritional choices, exercise, and sobriety (O’Cleirigh et al., 2007). High conscientiousness scorers are pragmatic, systematic, avoid and prepare for predictable stress, abstain from impulse, and tend to engage in problem-focused coping (O’Brien & DeLongis, 1996; Carver & Connor-Smith, 2010). Thus, conscientiousness should be considered in terms of core cognitions, behaviours, and the extent to which people are concerned over controlling future outcomes.

Conscientiousness has been shown to predict significant health-relevant contributions to mortality, with high scores attributing a 40%-50% reduced mortality risk from both CHD and stroke, even after controlling for obesity, diabetes, smoking, hypertension, and physical inactivity (Jokela et al., 2014). Stable, predictable trait patterns for conscientiousness have been documented across numerous longevity studies such as the Terman Cycle and the Hawaii Personality and Health Cohort (Friedman et al., 1993; Hampson & Goldberg, 2006), regardless of normal variations seen from adolescence through young adulthood onwards (McCrae et al., 2002; Klimstra, Hale, Raaijmakers, Branje, & Meeus, 2009; Soto et al., 2011; Roberts, Walton, & Viechtbauer, 2006). Following the plethora of research associating higher conscientiousness with longevity (Hagger-Johnson et al., 2012; Turiano et al., 2015), evidence suggests a strong genetic component influenced by little to no contribution by family environment, cultural differences, or sex (Loehlin et al., 1998; Costa Jr., Terracciano, & McCrae, 2001; Bouchard Jr., 2004; Luciano et al., 2006; Vernon, Martin, Schermer, & Mackie, 2008), with studies of Big Five factors in youth and adult twins reporting a 43-52% heritability for the trait (Bouchard Jr. & McGue, 2003; Distel et al., 2009; Soto et al., 2011). Heritable differences in psychophysiological arousal may be further shaped by social or environmental situations.
Although current focus has centred on the indirect effects of conscientiousness on health-beneficial behaviours, direct influences on health-relevant outcomes also elucidate the role of biological markers in personality research. Immunoassay tests highlight affiliations between distinct biomarkers and five factor traits. High conscientiousness has been associated with reduced cortisol response, and lower levels of interleukin-6 and C-reactive protein. Low conscientiousness has been associated with higher levels of these biomarkers and increased risks of diabetes, CVD, and osteoporosis (Sutin et al., 2010). High conscientiousness has also been linked to anti-inflammatory glucocorticoid resistance during intense chronic stress, which increases the risk of developing inflammatory conditions. However, findings for immunoassay tests are often inconsistent and should be used in addition to additional biometric variables such as blood pressure (Christensen et al., 2002; Linden, Gerin, & Davidson, 2003; Chapman, et al., 2011; Bibbey, Carroll, Roseboom, Phillips, & de Rooij, 2012). Haemodynamic biomarkers have a long documentation of consistency and reliability, and therefore useful as primary measures for quantifying and tracking psychophysiology. See Chapter 3 for further details (p. 48; Physiological assessment). Use of blood pressure variables in measuring stress responsivity has been well-documented in the NEO factors, but is distinctly lacking within research regarding conscientiousness.

Research suggests that repeated exposure to acute stressors increases the ability to withstand lengthier and challenging exposures (Hughes et al., 2011; Lee & Hughes, 2014). However, exaggerated and persistent CVR is known to directly impact long-term CVD outcomes (Obrist, 1981; Lovallo, 2005). Prolonged and repeated exposure to acute psychological stress leads to increased resting blood pressure, LVM, carotid arterial plaque, and hypertension (Treiber et al., 2003). BH adults with heightened SBP and HR reactivity reported significantly greater resting blood pressure at 5-year follow-ups (Carroll et al., 2003), and a greater risk of hypertension at 10 and 20-yr follow-ups (Borghi et al., 1996; Wood et al., 1984). In young samples whom either developed hypertension as adolescents (Falkner et al., 1981) or pre-hypertensive children (Falkner, 2010), youth with hypertensive parents were reported twice as likely to inherit high resting blood pressure levels as youth with normotensive parents (Hunt et al., 1986; Turner, 1994).

Additional psychosocial factors, such as motivation and workload, are also known to substantially contribute to differences in cardiovascular stress responses (Hjortskov et al., 2004; Stoeber et al., 2009). Robie and Ryan (1999b) conducted a study analysing conscientiousness and job performance in private and public-sector employees and found a significant interaction for conscientiousness and performance monitoring where high scorers
outperformed low ones. The unmonitored condition yielded little to no effect on task performance. This study highlights a model for situational context, wherein differences or manipulations in affect and motivation can influence psychophysiological arousal (Turner, 1994). One such form of motivation, evaluative observation, is known to significantly disrupt cardiovascular habituation to recurrent stress tasks (Kelsey, Soderlund, & Arthur; 2004). The presence of challenging stressors, rather than threatening ones, also appears to contribute to successful performance and adaptive blood pressure responses amongst high conscientiousness scorers (Cleveland et al., 2012; Allen et al., 2012). Given the theoretical relevance of conscientiousness with goal-oriented achievement, persistence, and problem-focused challenge management, quantitative research should shift greater attention to manipulations in motivational context when measuring this trait within the CVR paradigm.

To expand on the findings observed in Study 2, this study investigates whether the addition of performance evaluation to the CVR paradigm significantly alters distinctive patterns of stress response related to conscientiousness (see Figure 1.1). A second round of data was collected by the lab, using a sample of healthy female university students. A psychosocial element of performance evaluation was incorporated into the same CVR protocol used in the previous chapter. Cardiovascular responses to repetitive acute stress tasks were examined in young, college-educated individuals (namely, SBP, DBP, HR, MAP, CO, & TPR). The aim of Study 3 is to investigate the degree of influence conscientiousness may have in predicting cardiovascular health outcomes beyond the present theoretical body of research; in other words, does the relationship between conscientiousness and CVR presented in Chapter 3 remain consistent when additional stressors are incorporated into the paradigm? If conscientiousness continues to impact cardiovascular response patterns over time, then the implications of Study 2 would corroborate the claim that conscientiousness yields a significant influence on CVR across changes in situational context.

**Materials and Methods**

*Participants*

Participants were drawn from a starting sample of 89 undergraduate women. After removing outliers and missing data, the sample was reduced to a total of 81 participants, aged 18 to 24 yrs. (19.17 ± 1.116 years), with an average BMI of 23.60kg/m² (±3.98). Due to the large selection pool of women in the sampling population, men were excluded from analyses. Participants with circulatory disorders and individuals beyond the age of 27 yrs. were excluded from analyses since they exhibit different cardiovascular response profiles.
Smokers, caffeine consumers, and participants with a personal history of hypertension were included in the final sample, as it was determined the inclusion did not significantly alter findings. Procedures and methods were approved by an institutional REC.

**Design**

The study incorporated a $7 \times 1$ repeated measures within-subjects ANCOVA design comprising time across seven levels. The DV’s comprised of SBP, DBP, HR, MAP, CO, and TPR measures assessed in the laboratory. Mean conscientiousness served as a covariate in all ANCOVAs. Repeated measures ANOVA were included to examine significant interactions of change for each exposure and recovery pair across time points. Paired-sample $t$-tests were conducted to investigate between-subjects differences that may have occurred in self-reported perceived stress from baseline to the end of recovery phase 3, and linear regressions were included to assess conscientiousness and state-trait anxiety. See Chapter 3 for further detail (p. 46; Design).

**Measurement apparatus and materials**

**Psychometric assessment**

Conscientiousness was assessed using the NEO-PI-R (Costa Jr. & McCrae, 1992a). The average score for conscientiousness was 58.18 ($\pm$10.30), which was slightly higher than reported national averages (Mõttus et al., 2010). As such, tests for normal distributions were conducted using exploratory analyses (see Table 4.1). Reliability analyses for conscientiousness demonstrated strong internal reliability (Cronbach’s $\alpha = 0.848$). See Chapter 3 for further details (p. 47; Psychometric assessment).

**Physiological assessment**

Continuous (beat-to-beat) cardiovascular assessment was conducting using a Finapres Finometer device (Finapres Medical Systems BV, BT Arnhem, The Netherlands). Reliability analyses of the combined minute-by-minute beat phase intervals demonstrated strong internal reliability with SBP (Cronbach’s $\alpha = 0.977$), DBP (Cronbach’s $\alpha = 0.986$), HR (Cronbach’s $\alpha = 0.982$), MAP (Cronbach’s $\alpha = 0.983$), CO (Cronbach’s $\alpha = 0.987$), and TPR (Cronbach’s $\alpha = 0.955$). See Chapter 3 for further details (p. 48; Physiological assessment).
Chapter 4: Conscientiousness and performance evaluation

Mental arithmetic task

This study follows the same procedure for acute stress tasks outlined in Chapter 3 (p. 48; Mental arithmetic task). Further information has been provided in this section.

Performance Evaluation

During the consent process, participants were informed that their performance would be monitored via webcam placed on top of the computer monitor to ensure quality control during the experiment. They were instructed that all information recorded during the experiment would be reviewed by the investigator but remain private and secure. The procedure was approved by the university research ethics committee, and the protocol did not cause severe psychological or physical discomfort to participants. Upon completion, participants were debriefed and informed that no recording took place. Steps were taken to safeguard participant wellbeing should discomfort take place, and to provide a list of community access resources if so desired.

Procedure

The complete procedure has been outlined in Chapter 3 (p. 49; Procedure). Further information has been provided in this section.

Statistical Analyses

Mean levels of SBP, DBP, HR, MAP, CO, and TPR were computed for each phase of the procedure. ANCOVA were completed to identify if changes across the phases on the cardiovascular measures were associated with conscientiousness. Since phase effects for each ANCOVA were based on seven within-subjects levels, Mauchly’s tests of sphericity were used to reveal violations of sphericity assumptions and to adjust for degrees of freedom, in which case either Greenhouse-Geisser (\(\epsilon < .75\)) or Huyhn-Feldt (\(\epsilon > .75\)) effects were reported (Girden, 1992). Phase effects for patterns of cardiovascular functioning were examined using both linear and non-linear within-subjects contrasts to assess potential polynomial trends across the seven experimental phases. Effect sizes are presented as \(\eta^2_p\) for ANCOVA effects (Cohen, 1988; Cohen, 1992). Mean (SD) values are reported for each parameter across time (see Table 4.3).

Results

Tests of Normality
Since the mean score for conscientiousness in the sample was higher than average (Costa Jr. & McCrae, 1992a; Mõttus et al., 2010), normality checks were conducted to using exploratory analyses to verify the sample distribution. Comparisons between mean and median values indicated a -1.4% difference; as such, differences between mean and median values were almost identical and suggests that a normal distribution is present. Skewness and kurtosis statistics also indicate that conscientiousness is within the critical range of normality (±1.96), with a slight negative skew (see Table 4.1). Additional tests of normality were conducted using Kolmogorov-Smirnov (corrected by Lilliefors significance) and Shapiro-Wilk statistics. Results from both tests provided evidence that the distribution was not significantly different from normal ($p > .05$).

Table 4.1. *Statistics for normal distributions*

<table>
<thead>
<tr>
<th>Conscientiousness</th>
<th>Skewness (SE)</th>
<th>Critical Value</th>
<th>Kurtosis (SE)</th>
<th>Critical Value</th>
<th>Kolmogorov-Smirnov</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-.073(.267)</td>
<td>-.27</td>
<td>.144(.529)</td>
<td>.027</td>
<td>$p = .200$</td>
<td>$p = .702$</td>
</tr>
</tbody>
</table>

**Perceived Stress**

Pair-wise and one sample $t$-tests were conducted to test for differences in perceived stress reporting before and after the experiment (see Table 4.2). Paired-sample $t$-tests demonstrated that there were no statistically significant changes in mean score within the overall sample from pre-experiment to post-experiment for either stress, $t(80) = -1.831, p = .071$, or calmness, $t(80) = .251, p = .803$. Participants reported that the experiment was stressful overall, $t(80) = 20.242, p > .001$, and that self-reported stress would be high if the study was repeated again, $t(80) = 18.361, p > .001$.

Table 4.2. *Means and standard deviations for perceived stress and state-trait anxiety*

<table>
<thead>
<tr>
<th>Scale</th>
<th>Question</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M (SD)</td>
</tr>
<tr>
<td><strong>Pre-stress exposure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>How stressed now</td>
<td>2.64(1.79)</td>
</tr>
<tr>
<td></td>
<td>How calm now</td>
<td>7.16(2.08)</td>
</tr>
<tr>
<td><strong>Post-stress exposure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>How stressed now</td>
<td>3.02(1.92)</td>
</tr>
<tr>
<td></td>
<td>How calm now</td>
<td>7.10(2.13)</td>
</tr>
<tr>
<td></td>
<td>How stressful overall</td>
<td>4.60(2.05)</td>
</tr>
<tr>
<td></td>
<td>How stressed if repeated</td>
<td>3.91(1.92)</td>
</tr>
<tr>
<td><strong>STAI</strong></td>
<td>State Anxiety</td>
<td>33.43(8.33)</td>
</tr>
<tr>
<td></td>
<td>Trait Anxiety</td>
<td>40.43(10.67)</td>
</tr>
</tbody>
</table>
Chapter 4: Conscientiousness and performance evaluation

State-Trait Anxiety

Linear enter regressions were conducted to investigate the degree to which conscientiousness predicted state- and trait-level anxiety. Similar to the results in Study 2, conscientiousness was found to be a significant predictor of trait-level anxiety, \( F(1, 79) = 8.738, p = .004, R^2 = .100 \), but not state-level anxiety, \( F(1, 79) = .888, p = .349, R^2 = .011 \). Participants’ predicted scores for trait anxiety equalled 59.460 - .327 (conscientiousness). Participants’ scores for trait-level anxiety decreased by -.327 points for every one T-score increase in conscientiousness (see Figure 4.1).

![Figure 4.1. Linear regression of trait anxiety and conscientiousness scores.](image)

Table 4.3. Mean (SD) cardiovascular measures across all phases

<table>
<thead>
<tr>
<th>Phase</th>
<th>Baseline M (SD)</th>
<th>Baseline M (SD)</th>
<th>Baseline M (SD)</th>
<th>Exposur e 2 M (SD)</th>
<th>Exposur e 3 M (SD)</th>
<th>Exposur e 3 M (SD)</th>
<th>Recover y 3 M (SD)</th>
<th>Recover y 3 M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP (mmHg)</td>
<td>124.40 (13.18)</td>
<td>135.33 (16.93)</td>
<td>132.16 (15.26)</td>
<td>134.85 (17.46)</td>
<td>133.63 (15.54)</td>
<td>136.75 (17.46)</td>
<td>136.28 (17.59)</td>
<td></td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>79.20 (8.84)</td>
<td>85.40 (10.59)</td>
<td>82.61 (10.06)</td>
<td>85.18 (11.03)</td>
<td>84.90 (10.44)</td>
<td>86.89 (11.62)</td>
<td>85.98 (11.88)</td>
<td></td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>85.53 (11.18)</td>
<td>87.77 (11.51)</td>
<td>82.81 (9.93)</td>
<td>84.19 (10.04)</td>
<td>81.64 (9.72)</td>
<td>83.25 (9.54)</td>
<td>80.96 (9.68)</td>
<td></td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>0.72 (0.11)</td>
<td>0.70 (0.10)</td>
<td>0.75 (.10)</td>
<td>0.73 (0.10)</td>
<td>0.76 (0.10)</td>
<td>0.74 (0.09)</td>
<td>0.76 (0.09)</td>
<td></td>
</tr>
<tr>
<td>CO (lpm)</td>
<td>5.20 (1.24)</td>
<td>5.55 (1.29)</td>
<td>5.19 (1.10)</td>
<td>5.21 (1.16)</td>
<td>5.06 (1.13)</td>
<td>5.07 (1.23)</td>
<td>4.94 (1.22)</td>
<td></td>
</tr>
<tr>
<td>TPR (pru)</td>
<td>1.29 (.72)</td>
<td>1.04 (.29)</td>
<td>1.28 (.39)</td>
<td>1.31 (.41)</td>
<td>1.33 (.42)</td>
<td>1.38 (.52)</td>
<td>1.41 (.53)</td>
<td></td>
</tr>
</tbody>
</table>
Conscientiousness and performance evaluation

SBP, DBP, and HR

Data were analysed using a mixed-design ANCOVA with a within-subjects factor of SBP (baseline, exposure 1, recovery 2, exposure 2, recovery 2, exposure 3, recovery 3) and conscientiousness was treated as a continuous covariate. Significant non-linear interactions present for conscientiousness (e.g. quadratic and cubic effects) were taken to represent significant effects for phases across the paradigm. Mauchly's test of sphericity revealed that the assumption of sphericity had been violated and therefore, degrees of freedom for repeated measure effects were corrected using Greenhouse-Geisser estimates ($\varepsilon = .433$, $p < .001$). No significant within-subjects main effects for time were observed ($p = .450$), nor any significant main effects for within-subjects contrasts ($p > .20$). A significant order 6 conscientiousness $\times$ time interaction occurred, $F(1, 79) = 4.634$, $p = .034$, $\eta_p^2 = .055$, along with a near-significant order 4 level effect, $F(1, 79) = 3.863$, $p = .053$, $\eta_p^2 = .047$. There were no between-subjects effects present, $F(1, 79) = .120$, $p = .730$, $\eta_p^2 = .002$.

