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Self-Control, Nonattachment, And Cardiovascular Functioning: The Effects Of Self-Control And Nonattachment On Cardiovascular Responses To Stress

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SELF-CONTROL, NONATTACHMENT, AND CARDIOVASCULAR FUNCTIONING: THE EFFECTS OF SELF-CONTROL AND NONATTACHMENT ON CARDIOVASCULAR RESPONSES TO STRESS

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ABSTRACT

Cardiovascular Disease (CVD) is the leading cause of death globally and creates a large economic burden on society, through cost of treatment and missed workdays (Center for Disease Control and Prevention [CDC], 2022). The body of research examining factors contributing to the development and exacerbation of CVD primarily focused on identifying biological factors until the development of George Engel's biopsychosocial model in the 1970s (Engel, 1977). Researchers then turned to identifying psychosocial factors contributing to CVD, particularly in the context of identifying modifiable psychosocial factors. Trait self-control and nonattachment are two psychosocial constructs that have been associated with positive outcomes (physical health, mental health, behavior regulation, emotion regulation, and interpersonal relationships) (de Ridder et al., 2012; Kemeny et al., 2011; Ritchie et al., 2016; Stavorva et al., 2020; Tangney et al., 2004). However, their impact on CVD is less understood. The stress reactivity hypothesis (Cohen & Manuck, 1995) provides an ideal framework to examine the effects of psychosocial factors on cardiovascular health by means of observing the influence of psychosocial factors on cardiovascular responses to stress. The goal of the present study was to examine the relationship between trait self-control, nonattachment, and cardiovascular health, by identifying the influence trait self-control and nonattachment have on cardiovascular responses to stress. It was expected that individuals possessing higher levels of trait self-control and nonattachment would demonstrate more adaptable cardiovascular responses to stress compared to those with lower levels. These hypothesized relationships were not found. However, exploratory analyses examining cardiovascular differences between race/ethnicity revealed support for the cardiovascular conundrum. The implications of the present findings for future clinical research and treatment implications are discussed.

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CHAPTER 1

Introduction

Cardiovascular disease (CVD) is the leading cause of death globally. Examples of CVD include coronary artery disease, cardiomyopathy, atrial fibrillation, and peripheral artery disease. According to the American Heart Association, nearly 19.1 million people died in 2020 globally from a form of CVD, which accounted for 30 percent of all deaths worldwide. Geographical regions accounting for the highest rates of CVD-related deaths include Eastern Europe, Central Asia, Oceania, North Africa, the Middle East, Central Europe, sub-Saharan Africa, and South and Southeast Asia. The lowest rates of CVD deaths exist in higher socioeconomic areas, including Asia Pacific, North America, Latin America, Western Europe, and Australasia (Tsao et al., 2022). In the United States, approximately 697,000 people died from heart disease in 2020, accounting for twenty percent of total deaths in the country (Center for Disease Control and Prevention [CDC], 2022).

Due to the high prevalence rates of CVD, it has been one of the largest economic burdens in the United States. Retrospective data suggests that CVDs cost the United States nearly 555 billion dollars in 2016, as a result of treatment costs and loss of productivity (American Heart Association, 2017). The economic burden of CVD is significantly more than any other disease. The American Heart Association predicts that by 2035, CVD will cost the United States 1.1 trillion dollars and nearly half of the population will have some form of CVD. Despite the alarming number of deaths caused by CVD and its economic burden on the United States, the National Institute of Health (NIH) spends only 7 percent of its budget (4 percent on heart disease, 1 percent on stroke, and 2 percent on “Other” research) on CVD research. Furthermore,

only a portion of this research is committed to understanding the psychosocial characteristics associated with the development or exacerbation of heart disease.

Despite the relatively low level of public research funding focused on studying psychosocial factors associated with CVD, research dating back to the 1970s has documented the correlations among psychosocial characteristics and heart disease (Johns, 1975; Siltanen et al., 1975). This research coincided with the development of a new perspective on health and disease – the biopsychosocial model (Engel, 1977). Engel proposed that mental health treatment, psychiatry in particular, gradually became more opinion-focused rather than empirically-based. Therefore, he suggested a new model through which health should be viewed, the biopsychosocial model (Engel, 1977, 1980). Engel's primary concern with the previously used medical model, or the biomedical model, was that it viewed disease as entirely somatic and disregarded the impact of psychosocial factors influencing health. As a result, many medical providers believed they should not concern themselves with psychosocial factors of illness, as these characteristics were not considered a part of medicine. Overall, this strengthened their belief that they should focus solely on somatic processes or matters organic in nature. Engel's newly proposed biopsychosocial model posited that in order to fully comprehend and provide adequate treatment for a disease, one must consider the different ways biological, social and psychological factors contribute to the development and maintenance of a disease (Engel, 1977; Engel, 1980). Engel's biopsychosocial paradigm provides a framework to research cardiovascular disease, which is necessary given its scope and impact on society.

Therefore, in order to fully comprehend and provide adequate treatment for CVD, one must first consider the psychosocial factors that contribute to the development and maintenance of CVD. Previous research has indicated that several psychosocial risk factors are associated

with the development of CVD, including dietary factors (e.g., excessive intake of saturated fats and sodium, obesity, excessive alcohol intake), tobacco use, a sedentary lifestyle, and potentially, Type A personality (Lim et al., 2012; Petticrew et al., 2012; Sahoo et al., 2018; Yusuf et al., 2004). Specifically, these behavioral factors increase the likelihood of developing hypertension, which is a significant risk factor for coronary artery disease and acute myocardial infarctions (Lim et al., 2012; Yusuf et al., 2004). Identifying psychosocial variables associated with blood pressure and heart rate can contribute to increasing the understanding of the development of CVD and also provide valuable information for CVD prevention and treatment, by means of identifying modifiable psychological, behavioral, and social risk factors for CVD. Previous research has identified several modifiable psychosocial variables related to heart disease, including depression, anxiety, anger, hostility, repeated emotional stress, socioeconomic status (including income, education, and occupation), overall psychological well-being (optimism, life satisfaction, emotional vitality, and emotion regulation), and social support (emotional, informational, and instrumental) (Cuevas et al., 2017; Meng et al., 2012; Pan et al., 2015).

Now that many of these psychosocial variables have been identified, research efforts have turned to understanding mechanisms or pathways by which these psychosocial variables influence the development and maintenance of CVD. One mechanism by which psychosocial variables contribute to heart disease is through maladaptive stress responses. Research has found that personality characteristics account for a portion of the variance of an individual's response to stress, including exposure to stress, severity of stress experienced, and physiological and emotional reactivity to stress. Regarding psychophysiological responses to stress, the duration of time it takes to recover from stress, as well as the degree to which there is adequate restoration during and after stressful events, may differ between individuals (Williams et al., 2011). The

expanded stress reactivity hypothesis seeks to explain the effects of stress on health and . Specifically, this hypothesis posits that individuals differ in the extent to which they are exposed to stress, initial psychophysiological reactivity to stress, recovery from the effects of stress, and restorative processes (Williams et al., 2011). Taken together, it seems likely that individual differences in personality can influence exposure, reactivity, recovery, and restorative processes involved in the stress response, which ultimately contribute to CVD.

In terms of exposure to stress, it is believed that individuals do not randomly encounter stressful events in their lives. Rather, the frequency of stressful events encountered is partially influenced by aspects of personality. Research utilizing the Five Factor Model of personality as a paradigm suggests that individuals high in neuroticism (i.e., facets including anxiety, anger, hostility, depression, self-consciousness, impulsiveness, and vulnerability) think, feel, and behave in a manner that leads to higher exposure to stress (perceived or real) compared to individuals low in these personality characteristics (Williams et al., 2011).

Similarly, physiological reactivity is another component of the stress response that is believed to be affected by personality, and when maladaptive, can lead to deleterious physical health outcomes and possibly contribute to CVD. Stress reactivity includes an individual's autonomic response (e.g., sympathetic activation) to a potentially stressful (perceived or real) situation (Williams et al., 2011). Stress reactivity encompasses the individual's perception of the situation, subjective discomfort, and physiological arousal. One's physiological arousal refers specifically to an increase in heart rate, blood pressure, and cortisol production, as well as changes in heart rate variability. According to Chida and Steptoe (2010), stress reactivity can lead to negative physical health outcomes such as CVD over extended periods of time.

Therefore, personality factors appear to bear a significant responsibility in terms of individual differences in the stress response, particularly during the exposure and reactivity processes.

In addition to the stress response, personality factors contribute to mood, which influences cardiovascular health (Kupper & Denollet, 2007). According to Pressman and colleagues (2013), negative mood in particular, which is influenced by personality characteristics, contributes to health problems. These findings were supported by Smith et al., (2004) who identified that individuals with high levels of negative affect, in the form of anger, hostility, and depression, demonstrate greater levels of activation of the sympathetic adrenomedullary system and hypothalamic-pituitary-adrenocortical axis when exposed to stress. Consequently, high levels of anxiety and neuroticism have been associated with increased hypothalamic-pituitary-adrenocortical axis reactivity as well (Carver et al., 2008). Specifically, chronic anxiety and depression, which are related to neuroticism, have been associated with a change in autonomic regulation of the cardiovascular system, which may impact the recovery component of the stress response process. The aforementioned traits of negative affect have been associated with enduring effects on the immune system as well (Williams et al., 2011).

In terms of cardiovascular reactivity, individuals with high levels of neuroticism may have a dramatically increased heart rate in response to a stressor due to heightened sympathetic activation; furthermore, their heart rate variability (i.e., the variation in the time period between each heartbeat) may decrease, which can have a negative impact on cardiovascular functioning (Williams et al., 2011). The relationship between neuroticism and decreased heart rate variability as a result of stress is thought to be explained by an altered autonomic regulation of the cardiovascular system, which may be expressed as poorer cardiovascular recovery from stress (Berntson & Cacioppo, 2004). Typically, greater heart rate variability in response to stress

suggests enhanced cardiovascular health because a person is demonstrating self-regulatory capacity (i.e., a balance between sympathetic and parasympathetic processes). Alternatively, individuals with lower heart rate variability in response to stress may be experiencing parasympathetic withdrawal and their heart rate is chronically fast, suggesting less variability. The cardiovascular activity associated with high levels of neuroticism is thought to be a function of poorer cardiovascular health in the form of less effective autonomic regulation, as manifested by poorer cardiovascular recovery from stress.

Reactivity recovery refers to how long it takes for an individual to return to emotional and physiological baseline after being exposed to a stressor. It has been posited that recovery from stress may play as significant a role as initial stress reactivity in the development of cardiovascular disease, especially in terms of increased blood pressure (Brosschot et al., 2006; Mosely & Linden, 2006). Carver et al. (2008) found that individuals high in neuroticism recover at a slower rate compared to individuals with lower levels of neuroticism. Other individual difference variables such as trait anger are also associated with slower recovery to baseline levels of blood pressure when exposed to stress (Quinn et al., 2014). Rumination is an example of another individual difference variable that has been associated with slower recovery to baseline levels of blood pressure when exposed to stress (Radstaak et al., 2011). Individuals engaging in rumination tend to hyper focus on their distress repeatedly, in a manner that is not solution based, which is thought to prevent blood pressure from returning to normative levels following exposure to stress.

The final stage of the stress response process is called restoration. Restoration describes the process of when the body's functions aim to "refresh, buttress, and repair various forms of cellular damage," (Williams et al., 2011, p.239) after functioning has been disrupted by stress. A

common example of a restoration process in response to stress is sleep. Sleep deprivation has been associated with decreased immune function, various forms of mortality, and impaired emotional regulation and cognitive functioning, which influences how individuals react to, and recover from, stress (Lange et al., 2003, Williams et al., 2011). Personality characteristics likely influence the restorative process.

The stress response, and the stress reactivity hypothesis, provide a unique paradigm for psychological researchers to examine the influence of psychosocial variables on cardiovascular health. Trait self-control and nonattachment are two empirically supported, salubrious variables (Daly et al., 2014; Kemeny et al., 2012; Ritchie et al., 2016). Nonattachment has been defined as a nonrigid, balanced manner of relating to experiences, absent of grasping and suppressing (Sahdra et al., 2016). To provide a few examples, trait self-control has been associated with healthy eating behaviors, increased levels of exercise, and emotional stability (Daly et al., 2014; Li et al., 2022). Whereas nonattachment has been associated with social competence, task leadership, and emotional stability (Sahdra et al., 2016). A more detailed review covering the array of positive associations with these variables is provided within the literature review. The current study sought to examine the influence of trait self-control and nonattachment on the cardiovascular response to stress.

CHAPTER 2

Literature Review

Cardiovascular Disease

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in the United States, and there are tremendous costs associated with the disease. A great deal of research has been conducted to identify the causes and correlates of CVD to prevent and effectively treat these conditions. The biomedical approach to healthcare has resulted in significant advances in heart disease treatment. For example, specific coronary care units in hospitals were developed in the early 1960's resulting in greater recovery and lower mortality from CVD. In fact, prior to the advent of coronary care units, 30% of individuals admitted to a hospital due to a myocardial infarction would die while hospitalized. With the development of these specific hospital units dedicated to heart care, the risk of death dropped to 15% (Nabel & Braunwald, 2012). By the mid-1990's, the risk of death in the hospital after an acute myocardial infarction was further decreased to 3% due to stent implantation and the use of blood thinners and thrombolytic agents (Grines et al., 1999). Coinciding with the above advances are drug therapies, perhaps the biggest of which was the discovery of statins in the 1980's (Endo, 2008) for the treatment of high cholesterol. Heart failure treatment has also considerably improved with advances in drug therapies, including the development of statins, beta-blockers, ACE inhibitors, and later, neprilysin inhibitors (Armstrong & Moe, 1993; McMurray et al., 2014).

With the average lifespan in the United States being 78.5 years, and 40% of individuals developing cardiovascular disease between the ages of 40 and 59 years old, people are living longer periods of their life dealing with chronic CVD (Rodgers et al., 2019). In addition to the above biomedical advances, there has been a greater appreciation of psychosocial factors

relevant to the prevention of heart disease, its pathogenesis, and its treatment. For example, Type A personality was the first psychosocial variable considered to be a risk factor of a major physical condition such as CVD (Rosenman et al., 1975). Other correlates of heart disease include depression, neuroticism, social isolation, loneliness, and job stress (Khayyam-Nekouei et al., 2013). Given that there are several psychosocial variables associated with heart disease, research has turned toward identifying mechanisms explaining the relationship between psychosocial variables and heart disease. These mechanisms range from indirect pathways (e.g., health behaviors) to direct pathways involving physiology. One such mechanism that has accumulated research evidence since the 1980's has been cardiovascular reactivity, which is commonly measured by heart rate variability (HRV).

Historically, HRV was utilized to detect stress in fetuses (Hon & Lee, 1963). Throughout the course of research, including the creation of the biopsychosocial model and its specific application to self-regulation and interaction, HRV has been increasingly accepted as an indicator of health. Furthermore, HRV is now commonly used to measure physiological variance in response to stress, as well as one's risk of developing CVD and mortality (Tsuji et al., 1996).

HRV refers to the fluctuation of the length of heartbeat intervals, and as a measure, HRV is sensitive to changes in autonomic system regulation of the heart rhythm. For example, the parasympathetic nervous system regulates the heartbeat when at rest, but when stressed, both the parasympathetic and sympathetic processes are operative. Therefore, one can examine changes in HRV in response to stress in which heart rate accelerates in comparison to a baseline period when the person is relaxed. In other words, there is a fluctuation of instantaneous heart rate over time. Originally, HRV was calculated manually by averaging the length of heartbeat intervals and examining the standard deviation with a smaller standard deviation reflecting lower HRV.

Though beyond the scope of this paper (see Balzarotti et al., 2017 for a review), HRV is now determined by examining the high frequency component of the electrocardiogram (ECG), which is synchronous with respiration (i.e., heart rate variability corresponding to the respiratory cycle frequency – a respiratory parameter associated with heart rate).

There is thought to be an optimal amount of HRV that reflects a person's capacity for self-regulation (McCraty et al., 2009). Optimal HRV is reflected by the various demands on a person that may require an increase in heartbeat (e.g., being threatened by someone) or decrease in heartbeat (e.g., relaxing with one's partner). This pattern indicates that the person has the regulatory capacity – reflected in his or her nervous system and heart functioning – to respond to internal and external circumstances. However, when a person is chronically stressed, or has been exposed to chronic stress, HRV decreases and is thought to place the person at risk of deleterious mental and physical health outcomes (Kemp, 2016). In experimental paradigms, exposing a participant to a stressor and measuring HRV in comparison to baseline can reveal a pattern of autonomic functioning that confers risk or resilience. Autonomic functioning that includes too much sympathetic activation leads to a shorter heart period reflecting lower HRV. Autonomic functioning with lower sympathetic activation and/or higher parasympathetic activation is associated with greater HRV. As such, examining how a person responds to a stressor can provide an indication of his or her overall pattern of HRV.

Studies examining HRV and emotion regulation have demonstrated that individuals possessing greater emotion regulation abilities also illustrate greater levels of HRV at rest. Additionally, studies have shown that during successful participation in emotion regulation tasks, HRV is increased (Thayer et al., 2010). Furthermore, Thayer and colleagues (2010) suggest that these relationships exist due to HRV's involvement in regulating emotions, such that HRV

reflects a similar process with emotions that it does with providing the body with environmentally appropriate blood flow in certain situations. This indicates that HRV facilitates emotional expression appropriate for environmental and situational demands (Thayer et al., 2010). Overall, HRV reflects the ability to self-regulate, and therefore, one would expect it to be associated with other constructs associated with self-regulation (i.e., self-control and mindfulness).

