2023

Dispositional Optimism and Autonomic Reactivity During Passive-Coping and Active-Coping Stress Tasks

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Dispositional Optimism and Autonomic Reactivity

During Passive-Coping and Active-Coping Stress Tasks

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Master's thesis submitted

to the Eberly College of Arts and Sciences

at West Virginia University

in partial fulfillment of the requirements for the degree of

Master of Science in

Psychology

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2023

Keywords: Optimism, Autonomic Reactivity, Positive Psychology, Health Psychology, Coping Tasks, Passive Coping, Active Coping

ABSTRACT

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Optimism is a positive psychological factor that has been associated with improved mental and physical health outcomes. To better understand the mechanism through which optimism results in improved health, researchers have examined whether autonomic reactivity to stress moderates this relation. While many studies have examined the relation between optimism and autonomic reactivity to stress, findings are mixed. Although some studies have found optimism to be associated with reductions in heart rate and blood pressure responses to acute stress presentations, many studies exploring this relation have found optimism to be associated with greater blood pressure responses to stress. However, most of these studies have used active-coping versus passive-coping stress tasks to assess autonomic reactivity. This study aimed to investigate the relation between optimism and autonomic reactivity using both active-coping and passive-coping stress tasks to examine whether observed differences in reactivity to stress in previous studies is moderated by this task dimension. Participants with high and low scores on a standardized measure of optimism completed both an active- and passive-coping stress task. Various reactivity measures, including blood pressure, heart rate, and heart rate variability were monitored to assess cardiovascular reactivity to the tasks. It was hypothesized that participants with high optimism would demonstrate higher cardiovascular reactivity during the active-coping stress task than participants low in optimism, while there would be no significant differences in cardiovascular reactivity between the two groups during the passive-coping stress task. Findings revealed that task type did not moderate the relation between optimism and reactivity. There was a significant main effect of optimism on DBP reactivity to stress, though this effect disappeared when controlling for social anxiety. Findings support future examination of the relation between optimism and autonomic reactivity, and subsequently, the relation between optimism and health.

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To understand the complex interplay between mental and physical health, many studies have examined the role that psychosocial factors play on health outcomes (e.g., Albus et al., 2019; Boehm & Kubzansky, 2012). Much of the research in this area has looked at negative psychosocial factors and their relation to the onset and maintenance of various health conditions, including depression, anxiety, anger, and hostility (e.g., Cuevas et al., 2017; Everson-Rose & Lewis, 2005; Rozanski et al., 1999). Notably, research has examined negative emotional states that interfere with maintenance of cardiovascular health as well as predict onset of cardiovascular disease (e.g., Everson-Rose & Lewis, 2005; Rozanski et al., 1999). There is considerable evidence linking negative emotional states of depression, anxiety, anger, hostility, and stress to the onset of cardiovascular disease (Everson-Rose & Lewis, 2005; Rozanski et al., 1999). Additionally, and more recently, Albus et al. reported that low socioeconomic status, acute and chronic stress, depression, anxiety, and low social support were associated with an “unfavorable” cardiovascular disease prognosis (2019). These findings are consistent with previous research in this area and suggest that psychosocial factors do indeed have a relation to cardiovascular health (Albus et al., 2019; Everson-Rose & Lewis, 2005). Cuevas and colleagues (2017) concurred with these results, finding that socioeconomic status, along with stress, anxiety, depression, anger, and hostility, were associated with increased risk of hypertension. However, this study also examined positive psychosocial traits in relation to hypertension and found that emotional support as well as social integration was associated with a lower incidence of hypertension (Cuevas et al., 2017).

While many studies have examined negative psychosocial factors, there has been an increasing amount of literature that has explored the impact of positive psychosocial factors on health issues. Positive psychology is defined the "optimal experience" of people who are doing their best and emphasizes the study of positive psychological and psychosocial factors like life satisfaction and optimism (Park et al., 2016). Studies have shown that various positive psychosocial factors, including positive emotions, life satisfaction, optimism, a sense of life purpose, and social support are each associated with overall good health (Park et al., 2016). Furthermore, research has examined the relation between these positive psychosocial factors and specific health issues, namely, cardiovascular health (Boehm & Kubzansky, 2012). In this study, cardiovascular health was associated with both optimism and hedonic well-being (Boehm & Kubzansky, 2012).

Among the positive psychosocial traits that have been examined, optimism, namely dispositional optimism, is a commonly studied phenomena within health-related research (e.g., Kubzansky et al., 2007; Marton et al., 2021). Dispositional optimism refers to "the tendency to believe that one will generally experience good versus bad outcomes in life" (Scheier & Carver, 1992). A brief overview of the literature comprising this area of scientific inquiry follows.

The Relation Between Dispositional Optimism and Health

Dispositional optimism has been shown to have numerous health benefits across different populations and diseases. A systematic review of studies on cancer patients found that across studies, dispositional optimism was related to quality of life (Marton et al., 2021). Specifically, higher levels of dispositional optimism predicted higher reported quality of life in cancer patients, leading to benefits in not only mental but physical health (Marton et al., 2021). Additional research has shown that higher levels of optimism can extend the lifespan by 11 to 15

percent and increase one's chances of reaching "exceptional longevity," meaning living to age 85 or older (Lee et al., 2017). Optimism has also been associated with reducing the risk of early death from an illness by 50 to 70 percent and is related to maintenance of a healthier lifestyle (Brown & Silva, 2021).

Multiple studies have examined the relation between optimism and cardiovascular health. In 1987, Scheier and Carver reviewed this literature and found a significant positive relation between optimism and positive health outcomes. They found that persons scoring high in optimism showed faster recovery from coronary artery bypass surgery and reported reaching their recovery milestones faster than those with low scores in optimism (Scheier & Carver, 1987). This review also found that those with high scores in optimism were less likely than those with low scores to develop new Q-waves on their electrocardiograms, which are signs of myocardial infarctions (Scheier & Carver, 1987). These findings suggest a relation between optimism and positive cardiovascular-related health outcomes (Scheier & Carver, 1987). Over two decades later, Boehm and Kubzansky (2012) continued to confirm that optimism was associated with reduced risk of cardiovascular events. These findings suggest optimism may offer some protective properties for experiencing cardiovascular disease consequences (Boehm & Kubzansky, 2012). This finding is further supported by a study conducted in 2007 that examined rates of coronary heart disease in older men (Kubzansky et al., 2007). This study showed that older men who exhibited high levels of optimism had lower rates of coronary heart disease than more pessimistic individuals, suggesting that optimism may have protective factors against these types of cardiovascular illnesses (Kubzanksy et al., 2007). In 2009, a meta-analysis of 83 studies examining the link between optimism and physical health found that in all cases, optimism was a significant predictor of health outcomes with small to medium effect sizes

(Rasmussen et al., 2009). Overall, optimism was shown to have a positive impact on physical health (Rasmussen et al., 2009). More specifically, studies included in the meta-analysis found that optimists demonstrated many positive health outcomes, including lower incidence of reporting pain and physical symptoms and better physical functioning in general (Rasmussen et al., 2009).

Potential Explanatory Mechanisms for Optimism's Impact on Health

While research has demonstrated a link between optimism and various health issues, including cardiovascular health, the mechanisms through which optimism improves health have yet to be fully understood. One potential explanation for the positive impact of optimism on health is through optimism's relation to adaptive coping strategies (Conversano et al., 2010). Research has shown that optimism is positively related to coping strategies (e.g., acceptance of situations, sense of humor, etc.), implying an indirect effect of optimism on quality of life (Conversano et al., 2010). Studies have also shown that optimists tend to engage in active coping strategies, meaning that they actively and intentionally tackle stressors thinking that their effort will enhance the probability of obtaining positive outcomes (Billingsley et al., 1993).

It is also possible that optimists engage in better health habits than pessimists. A meta-analysis conducted in 2018 included 38 studies which examined the relation between optimism and various health behaviors (Boehm et al., 2018). Overall, findings showed that individuals who were more optimistic engaged in better health behaviors than those who were less optimistic (Boehm et al., 2018). In this meta-analysis, optimism was shown to be related to three health behaviors: physical activity, diet, and smoking, though these relations only demonstrated modest effect sizes (Boehm et al., 2018). This research suggests that people who are more optimistic do

lead healthier lifestyles, which could explain the association between optimism and improved health that has been demonstrated by previous research.

Another way that researchers believe optimism may improve health is through its impact on autonomic reactivity to stress. Studies have shown that autonomic reactivity to stress, commonly assessed by measuring changes in blood pressure, heart rate, and heart rate variability in response to acute stress presentations, has been associated with the development of cardiovascular disease (Carroll et al., 2012; Treiber et al., 2003). In brief, individuals who exhibit exaggerated heart rate and blood pressure reactions to acute stress presentations exhibit a greater risk for developing coronary heart disease and essential hypertension than those with lesser cardiovascular reactions (Krantz & Manuck, 1984; Treiber et al., 2003). Evidence for the relation between increased cardiovascular reactivity to stress and cardiovascular disease consequences comes from well-controlled studies on macaques (e.g., Manuck et al., 1988) as well as prospective studies of humans (Keys et al., 1971; Treiber et al., 2003). Based on these findings, many researchers have explored whether optimism was associated with the magnitude or patterning of cardiovascular reactivity to acute stress presentations by hypothesizing that individuals with higher optimism scores exhibited lower autonomic reactivity to stress and faster autonomic recovery after a stressor.