2 × 3 repeated measures ANOVA were also conducted for each cardiovascular parameter to estimate the average effects of time and change for each exposure and recovery set at time 1 (exposure 1 vs. recovery 1), time 2 (exposure 2 vs. recovery 2), and time 3 (exposure 3 vs. recovery 3). Mauchly’s test indicated that sphericity was violated for time point ($p < .001$) and phase $\times$ time point ($p = .025$). The Greenhouse-Geisser correction was applied to time point ($\varepsilon = .719$) while the Huynh-Feldt correction was used for phase $\times$ time point ($\varepsilon = .939$). Tests of within-subjects effects indicated significance for main effects for phase ($F(1, 80) = 10.698$, $p = .002$, $\eta_p^2 = .118$), time point ($F(1.439, 115.091) = 10.529$, $p < .001$, $\eta_p^2 = .116$), and phase $\times$ time point ($F(1.878, 150.212) = 8.397$, $p < .001$, $\eta_p^2 = .095$). Tests of within-subjects contrasts showed significant linear trends for time point, $F(1, 80) = 11.403$, $p = .001$, $\eta_p^2 = .125$, and for phase $\times$ time point, $F(1, 80) = 12.621$, $p = .001$, $\eta_p^2 = .136$. Pair-wise comparisons test showed significant differences between exposure and recovery pairs ($p = .002$) and between time point 1 and time point 3 ($p = .003$) as well as between time point 2 and time point 3 ($p < .001$) for SBP.

The order 6 time $\times$ conscientiousness interactions may be indicative of significant changes for conscientiousness at each phase across the whole paradigm. The significance of this interaction at the order 6 level suggests that patterns of responding across multiple phases differed depending on conscientiousness. Analyses showed a significant effect for conscientiousness in determining the entire increase-decrease-increase sequence of SBP, thus encompassing changes in SBP across all time points (see Figure 4.2).
Figure 4.2. SBP function across phases for low ($n = 7$), mid ($n = 25$), and high ($n = 50$) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.

For DBP, sphericity was violated so degrees of freedom were corrected using Greenhouse-Geisser estimates ($\varepsilon = .518, p < .001$). No significant within-subjects main effects for time were observed ($p = .083$), but there was a significant linear main effect for within-subjects contrasts, $F(1, 79) = 4.177, p = .044, \eta_p^2 = .050$, and a significant order 6 conscientiousness × time interaction, $F(1, 79) = 5.405, p = .023, \eta_p^2 = .064$, which showed increased elevations in DBP. No significant between-subjects effects were demonstrated, $F(1, 79) = .002, p = .969, \eta_p^2 < .001$; however, order 6 interactions present for DBP indicate significant changes at each phase for conscientiousness.

To assess differences arising from phase and time effects, ANOVA were also conducted. Mauchly’s test indicated that sphericity was violated ($p < .001$), so Greenhouse-Geisser corrections were used ($\varepsilon = .611; \varepsilon = .586$). Tests of within-subjects effects indicated significance for main effects for phase ($F(1, 80) = 1306.179, p < .001, \eta_p^2 = .942$), time point ($F(1.223, 97.823) = 12580.560, p < .001, \eta_p^2 = .940$), and phase × time point ($F(1.171, 93.700) = 2264.178, p < .001, \eta_p^2 = .966$). Tests of within-subjects contrasts showed significance at all levels. Quadratic trends for time point, $F(1, 80) = 1508.767, p < .001, \eta_p^2 = .950$, and for phase × time point, $F(1, 80) = 2386.162, p < .001, \eta_p^2 = .968$. Pair-wise comparisons test showed significant differences between exposure and recovery pairs ($p <$...
.001) and between time point 1 and time point 3 \((p < .001)\) as well as between time point 2 and time point 3 \((p < .001)\) for DBP.

![Graph showing DBP function across phases for low \((n = 7)\), mid \((n = 25)\), and high \((n = 50)\) conscientiousness.](image)

Figure 4.3. DBP function across phases for low \((n = 7)\), mid \((n = 25)\), and high \((n = 50)\) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.

Assumptions of sphericity were violated for ANCOVA for HR and corrected using Greenhouse-Geisser \((\epsilon = .503, p < .001)\). No significant within-subjects main effects for time were observed \((p = .319)\). There was a significant cubic main effect for within-subjects contrasts, \(F(1, 79) = 4.623, p = .035, \eta_p^2 = .055\), and significant conscientiousness × time interactions at the cubic \((F(1, 79) = 6.164, p = .015, \eta_p^2 = .072)\), order 4 \((F(1, 79) = 4.434, p = .038, \eta_p^2 = .053)\), and order 5 levels \((F(1, 79) = 5.948, p = .017, \eta_p^2 = .070)\). Again, no significant between-subjects effects were observed, \(F(1, 79) = .983, p = .325, \eta_p^2 = .012\).

For ANOVA for HR, sphericity was violated so Greenhouse-Geisser corrections were used for time point \((\epsilon = .716)\) and Huynh-Feldt corrections were used on phase × time point \((\epsilon = .893)\). Tests of within-subjects effects showed significant main effects across all measures for phase \((F(1, 80) = 47.115, p < .001, \eta_p^2 = .371)\), time point \((F(1.432, 114.577) = 45.142, p < .001, \eta_p^2 = .361)\), and phase × time point \((F(1.786, 142.887) = 23.350, p < .001, \eta_p^2 = .226)\). Tests of within-subjects contrasts also showed significant trends across all measures. Significant linear effects were noted for time point \((F(1, 80) = 52.246, p < .001, \eta_p^2 = .395)\) and for phase × time point \((F(1, 80) = 28.452, p = .001, \eta_p^2 = .262)\). Pair-wise
comparisons demonstrated significant group differences for both phases ($p < .001$) and all
time points ($p < .007$).

![Figure 4.4. HR function across phases for low ($n = 7$), mid ($n = 25$), and high ($n = 50$)
conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the
covariate analysis. Error bars denote ± 1 standard error of the mean.

**MAP**

Sphericity was also violated for MAP, so degrees of freedom were adjusted using
Greenhouse-Geisser ($\varepsilon = .46$, $p < .001$). No significant within-subjects main effects for time
were observed ($p = .284$). There were no significant within-subjects contrast main effects for
time ($p > .10$), but there was a significant time × conscientiousness interaction $F(1, 79) =
4.888$, $p = .030$, $\eta^2_p = .058$, at the order 6 level, and a near-significant order 4 interaction, $F(1,
79) = 3.772$, $p = .056$, $\eta^2_p = .046$. Tests of between-subjects demonstrated no significant
effects, $F(1, 79) = .048$, $p = .828$, $\eta^2_p = .001$. ANOVA for MAP indicated that sphericity was
violated so the Greenhouse-Geisser correction was applied to time point ($\varepsilon = .710$), while the
Huynh-Feldt correction was applied to phase × time point ($\varepsilon = .920$). Tests of within-subjects
effects showed significant main effects for phase ($F(1, 80) = 27.109$, $p < .001$, $\eta^2_p = .253$),
time point ($F(1.419, 113.558) = 12.855$, $p < .001$, $\eta^2_p = .138$), and main interaction effects for
phase × time point ($F(1.839, 147.130) = 19.705$, $p < .001$, $\eta^2_p = .198$). Tests of within-
subjects contrasts showed significant linear effects present for time point ($F(1, 80) = 14.031$,
$p < .001$, $\eta^2_p = .149$) and phase × time point interactions ($F(1, 80) = 27.954$, $p < .001$, $\eta^2_p = $
.259). Pair-wise comparisons test showed significant differences between phases \( (p < .001) \), between time points 1 and 3 \( (p = .001) \), and between time points 2 and 3 \( (p < .001) \).

![Figure 4.5. MAP function across phases for low \( (n = 7) \), mid \( (n = 25) \), and high \( (n = 50) \) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.](image)

**CO & TPR**

In the ANCOVA for CO, Mauchly's test of sphericity revealed that the assumption of sphericity was violated, so degrees of freedom were adjusted using Greenhouse-Geisser \( (\epsilon = .466, p < .001) \). No significant within-subjects main effects for time were observed \( (p = .071) \). There was a significant linear within-subjects contrast effect for time \( F(1, 79) = 4.238, p = .043, \eta_p^2 = .051 \), and a significant cubic time \( \times \) conscientiousness interaction \( F(1, 79) = 7.610, p = .007, \eta_p^2 = .088 \). Tests of between-subjects effects yielded no significance, \( F(1, 79) = 1.158, p = .285, \eta_p^2 = .014 \).

ANOVA conducted for CO indicated violations of sphericity \( (p < .001) \) that led to use of Greenhouse-Geisser corrections for time point \( (\epsilon = .702) \) and Huynh-Feldt corrections to be applied on phase \( \times \) time point \( (\epsilon = .837) \). Significant main effects were evident for all measures at phase \( F(1, 80) = 49.974, p < .001, \eta_p^2 = .384 \), time point \( F(1.403, 112.243) = 49.070, p < .001, \eta_p^2 = .380 \) and phase \( \times \) time point \( F(1.675, 133.960) = 20.105, p < .001, \eta_p^2 = .201 \). Tests of within-subjects contrasts also highlighted significant trends across all measures, where significant linear effects were present for time point, \( F(1, 80) = 57.580, p < .001, \eta_p^2 = .419 \), and phase \( \times \) time point, \( F(1, 80) = 24.998, p < .001, \eta_p^2 = .238 \). Significant
group differences were observed between exposure and recovery groups ($p < .001$), as well as all time points ($p < .001$).

Figure 4.6. CO function across phases for low ($n = 7$), mid ($n = 25$), and high ($n = 50$) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.

In the ANCOVA for TPR, Mauchly’s test of sphericity revealed that the assumption of sphericity was violated, so degrees of freedom were adjusted again using Greenhouse-Geisser ($\varepsilon = .258$, $p < .001$). Tests of within-subjects effects were not significant ($p = .211$). There were no significant within-subjects contrasts for time ($p > .05$), nor any time × conscientiousness interactions ($p > .05$). Tests of between-subjects effects showed no significance, $F(1, 79) = 2.246$, $p = .138$, $\eta^2_p = .028$. ANOVA results showed sphericity violations ($p < .001$) which led to use of Greenhouse-Geisser corrections for time point ($\varepsilon = .594$) and Huynh-Feldt corrections for phase × time point ($\varepsilon = .777$). Significant main effects were present for all measures at phase ($F(1, 80) = 151.161$, $p < .001$, $\eta^2_p = .654$), time point ($F(1.188, 95.060) = 58.922$, $p < .001$, $\eta^2_p = .424$) and phase × time point ($F(1.553, 124.242) = 50.235$, $p < .001$, $\eta^2_p = .386$). Tests of within-subjects contrasts also showed significant trends across all measures; strong linear effects were observed for time point, $F(1, 80) = 63.510$, $p < .001$, $\eta^2_p = .443$, and phase × time point, $F(1, 80) = 60.137$, $p < .001$, $\eta^2_p = .429$. Significant group differences were observed between exposure and recovery groups ($p < .001$), as well as all time points ($p < .005$).
After reviewing these results, conscientiousness appeared to significantly influence cardiovascular response to psychological stress across time for all measures except TPR when performance evaluation was introduced to the model. Significant higher-order effects across the entire protocol (i.e. order 6) were observed for SBP, DBP, and MAP, with order 5 interaction effects observed for HR. CO also demonstrated significant non-linear interaction effects at the cubic level. ANOVA results corroborated ANCOVA findings by establishing time point significant effects for each exposure-recovery set at time 1, time 2, and time 3. Where significant trends were observed at phase, time point, and phase × time point for both main effects and interaction effects, both linear and quadratic effects were present. Results for all parameters demonstrated significant phase × time point interaction effects and significant group differences amongst phases and time points. These findings indicate that strong phase by time point interaction effects were present across parameters during the CVR paradigm.

**Discussion**

This research aimed to assess the influence of conscientiousness on psychological stress response. Extending from the findings reported in Study 2, this study sought to find out if altering the stressor would change how conscientious individuals respond to the CVR paradigm. Research implicates high conscientiousness with successful stress management during achievement-oriented and challenging tasks, while low conscientiousness does not. Hypotheses supported some of these suppositions, and provide evidence that conscientiousness affects acute recurrent stress responses.

Results from this study demonstrate that conscientiousness was associated with SBP, DBP, HR, and MAP throughout the entire paradigm, and through half of the paradigm for CO. Significant time point and phase differences between exposure and recovery pairs were demonstrated by all parameters at time point 1 and all parameters, which was an expansion of parameters compared to the findings presented in Study 2. Both HR and CO were robustly significant across all time points and groups, which was similar to some of the findings reported in Study 2. These findings indicate that the interaction effects demonstrated for parameters were indicative of significant changes from each exposure and recovery time point across the paradigm for all parameters, which may suggest a plausible influence of performance evaluation as a situational context shift. While significant phase × time effects did exist, so did equally robust time × conscientiousness effects. Performance enhancement appeared to increase the response significance across the paradigm. These results appear
somewhat consistent to similar findings of different personality traits and cardiovascular attenuation to recurrent stress, but for distinct parameters (Carroll, Cross, & Harris, 1999; Hughes, 2007; Hughes et al., 2011; Ó Súilleabháin, Howard, & Hughes, 2017).

Prolonged and recurrent psychological stress exposure is known to influence the predictability, control, and habituation of responses to stress across repeated exposure (Hjemdahl et al., 2012); visual trends illustrated for low conscientiousness project poor CVR patterns and a failure to adapt to the stressor in low scorers, which is consistent with current research. Additionally, findings for perceived stress and state-trait anxiety measures were consistent with those reported in Chapter 3; no significant changes in perceived stress or perceived calmness occurred from the beginning through to the end of the protocol. However, trait-level anxiety was still significant. This indicates that the present situation likely did not contribute to a significant deal of stress but rather, may perhaps incur at the trait-level during stress appraisal.

The absence of significant TPR findings in this study may imply other underlying haemodynamic determinants of blood pressure, seen in significant findings for CO (and other reported myocardial response parameters). CO and TPR serve as indirect markers of underlying physiological states. Athletes (Cleveland et al., 2012), students (Seery et al., 2010), and unemployed persons (Boyce et al., 2011) report greater distress following self-perceived failure and threat compared to the low, and therefore exhibited exaggerated stress during perceived threat (Ferguson et al., 2014). This may be due to a greater sense of pressure to achieve higher-set challenges and goals or lack of personal ability, and possibly contribute to an increased risk for perfectionism (Stoeber et al., 2009).

A downwards trend in HR responding was present across time for all groups and is consistent with previous work by Allen et al. (2012) reporting lower CO, lower HR, and greater TPR responses high conscientiousness-scoring athletes. Frankish and Linden (1991) reported decreased HR across MA stress exposures, where high reactors displayed greater adaptation and response across repeated exposures compared to low reactors. These findings expand on the consistent findings of previous research to further the body of research and suggest an inability to habituate to performative stress during acute MA tasks for low conscientiousness, which if persistent, implies a greater risk for future cardiovascular health outcomes. Adding an evaluative performance component to the CVR paradigm appeared to yield a substantial effect on the paradigm.

Thus far, an emerging pattern is starting to take shape for conscientiousness. While research examining CVR has traditionally examined responses to repeated stressors, this study
contributes to a growing body of research implicating patterns of response to additional stressors (O’Suilleabhain, Howard, & Hughes, 2018). As such, this study provides implications for cardiovascular stress research, in that individual differences are associated with patterns of adaptation to varying stress experiences. Distinctions for maladaptive coping strategies and psychophysiological arousal have been demonstrated for low conscientiousness, so these findings are consistent with theoretical findings published thus far on this five-factor trait. Interestingly, a surprising new discrepancy now exists for the assumed success of high conscientiousness: high conscientiousness may be inherently protective, but its success may possibly be attributed to elements of control and performance within the situational context.

These findings have several limitations. Group allocations within this sample for visual distributions were also disproportionate; the majority of the respondents were in the high conscientiousness group. Between group comparisons using proportionate group samples would shed greater light on conscientiousness group differences. Methodologies in this study highlight an important limitation in the findings: participant samples for Studies 2 and 3 are primarily female and have thus far excluded male participants, so these results cannot necessarily be generalised. Further examination and replication of between-group effects within conscientiousness is required to substantiate the links between psychophysiological arousal and the risk of future CVD development. Sex differences (and similarities) will be considered further in Chapter 5.
CHAPTER V
CONSCIENTIOUSNESS AND CARDIOVASCULAR REACTIVITY: SEX DIFFERENCES AND SIMILARITIES IN ACUTE STRESS RESPONSE

Introduction

As conscientiousness signifies an individual’s diligence and concern over outcomes, a priori assumptions suggest a significant impact for trait influences on cardiovascular psychophysiology. Due in part to these heritable differences, conscientiousness is considered relatively stable across the lifespan (McCrae et al., 2002; South & Krueger, 2014). Personality tracking in twin and sibling studies has reported on the relative stability of five factor traits across the lifespan and has attributed little to no genetic influences on personality trait development from shared familial environments, as evidenced by data reporting and follow-ups documented throughout youth and middle age (Soto et al., 2011; McGue, Bacon, & Lykken, 1993). High conscientiousness is typically associated with pro-health behaviours and lower cardiovascular mortality risk (Friedman et al., 1993; Goodwin & Friedman, 2006; Jokela et al., 2014), but the moderating role of sex in this interaction is uncertain. No significant sex differences in mortality risk have been reported for either high or low conscientiousness (Martin et al., 2007; Jokela et al., 2013).