In sum, individual differences in personality impact several components of the stress response, which ultimately contribute to CVD. For example, neuroticism can play a role in increased exposure to stress, and individuals with high levels of negative affect demonstrate greater levels of cardiovascular reactivity in response to stress (Carver et al., 2008; Smith et al., 2004). The relationship between neuroticism and a decrease in HRV as a result of stress is thought to be explained by altered autonomic regulation of the cardiovascular system, which may be expressed as poorer cardiovascular recovery from stress (Berntson & Cacioppo, 2004). Below is a summation of the literature that describes the relationships between CVD and personality factors.

Personality Factors that Influence CVD

Personality has long since been associated with overall health and longevity in life (Daly et al., 2014). As a result, it is important to understand the different components and characteristics of personality contributing to positive and negative outcomes. Research has accumulated suggesting that the development and course of CVD is influenced by a variety of psychosocial factors including self-control.

Self-control

Individual differences in self-control are reflected in a person's ability to adjust or adapt to internal or external circumstances (Tangney et al., 2004). Self-control refers to the ability to regulate or manage one's emotions, behaviors, and thoughts for the purpose of pursuing goals. Individuals high in self-control have the ability to modulate and override thoughts, emotions, and action tendencies for the purpose of behaving in a manner conducive to goals, demands, laws, or standards, even when experiencing an intense urge or proclivity to carry out an opposite behavior (Baumeister et al., 2006). In essence, self-control reflects an individual's ability to change his or her inner response if it is not helpful to overall wellbeing, and avoid carrying out behaviors that are potentially or actually harmful. Specific facets of self-control include: control over thoughts, emotional control, impulse control, performance regulation, and habit breaking. In theory, high levels of dispositional self-control should provide a plethora of positive outcomes (Tangney et al., 2004).

Individuals possessing high levels of dispositional self-control exhibit discipline, reliability, and hard work. They are thought to possess more adaptive functioning, particularly in the following areas: academic achievement, self-esteem, interpersonal skills, satisfying relationships, secure attachment, and overall positive emotions. In particular, high scores of dispositional self-control have been associated with higher grade-point averages, self-esteem, secure attachment, favorable emotional responses, and less binge eating and alcohol abuse. Additionally, low levels of dispositional self-control are thought to contribute to personal and interpersonal problems, including depression and anxiety (de Ridder et al., 2011; Stavorva et al., 2020; Tangney et al., 2004).

Impulsivity and Self-Control. For the sake of the present study, it is also relevant to discuss the construct of impulsivity, as impulsivity is thought to be the converse of self-control and there is a vast body of research examining the relationship between impulsivity and cardiovascular health. Individuals low in self-control are thought to be more influenced by impulses; alternatively, individuals high in trait impulsivity are more prone to disinhibited behaviors (e.g., acting without thinking). Many researchers use measures of self-control as an indicator or proxy of impulsivity and vice versa (Duckworth & Seligman, 2005; Tangney et al., 2004).

Researchers have assessed impulsivity through various theoretical orientations, including characterological, biological, neuropsychological, cognitive, behavioral, social, and biopsychosocial perspectives (Bakshani, 2014). Eysenck (1993) proposed that impulsivity is simply exemplified by unplanned risky behaviors and an individual's tendency to make their mind up quickly (Eysenck, 1993). Dickman (1993) confirmed Eysenck's construct that impulsivity is personified by individuals making their minds up quickly and then acting, as well as adding that individuals high in impulsivity engage in unplanned risky behaviors due to high levels of impulsivity. Additionally, Dickman (1993) proposed that an aspect of impulsivity, which he referred to as disinhibition, is expressed as insufficient attention, which seems to be highly related to the personality construct of self-control.

Barratt (1994) clarified the construct of impulsivity by dissecting it into three components: motor (behavioral), cognitive, and non-planning impulsivity. He described the motor component as individuals carrying out behaviors without thinking, the cognitive component as making decisions very quickly, and non-planning as a decreased orientation towards the future (Barratt, 1994). A year later, Patton and colleagues (1995), with the help of

Barrett, suggested a slightly different three-part framework of impulsivity, characterized by acting on the spur of the moment (motor activation), not focusing on the task at hand (inattentiveness), and not-planning and thinking carefully (non-planning). More recently, Nigg and colleagues (2005) simplified the construct of impulsivity by suggesting it is a rash response in scenarios where a considerate response would be more suitable. While all of the aforementioned characterological perspectives propose different components, they share considerable overlap and seem to create a similar paradigm for impulsivity, with all conceptualizations of impulsivity previously mentioned involving the component of a lack of self-control. In addition to creating a paradigm of impulsivity, there has been a plethora of research examining biological, psychological, and social aspects of the construct.

Neuropsychologists and other researchers emphasizing the biological and neuropsychological aspects of impulsivity suggest that it is characterized by individuals being unable to inhibit a potentially risky impulse due to their physiological makeup (Bakshani, 2014). Neurobiological research suggests the monoaminergic corticostriatal systems, and its circuitry, are heavily linked to impulsivity. For example, impulsive individuals have demonstrated structural and functional differences in their corticostriatal circuity, particularly in the context of dysregulated monoaminergic signaling within the dopaminergic and serotonergic systems, compared to non-impulsive individuals. Additionally, higher levels of impulsivity have been associated with lower gray matter volumes in the orbitofrontal cortex, right inferior frontal gyrus, and bilateral caudate, and with lower white matter volumes in the left inferior and middle frontal gyri, superior temporal gyrus, right anterior cingulate cortex and caudate (Mitchell & Potenza, 2014).

From a physiological perspective, it seems that an absence of self-control is highly involved in impulsivity. Cognitive psychologists explain that impulse control is an important aspect of executive functioning, which contributes to social and personal functioning. Individuals with high levels of impulsivity possess a lack of behavioral inhibition, or seemingly self-control, which is thought to be a cognitive process (Bakshani, 2014).

Lastly, behaviorists discuss the importance of the particular behaviors involved in impulsivity, characterizing these as immature, dangerous, and unsuitable for particular situations, typically leading to negative outcomes. Impulsive individuals behave in ways that suggest they prefer less significant, immediate rewards over later-occurring more significant goals. Impulsive behavior also typically reflects delaying small, immediate consequences (e.g., unpleasantness of studying), which leads to the experience of larger, delayed consequences (e.g., failing an exam) (Ho et al., 1998). For example, an impulsive individual might avoid the unpleasant task of studying one hour per day for an exam, in the short term reaping the reward of avoiding the unpleasant task of studying, but then find themself cramming for the exam and/or not being prepared for the exam, the larger, delayed consequence.

Self-control and Health Outcomes. Laboratory studies have linked high levels of trait self-control to a variety of positive outcomes, including emotional control and stability (Daly et al., 2014). Typically, individuals with high levels of trait self-control are more successful with task time management, resisting temptations that interfere with long term goals, and completing immediate tasks necessary for long term goals (Linder et al., 2015). It has also been shown that children possessing high levels of self-control tend to become healthy, emotionally stable adults later in life (Daly et al., 2014).

Trait self-control has also been linked to specific health behaviors. For example, high levels of self-control have been associated with healthy eating behaviors and increased levels of physical activity (Li et al., 2022). In contrast, low levels of self-control have been associated with increased alcohol consumption, overall poorer nutrition, unhealthy eating patterns, repeated dieting attempts, and reduced levels of exercising (Cobb-Clark et al., 2022; Hagger et al., 2019). Additionally, low levels of self-control during childhood have been linked to the development of asthma, cancer, high blood pressure, and high cholesterol, as well overall risk for mental illness (Moffitt et al., 2011). Essentially, trait self-control has been associated with many health specific behaviors that affect longevity and morbidity, such that individuals high in self-control tend to carry out more positive health behaviors, whereas individuals low in self-control appear to do the opposite.

The relationship between high trait self-control and positive health outcomes involves multiple psychological and biological mechanisms. Possible mechanisms explaining these relationships include physiological changes in response to stress with involvement from the cardiovascular, immune, and neuroendocrine systems, all of which are governed by the sympathetic nervous system, parasympathetic nervous system, and the hypothalamic-pituitary-adrenocortical (HPA) axis. For example, in adolescents with conduct disorder, a disorder marked by impulsivity and low self-control, higher cortisol levels have been found in comparison to individuals with more self-control (Van Bokhoven et al., 2005).

HRV may be one of the biological mechanisms that plays a role in the relationship between self-control and salubrious health outcomes. HRV, a reliable predictor of cardiovascular morbidity and mortality, has been recently identified as a possible biological marker of a person’s trait ability to inhibit responses (Spangler et al., 2018). For example, baseline HRV

successfully predicted the length of time participants persisted on an unsolvable anagram task, such that individuals with greater baseline HRV persisted for a longer time period. Additionally, HRV seems to be influenced by self-regulatory effort, especially when the effort is exerted at controlling emotions. Specifically, Daly and colleagues (2014) hypothesized that self-control may activate the vagus nerve, slowing down heart rate and increasing HRV. Following this logic, differences in self-regulatory behaviors are likely measurable by observing the interaction of the parasympathetic nervous system and sympathetic nervous system as reflected in HRV (Daly et al., 2014).

Zahn and colleagues (2016) also suggest that HRV is a biological correlate of self-control. An array of studies have identified an association between HRV at rest and self-control, however, the effect sizes differ significantly amongst studies in terms of size and direction. In order to better understand the relationship between HRV at rest and self-control, Zahn and colleagues performed a meta-analysis of the research examining the relationship between self-control and HRV. In order to most precisely collect data, the studies examined were all conducted in laboratory settings. Self-control tasks are thought to reflect a similar experience to the natural environment, as individuals must inhibit impulses to achieve specific goals. Twenty-six studies were included in the meta-analysis, and overall greater HRV was found to be associated with higher levels of self-control. However, it was a small effect size with moderate heterogeneity. There was also significant evidence of publication bias throughout the examined studies and significant moderators were not found. Finally, their study was limited, as it did not examine HRV reactivity.

It seems conceivable that psychosocial variables may also influence heart rate variability in response to stress (i.e., heart rate variability reactivity), as psychosocial variables have been

linked to the development and maintenance of cardiovascular disease. Heart rate variability reactivity often occurs as a result of an individual experiencing stress and it seems likely that psychosocial variables moderate reactivity to stress. One supposition is that HRV at rest is less related to heart variability reactivity because they are distinct cardiovascular responses to two different experiences (absence of stress compared to stress). Self-control may be more closely linked to heart rate variability reactivity, such that it moderates the relationship between stress and heart rate variability reactivity. In other words, when exposed to something stressful, someone high in self-control may show more HRV while undergoing the stressor compared to someone low in self-control.

Self-control may moderate this relationship via adaptive or maladaptive coping. For example, individuals high in self-control may practice more adaptive coping (problem solving, enhanced interpersonal communication, exercise, emotion regulation, seeking social support) when exposed to stress, leading to greater HRV. Contrarily, individuals low in self-control likely practice maladaptive coping (smoking, alcohol use, anger, interpersonal conflict, binge eating, rumination) when exposed to stress, leading to lower HRV. Essentially, it seems likely that the construct of self-control is more influential in terms of how an individual responds to stress compared to their HRV at rest, which in turn makes self-control more influential in HRV reactivity. The present study seeks to provide a degree of insight into this hypothesis, such that the present study will provide data on the relationship between trait self-control and HRV (both at rest and during active task participation).

In addition to trait self-control and HRV, Daly and colleagues (2014) examined the relationship between trait self-control and cardiovascular and endocrine outcomes. The purpose of their study was to identify the influence of trait self-control on heart rate, heart rate variability,

and cortisol slope. Participants completed the Brief Self-Control Scale, in which they self-reported their exercise level, cigarette use, alcohol use, and provided a comprehensive account of their emotional experiences throughout an entire day. Additionally, participants provided salivary cortisol samples and heart rate was obtained by use of a lightweight heartbeat interval recorder, which each participant wore for the entirety of the day of the study. Results of this study suggest that individuals high in trait self-control exhibit lower resting heart rate, higher HRV, and a steeper cortisol slope (which has been associated with emotion regulation). Comparatively, flat cortisol slopes have been associated with negative health outcomes, including premature death, higher levels of fatigue, cancer, and PTSD. Further, those with high trait self-control also evidenced more stable emotional patterns, providing insight into the association between trait self-control and cortisol slope. Lastly, individuals with high trait self-control also consumed fewer cigarettes, which may have explained their lower overall heart rates (Daly et al., 2014).

Mindfulness and Nonattachment

The construct of nonattachment has been defined as a nonrigid, balanced manner of relating to experiences, absent of grasping and suppressing (Sahdra et al., 2016). Simply, nonattachment is a way of attending to the present moment with an observation and awareness of internal and external experiences in a nonjudgmental, accepting, and open manner (Kabat-Zinn, 1982). Nonattachment is a relatively new concept in psychological research, and it is related to, but not equivalent to, the construct of mindfulness. Mindfulness reflects “paying attention purposely in the present moment while refraining from judgment and impulsive reactions” (Sahdra et al., 2016, p.819). Mindfulness can be acquired through meditation and behavioral

skills training, however, its expression in trait form also exists absent of mindfulness training (Brown & Ryan, 2003).

In order to empirically separate these two related but distinct constructs, Sahdra and colleagues (2016) performed a study where participants completed the seven-item Nonattachment Scale (NAS-7) and the Mindfulness Attention Awareness Scale, which are respectively designed to measure nonattachment and mindfulness. Sahdra et al. (2016) found a moderate correlation between the two constructs. For the purpose of Sahdra's et al. (2016) study, the construct of mindfulness referred to and was measured by behaviors that people complete, such as acting with awareness and describing their internal experiences, whereas nonattachment referred to and was measured by a quality of "letting be." In other words, nonattachment allows pleasant and uncomfortable experiences to flow freely, without becoming preoccupied with them. In short, mindfulness refers to behaviors, whereas nonattachment is a personality construct that captures a state or approach to life sometimes referred to as "dispositional mindfulness."

Sahdra and colleagues (2016) sought to identify positive outcomes associated with nonattachment. They hypothesized that individuals possessing high levels of nonattachment, as measured by high NAS-7 scores, would exhibit superior time management, better handling of social situations, achieve more important goals, and encounter challenges with a sense of balance and calmness. Consistent with their hypotheses, Sahdra and colleagues (2016) found a significant relationship between NAS-7 scores and emotional control, between NAS-7 scores and social competence, and between NAS-7 scores and task leadership.

While Sahdra and colleague's (2016) research identified positive social factors associated with nonattachment, others have directed their efforts to discovering positive and negative physiological factors associated with nonattachment levels and mindfulness-based interventions.

For example, research conducted by Kemeny and colleagues (2011) and Ritchie (2016) provided some evidence for slower physiological recovery following stress in individuals with lower levels of dispositional mindfulness, absent of mindfulness training. Erisman and Roemer (2010) provided support for individuals possessing high levels of nonattachment secreting lower cortisol levels when exposed to stress compared to individuals with low levels of nonattachment, suggesting a more adaptive stress response. Based on the aforementioned findings, it seems conceivable to posit that individuals high in nonattachment would display greater heart rate variability when facing a socio-evaluative stressor compared to those low in nonattachment.

Nonattachment, Mindfulness Interventions, and Health Outcomes. Nonattachment and mindfulness interventions have been widely regarded as beneficial character traits and techniques that are overall beneficial to one's quality of life and mental health. However, the overall body of research examining the influence of nonattachment and mindfulness interventions on the cardiovascular response to stress is less clear, with some studies producing significant results suggesting high levels of nonattachment and implementation of mindfulness interventions are associated with a more adaptive cardiovascular response to stress (Kemeny et al., 2011; Ritchie et al., 2016), and others reporting no significant effect or mixed results (Corey et al., 2012; Fogarty et al., 2013; Kadziolka et al., 2016; Zaturenskaya, 2019). One potential reason for mixed results is that the cardiovascular response to stress has been examined via a variety of different cardiovascular measures, as the cardiovascular response to stress is complex and has many components for researchers to examine.

An important gap in the research to highlight is that the body of literature has almost entirely examined the relationship between cardiovascular responses to stress and the implementation of mindfulness interventions, rather than trait levels of nonattachment. The

following is a summary of the existing literature examining the relationships between mindfulness interventions and cardiovascular function when responding to stress.

The work of Kemeny and colleagues (2011) and Ritchie (2016) suggest the beneficial impact of mindfulness interventions on cardiovascular health. Kemeny and colleagues (2011) performed a study examining HRV and its relationship to mindfulness training. During this study, participants completed the Trier Social Stress Test (TSST), after participating in mindfulness training or not. Before the task, during the task, and after the task, respiratory sinus arrhythmia measures (an index of HRV) were obtained. High respiratory sinus arrhythmia indicates enhanced parasympathetic recovery, and thus, better recovery from stress (Kemeny et al., 2011). Results from this study indicated that participants trained in mindfulness exhibited higher respiratory sinus arrhythmia during the recovery period, as compared to participants in the control group.