Literature Review: Optimism and Autonomic Reactivity to Stress

A total of 18 studies have examined the relation between optimism and autonomic reactivity to date (Bajaj et al., 2019; Baumgartener et al., 2018; Bonfiglio, 2005; Boylan et al., 2016; Clark et al., 2006; Darragh et al., 2014; Endrighi et al., 2011; Geers et al., 2008; Kennedy & Hughes, 2004; Nes et al., 2005; Puig-Perez et al., 2015; Puig-Perez et al., 2017; Richman et al., 2007; Segerstrom, 2001; Segerstrom et al., 2003; Stephenson, 2018; Terrill et al., 2010;

Williams et al., 1990). In each of these studies, participants completed a measure of optimism and engaged in various stressor tasks (e.g., serial subtraction, mirror tracing task, etc.) during which measures of physiological indicators of autonomic nervous system activity (e.g., blood pressure, heart rate, heart rate variability, skin conductance, etc.) were obtained. Table 1 displays information about each of these studies, including the samples, the various tasks and measures employed, and the primary findings. Of the 18 studies, seven found that optimism was related to decreased autonomic reactivity to a range of different stressors (Bajaj et al, 2019; Boylan et al., 2016; Darragh et al., 2014; Geers et al., 2008; Puig-Perez et al., 2015; Terrill et al., 2010; Williams et al., 1990). These findings supported the previously mentioned theory that optimism is associated with lower autonomic reactivity to stress and could potentially explain optimism's positive effect on many health issues, including cardiovascular health and related illnesses. However, five studies failed to report any significant relations between optimism and measures of autonomic reactivity to stress (Baumgartener et al., 2018, Bonfiglio, 2005; Endrighi et al., 2011; Kennedy & Hughes, 2004; Segerstrom, 2001). Interestingly, three studies found that optimism was related to increased autonomic reactivity to stress (Puig-Perez et al., 2017; Richman et al., 2007; Stephenson, 2018). Additionally, Nes et al. (2005) found that optimism was associated with slower skin conductance recovery in a high self-awareness group following the completion of an anagram stress task. Collectively, these findings suggest that the relation between optimism and measures of cardiovascular reactivity to stress and autonomic recovery following stress is complex and may involve examination of potential moderating factors that might explain these inconsistent findings.

The two remaining studies that examined the relation between optimism and autonomic reactivity to stress found candidates for such moderating effects. In a study conducted on a

sample of 172 youth, Clark et al. (2006) found that for participants who scored high in optimism, violence exposure was inversely related to systolic blood pressure reactivity. Findings from this study also showed that for participants who were low in optimism, violence exposure was not significantly related to systolic blood pressure reactivity (Clark et al., 2006). The second study to find a potential moderator for the relation between optimism and autonomic reactivity was conducted by Segerstrom et al. (2003). The study utilized a sample of 30 first-year medical and law school students (Segerstrom et al., 2003). Results showed an interaction between academic optimism and stress in predicting an immune system response to a delayed-type hypersensitivity (DTH) skin test (Segerstrom et al., 2003). Although optimism was associated with a healthy rapid immune response under a long-term stress (examination) condition, optimism was associated with a reduced immune response when the test was conducted while participants engaged in a short-term mental arithmetic stress task (Segerstrom et al., 2003). These findings suggest that the nature of the stressor could moderate the relation between optimism and indices of autonomic response to stress. The findings from these two studies confirm that exploration of additional moderating variables is needed to explain the relation between optimism and autonomic reactivity to stress.

Active-Coping Versus Passive-Coping Stress Tasks

Notably, of the 18 studies that have examined the relation between optimism and autonomic reactivity to stress, 17 utilized a stressor task in which participants completed what are called active-coping tasks (see Table 1). Active coping tasks are those in which the study participant has instrumental control over the task outcome, such as a mental arithmetic task (Light & Obrist, 1983). During an active coping task, the participant’s responses influence task performance. For example, in mental arithmetic, if one puts effort into the task, individuals will

presumably perform better on the task than if they engaged in it with minimal effort. In contrast, task performance to a passive-coping task, according to Obrist, is relatively independent of participant effort and engagement, often involving simply enduring the passage of time (Light & Obrist, 1983). The task dimension of active- versus passive-coping may be worthy of further investigation among studies that have examined the relation between optimism and autonomic reactivity to stress. According to the behavioral self-regulation model proposed by Carver and Scheier (2000), optimists, in contrast to pessimists, typically utilize approach-focused or active coping strategies when faced with a stressor. Believing their goals are attainable, optimists exert more effort in confronting tasks in which outcomes are influenced by task effort and engagement (i.e., active-coping tasks). Consequently, during active-coping tasks, optimists may persist longer than pessimists, be more fully engaged, and exhibit increased autonomic reactivity during tasks and more prolonged autonomic recovery following task completion.

Only two studies comprising the literature examining the relation between optimism and autonomic reactivity to stress have included tasks that would be considered passive-coping tasks (Geers et al., 2008; Terrill et al., 2010). As noted above, passive coping tasks provide individuals very little control over task outcomes, and typically involve enduring the task for a specific time period (Choi et al., 2012; Light & Obrist, 1983). Examples of common passive coping stress tasks include the cold pressor task and watching stressful films (e.g., horror movies), as the individual does not have control over the task outcome itself. The two studies that used passive-coping stress tasks in examining the relation between optimism and autonomic reactivity to stress both used the cold pressor task (Geers et al., 2018; Terrill et al., 2020). In the cold pressor task, participants place their hand or forearm in a container of cold water which, over time, produces increased pain (Von Baeyer et al., 2005). The cold pressor task has been criticized as a

method of inducing psychological stress, as the physiological response of placing one's hand or arm in cold water, vasoconstriction, influences changes in heart rate and blood pressure as the body attempts to warm itself rather than solely eliciting psychological stress (Griffin & Howard, 2020).

No study has examined the potential moderating influence of active versus passive stress coping tasks on the relation between optimism and autonomic reactivity to stress. Furthermore, there is very little research on the use of passive-coping tasks at all in studies comprising this literature other than the two that have used the cold pressor task (Geers et al., 2018; Terrill et al., 2020). Based on (a) the inconsistent findings comprising the literature examining the relation between optimism and autonomic reactivity to stress, and (b) evidence that moderating factors are likely to be present, it is clear there is more to learn about the conditions under which optimism is associated with increased and/or reduced cardiovascular reactions to acute stress presentations. Although optimism has often been associated with reduced cardiovascular reactions to stress, the behavioral self-regulation model suggests that optimists may exhibit enhanced cardiovascular reactions to challenging tasks if they believe they have control over the results (Carver & Scheier, 2000). This model would suggest that under some conditions, like active-coping tasks, optimists would be expected to be more reactive than pessimists. Additionally, this model would suggest that during passive-coping stressor tasks, optimists and pessimists may show no significant difference in autonomic reactivity to stress, as with these tasks, participants do not have control over the outcome of the task. The type of stress task utilized in the studies comprising this body of literature (e.g., active-coping versus passive-coping) has not yet been examined in terms of the relation between optimism and autonomic

reactivity to stress. Examining these task influences may aid in the understanding of how optimism not only influences autonomic reactivity to stress, but overall health.

Aims of the Study

The aim of this study was to examine the relation between dispositional optimism and autonomic reactivity to both active- and passive-coping tasks. To explore this task dimension, undergraduate students characterized as being high and low in optimism using a validated measure of dispositional optimism were exposed to both active-coping and passive-coping tasks. Two active coping tasks were used: the Raven's progressive matrices task and a speech task. The Raven's progressive matrices task was selected as the active coping task because it has been used in a previous study in which optimism was found to be associated with increased diastolic blood pressure reactions to stress (Stephenson, 2018). A speech task was selected as a second active coping task as this has been shown to relate to autonomic reactivity and provides a basis for the passive coping task included in the study (Griffin & Howard, 2020). Participants were also exposed to a passive coping task (e.g., watching a recording of themselves giving a speech) using a within-subjects experimental design. Measures of heart rate, blood pressure, and respiration rate were obtained during both tasks as well as pre-task rest periods to assess cardiovascular and respiratory reactivity to stress. Additionally, measures of heart rate variability (HRV) were assessed throughout the experimental protocol to determine if any observed differences were associated with changes occurring in the parasympathetic nervous system as measured through HRV indices of vagal nerve activity. Furthermore, because social anxiety has been shown to impact reactivity during social tasks, a social anxiety measure was administered (Turner et al., 1986). Based on the behavioral self-regulation model and findings from previous research (e.g., Stephenson, 2018), it was hypothesized that there would be a significant optimism and task-type

interaction for autonomic reactivity. Specifically, it was hypothesized that participants with high optimism would demonstrate higher cardiovascular reactivity during the active-coping stress task than participants low in optimism, while there would be no significant differences in cardiovascular reactivity between the two groups during the passive-coping stress task.