Where effects for sex differences in health behaviour are concerned, robust evidence in biomedical research suggests that females generally exhibit greater longevity and report lower morbidity rates than males (Lash, Gillespie, Eisler, & Southard, 1991). Males have a three times greater risk of developing CHD and a five times greater risk of mortality than females (Jousilahti, Vartiainen, Tuomilehto, & Puska, 1999; Stramba-Badiale, 2010). However, substantial differences in sex and gender are often derived from health behaviour effects such as smoking, drinking, BMI, and cholesterol. These primary cardiovascular risk factors can attenuate or amplify blood pressure.

Sex differences in cognitive appraisals of social conditions have also been noted. When comparing masculine, feminine and gender-neutral instructions during the cold pressor task, Mathews et al. (1991) found that men exhibited greater SBP and HR reactivity than women when primed by masculine-instructions. These effects were not present for gender-neutral task instructions. This research suggests that some effects noted for physiological sex interactions may be mediated by confounding socio-environmental effects.

Sex differences are commonly reported across psychophysiological research. Some of the reported differences in cardiovascular biomarkers appear to arise from height and weight
indices, which are indicative of size-ratio differences. Age is another key variable in considering CVD risk (Skurnick, Aladjem, & Aviv, 2010; Basaria et al., 2010). In large European-based population studies, some central haemodynamic and hormone differences have been reported in cardiovascular patients (Nichols et al., 2011). Both male and female reproductive hormones are known to buffer blood pressure responses. The main differences between male and female reproductive hormone effects on cardiovascular response were reported in series of studies conducted by Stoney (1992), who reported that age appeared to be a more crucial risk factor than sex for moderating future CVD risk. Females were reported to have a greater risk for developing hypertension after the age of 55 (i.e., menopause), while males were at a greater risk until the age of 55, and it was found that lower levels of testosterone were associated with greater CVD risk in both males and females (Jackson, 2010; Laughlin et al., 2010). Oestrogen and progestogen deficiency in premenopausal females has also been associated with cardiovascular events (Shaw et al., 2009). Menstrual cycle phase and oral contraceptive (OC) use are known to affect SNS activity (Joyner et al., 2015). While there is evidence to suggest that female reproductive hormones mitigate the psychological stress response, their presence in altering haemodynamic responses to psychological stress generally appears to be minor and statistically insignificant (Matthews, Davis, Stoney, Owens, & Caggiula, 1991; Stoney, 1992; Turner, 1994).

In studies examining sex and blood pressure reactivity, males and females seem to respond similarly to standardized mental stress tasks (El Sayed, Macefield, Hissen, Joyner, & Taylor, 2018). Allen, Hogan, and Laird (2009) reported similarities in CVR among male and female participants and could attribute nonsignificant trends in response differences to high impulsiveness. Some sex differences in cardiovascular responding have been attributed to individual differences in socio-environmental influences on stress appraisal, coping behaviour, and social support (Gramer & Reitbauer, 2010). In a study conducted by Matud (2004), women were more likely to rate life events more negatively and as less controllable than men. Family and health were cited as the most prevalent stressors for women, while men reported relationship, financial, and work as primary stressors. In another study asking college students to rate male or female acquaintances, men were more likely to be rated more assertive, excitement-seeking, and open to ideas than women, who were rated higher in anxiety, vulnerability, aesthetics, feelings, and tender-mindedness (McCrae & Terracciano, 2005). However, sex differences in personality reported in large scale studies are modest in magnitude and not necessarily replicative (De Bolle et al., 2015). Furthermore, no sex differences have been noted for conscientiousness (McCrae et al., 2002).
The implication rather is that sex differences result from cultural contexts and gender roles, which may be internalized during childhood and become a source of gender differences reported in personality (Eagly, 1987; Klimstra et al., 2009; Hyde, 2014). These variations often arise from social contexts which dictate ideologies, values and power, which then determine expected and approved behaviours. Socio-political factors such as education access and the economic wealth of nations are strong predictors of larger variations in sex differences across cultures (Schmitt, Realo, Voracek, & Allik, 2008). As such, focus on individual differences in personality may be key to counteracting risk factors that regulate health-positive behaviours and socio-political interests. Five-factor traits are equally heritable and do not differ significantly between males and females (Loehlin et al., 1998). However, the dutifulness, achievement-orientation, and diligence associated with conscientiousness may moderate socio-contextual appraisals to daily stressors. Both men and women demonstrate similar patterns of CVR, and higher reactors overall demonstrate faster reaction times than low reactors (Light & Obrist, 1980). Since a crucial feature of high conscientiousness is tendency towards problem-focused coping (Carver & Connor Smith, 2010) and gender differences are not necessarily associated with problem-focused coping or avoidance strategies (Felsten, 1998), this implicates conscientiousness as a stronger predictor of CVR to psychological stress than differences due to sex.

This study sought to expand on the findings from Chapter 2 by not only investigating whether conscientiousness influences blood pressure response in CVR, but also investigating whether sex moderates the effects of conscientiousness on CVR. This will be accomplished by examining cardiovascular responses to recurrent acute stress in the CVR paradigm. For the first hypothesis, it was expected that differentiations in responding would arise based on conscientiousness scores, rather than sex physiology, in young adults (see Figure 1.1). Secondly, it was hypothesized that that conscientiousness would maintain an influence on psychophysiological stress response profiles, as demonstrated thus far in Studies 2 and 3.

Materials and Methods

Participants

Participants were derived from a sample of 84 undergraduate women ($n = 42$) and men ($n = 42$), ranging in age from 17 to 27 yrs. ($19.63 \pm 2.02$), with an average BMI of $23.94 \text{kg/m}^2 \pm 3.28$. When broken down by group averages, women ranged in age from 17-23 yrs. ($19.10 \pm 1.45$) with an average BMI of $24.02 \text{kg/m}^2 \pm 3.38$, and men ranged in age from 17 – 27 yrs. ($20.17 \pm 2.36$) with an average BMI of $23.86 \text{kg/m}^2 \pm 3.21$. Participants
were derived from the sample collected in Study 2, and male and female participants were matched by BMI. Participants beyond the age of 27 yrs. were excluded from analyses, since older adults reflect a different, age-specific CVR profile. Smokers, caffeine consumers, and participants with a personal history of hypertension were included in the final sample, as they did not significantly alter findings. All procedures and methods were approved by an institutional REC.

**Design**

To investigate the impact of sex and conscientiousness on patterns of CVR, the average responsivity of each variable was assessed across tasks (baseline, exposure 1, recovery 1, exposure 2, recovery 2, exposure 3, and recovery 3) was calculated using $7 \times 2 \times 1$ mixed-factorial repeated measures ANCOVA. DV’s consisted of variables for SBP, DBP, HR, CO, and TPR. Sex (males, females) was treated as a between-subjects factor, and conscientiousness was treated as a covariate. To account for individual differences in participants and prevent potential partial correlations, male and female participants were selected using a matched-subjects design. In order to estimate the average effects for time and change for each exposure and recovery set at time 1 (exposure 1 vs. recovery 1), time 2 (exposure 2 vs. recovery 2), and time 3 (exposure 3 vs. recovery 3) between sex (female vs. male), $2 \times 3 \times 1$ repeated measures ANOVA were used. Paired-sample $t$-tests were also conducted to investigate between-subjects differences that may have occurred in self-reported perceived stress from baseline to the end of recovery phase 3. See Chapter 3 for further detail (p. 46; Design).

**Measurement apparatus and materials**

**Psychometric assessment**

Conscientiousness was assessed using the NEO-PI-R (Costa Jr. & McCrae, 1992) and had strong internal reliability (Cronbach’s $\alpha = 0.926$). The average sample score for conscientiousness was 44.21 ($\pm 10.63$), with male participants averaging at 44.55 ($\pm 11.26$) and female participants averaging at 43.88 ($\pm 10.09$), which were similar to reported averages (Costa Jr. & McCrae, 1992; Mõttus et al., 2010). Likert scale items assessing perceived stress were administered. See Chapter 3 for further detail (p. 47; Psychometric assessment).

**Physiological assessment**
Continuous (beat-to-beat) cardiovascular assessment was conducted using Finapres Finometer device (Finapres Medical Systems BV, BT Arnhem, The Netherlands). Cronbach’s reliability analyses demonstrated strong internal reliability with SBP ($\alpha = 0.981$), DBP ($\alpha = 0.989$), HR ($\alpha = 0.989$), MAP ($\alpha = 0.987$), CO ($\alpha = 0.990$), and TPR ($\alpha = 0.971$). See Chapter 3 for further detail (p. 48; *Physiological assessment*).

**Mental arithmetic task**

This study follows the procedures outlined in Chapter 3 (p. 48; *Mental arithmetic task*). Further information has been provided in this section.

**Procedure**

The complete procedure has been outlined in Chapter 3 (p. 49; *Procedure*). More information is provided in this section.

**Statistical Analyses**

Mean levels of SBP, DBP, MAP, HR, CO, and TPR were computed for each phase of the procedure. Since phase effects for each ANCOVA were based on seven within-subjects levels, Mauchly’s tests of sphericity were used to reveal violations of sphericity assumptions to adjust degrees of freedom using either Greenhouse-Geisser ($\varepsilon < .75$) or Huyhn-Feldt ($\varepsilon > .75$) effects were reported (Girden, 1992). Phase effects for patterns of cardiovascular functioning were examined using both linear and non-linear within-subjects contrasts to assess potential polynomial trends across phases. Effect sizes were presented as $\eta^2_p$ for ANCOVA effects (Cohen, 1988; Cohen, 1992). Considerations were made for evidence of habituation and sensitization across the paradigm, compared amongst reactivity changes from baseline to exposure 1, recovery 1 to exposure 2, and recovery 2 to exposure 3. Mean (SD) values were reported for sex and conscientiousness at each parameter (see Tables 5.3 & 5.4).

**Results**

**Perceived Stress**

Pair-wise and one samples $t$-tests were conducted to test for differences in perceived stress reporting before and after the experiment. Paired-sample $t$-tests demonstrated that there were no statistically significant changes in mean score in the sample from pre-experiment to post-experiment for either stress, $t(82) = -1.408$, $p = .163$, or calmness, $t(71) = .530$, $p = .598$. 
Upon analysis of the one-sample $t$-tests, results indicated that participants reported that the experiment was stressful overall, $t(81) = 23.765, p < .001$, and that self-reported stress would be high if the study was repeated again, $t(71) = 15.101, p < .000$ (see Table 5.1).

When tested for between-sex differences, pair-wise $t$-tests indicated a statistically significant change in increased mean stress for men from baseline to the end of the protocol, $t(40) = -2.341, p = .024$, but not for calmness ($p = .557$). Mean self-reported stress following the protocol changed from $2.76 \pm 1.48$ to $3.29 \pm 1.65 (p < .05)$; an increase of $0.53 \pm 0.17$. No significant mean changes in stress or calmness were observed for women ($p > .80$). To examine any between-sex differences in how stressed participants felt overall and how they would feel if they repeated the study, independent-samples $t$-tests was conducted. No statistically significant between-subjects effects were observed between how stressful men and women felt about the study overall, $t(80) = -.927, p = .357$, or for repeating the study again, $t(70) = -.560, p = .577$.

### Table 5.1. Means and standard deviations for perceived stress and state-trait anxiety by sex

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td><strong>Pre-stress exposure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How stressed now</td>
<td>2.95(1.94)</td>
<td>2.76(1.48)</td>
<td>2.86(1.72)</td>
</tr>
<tr>
<td>How calm now</td>
<td>6.94(2.38)</td>
<td>7.11(2.04)</td>
<td>7.03(2.20)</td>
</tr>
<tr>
<td><strong>Post-stress exposure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How stressed now</td>
<td>3(1.95)</td>
<td>3.29(1.65)</td>
<td>3.14(1.80)</td>
</tr>
<tr>
<td>How calm now</td>
<td>6.86(2.37)</td>
<td>6.92(1.73)</td>
<td>6.89(2.06)</td>
</tr>
<tr>
<td>How stressful overall</td>
<td>5.20(2.10)</td>
<td>4.80(1.69)</td>
<td>5(1.91)</td>
</tr>
<tr>
<td>How stressed if repeated</td>
<td>4.25(2.55)</td>
<td>3.94(2.06)</td>
<td>4.10(2.30)</td>
</tr>
<tr>
<td><strong>STAI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Anxiety</td>
<td>34(6.96)</td>
<td>33.05(7.85)</td>
<td>33.52(7.39)</td>
</tr>
<tr>
<td>Trait Anxiety</td>
<td>39.76(7.26)</td>
<td>36.76(9.35)</td>
<td>38.26(8.45)</td>
</tr>
</tbody>
</table>

**State-Trait Anxiety**

Linear enter regressions were conducted to investigate the degree to which conscientiousness and sex predicted state- and trait-level anxiety. Conscientiousness was a significant predictor of trait-level anxiety, $F(1, 82) = 9.028, p = .004, R^2 = .099$, but not state-level anxiety, $F(1, 82) = 3.265, p = .074, R^2 = .038$. Participants’ scores for trait-level anxiety decreased -.250 points for each point increase in conscientiousness.

Univariate linear regressions were also conducted for sex; state- and trait-level anxiety were individually treated as DVs, conscientiousness was treated as a continuous covariate, and sex (female, male) was treated as a fixed factor. Levene’s test of equality of error variances demonstrated that assumptions for equal variances were not violated for either
state anxiety ($F = .061, p = .805$) or trait anxiety ($F = .816, p = .369$). Tests of between-subjects effects indicated that no statistically significant differences for sex were present for either state-level anxiety, $F(1, 81) = .291, p = .591$, or trait-level anxiety, $F(1, 81) = 2.641, p = .108$. Similar to the findings presented in Study 2 and Study 3, significant effects were present for conscientiousness and trait anxiety, $F(1, 81) = 8.891, p = .004$, but not for conscientiousness and state anxiety, $F(1, 81) = 2.641, p = .079$.

![Figure 5.1. Linear regression of trait anxiety and conscientiousness scores by sex.](image)

**SBP & DBP**

Based on the cyclical profile of physiological responses to the three repeated stress exposures described in Studies 2 and 3, special attention was paid to the curvilinear trends of each parameter in this study as well. 60-second time periods were included in the model as a set of linear through order 6 effects. Datum remained statistically significant after accounting for BMI, caffeine intake, smoking, OC intake, and drinking behaviour. Descriptive statistics for key demographic variables for participants were broken down by sex (see Table 5.2).
Table 5.2. Key demographic characteristics of participants by conscientiousness and sex

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sex group</th>
<th>Group (n = 84)</th>
<th>Low (n = 55)</th>
<th>Midrange (n = 15)</th>
<th>High (n = 14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years; mean ± SD)</td>
<td>Females</td>
<td>19.10 (1.40)</td>
<td>18.67 (1.03)</td>
<td>19.50 (2.07)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>19.96 (2.30)</td>
<td>21.11 (2.62)</td>
<td>19.75 (2.25)</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m2; mean ± SD)</td>
<td>Females</td>
<td>23.55 (3.24)</td>
<td>24.44 (3.10)</td>
<td>25.97 (4.13)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>24.37 (3.44)</td>
<td>22.65 (1.99)</td>
<td>23.66 (3.59)</td>
<td></td>
</tr>
<tr>
<td>Smokers</td>
<td>Females</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Drinkers</td>
<td>Females</td>
<td>28</td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>23</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Caffeine/24hrs</td>
<td>Females</td>
<td>20</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>21</td>
<td>6</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.3. Mean (SD) SBP, DBP, and HR for phase [n = 84 (42 males, 42 females)]

<table>
<thead>
<tr>
<th>Phase</th>
<th>SBP (mmHg)</th>
<th>DBP (mmHg)</th>
<th>HR (bpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n=42)</td>
<td>Female (n=42)</td>
<td>Male (n=42)</td>
</tr>
<tr>
<td>Baseline</td>
<td>121.34 (12.53)</td>
<td>117.07 (11.53)</td>
<td>75.39 (7.76)</td>
</tr>
<tr>
<td>Exposure 1</td>
<td>130.77 (13.82)</td>
<td>126.26 (15.92)</td>
<td>81.00 (9.16)</td>
</tr>
<tr>
<td>Recovery 1</td>
<td>123.86 (13.29)</td>
<td>122.85 (13.60)</td>
<td>76.40 (8.92)</td>
</tr>
<tr>
<td>Exposure 2</td>
<td>128.92 (14.08)</td>
<td>125.19 (16.00)</td>
<td>79.98 (9.09)</td>
</tr>
<tr>
<td>Recovery 2</td>
<td>124.13 (13.53)</td>
<td>125.20 (14.36)</td>
<td>76.72 (8.73)</td>
</tr>
<tr>
<td>Exposure 3</td>
<td>128.59 (13.31)</td>
<td>126.38 (14.59)</td>
<td>79.99 (9.56)</td>
</tr>
<tr>
<td>Recovery 3</td>
<td>125.49 (13.01)</td>
<td>126.59 (14.03)</td>
<td>77.98 (8.86)</td>
</tr>
</tbody>
</table>

Table 5.4. Mean (SD) MAP, CO and TPR for phase [n = 84 (42 males, 42 females)]

<table>
<thead>
<tr>
<th>Phase</th>
<th>MAP (mmHg)</th>
<th>CO (lpm)</th>
<th>TPR (pru)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n=42)</td>
<td>Female (n=42)</td>
<td>Male (n=42)</td>
</tr>
<tr>
<td>Baseline</td>
<td>92.95 (8.11)</td>
<td>88.94 (9.81)</td>
<td>6.78 (1.55)</td>
</tr>
<tr>
<td>Exposure 1</td>
<td>100.63 (10.49)</td>
<td>96.41 (13.13)</td>
<td>7.49 (1.69)</td>
</tr>
<tr>
<td>Recovery 1</td>
<td>94.75 (9.63)</td>
<td>93.08 (11.07)</td>
<td>6.95 (1.57)</td>
</tr>
<tr>
<td>Exposure 2</td>
<td>98.93 (10.38)</td>
<td>95.71 (13.61)</td>
<td>7.10 (1.60)</td>
</tr>
<tr>
<td>Recovery 2</td>
<td>94.86 (9.67)</td>
<td>94.70 (12.46)</td>
<td>6.77 (1.43)</td>
</tr>
<tr>
<td>Exposure 3</td>
<td>98.87 (10.61)</td>
<td>96.62 (12.83)</td>
<td>6.96 (1.53)</td>
</tr>
<tr>
<td>Recovery 3</td>
<td>96.18 (9.59)</td>
<td>96.18 (11.86)</td>
<td>6.64 (1.33)</td>
</tr>
</tbody>
</table>
For SBP, Mauchly’s test of sphericity showed that assumptions for sphericity were violated so Greenhouse-Geisser corrections were used ($\varepsilon = .595, p < .001$). Tests of within-subjects effects showed significant main effects for time ($F(3.570, 289.142) = 5.415, p = .001$) and time $\times$ sex ($F(3.570, 289.142) = 5.512, p < .001$). Tests of within-subjects contrasts revealed significant curvilinear effects for time ($p < .05$). No significant time $\times$ conscientiousness interactions were evident nor any between-subjects effects ($p > .10$).