Abbott and colleagues (2014) conducted a meta-analysis of the literature examining the effects of mindfulness-based stress reduction (MBSR) and mindfulness based cognitive therapy (MBCT) on depressive and physical symptoms in individuals with vascular diseases and those at high risk for vascular diseases. Both interventions have been shown to be efficacious for the treatment of anxiety and depression. Additionally, previous pilot and observational studies of MBSR and MBCT have been associated with enhancements in perceived health, overall quality of life, physiological responses in stroke survivors, and in a decrease of patient reported diabetes related distress. Additionally, MBSR has been associated with a decrease in blood pressure and increase in glycemic control in individuals suffering from diabetes. Results of the meta-analysis suggest that MBSR and MBCT lead to positive psychological outcomes, however, the impact of mindfulness-based interventions on physical disease is less understood (Abbot et al., 2014). The

positive effects of mindfulness-based interventions were often discovered in small and non-randomized studies. Thus, Abbott and colleagues (2014) included only randomized clinical trials in their meta-analysis in order to provide further clarity in the efficaciousness and treatment effects of MBSR and MBCT on individuals with vascular disease or at risk for vascular disease.

In terms of the influence of mindfulness interventions on psychological outcomes, results of the meta-analysis suggest that mindfulness interventions are effective for treating depression, anxiety, and psychological stress, as small to moderate effect sizes were found amongst the nine studies (Abbott et al., 2014). The influence of mindfulness interventions on physiological measures, and thus physical parameters of health, was less clear. Four of the nine studies found small significant effect sizes on blood pressure for participants with hypertension and diabetes. Two of the nine studies found no effect on markers of diabetes progression (Abbott et al., 2014). Commenting on the results of their meta-analysis, Abbott and colleagues (2014) discussed that the lack of clarity found in regard to physiological outcomes is in line with other literature reviews on the topic, as others have indicated that there is a small effect size for stress-based therapies for individuals with high blood pressure and with individual cognitive based therapy on those with diabetes and comorbid depression. Overall, the findings of Abbott and colleagues (2014) are optimistic, as mindfulness interventions seem effective at improving psychosocial health. Many studies that were not included in their meta-analysis seem to replicate their mixed findings.

Instead of mindfulness training, Ritchie (2016) measured trait mindfulness using the Mindfulness Attention and Awareness Scale to examine the impact of the Trier Social Stress Test (TSST) on HRV. Results were similar to Kemeny's (2011) study, as participants with higher scores of mindfulness exhibited greater HRV recovery following the stressor task

(Ritchie, 2016). However, other studies have yielded differing results depending upon when HRV was measured.

Zaturenskaya (2019) inspected the association between trait mindfulness and cardiovascular recovery from a laboratory-induced stressor. Prior to the laboratory stressor portion of the study, participants filled out the Mindful Attention and Awareness Scale to assess trait mindfulness. Based on scores of the Mindful Attention and Awareness Scale, individuals were then grouped into two categories, less mindful and more mindful. All participants then participated in a cold pressor task, during which heart rate variability was collected. Heart rate variability data was obtained during a baseline period, during actual participation in the task, and then during a recovery period, which was broken into two parts. The results of Zaturenskaya's (2019) study indicated that participants scoring higher in trait mindfulness recovered more fully from the task during the second part of the recovery period compared to those low in trait mindfulness. Additionally, higher scores in trait mindfulness were associated with a decrease in heart rate variability from the baseline period to the stressor task and with an increase in heart rate variability during the second portion of recovery. Zaturenskaya suggested that individuals with high scores of trait mindfulness illustrated an increase in heart rate variability during recovery due to their heightened awareness of context and tendency to be more present focused, which she suggests may elicit a superior cardiovascular response. This rationale mimics the results of the study as individuals with high scores of trait mindfulness facilitated more context appropriate cardiovascular responses during baseline and recovery periods (Zaturenskaya, 2019). Essentially, Zaturenskaya seems to argue that the mind-body connection is responsible for the adaptable cardiovascular response to individuals with higher levels of trait mindfulness. The mind knows the context of the situation and the body responds appropriately.

Corey and colleagues (2012) found mixed results depending on how mindfulness was measured. For example, the “Observing” facet of mindfulness is significantly associated with increased heart rate variability during recovery after exposure to a stressor, whereas other subscales of the Mindful Attention and Awareness Scale are not. Similarly, Kadziolka and colleagues (2016) found that only two subscales, “Observing” and “Act with Awareness,” of the Mindful Attention and Awareness Scale were significantly related with enhanced heart rate variability during recovery after exposure to a stressor. These positive results are contrasted by the findings of Fogarty and colleagues (2013) who found no difference in heart rate variability recovery between individuals high in trait mindfulness and low in trait mindfulness, using the Five Factor Mindfulness Questionnaire.

Additionally, Erisman and Roemer (2010) found mixed results. They examined the effects of a mindfulness intervention on psychological and physiological responses to positive, negative, and affectively mixed film clips. Individuals receiving the mindfulness intervention reported no difference in the amount of distress experienced during negative film clips but reported experiencing greater positive affect during positive film clips. Additionally, those receiving the mindfulness intervention reported more adaptive regulation (less self-reported problems with emotion regulation), while viewing the affectively mixed film clip and decreased levels of negative affect after viewing the affectively mixed film clip but not after a recovery period. Interestingly, there were no significant differences of heart rate and skin conductance between the mindfulness intervention group and control group (Erisman & Roemer, 2010).

Compared to research on mindfulness interventions, much less research has been dedicated to examining the relationship between nonattachment and its potential influence on cardiovascular responses to stress. Two key studies will be highlighted that share similarities to

the current study. The work of Brown and colleagues (2012) sought to identify the relationship between nonattachment, referred to in their study as trait mindfulness, and neuroendocrine and psychological stress responses. The purpose of their study was to shed light on the underlying mechanisms linking nonattachment to positive health outcomes. Brown and colleagues (2012) operated under the "stress buffering" hypothesis, such that high levels of nonattachment are thought to protect an individual from experiencing maladaptive cardiovascular responses to stress. They found that high levels of nonattachment predicted lower cortisol responses, less anxiety, and less negative affect while participating in the Trier Social Stress Test compared to a control task. Their results suggest that nonattachment modulates cortisol and affective responses to social stressors (Brown et al., 2012). However, their study did not examine heart rate variability, the main component of the present study.

Additionally, Forgarty and colleagues (2013) examined the relationship between nonattachment, again referred to as trait mindfulness in their study, and physiological recovery from stress. Participants completed a measure of nonattachment and then completed either an emotional or neutral writing task. The emotional writing task was the stress inducer. Results suggested that participants higher in nonattachment illustrated enhanced cardiovascular recovery, as measured by heart rate variability, following exposure to stress compared to individuals low in nonattachment. Results did not significantly differ between those high in nonattachment and those low in nonattachment when completing the neutral writing task. Their results suggest that nonattachment promotes more adaptive cardiovascular responses to stress but only in the presence of stress, not in its absence (Fogarty et al., 2013). Results of the aforementioned two studies suggest that nonattachment may have a beneficial influence on cardiovascular reactivity to stress that is observable via the underlying mechanism of heart rate variability.

Masciampo and Baumeister (2007) argue that mindfulness interventions are actually one facet of self-control, and that mindfulness interventions are an example of self-control exercises. It has been posited by Brown and colleagues (2008) that mindfulness interventions lead to successful outcomes by furthering metacognitive insight, exposure to internal and external states, and increasing an individual's ability to be non-attached to circumstances and goals. The increases in the aforementioned areas are thought to work synergistically to facilitate successful functioning. Masicampo and Baumeister (2007) oppose this position, suggesting that mindfulness interventions actually increase an individual's general capacity of self-control, hence they posit a causal relationship between mindfulness interventions and increased self-control, which then in turn benefits the individual overall.

Increasing an individual's capacity to self-regulate behavior, and hence, be mindful and exhibit self-control, seems to be an important therapy tool. High levels of both constructs have been associated with several positive outcomes and low levels of both constructs have been associated with several negative outcomes that have been previously discussed (Masicampo & Baumeister, 2007). Masicampo and Baumeister (2007) detail the theoretical overlap between the constructs of mindfulness and self-control and explain the need to differentiate these two distinct constructs. Additionally, understanding if each construct impacts cardiovascular health differently seems like it would provide further insight into their similarities and differences.

The Relationship Between Self-Control and Mindfulness

Research examining impulsivity seems to provide a plethora of information in regard to trait self-control and mindfulness as well. For example, Dixon and colleagues (2019) investigated the effect of a brief mindfulness intervention to improve self-control. These researchers used the concept of delayed discounting, the propensity to choose immediate, small

rewards over later-occurring large rewards, which is the opposite of the reflection of high self-control. They had participants fill out a questionnaire asking if they would rather have a small amount of money now or a large amount of money later followed by a five-minute mindfulness intervention or a music video (control) and then had the participants fill out the same questionnaire again. Participants receiving the mindfulness intervention displayed less impulsive responding compared to the control group, suggesting that brief mindfulness interventions are effective at reducing impulsive choices, or increasing self-control ability (Dixon et al., 2019).

Reid and colleagues (2014) conducted a study examining the relationship between mindfulness, emotional dysregulation, impulsivity, and stress proneness in participants with hypersexual disorder. They gave participants questionnaires measuring the aforementioned constructs and hyper-sexuality. Hierarchical regression analyses revealed that high levels of mindfulness (i.e., nonattachment, present attention, awareness, and nonjudgment of one's experience) were correlated with reduced levels of hyper-sexuality (i.e., engaging in sex in response to stress, difficulty controlling sexual thoughts, urges, and behaviors). Again, hyper-sexuality seems to reflect low self-control. Additionally, their findings revealed that high levels of mindfulness were correlated with reduced levels of impulsivity, or alternatively, high levels of self-control. Consistent with these results, Lattimore and colleagues (2011) found a negative relationship between mindfulness and impulsivity suggesting that mindfulness might be an important technique to incorporate into treatment for individuals with impulsivity and self-control issues.

The presence of self-control, or low trait impulsivity, is associated with a variety of positive mental and physical health outcomes (Stavrova et al., 2020; May et al., 2017). Similar to other areas of executive functioning (e.g., emotion regulation, planning), self-control can be

developed or modified. One way to do so is through practicing mindfulness. Specifically, mindful practices involving nonattachment, acceptance, and nonjudgment can improve impulsivity leading to gains in the ability to control one's behaviors, emotions, and thoughts.

Overall, there is a conceptual overlap between self-control and mindfulness, and research has documented a positive association. However, one component of mindfulness, nonattachment, has not been examined in terms of its specific relationship with self-control. Further identifying the relationship and associations between nonattachment and self-control may provide further insight into their overall health benefit effects.

In order to better understand the manner in which nonattachment and self-control are related, a theoretical explanation of the constructs is necessary. The enhancement of self-control is best understood using the metaphor of a weightlifter increasing their muscle mass. Weightlifters repeatedly use their muscles over and over again in order to make them stronger. The same explanation is provided for an individual's enhancement of self-control (Masicampo & Baumeister, 2007). Research findings support this theory as findings demonstrate that individuals participating in back-to-back tasks requiring self-control are able to exert increased self-control abilities on the first task and then display decrements in self-control ability on the following task. In essence, the self-control "muscle" becomes fatigued and the individual is unable to meet the demands of the task (Masicampo & Baumeister, 2007).

Additionally, research studies seeking to understand an individual's ability to increase their self-control abilities have examined the benefits of repeated self-regulatory exercise. Research outcomes suggest that self-regulatory exercise has the ability to increase daily regimens of physical exercise, better management of household chores, less substance use, healthier diets, regulation of posture, overall time spent studying and study habits, financial monitoring, speech

control, better emotional control, and the use of one's non-dominant hand. Importantly, individuals fulfilling the self-regulatory exercises also exhibited less self-control fatigue, as demonstrated by laboratory measures (Baumeister et al., 2006; Muraven & Baumeister, 2000; Oaten & Cheng, 2006). Briefly summarizing the aforementioned research outcomes, participation in self-regulatory exercises is thought to increase an individual's general ability for self-control, which has been shown to be conducive to many positive outcomes in many domains for one's overall wellbeing (Masicampo & Baumeister, 2007).

Masicampo and Baumeister (2007) point out that the research examining mindfulness interventions and self-control exercises often utilize similar methods and render similar outcomes. As self-control involves the act of altering the self's responses, Brown and colleagues (2008) summary of the mindfulness literature similarly notes that mindfulness interventions encourage participants to alter and control their behavior in one aspect or another (Masicampo & Baumeister, 2007). In particular, psychological research in self-control and mindfulness operationalizes these constructs similarly.

Laboratory studies examining the construct of self-control often incorporate a task which requires managing attention by concentrating on specific visual or auditory stimuli, while ignoring inconsequential stimuli. The mindfulness interventions which Brown and colleagues (2008) describe place similar demands on participants. For example, the mindfulness intervention of mindfulness-based stress reduction (MBSR) involves participants completing daily exercises that direct participants' attention to their bodies, thoughts, and specific images. This session can last up to ninety minutes. In laboratory studies incorporating tasks of self-control, participants are directed to focus their attention on specific stimuli for periods of time as short as seven minutes, which has demonstrated as being lengthy enough to create self-control

fatigue (DeWall et al., 2007). The involvement of the conscious control of motor behaviors is also a component of overlap between mindfulness interventions and laboratory tasks of self-control. For example, Hanh's (1976) "Cleaning House" mindfulness exercise directs individuals to focus their attention on completing tasks three times as slowly compared to their usual pace, whereas laboratory tasks of self-control have required participants to track their movements by observing their posture and utilizing their nondominant hand to complete various tasks, such as eating, brushing their teeth, opening doors, and using a computer mouse. In a sense, both mindfulness interventions and laboratory tasks of self-control require participants to complete ordinary tasks in an anomalous manner (Brown et al., 2007; Masicampo & Baumeister, 2007). Based on the similarities between mindfulness interventions and laboratory tasks of self-regulation, it is posited that mindfulness interventions are more enduring versions of attention controls tasks used in self-control research. In short, both techniques require the precise regulation of thoughts and behaviors, daily adherence to exercises, and completing the aforementioned behaviors consistently over time (Masicampo & Baumeister, 2007).

As the composition and implementation of mindfulness interventions and laboratory manipulations of self-control are so similar, it is unsurprising that they yield similar outcomes. Mindfulness interventions have been associated with improvements in physical health, mental health, behavior regulation, emotion regulation, and interpersonal relationships. Many of the same positive outcomes have been associated with participation in regular self-control exercises as well (Masicampo & Baumeister, 2007). For example, research conducted by Oaten and Cheng (2006) has associated regular self-control exercises with improvements in behavior regulation, emotional regulation, and adherence to daily habits conducive to physical health. However, a direct causal link amongst self-control exercises and positive outcomes has not been

demonstrated in the body of research, but because self-control exercises have been shown to generally increase the capacity of self-regulation, it seems conceivable that self-control exercises, at a minimum, indirectly contribute to positive outcomes and have already been linked to healthier interpersonal relationships, and higher-ranking academic performance as a result of participating in regular self-control exercises (Masicampo & Baumeister, 2007).

Regarding impulsivity and self-control, neuroticism has been significantly associated with behavioral dysregulation, particularly in the form of high levels of impulsivity and low levels of self-control and nonattachment (Fetterman et al., 2010). For example, trait self-control is negatively correlated with neuroticism, such that individuals higher in neuroticism possess lower levels of trait self-control (Chen et al., 2018; Fetterman et al., 2010).

Regarding mindfulness, Fetterman and colleagues (2010) suggest that an inverse relationship between neuroticism and mindfulness also exists, such that higher neuroticism is associated with lower mindfulness (Fetterman et al., 2010). Relevant to the present study, a main component of mindfulness – nonattachment – refers to being fully present and not fixated on internal experiences such as negative emotions. Similar to the relationship between neuroticism and mindfulness, nonattachment has been shown to be significantly related to neuroticism, such that individuals higher in neuroticism possess lower levels of nonattachment (Fetterman et al., 2010; Sahdra et al., 2010).

Fetterman and colleagues (2010) provide a theoretical and empirical basis for understanding how neuroticism is inversely associated with trait mindfulness, and the salubrious effects of trait mindfulness on two primary elements of neuroticism: self-control and impulsivity (Cassin & van Ranson, 2005). Fetterman and colleagues (2010) suggest that nonattachment explains the relationship between neuroticism and self-control and impulsivity. Neuroticism has

been shown to have a statistically significant, negative relationship with self-control, and a statistically significant, positive relationship with impulsivity. According to Fetterman and colleagues (2010), nonattachment was shown to be a significant mediator between neuroticism, self-control, and impulsivity. This is likely because nonattachment is highlighted by attention and awareness, which is necessary for self-regulation processes (i.e., lack of impulsivity, presence of self-control). In essence, it can be posited that individuals high in neuroticism tend to have lower levels of trait self-control and nonattachment, which may be suggestive of particular patterns of cardiovascular stress responses. The stress reactivity hypothesis provides a paradigm through which researchers are able to examine the relationship between psychosocial factors and health outcomes.

The Stress Reactivity Hypothesis

The stress reactivity hypothesis seeks to explain the effects of stress on health and well-being (Cohen & Manuck, 1995). This hypothesis is composed of four stages: *exposure to stress*, *reactivity to stress*, *recovery from stress*, and *restoration*. According to Williams et al. (2011) individuals differ in the extent to which they experience each of these four components due to personality factors, which ultimately contribute to CVD. For example, research utilizing the Five Factor Model of personality as a paradigm suggests that individuals high in neuroticism (i.e., facets including anxiety, anger, hostility, depression, self-consciousness, impulsiveness, and vulnerability) behave in a manner that leads to increased exposure to stress (Williams et al., 2011). The following is a brief review of the findings in regard to individual difference factors and the stress reactivity hypothesis.