Method

Participants

A sample of 41 undergraduate students from West Virginia University was selected based on scores on a measure of optimism obtained via an online screener. Participants completed the Life Orientation Test – Revised (LOT-R) as a measure of optimism, as well as the Social Avoidance and Distress Scale (SADS) as a measure of social anxiety (Scheier et al., 1994; Watson & Friend, 1969). A tertile split was then conducted of all participants who completed the LOT-R. Participants who scored in the top tertile of the distribution were categorized as the high optimism group (scores of 15 and higher), while participants in the bottom tertile of the distribution of scores were categorized as the low optimism group (scores of 13 or below).

In order to determine the appropriate sample size for the study, a power analysis was conducted using G*Power 3.1.9.2 (Erdfelder et al., 1996). Study design was entered as "ANOVA: Repeated measures, within factors." An effect size of $f = 0.237$ was utilized for the power analysis. This effect size was based on an average of Puig-Perez et al.'s (2015) effect size ($R^2 = 0.069$) and Stephenson's (2018) effect size ($n_p^2 = 0.039$) and represents a medium effect which is consistent with other studies of optimism and autonomic reactivity. A power level of 0.80 ($\alpha = .05$) was also utilized to determine the sample size in G*Power. G*Power recommended a sample size of 38, but 40 individuals were aimed to be recruited for counterbalancing purposes.

To incentivize participation, extra credit was offered through WVU's SONA research system. To control for extraneous variables, participants were screened before the study on several factors known to influence the physiological parameters used in the study. Participants who used tobacco products more than 10 days per month or who reported major chronic health issues (e.g., heart disease, diabetes) were excluded, as well as participants who reported taking medications that influence cardiovascular reactivity (e.g., heart rate, blood pressure). To control for social anxiety, participants scoring 12 or higher on the SADS were excluded, as this indicates high levels of social anxiety (Watson & Friend, 1969). Once agreeing to participate in the study, participants were instructed to refrain from caffeine and alcohol use, as well as vigorous exercise for at least two hours prior to their scheduled session. Participants were asked to refrain from tobacco use for 24 hours prior to their session.

A total of 411 participants completed the screening assessment, 65 men, 341 women, 1 trans-gendered, and 4 non-binary/gender fluid/gender queer. The majority of the screening sample was White (86.9 percent, n = 357), with a mean age of 19.88 years. In terms of education, most participants reported having completed one year of college (34.8 percent, n = 143), Among these individuals, participants were excluded for tobacco use (n = 36), presence of a major chronic health condition (n = 26), taking medications the influence cardiovascular reactivity (n = 51), exhibiting high social anxiety scores (n = 201), and/or failing to indicate an interest in completing the laboratory portion of the experiment (n = 47). All participants meeting inclusion criteria, including having high and low optimism scores were invited to complete the laboratory phase of the study (n = 129). Using this approach, 21 of the 59 participants categorized as having high optimism (35.59 percent) and 20 of the 70 participants categorized as having low optimism (28.57 percent) completed the laboratory session.

Measures

Blood pressure. To measure systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial blood pressure (MAP), a *GE* Carescape V100 Vital Signs Monitor was used. The device was placed on the participants' non-dominant arm over the brachial artery. Maximum cuff inflation was set at 165 mm Hg, with rate of deflation set at 3 mm Hg per second.

Heart rate (HR). To measure HR, a *Polar* heart rate monitor Model H10 (Kempele, Finland) was used. This device continuously measures HR data throughout the experimental session by sending ECG signals from a sensor around the participants' chest to a receiver. Heart rate variability (HRV) was also measured with this device and included the root mean square of successive R-R intervals (RMSSD), low frequency (LF) HRV, and high frequency (HF) HRV. Respiration rate (RR) was also determined from the frequency of the ECG signals from the *Polar* monitor. See Appendix A for descriptions of HRV variables. Kubios HRV Premium version 3.5.0 software was used for estimating measures of HRV and RR.

Self-Report Measures

Demographic information. Demographic information was collected through a short questionnaire (see Appendix B). The questionnaire included items regarding participant age, sex, height, and weight (for purposes of calculating body mass index), race/ethnicity, and education level. The questionnaire also included questions about participants' current health status and health behaviors. Questions regarding family history were included to collect data on participant's family health status, as this can be an indicator of individual health. Further, family history of cardiovascular issues or hypertension is related to increased autonomic reactivity to stressors (Frazer et al., 2002; Semenchuk & Larkin, 1993). Because the screener asked questions

regarding legal or illegal substance use, a Certificate of Confidentiality was obtained from the National Institute of Health.

Life Orientation Test – Revised (LOT-R). The LOT-R is a 10-item self-report questionnaire designed to measure dispositional optimism (Scheier et al., 1994). The LOT-R includes four distractor items and uses a Likert response format with response options ranging from 0 or "strongly disagree" to 4 or "strongly agree" (Scheier et al., 1994). Items on the LOT-R include "in uncertain times, I usually expect the best" and "I hardly ever expect things to go my way" (Scheier et al., 1994). The LOT-R includes two subscales containing three items each: an optimism subscale, and a pessimism subscale (Scheier et al., 1994). The LOT-R has demonstrated acceptable convergent and discriminant validity, sharing only a modest amount of variance with related constructs like self-esteem and neuroticism (Scheier et al., 1994). The measure has also demonstrated good internal consistency ($\alpha = 0.78$) and test-retest reliability (Scheier et al., 1994). Based on these psychometric characteristics and the fact that it is frequently used in this literature, the LOT-R is an acceptable measure of dispositional optimism for purposes of the study.

Positive and Negative Affect Schedule (PANAS). The PANAS is a 20-item self-report questionnaire that measures positive and negative affect (Watson et al., 1988). The PANAS includes two scales: a positive affect (PA) and negative affect (NA) scale (Watson et al., 1988). Participants are instructed to rate the extent that they have felt various emotions over the past week (e.g., interested, excited) using a Likert response format with responses ranging from 1, "very slightly or not at all" to 5, "extremely" (Watson et al., 1988). The PANAS has demonstrated sufficient internal consistency for both scales (PA: $\alpha = .86 - .90$; NA: $\alpha = .84 - .87$) in addition to good test-retest reliability with an eight-week interval (PA: $\alpha = .68$, $p < .05$; NA: α

= .71, $p < .05$) (Watson et al., 1988). The PANAS has also shown sufficient external validity, demonstrating correlations with the Hopkins Symptom Checklist (HSCL) (PA: α = -.19, -.29; NA: α = .74, .65), Deck Depression Inventory (BDI) (PA: α = -.35, -.36; NA: α = .56, .58) and STAI State Anxiety Scale (A-State) (PA: α = -.35; NA: α = .51) (Watson et al., 1988). For the purposes of the current study, instructions on the PANAS were changed to read “over the last five minutes” rather than “over the past week”. Given the correlation between the PANAS and measures of state affect such as the STAI State Anxiety Scale (A-Scale) it is an appropriate measure of affective reactivity to the tasks used in this study (Watson et al., 1988). Additionally, the PANAS has been used as a state measure of affect in prior studies (Tiani, 2022).

Social Avoidance and Distress Scale (SADS). The Social Avoidance and Distress Scale is a 28-item self-report questionnaire that measures symptoms of social anxiety (Watson & Friend, 1969). Participants are instructed to respond whether a series of statements are true or false about them (Watson & Friend, 1969). Items on the SADS include “I often want to get away from people” and “I tend to withdraw from people” (Watson & Friend, 1969). The SADS has demonstrated adequate reliability (*KR-20* = .94) (Watson & Friend, 1969). The SADS has also demonstrated adequate convergent validity, with correlations to other anxiety measures such as the Manifest Anxiety Scale and the Anxiety Sensitivity Index being .54 and .76, respectively (Watson & Friend, 1969). Based on these data, the SADS is an appropriate measure of social anxiety for use in the current study.

Post-Task Questionnaire. A post-task self-report questionnaire was given which assessed the stress level of the participant during active-coping and passive-coping stress tasks and their perceived difficulty of the tasks (see Appendix C and Appendix D). For active task

questionnaires, Question 6 "I rated my performance as extremely well" also included a "Not applicable" option that was treated as missing data.

Experimental Design

The current study employed a quasi-experimental design, as participants were selected based on existing levels of optimism. The independent variables of interest in the study were optimism level (e.g., high optimism, low optimism) and stressor task type (e.g., active-coping versus passive-coping). Participants were classified as being high or low in optimism based on their total LOT-R score, with those in the top tertile being in the high optimism group and those in the bottom tertile in the low optimism group. Stressor task type was a within-subjects factor, and all participants completed both tasks in a counterbalanced order. All participants completed the active coping speech task first to eliminate the first task reactivity effect commonly observed in psychophysiological research. Following this, half of the high optimism participants completed the Raven’s task first and the remaining half completed the passive coping task first, and likewise for participants low in optimism.

Experimental Tasks

Active Stress Tasks. The first active coping task included in the study was a three-minute speech task. While this task was not the active-coping task used in the primary analyses, it was included to create the video stimuli for the passive-coping task. This task was conducted in line with recommendations from Griffin and Howard (2020). More specifically, random words (either neutral-emotion or negative emotion-words) were selected from the Affective Norms for English Words (ANEW) (Bradley & Lang, 1999). Participants were shown these words and instructed to speak about them for as long as possible (see Appendix E). Participants were told

they could speak about anything that came to mind regarding the word. This speech task has been shown to elicit changes in autonomic reactivity (Griffin & Howard, 2020).