However, there were linear ($F(1, 81) = 7.775, p = .007, \eta_p^2 = .088$) and order 6 ($F(1, 81) = 10.850, p = .001, \eta_p^2 = .118$) time $\times$ sex interactions present.

In order to estimate the average effects for time and change for each exposure and recovery set at time 1 (exposure 1 vs. recovery 1), time 2 (exposure 2 vs. recovery 2), and time 3 (exposure 3 vs. recovery 3), 2 $\times$ 3 $\times$ 1 repeated measures ANOVA were conducted for each cardiovascular parameter, with sex (male, female) incorporated as a between-subjects factor. For SBP, Mauchly’s test of sphericity indicated that equal variances were not assumed for time point so the Huynh-Feld correction was applied ($\varepsilon = .809; p < .001$). Tests of within-subjects effects indicated that main effects were present for phase ($F(1, 82) = 31.814, p < .001, \eta_p^2 = .280$), phase $\times$ sex ($F(1, 82) = 12.772, p = .001, \eta_p^2 = .135$), and phase $\times$ time point ($F(2, 164) = 24.252, p < .001, \eta_p^2 = .228$). Tests of within-subjects contrasts showed significant linear interaction effects for phase $\times$ time point ($F(1, 82) = 40.924, p < .001, \eta_p^2 = .333$) and phase $\times$ sex ($F(1, 82) = 12.772, p = .001, \eta_p^2 = .333$).

Sphericity was also violated for DBP, so Greenhouse-Geisser corrections were used as well ($\varepsilon = .642, p < .001$). Tests of within-subjects effects once again showed that no significant main effects for time $\times$ conscientiousness interactions were demonstrated, although time ($F(3.851, 311.943) = 4.023, p = .004$) and time $\times$ sex effects ($F(3.851, 311.943) = 6.561, p < .001$) were present. Significant within-subjects contrasts were shown for time ($p < .05$), as well as significant linear ($F(1, 81) = 13.111, p = .001, \eta_p^2 = .139$) and order 6 ($F(1, 81) = 7.873, p = .006, \eta_p^2 = .089$) time $\times$ sex effects. Similar to results for SBP, Mauchly’s test indicated that equal variances were not assumed for time point so the Huynh-Feld correction was applied ($\varepsilon = .906; p = .002$). Tests of within-subjects effects indicated that main effects were present for phase ($F(1, 82) = 50.788, p < .001, \eta_p^2 = .382$), phase $\times$ sex ($F(1, 82) = 11.512, p = .001, \eta_p^2 = .123$), time point ($F(1.811, 148.517) = 7.406, p = .001, \eta_p^2 = .102$), time point $\times$ sex ($F(1.811, 148.517) = 3.526, p = .036, \eta_p^2 = .041$), and phase $\times$ time period ($F(2, 164) = 23.222, p < .001, \eta_p^2 = .221$). Tests of within-subjects contrasts demonstrated significant linear interaction effects for time point ($F(1, 82) = 9.343, p = .001,$
\( \eta_p^2 = .102 \), phase \( \times \) sex \( (F(1, 82) = 11.512, p = .001, \eta_p^2 = .123) \), time point \( \times \) sex \( (F(1, 82) = 4.965, p = .029, \eta_p^2 = .057) \), and phase \( \times \) time point \( (F(1, 82) = 42.735, p < .001, \eta_p^2 = .343) \).  

**HR & MAP**  
Findings for HR demonstrated differences in variance and used Greenhouse-Geisser corrections (\( \epsilon = .487, p < .001 \)). There were significant within-subjects effects for time, \( F(2.921, 236.627) = 3.766, p = .012 \). The only significant within-subjects contrasts present were at the linear level for time \( (F(1, 81) = 8.160, p = .005, \eta_p^2 = .092) \). Tests of between-subjects effects showed significance for sex, \( F(1, 81) = 5.239, p = .025, \eta_p^2 = .061 \). ANOVA for HR were also conducted. Mauchly’s test indicated that sphericity was violated again for time point so the Huynh-Feldt correction was used (\( \epsilon = .854; p < .001 \)). Tests of within-subjects effects indicated that main effects were present for phase \( (F(1, 82) = 48.283, p < .001, \eta_p^2 = .371) \), time point \( (F(1.455, 119.330) = 49.964, p < .001, \eta_p^2 = .379) \), and phase \( \times \) time period \( (F(2, 164) = 11.943, p < .001, \eta_p^2 = .127) \). Tests of within-subjects contrasts revealed significant quadratic effects for time point \( (F(1, 82) = 5.768, p = .019, \eta_p^2 = .066) \), and linear interactions for time point \( \times \) sex \( (F(1, 82) = 4.581, p = .035, \eta_p^2 = .053) \), phase \( \times \) time point \( (F(1, 82) = 59.087, p < .001, \eta_p^2 = .419) \), and phase \( \times \) sex \( (F(1, 82) = 11.941, p = .001, \eta_p^2 = .127) \).  

Greenhouse-Geisser corrections were used for MAP as well (\( \epsilon = .603, p < .001 \)). Tests of within-subjects effects showed significant main effects for time, \( F(3.615, 292.822) = 6.317, p < .001 \), and time \( \times \) sex, \( F(3.615, 292.822) = 6.120, p < .001 \). Tests of within-subjects contrasts revealed significant effects for time \( (p < .05) \). No time \( \times \) conscientiousness interactions were present, but time \( \times \) sex interaction effects were present at both the linear \( (F(1, 81) = 10.622, p = .002) \) and order 6 levels \( (F(1, 81) = 9.253, p = .003) \). ANOVA for MAP indicated that sphericity for both time point and phase \( \times \) time point were violated, so Greenhouse-Geisser corrections were used on time point \( (\epsilon = .710, p < .001) \) while Huynh-Feldt corrections were applied to phase \( \times \) time point \( (\epsilon = .949, p = .022) \). Tests of within-subjects effects resulted in significant main effects for phase \( (F(1, 82) = 58.953, p < .001, \eta_p^2 = .418) \), time point \( (F(1.657, 135.905) = 3.812, p = .032, \eta_p^2 = .044) \), and phase \( \times \) time point \( (F(2, 164) = 33.180, p < .001, \eta_p^2 = .288) \). Tests of within-subjects contrasts also revealed statistically significant linear effects for time point \( (F(1, 82) = 60.589, p < .001, \eta_p^2 = .425) \) and phase \( \times \) time point \( F(1, 82) = 19.624, p < .001, \eta_p^2 = .193 \). Tests of between-subjects effects also found a significant effect for sex, \( F(1, 82) = 5.221, p = .025, \eta_p^2 = .060 \).
**CO & TPR**

In the case of CO and TPR parameters, assumptions for sphericity were violated as well so Greenhouse-Geisser corrections were used ($\varepsilon = .503, p < .001; \varepsilon = .495, p < .001$). Tests of within-subjects effects were conducted. Significant main effects for time were present for both CO ($F(3.015, 244.250) = 5.097, p < .001$) and TPR ($F(2.969, 240.519) = 3.511, p = .016$), with additional significant time × sex main effects present for TPR, $F(2.969, 240.519) = 2.783, p = .042$. For CO, significant within-subjects contrasts were demonstrated for time ($p < .05$), in addition to significant order 6 time × conscientiousness interactions ($F(1, 81) = 4.231, p = .043, \eta_p^2 = .050$) as well as a quadratic time × sex interaction ($F(1, 81) = 4.674, p = .034, \eta_p^2 = .055$). Tests of between-subjects effects showed a significant effect for sex, $F(1, 81) = 13.722, p < .001, \eta_p^2 = .145$.

ANOVA conducted for CO indicated violations of sphericity ($p < .001$) that led to use of Greenhouse-Geisser corrections for time point ($\varepsilon = .653$). Significant main effects were detected for measures at phase ($F(1, 82) = 50.482, p < .001, \eta_p^2 = .381$), time point ($F(1.305, 107.036) = 45.059, p < .001, \eta_p^2 = .355$), and phase × time point ($F(2, 164) = 19.464, p < .001, \eta_p^2 = .192$). Tests of within-subjects contrasts also highlighted significant trends across measures, where significant linear effects were present for time point $F(1, 82) = 49.486, p < .001, \eta_p^2 = .376$, and phase × time point, $F(1, 82) = 25.344, p < .001, \eta_p^2 = .236$. Significant group differences were also evident in tests of between-subjects effects, between males and females, $F(1, 82) = 14.264, p < .001, \eta_p^2 = .148$.

Finally, tests of within-subjects contrasts for TPR revealed significant effects for time ($p < .05$), for time × conscientiousness at the order 6 level, $F(1, 81) = 5.845, p = .018$, and for time × sex at the linear level ($F(1, 81) = 8.515, p = .005, \eta_p^2 = .095$) and nearly for order 6, $F(1, 81) = 3.711, p = .058, \eta_p^2 = .044$. Tests of between-subjects effects showed significance for sex ($F(1, 81) = 8.231, p = .005, \eta_p^2 = .092$). ANOVA for TPR demonstrated violations of sphericity so Greenhouse-Geisser corrections for time point ($\varepsilon = .726, p < .001$) and Huynh-Feldt corrections for phase × time point ($\varepsilon = .928, p = .007$). Significant main effects were reported for all measures at phase, phase × sex, time point, time point × sex, and phase × time period. Tests of within-subjects contrasts also showed significant trends across a majority of measures. Robust linear effects were observed for phase × sex ($F(1, 82) = 8.569, p = .004, \eta_p^2 = .095$), time point ($F(1, 82) = 90.103, p < .001, \eta_p^2 = .524$), time point × sex ($F(1, 82) = 8.176, p = .005, \eta_p^2 = .091$), and a quadratic phase × time point interaction effect was also present, $F(1, 82) = 18.014, p < .001, \eta_p^2 = .180$. Tests of between-subjects effects indicated a significant sex effect for group differences ($F(1, 82) = 9.736, p = .002, \eta_p^2 = .106$).
Interaction effects for conscientiousness and sex

Significant time × conscientiousness interactions were found for CO and TPR, while time × sex interactions were present across parameters for SBP, DBP, MAP, CO, and TPR. Visual demonstrations of these interactions were illustrated in Figures 5.3 and 5.4. No personality differences were noted for males in SBP, CO and TPR response, but striking differences were seen in SBP and DBP for females. Results for females demonstrated similar SBP and DBP trajectories, mirroring those seen in Study 2; linear and order 6 sex × conscientiousness effects were demonstrated across time. For males, SBP demonstrated minimal attenuation (see Table 5.4). Similar responding for males was demonstrated for DBP. An overall increase of responsivity in low conscientiousness was demonstrated in SBP and DBP. Responsivity, although attenuated, appeared to increase overall across time in SBP and DBP parameters for all groups in females. For CO and TPR, illustrations of high conscientiousness appeared to be significantly deviant from low and mid-range groups of conscientiousness for both sexes, exhibiting less response overall across all exposures and rest phases (see Figures 5.4 & 5.5). Overall, conscientiousness appeared to significantly influence cardiovascular response to psychological stress across time for CO and TPR, while significant influences for sex across time appeared for SBP, DBP, MAP, CO, & TPR. No significant differences effects were present for HR. These results were similar to the findings reported in Studies 2 and 3.
Figure 5.2. Illustrations of mean SBP, DBP, and HR across phases for low ($n = 55$), mid ($n = 15$), and high ($n = 14$) conscientiousness by sex. Effect was significant for the covariate analysis. Note: Groups used for illustrative purposes. Error bars denote ± 1 standard error of the mean.
Figure 5.3. Illustrations of mean MAP, CO, and TPR across phases for low (n = 55), mid (n = 15), and high (n = 14) conscientiousness by sex. Effect was significant for the covariate analysis. Note: Groups used for illustrative purposes. Error bars denote ± 1 standard error of the mean.
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Figure 5.4. Illustration of mean CO across phases for low \((n = 55)\), mid \((n = 15)\), and high \((n = 14)\) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.

Figure 5.5. Illustration of mean TPR across phases for low \((n = 55)\), mid \((n = 15)\), and high \((n = 14)\) conscientiousness. Note: Groups used for illustrative purposes. Effect was significant for the covariate analysis. Error bars denote ± 1 standard error of the mean.

Discussion

The central research of this study sought to address investigate the role of conscientiousness on stress reactivity in male and female participants. Furthermore, this study also sought to elucidate whether sex significantly mediated CVR by examining haemodynamic response trajectories across a recurrent acute stress exposure paradigm. Sex
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appeared to be a stronger predictor of cardiovascular response to psychological stress than conscientiousness, where conscientiousness indicated significant effects for predominantly haemodynamic responsivity. ANOVAs testing for significant differences between exposure and recovery pairs indicated significant time point effects by all parameters. Significant interactions for sex by phase were associated with SBP, DBP, HR, and TPR, while interactions for sex by time point were associated with DBP, HR, and TPR. Significant differences between males and females were noted in MAP, CO, and TPR. Phase by time interactions were associated with all parameters. Findings suggest that the interaction effects demonstrated for cardiovascular parameters in this study indicate significant changes from each exposure and recovery time point across the paradigm. Specifically, these results corroborate sex interaction effects demonstrated by ANCOVA for SBP, DBP, and MAP, time effects reported for MAP, and time $\times$ conscientiousness effects reported for CO and TPR.

Concerning the CVR hypothesis (e.g., Hughes, 2013), the findings in this study imply an existing link between personality and direct CVD outcomes and complement previous research regarding the relationship between conscientiousness and health. Males appeared to demonstrate optimal cardiovascular response across recurrent acute stress exposures compared to females and independent of conscientiousness for CVR. However, conscientiousness appeared to moderate cardiovascular responding to recurrent acute stress in females; in which case, appeared to favour an adaptive cardiovascular response profile. Only the parameters CO and TPR, statistically moderated by conscientiousness, were independent of sex. Findings illustrated for females cohere to principles of natural selection, consistent with the view that mid-range conscientiousness may be more adaptive. Sex differences may signify a greater influence for personality and recurrent acute stress exposure in this context, although the influence of cognitive appraisals on the paradigm is unclear. More data are necessary to clarify these associations.

Statistical analyses yielded no discernible effects for conscientiousness or sex interactions with time for HR, which are consistent with findings for Study 2. Trends in myocardial $\beta$-adrenergic response suggested by SBP, DBP and CO across tasks were noted, and vascular $\alpha$-adrenergic responding (suggested by TPR and DBP) across tasks were present. Results for CO and TPR indicate a lesser decline in CO than increase in TPR across time, both independent and concurrent with sex classification. The decline-incline across time exhibited by males suggests a pattern of vascular response. Statistical significance for both SBP and DBP suggest a strong $\alpha$-adrenergic response while vascular resistance remained at a near constant. These findings reaffirm previous reports wherein recurrent exposure to the
same stressor results in myocardial CVR habituation patterns (Frankish & Linden, 1991; Kelsey et al., 1999). As such, these analyses suggest the potential for significant differences between conscientiousness groups.

This study strengthens the thesis by incorporating and comparing sample males, previously excluded from Studies 2 and 3. Males were initially excluded from Study 2 due to low participant turnout during the recruitment stage. Exclusion was initially necessary to ensure robust effect sizes and participant homogeneity (i.e., outliers). However, such findings could not necessarily be generalised to males without further testing. As such, a sub-sample of male participants initially recruited during Study 2 were matched pair-wise by BMI, height, and weight to similar female participants recruited during this period. Even so, several limitations must be noted. The consequence of incorporating the matched-subjects design led to a smaller sample and a reduction in power. Participants were all young, healthy college-educated adults from one location and may not necessarily reflect gender influences incurred by cultural influences, which may be a key predictor of gender variation (Schmitt, et al., 2008). The distribution of subsamples for high, mid-range, and low conscientiousness were also disproportionate. The models tested were linear and therefore, meaningful curvilinear group differences could not be deduced. The influence of social gender constructs may also be associated with differences in conscientiousness and the concern over potential stress outcomes in female participants.