Considering the first component, e*xposure to stress*, personality factors seem to contribute to the extent that individuals are exposed to stress inducing situations. In particular,

individuals with high levels of neuroticism find themselves exposed to major life events, daily hassles, and chronic stressors more frequently than those with lower levels of neuroticism (Williams et al., 2011). For instance, individuals who are more prone to experiencing anger, a facet of neuroticism, may expose themselves to more stressful experiences compared to someone who is not prone to anger. Other character traits such as impulsivity and self-control may also influence the experience of stress. For example, high impulsivity and low self-control are marked by quick, careless, or unmindful behaviors that may be reflective of emotional dysregulation. An illustration of this might be an individual reacting quickly to something another person says, without thinking about their response, resulting in a response that leads to an interpersonal conflict.

While high levels of neuroticism, and often an accompanying high level of impulsivity and low self-control, are associated with increased exposure to stressful situations, the personality facet of conscientiousness (i.e., competence, order, dutifulness, achievement striving, self-discipline, and deliberation) is associated with reduced exposure to stressful situations (Williams et al., 2011). Conscientiousness reflects components such as self-discipline and self-control which are negatively correlated with impulsivity. Additionally, aspects of conscientiousness seem to share some conceptual overlap with components of mindfulness and nonattachment. In fact, research demonstrates strong associations between conscientiousness and trait mindfulness (Latzman & Masuda, 2013). Conscientious individuals have the self-control to avoid impulsive reactions that often contribute to stress exposure. While an impulsive individual may find themselves more likely exposed to stressful situations, an individual with high levels of conscientiousness has the self-control to pause before reacting and respond in a more thoughtful

and potentially adaptive manner. Interpersonal conflict may be avoided, and hence, the potentially chronic stressor and its negative impact on health is avoided.

Following stress exposure, the second component of the stress reactivity hypothesis is *initial reactivity to stress*, which entails the extent to which emotions and physiological correlates increase in response to stress. Personality factors are thought to contribute to individual differences in physiological reactivity to stress. Over extended periods of being exposed to stressful circumstances, stress reactivity can lead to negative physical health outcomes such as CVD because the sympathetic adrenomedullary system and hypothalamic-pituitary-adrenocortical axis are chronically activated when an individual experiences consistent levels of stress (Herman et al., 2016). According to Williams et al. (2011), marked features of sympathetic adrenomedullary system activation include elevated systolic and diastolic blood pressure and heart rate. Individuals vary, however, in the extent to which they react to stress, and various personality characteristics have been associated with individual differences in stress reactivity. In essence, personality factors are thought to influence whether an individual exhibits excessive or attenuated stress reactivity. More specifically, Kimmes et al. (2018) hypothesized that self-control and components of mindfulness (e.g., nonattachment) influence this relationship.

The third component of the stress reactivity hypothesis, *recovery*, occurs after being exposed to a stressor and experiencing physiological reactivity. Recovery encompasses how long it takes an individual to return to their emotional and/or physiological baseline. It has been posited that recovery from stress may play as significant a role in the development of CVD as stress reactivity, especially in terms of increased blood pressure (Brosschot et al., 2006; Mosely & Linden, 2006). Similar to the impact of personality factors on stress exposure, Carver et al. (2008) found that individuals high in levels of neuroticism recover at a slower rate compared to

individuals with lower levels of neuroticism. Other individual difference variables, such as trait anger, are also associated with slower recovery to baseline blood pressure when exposed to stress (Quinn et al., 2014).

In addition to personality factors, coping strategies for stress are thought to influence the stress recovery period, with healthy coping strategies decreasing the duration of time it takes to recover, and maladaptive coping strategies lengthening the duration. The association between individuals high in levels of impulsivity, and thus low in self-control and nonattachment, and maladaptive coping strategies has previously been established. Specifically, it has been shown that many of these individuals tend to utilize avoidant-coping techniques which may prolong the stress response (Nower et al., 2004). For example, maladaptive coping techniques associated with high levels of impulsivity include alcohol use, smoking, and dysregulated eating, and these are associated with a negative effect on the autonomic nervous system, and, subsequently, the stress response (Borges et al., 2019; Buchhorn, 2016; Cyders & Coskunpinar, 2011; Lee-Winn et al., 2016; Ralevski et al., 2019).

The final stage of the stress response, *restoration*, describes the process of when the body's functions aim to "refresh, buttress, and repair various forms of cellular damage" (Williams et al., 2011, p. 239), after functioning has been disrupted by stress. A common example of a restoration process in response to stress is sleep. According to Lange et al. (2003), sleep deprivation has been associated with lowered immune functioning as well as many forms of mortality. Additionally, sleep deprivation and disturbed sleep have been associated with impaired emotion regulation and cognitive functioning, which influence how individuals react to, and recover from, stress (Williams et al., 2011). Similar to the relationship between personality factors, stress exposure, and recovery, high levels of neuroticism and constructs related to

anxiety have been associated with sleep deprivation and disturbed sleep. More specifically, Gray and Watson (2003) found that hostility (primarily as a result of interpersonal conflict) has been associated with poor sleep. Due to the negative association between impulsivity and self-control and nonattachment, it seems likely that those high in impulsivity may respond in maladaptive ways (e.g. without foresight of potential consequences) when confronted with interpersonal conflict. This response style has the potential of creating prolonged interpersonal difficulties that may disrupt sleep, and thus cardiovascular health. In other words, it seems plausible that an association between the personality characteristics of self-control and nonattachment exist with physiological reactivity.

Comparatively, individuals high in the personality trait of conscientiousness report better sleep quality than those with lower levels of conscientiousness (Gray & Watson, 2003; Haliwa et al., 2021; Jensen-Campbell et al., 2007). Furthermore, individuals high in neuroticism tend to experience adverse effects associated with poor sleep, such as depression and impairment in day-to-day functionality. Interestingly, Williams and Moroz (2009) hypothesized that low levels of conscientiousness moderate this effect, such that individuals with high levels of neuroticism and low levels of conscientiousness experience greater adverse effects from poor sleep compared to individuals with high levels of neuroticism and high levels of conscientiousness. However, their results suggested conscientiousness did not significantly moderate the relationship between neuroticism and sleep quality.

A key component of conscientiousness, and several mindfulness techniques, is self-discipline. Thus, mindfulness interventions may serve to help those with high levels of neuroticism, and possibly impulsivity, acquire better sleep quality. This implies that psychosocial variables have the potential to significantly moderate negative behavioral and physiological

outcomes, such as heart rate variability (HRV). The current study sought to identify two psychosocial variables, trait self-control and nonattachment, that moderate HRV.

Current Study

It has been posited that health behaviors and coping styles, by means of various physiological mechanisms, mediate the relationship between personality constructs and associated health outcomes. For example, as previously discussed, high levels of self-control have been associated with a plethora of positive health behaviors and coping styles (increased healthy eating, increased physical activity) and negative health behaviors and coping styles (increased alcohol consumption, overall poorer nutrition, unhealthier eating patterns, repeated attempts at dieting, and reduced levels of exercise) (Cobb-Clark et al, 2022; Hagger et al., 2019; Li et al., 2022). As such, these are key examples of how health behaviors and coping styles may mediate the relationship between personality constructs and cardiovascular health.

However, the biological underpinnings of this relationship have not been fully elucidated, and research examining this topic thus far has often used self-report measures, (which can be subjective), and behavioral outcomes. Thus, it is important that the field of research turn to identifying biological intermediaries that are responsible for the relationship between self-control, nonattachment, and positive health factors.

The proposed study will examine the association of self-control and nonattachment with physiological responses to a modified Trier Social Stress Test. The primary physiological response includes HRV. Cardiovascular responses are widely-studied mechanisms in studies of psychosocial vulnerability (Chida & Steptoe, 2010), and as noted above, HRV is an important component of cardiovascular functioning. The present study seeks to add to the body of literature

examining psychosocial variables and cardiovascular health by better understanding the relationship between trait self-control, nonattachment, and heart rate variability.

Hypotheses

For the present study, archival data will be utilized from an experimental study in which participants engaged in a modified Trier Social Stress Test (TSST). Heart rate variability was assessed during participation in the stress test and during a baseline period, which consisted of a neutral task not involving social stress.

Based on the preceding, the following hypotheses have been developed:

1. There will be a positive relationship between self-control and nonattachment as measured by the Brief Self-Control Scale and Nonattachment Scale, respectively.
2. Compared to the control condition, participants exposed to the TSST will demonstrate lower heart rate variability.
3. Participants high in self-control, as measured by the Brief Self-Control Scale, will demonstrate greater heart rate variability in response to the TSST compared to participants low in self-control.
4. Participants high in nonattachment, as measured by the Nonattachment Scale, will demonstrate greater heart rate variability in response to the TSST compared to participants low in nonattachment.

CHAPTER 3

Method

Participants

The present study made use of archival data based on a sample of 143 undergraduate students enrolled in psychology courses at a midwestern university. The participants' ages ranged from 18 to 37 years (M = 19.25, SD = 2.28), with 65.5% identifying as women and 34.5% identifying as men. Regarding ethnicity, 47% identified as non-Hispanic White, 34% Black, 11% Hispanic, 4% Asian, and the remaining "other" or "prefer not to answer." The majority (70.4%) of the sample was in their first year of college

Students were recruited on a voluntary basis through use of the SONA online system to sign up for the study. Participants were required to have abstained from caffeine and nicotine for at least two hours prior to participating in the experiment. This was assessed via participant self-report. Participants taking medications known to impact cardiovascular activity, such as beta-blockers, were excluded from the study.

Measures

Physiological Measures

Impedance Cardiography and Heart Rate Variability. Seven spot electrodes were placed in a hepta polar configuration according to published guidelines (Sherwood et al., 1990). A Mindware 2000D Impedance Cardiograph was used to measure ECG, basal thoracic impedance (Z_O), and the first derivative of the impedance signal (dZ/dt). Version 5.2 of Mindware Cardiography Analysis Software was used to verify, edit, and summarize cardiovascular data. It was also used, through spectral analysis of the interbeat interval series, to determine high frequency heart rate variability (hf-HRV) (Smith et al., 2011).

Questionnaire Measures. The following questionnaires and demographic items (see Appendix A) were completed through the Qualtrics Survey System.

Brief Self-Control Scale. The Brief Self-Control Scale (BSCS) is a 13-item self-report questionnaire designed to measure the construct of self-control. Self-control can be measured as a trait or behaviorally, and for the purpose of this study, the BSCS was used as it measures trait self-control ("I am good at resisting temptation"). Self-control is thought to reflect the ability to alter and modify one's self to create a more favorable match between one's self and the environment (Tangney et al., 2004). The BSCS demonstrates good convergent and discriminant validity, with high scores on the BSCS correlated with higher grade-point averages, higher self-esteem, less binge eating and alcohol abuse, better relationships and interpersonal skills, more secure attachment, and more favorable emotional responses (Tangney et al., 2004).

The creation of the BSCS resulted from condensing the Total Self-Control Scale. The Total Self-Control Scale began with 93 items that encompassed measurements of control over thoughts, emotional control, impulse control, performance regulation, and habit breaking. These 93 items were then condensed into 36 items, based on rational and empirical methods, to form the Total Self-Control Scale. In order to create a more time efficient measure, the Total Self-Control Scale was then condensed into 13 items to form the BSCS. Tangney and colleagues (2004) performed two studies to establish that the BSCS remained an adequate measure of self-control after its reduction from the Total Self-Control Scale. The BSCS was highly correlated with the Total Self-Control Scale in study one (r = .93) and study two (r = .92). The BSCS established good internal consistency and retest reliability. Additionally, the BSCS was found to measure the same domains and content of self-control as the Total Self-Control Scale (Tangney et al., 2004). See Appendix B for complete scale.

Nonattachment Scale. The Nonattachment Scale (NAS) is a 30-item self-report questionnaire designed to measure the Buddhist construct of nonattachment. Nonattachment reflects an individual's ability to be in the present moment without judgment of their past or consideration of their future ("I can let go of regrets and feelings of dissatisfaction about the past") (Sahdra et al., 2010). More specifically, nonattachment encapsulates psychological flexibility, non-reactiveness to aversive and pleasant stimuli, moving on from low moods quickly, detachment from others (in a supportive manner), and an overall sense of ease. Essentially, individuals possessing high trait nonattachment do not depend on particular events occurring in order to have peace of mind (Sahdra et al., 2010).

The creators of the scale (Sahdra et al., 2010) generated face valid items of nonattachment, derived from research on classical Buddhist texts and contemporary Buddhist writings, and then consulted 18 Buddhist experts (mixture of scholars and teachers) with decades of experience to ensure construct validity. Scale construction started with 135 items, equally split into positively and negatively worded items. These items were ranked by the 18 Buddhist experts as indicators of nonattachment on a Likert scale, and 72 items were retained. The scale was then normed on undergraduate students who were representative of the American population and meditators. Exploratory and confirmatory factor analyses were performed after these two populations completed the scale, which led to a final scale containing 30-items. Test-retest reliability was also shown to be good, with an intraclass correlation of $r =. 87$, $p < .001$. The Nonattachment Scale demonstrates good convergent and divergent validity, when compared to other similar and distinct constructs (Sahdra et al., 2010). See Appendix C for complete scale.

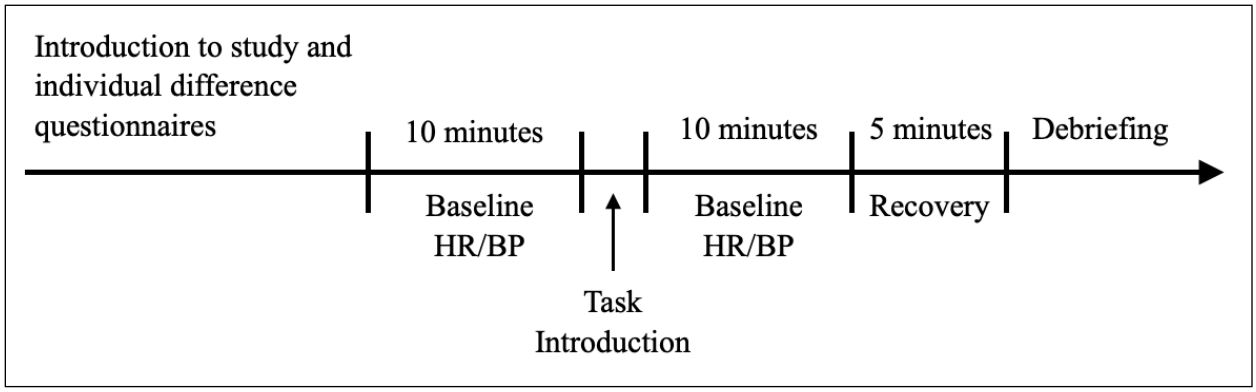
Procedure

Temporal Sequence

Participants arrived at the laboratory for their scheduled experiment with random assignment to their condition. Thirty-six participants were in condition 1 (control). Thirty-six participants were in condition 2 (agency). Thirty-six participants were in condition 3 (communion). Thirty-five participants were in condition 4 (combined). A timeline of the study is presented in Figure 1.

Figure 1

Temporal Sequence of Measurements and Tasks



Participants were introduced to the study and signed the informed consent. They then completed a demographic information questionnaire (Appendix A) followed by measures of dispositional self-control and dispositional nonattachment (Appendices B and C).

Baseline

A 10-minute baseline for physiological measures was assessed during a minimally engaging task in which the participants were asked to rate a set of pictures regarding the pleasantness of the photo. Audio instructions guided the participants through the task. The

participants had one minute to look at two pictures of pleasant scenery and select the photo they preferred. Audio instructions informed the participants when to turn to the next pair of pictures, and this process was repeated until the 10th pair had been rated. ECG data was continuously gathered during the baseline period.

Experimental Tasks

Evaluative threat conditions were manipulated in the same manner as in prior studies in other laboratories (Smith et al., 2011). As part of the modified TSST, participants were exposed to one of four conditions, all of which required participation in a role played interaction. In the communion threat condition, participants were told that raters will judge how likable, interesting, and friendly they were. In the agency threat condition, participants were told that raters will judge how intelligent, competent, and skilled they were. In the combined condition, the participants were told that raters will judge them both on how likable and intelligent they were. In the control condition, the participants were told that they need to respond to the tasks but their responses will not be evaluated in any way. Additionally, raters were not present in the control condition.

The task was then provided to the participants orally, in which they talked about a role-playing interaction with a pre-recorded hostile passenger in a car accident. The task involved two components in which the participant responded for 90 seconds. For example, the participant heard the following audio instruction and was also given a hard copy to follow along:

> For this task, we would like you participate in a role played interaction. The interaction revolves around a car accident. Both you and the person you will interact with were the passengers, NOT the drivers of the cars involved in the accident. First, let me describe to you the events leading up to the interaction. You've been out for the day with your

younger brother doing some shopping. He has had his license for 2 years and he is a good driver. He loves his old red Toyota. Your brother is an honor student, gets good grades, and is responsible. You stop at one shopping center that is pretty crowded. He drives slowly in the parking lot looking for a space to park. As he passes a gray van, it abruptly backs up and hits your brother's car on the right side. Specifically, the gray van strikes the side of your brother's car near the right front tire. It was clear that the driver never looked. The passenger in the gray van is a young man and the driver is an older woman. When the older woman gets out, she looks confused about what just happened. The young man gets out and inappropriately blames you and your younger brother. You will now listen to the passenger of the other car speak for a few seconds. You're going to hear his point of view of what happened. Then we would like you to role play and respond to him for 90 seconds. You can go over your own point of view about what happened and respond to his inappropriate blaming of you and your younger brother. You will then stop and the other driver will respond. After his second response, we will ask you to respond for another 90 seconds. Now imagine that this accident has just happened and the passenger of the other car steps out and addresses you. Again, you will hear his point of view, and afterwards, we will ask you to respond.