Raven's Matrices puzzles was used as the primary active coping task in the study (Raven, 1998). Items were presented electronically through a computer for 20 seconds each, after which participants were prompted to answer. A total of 10 items were selected, five of which were easy and five of which were difficult items to account for task difficulty. Task duration for the Raven's Matrices puzzles was set to three minutes. This task has been used in previous studies in the Behavioral Physiology Laboratory and shown to elicit moderate cardiovascular reactions (Stephenson, 2018; Tiani, 2022)

Passive Stress Task. A recording of the participant's speech was used as the passive coping task in the study. Participants viewed a recording of the speech task they completed at the beginning of the experimental session (see Appendix E). This task has been shown to elicit a vascular response in line with other passive coping tasks (Griffin & Howard, 2020).

Procedure

Participants completed the demographic questionnaire as well as the LOT-R and social anxiety questionnaire through the WVU SONA system. Participants scoring in the top or bottom tertile on the LOT-R and who met all necessary inclusion criteria were invited to participate as described above. At the beginning of each scheduled session, the experimenter described the study, including potential risks and benefits of participation, and obtained informed consent. This consent process reviewed the requirements that participants had refrained from caffeine, alcohol, and vigorous exercise for at least two hours prior to the session and had refrained from tobacco use for at least 24 hours prior. Participants were also asked to refrain from cell phone use for the duration of the experiment and were monitored via a window by the researcher. Due to the

invasive nature of attaching the *Polar* heart rate monitor, the experimenter left the room, asking the participant to attach the monitor around their chest themselves. The experimenter then returned and attached the blood pressure cuff to the participant's non-dominant arm. A 15-minute rest period then took place, during which participants were instructed to sit quietly with both feet on the floor. Participants were provided with a neutral reading material throughout the baseline period to avoid reactivity related to boredom or rumination (e.g., a *National Geographic* magazine). HR was measured continuously throughout the rest period, with blood pressure measurements taken beginning after eight minutes and then every two minutes during the rest period. Participants also completed the PANAS questions at the end of the rest period to assess resting positive and negative affect levels. Tasks were presented to each participant according to a script (see Appendix E). See Figure 1 for a visual representation of the procedure.

After the rest period, participants received instructions for completing the speech task. After providing instructions, the researcher left the room. Blood pressure was measured during the first and third minute of the task, while HR was measured continuously. After finishing the first task, participants completed the PANAS again and the active coping post-task questionnaire. A five-min rest period then occurred following completion of the speech task; cardiovascular measures were obtained in a manner identical to the initial rest period.

Next, participants were instructed to complete the next stress task. As noted above, half of the study participants completed the Raven's Matrices stress task first and the other half watched the recorded speech first. Blood pressure was measured during the first and third minute of the task period, while HR was measured continuously. The PANAS was administered after completion of this task, as well as either the active or passive coping post-task questionnaire.

This task was followed by another five-min rest period, during which cardiovascular measures were obtained.

Participants were then instructed to complete the remaining task. Measures were obtained identical to the initial task period. BP was measured two times and HR was measured continuously. Following the second task, the PANAS was administered for a final time in addition to either the active or passive coping post-task questionnaire. Participants were then debriefed and awarded class credit and $20 compensation.

Results

Artifact Detection and Tests of Assumptions

HR data was subjected to artefact detection and correction using the Kubios program. Invalid blood pressure measures were examined for validity using the criteria from Marler et al. (1988). Specifically, SBP recordings lower than 70 mm Hg or higher than 250 mm Hg were considered for replacement with average of blood pressure readings from the remaining minutes of the data collection period (Marler et al., 1988). This same process was performed for DBP readings that were lower than 45 mm Hg or higher than 150 mm Hg, or when pulse pressure between SBP and DBP readings was lower than 30 mm Hg (Marler et al., 1988). No blood pressure data violated the Marler et al. criteria for SBP and DBP values. Five pulse pressure values, however, were less than 30 mm Hg and needed to be evaluated further. For two of these values, the invalid measure was identified and replaced with a proximate valid measure and new averages were calculated. For the remaining three values, the invalid measure could not be determined and thus was not replaced. These pulse pressures (28, 29, and 29 mm Hg), however, were very close to the Marler criterion of being greater than 30 mm Hg. Two participants had

missing data for one of two speech task BP measures. In these two cases, average BPs during the speech task were calculated based on the remaining valid BP values.

To ensure normality for study variables, descriptive statistics were run for all outcome variables. Variables with a skew or kurtosis outside of the range of -2 to 2 and -7 to 7 were log transformed, respectively. Log transformations were also conducted for variables that violated assumptions of homoscedasticity, which was assessed using the Shapiro-Wilk test of normality. To address outliers, a 90 percent winsorization was performed on the following variables: adaptation PANAS (negative affect), speech viewing PANAS (negative affect), and Ravens task RESP Hz. See Table F-1 in Appendix F for values of normality pre- and post-transformation.

Prior to conducting the primary data analyses, SBP and DBP values within each experimental period were averaged to create six variables per parameter: (1) first rest period; (2) first task period; (3) second rest period; (4) second task period; (5) third rest period; and (6) third task period. Habituation and anticipation effects could not be analyzed, as only two BP measures were collected per rest and task period. However, it is unlikely any habituation or anticipation effects would have occurred given that participants were not informed when the next task would begin. Because counterbalancing of the last two tasks was conducted, parameters for the second and third rest and task periods were recoded in order to compare active-coping and passive-coping tasks directly in the primary study analyses.

Demographics and Group Differences

The final sample of 41 participants was mostly female (75.6 %) and White (82.9 %) (see Table 2) . High optimism and low optimism groups were compared across demographic variables using independent samples t-tests and chi-square tests of independence (see Table 2).

The only variable for which the two groups were significantly different was social anxiety (M_{hi} = 3.24, SD_{hi} = 2.19; M_{lo} = 6.84, SD_{lo} = 3.18).

Preliminary Analyses

Task Reactivity. Prior to conducting the primary analyses, it was important to test whether the active and passive coping tasks evoked any change in physiological and affective reactivity. To assess physiological reactivity, a series of paired-samples t-tests was conducted comparing physiological parameters during task periods with their respective pre-task rest periods. Results of these analyses are shown in Table F-2 in Appendix F. The speech task demonstrated significantly increased heart rate and blood pressure responses compared to baseline, accompanied by evidence for both increased sympathetic nervous system reactivity and parasympathetic withdrawal as measured by most of the measures of HRV. A significant reduction in respiration rate was observed during the speech task, but this finding was likely due to the fact that participants were speaking during the speech and not the pre-speech adaptation period. Physiological reactions to both the passive coping (viewing) and active coping (Ravens) tasks were less apparent. Although significant reductions in HR were observed for both tasks, no significant changes in measures of BP were noted for either task. (see Table F-2 in Appendix F). The decreased HR was accompanied by a significant increase in PNS index during the passive coping task, but no changes in any HRV parameter were observed during the active coping task. Respiration rate also increased in response to the passive coping but not active coping task.

To determine if affective reactivity changed from baseline, a series of paired-samples t-tests were run with positive and negative affect scores as measured by the PANAS. Results of these analyses are presented in Table F-3 in Appendix F. Positive affect significantly declined for the passive coping task, though there were no significant changes in positive affect reactivity

reported for the speech or active coping task (see Table F-3). Negative affect significantly increased for the speech and active coping task, though no significant change in negative affect was observed for the passive coping task (see Table F-3).

Order Effects. Additionally, a separate analysis was conducted to confirm that no order effect was observed between participants who were exposed to the active coping task first and those who were exposed to the passive coping task first. A 2 [Order 1(passive coping first, active coping second), Order 2 (active coping first, passive coping second)] x 2 (Active Coping Task, Passive Coping Task) ANCOVA was conducted to assess order effects for physiological measures, with order serving as the between-subjects factor and task-type as the within subjects' factor. Covariates were corresponding rest measures. Results of these analyses are displayed in Table F-4 in Appendix F. There was one interaction between task type and order for HF Power (ms^2 log), F (1, 38) = 4.97, p = 0.03, η^2 = 0.12. No other order effects or order x task interactions were significant. To understand the nature of this interaction, simple main effects analyses using F tests were conducted. One-way ANOVAs revealed no significant differences among means of HF Power reactivity (see Table F-4). To further explore this effect, a series of exploratory one-way repeated measures ANCOVAs were run comparing various combinations of task type and order on HF Power (ms^2 log). The majority of these analyses were non-significant (see Table F-4). However, when examining HF Power (ms^2 log) for rest versus task periods excluding the passive task for condition one only, results revealed a significant difference, F (1, 60) = 5.20, p = 0.03, η_p^2 = 0.08. Results show that HF Power (ms^2 log) did not change for the viewing task in condition one, however, reactivity seen across all other task and order means shows a significant increase in HF Power (ms^2 log) (see Figure F-1 in Appendix F).

Order effects for affective parameters were assessed using two mixed factors Order by Task Type ANCOVAs, one for positive affect, and one for negative affect. Results are displayed in Table F-5 in Appendix F. No order effects were significant for affective measures.