A strong addition to these analyses were the itemized scales to assess measures in perceived stress and state-trait anxiety. Findings for both of these measures indicated no significant change in self-reported stress and perceived calmness from the beginning to the end of the protocol, nor were there sex differences in state-level or trait-level anxiety. No significant sex differences in stress or anxiety occurred except for a single measure assessing the progression of stress in the study; in which case, men self-reported higher levels of perceived stress than women. Results from the self-reported stress questions and the STAI indicated that female participants had more labile responsivity overall, but also had quicker recovery trajectories than their male counterparts to the protocol. It is unclear if additional underlying mechanisms or extraneous variables might distinguish whether these results explicate differences in gender influence on stress appraisal, habituation and/or sensitization, or innate sex-based physiological differences.

Due to the many socioeconomic changes that have occurred across industrialized countries of the last century, distinct cohort differences in personality may have arisen through different experiences across the lifespan which shape personality in different ways,
such as labour force participation, education, and family structure. In this way, societal norms and expectations may have shaped trait adaptations in personality over time to suit certain outcomes (Hülür, 2017), and additional measures were not included to consider these effects. One factor relevant to this concern is the consideration of a potential experimenter effect; the primary investigator was female, which may have inadvertently influenced the perceived stress reporting and responses seen in male participants in Study 4. Efforts to offset this effect included brief contact and the use of a partition screen during the protocol. Regardless, the resource access and findings resulting from the Finometer device utilised in this study are reliable measures for denoting subtle sex effects than other measures, such as sphygmomanometry (Nichols et al., 2011). The results presented in this chapter contributes further insight into the area of personality, psychophysiology, and sex.

In summary, the present study expanded from the findings reported in Chapters 2, 3, and 4 by highlighting the potential role of conscientiousness in moderating psychophysiological stress reactivity within the CVR paradigm. Results showed differentiation in cardiovascular responding between males and females across recurrent acute stress exposures. Furthermore, findings demonstrated an influence of conscientiousness as a covariate in the model, with almost exclusive distinction to female participants. It is still inconclusive whether the sex-specific associations reported in this study reflect inherent physiological sex-variations in reactivity. Many variations may rise from individual differences in conscientiousness to stress appraisal and socio-environmental contexts. Results may be more robust with a larger sample size. Future inclusion for scaled measures in challenge-threat states may indicate a derived difference resulting from social gender influences rather than sex physiology and may considerably elucidate future directions for personality research in cardiovascular health outcomes.
CHAPTER VI
DISCUSSION

Integrated Summary of Studies

As demonstrated thus far across theoretical research methodologies, conscientiousness is strongly associated with sociobehavioural lifestyle effects on morbidity and mortality (O’Cleirigh et al., 2007; Jokela et al., 2014; Leahy et al., 2015). This dissertation sought to examine the role of conscientiousness in moderating psychophysiological mechanisms associated with stress responsivity. Four empirical studies were presented; three of which were laboratory-based. Consistent with theory and empirical research findings, significant relationships were found between conscientiousness and stress response across all four studies.

Overall, conscientiousness appeared to exude a significant influence on cardiovascular response patterns across repeated exposures to acute psychological stressors. However, when these results are fitted into the theoretical narrative of conscientiousness as a phenotypic trait associated with health outcomes, they offer a preliminary view of the potential role of biological and environmental influences on stress mechanisms related to this particular trait expression. This research contributes biometric data that support the associations that have already been established between low conscientiousness, stress, and poor health outcomes. It is possible that conscientiousness may promote a healthful CVR response at mid-range levels and high levels, as visually demonstrated by the predominantly myocardial responses shown in illustrations across Studies 2, 3, and 4. Mid-range illustrations suggest evolutionary perspectives worth investigating on trait distribution at the population level. High levels of conscientiousness have been well-associated with longevity and healthful outcomes, which may be further augmented by situational context appraisals. Sex appeared to partially moderate myocardial response, while conscientiousness appeared to have more of an influence on vascular responding. Together, these findings suggest that the relationship between conscientiousness and psychophysiological stress response might be partially context-driven in particular circumstances; further suggested by trait level (not state level) anxiety findings across studies, and the self-reported stress increase for male respondents described in Study 4. Research is needed to replicate and substantiate these results before making decisive conclusions, including adjustments for stressor types, non-lab environments, and diverse ranges of participants across various sample populations.
Robust research indicates that exaggerated CVR to psychological stress is associated with poor health outcomes; see Chapter 1 for further details (p. 9; The Reactivity Hypothesis and Psychological Stress). The central findings of this research suggest that conscientiousness is an influential factor within this paradigm, and the data supports a relationship between conscientiousness and CVR. In this dissertation, conscientiousness was associated with significant linear and nonlinear effects for blood pressure reactivity across time. These findings are consistent with theoretical research which has postulated this relationship (Friedman et al., 1993; Martin & Friedman, 2000; Weiss & Costa Jr., 2005; Martin et al., 2007). The current findings contribute broadly to both cardiovascular stress responding and five factor dimension literature by demonstrating a psychophysiological relationship between this trait and haemodynamic reactivity. The biometric evidence offered in this thesis provides a superior biopsychosocial model of conscientiousness by addressing the nonlinear relationships between traitedness and psychophysiology. These findings argue for a need to understand the impact of conscientiousness on cardiovascular outcomes as they develop across the lifespan.

Overview of Study 1

The results from Study 1 demonstrated a significant, replicable association between high conscientiousness and problem-focused coping behaviours. Conversely, low conscientiousness was significantly associated with emotion-focused coping behaviours. These results are consistent with findings across numerous small and large datasets utilizing conventional measures of conscientiousness and coping (O’Brien & DeLongis, 1996; Vollrath & Torgersen, 2000; Penley & Tomaka, 2002; Carver & Connor-Smith, 2010). Study 1 also investigated similarities in coping behaviours with mindfulness. Measures for mindfulness in the MIDUS dataset appeared to be conflated with five factor measures derived for conscientiousness. Effectively, the scale used to assess mindfulness appeared to be constructed arbitrarily, without reference to or indication of a test-retest validated instrument. Additionally, scale questions were phrased to assess mindfulness in an overt religious-spiritual context, potentially excluding a portion of the sample population. The contrived mindfulness scale may not be reliable, especially so in context of the MIDUS dataset. As such, further scrutiny is warranted in future findings regarding the validity of this instrument in future scientific reporting.

Overall, this study does corroborate previous findings in the existing literature, providing evidence for the association between levels of conscientiousness and particular
Chapter 6: Discussion

coping behaviours. Specifically, persons higher in conscientiousness tended to engage in problem-focused coping behaviours when encountering stressful events, while persons lower in conscientiousness tended to utilise emotion-focused coping behaviours. Since higher conscientiousness is associated with a greater concern over outcomes, these findings are not surprising. Persons with higher conscientiousness frequently engage in preventative measures, troubleshoot problems, and systematically address conflicts, thereby mitigating the stress associated with those outcomes. By minimizing distressful outcomes, persons with higher conscientiousness are more likely to have positive health outcomes, including greater longevity and less morbidity. Thus, a distinct health advantage is apparent for coping mechanisms associated with high conscientiousness rather than low conscientiousness. However, no physiological data accompanies the findings presented in Study 1 that could illuminate the mechanism underlying this difference. Nor is any information provided in the dataset that specifies the context of these self-reported stressful experiences. These deficits constitute the main shortcomings of this research.

Overview of Study 2

Building on the findings demonstrated in Study 1, Study 2 sought to establish the relationships among conscientiousness and physiological responses to stress exposures using a laboratory-based task. Conscientiousness was associated with myocardial reactivity across a standardised CVR protocol consisting of repeated exposures to an acute psychological stressor. More specifically, significant interactions were found between conscientiousness and SBP and MAP reactivity across the protocol. Higher conscientiousness was associated with lower trait-level anxiety, and an increase in perceived stress was reported across the course of the experiment.

This study provides evidence that conscientiousness is associated with moderated blood pressure reactivity during acute stress exposures, confirming the relevance of conscientiousness as a psychological trait variable related to physiological consequences. This is a novel finding indicative of potential nonlinear relationships between conscientiousness and CVR, and elucidates the ways that conscientiousness is related to physiological stress responses that may affect cardiovascular health. The findings present a basis for continued examination of conscientiousness and CVD risk factors.

Overview of Study 3
Study 3 sought to determine if conscientiousness was associated with cardiovascular stress response in the presence of performance evaluation. Study 3 found that conscientiousness continued to associate with cardiovascular response trajectories across a standardised CVR paradigm in the presence of performance evaluation. Conscientiousness was primarily associated with myocardial response parameters across the entire protocol. As in Study 2, findings from Study further implicate conscientiousness with CVR. Across the protocol, nonlinear associations were noted for all significant cardiovascular parameters tested, with significant higher-order non-linear findings reported for all myocardial parameters, and especially SBP, DBP, and MAP, and HR, with CO also at the cubic level. High conscientiousness was also associated with lower scores for trait-level anxiety, and an overall increase in self-reported stress occurred, as was also reported in Study 2. Although the paradigm remained identical to the one used in Study 2, the contextual shift resulted in slightly differing patterns of reactivity for conscientiousness, and stronger significance across parameters. The explanation for this result may be that conscientious persons typically succeed in situations they regard as challenging, thereby thriving in situations in which their performance may be evaluated.

These findings also suggest that situational context shifts are more likely to be representative of real-world stressors and are potentially more ecologically valid for assessing CVR than Study 2 (Linden, Rutledge, & Conn, 1998; Schwartz et al., 2003). Conversely, this particular cohort may have appraised the task as appropriately demanding. In other populations, demanding work environments were associated with greater atherosclerotic progression and thus in this experiment, context may be key (Everson et al., 1997). When combined with Studies 1 and 2, findings for Study 3 provide additional evidence that conscientiousness is associated with CVR to recurrent acute stress, that the mitigating effects of conscientiousness may be augmented or attenuated depending on the situational context. This research contributes new findings on the relationship between conscientiousness, acute stress reactivity and adaptation to recurrent stress over time.

Overview of Study 4

Due to the low numbers across recruitment, males were primarily excluded from this course of research. Implementing a matched-subjects design, Study 4 sought to determine if the pattern of cardiovascular stress reactivity originally demonstrated in Study 2 may have been confounded by sex differences. Results for Study 4 found significant effects for sex on
CVR. Conscientiousness affected CVR in females and in haemodynamic responsivity in the CVR paradigm. There is evidence to support biological sex differences in reactivity to recurrent acute stress across measures for SBP, DBP, MAP, CO, and TPR, present in significant nonlinear effects across time. Lower conscientiousness was associated with higher trait-level anxiety across both groups, while male participants reported higher levels of self-reported stress across the experiment compared to female participants.

Significant sex differences in reactivity were present, where women demonstrated higher initial reactivity to the first stress exposure, followed by faster recovery rates than men in the sample. These findings may also be reflected in significant results for self-reported stress which indicated that male participants perceived the study to be more stressful overall than female participants. This could be indicative of blunted reactivity; however, the influence of social support, gender constructs, or the concern over potential stress outcomes may also be associated with these differences. Situational effects should also be considered. Further investigation will be required before inferring gender-specific implications for future research.

Methodological Implications

This compendium of research supports the argument for conscientiousness as a psychosomatically-relevant trait and direct mechanism for moderating CVR. Furthermore, this course of research has elucidated a series of novel findings for both fields of conscientiousness and CVR. The effects seen across all studies were apparent for both males and females, wherein the majority were young and healthy (apart from Study 1) with some college-level education. As such, there are some methodological strengths and weaknesses in this body of work.

Although the findings in this thesis are preliminary to future research initiatives, several methodological enhancements were incorporated into the current framework of this research. First and foremost, participants’ conscientiousness levels were assessed as a continuous variable. Projected CVD risk was also operationalized as CVR, which included haemodynamic determinants of blood pressure and reactivity across time. While the present methodology has been frequently utilised in previous research, the reactivity paradigm was extended to include a third exposure and recovery phase. This extension was incorporated to ensure a more robust examination of differences in habituation and sensitization patterns to repetitive stressors across time (Studies 2, 3, & 4).
While the samples in these studies are comparable to similar existing research conducted with other five factor dimensional variables, the potential for the study being underpowered cannot be ruled out. Power analyses were conducted accordingly for estimated small to moderate sample sizes based on Cohen’s (1988) guidelines for significant bivariate correlation. Several referential studies included large multinational samples of 400 to 76,000 participants (Jokela et al., 2013; Luchetti, Barkley, Stephan, Terracciano, & Sutin, 2014), and other studies have included moderate sample sizes of 150-200 participants (O’Donovan & Hughes, 2008; Williams, Rau, Cribbet, & Gunn, 2009; Creaven, Howard, & Hughes, 2013). Although the reported effect sizes for all studies present are suitable based on the sample size ratios given by Cohen, effects for Studies 2, 3, and 4 are small to medium and as such, may be subject to scrutiny. See Chapters 3, 4, and 5 for further detail (p. 46; p. 62; p. 78; Materials and Methods).

Studies 2, 3, and 4 have each demonstrated clear associations between conscientiousness and cardiovascular reactivity; with Studies 2, 3, and 4 displaying these patterns of reactivity across three repeated acute stress exposures. CVR can predict long-term cardiovascular morbidity and mortality incidents across the lifespan. This body of research supports recent evidence for patterns of cardiovascular adaptation across identical repeated stress exposures, which may reflect potential long-term cardiovascular health outcomes (Kelsey, 1993; Hughes et al., 2011). The use of Finometer to measure continuous beat-to-beat cardiovascular measurements lends strength to this type of research, parsing reactivity into detailed frames for each minute of reactivity across time. Study 3 has provided additional evidence that these patterns of reactivity may also be context dependent, possibly derived from gender constructs (Study 4), and demonstrated across a variety of haemodynamic (Study 3) parameters.

Adaptive coping behaviours (Study 1) and patterns in CVR (Study 3) were illustrated for participants in the high conscientiousness group. This pattern was attributed to trait-related coping preferences, as well as motivational appraisal and arousal instigated by situational context changes. In Study 4, sex differences were investigated. Sex differences in SBP, DBP, CO, and TPR responses were indicative of performance expectations, especially for differing groups of conscientiousness amongst female participants. The results reported in Studies 3 and 4, which highlight underlying haemodynamic determinants associated with challenge and threat state appraisals, appeared sensitive to performance evaluation within sex. Considering CO and TPR in haemodynamic models of psychophysiological stress
arousal provide insight into effects and states that go undetected in research reliant on blood pressure responses alone.

**Theoretical Implications**

In these samples, low conscientiousness was consistently less adaptive across all studies. However, these results do not necessarily reflect a lack of adaptability in low conscientious persons, such as in situations where work challenges demand creativity and flexibility (Ferguson et al., 2014). Chronic stressors are known to augment CVR to acute stress across both human and animal populations (van Doornen & Turner, 1992), and little is known of the effects of chronic stress in these present studies. Further analysis of variance on these samples may shed light on the effects, if any, in this data set. Incorporation of cognitive behavioural assessment scales may also contribute to further insight on this matter.

These findings, including the present research, contribute to an enhanced theoretical and methodological approach to studying traits. In and of themselves, personality characteristics do not necessarily affect reactivity or CVD risk alone; rather, a trait such as conscientiousness may lend its influence via specific contexts. Through engagement in problem-solving coping strategies, high conscientious individuals can avoid potentially stressful and threatening situations via responsible and healthful life choices and, thus, serve as a protective factor from stress (Bartley & Roesch, 2011). However, conscientiousness does not always confer benefits. High conscientiousness may only be adaptive and healthful in some contexts, such as those perceived as challenging and controllable. Much of this relationship may ultimately be affected by the amount of concern an individual has regarding the number and severity of potential outcomes that may occur.

Many human traits have an optimal range wherein they best support human adaptation and survival. This research argues for future research regarding curvilinear effects for conscientiousness on psychophysiology. Theoretical research has often pointed to a distinct, dichotomous linear effect for conscientiousness — that high is beneficial, and low is detrimental. Moderate levels of traits based on normal distributions (or rather, traits which are the most successful in populations) are typically the most adaptive and thus remain dominant within the gene pool of that population. By limiting the central focus on linear contrasts between high and low conscientiousness, research misconstrues ‘good’ and ‘bad’ trait system. Few traits are inherently so and as such, high conscientiousness does not imply an inherent evolutionary advantage. In addition, ascribing groups in the highest group for conscientiousness as ‘good’ and groups in the lowest group as ‘bad’ without relativism
creates a paradox which attaches traits to enticements (e.g., health or success) rather than terms and contexts (Hughes, 2016), which corroborates research emphasizing the distinction of conscientiousness from morality (Ekehammar et al., 2004). The non-linear trends depicted across numerous cardiovascular parameters in this research indicate a strong effect for conscientiousness on cardiovascular response to repeated stressors across time. Distinct groups effects have yet to be concluded and warrant future research in this area.

Methodologically, some research has also assumed that the effects of conscientiousness are linear. That assumption is questioned by this body of research. The current findings suggest that conscientiousness may be detrimental depending on the context and support similar findings regarding this trait (Costa Jr. & Widiger, 1994; Le et al., 2011; Carter et al., 2016). High conscientiousness is considered adaptive and healthful until an inflection point is reached where high conscientiousness is associated with poor performance (Converse & Oswald, 2014). As demonstrated by the findings reported in Studies 2, 3, and 4, conscientiousness was associated with a pattern of adaptive cardiovascular responsivity to recurrent, acute novel stressors. This body of research provides evidence of significant nonlinear effects on biometric variables. However, this does not necessarily imply that curvilinearity exists across all contexts. Rather, this study contributes to a growing body of literature that addresses new definitions for what constitutes a successful level of traitedness for conscientiousness. It is possible that mid-range individuals might demonstrate better work and life outcomes than individuals at the extremes of the trait, but there may also be higher variability within the ‘successful’ zone (Carter et al., 2018). Research demonstrating the relevance of mid-range theory in personality appears limited, as do any biometric data to substantiate these suggestions (Haynes, Hitt, & Campbell, 2015; Raggatt & Weatherly, 2015). The findings demonstrated across Studies 2, 3 and 4 argue the need for further discourse on personality factors and parabolic effects in time series analyses.