The hostile passenger audio was played, and then the participant responded. After speaking for 90 seconds, the participant heard a follow-up pre-recorded interaction with the hostile passenger and then the participant responded a second time for 90 seconds.

Two "raters" were seated across from the participant in the threat conditions to make ratings on a clipboard as the participant talked. For each experimental condition the "raters" consisted of one male and one female individual between the ages of 20 to 30 of varying

ethnic/cultural backgrounds. Throughout the task, the interaction between the raters and the participant was minimal, with the raters maintaining professional demeanor and limiting emotional reaction to the participant's response, responding only with prompts (i.e., "please try and speak for the entire 90 seconds") encouraging the participant to try their best or continue speaking. The raters made their first rating 10 seconds into the speaking task and their second rating at the end of the 90-second interval. In total, the experimental task took approximately 10 minutes to complete. During the recovery stage the participants were left alone in the room for a period of five minutes. Throughout this time, ECG data was continuously gathered. At the conclusion of the experiment one of the raters explained the purpose of the experiment to the participant along with debriefing.

CHAPTER 4

Results

Preliminary Analyses

The data was examined for missing data prior to conducting analysis. A total of 24 participants exhibited missing questionnaire data, with 5 missing more than one data point per questionnaire. Participants' mean scores for completed items on the BSCS and NAS were entered in place of missing items on the respective questionnaires. One participant did not complete any items on the BSCS or the NAS, and was therefore excluded from the analyses.

Descriptive Analyses

Table 1 visualizes descriptive statistics related to self-control as measured by the BSCS and nonattachment as measured by the NAS. The mean score of self-control (M = 39.16, SD = 6.24) was similar to findings from Tangey et al. (2004), which utilized two samples of undergraduate students (M^1 = 39.22, SD^1 = 8.58, M^2 = 39.85, SD^2 = 8.61). The mean score of nonattachment (M = 123.10, SD = 19.49) for the current study was similar to that of the Sahdra et al. (2010) study examining nonattachment, which incorporated undergraduate students as their sample.

Table 1

Descriptive Statistics for Self-Control and Nonattachment Across Conditions

	Self-Control[a]	Nonattachment[b]
M	39.16	123.10
SD	6.24	19.49
Range	33	102
Internal Consistency	.58	.89

Note. [a]Self-control was measured with the BSCS, with scores ranging from 1-5 and higher scores suggesting higher levels of self-control. [b]Nonattachment was measured with the NAS, with scores ranging from 1-6 and higher scores suggesting higher levels of nonattachment.

Results of Experimental Threat Manipulation

Physiological reactivity (i.e., HRV change) in response to the social tasks was analyzed as task minus baseline change scores in a 2 (high vs. low agency threat) X 2 (high vs. low communion threat) X 2 (gender) factorial ANOVA. Main effects for agency threat and communion threat were examined to determine if participants in the agency, communion, and combined conditions experienced greater physiological reactivity relative to controls. Partial η^2 was used to describe effect sizes. Gender was included as one of the factors as there are historically gender differences present in responding to agency and communion threats. Typically, men are more threatened by agentic threats and women are more threatened by communion threats.

Baseline Equivalence of Groups

An independent samples t-test was utilized to compare baseline HRV levels in men and women. There was not a significant difference in HRV levels between men (M = 6.93, SD = 1.03) and women (M = 6.78, SD = .88); $t(108) = .786$, $p = .43$ The similarity of resting HRV between men and women has been demonstrated in other research (D'Antono et al., 2005; Feurer et al., 2019). The average resting HRV levels were also consistent with previously published norms (Gilbert, 2002).

Primary Analyses

A correlation analysis was conducted between scores for self-control and nonattachment. Self-control had a positive correlation with nonattachment ($r = .309$, $p < .001$), suggesting that higher levels of trait self-control were associated with higher levels of nonattachment. This finding is consistent with hypothesis 1.

Effects of Agency and Communion Threats

In contrast with hypothesis 2, neither of the main effects of agency or communion were significant. High agency threat participants did not have a significantly different change in HRV (-.167 vs. -.215, SEs = .16, .13), F (1,107) = .054, $p = .82$, $\eta^2 = .001$. High communion threat participants did not have a significantly different change in HRV (-.29 vs -.10, SEs = .14, .16), F (1,107) = .84, $p = .36$, $\eta^2 = .01$). Additionally, the agency X communion threat interaction was not significant, F (1,107) = .02, $p = .89$, $\eta^2 = .000$. Gender did not influence change in HRV (-.03 vs. -.35, SEs = .17, .12), F (1,107) = 2.32, p = .13, $\eta^2 = .02$, and no interactions between gender, agency, and communion were significant.

Effects of Self-Control and Nonattachment

Self-Control. A hierarchical regression analysis was used to assess 1) the association between self-control and change in HRV, and 2) the moderating effect of self-control on social evaluative threat. The rationale of the order of each step of the hierarchical regression analysis is consistent with previous research (Smith & Jordan, 2015). Communion was added first, followed by agency, self-control, agency x self-control and communion x self-control, and agency x communion x self-control. Contrary to hypothesis 3, self-control was not associated with change

in HRV F (7,90) = .49, p = .84, R^2 = .034 (see Table 2). Similarly, none of the tests of the moderating effect of self-control on social evaluative threat were significant.

Table 2

Hierarchical Regression Analysis Examining Whether Self-Control Moderates the Effect of Social Threat on HRV

Model	Variables	Unstandardized β	SE	Coefficients β	t	p
1	(Constant)	-.24	.10		-2.56	<.05
	Agency	-.02	.10	-.02	-.15	.88
	Communion	.06	.94	.06	.60	.55
2	(Constant)	-.24	.10		-2.56	< .05
	Agency	-.01	.10	-.02	-.15	.88
	Communion	.06	.10	.06	.59	.56
	Agency x Communion	.01	.10	.01	.15	.88
3	(Constant)	-.36	.62		-.58	.57
	Agency	-.01	.10	-.01	-.14	.89
	Communion	.05	.10	.06	.57	.57
	Agency x Communion	.02	.10	.02	.16	.87
	Self Control	.00	.02	.02	.19	.85
4	(Constant)	-.56	.64		-.87	.39
	Agency	1.01	.64	1.13	1.71	.09
	Communion	-.14	.64	-.14	-.21	.83
	Agency x Communion	.04	.10	.04	.36	.72
	Nonattachment	.01	.02	.05	.48	.63
	Agency x Self Control	-.03	.02	-1.16	-1.75	.08
	Communion x Self Control	.00	.02	.18	.28	.78
5	(Constant)	-.55	.65		-.84	.40
	Agency	1.10	.65	1.14	1.70	.09
	Communion	-.13	.65	-.13	-.19	.85
	Agency x Communion	-.03	.65	-.04	-.05	.96
	Self Control	.01	.02	.05	.46	.65
	Agency x Self Control	-.03	.02	-1.17	-1.73	.09
	Communion x Self Control	.00	.02	.17	.26	.80
	Agency x Communion x Self Control	.00	.02	.07	.11	.92

Nonattachment. A hierarchical regression analysis was used to assess 1) the association between nonattachment and change in HRV, and 2) the moderating effect of nonattachment on social evaluative threat. The rationale of the order of each step of the hierarchical regression analysis is consistent with previous research (Smith & Jordan, 2015). Contrary to hypothesis 4, nonattachment was not associated with change in HRV F (7,90) = .88, p = .52, R^2 = .064 (see Table 3). Similarly, none of the tests of the moderating effect of nonattachment on social evaluative threat were significant.

Table 3

Hierarchical Regression Analysis Examining Whether Nonattachment Moderates the Effect of Social Threat on HRV

Model	Variables	Unstandardized β	SE	Coefficients β	t	p
1	(Constant)	-.25	.09		-2.70	<.01
	Agency	-.06	.09	-.06	-.62	.54
	Communion	.12	.09	.13	1.29	.20
2	(Constant)	-.25	.09		-2.65	.01
	Agency	-.06	.09	-.07	-.64	.53
	Communion	.12	.09	.14	1.32	.19
	Agency x Communion	-.03	.09	-.04	-.36	.72
3	(Constant)	-1.01	.66		-1.53	.13
	Agency	-.08	.10	-.09	-.84	.41
	Communion	.11	.09	.13	1.21	.23
	Agency x Communion	-.02	.09	-.02	-.19	.85
	Nonattachment	.01	.01	.12	1.16	.25
4	(Constant)	-.99	.67		-1.48	.14
	Agency	-.65	.67	-.71	-.97	.34
	Communion	-.02	.67	-.03	-.04	.97
	Agency x Communion	.03	.10	-.03	-.31	.76
	Nonattachment	.01	.01	.12	1.09	.28
	Agency x Nonattachment	-.01	.01	.63	.87	.39
	Communion x Nonattachment	.00	.01	.17	.23	.82
5	(Constant)	-1.12	.67		-1.67	.10
	Agency	-.60	.67	-.65	-.89	.38
	Communion	-.08	.67	.09	-.12	.90
	Agency x Communion	.89	.67	.98	1.33	.19
	Nonattachment	.01	.01	.14	1.26	.21
	Agency x Nonattachment	.00	.01	.59	.80	.43
	Communion x Nonattachment	.00	.01	.26	.35	.73
	Agency x Comm. x Nonattachment	-.01	.01	-1.02	-1.39	.17

Exploratory Analyses

Given that hypotheses 2, 3, and 4 were not confirmed, exploratory analyses were conducted to further examine 1) baseline differences and 2) overall changes from baseline averaging across conditions (e.g., the general effect of the stressful task). Recent research suggests that African Americans have higher resting HRV compared to non-Hispanic Whites (Hill et al., 2015). Therefore, a categorical variable was created (1 = African American; 2 = non-Hispanic White) to determine if there were differences in resting HRV. In a separate analysis, a categorical variable was created (1 = African American; 2 = non-African American) to examine the role of race and its effect on the experimental manipulation (i.e., social evaluative threat).

For the individual difference variables of self-control and nonattachment, baseline differences were also investigated. There is limited evidence that self-control is associated with higher resting HRV. To this researcher's knowledge, no research has explored the relationship between resting HRV and nonattachment, though there is reason to believe that it, too, has this association given that related constructs (e.g. resilience, emotional intelligence, and well-being) are associated with higher resting HRV (Alen et al., 2022; Gordon, et al., 2020; Sharma et al., 2019).

The exploratory analysis related to overall changes from baseline averaging across conditions was meant to investigate the general effect of engaging in the stressful task. While the main hypotheses of the present study showed no effect of agency or communion on change in HRV, it is possible that while these independent variables had no effect on the dependent variable, the mean of the overall response (i.e., when all predictors are zero) could be significant, which would shed some light on the general effect of simply engaging in the stressful task.

Baseline Differences in Resting HRV

An independent samples t-test was utilized to compare baseline HRV levels in African Americans and non-Hispanic Whites. Compared to non-Hispanic Whites, African Americans had higher resting HRV ($t(84) = 2.16$, $p < .05$; $M = 7.08$, $SD = 1.14$ vs $M = 6.64$, $SD = .74$; 95% CI of difference = .03 to .84; Cohen's d = .47). This finding is consistent with recently reported data and will be further discussed below.

Two categorical variables were created (i.e., high and low) for self-control and nonattachment via median split. There was no difference in resting HRV between high and low self-control ($t = .24$, $p = .81$). However, there was a trend toward different resting HRV between high and low nonattachment ($t(109) = -1.82$, $p = .07$; $M = 6.66$, $SD = .91$ vs $M = 6.98$, $SD = .93$; 95% CI of difference = -.67 to .03; Cohen's d = -.35). In other words, individuals with higher nonattachment demonstrated a trend toward having higher resting HRV.

Effects of Agency and Communion Threats and the Role of Race

Physiological reactivity (i.e., HRV change) in response to the social task was analyzed as task minus baseline change scores in a 2 (high vs. low agency threat) X 2 (high vs. low communion threat) X 2 (gender) X 2 (race) factorial ANOVA. Adding in the categorical variable of race did not influence the results of hypothesis 2 (i.e., there was not a main effect of agency or communion nor an interaction); however, a communion by gender by race interaction emerged ($F(15,91) = 4.21$, $p < .05$, $\eta^2 = .044$). As depicted in Table 4 and Figure 2, African American men had a trend toward a larger increase in HRV when exposed to communion threat compared to African American men not exposed to communion threat ($F(1,91) = 3.18$, $p = .078$, $\eta^2 = .034$). In other words, compared to baseline, African American men had a trend toward greater heart rate variability during the stressor task involving communion social evaluative threat.

Furthermore, African American women had greater HRV when not exposed to communion threat compared to White women not exposed to communion threat ($F(1,91) = 4.77$, $p < .05$, $\eta^2 = .05$).

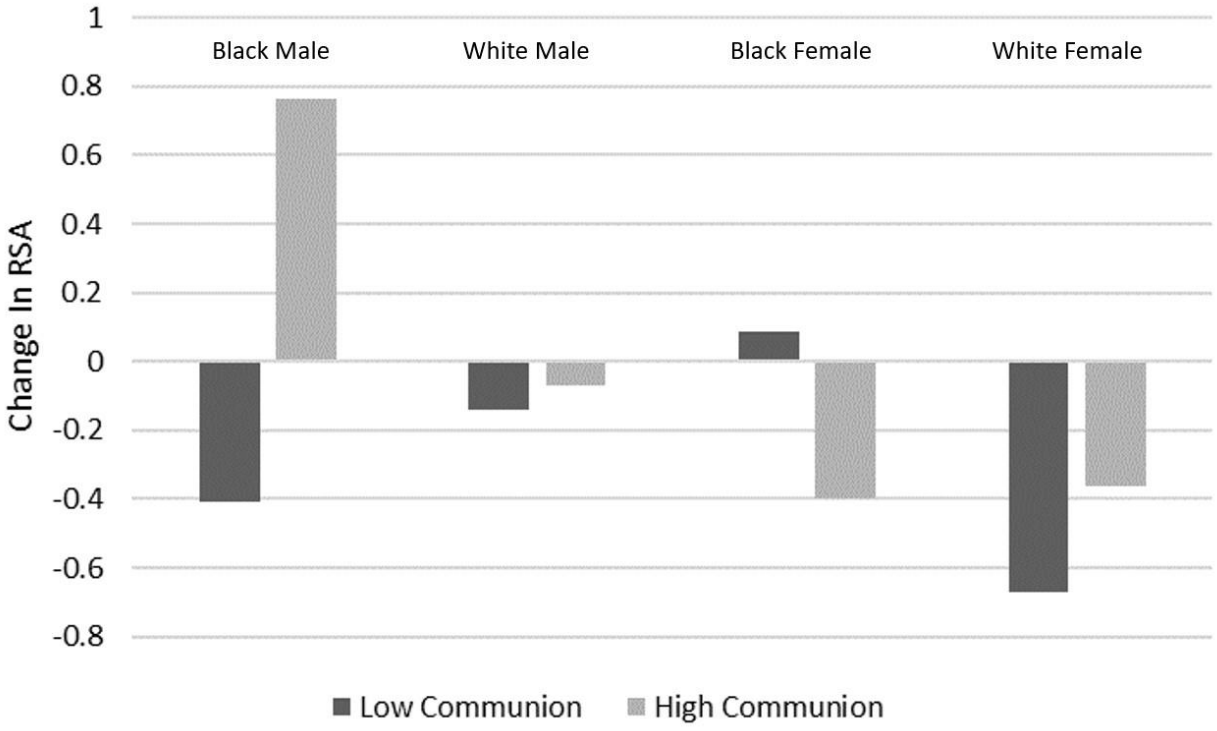
Table 4

Means for HRV Change Based on Gender, Race, and Communion Threat

Communion	Gender	Race	Mean	Std. Error
-1 (low threat)	Men	African American	-.41	.38
		Non-African American	-.14	.25
	Women	African American	.09	.26
		Non-African American	-.67	.23
1 (high threat)	Men	African American	.76	.54
		Non-African American	-.07	.32
	Women	African American	-.40	.31
		Non-African American	-.36	.20

Figure 2

Changes in HRV Based on Gender, Race, and Communion Threat



Overall Changes from Baseline Averaging across Conditions

The test of the significance of the intercept in multiple regression (regressing the dependent variable of the present study on the independent variables) provides information on overall change in HRV collapsed across conditions. In other words, it provides the mean response when the predictors (i.e., agency and communion) are zero. The stressful task evoked significant change in HRV ($F(1, 104) = 7.91$, $p < .01$, ${}_p\eta^2 = .07$). This finding means that when examining the effect of the stressful task for all participants, HRV decreased on average ($M = -.27$, $SE = .10$), which is expected.