Primary Analyses

Physiological Parameters. To assess the effect of optimism and task type on each physiological reactivity measure, a 2 (High Optimism, Low Optimism) x 2 (Active Coping Task, Passive Coping Task) analysis of covariance (ANCOVA) was conducted using respective pre-task rest periods as varying covariates. Output of these analyses is displayed in Table 3. Results showed the only significant main effect for Optimism was on DBP reactivity to stress, F (1, 36) = 6.69, p = .014, η^2 = .16. The high optimism group demonstrated higher DBP values during both the active coping task (M_{hi} = 73.81 mm Hg, SD_{hi} = 7.24; M_{lo} = 69.08 mm Hg, SD_{lo} = 8.21) and the passive coping task (M_{hi} = 73.05 mm Hg, SD_{hi} = 7.98; M_{lo} = 69.72 mm Hg, SD_{lo} = 7.29) compared to the low optimism group. None of the Optimism by Task Type interactions were significant for any physiological parameter, but significant main effects for Task Type were observed for both HR reactivity to stress, F (1, 38) = 12.75, p = .001, η^2 = .25, and RR interval, F (1, 38) = 15.95, p < .001, η^2 = .30. Greater HR and RR reactivity to stress (increased HR and reduced RR interval) were observed in response to the active coping Raven's Task in contrast to the passive coping speech viewing task. No other main effects for Task Type were significant (see Table 3).

Affective Parameters. To assess the effect of optimism and task type on affective reactivity, similar 2 x 2 ANCOVAs were run. Output of these analyses is displayed in Table 4. The only main effect or interaction effect that was significant was a main effect for Task Type on positive affect, F (1, 38) = 4.39, p = .04, η^2 = .10. All study participants reported more positive

affect during the active coping Raven's matrices task in contrast to the passive coping speech viewing task.

Task Appraisals. To assess the effect of optimism and task type on post-task questionnaire measures, comparable 2 x 2 ANOVAs were conducted on the items that were consistent for both active coping and passive coping tasks. Simple one factor ANOVAs were used to compare high and low optimism groups on the post-task questionnaire items only used for the active coping task. Output of these analyses is displayed in Table 5 and 6. The only main effect or interactions that were significant were main effects for Task Type on perception of stressfulness of the task, F (1, 39) = 24.11, p <.001, η^2 = 0.38, and difficulty to continue the task for three additional minutes, F (1, 37) = 8.33, p = .006, η^2 = 0.18. Participants rated the active coping Raven's task as more stressful than the passive coping viewing task. They also reported that continuing the passive coping task would be easier than continuing the active coping task.

Secondary Analyses

Speech Task Reactivity. Because the speech task was only used in this study to secure the video used for the passive coping task, it was analyzed separately. A series of analyses of covariance (ANCOVAs) was conducted to compare high and low optimism groups using all physiological measures of stress including adaptation measures as covariates. There was no effect of optimism for any of the speech task physiological variables (see Table 7).

To assess affective reactivity for the speech task as well as task appraisals, similar ANCOVAs were run. There was no effect of optimism on affective reactivity during the speech task (see Table 8) or task appraisals (see Table 9).

Social Anxiety. Because high and low optimism groups differed at baseline on measures of social anxiety, an additional 2 by 2 ANCOVA was conducted on DBP values only.

Controlling for social anxiety, optimism no longer was significantly associated with DBP reactivity to the active and passive tasks, F (34,1) = .106, p = .746, η^2 = 0.12.

Discussion

The aim of the current study was to examine the relation between dispositional optimism and autonomic reactivity during different types of tasks. It was hypothesized that participants who were high in optimism would demonstrate higher autonomic reactivity than participants low in optimism during the active-coping task, though there would be no differences between high and low optimists for the passive-coping task. Though the interaction between optimism and task type was not significant, there was a significant main effect for optimism on DBP reactivity to stress. However, after controlling for social anxiety, this effect disappeared. The main effect for optimism on DBP reactivity observed in this study is congruent with prior research that showed a relation between high optimism and increased DBP reactivity (Richman et al., 2007; Stephenson, 2018). Together, these findings support the behavioral self-regulation model, as they demonstrate that optimists may exert more effort on laboratory stress tasks and therefore exhibit increased autonomic reactivity when tackling them (Carver & Scheier, 2000). However, results also indicate that task type (active versus passive) is not a moderating factor impacting the relation between optimism and physiological reactivity.

Despite the lack of autonomic reactivity to stress observed during presentations of both the active and passive coping tasks employed in this study, the elevated DBP reactions observed in previous studies was detected. Although findings provide support for the behavioral self-regulation model (Carver & Scheier, 2000), the current study provides evidence for an alternative explanation. Once a measure of social anxiety was entered as a covariate, the effect of optimism became non-significant. Although social anxiety scores were included in the study for

exclusion criteria during recruitment, high and low optimists significantly differed on social anxiety scores with higher optimism scores associated with lower scores on social anxiety. It is possible that social anxiety played a significant role in this study as the speech and subsequent passive (viewing) tasks revealed an underlying anxiety associated with exposure to social stressors. Though prior literature in this area has not examined social anxiety as a covariate, Kennedy and Hughes demonstrated that neuroticism, not optimism, influenced DBP responses (2004). With the findings of the current study, these results indicate that the effect of optimism on DBP may not be independent of social anxiety. It should be noted that because potential participants with high levels of social anxiety were excluded, the range of social anxiety scores of those who completed the study was restricted, suggesting this factor may have influenced the association between optimism and DBP reactivity more had the study sample included participants with high levels of social anxiety. Because most studies that have examined the relation between optimism and autonomic reactivity have not used classically "social" stressors, the effect of social anxiety may not play a role in prior research findings. However, even with tasks that are not considered social stressors (e.g., mental arithmetic), there may be an evaluative property involved as participants are being watched as they complete a task. The findings of the current study highlight a consideration for future studies to control for social anxiety in analyses of tasks that involve social evaluation. Future researchers who use social stressors should also consider using measures of social anxiety as exclusion criteria to ensure a main effect of optimism can be adequately captured.

Many findings of the current study should be further examined. Interestingly, it appeared that while the speech task elicited sufficient blood pressure and heart rate reactivity for all participants, the active and passive coping tasks demonstrated less reactivity. In fact, none of the

autonomic stress responses typically seen in laboratory studies were observed to either the active coping or passive coping tasks employed in this study. Heart rate decelerations were observed during both tasks instead of the more commonly observed heart rate accelerations and an increased parasympathetic response was observed during the passive coping task. In contrast, the initial speech task revealed the expected pattern of increased sympathetic nervous system arousal and parasympathetic reduction. Based on this pattern of findings, it is possible to suspect that participant's pre-active and passive task rest periods were not representative of true physiological baselines due to a failure to recover following the initial speech task or anticipation of the upcoming tasks. Additionally, the speech task elicited higher reactivity as it was the first task presented and required participants to speak for a full three-minute period, ensuring they were engaged with the task the entire time. This procedure made the speech task unique, as unlike the active and passive tasks, it required prolonged focus and effort. During the active Raven's matrices task, in theory, participants were able to provide guesses for problems without working through them. Relatedly, during the passive task, participants may have not been paying attention to the recording of their performance, despite being instructed to watch the screen the entire time. It is also possible that following completion of the anxiety-evoking speech task, the latter two tasks seemed comparatively less stressful. Regardless of reason, no differences were observed between high and low optimists to the speech task in the current study. Because the recording of the speech task was needed for use as the experimental stimulus for the subsequent passive coping task, it needed to occur at the beginning of the study protocol. Thus, the speech task was used as the first task across all participants to ensure the novelty effect associated with completing the first task did not impact reactivity across the active and passive tasks. Consequently, the location of the speech task may have been at least partly responsible for the

lesser than expected physiological stress responses observed during both the active and passive coping tasks employed in this study.

Another possible explanation for the lack of sympathetic reactivity and increased parasympathetic activity demonstrated by the active and passive tasks, respectively, relates to the sensory processing dimensions of each task. There are two types of sensory processing tasks: sensory intake and sensory rejection. Sensory intake tasks require that participants attend to their surroundings to receive sensory information during a stress task, whereas sensory rejection tasks require participants to ignore sensory information (Williams et al., 1975). Research has shown that these sensory processing modalities are tied to autonomic reactivity in unique ways. Specifically, sensory intake tasks are associated with increased parasympathetic activity, whereas sensory rejection tasks are generally associated with higher sympathetic activity (Williams et al., 1975). In the current study, both the active and passive task would be considered sensory intake tasks, as they required participants to be engaged with visually-presented stimuli for the entire task period. This task dimension may explain why there was a significant lack of sympathetic activity across the main tasks in this study, and why parasympathetic activity was exhibited instead. This phenomenon may also explain why the speech task, which would be considered a sensory rejection task, elicited high levels of sympathetic activity.