In terms of behavioural implications, there is a breadth of research pointing to the positive effects of high conscientiousness on health outcomes; see Chapter 1 for further details (p. 7; Conscientiousness and Health). Conscientiousness has been well-documented as a stable, heritable, and universal trait that exhibits little significant variation across the lifespan (Jang et al., 1996; Yamagata et al., 2006; Weiss et al., 2015). However, some researchers have suggested that cross-cultural and longevity studies related to behaviour genetics fail to uphold McCrae and Costa Jr.’s (1999) assertions that five-factor traits are largely genetic (Roberts et al., 2005); others have proposed that five-factor traits plastic and can change drastically over time (Stephan, Sutin, Luchetti, Bosselut, & Terracciano, 2018).
These effects appear to be more influential on behavioural aspects, such as the relationship between low conscientiousness and increased physiological dysregulation over time (Stephan, Sutin, Luchetti, & Terracciano, 2016). Behaviour-related facets such as organisation, diligence, and achievement may be more affected by lack of control or behaviour-modifying medications (Williams et al., 1995). Research on AD also suggests that marked decreases in conscientiousness are the result of neurodegenerative factors, rather than non-disease-related cognitive decline (Robins-Wahlin & Byrne, 2011).

Suggestions for promoting conscientiousness in vulnerable populations have also centralised around positive health-behaviour change initiatives (Chapman, Hampson, & Clarkin, 2014; Magidson et al., 2014). Although perhaps thoughtful, these suggestions may be misguided. More broadly, certain behaviours can also be conditioned or learned; for example, studying for exams will result in improved test scores, smoking increases the risk of developing hypertension, and incorporating exercise and a healthy diet into one’s can lower morbidity and mortality risks across the lifespan (Primasteta et al., 2001; O’Cleirigh et al., 2007; Roberts & Jackson, 2008; Pérez-López, Chedraui, Haya, & Cuadros, 2009). According to a series of studies conducted by Hudson and Roberts (2014), 90% of persons surveyed reported that they wanted to change some aspect of their personality. In some cases, cultural or social demands (e.g., encouraging conscientious behaviours in work and academic settings) may dictate these desires. Volitional changes take greater effort to yield potentially short-term outcomes (Hudson & Fraley, 2014). In a study measuring personality traits at baseline and at a 1-year follow-up, Robinson et al. (2015) reported that no significant changes were demonstrated from implementing volitional efforts towards personality change. A more promising approach may be to shift towards the use of environmental modification to encourage and promote behaviour change (South & Krueger, 2014). Volitional personality change may lie only in state-level behavioural changes, rather than lasting trait-level changes that have been automated over time (Hennecke et al., 2014; Hudson & Fraley, 2015).

If conscientiousness is indeed a relatively immutable, consistent, universal, and genetically-heritable trait, then theory suggests that volitional behavioural changes will yield little significant effect on trait alteration across the lifespan. However, these findings do not signify that persons who score in the lowest group of conscientiousness are inherently disadvantaged by their trait circumstances than others. Neither do these findings indicate that persons scoring in the highest group will inevitably develop CVD should they encounter unplanned or unavoidable acute stressors. These findings do describe a distinct pattern of psychophysiological response to stress which, if fixed, may increase cardiovascular risk.
As far as this dissertation’s assertions go, findings derived from studies 2, 3, and 4 suggest a prescient role for trait influences on potential biobehaviour outcomes related to conscientiousness. This was demonstrated in Chapters 3, 4, and 5 with the CVR paradigm, and supports a biopsychosocial model approach for conscientiousness. Where certain traits may yield high genetic influences (e.g., neuroticism) or socio-environmental influences (e.g., extraversion and openness to experience), this research suggests a trait influence for conscientiousness when contextual, non-shared environmental factors are present. This is further supported by findings for trait-level anxiety; Studies 2, 3, and 4 all reflected significant relationships which demonstrated that higher levels of conscientiousness were associated with lower levels of trait-level anxiety. These associations were further linked to male participants’ myocardial stress reactivity in Chapter 4, whom exhibited a slower recovery patterns than their female counterparts. Since these effects were not present for state-level anxiety, the research suggests that conscientiousness has strong trait-level associations and influences that require further investigation. Approaching this perspective using the five-factor model (Costa Jr. & McCrae, 1992b), transactional model of stress (Lazarus & Folkman, 1987) and the individual differences model of CVR (Obrist, 1981), the author concludes that active biological components influencing the trait likely inform moderate behavioural and cognitive tendencies. Conscientiousness may contribute to CVD risk in part by influencing stress appraisal, coping behaviours, and psychophysiology.

The research primarily concentrated on the biological trait definition for conscientiousness and its role in influencing stress mechanisms. However, definitions grounded in population-based thinking are often subject to criticism for contribute little information regarding the contexts in which they occur, and thus limit the scope of generalisability that may be attributed to individual differences (Lohman, 2001). Indeed, where shared environment appears to yield little effect on conscientiousness, non-shared environment appears to have a more substantial impact and may compliment underlying the genetic factors associated with trait conscientiousness. This conclusion is further informed by heritable biological components of blood pressure and cardiovascular psychophysiology, and the adaptive role of trait success within specific ecologies (Cronbach & Snow, 1977; Jorgensen & Houston, 1981). Individual differences in personality traitedness, not shared within home environments, may exert varied degrees of psychological appraisal and stress reactivity on individuals who may be already predisposed for higher risk. Some trait effects, such as neuroticism, may be even stronger. A greater epidemiological interest should be considered regarding the influence of conscientiousness on heightened CVR during psychological stress.
exposure. Indeed, a similar point of view was documented by Manuck and Proietti (1982, p.489), who stated that “younger individuals carrying a familial disposition to hypertension… who also exhibit a heart rate hyperreactivity to behavioural stressors may be among those who are most likely to develop an essential hypertension in later life.” While the researcher acknowledges that not all contexts are standardised and further research on this topic is undoubtedly needed, this thesis highlights potential research avenues associated with conscientiousness, such as control, which may also be a crucial element in mediating resilience (Penley & Tomaka, 2002). In complement of previous findings (Christensen et al., 2002; Roberts & Bogg, 2004; Weiss & Costa Jr., 2005), this thesis provides evidence that conscientiousness may predict key cardiovascular outcomes via patterns of reactivity. This dissertation suggests that further attention to psychophysiological pathways, in addition to biological and psychosocial aspects, be included in future research. These findings also suggest a potential value of looking at distinct levels of conscientiousness, indicative of potential for future research directions.

A Conceptual Model: Reflections

Based on the collected findings of studies 1, 2, 3, and 4, the hypotheses which contributed to the formation of the conceptual model outlined in Chapter 1 (see Figure 1.1, p. 32) remains relatively stable, pending minute adjustments for sex based on the findings reported in Chapter 5 (see Study 5). Overall, the model is supported by both the theoretical research presented in Chapter 1, as well as the empirical research presented in Chapters 2, 3, 4, and 5 of this thesis. The model showed the flow or an introduced stressor and presented how conscientiousness influenced coping behaviours, as seen in Study 1; influenced CVR, as seen in Study 2; and continued affecting this pattern of response but was altered slightly by situational contextual effects, as seen in Study 3. A minor update to the model is now required following the results presented in Study 4. In this study, it was found that myocardial differences for conscientiousness were distinct within females, rather than males. However, response differences in hemodynamic reactivity (namely, CO & TPR) were present for both male and female participants when assessed as an entire sample, in which case personality effects were also demonstrated. Likewise, perceived stress scales indicated that men perceived higher stress than women, indicating that perhaps some situational contexts may be at influence. It is inferred from these findings that perhaps sex differences in CVR may have more to do with differences in appraisal rather than personality influences. The updated model, seen in Figure 6.1, is presented below.
Figure 6.1. Updated conceptual model of how conscientiousness and situational context directly and indirectly influences stress evaluation and coping behaviours during CVR.

**Limitations**

Some of the limitations within this study may include the validity of measures for conscientiousness, specifically the omission of trait facets and substantial group comparisons from analysis. Where visual distinction among groups for high, mid-range, and low conscientiousness were presented visually, the scoring categorizations outlined by Costa Jr. and McCrae (1992a) allocated irregular sample distributions across groups. The sample pool from Study 3 were much higher in average conscientiousness than the participants sampled in Study 2 and as such, substantial between-subjects analyses could not be conducted without reducing sample proportions, stratification, and/or elevated risk for Type 1 errors.

Likewise, growing interest into local facets is hailed as a specialised area of research which determines specific and individualised effects of trait influences. However, this can be difficult to accomplish because facets often overlap one another and thus more difficult to measure orthogonally like global traits themselves. Although studies have reported substantial findings for trait facet heritability, the genetic influence was largely non-additive.
compared to shared environmental influence (Jackson et al., 2009; Jang et al., 1996). Facet measures are often derived from statistical artefacts and thus, broader traits are more valid (Ones & Viswesvaran, 1996). Conscientiousness is capable of existing as an independent and reliable measure replicated across a diverse array of instruments (Martin & Friedman, 2000; Costa Jr. & McCrae, 1992b; Heaven et al., 2013).

Data collected in this research was obtained in a controlled laboratory environment. In consideration of the generalisability of findings from Chapters 3, 4, and 5 of this thesis, the experimental-design studies are generally applicable to real-life acute stress responses. The MA tasks used in Studies 2, 3, and 4 were modeled and replicated from an established body of literature on psychophysiological responsivity research (Brod, Fencl, Hejl, & Jirka, 1959; Obrist, 1981; Frankish & Linden, 1991; Steptoe & Vögele, 1991; Kelsey et al., 1999; Hughes et al., 2011; Ó Súilleabháin et al., 2017). Although these studies took place in a closed laboratory, the strict environmental control can be considered an advantage due to the elimination of external factors, such as noise, visual and social interaction, or inadvertent physiological or emotional arousal, which was further accounted for by a prolonged ‘vanilla’ baseline which aided in environmental adjustment. Since the CVR paradigm is modelled off the cardiovascular-hormonal patterns associated with the ‘fight-or-flight’ response, psychological stress tasks like MA are suitable to measure stress reactivity. This pattern of response is demonstrated across individuals and groups and reveal distinctive cardiovascular patterns associated with underlying haemodynamic states (Turner, 1994). While precautions were taken in choosing a simplified novel acute stressor encountered in daily life, findings may not be generalisable to specific stressors in daily life. It can be noted, however, that laboratory-based reactivity experiments are reliably correlated with future blood pressure and hypertension status from 10-15 years onwards and are predictive of similar endpoints (Light, Dolan, Davis, & Sherwood, 1992). As such, this laboratory paradigm only exposed participants to acute psychological stressors and does not reflect the activities of participants exposed to chronic psychological stress outside the laboratory environment. Furthermore, these studies were limited to psychologically-constructed measures by the NEO-PI-R. In efforts to partially address this concern, perceived stress and anxiety measures were included in these analyses; no significant findings were reported for either state anxiety or for change in calmness across the protocol. Still, future investigations would benefit from additional analyses of psychosocial stress, such as cognition, behavioural assessments, and/or social support measures, to name a few.
All participants recruited for this research were young and healthy college-educated adults; and as such, the results may not be generalisable to all ages or educational and vocational backgrounds, or comparable to the results reported in clinical samples. The majority of these participants were also female. The minimal turnout of male participants limited the validity of this research; although this distribution was a direct result of the respondents within the sample pool. As such, females were the primary participants, apart from the open dataset used in Study 1, and the pair-wise sample comparison in Study 4. Additional considerations for experimenter effects may have also influenced the stress reporting and response seen in male participants in Study 4.

Additional concerns relate to the exclusionary and accounted for variables. Some respondents didn’t complete either the lab portion or return the survey instruments, resulting in loss of data for some items. Some variables, such as caffeine consumption, appeared to have a more significant impact on the sample in Study 2 than the sample collected in Study 3. Likewise, the number of participants within the Study 2 recruitment sample constituted a larger subsample that potentially weakened the overall power and effect size of the analyses. While the researcher accedes that not all variables in this dissertation could be itemized and assessed, consistencies amongst the samples remain a concern, and continued investigation is necessary to draw a clear conclusion.

Previous research has also demonstrated that OC use is associated with mild increases in blood pressure in healthy normotensive women; no significant changes in sympathetic response activity have been associated with its use (Carter et al., 2010; Boldo & White, 2011; Harvey et al., 2015). Research suggests that haemodynamic variables can be widely mediated by the influences of age, cholesterol, and individual differences (Wingard, Suarez, & Barret-Connor, 1983; Shaw et al., 2009; Joyner et al., 2015; Joyner, Wallin, & Charkoudian, 2016). CVR and blood pressure regulation research often omits female participants for concern of interference by endogenous ovarian hormones (Turner, 1994). One-third of US women report using some form of hormone-based birth control, and it is the most commonly used form of contraception in the UK (Jones, Mosher, & Daniels, 2013). Moderating effects have been found regarding the influence of menstrual cycle phase and OC use on blood pressure responsivity, particularly in OC users during the luteal phase (Schallmayer & Hughes, 2010).

However, results for the effects of exogenous hormone use remain inconclusive. OC use and menstrual cycle phase have limited effects on stress responsivity in healthy women, and associations present with CVD risk may be further augmented or attenuated by individual variations in age, health behaviours (e.g., smoking), and BMI, and by differing hormone
intake methods (Garrett & Elder, 1984; Stoney, 1992; Nichols et al., 2011). Any omission of participants who use hormonal contraception could not be considered a true representation of the average female population. Consideration for these findings was given, and the primary investigator ultimately chose to include OC users in the statistical analyses. Descriptive statistics and ANCOVA demonstrated no significant effects for OC use across all studies in this thesis. All haemodynamic variables were considerably robust and the samples in Studies 3 and 4 were of substantial size, so errors due to statistical artefact were relatively low for this particular variable.

An additional factor to consider is the demographically homogenous profile of the participants from Studies 2, 3, and 4. As previously mentioned, most of the participant composition were young, healthy, college-educated women. The majority of participants were also white. No analyses regarding ethnicity comparisons were conducted from the datum due to the low numbers, although systematic differences in cardiovascular function have been reported amongst black and white North Americans and South Africans (Nichols et al., 2011). Furthermore, the risk for hypertension is twice more likely to occur in non-Hispanic black Americans than white Americans and Asians, which is associated with exaggerated CVR to stressors (Anderson, McNeilly, Armstead, Clark, & Pieper, 1993; He et al., 2009). Thus, these samples are not demographically representative of CVR patterns across all groups for ethnicity, age, and sex. However, the primary variable in this thesis is conscientiousness, which is a universal trait independent of significant differences in age, sex, and ethnicity (Yamagata et al., 2006). Despite these considerations, the research presented in this dissertation provides sufficient evidence for clear, direct, and linear relationships between conscientiousness and coping, as well as nonlinear effects across time for CVR, which is complementary and contributes to relevant works (Merecz et al., 1999; Murphy et al., 2013). Replication of these findings and further analysis is encouraged.

Overall Conclusions

The central thesis of this research was to investigate and establish evidence for the psychophysiological effects of conscientiousness on haemodynamic variables on stress responsivity. Findings across all studies demonstrate the validity of conscientiousness as a potential mechanism which moderates cardiovascular stress reactivity and future cardiovascular health outcomes. In support of trait theory, conscientiousness has demonstrated an attenuated and overall adaptive myocardial pattern of cardiovascular responding across single and multiple acute stressors, although context and paradigm shifts
may augment or attenuate the response (See Chapter 4, p. 76). Conscientiousness can be considered the concern over outcomes; as such, average persons are not over or under concerned over outcomes. Highly conscientious persons are presumably very concerned over outcomes and tend to over-strive for order, which may be counterproductive in situations characterised by flux, ambiguity, or novelty. Since high conscientious types attempt to systematically plan for predictable stressors, problem-focused coping approaches (Study 1) may not necessarily be adaptive across all contexts and may not have adapted to the novel stress tasks utilised in Studies 2 and 4 (Carver & Connor-Smith, 2010). Indeed, some research indicates that difficult tasks were correlated with increased CVR and a decreased capability to flexibly modify their coping behaviour to the task at hand, which may indicate a lower propensity to environmentally adapt (Kato, 2017). However, high conscientious persons tend to excel when contexts emphasise achievement and challenge, while low individuals overall tend to exhibit maladaptive responses to stressful situations (Allen et al., 2012). Consistent with both the available theoretical and empirical research to date, these findings suggest that extreme scores on conscientiousness may signal not only maladaptive behaviours, but also a grave risk for physiological dysfunction, and gives rise to future endeavours to investigate to whole trait spectrum. Again, although visual demonstrations for suggested nonlinear effects across time were depicted for tertile groups of conscientiousness, all results reported are for linear ANCOVA and between-group effects still remain statistically inconclusive.