CHAPTER 5

Discussion

Examining, and ideally identifying, psychosocial determinants of cardiovascular health is of particular importance due to the high rates and often negative outcomes of CVD, the large economic burden created by CVD treatment, the lack of attention and resources directed towards researching this aspect of CVD, and the need for improved CVD treatment, particularly in terms of treating CVD through a biopsychosocial framework. By continuing to gather further information regarding psychosocial factors contributing to CVD, professionals treating and researching cardiovascular health should be able to better understand the etiology and prognosis of CVD from a more holistic framework, creating a biopsychosocial paradigm to guide and create patient specific treatments. The current study sought to determine plausible benefits of psychosocial factors on the cardiovascular response to stress by examining the impact of trait self-control and nonattachment on HRV, as measured by HRV.

First, it was hypothesized that trait self-control and nonattachment would be positively associated with one another. Second, it was hypothesized that in response to the modified TSST the experimental conditions would have lower HRV compared to the control condition. Third, it was hypothesized that participants high in trait self-control would demonstrate greater HRV in response to the TSST compared to participants low in trait self-control. Lastly, it was hypothesized that participants high in nonattachment would demonstrate greater HRV in response to the TSST compared to participants low in nonattachment. The results of the current study supported the first hypothesis and but did not support hypotheses two, three, and four.

Consistent with our first hypothesis, the present study found a significant association between self-control and nonattachment, suggesting that higher levels of trait self-control were

associated with higher levels of nonattachment. One possible explanation for this significant positive association is theoretical overlap. Psychological research often operationalizes the constructs of self-control and nonattachment in a similar manner, such that self-control is characterized by altering the self's responses and mindfulness interventions incorporate altering, or controlling, an aspect of behavior (Brown et al., 2008; Masicampo & Baumeister, 2007), which creates significant theoretical overlap. Additionally, psychological research has examined these constructs through similar methods, tasks that are anomalous in nature and require sustained attention (Brown et al., 2007; Masicampo & Baumeister, 2007). For example, studies examining the impact of MBSR direct participants to focus their attention on their bodies, thoughts, and specific images, whereas studies examining self-control incorporate tasks requiring managing attention to specific visual or auditory stimuli, while disregarding insignificant stimuli (Brown et al., 2008). Methods also involved in measuring both constructs highlight conscious control of motor behaviors (Brown et al., 2007; Masicampo & Baumeister, 2007). In essence, psychological research characterizes trait self-control and nonattachment using similar concepts, and even language, and measures these constructs through tasks with significant overlap.

Masicampo and Baumeister (2007) also postulated on the similarity between these two constructs, suggesting that nonattachment may be a facet of the construct of self-control. They suggested mindfulness interventions may be more enduring versions of attention control tasks used in self-control research. Their explanation provides some clarity for the association found in the current study.

An additional potential explanation for the positive association between trait self-control and nonattachment are their associations with many of the same positive outcomes. Trait self-control and nonattachment have been individually linked to many positive outcomes (physical

health, mental health, behavior regulation, emotion regulation, and interpersonal relationships). Individuals high in trait self-control or high in nonattachment often experience the same positive benefits, suggesting the constructs are somewhat related. This also makes it conceivable that high levels of both these constructs would be associated with a known positive biomarker of cardiovascular health: greater HRV.

In regard to hypothesis 2, the present study found that compared to the control condition, participants exposed to social evaluative threat did not demonstrate lower HRV. It is posited that this hypothesis may have been refuted due to the task being too stressful overall, hence not being able to find additional effects of adding a social evaluative threat. In other words, participants may have found the study to be very stressful regardless of the condition. Participants of all conditions participated in a pseudo confrontation with an imagined third party. This imagined confrontation may have been so inherently stressful that adding a social evaluative component was not observable between groups. This was supported by our finding that HRV decreased for all participants, regardless of condition, but that agency or communion did not have an effect. Additionally, participants in the non-social evaluative condition may have inferred that research assistants were still observing their participation, despite not physically being present, creating a stressful experience similar to having the social evaluation present.

In regard to hypothesis 3, results of the current study did not show that self-control moderates the relationship between social evaluative threat and HRV reactivity. One possible explanation for this result is the measure's low reliability ($\alpha = .58$) observed in the current study. Items on the trait self-control measure may have been too obvious in what they were measuring (e.g., "I am good at resisting temptation" and "I am lazy"), particularly for the current study's population, to obtain accurate measures of trait self-control. This could have led to participants

responding in a socially desirable manner. The majority of the participant sample were first-year undergraduate students in college and may have not adequately attended to all items on the measure. Participants completed several measures and participated in the TSST, creating a potentially cognitively taxing experience for many of the participants. It seems plausible that this may have affected participant's scores on the measures, and subsequently internal consistency.

Similarly, in regard to hypothesis 4, results of the current study did not show that nonattachment moderates the relationship between social evaluative threat and HRV reactivity. This may be due to the manipulation of the study being less than ideal. Essentially, the task induced stressor led to a significant stress reaction within all groups of the study. Ideally, the task induced stressor would have led to differences in stress reactions amongst the groups, which may have made the relationship between nonattachment and HRV reactivity significant.

However, there was a trend toward different resting levels of HRV between participants with high and low nonattachment, such that individuals with higher nonattachment demonstrated a trend towards having higher resting HRV. With a larger sample size, it seems plausible that this trend would have reached statistical significance. This observed trend is particularly important, as higher resting HRV is associated with many positive outcomes, and could potentially provide some theoretical support for utilizing mindfulness-based interventions within CVD populations. It also provides some support for identifying a specific biological mechanism that is potentially responsible for the association between high levels of nonattachment and positive health outcomes. Additionally, trait self-control has also been associated with greater HRV at rest, providing more overlap between the constructs of nonattachment and trait-self control.

Overall, three of the four hypotheses of the study were not supported. Exploratory analyses were conducted to assess outcomes that were not directly hypothesized in the current

study. Two key findings were identified, both illuminating race/ethnicity differences in cardiovascular functioning between African Americans and non-Hispanic White Americans. First, African American participants demonstrated greater resting HRV compared to non-Hispanic White American participants, which replicates many recent findings examining race and ethnicity differences in cardiovascular health (Hill et al., 2015; Hill & Thayer, 2019; Rosati et al., 2021). Second, there was a trend that African American men participants demonstrated greater HRV during the stressor task involving communion social evaluative threat compared to African American men participants not exposed to communion threat, which differs from the literature suggesting that African Americans experience blunted cardiovascular responses to stress, particularly in terms of exposure to race-related stress (Hill & Thayer, 2019). These two findings significantly contribute to the literature examining race/ethnicity differences in cardiovascular functioning, particularly in context of the "Cardiovascular Conundrum," with the first finding supporting the cardiovascular conundrum and the second finding identifying an atypical cardiovascular response within African American men. Additionally, African American women participants demonstrated significantly greater HRV compared to European American women participants in the low communion group.

The Cardiovascular Conundrum refers to the perplexing pattern of cardiovascular functioning found within African Americans. Specifically, African Americans suffer significantly higher rates of heart disease and CVD risk factors compared to European Americans, yet also demonstrate *greater* HRV at rest compared to European Americans (Hill et al., 2015). This is particularly puzzling as HRV has been considered a protective factor of CVD. A meta-analysis of 17 studies examining the subject, consisting of approximately 11,000 participants, found support that African Americans demonstrate significantly greater HRV at rest

compared to European Americans, even when controlling for age, sex, and health status (Hill et al., 2015). However, exposure to discrimination was identified as a moderator between race and HRV for African Americans, such that African Americans endorsing greater exposure to discrimination demonstrated lower HRV compared to African Americans endorsing less exposure to discrimination (Hill & Thayer, 2019). Including exposure to discrimination in the analysis of race and HRV significantly lessened the differences in HRV between African Americans and European Americans, suggesting that racial discrimination is associated with HRV within African Americans, particularly in the context of racial discrimination reducing HRV (Hill et al., 2015; Hill & Thayer, 2019).

Rosati and colleagues (2021) sought to examine the impact discrimination has on HRV within another marginalized group, the Lesbian, Gay, and Bisexual (LGB) population. The LGB population is a minority group documented to have experienced repeated discrimination. Their study observed greater levels of HRV, both at rest and while being exposed to an emotional and cognitive stressor, within the LGB population compared to heterosexuals (Rosati et al., 2021). Results from this study likely nullify genetics as a primary contributor to greater HRV at rest, and rather point towards discrimination as an overlapping factor amongst two different minority groups. It seems that discrimination likely plays a unique role in greater HRV within minority groups and it has been posited that emotion regulation may be an underlying factor (Rosati et al., 2012).

Individual differences in emotion regulation have been associated with greater resting HRV (Makovac et al., 2022). Therefore, emotion regulation strategies may account for differences in resting HRV between African Americans, the LGB population, and European Americans, such that African Americans and the LGB population have developed greater resting

HRV as a result of repeatedly coping with discrimination. It has been theorized that minority groups encounter unfair treatment more often and must regulate their emotional responses, through inhibition or suppression, which would provide context for their overall greater levels of resting HRV (Hill et al., 2015). This finding has led to the supposition that discrimination paired with emotion regulation tactics uniquely interact with HRV to affect cardiovascular health.

Rosati and colleagues (2021) posit that the repeated efforts to control one's negative emotions, through reappraisal and suppression, due to exposure to discrimination is likely responsible for the cardiovascular conundrum within African Americans and the LGB population. The emotion regulation strategy of reappraisal seems to be of particular importance within the context of coping with discrimination. Reappraisal is considered to be particularly useful for coping with stressors that are uncontrollable and more maladaptive for stressors that are controllable (Troy et al., 2013). Reappraisal seems ideal for coping with discrimination, as some stressors related to discrimination are uncontrollable in a society filled with systemic racism. While the aforementioned cannot be concluded due to a lack of empirical evidence, their theory highlights the importance of continuing to research psychosocial factors affecting cardiovascular health, particularly in the context of the cardiovascular conundrum.

The present finding that there was a trend for African American men illustrating greater HRV during the stressor task involving communion social evaluative threat compared to African American men not exposed to the communion social evaluative threat is unique in that it represents a psychosocial stressor that elicited more adaptable HRV within African American men, which is largely inconsistent with previous literature, particularly the meta-analysis performed by Hill and Thayer (2019). In particular, African Americans experiencing race related stress actually demonstrated blunted HRV, whereas in the present study, African American men

experienced greater HRV when experiencing communal social evaluative threat. This is important as it may provide more evidence for the impact that different types of stressors have on HRV in a marginalized population.

In order to better understand potential reasons for the trend that African American men demonstrated greater HRV to the communal stressor, the context of the communion social evaluative stressor should be discussed. In the communion condition, participants were told they would be rated on how likable, interesting, and friendly they were. It seems plausible that these instructions came across as positive, or at the very least neutral, which appears opposite to racial discrimination. Our social evaluation was presented to participants in a manner suggesting our raters would observe their behavior and then make a conclusion on likability, interesting level, and friendliness. Essentially, our evaluation would be fair. Racial discrimination seems to be opposite to our social stressor in that it infers negative attributes to a specific population, absent of any sort of evaluation or fairness. Essentially, it is predetermined. This suggests that HRV may be dependent on type of stress experienced, rather than any kind of stress. This also highlights that emotion regulation involved in coping with race related stress may be different from emotion regulation used for more neutral stressors (i.e., research assistants judging), or that it at least affects the cardiovascular response in a different manner.

Overall, in regard to the exploratory analyses, the first finding that African American participants demonstrated higher resting HRV compared to non-Hispanic White American participants, is consistent with previous findings and further provides evidence for the cardiovascular conundrum. However, the second finding the trend that African American male participants demonstrated greater HRV during the stressor task involving communion social evaluative threat compared to African American men not exposed to communion social

evaluative threat, seems to lead to more questions than answers, as it has been documented that African Americans typically experience blunted HRV. The present study provides further evidence for the cardiovascular conundrum, with African Americans demonstrating greater resting HRV, while also identifying a unique HRV reaction within African American men experiencing stress potentially absent of discrimination.

While HRV has often been accepted as a universal indicator of good cardiovascular health, results from this study and several recent studies suggest this may not be the case for African Americans. The plethora of research on HRV suggests that it is beneficial for European Americans, while African Americans display good HRV but continue to suffer the highest rates of CVD. Thus, HRV may be a less than an ideal biomarker of universal cardiovascular health.

Lastly, African American women demonstrated greater HRV when exposed to the low communion threat compared to European American women exposed to the low communion threat. Perhaps African American women did not feel as stressed during this condition compared to European American women due to their experience with racial discrimination. It is well documented that African Americans, and particularly African American women, experience racial discrimination at a high rate throughout their lives. The current stress evoker, the low communion condition, may have been much less stressful compared to other instances of stress within their lives, resulting in greater HRV compared to European American women.

Strengths

In regard to strengths, despite the task demands of the study's manipulation, the experimental methods can be considered a strength of the study. Another strength of the study, compared to the bulk of research examining the cardiovascular response to stress, was the use of social evaluation by means of either agency or communion. The majority of studies examining

the cardiovascular response to stress have opted to evoke a stress response using the Trier social stress test or the cold pressor task, as these methods have reliably elicited a stress response in participants. However, utilizing the Trier social stress test emphasizes the agency motive component of the test and the cold pressor task, and other similar tasks, are less clear in terms of exactly what they are eliciting. In the present study, the stress response was evoked utilizing a manipulation of social evaluation, which ideally mimics the stress response individuals experience in their daily lives, outside of the laboratory setting. At the very least, it seems much closer to mimicking a more organic stress response compared to the cold pressor task.

Limitations

One limitation of the current study was that it relied on measuring trait self-control through the use of self-report measures. Trait self-control is a socially desirable trait to possess, and participants may have responded to items on the BSCS in a socially desirable manner rather than answering honestly. Self-report measures also require participants to make a self-evaluation, which is a difficult task to accomplish, and responses on the BSCS may have reflected the participants' self-evaluation rather than their authentic level of self-control. As self-control is a multidimensional personality construct, Duckworth and Kern (2012) suggested that in order to most accurately assess the construct, multiple methods should be used. It likely would have been more accurate to assess trait self-control through the use of self-report measures and behavioral measures (executive functioning tasks, delayed gratification tasks) to obtain more accurate data assessing self-control levels.

An additional limitation of the study was that the HRV data relied on analysis software (Mindware Cardiography Analysis Software) that estimates where heart beat intervals occur when there was an error (or "noise") interfering with clean collection of the heart rhythm. It is

possible that misestimations occurred that led to a less reliable index of HRV. However, multiple steps were taken to mitigate this possibility including removing potential electrical interferences (i.e., having the participants place their cell phones in a different room) and having research assistants review the heart rhythm both during the experiment and afterwards when downloading the data.

There are also limitations with using a university sample with relatively young adults. It seems likely that our participants are overall healthier compared to the general population, such that they are younger. Additionally, it seems plausible that our participants likely have not encountered as much stress throughout their young lives compared to older individuals. Both of these factors create a limitation such that our participant population is likely not as generalizable to the overall population.

Finally, while the experimental rigor of the study is notable, it may have reduced the external validity of the results. The context of an experimental setting is unique and may not be generalizable. This limitation is especially important to keep in mind when considering the exploratory analyses. Ambulatory studies assessing moment-to-moment self-control, nonattachment, and HRV may provide greater ecological validity.

Future Directions

The results of the current study emphasize missing knowledge in the current literature and identify important directions for future research. First, future research should aim to empirically differentiate the constructs of trait self-control and nonattachment. It can be concluded that higher levels of these constructs are both associated with better overall health compared to lower levels, however, it appears that significant construct overlap exists, making it

difficult to fully understand the exact mechanisms leading to better overall health. Second, the positive association between trait self-control and nonattachment found in the current study may be particularly valuable in terms of treatment guidance, and future research should seek to identify if treatment modalities are capable of increasing self-control and nonattachment. For example, mindfulness-based interventions incorporate principles and techniques that comprise aspects of nonattachment, suggesting that one can learn to behaviorally implement aspects of nonattachment into one's life, and subsequently experience similar positive health outcomes associated with nonattachment. However, further research is needed to determine whether mindfulness-based interventions personify the positive effects from high levels of nonattachment.

Third, greater HRV has been conceptualized as a biomarker of well-functioning cardiovascular health, however, African Americans exhibit higher rates of CVD and greater HRV at rest. This "cardiovascular conundrum" warrants more research in order to better conceptually understand HRV as it applies to race and ethnicity, as well as examine underlying mechanisms leading to increased HRV within African Americans. In particular, research should also examine the influence of emotion regulation on HRV within African Americans, to better understand the influence of emotion regulation in the context of various stressors (e.g., regulation used for neutral stressors vs. race related stressors) on HRV.

Conclusion

Self-control and nonattachment are two components of self-regulation that have a high degree of conceptual overlap. They share many positive health correlates, and in the context of CVD, show promise for reducing risk and morbidity. While the present study did not demonstrate that self-control and nonattachment moderate the relationship between stress and

HRV reactivity, exploratory analyses did shed some light on the cardiovascular conundrum providing an impetus for continued research on the various ways that psychosocial factors “get under the skin” to influence health and well-being.