In terms of affective task reactivity compared to baseline, participants showed significantly decreased positive affect for the passive task only, though negative affect was only significantly higher for the speech and active tasks. Interestingly, though positive affect significantly decreased according to PANAS scores, analyses of self-reported task appraisals indicated a significant main effect of task type on self-rated stressfulness of the task and ability to continue the task. Specifically, findings showed that participants found the passive (viewing)

task to be less stressful and reported it would be easier to continue than the active (Raven's) task. While this finding supports significant increases in negative affectivity for the active task, it does contradict the finding of a significant reduction in positive affectivity during the passive task. The unique effect displayed for positive affect during the passive task may be explained by participants' negative reactions to viewing the video recording of themselves while speaking. Although the study did not code participant reactions during the speech task, it is notable that the researcher observed that many participants appeared uncomfortable or upset when informed they would be watching a recording of themselves. Although not perceived as being particularly stressful, negative affect did not increase during the passive task as it did with the other two tasks. This finding suggests that the affective response to watching one's performance involves more of a reduction in positive affect than of increased negative affect or perceived stressfulness of a laboratory task.

Although the majority of order effects analyses were not significant, there was a significant order by task interaction for HF Power (ms^2 log). Interestingly, when analyzing simple main effects for this interaction, none were significant. However, exploratory analyses revealed that HF Power (ms^2 log) did not change during the passive task for condition one, though it increased across all other tasks and conditions.

One potential explanation for this finding may be that the order in which the passive task was presented impacted reactivity, while the order in which the active task was presented did not matter. It is possible that the lack of any change in HF Power reactivity that occurred when the passive coping task was presented first was due to the contiguity between giving the speech and watching it. In essence, participants completing the study in this order failed to habituate to seeing the speech they had just given and consequently did not show the "calming" response

seen for groups experiencing the passive viewing task second or the active coping task presented in either order. This is speculation as to why this finding may have occurred, however; the reason for this effect cannot sufficiently be determined with the current data.

It should be noted that no other main effect or interaction for order was significant across all other physiological and affective measures. Overall, despite the significant interaction demonstrated for HF Power (ms^2 log), order did not appear to play a significant role in physiological or affective reactivity across the experiment. The main effect of optimism was also not significant for HF Power (ms^2 log), thus, this significant order by task interaction did not ultimately impact conclusions related to the main hypothesis.

Limitations and Future Directions

The current study has several limitations. First, participants were drawn from a convenience sample in a university setting, which impacts the generalizability of these findings. Though the current college sample may differ from other populations, it is similar to prior research on optimism and autonomic reactivity, the majority of which has used undergraduate samples. The sample was not diverse, with most participants identifying as female and White. Future studies should make use of community samples to aid in generalizability of findings and should emphasize the inclusion of participants from diverse backgrounds, particularly from minoritized populations.

Another limitation involves the type of physiological data employed by the current study. Only select measures of autonomic functioning were used, including BP and HRV data. However, these measures do not include other important aspects of reactivity that have been examined in physiology literature, such as hormonal changes. As such, the findings of the current study can only be interpreted in relation to the cardiovascular measures used. Future

studies may make use of other measures of reactivity to stress, such as salivary cortisol or skin conductance level, to obtain a more complete understanding of the influence of optimism on physiological stress reactions.

Further, according to analyses of task reactivity, the active and passive coping tasks selected in this study may have been insufficiently stressful. Despite these findings, the speech task did elicit increased physiological reactivity across measures of BP, HR, and HRV. This finding may have been due to the speech being presented as the first task for all participants. Future studies should ensure tasks are sufficiently stressful for participants and may opt to include longer rest periods to measure possible anticipation or habituation effects. Studies may include a variety of stressors that have been established in literature, such as mental arithmetic or mirror tracing, to ensure that physiological reactivity can by adequately elicited. In including a variety of both active and passive coping tasks, future studies can more sufficiently understand the way these different types of tasks interact with optimism to impact physiological reactivity. Additionally, should future studies make use of speech-based tasks, counterbalancing can allow the effect of order on speech task reactivity to be understood. However, the results of the current study indicate that speech tasks requiring continuous effort should not be the only active coping task included in examining the relation between optimism, task type, and reactivity, as these tasks do not allow for differences in coping between high and low optimists to be captured.

Although the current study did not support the hypothesis that task type is a moderating mechanism explaining the mixed relation between optimism and autonomic reactivity observed in the literature, it contributes to existing literature in that it is the first to examine task type as a potential mechanism. This study also utilized a within-subjects design to replicate the effect of optimism on DBP, as has been demonstrated in prior literature (e.g., Stephenson, 2018). Future

research should continue to make use of within-subjects designs to examine the relation between optimism and autonomic reactivity. However, should future studies use this design, the potential for unexpected order effects to be detected does exist. Additionally, because one task inevitably must be done first, the impact of the first task effect on reactivity must be considered. To alleviate this effect, researchers may make use of counterbalancing and could include an additional task that is not of interest to be used as the first task for all participants.

Though the current study did not support the hypothesis that task type impacts the relation between optimism and autonomic reactivity, further research on active versus passive coping tasks should be conducted. Future studies may benefit from using numerous active and passive coping tasks that have been established in literature to elicit physiological responses. A limited number of passive tasks have been established in literature, with the most commonly used being the cold pressor task and watching of stressful films. While the passive task used in the current study reduced issues with these commonly used passive tasks, it also relied on the recording of the initial speech task which likely impacted reactivity across the entire experiment. Future literature that explores this relation could benefit from the development of other passive coping tasks that do not have these issues. Task options may include the use of pictures or films to induce stress. However, researchers should be mindful of the use of horror films in particular, as they may elicit fear rather than true stress responses and may have been viewed by participants prior to the study. Pain-related tasks may also be used, though the cold pressor should be avoided due to issues with vasoconstriction (Griffin & Howard, 2020). However, because the current study did not demonstrate an interaction between task type and optimism, additional mechanisms for the relation between optimism and autonomic reactivity should be examined, as well as factors that could interact with optimism to produce an effect. One possible

mechanism for future research is the sensory processing dimensions of tasks, as these tasks have been shown to influence reactivity differently (Williams et al., 1975). Finally, for research that uses socially based stressors, social anxiety measures should be included as a covariate to determine if the effect of optimism on reactivity is independent of social anxiety.

Overall, though controlling for social anxiety erased the effect of optimism on DBP reactivity, results show that high optimism may be related to greater DBP reactivity to stress. Based on current findings, task-type (active coping versus passive coping) does not appear to be the explanatory mechanism for the relation between optimism and autonomic reactivity observed in previous studies. The mechanism explaining the relation between optimism and reactivity has yet to be discovered. Future research should continue to explore other avenues of explanation for this relation to better understand the role optimism plays in physiological reactivity and health outcomes broadly.

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Table 1. *Studies of Optimism and Autonomic Reactivity to Stress*

Article	Participants	Measure of Optimism Used/Cutoffs for Optimism vs. Pessimism Groups (if utilized)	Reactivity Measure	Task Used	Active or Passive	Results	Effect Size
Bajaj et al., 2019	113 undergrads	LOT-R used for optimism measure. Used optimism and pessimism subscale scores.	SBP, DBP, and HR	Autobiographical recall task	A	Dispositional optimism was inversely related to SBP and HR (but not DBP) while engaging in anger and sadness inducing events	Optimism and anger elevations (sr^2 = .0445); LOT-R scores and sadness (sr^2 = .0296)
Baumgartener et al., 2018	153 undergrads	LOT-R. Median split resulted in high v. low optimism groups	Impedance cardiograph (measured surface potential across thoracic cylinder) and continuous BP monitor (cardiac output and total peripheral resistance)	Vocal mental arithmetic	A	Optimism did not predict cardiovascular reactivity	DNR
Bonfiglio, 2005	91 female college students	LOT-R. Participants who scored in the upper quartile (above 18) were considered to be high optimism, and participants who scored in the lower quartile (less than 12) were considered to be low optimism.	Oscillometric BP monitor for SBP and DBP, HR data collected through electrocardiogram	Serial subtraction	A	Results showed no main effect of LOT-R score on DBP or SBP.	DNR
Boylan et al., 2016	246 men from Pittsburgh, PA	LOT-R	SBP, DBP, HR, and HF-HRV	Mental arithmetic, mirror tracing, anger recall speech task	A	Psychological resources (including optimism) were inversely related to SBP at recovery.	DNR
Clark et al., 2006	172 youth	Perceived Life Chances Scale	SBP	Digit span	A	For participants high in optimism, violence exposure was inversely related to SBP reactivity	DNR
Darragh et al., 2014	63 participants (recruited through university)	LOT-R. Higher socres inidcate higher levels of optimism.	HR and HRV	Mental arithmetic (serial subtraction)	A	Optimism was associated with greater stress reduction over time	DNR
Endrighi et al., 2011	543 health adults (aged 53 and older)	LOT-R. Single optimism score was utilized.	Saliva samples (cortisol)	Computerized color-word inference task; Mirror tracing task	A	Optimism was not associated with any of the laboratory cortisol measure.	DNR
Geers et al., 2008	72 college students	LOT-R used for optimism measure. Reverse scored negatively worded items for a total dispositional optimism score.	BP and HR	Cold pressor task	P	Dispositional optimism associated with lower cardiovascular reactivity in the neutral prime condition, not in the health prime condition	DNR
Kennedy & Hughes, 2004	50 women from screening sample of undergrads	LOT-R used to measure optimism. Based on scores in the top and bottom quartiles (low optimism and high optimism group).	SBP, DBP, and HR	Serial subtraction	A	Neuroticism, not optimism, exerted influence on diastolic BP responses. Neither impacted systolic BP. Optimism is not independent from neuroticism in disease risk.	Correlation between neuroticism and DBP in midstressor phase(r = .283) : Medium
Nes et al., 2005	54 undergraduates	LOT-R (full scale score)	Skin conductance	Anagram stress task	A	Optimism associated with slower skin conductance recovery during recovery period, only in the high self awareness group	Self Consciousness x Optimism for skin conductance at 15 minutes (R^2 = .04); 45 minutes (R^2 = .04) : Both small
Puig-Perez et al., 2015	72 participants (directed at students over 55 yo)	LOT-R	HR; Saliva samples (cortisol)	Trier Social Stress Task	A	Optimism associated with better physiological adjustment to stressor. Pessimism related to situational appraisal.	Optimism and HR reactivity (R^2 = .069) : Medium