This thesis indicates that, across all five studies, low conscientiousness may be associated with maladaptive coping behaviours (Study 1) and CVR response (Studies 2, 3, & 4). Sex differences (Study 4) in responding found no significant differences in conscientiousness to recurrent acute stress response for males, although distinct differences in reactivity were seen amongst females. However, further research establishing group differences in conscientiousness is needed. Regardless, these findings are still consistent with previous research establishing differences in high and low conscientiousness in coping behaviours (Connor & Carver-Smith, 2010) and acute stress response (Kelsey, 1999). These findings suggest that a relationship between CVR and conscientiousness exists, and that there is a rationality to pursue future research on between-groups differences in traits by analysing data using multi-quantile splits; wherein the lowest tertile scores tend to report a 37% higher mortality risk compared to individuals in the top two tertiles (Jokela et al., 2013).

In conclusion, this body of research highlights the relevance of conscientiousness within the CVR paradigm. It appears to be the case that conscientiousness is associated with
CVR to recurrent acute stress exposures and that distinct response patterns may be indicative of future cardiovascular health risks. The literature review in this research provides an argument for which trait group comparisons should be considered in future analyses. As a potential mechanism, conscientiousness elicits sensitized linear effects across nearly every single time phase during recurrent acute stress exposure. In the absence of habituation, recurrent exaggerated reactivity may cause damage to the tunica intima of the arteries, in turn causing a loss of elasticity over time. The resulting stiffness can lead to the development of arteriosclerosis and/or hypertension, especially before 45 years of age (Alpert & Wilson, 1992). Further research may aid in identifying high risk individuals in need of primary intervention strategies, such as reminder prompts for medication adherence, and flagging particular patients for future interventions. Acknowledging these key individual differences in reactivity to stress will help account for cardiovascular health outcomes across the lifespan and support an integrative approach to conscientiousness in predicting psychosomatic cardiovascular aetiology.
REFERENCES


References


113


References


References


References


References


References


References


References


References


# APPENDIX A

## Demography

**CONFIDENTIAL (ANONYMISED)**

Please try to complete all sections of this questionnaire.

**Date:** ______________

### SECTION A

<p>| | | | | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Age:</td>
<td>Height:</td>
<td>Weight:</td>
<td>Sex:</td>
<td></td>
</tr>
</tbody>
</table>

**A1. Handedness:**
- Left: ☐
- Right: ☐
- Ambidextrous: ☐

**A2. Diabetes?**
- Yes ☐
- No ☐

**A3. Do you smoke?**
- Yes ☐
- No ☐

**A3. If yes, how many per week?** ___________

**A3. Do you drink alcohol?**
- Yes ☐
- No ☐

**A4. If yes, how many per week?** ___________

**A5. Do you suffer from any heart-related condition?**
- Yes ☐
- No ☐

**A6. If yes, please describe:** ______________________________________________________

**A7. Are you on any medication?**
- Yes ☐
- No ☐

**A8. If yes, please describe:** ______________________________________________________

*If a smoker:

**A9. What time was your last cigarette?** ____________________________

**A10. What time did you last eat something?** ____________________________

**A11. What time did you last drink a caffeinated beverage?**

**A12. Do you have diagnosed Raynaud’s Syndrome or other diagnosed circulatory problems?**
- Yes ☐
- No ☐

**A13. If yes, please describe:** ______________________________________________________

### SECTION B

Please answer the questions below by marking the correct response as to how you feel right now about the TASKS you will be taking part in.

**Not at all** → → → → **Extremely**

<p>| | | | | | | | | | |</p>
<table>
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</tbody>
</table>

**B1. How stressed do you feel right now?**
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐

**B2. How calm do you feel right now?**
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
- ☐
**APPENDIX B**

**NEO-PI-R**

**Instructions:** Read each of the following statements that people have used to describe themselves and tick the appropriate box to indicate your agreement with them.

<table>
<thead>
<tr>
<th>ID#</th>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I am not a worrier</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2.</td>
<td>I really like most people I meet</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3.</td>
<td>I have a very active imagination</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4.</td>
<td>I tend to be cynical and sceptical of others’ intentions</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5.</td>
<td>I’m known for my prudence and common sense</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6.</td>
<td>I often get angry at the way people treat me</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7.</td>
<td>I shy away from crowds of people</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8.</td>
<td>Aesthetic and artistic concerns aren’t very important to me</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>9.</td>
<td>I’m not crafty or sly</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>10.</td>
<td>I would rather keep my options open than plan everything in advance</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>11.</td>
<td>I rarely feel lonely or blue</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>12.</td>
<td>I am dominant, forceful, and assertive</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>13.</td>
<td>Without strong emotions, life would be uninteresting to me</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>14.</td>
<td>Some people think I’m selfish and egotistical</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>15.</td>
<td>I try to perform all the tasks assigned to me conscientiously</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>16.</td>
<td>In dealing with other people, I always dread making a social blunder</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>17.</td>
<td>I have a leisurely style in work and play</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>18.</td>
<td>I am pretty set in my ways</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>19.</td>
<td>I would rather cooperate with others than compete with them</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>20.</td>
<td>I am easy going and lackadaisical</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>21.</td>
<td>I rarely overindulge in anything</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<td>☐</td>
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<tr>
<td>22.</td>
<td>I often crave excitement</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>23.</td>
<td>I often enjoy playing with theories or abstract ideas</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>24.</td>
<td>I don’t mind bragging about my talents and accomplishments</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>25.</td>
<td>I am pretty good about pacing myself so as to get things done on time</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>26.</td>
<td>I often feel helpless and want someone else to solve my problems</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>27.</td>
<td>I have never literally jumped for joy</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<td>28.</td>
<td>I believe letting students hear controversial speakers can only confuse and mislead them</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>29.</td>
<td>I think political leaders need to be more aware of the human side of their policies.</td>
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<tr>
<td>30.</td>
<td>Over the years I have done some pretty stupid things</td>
<td>☐</td>
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<tr>
<td>31.</td>
<td>I am easily frightened</td>
<td>☐</td>
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<tr>
<td>32.</td>
<td>I don’t get much pleasure from chatting with people</td>
<td>☐</td>
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<td>33.</td>
<td>I try to keep all my thoughts directed along realistic lines and avoid flights of fancy</td>
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<tr>
<td>34.</td>
<td>I believe that most people are basically well-intentioned</td>
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<td>35.</td>
<td>I take civic duties like voting seriously</td>
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<tr>
<td>36.</td>
<td>I am an even-tempered person</td>
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<td>37.</td>
<td>I like to have a lot of people around me</td>
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<td>38.</td>
<td>I am sometimes completely absorbed in music I am listening to</td>
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<td>39.</td>
<td>If necessary, I am willing to manipulate people to get what I want</td>
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<td>40.</td>
<td>I keep my belongings neat and clean</td>
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<td>41.</td>
<td>Sometimes I feel completely worthless</td>
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<tr>
<td>42.</td>
<td>I sometimes fail to assert myself as much as I should</td>
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<td>43.</td>
<td>I rarely experience strong emotions</td>
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<td>44.</td>
<td>I try to be courteous to everyone I meet</td>
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<td>45.</td>
<td>Sometimes I’m not as dependable or reliable as I should be</td>
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<tr>
<td>46.</td>
<td>I seldom feel self-conscious when I am around people</td>
<td>☐</td>
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<td>47.</td>
<td>When I do things, I do them vigorously</td>
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<tr>
<td>48.</td>
<td>I think it’s interesting to learn and develop new hobbies</td>
<td>☐</td>
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<tr>
<td>49.</td>
<td>I can be sarcastic and biting when I need to be</td>
<td>☐</td>
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<td>50.</td>
<td>I have a clear set of goals and work towards them in an orderly fashion</td>
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<td>51.</td>
<td>I have trouble resisting my cravings</td>
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<tr>
<td>52.</td>
<td>I wouldn’t enjoy vacationing in Las Vegas</td>
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<tr>
<td>53.</td>
<td>I find philosophical arguments boring</td>
<td>☐</td>
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<tr>
<td>54.</td>
<td>I’d rather not talk about myself and my achievements</td>
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<tr>
<td>55.</td>
<td>I waste a lot of time before settling down to work</td>
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<tr>
<td>56.</td>
<td>I feel I am capable of coping with most of my problems</td>
<td>☐</td>
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<td>57.</td>
<td>I have sometimes experienced intense joy or ecstasy</td>
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<td>Strongly disagree</td>
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<td>58</td>
<td>I believe that laws and social policies should change to reflect the needs of a changing world</td>
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<td>59</td>
<td>I am hard-headed and tough-minded in my attitudes</td>
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<td>60</td>
<td>I think things through before coming to a decision</td>
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<tr>
<td>61</td>
<td>I rarely feel fearful or anxious</td>
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<tr>
<td>62</td>
<td>I am a warm and friendly person</td>
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<tr>
<td>63</td>
<td>I have an active fantasy life</td>
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<tr>
<td>64</td>
<td>I believe that most people will take advantage of you if you let them</td>
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<tr>
<td>65</td>
<td>I keep myself informed and usually make intelligent decisions</td>
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<tr>
<td>66</td>
<td>I am hot-blooded and quick-tempered</td>
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<td>67</td>
<td>I usually prefer to do things alone</td>
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<td>68</td>
<td>Watching ballet or modern dance bores me</td>
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<tr>
<td>69</td>
<td>I couldn’t bring myself to deceive anyone even if I wanted to</td>
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<tr>
<td>70</td>
<td>I am not a very methodical person</td>
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<tr>
<td>71</td>
<td>I am seldom sad or depressed</td>
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<tr>
<td>72</td>
<td>I have often been a leader of groups I have belonged to</td>
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<td>73</td>
<td>How I feel about things is important to me</td>
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<tr>
<td>74</td>
<td>Some people think of me as cold and calculating</td>
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<tr>
<td>75</td>
<td>I pay my debts promptly and in full</td>
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<td>76</td>
<td>At time I have been so ashamed I just wanted to hide.</td>
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<td>77</td>
<td>My work is likely to be slow but steady</td>
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<tr>
<td>78</td>
<td>Once I find the right way to do something, I stick to it</td>
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<td>79</td>
<td>I hesitate to express my anger even when it’s justified</td>
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<td>80</td>
<td>When I start a self-improvement program, I usually let it slide after a few days</td>
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<td>81</td>
<td>I have little difficulty resisting temptation</td>
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<tr>
<td>82</td>
<td>I have sometimes done things just for “kicks” or “thrills”</td>
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<tr>
<td>83</td>
<td>I enjoy solving problems or puzzles</td>
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<tr>
<td>84</td>
<td>I think I am better than most people</td>
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<tr>
<td>85</td>
<td>I am a productive person who always gets the job done</td>
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<td>86</td>
<td>When I am under a great deal of stress, sometimes I feel like I am going to pieces.</td>
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<tr>
<td>87</td>
<td>I am not a cheerful optimist</td>
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<td></td>
<td></td>
<td>Strongly disagree</td>
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<td>88.</td>
<td>I believe we should look to our religious authorities for decisions on moral issues</td>
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<tr>
<td>89.</td>
<td>I feel we can never do too much for the poor and elderly</td>
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<td>90.</td>
<td>Occasionally I act first and think later</td>
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<tr>
<td>91.</td>
<td>I often feel tense and jittery</td>
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<tr>
<td>92.</td>
<td>Many people think of me as somewhat cold and distant</td>
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<tr>
<td>93.</td>
<td>I don’t like to waste my time daydreaming</td>
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<td>94.</td>
<td>I think most of the people I deal with are honest and trustworthy</td>
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<td>95.</td>
<td>I often come into situations without being fully prepared</td>
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<tr>
<td>96.</td>
<td>I am not considered a touchy or temperamental person</td>
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<td>97.</td>
<td>I really feel the need for other people if I am by myself for long</td>
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<tr>
<td>98.</td>
<td>I am intrigued by the patterns I find in art and nature</td>
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<td>99.</td>
<td>I think being perfectly honest is a bad way to do business</td>
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<tr>
<td>100.</td>
<td>I like to keep everything in its place so I’ll know just where it is</td>
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<tr>
<td>101.</td>
<td>I have sometimes experienced a deep sense of guilt or sinfulness</td>
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<td>102.</td>
<td>In meetings, I usually let others do the talking</td>
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<td>103.</td>
<td>I seldom pay much attention to my feelings of the moment</td>
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<td>104.</td>
<td>I generally try to be thoughtful and considerate</td>
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<td>105.</td>
<td>Sometimes I cheat when I play solitaire</td>
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<td>106.</td>
<td>It doesn’t embarrass me too much if people ridicule and tease me</td>
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<td>107.</td>
<td>I often feel as if I am bursting with energy</td>
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<td>108.</td>
<td>I often try new and foreign foods</td>
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<td>109.</td>
<td>If I don’t like people, I let them know it</td>
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<td>110.</td>
<td>I work hard to accomplish my goals</td>
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<td>111.</td>
<td>When I am having my favourite foods, I tend to eat too much</td>
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<td>112.</td>
<td>I tend to avoid movies that are shocking or scary</td>
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<td>113.</td>
<td>I sometimes lose interest when people talk about very abstract, theoretical matters</td>
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<td>114.</td>
<td>I try to be humble</td>
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<td>115.</td>
<td>I have trouble making myself do what I should</td>
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<td>116.</td>
<td>I keep a cool head in emergencies</td>
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<td>117.</td>
<td>Sometimes I bubble with happiness</td>
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<td></td>
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<tr>
<td>118</td>
<td>I believe that the different ideas of right and wrong that people in other societies have may be valid for them</td>
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<td>119</td>
<td>I have no sympathy for panhandlers</td>
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<tr>
<td>120</td>
<td>I always consider the consequences before I take action</td>
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<td>121</td>
<td>I am seldom apprehensive about the future</td>
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<tr>
<td>122</td>
<td>I really enjoy talking to people</td>
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<td>123</td>
<td>I enjoy concentrating on a fantasy or daydream and exploring all its possibilities, letting it grow and develop</td>
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<td>124</td>
<td>I am suspicious when someone does something nice for me</td>
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<td>125</td>
<td>I pride myself on my sound judgment</td>
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<tr>
<td>126</td>
<td>I often get disgusted with people I have to deal with</td>
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<tr>
<td>127</td>
<td>I prefer jobs that let me work alone without being bothered by other people</td>
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<tr>
<td>128</td>
<td>Poetry has little or no effect on me</td>
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<tr>
<td>129</td>
<td>I would hate to be thought of as a hypocrite</td>
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<td>130</td>
<td>I never seem to be able to get organized</td>
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<tr>
<td>131</td>
<td>I tend to blame myself when anything goes wrong</td>
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<td>132</td>
<td>Other people often look to me to make decisions</td>
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<tr>
<td>133</td>
<td>I experience a wide range of emotions or feelings</td>
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<td>134</td>
<td>I’m not known for my generosity</td>
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<td>135</td>
<td>When I make a commitment, I can always be counted on to follow through</td>
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<td>136</td>
<td>I often feel inferior to others</td>
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<td>137</td>
<td>I am not as quick and lively as other people</td>
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<tr>
<td>138</td>
<td>I prefer to spend my time in familiar surroundings</td>
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<td>139</td>
<td>When I have been insulted, I just try to forgive and forget</td>
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<td>140</td>
<td>I don’t feel like I’m driven to get ahead</td>
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<td>141</td>
<td>I seldom give in to my impulses</td>
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<tr>
<td>142</td>
<td>I like to be where the action is</td>
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<tr>
<td>143</td>
<td>I enjoy working on “mind-twister” --type activities</td>
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<td>144</td>
<td>I have a very high opinion of myself</td>
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<td>145</td>
<td>Once I start a project, I almost always finish it</td>
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<td>146</td>
<td>It’s often hard for me to make up my mind</td>
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<td></td>
<td></td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
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<td>147.</td>
<td>I am not especially “light-hearted”</td>
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<tr>
<td>148.</td>
<td>I believe that loyalty to one’s ideals and principles is more important than “open-mindedness”</td>
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<td>149.</td>
<td>I believe that human need should always take priority over economic considerations</td>
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<td>150.</td>
<td>I often do things on the spur of the moment</td>
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<td>151.</td>
<td>I often worry about things that might go wrong</td>
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<td>152.</td>
<td>I find it easy to smile and be outgoing with strangers</td>
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<td>153.</td>
<td>If I feel my mind starting to drift off into daydreams, I usually get busy and start concentrating on some work or activity instead</td>
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<td>154.</td>
<td>My first reaction is to trust people</td>
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<td>155.</td>
<td>I don’t seem to be completely successful at anything</td>
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<td>156.</td>
<td>It takes a lot to get me mad</td>
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<td>157.</td>
<td>I’d rather vacation at a popular beach than an isolated cabin in the wood</td>
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<td>158.</td>
<td>Certain kinds of music have an endless fascination for me</td>
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<td>159.</td>
<td>Sometimes I trick people into doing what I want</td>
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<td>160.</td>
<td>I tend to be somewhat fastidious or exacting</td>
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<td>161.</td>
<td>I have a low opinion of myself</td>
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<td>162.</td>
<td>I would rather go my own way than be a leader of others</td>
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<td>163.</td>
<td>I seldom notice the moods or feelings that different environments produce</td>
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<td>164.</td>
<td>Most people I know like me</td>
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<td>165.</td>
<td>I adhere strictly to my ethical principles</td>
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<td>166.</td>
<td>I feel comfortable in the presence of my bosses or other authorities</td>
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<td>167.</td>
<td>I usually seem to be in a hurry</td>
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<td>168.</td>
<td>Sometimes I make changes around the house just to try something different</td>
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<td>169.</td>
<td>If someone starts a fight, I am ready to fight back</td>
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<td>170.</td>
<td>I strive to achieve all I can</td>
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<td>171.</td>
<td>I sometimes eat myself sick</td>
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<td>172.</td>
<td>I love the excitement of roller coasters</td>
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<td>173.</td>
<td>I have little interest in speculating on the nature of the universe or the human condition</td>
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<td>174.</td>
<td>I feel that I am no better than others, no matter what their condition</td>
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<td>175.</td>
<td>When a project gets too difficult, I’m inclined to start a new one</td>
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<td>176.</td>
<td>I can handle myself pretty well in a crisis</td>
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<td>177.</td>
<td>I am a cheerful, high-spirited person</td>
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<td>178.</td>
<td>I consider myself broad-minded and tolerant of other people’s lifestyles</td>
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<td>179.</td>
<td>I believe all human being are worthy of respect</td>
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<td>180.</td>
<td>I rarely make hasty decisions</td>
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<td>181.</td>
<td>I have fewer fears than most people</td>
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<td>182.</td>
<td>I have strong emotional attachments to my friends</td>
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<td>183.</td>
<td>As a child I rarely enjoyed games of make believe</td>
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<td>184.</td>
<td>I tend to assume the best about people</td>
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<td>185.</td>
<td>I’m a very competent person</td>
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<td>186.</td>
<td>At times I have felt bitter and resentful</td>
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<td>187.</td>
<td>Social gatherings are usually boring to me</td>
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<td>188.</td>
<td>Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement</td>
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<td>189.</td>
<td>At times I bully or flatter people into doing what I want them to</td>
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<td>190.</td>
<td>I’m not compulsive about cleaning</td>
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<td>191.</td>
<td>Sometimes things look pretty bleak and hopeless to me</td>
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<td>192.</td>
<td>In conversations, I tend to do most of the talking</td>
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<td>193.</td>
<td>I find it easy to empathize – to feel myself what others are feeling</td>
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<td>194.</td>
<td>I think of myself as a charitable person</td>
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<td>195.</td>
<td>I try to do jobs carefully, so they won’t have to be done again</td>
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<td>196.</td>
<td>If I have said or done the wrong thing to someone, I can hardly bear to face them again</td>
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<td>197.</td>
<td>My life is fast-paced</td>
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<td>198.</td>
<td>On a vacation, I prefer going back to a tried and true spot</td>
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<td>199.</td>
<td>I’m hard-headed and stubborn</td>
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<td>200.</td>
<td>I strive for excellence in everything I do</td>
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<td>201.</td>
<td>Sometimes I do things on impulse that I later regret</td>
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<td>202.</td>
<td>I’m attracted to bright colours and flashy styles</td>
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<td>203.</td>
<td>I have a lot of intellectual curiosity</td>
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<td><strong>204.</strong></td>
<td>I would rather praise others than be praised myself</td>
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<td><strong>205.</strong></td>
<td>There are so many little jobs that need to be done that I sometimes just ignore them all</td>
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<td><strong>206.</strong></td>
<td>When everything seems to be going wrong, I can still make good decisions</td>
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<td><strong>207.</strong></td>
<td>I rarely use words like “fantastic!” or “sensational!” to describe my experiences</td>
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<td><strong>208.</strong></td>
<td>I think that if people don’t know what they believe in by the time they’re 25, there’s something wrong with them</td>
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<td><strong>209.</strong></td>
<td>I have sympathy for others less fortunate than me</td>
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<td><strong>210.</strong></td>
<td>I plan ahead carefully when I go on a trip</td>
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<td><strong>211.</strong></td>
<td>Frightening thoughts sometimes come into my head</td>
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<td><strong>212.</strong></td>
<td>I take a personal interest in the people I work with</td>
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<td><strong>213.</strong></td>
<td>I would have difficulty just letting my mind wander without control or guidance</td>
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<td><strong>214.</strong></td>
<td>I have a good deal of faith in human nature</td>
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<td><strong>215.</strong></td>
<td>I am efficient and effective at my work</td>
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<td><strong>216.</strong></td>
<td>Even minor annoyances can be frustrating to me</td>
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<td><strong>217.</strong></td>
<td>I enjoy parties with lots of people</td>
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<td><strong>218.</strong></td>
<td>I enjoy reading poetry that emphasizes feelings and images more than story lines</td>
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<td><strong>219.</strong></td>
<td>I pride myself on my shrewdness in handling people</td>
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<td><strong>220.</strong></td>
<td>I spend a lot of time looking for things I’ve misplaced</td>
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<td><strong>221.</strong></td>
<td>Too often, when things go wrong, I get discouraged and feel like giving up</td>
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<td><strong>222.</strong></td>
<td>I don’t find it easy to take charge of a situation</td>
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<td><strong>223.</strong></td>
<td>Odd things – like certain scents or the names of distant places – can evoke strong moods in me</td>
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<td><strong>224.</strong></td>
<td>I go out of my way to help others if I can</td>
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<td><strong>225.</strong></td>
<td>I’d really have to be sick before I’d miss a day of work</td>
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<td><strong>226.</strong></td>
<td>When people I know do foolish things, I get embarrassed for them</td>
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<td><strong>227.</strong></td>
<td>I am a very active person</td>
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<td><strong>228.</strong></td>
<td>I follow the same route when I go someplace</td>
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<td><strong>229.</strong></td>
<td>I often get into arguments with my family and co-workers</td>
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<td><strong>230.</strong></td>
<td>I’m something of a “workaholic”</td>
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<td><strong>231.</strong></td>
<td>I’m always able to keep my feelings under control</td>
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<td><strong>232.</strong></td>
<td>I like being part of the crowd at sporting events</td>
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<td></td>
<td>Statement</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>----------</td>
<td>---------</td>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>233.</td>
<td>I have a wide range of intellectual interests</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>234.</td>
<td>I think I am a superior person</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>235.</td>
<td>I have a lot of self-discipline</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>236.</td>
<td>I’m pretty stable emotionally</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>237.</td>
<td>I laugh easily</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>238.</td>
<td>I believe that the “new morality” of permissiveness is no morality at all</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>239.</td>
<td>I would rather be known as “merciful” than as “just”</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>240.</td>
<td>I think twice before I answer a question</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
### APPENDIX C