REFERENCES

Abbott, R., Whear, R., Rodgers, L., Bethal, A., Coon, J., Kuyken, W., Stein, K., & Dickens, C. (2014). Effectiveness of mindfulness-based stress reduction and mindfulness based cognitive therapy in vascular disease: A systematic review and meta-analysis of randomized controlled trials. *Journal of Psychosomatic Research, 76*(5), 341-351. https://doi.org/10.1016/j.jpsychores.2014.02.01

Alen, N., Deer, L., & Hostinar, C. (2022). Respiratory sinus arrhythmia as a physiological resilience marker for children's health. *Psychosomatic Medicine, 84*(3), 374-382. https://doi.org/10.1097/PSY.0000000000001057

American Heart Association. (2017). *Cardiovascular disease: A costly burden for America projections through 2035*. https://healthmetrics.heart.org/cardiovascular-disease-a-costly-burden/

Armstrong, P. & Moe, G. (1993). Medical advances in the treatment of congestive heart failure. *Circulation, 88*(6), 2941-2952. https://doi.org/10.1161/01.cir.88.6.2941

Bakhshani, N. (2014). Impulsivity: A predisposition toward risky behaviors. *International Journal of High Risk Behaviors & Addiction, 3*(2), 1-3https://doi.org/10.5812/ijhrba.20428

Balzarotti, S., Biassoni, F., Colombo, B., & Ciceri, M. R. (2017). Cardiac vagal control as a marker of emotion regulation in healthy adults: A review. Biological Psychology, 130, 54-66. https://doi.org/10.1016/j.biopsycho.2017.10.008

Barratt, E. (1994). Impulsiveness and aggression. In J. Monahan & H. J. Steadman (Eds.), *Violence and mental disorder: Developments in risk assessment* (pp. 61-79). The University of Chicago Press.

Baumeister, R., Gailliot, M., DeWall, N., & Oaten, M. (2006). Self-regulation and personality: How interventions increase regulatory success, and how depletion moderates the effects of traits or behavior. *Journal of Personality, 74*(6), 1773-1802. https://doi.org/10.1111/j.1467-6494.2006.00428.x

Berntson, G. & Cacioppo, J. (2004). Heart rate variability: Stress and psychiatric conditions. In M. Malik & A. Camm (Eds.), *Dynamic electro cardiography* (pp. 56-63). Futura.

Borges, A., Selby, E., Bates, M., Zvolensky, M., Leyro, T. (2019). Examining the relation between physiological and psychological components of stress reactivity and recovery in cigarettes smokers. *Applied Psychophysiology and Biofeedback, 44*(2), 131-141. https://doi.org/10.1007/s10484-019-09429-z

Brosschot, J., Gerin, W., & Thayer, J. (2006). The preservative cognition hypothesis: A review of worry, prolonged stress-related physiological activation, and health. *Journal of Psychosomatic Research, 60*(2), 113-124. https://doi.org/10.1016/j.jpsychores.2005.06.074

Brown, K. & Ryan, R. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822-848. https://doi.org/10.1037/0022-3514.84.4.822

Brown, K., Ryan, R., & Creswell, J. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry, 18*(14), 211-237. https://doi.org/10.1080/10478400701598298

Brown, K., Ryan, R., Creswell, J., & Niemiec, C. (2008). Beyond me: Mindful responses to social threat. In H. A. Wayment & J. J. Bauer (Eds.), *Transcending self-interest: Psychological explorations of the quiet ego* (pp. 75-84). American Psychological Association. https://doi.org/10.1037/11771-007

Brown, K., Weinstein, N., Creswell, J. (2012). Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat. *Psychoneuroendocrinology, 37*(12), 1-9. https://doi.org/10.1016/j.psyneuen.2012.04.003

Buchhorn, R. (2016). The impact of nutrition on the autonomic nervous system. *International Journal of Food and Nutritional Science*. https://doi.org/10.15436/2377-0619.16.942

Carver, C., Johnson, S., Joormann, J. (2008). Serotonergic function, two-mode models of self-regulation, and vulnerability to depression: What depression has in common with impulsive aggression. *Psychological Bulletin, 134*(6), 912-943. https://doi.org/10.1037/a0013740

Cassin, S. E. & van Ranson, K. M. (2005). Personality and eating disorders: A decade in review. *Clinical Psychology Review, 25*(7), 895-916. https://doi.org/10.1016/j.cpr.2005.04.012

Centers for Disease Control and Prevention. (2022). *Heart Disease.* https://www.cdc.gov/nchs/fastats/heart-disease.htm

Chen, X., Li, B., & Xie, J. (2018). The big five, self-efficacy, and self-control in boxers. *BioRxiv*, 1-16. https://doi.org/10.1101/361295

Chida, Y., & Steptoe, A. (2010). Greater cardiovascular responses to laboratory mental stress are associated with poor subsequent cardiovascular risk status: A meta-analysis of prospective evidence. *Hypertension, 55*(4), 1026-1032. https://doi.org/10.1161/HYPERTENSIONAHA.109.146621

Cobb-Clark, D., Dahmann, S., Kamhofer, D., & Schildberg-Horisch, H. (2022). Self-control and unhealthy body weight: The role of impulsivity and restraint. *Life Course Centre Working Paper No. 2022-01*. https://dx.doi.org/10.2139/ssrn.4010275

Cohen, S. & Manuck, S. B. (1995). Stress, reactivity, and disease. *Psychosomatic Medicine, 57*(5), 423-426. https://doi.org/10.1097/00006842-199509000-00002

Corey, S., Moran, P., Koslov, K., Daubenmier, J., Mendes, W., Bacchetti, P, Acree, M., Kemeny M., Goldman, V., Hall, M., Epel, E., & Hecht, F. (2012). Effect of dispositional mindfulness on recovery from an acute laboratory stressor. *BMC Complementary and Alternative Medicine, 12*(1), 190. https://doi.org/ 10.1186/1472-6882-12-S1-P190

Cuevas, A., Williams, D., & Albert, M. (2017). Psychosocial factors and hypertension: A review of the literature. *Cardiology Clinics, 35*(2), 223-230. https://doi.org/10.1016/ j.ccl.2016.12.004

Cyders, M. & Coskunpinar, A. (2011). Depression, impulsivity, and health-related disability: A moderate mediation analysis. *Journal of Research in Personality, 45*(6), 679-682. https://doi.org/10.1016/j.jrp.2011.08.005

Daly, M., Baumeister, R., & Maclachlan, M. (2014). Self-control and its relation to emotions and psychobiology: Evidence from a day reconstruction method study. *Journal of Behavioral Medicine, 37*(1), 81-93. https://doi.org/10.1007/s10865-012-9470-9

D'Antono, B., Moskowitz, D., Miners, C., & Archambault, J. (2005). Gender and communal trait differences in the relations among social behaviour, affect arousal, and cardiac autonomic control. *Journal of Behavioral Medicine, 28*(3), 267-279. https://doi.org/10.1007/s10865-005-4663-0

de Ridder, D., Lensvelt-Mulders, G., Finkenauer, C., Stok, F., & Baumeister, R. (2012). Taking stock of self-control: A meta-analysis of how trait self-control relates to a wide range of behaviors. *Personality and Social Psychology Review, 16*(1), 76-99. https://doi.org/10.1177/1088868311418749

DeWall, C., Baumeister, R., Stillman, T., & Galliot, M. (2007). Violence restrained: Effects of self-regulation and its depletion on aggression. *Journal of Experimental Social Psychology, 43*(1), 62-76. https://doi.org/10.1016/j.jesp.2005.12.005

Dickman, S. (1993). Impulsivity and information processing. In W. G. McCown, J. L. Johnson, & M. B. Shure (Eds.), *The impulsive client: Theory, research, and treatment* (pp. 151-184). American Psychological Association. https://doi.org/10.1037/10500-010

Dixon, M., Paliliunas, D., Belisle, J., Speelman, R., Gunnarsson, K., & Shaffer, J. (2019). The effect of brief mindfulness training on momentary impulsivity. *Journal of Contextual Behavioral Science, 11*, 15-20. https://doi.org/10.1016/j.jcbs.2018.11.003

Duckworth, A. L. & Seligman, M. E. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological Science, 16*(12), 939-944. https://doi.org/10.1111/j.1467-9280.2005.01641.x

Duckworth, A. L., & Kern, M. (2012). A meta-analysis of the convergent validity of self-control measures. *Journal of Research in Personality, 45*(3), 259-268. https://doi.org/10.1016/j.jrp.2011.02.004

Endo, A. (2008). A gift from nature: The birth of the statins. *Natural Medicine, 14*(10), 1050-1052. https://doi.org/10.1038/nm1008-1050

Engel, G. (1977). The need for a new medical model: A challenge for biomedicine. *Science, 196,* 129-136. https://doi.org/10.1126/science.847460

Engel, G. (1980). The clinical application of the biopsychosocial model. T*he American journal of Psychiatry, 137*(5), 535–544. https://doi.org/10.1176/ajp.137.5.535

Erisman, S. & Roemer, L. (2010). Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat. *Emotion, 10*(1), 72-82. https://doi.org/10.1037/a0017162

Eysenck, S. B. (1993). The I_7: Development of a measure of impulsivity and its relationship to the superfactors of personality. In W. G. McCown, J. L. Johnson, & M. B. Shure (Eds.), *The impulsive client: Theory, research, and treatment* (pp. 141-149). American Psychological Association https://doi.org/10.1037/10500-009

Fetterman, A., Robinson, M., & Ode, S. (2010). Neuroticism as a risk factor for behavioral dysregulation: A mindfulness-mediation perspective. *Journal of Social and Clinical Psychology, 29*(3), 301-321. https://doi.org/10.1521/jscp.2010.29.3.301

Feurer, C., Woody, M., James, K., Kudinova, A., & Gibb, B. (2019). Neighborhood crime risk and resting respiratory sinus arrhythmia in middle childhood: Evidence of gender differences. *Developmental Psychobiology, 62*(2), 1-8. https://doi.org/10.1002/dev.21893

Fogarty, F., Lu, L., Sollers III, J., Krivoschekov, S., Booth, R., & Consedine, N. (2013). Why it pays to be mindful: Trait mindfulness predicts physiological recovery from emotional stress and greater differentiation among negative emotions. *Mindfulness, 6*(2), 175-185. https://doi.org/10.1007/s12671-013-0242-6

Gilbert, C. (2002). Interaction of psychological and emotional effects with breathing dysfunction. In L. Chaitow, D. Bradley, and C. Gilbert (Eds)., *Multidisciplinary Approaches to Breathing Pattern Disorders* (pp. 111-129). Churchill Livingstone.

Gordon, I., Horesh, D., Milstein, N., Tomashin, A., Mayo, N., & Korisky, A. (2020). Pre-pandemic autonomic nervous system activity predicts well-being during COVID-19 in Israel. *Psychophysiology, 58*(11) https://doi.org/10.1111/psyp.13910

Gray, E. & Watson, D. (2003). General and specific traits of personality and their relation to sleep and academic performance. *Journal of Personality, 7*0(2), 177-206. https://doi.org/10.1111/1467-6494.05002

Grines, C., Cox, D., Stone, G., Garcia, E., Mattos, L., Giambartolomei, A., Brodie, B., Madonna, O., Eijgelshoven, M., Lansky, A., O'Neill, W., & Morice, M. Coronary. (1999). Coronary angioplasty with or without stent implantation for acute myocardial infarction. *New England Journal of Medicine, 341*(26), 1949-1956. https://doi.org/10.1056/NEJM199912233412601

Hagger, M., Gucciardi, D., Turrell, A., & Hamilton, K. (2019). Self-control and health behaviour: The role of implicit self-control, trait self-control, and lay beliefs in self-control. *British Journal of Health Psychology, 24*(4), 764-786. https://doi.org/10.1111/bjhp.12378

Hahn, T. (1976). *Miracle of mindfulness*. Beacon Press.

Haliwa, I., Wilson, J., Spears, S., Strough, J., & Shook, N. (2021). Exploring facets of the mindful personality: Dispositional mindfulness and the big five. *Personality and Individual Differences, 171*. https://doi.org/10.1016/j.paid.2020.110469

Herman, J., McKlveen, J., Ghosal, S., Kopp, B., Wulsin, A., Makinson, R., Scheimann, J., & Myers, B. (2016). Regulation of the hypothalamic-pituitary-adrenocortical stress response. *Comprehensive Physiology, 6*(2), 603-621. https://doi.org/10.1002/cphy.c150015

Hill, L., Hu, D., Koenig, J., Sollers, J., Kapuku, G., Wang, W., Snieder, H., & Thayer, J. (2015). Ethnic differences in resting heart rate variability: A systematic review and meta-analysis. *Psychosomatic Medicine, 77*(1), 16-25. https://doi.org/10.1097/PSY.0000000000000133

Hill, L. & Thayer, J. (2019). The autonomic nervous system and hypertension: Ethnic differences and psychosocial factors. *Curr Cadriol Rep, 21*(3), 15. https://doi.org/10.1007/s11886-019-1100-5

Ho, M., Al-Zharani, S., Al-Ruwaitea, A., & Bradshaw, C. (1998). 5-Hydroxytryptamine and impulse control: Prospects for a behavioral analysis. *Journal of Psychopharmacology, 12*(1), 68-78. https://doi.org/10.1177/026988119801200109

Hon. E.H. & Lee, S.T. (1963). Electronic evaluation of the fetal heart rate. VIII. Patterns preceding fetal death, further observations. *American Journal of Obstetrics and Gynecology, 87*, 814-826.

Jensen-Campbell, L., Knack, J., Waldrip, A., & Campbell, S. (2007). Do big five personality traits associated with self-control influence the regulation of anger and aggression?. *Journal of Research in Personality, 41*(2), 403-424. https://doi.org/10.1016/j.jrp.2006.05.001

Johns, M. (1975). Stress and coronary heart disease. *Ergonomics, 16*(5), 683-690. https://doi.org/10.1080/00140137308924559

Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations preliminary results. *General Hospital Psychiatry, 4*(1), 33-47. https://doi.org/10.1016/0163-8343(82)90026-3

Kadziolka, M., Pierdomenico, E., & Miller, C. (2016). Trait-like mindfulness promotes healthy self-regulation of stress. *Mindfulness, 7*(1), 236-245. https://doi.org/10.1007/s12671-015-0437-0

Kemeny, M., Foltz, C., Cavanagh, J., Cullen, M., Giese-Davis, J., Jennings, P., Rosenberg, E., Gillath, O., Shaver, P., Wallace, B., & Ekman, P. (2011). Contemplative/emotion training reduces negative emotional behavior and promotes prosocial responses. *Emotion, 12*(2), 1-13. https://doi.org/10.1037/a0026118

Kemp, A. H. (2016). Heart rate variability, affective disorders and health. In B. T. Baune & P .J. Tully (Eds.), *Cardiovascular diseases and depression: Treatment and prevention in psychocardiology.* Springer International Publishing.

Khayyam-Nekouei, Z., Neshatdoost, H., Yousefy, A., Sadeghi, M., & Manshaee, G. (2013). Psychological factors and coronary heart disease. *ARYA Atheroslcerosis,* 9(1), 102-111.

Kimmes, J., May, R., Seibert, G., Jaurequi, M., & Fincham, F. (2018). The association between trait mindfulness and cardiovascular reactivity during marital conflict. *Mindfulness, 9*(4), 1160-1169. https://doi.org/10.1007/s12671-017-0853-4

Kupper, N. & Denollet, J. (2007). Type D personality as a prognostic factor in heart disease: Assessment and mediating mechanisms. *Journal of Personality Assessment,* 89(3), 265-276. https://doi.org/10.1080/00223890701629797

Lange, T., Perras, B., Fehm, H., & Born, J. (2003). Sleep enhances the human antibody response to hepatitis A vaccination. P*sychosomatic Medicine, 65*(5), 831-855. https://doi.org/10.1097/01.psy.0000091382.61178.f1

Lattimore, P., Fisher, N., & Malinowski, P. (2011). A cross-sectional investigation of trait disinhibition and its association with mindfulness and impulsivity. *Appetite, 56*(2), 241-248. https://doi.org/10.1016/j.appet.2010.12.007

Latzman, R. & Masuda, A. (2013). Examining mindfulness and psychological inflexibility within the framework of Big Five personality. *Personality and Individual Differences, 55*(2), 129-134. https://doi.org/10.1016/j.paid.2013.02.019

Lee-Winn, A., Townsend, L., Reinblatt, S., & Mendelson, T. (2016). Associations of neuroticism-impulsivity and coping with binge eating in a nationally representative sample of adolescents in the united states. *Eating Behaviors, 22*, 133-140. https://doi.org/10.1016/j.eatbeh.2016.06.009

Li, X., Gao, Q., Sun, L. & Gao, W. (2022). Effect of self-control on health promotion behavior in patients with coronary heart disease: Mediating effect of ego-depletion. P*sychology, Health & Medicine, 27*(6), 1268-1276. https://doi.org/10.1080/13548506.2020.1867316

Lim, S., Vos, T., Flaxman, A., Danaei, G., Shibuya, K., Adair-Rohani, H., Amann, M., Anderson, H., Andrews, K., Aryee, M., Atkinson, C., Bacchus, L., Bahalim, A., Balakrishnan, K., Balmes, J., Barker-Collo, S., Baxter, A., Bell, M., Blore, J., … Memish, Z. (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: A systematic analysis for the global burden of disease study 2010. L*ancet, 380*(9859), 2224-2260. https://doi.org/10.1016/S0140-6736(12)61766-8

Linder, C., Nagy, G., & Retelsdorf, J. (2015). The dimensionality of the Brief Self-Control Scale-An evaluation of unidimensional and multidimensional applications. *Personality and Individual Differences, 86*, 465-473. https://doi.org/10.1016/j.paid.2015.07.006

Makovac, E., Carnevali, L., Medine, S., Sgoifo, A., Petrocchi, N., Ottaviani, C. (2022). Safe in my heart: Resting heart rate variability longitudinally predicts emotion regulation, worry, and sense of safeness during COVID-19 lockdown. *Stress, 25*(1), 9-13. https://doi.org/10.1080/10253890.2021.1999408

Masicampo, E. & Baumeister, R. (2007). Relating Mindfulness and Self-Regulatory Processes. *Psychological Inquiry, 18*(4), 255-258. https://doi.org/10.1080/10478400701598363

May, R., Seibert, G., Sanchez-Gonzalez, M., Fitzgerald, M., & Fincham, F. (2017). Dispositional self-control: Relationships with aerobic capacity and morning surge in blood pressure. *Stress, 20*(1), 46-52. https://doi.org/10.1080/10253890.2016.1260543

McCraty, R., Atkinson, M., Tomasino, D., & Bradley, R. T. (2009). The coherent heart: Heart-brain interactions, psychophysiological coherence, and the emergence of system-wide order. *Integral Review, 5*, 10-115.