Puig-Perez et al., 2017	140 participants with diagnosed T2D	LOT-R	SBP, DBP	Stroop color-word task; mirror-trace stress task	A	Optimism was related to increased SBP and DBP reactivity in people with T2D, supports protective role of optimism in T2D	Optimism and SBP (R^2 = .041); Optimism and DBP (R^2 = .042) : Both small
Richman et al., 2007	165 normotensive adults	LOT	DBP	Recall personal story	A	DBP increased among PTs with high perceived discrimination and high optimism, especially for black PTs	Race x Optimism x Perceived Discrimination on DBP (R^2 = .01) : Small
Segerstrom, 2001	48 undergraduates	LOT-R	Skin conductance	Emotional Strrop task	A	When controlling for trait anxiety, interaction between optimism and emotional content of words is not significant in predicting skin conductance	Optimism and SCR magnitude (η = .29)
Segerstrom et al., 2003	30 participants from first-year medical school and law school classes	LOT-R	HRV (EKG); DTH skin test	Mental arithmetic	A	Significant academic optimism by mental arithmetic interaction predicting DTH response.	DNR
Stephenson, 2018	152 undergrads at WVU	LOT-R. Tertile split performed. Scores that were 22 or above were optimists; scores that were 17 or below considered pessimists	BP (diastolic, systolic, and mean arterial); HR variability	Raven's Matrices	A	Optimists had greater DBP reactivity to easy/difficult tasks than pessimists, no effect of task difficulty	Optimists exhibit higher DBP reactivity to task (η_p^2 = .039); MAP Optimism main effect (η_p^2 = .007) : Small; NS
Terrill et al., 2010	90 undergrads	LOT-R with optimism/pessimism subscales.	DBP, mean arterial BP, HR	Speech task; cold pressor	A (speech task); P (cold pressor)	Higher dispositional optimism attenuated cardiovascular responses to a social (speech) but not non-social stressor task.	Total optimism related to faster SBP and MAP recovery (R^2 = .05): Small
Williams et al., 1990	56 undergraduates	LOT-R. Chose 45 highest scoring subjects to be in high optimism group and 45 lowest scoring subjects to be in low optimism group.	DBP	Mental math, Simon stress task	A	Dispositional optimism associated with lower DBP during mental math only; mechanism through which dispositional optimism associated with improved health could be reduced autonomic reactivity to stress	DNR
					Key: A - active; P - passive		*Key: DNR - Did Not Report*

Table 2

Demographics and Group Differences

Variable	High Optimism (*N* = 21)		Low Optimism (*N* = 20)			
	Mean	SD	Mean	SD	t	*p*
Age	22.00	5.68	19.80	1.51	1.68	0.10
Socioeconomic Status	6.14	1.59	6.50	1.19	-0.81	0.42
Body Mass Index	23.53	3.02	24.81	5.06	-0.86	0.40
SADS Total	3.24	2.19	6.84	3.18	-4.21	<.001*
	Percent	*N*	Percent	*N*	χ^2	*p*
Gender					1.12	0.57
Male	23.81	5	20.00	4		
Female	76.19	16	75.00	15		
Nonbinary/Gender Fluid/Gender Queer	0.00	0	0.05	1		
Race					5.92	0.32
White	80.95	17	89.47	17		
Black or African American	0.00	0	5.26	1		
Asian American	9.52	2	0.00	0		
Asian, Native Hawaiian, or Pacific Islander	4.76	1	0.00	0		
Asian and White	0.00	0	5.26	1		
No response	0.00	0	5.26	1		
Father High BP					-1.74	0.09
Yes	19.05	4	44.44	8		
No	80.95	17	55.56	10		
No response	0.00	0	16.67	3		
Mother High BP					0.41	0.68
Yes	14.29	3	10.00	2		
No	85.71	18	90.00	18		
Father Heart Condition					0.54	0.59
Yes	9.52	2	5.00	1		
No	90.48	19	95.00	19		
Mother Heart Condition					0.94	0.36
Yes	14.29	3	5.00	1		
No	85.71	18	90.00	18		
No response	0.00	0	5.00	1		

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* $p < 0.05$

Table 3

Summary Tables for Optimism x Task Type ANCOVAs on Physiological Parameters

Variable	*F*	*p*	η^2	Mean	SD
SBP (mm Hg)					
Optimism	0.01	0.94	0.00		
High Optimism					
Active				121.38	12.00
Passive				120.36	12.10
Low Optimism					
Active				119.83	12.56
Passive				119.39	12.19
Task Type	0.58	0.45	0.02		
Optimism X Task Type	0.09	0.76	0.00		
DBP (mm Hg)					
Optimism	6.69	0.014*	0.16		
High Optimism					
Active				73.81	7.24
Passive				73.05	7.98
Low Optimism					
Active				69.08	8.21
Passive				69.72	7.29
Task Type	0.02	0.89	0.00		
Optimism X Task Type	1.69	0.20	0.04		
Mean HR (bpm)					
Optimism	0.59	0.45	0.02		
High Optimism					
Active				77.10	8.64
Passive				75.29	8.90
Low Optimism					
Active				75.75	8.84
Passive				73.80	7.96
Task Type	12.75	0.001**	0.25		
Optimism X Task Type	0.03	0.87	0.00		

(Table continues on next page)

Variable	*F*	*p*	η^2	Mean	SD
Mean RR (ms)					
Optimism	0.07	0.79	0.00		
High Optimism					
Active				787.62	90.67
Passive				807.43	95.52
Low Optimism					
Active				801.75	96.23
Passive				823.10	99.01
Task Type	15.95	0.00***	0.30		
Optimism X Task Type	0.03	0.86	0.00		
RMSSD (ms log)					
Optimism	0.04	0.85	0.00		
High Optimism					
Active				1.59	0.22
Passive				1.58	0.23
Low Optimism					
Active				1.61	0.25
Passive				1.60	0.25
Task Type	0.54	0.47	0.01		
Optimism X Task Type	0.01	0.93	0.00		
PNS Index					
Optimism	0.01	0.93	0.00		
High Optimism					
Active				-0.53	1.07
Passive				-0.46	1.08
Low Optimism					
Active				-0.36	1.37
Passive				-0.25	1.43
Task Type	2.48	0.12	0.06		
Optimism X Task Type	0.15	0.73	0.00		

(Table continues on next page)

Variable	*F*	*p*	η^2	Mean	SD
SNS Index					
Optimism	0.10	0.76	0.00		
High Optimism					
Active				1.07	1.11
Passive				1.02	1.40
Low Optimism					
Active				0.88	1.14
Passive				0.84	1.13
Task Type	0.35	0.56	0.01		
Optimism X Task Type	0.00	0.98	0.00		
Stress Index					
Optimism	0.00	0.95	0.00		
High Optimism					
Active				11.69	3.75
Passive				12.11	5.51
Low Optimism					
Active				10.95	4.06
Passive				11.69	4.42
Task Type	1.69	0.20	0.04		
Optimism X Task Type	0.14	0.71	0.00		
HF Power (ms^2 log)					
Optimism	0.18	0.67	0.00		
High Optimism					
Active				6.54	0.10
Passive				6.39	1.06
Low Optimism					
Active				6.43	1.21
Passive				6.41	1.22
Task Type	0.71	0.41	0.02		
Optimism X Task Type	0.54	0.47	0.01		

(Table continues on next page)

Variable	*F*	*p*	η^2	Mean	SD
LF Power (ms^2 log)					
Optimism	0.10	0.75	0.00		
High Optimism					
Active				6.55	0.74
Passive				6.62	0.82
Low Optimism					
Active				6.95	0.96
Passive				6.55	1.15
Task Type	1.26	0.27	0.03		
Optimism X Task Type	2.59	0.12	0.06		
RESP (Hz)					
Optimism	1.11	0.30	0.03		
High Optimism					
Active				0.26	0.04
Passive				0.26	0.05
Low Optimism					
Active				0.25	0.07
Passive				0.28	0.07
Task Type	2.48	0.12	0.06		
Optimism X Task Type	2.03	0.16	0.05		