**Short Rating Scale Questions**

Please answer the questions below by marking the correct response as to how you feel *right now* about the **TASKS** you will be taking part in.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Not at all</th>
<th>→</th>
<th>→</th>
<th>→</th>
<th>Extremely</th>
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<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td><strong>B1.</strong></td>
<td>How stressed do you feel right now?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>B2.</strong></td>
<td>How calm do you feel right now?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>B3.</strong></td>
<td>How stressful did you find the study?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><strong>B4.</strong></td>
<td>Should I repeat these tasks again, how stressed would I feel?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
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</table>
APPENDIX D

Self-Evaluation Questionnaire Form Y-1 (Part 1)

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

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<thead>
<tr>
<th></th>
<th>Statement</th>
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<th>Somewhat</th>
<th>Moderately So</th>
<th>Very Much So</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I feel calm…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I feel secure…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I am tense…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I feel strained…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I feel at ease…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I feel upset…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I am presently worrying over possible misfortunes…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I feel satisfied…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I feel frightened…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>I feel comfortable…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>I feel self-confident…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>I feel nervous…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>I am jittery…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>I feel indecisive…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>I am relaxed…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>I feel content…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>I am worried…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>I feel confused…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>I feel steady…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>I feel pleasant…</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Self-Evaluation Questionnaire Form Y-1 (Part 2)
Directions: A number of statements which people have used to describe themselves are given below. Read each statement and then tick in the appropriate box to the right of the statement to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Somewhat</th>
<th>Moderately So</th>
<th>Very Much So</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.</td>
<td>I feel pleasant…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>22.</td>
<td>I feel nervous and restless…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>23.</td>
<td>I feel satisfied with myself…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>24.</td>
<td>I wish I could be as happy as others seem to be…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>25.</td>
<td>I feel like a failure…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>26.</td>
<td>I feel rested…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>27.</td>
<td>I am “calm, cool, and collected”…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>28.</td>
<td>I feel that difficulties are piling up so that I cannot overcome them…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>29.</td>
<td>I worry too much over something that really doesn’t matter…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>30.</td>
<td>I am happy…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>31.</td>
<td>I have disturbing thoughts…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>32.</td>
<td>I lack self-confidence…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>33.</td>
<td>I feel secure…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>34.</td>
<td>I make decisions easily…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>35.</td>
<td>I feel inadequate…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>36.</td>
<td>I am content…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>37.</td>
<td>Some unimportant thought runs through my mind and bothers me…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>38.</td>
<td>I take disappointments so keenly that I can’t put them out of my mind…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>39.</td>
<td>I am a steady person…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>40.</td>
<td>I get in a state of tension or turmoil as I think over my recent concerns and interests…</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
APPENDIX E

Participant Information Sheet

Personality and Blood Pressure Study

You are invited to take part in a research study. Before you decide, it is important that you understand why the research is being done and what it will involve. This Participant Information Sheet tells you about the purpose, risks and benefits of this research study. If you agree to take part, we will ask you to sign a Consent Form. If there is anything that you are not clear about, we will be happy to explain it to you. Please take as much time as you need to read this information. You should only consent to participate in this research study when you feel you understand what is being asked of you, and you have had enough time to think about your decision. Thank you for reading this.

Purpose of the Study
This study is concerned with the impact of personality on an individual’s response to stress. Psychophysiological research suggests that different personalities respond differently when presented with various tasks. However, we cannot inform you of the complete purpose of the study as it may influence your performance on the tasks. We will ask you to complete a number of tasks while your heart rate will be monitored. This study will last approximately 50 minutes.

Taking Part – What this Study Involves

Do I have to take part?
It is up to you to decide whether or not to take part. If you do decide to take part you will be given this Information Sheet to keep and be asked to sign a Consent Form. If you decide to take part you are still free to withdraw at any time and without reason or consequence.

If you decide you would like to take part, you have the option of participating immediately or alternatively arranging a later time in which to participate. If you wish to defer your decision for 24 hours or longer, we can arrange to contact you. Alternatively, if you prefer, I will give you my contact details, and you can contact me if you wish to take part. At that point, you can decide to take part or to decline. It is completely up to you.

What will happen to me if I take part?
If you decide you would like to take part, your participation in this study will take approximately 50 minutes in total. During your participation you will be required to complete a series of questionnaires followed by completing a series of stressor tasks, and your heart rate will be monitored. The task will constitute an arithmetic task which you will be required to perform aloud.

What are the possible benefits in taking part?
You will receive a total of an hour’s worth of credit towards the research participation credit you require for your undergraduate Psychology course. Furthermore, with participating in this study, you will also be able to learn more regarding your own blood pressure level.

What are the possible disadvantages and risks of taking part?
This study will include a questionnaire that will include questions regarding your well-being. You may find, while you are answering it, that you would like to talk to someone about some of the issues it may raise. We will be happy to recommend someone to you.

What happens at the end of the study?
When all participants have been tested (this should be within 12 months of your participation), we can send you an overall summary of our main findings. While it may be up to two years until final results are published, we would be pleased to include you on an email address list to receive publications arising from the study. Only general findings will be reported, without any reference in which to identify individual results.

What happens if I change my mind during the study?
Your participation is voluntary, and you are free to withdraw at any time without giving any reason and without any consequences.

Who do I contact for more information or if I have further concerns?
If you would like further information, please contact the researcher in the first instance.

Amanda Sesker
PhD Candidate, School of Psychology
National University of Ireland, Galway
University Road
Galway
PH: 087 714-2445
a.sesker1@nuigalway.ie

Prof Brian Hughes
School of Psychology
National University of Ireland, Galway
University Road
PH: 091 493568
brian.hughes@nuigalway.ie

Dr. Siobhán Howard
School of Psychology
Mary Immaculate College,
South Circular Road
Limerick
PH: 061 204533
siobhan.howard@mic.ul.ie

Otherwise if you have any concerns about this study and wish to contact a different individual in confidence, you may contact: The Head of Psychology, School of Psychology, National University of Ireland, Galway.
APPENDIX F

Participant Consent Form

Personality and Blood Pressure during Challenging Tasks

Researchers: Amanda Sesker, Prof. Brian Hughes & Dr. Siobhán Howard

Please check box

1. I confirm that I have read the information sheet for the above study and have had the opportunity to ask questions.

2. I am satisfied that I understand the information provided and have had enough time to consider the information.

3. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected.

4. I agree to take part in the above study.

________________________                    ________________                    ________________
Name of Participant                  Date                              Signature

________________________                    ________________                    ________________
Name of Participant                  Date                              Signature

1 copy for participant; 1 copy for researcher; 1 copy to be kept with research notes
APPENDIX G

Research Ethics Approval

28th July 2015

Dear Ms Sesker

Ref: Ethics Application – Conscientiousness and Cardiovascular Reactivity to Recurrent Acute Stress

I write to you regarding the above proposal which was submitted for Ethical review. Having reviewed your response to my letter, I am pleased to inform you that your proposal has been granted APPROVAL.

All NUI Galway Research Ethic Committee approval is given subject to the Principal Investigator submitting annual and final statements of compliance. The first statement is due on or before 30th January 2016. Please see section 7 of the REC’s Standard Operating Procedures for further details which also includes other instances where you are required to report to the REC.

Yours Sincerely

Allyn Fives

Chair, Research Ethics Committee
Annual Statement of Compliance

Name: __Amanda Sesker__

Project Title: Conscientiousness and Cardiovascular Reactivity to Recurrent Acute Stress

Research Ethic Reference: __14 – Nov - 02______________

I confirm that the above referenced project (including any amendments hereto) has been carried out in accordance with the approval of the Research Ethics Committee (REC) at the National University of Ireland, Galway

PI signature ________________________________

Date __23rd July, 2015________________________
Study Protocol Amendments (Study 3)

The study will take place in a designated laboratory within the Psychology Building at the National University of Ireland, Galway. In order to account for variations in the Conscientiousness trait, approximately 60 1st and 2nd year female students, ages 17-25, will be recruited from the undergraduate population of NUI Galway through the School of Psychology online computer system (Sona Systems). The details of this study will be communicated to students directly during tutorials, at lectures, in their student handbook, and on the NUI Galway Psychology website. Participants will be required to give full informed consent (Appendix B) in order to participate. Participants who have no competence in the English language, have a history of heart related illnesses, as well as those who are taking any form of medication known to have a direct effect on cardiovascular responses, will be excluded from the present study.

The participants will be greeted by the researcher and have their height and weight calculated within the laboratory. They will then be seated in a comfortable chair with an arm support within the experimental laboratory, and be required to give fully-informed consent prior to commencement of testing (see Appendix A & B) and fill out a participant information form (see Appendix D). At the beginning of each session, each participant will be presented with psychometric and physiological measures (including the NEO-PI-R; see Appendix D, E, F, G, H, & I) which will be required to be completed. The participants will be reminded that they can withdraw from the study at any time without penalty or consequence. The Finometer will be attached to the participant’s middle finger of their non-dominant hand. Participants will then be given 25 min. to acclimatize to the laboratory environment, during which their acclimation activity will be monitored and recorded. Reading material will also be supplied in order to facilitate genuine relaxation and the establishment of cardiovascular baselines. The reading material will be pre-screened for emotive content. All participants will be allocated to one group. The group will be required to complete the exact same stressor task three times. Participants will be instructed that they will be monitored via webcam and evaluated based on their arithmetic performance during the laboratory session.

Following the acclimatization period, formal baseline measures will be assessed over a 3 min. resting period. Prior to beginning the initial stressor task, each participant will be required to complete a series of Likert scales which will assess anticipatory stress prior to beginning the series of tasks (see Appendix J). Participants will then be required to complete a 3 min. verbal mental arithmetic task. During the task, each participant will be required to serially subtract aloud in increments of 7, from the number 4,170. This is merely used to illicit a stress response, and whether the subtractions are correct are of no relevance. The 3 min. task will then be followed by a 3 min. inter-task resting period and then by a second and third 3 min. re-exposure to the exact same task. Beat-by-beat cardiovascular parameters will be recorded automatically throughout the procedure, and will later be averaged to produce minute-level readings. Throughout the experiment the researcher will be situated behind an opaque screen. On completion of the task, each participant will again be required to complete a series of Likert scales to rate perceived stress experienced during the tasks (see Appendix K). Participants will be partially debriefed following completion of the laboratory session, with full debriefing completed following data collation (see Appendix L).
APPENDIX 4: Annual Statement of Compliance

Name: Amanda Sesker

Project Title: Consciousness and Cardiovascular Reactivity to Recurrent Acute Stress

Research Ethic Reference: ___________________________

I confirm that the above referenced project (including any amendments hereto) has been carried out in accordance with the approval of the Research Ethics Committee (REC) at the National University of Ireland, Galway

PI signature: ___________________________
Date: 9/5/2016
APPENDIX 5: Final Statement of Compliance

Name: Amanda Sesker

Project Title: Consciousness and Cardiovascular Reactivity to Recurrent Acute Stress

Research Ethic Reference: 14-Nov-02

I confirm that the above referenced project (including any amendments hereto) has been carried out in accordance with the approval of the Research Ethics Committee (REC) at the National University of Ireland, Galway.

PI signature

Date: 11-7-2017 (July)
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<tr>
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<td>Amanda A. Sesker, Páraic Ó Súilleabháin, Siobhán Howard, Brian M. Hughes</td>
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<td>Expected completion date</td>
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<td>Requestor Location</td>
<td>Ms. Amanda Sesker 45 Whitestrand Road</td>
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Galway, Galway H91 FV38
Ireland
Attn: Ms. Amanda Sesker

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Appendix H

Galway, Ireland H91 FV38
Attn: Ms. Amanda Sesker

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v1.10 Last updated September 2015

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