McMurray, J., Packer, M., Desai, A., Gong, J., Lefkowitz, M., Rizkala, A., Roleau, J., Shi, V., Solomon, S., Swedberg, K., Zile, M., & PARADIGM-HF Investigators and Committees. (2014). Angiotensin-neprilysin inhibition versus enalapril in heart failure. *New England Journal of Medicine, 371*(11), 993-1004.https://doi.org/10.1056/NEJMoa1409077

Meng, L., Chen, D., Yang, Y., Zheng, Y., & Hui, R. (2012). Depression increases the risk of hypertension incidence: A meta-analysis of prospective cohort studies. *Journal of Hypertension, 30*(5), 842-851. https://doi.org/10.1097/HJH.0b013e32835080b7

Mitchell, M. & Potenza, M. (2014). Recent insights into the neurobiological of impulsivity. *Current Addiction Reports, 1*(4), 309-319. https://doi.org/10.1007/s40429-014-0037-4

Moffitt, T., Arseneault, L., Belsky, D., Dickson, N., Hancox, R., Harrington, H., Houts, R., Poulton, R., Roberts, B., Ross, S., Sears, M., Thomson, M., & Caspi, A. (2022). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences of the United States of America, 108*(7), 2693-2698. https://doi.org/10.1073/pnas.1010076108

Mosely, J. & Linden, W. (2006). Predicting blood pressure and heart rate change with cardiovascular reactivity and recovery: Results from a 3-year and 10-year follow-up. *Psychosomatic Medicine, 68*(6), 833-843. https://doi.org/10.1097/01.psy.0000238453.11324.d5

Muraven, M. & Baumeister, R. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle?. *Psychological Bulletin, 126*(2), 247-259. https://doi.org/10.1037/0033-2909.126.2.247

Nabel, E.G. & Braunwald, E. (2012). A tale of coronary artery disease and myocardial infarction. *New England Journal of Medicine, 366*(1), 54-63. https://doi.org/10.1056/NEJMra1112570

Nigg, J., Silk, K., Stavro, G., & Miller, T. (2005). Disinhibition and borderline personality disorder. *Development of Psychopathology, 17*(4), 1129-1149. https://doi.org/10.1017/s0954579405050534

Nower, L., Derevensky, J., Gupta, L. (2004). The relationship of impulsivity, sensation seeking, coping, and substance use in youth gamblers. *Psychology of Addictive Behaviors, 18*(1), 49-55. https://doi.org/10.1037/0893-164X.18.1.49

Oaten, M. & Cheng, K. (2006). Improved self-control: The benefits of a regular program of academic study. *Basic and Applied Social Psychology, 28*(1), 1-16. https://doi.org/10.1207/s15324834basp2801_1

Pan, Y., Cai, W., Cheng, Q., Dong, W., An, T., & Yan, J. (2015). Association between anxiety and hypertension: A systematic review and meta-analysis of epidemiological studies. *Neuropsychiatric Disease and Treatment, 22*(11), 1121-1130. https://doi.org/10.2147/NDT.S77710

Patton, J., Stanford, M., & Barratt, E. (1995). Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology, 51*(6), 768-774. https://doi.org/10.1002/1097-4679(199511)51:6<768::aid-jclp2270510607>3.0.co;2-1

Petticrew, M., Lee, K., & McKee, M. (2012). Type A behavior pattern and coronary heart disease: Philip Morris's "crown jewel." *American Journal Public Health, 102*(11), 2018-2025. https://doi.org/10.2105/AJPH.2012.300816

Pressman, S., Gallagher, M., & Lopez, S. (2013). Is the emotion-health connection a "first-world problem?". *Psychological Science, 24*(4). https://doi.org/10.1177/0956797612457382

Quinn, C., Rollock, D., & Vrana, S. (2014). A test of Spielberger's state-trait theory of anger with adolescents: Five hypotheses. *Emotion, 14*(1), 74-84. https://doi.org/10.1037/a0034031

Radstaak, M., Geurts, S., Brosschot, J., Cillessen, A., & Kompier, M. (2011). The role of affect and rumination in cardiovascular recovery from stress. *International Journal of Psychology, 81*(3), 237-244. https://doi.org/10.1016/j.ijpsycho.2011.06.017

Ralevski, E., Petrakis, I., & Altemus, M. (2019). Heart rate variability in alcohol use: A review. *Pharmacology, Biochemistry, and Behavior, 176,* 83-92. https://doi.org/10.1016/j.pbb.2018.12.003

Reid, R., Bramen, J., Anderson, A., & Cohen, M. (2014). Mindfulness, emotional dysregulation, impulsivity, and stress proneness among hypersexual patients. *Journal of Clinical Psychology, 70*(4), 313-321. https://doi.org/10.1002/jclp.22027

Ritchie, R. (2016). *Don't worry, be mindful: Mindfulness, preservation, and heart rate variability* [Master's Thesis, Bowling Green State University]. OhioLINK.

Rodgers, J., Jones, J., Bolleddu, S., Vanthenapalli, S., Rodgers, L., Shah, K., Karia, K., & Panguluri, S. (2019). Cardiovascular risk associated with gender and aging. *Journal of Cardiovascular Development and Disease, 6*(2), 19. https://doi.org/10.3390/jcdd6020019

Rosati, F., Williams, D., Juster, R., Thayer, J., Ottaviani, C., & Baiocco, R. (2021). The cardiovascular conundrum in ethnic and sexual minorities: A potential biomarker of constant coping with discrimination. *Frontiers in Neuroscience, 15*. https://doi.org/10.3389/fnins.2021.619171

Rosenman, R., Brand, R., Jenkins, D., Friedman, M., Straus, R., & Wurm, M. (1975). Coronary heart disease in western collaborative group study. Final follow-up experience of 8.5 years. *Journal of the American Medical Association, 233,* 872-877.

Sahdra, B., Shaver, P., & Brown, K. (2010). A scale to measure nonattachment: A Buddhist complement to western research on attachment and adaptive functioning. *Journal of Personality Assessment, 92*(2), 116-127. https://doi.org/10.1080/00223890903425960

Sahdra, B., Ciarrochi, J., & Parker, P. (2016). Nonattachment and mindfulness: Related but distinct constructs. *Psychological Assessment, 28*(7), 819-829. http://dx.doi.org/10.1037/pas0000264

Sahoo, S., Padhy, S., Padhee, B., Singla, N. & Sarkar, S. (2018). Role of personality in cardiovascular diseases: An issue that needs to be focused on too. *Indian Heart Journal, 70*(3), 471-477. https://doi.org/10.1016/j.ihj.2018.11.003

Sharma, V., Kaur, M., Gupta, S., & Kapoor, R. (2019). Relationship of emotional intelligence, intelligence quotient, and autonomic reactivity tests in undergraduate medical students. *Medical Science Educator*, *29*(3), 673-681. https://doi.org/10.1007/s40670-019-00763-9.

Sherwood, A., Dolan, C. A., & Light, K. C. (1990). Hemodynamics of blood pressure responses during active and passive coping. *Psychophysiology, 27*(6), 656-668. https://doi.org/10.1111/j.1469-8986.1990.tb03189.x

Siltanen, P., Lauroma, N., Punsar, S., Pyoraia, K., Tuominen, H., & Vanhala, K. (1975). Psychological characteristics related to coronary heart disease. *Journal of Psychosomatic Research, 19*(3), 183-195. https://doi.org/10.1016/0022-3999(75)90099-9

Smith, T., Cribbet, M. R., Nealey-Moore, J. B., Uchino, B. N., Williams, P. G., MacKenzie, J., & Thayer, J. F. (2011). Matters of the variable heart: Respiratory sinus arrhythmia response to marital interaction and associations with marital quality. *Journal of Personality and Social Psychology, 100*(1), 103-119. https://doi.org/10.1037/a0021136

Smith, T., Glazer, K., Ruiz, J., & Gallo, L. (2004). Hostility, anger, aggressiveness, and coronary heart disease: an interpersonal perspective on personality, emotion, and health. J Pers., 72(6), 1217-1270. https://doi.org/10.1111/j.1467-6494.2004.00296.x

Smith, T. & Jordan, K. (2015). Interpersonal motives and social evaluative threat: Effects of acceptance and status stressors on cardiovascular reactivity and salivary cortisol response. *Psychophysiology, 52*(2), 269-276.

Spangler, D., Gamble, K., McGinley, J., Thayer, J., & Brooks, J. (2018). Intra-individual variability in vagal control is associated with response inhibition under stress. *Frontiers in Human Neuroscience, 12*(475), 1-9. https://doi.org/10.3389/fnhum.2018.00475

Stavrova, O., Pronk, T., & Kokkoris, M. (2020). Finding meaning in self-control: The effect of self-control on the perception of meaning in life. *Self and Identity, 19*(2), 201-218. https://doi.org/10.1080/15298868.2018.1558107

Tangney, J., Baumeister, R., & Boone, L. (2004). High self-control predicts good adjustment, less pathology, and interpersonal success. *Journal of Personality, 72*(2), 271-324. https://doi.org/10.1111/j.0022-3506.2004.00263.x

Thayer, J. F., Yamamoto, S. S., & Brosschot, J. F. (2010). The relationship of autonomic imbalance, heart rate variability and cardiovascular disease risk factors. *International Journal of Cardiology,141*(2), 122-131. https://doi.org/10.1016/j.ijcard.2009.09.543

Troy, A., Shallcross, A., & Mauss, I. (2013). A person-by-situation approach to emotion regulation: Cognitive reappraisal can either help or hurt, depending on the context. *Psychological Science, 24*(12), 2505-2514. https://doi.org/10.1177/0956797613496434

Tsao, C., Aday, A., Almarzooq, Z., Alonso, A., Beaton, A., Bittencourt, M., Boehme, A., Buxton, A., Carson, A., Commodore-Mensah, Y., Elkind, M., Evenson, K., Eze-Nliam, C., Ferguson, J., Generoso, G., Ho, J., Kalani, R., Khan, S., Kissela, B., … Martin, S. (2022). Heart disease and stroke statistics—2022 update: A report from the American Heart Association Circulation. *Circulation, 145*(8), e157-e693. https://doi.org/10.1161/CIR/.0000000000001052

Tsuji, H., Venditti, F. J., Manders, E. S., Evans, J. C., Larson, M. G., Feldman, C. L., & Levy, D. (1996). Reduced heart rate variability and mortality risk in an elderly cohort. The Framingham Heart Study. *Circulation, 94*(11), 878-883. https://doi.org/ 10.1161/01.cir.94.11.2850

Van Bokhoven, I., Goozen, S., Engeland, H., Schaal, B., Arsenault, L., Seguin, J., Nagin, D., Vitaro, F., & Tremblay, R. (2005). Salivary cortisol and aggression in a population-based longitudinal study of adolescent males. *Journal of Neural Transmission, 112*(8), 1083-1096. https://doi.org/10.1007/s00702-004-0253-5

Williams, P. & Moroz, T. (2009). Personality vulnerability to stress-related sleep disruption: Pathways to adverse mental and physical health outcomes. *Personality and Individual Differences, 46*(5-6), 598-603. https://doi.org/10.1016/j.paid.2008.12.017

Williams, P., Smith, T., Gunn, H., & Uchino, B. (2011). Personality and stress: Individual differences in exposure, reactivity, recovery, and restoration. In R. J. Contrada & A. Baum (Eds.), *The handbook of stress science: Biology, psychology, and health* (pp.231-245). Springer Publish Company.

Yusuf, S., Hawken, S., Ounpuu, S., Dans, T., Avezum, A., Lanas, F., McQueen, M., Budaj, A., Pais, P., Varigos, J., Lisheng, L., & INTERHEART Study Investigators. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *Lancet, 364*(9438), 937-952. https://doi.org/10.1016/S0140-6736(04)17018-9

Zahn, D., Adams, J., Krohn, J., Wenzel, M., Mann, C., Gomille, L., Jacobi-Scherbening, V., & Kubiak, T. (2016). Heart rate variability and self-control – a meta-analysis. *Biological Psychology, 115*, 9-26. https://doi.org/10.1016/j.biopsycho.2015.12.007

Zaturenskaya, M. (2019). *The role of mindfulness in cardiovascular recovery from stress*. [Doctoral Dissertation, Bowling Green State University]. OhioLINK.

APPENDIX A: Demographics Page

1. Subject ID _____
2. Today's Date: _____
3. Gender: Male Female Transgender
4. Which race/ethnicity do you identify with:

   African American/Black
   Non-Hispanic White
   White Hispanic / Latino American
   Asian
   Pacific Islander
   Persian
   Arab
   American Indian or Alaska Native
   Other

5. How would you classify yourself in terms of religious faith or spirituality?

   Atheist
   Buddhist
   Hindu
   Jehovah's Witness
   Jew
   LDS (i.e., Mormon)
   Muslim
   New Age
   Traditional African religion
   Lutheran
   Roman Catholic
   Episcopalian
   Methodist
   Presbyterian
   Christian

Baptist
Pentecostal
Adventist
Taoist
Unitarian
Baha'i
Other (please specify) _____

6. Please enter your marital status:

Married
Single
Divorced

7. What is your age: _____

8. Year in school:

Freshman
Sophomore
Junior
Senior

9. How many hours of sleep did you get last night?

Less than 2 hours
3 hours
4 hours
5 hours
6 hours
7 hours
8 hours
More than 9 hours

APPENDIX B: Brief Self-Control Scale

Using the 1 to 5 scale below, please indicate how much each of the following statements reflects how you typically are:

not at all very much

1 2 3 4 5

	Type of Activity	Frequency
1.	I am good at resisting temptation	
2.	*I have a hard time breaking bad habits*	
3.	*I am lazy*	
4.	*I say inappropriate things*	
5.	*I do certain things that are bad for me, if they are fun*	
6.	I refuse things that are bad for me	
7.	*I wish I had more self-discipline*	
8.	People would say that I have iron self-discipline	
9.	*Pleasure and fun sometimes keep me from getting work done*	
10.	*I have trouble concentrating*	
11.	I am able to work effectively toward long-term goals	
12.	*Sometimes I can't stop myself from doing something, even if I know it is wrong*	
13.	*I often act without thinking through all the alternatives*	

Italicized questions (2, 3, 4, 5, 7, 9, 10, 12, 13) should be reverse scored (subtract score from 6). Total score (13-65) = average (mean) score for 606 students was 39.5, with approximately 70% falling in the range 31 to 48, and approximately 95% in the range 22.5 to 56.

APPENDIX C: Nonattachment Scale

Using the 1 to 6 scale below, please indicate how much each of the following statements reflects how you typically are:

Strongly Disagree — Strongly Agree

1 2 3 4 5 6

Item	Rating
1. I can accept the flow of events in my life without hanging onto them or pushing them away.	
2. I can let go of regrets and feelings of dissatisfaction about the past.	
3. I find I can be calm and/or happy even if things are not going my way.	
4. I have a hard time appreciating others' successes when they outperform me.	
5. I can remain open to what life offers me regardless of whether it seems desirable or undesirable at a particular time.	
6. I can enjoy pleasant experiences without needing them to last forever.	
7. I view the problems that enter my life as things/issues to work on rather than reasons for becoming disheartened or demoralized.	
8. I can enjoy my possessions without being upset when they are damaged or destroyed.	
9. The amount of money I have is not important to my sense of who I am.	
10. I do not go out of my way to cover up or deny my negative qualities or mistakes.	
11. I accept my flaws.	
12. I can enjoy my family and friends without feeling I need to hang on to them.	
13. If things aren't turning out the way I want, I get upset.	
14. I can enjoy the pleasures of life without feeling sad or frustrated when they end.	
15. I can take joy in others' achievements without feeling envious.	

16. I find I can be happy almost regardless of what is going on in my life.	
17. Instead of avoiding or denying life's difficulties, I face up to them.	
18. I am open to reflecting on my past mistakes and failings.	
19. I do not get "hung up" on wanting an "ideal" or "perfect" life.	
20. I am comfortable being an ordinary, less than perfect human being.	
21. I can remain open to thoughts and feelings that come into my mind, even if they are negative or painful.	
22. I can see my own problems and shortcomings without trying to blame them on someone or something outside myself.	
23. When pleasant experiences end, I am fine moving on to what comes next.	
24. I am often preoccupied by threats or fears.	
25. I am not possessive of the people I love.	
26. I do not have to hang on to the people I love at all costs; I can let them go if they wish to go.	
27. I do not feel I need to escape or avoid bad experiences in my life.	
28. I can admit my shortcomings without shame or embarrassment.	
29. I experience and acknowledge grief following significant losses, but do not become overwhelmed, devastated, or incapable of meeting life's other demands.	
30. I am not possessive of the things I own.	