$^*p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 4

Summary Tables for Optimism X Task Type ANCOVAs on Affective Parameters

Variable	*F*	*p*	η_p^2	Mean	SD
Positive Affect					
Optimism	0.47	0.50	0.01		
High Optimism					
Active				28.29	8.53
Passive				23.57	8.91
Low Optimism					
Active				23.90	9.27
Passive				20.65	9.24
Task Type	4.39	0.04*	0.10		
Optimism X Task Type	0.87	0.36	0.02		
Negative Affect					
Optimism	0.37	0.55	0.01		
High Optimism					
Active				1.16	0.11
Passive				1.13	0.16
Low Optimism					
Active				1.16	0.11
Passive				1.13	0.09
Task Type	0.41	0.53	0.01		
Optimism X Task Type	0.03	0.87	0.00		

*p < .05

Table 5

Summary Tables for Optimism x Task Type ANOVAs on Self-Reported Task Appraisals

Variable	*F*	*p*	η_p^2	Mean	SD
Stress of Task					
Optimism	0.29	0.59	0.01		
High Optimism					
Active				3.05	1.07
Passive				1.90	1.22
Low Optimism					
Active				3.20	1.11
Passive				2.05	1.23
Task Type	24.11	<.001***	0.38		
Optimism X Task Type	0.00	0.99	0.00		
Task Difficulty					
Optimism	0.00	0.97	0.00		
High Optimism					
Active				0.55	0.10
Passive				0.09	0.19
Low Optimism					
Active				0.53	0.16
Passive				0.10	0.22
Task Type					
Optimism X Task Type					
Continue Task for 3 Min					
Optimism	1.13	0.30	0.03		
High Optimism					
Active				2.45	1.23
Passive				1.70	1.17
Low Optimism					
Active				2.84	1.26
Passive				1.89	1.37
Task Type	8.33	0.006**	0.18		
Optimism X Task Type	0.11	0.74	0.00		

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Table 6

Summary Tables for One-Way Optimism ANOVAs on Active Self-Reported Task Appraisals

Variable	*F*	*p*	η_p^2	Mean	SD
Task Effort					
Optimism	0.81	0.37	0.02		
High Optimism				4.38	0.59
Low Optimism				4.20	0.70
Task Performance					
Optimism	2.43	0.13	0.06		
High Optimism				2.85	1.14
Low Optimism				2.35	0.88
Task Persistence (Active only)					
Optimism	2.25	0.14	0.06		
High Optimism				4.14	0.66
Low Optimism				3.89	0.32
Upset Over Task Performance (Active only)					
Optimism	1.49	0.23	0.04		
High Optimism				2.10	0.89
Low Optimism				2.47	1.07

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table 7

Summary Tables for Optimism ANCOVAs on Speech Task Physiological Parameters

Variable	*F*	*p*	η_p^2	Mean	SD
SBP (mm Hg)					
Optimism	0.69	0.41	0.02		
High Optimism				135.90	13.21
Low Optimism				132.03	15.08
DBP (mm Hg)					
Optimism	0.47	0.50	0.01		
High Optimism				84.00	8.66
Low Optimism				80.39	10.19
Mean HR (bpm)					
Optimism	1.07	0.31	0.03		
High Optimism				88.00	12.08
Low Optimism				84.40	11.19
Mean RR (ms)					
Optimism	1.05	0.31	0.03		
High Optimism				693.67	90.46
Low Optimism				724.10	99.78
RMSSD (ms log)					
Optimism	1.74	0.20	0.04		
High Optimism				1.47	0.23
Low Optimism				1.54	0.28
PNS Index					
Optimism	1.45	0.24	0.04		
High Optimism				-1.32	1.02
Low Optimism				-0.89	1.55

(Table continues on next page)

Variable	F	p	η^2	Mean	SD
SNS Index					
Optimism	2.24	0.14	0.06		
High Optimism				2.08	1.46
Low Optimism				1.55	1.35
Stress Index					
Optimism	2.18	0.15	0.05		
High Optimism				12.94	4.44
Low Optimism				11.36	3.93
HF Power (ms^2 log)					
Optimism	0.21	0.65	0.01		
High Optimism				6.17	0.98
Low Optimism				6.29	1.10
LF Power (ms^2 log)					
Optimism	0.53	0.47	0.01		
High Optimism				7.02	0.90
Low Optimism				7.26	0.92
RESP (Hz)					
Optimism	0.05	0.82	0.00		
High Optimism				0.20	0.04
Low Optimism				0.19	0.04

*p < .05; **p < .01; ***p < .001

Table 8

Summary Tables for Optimism ANCOVAs on Speech Task Affective Parameters

Variable	*F*	*p*	η_p^2	Mean	SD
Positive Affect					
Optimism	0.02	0.89	0.00		
High Optimism				26.38	9.12
Low Optimism				23.60	8.40
Negative Affect					
Optimism	1.09	0.30	0.03		
High Optimism				1.18	0.13
Low Optimism				1.17	0.11

$*p < .05$

Table 9

Summary Tables for One-Way ANOVAs of Optimism on Speech Self-Reported Task Appraisals

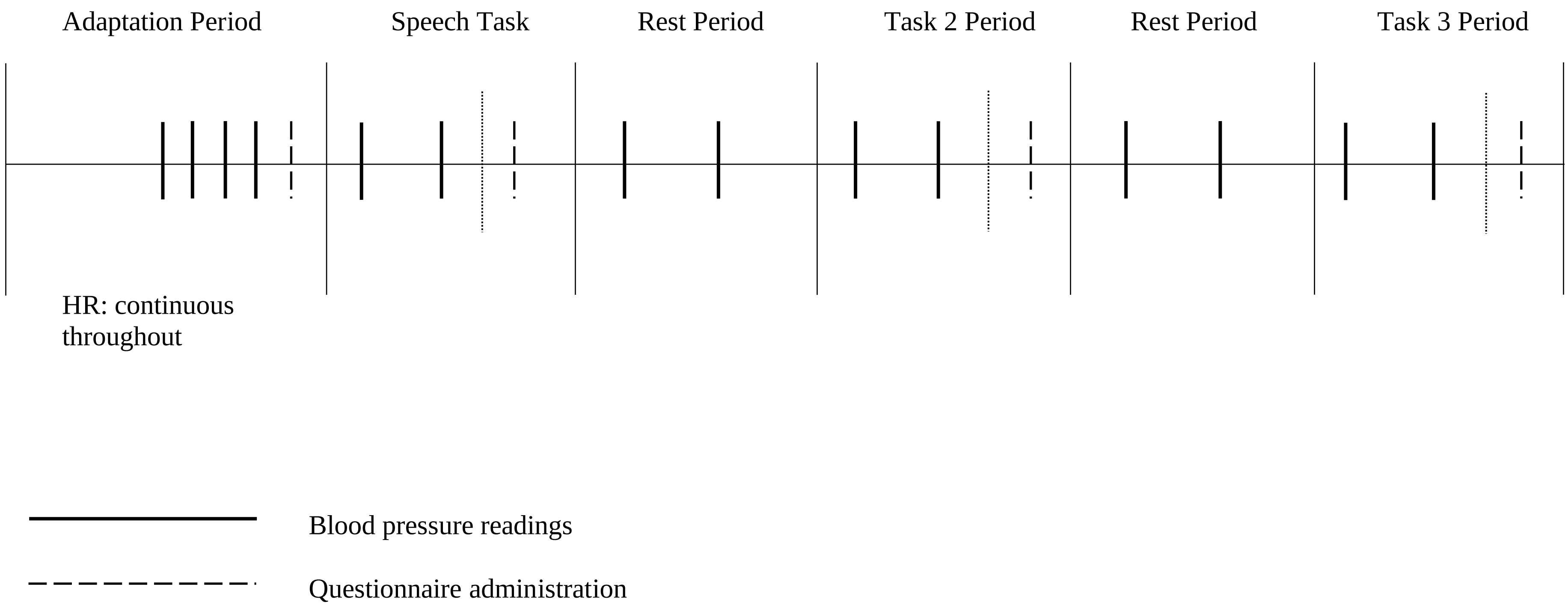
Variable	*F*	*p*	η_p^2	Mean	SD
Stress of Task					
Optimism	0.04	0.85	0.00		
High Optimism				2.56	0.92
Low Optimism				2.50	0.89
Task Difficulty					
Optimism	0.01	0.92	0.00		
High Optimism				0.35	0.22
Low Optimism				0.34	0.21
Continue Task for 3 Min					
Optimism	1.73	0.20	0.05		
High Optimism				2.22	1.17
Low Optimism				2.75	1.29
Task Effort					
Optimism	0.73	0.40	0.02		
High Optimism				3.83	0.86
Low Optimism				3.60	0.82
Task Performance					
Optimism	0.04	0.84	0.00		
High Optimism				2.94	0.94
Low Optimism				3.00	0.73
Task Persistence					
Optimism	0.02	0.88	0.00		
High Optimism				3.78	0.55
Low Optimism				3.75	0.55

(Table continues on next page)

Variable	*F*	*p*	η_p^2	Mean	SD
Upset Over Task Performance					
Optimism	0.29	0.60	0.01		
High Optimism				1.89	0.96
Low Optimism				2.05	0.89

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Figure 1. *Procedural Flowchart*



Appendix A. Kubios HRV Variables (Tarvainen et al., 2021)

Table I-1. *Descriptions of HRV Variables.*

Variable	Description
Mean HR (bpm)	Heart rate
Mean RR (ms)	Mean of RR intervals (interbeat intervals)
RMSSD (ms log)	Square root of the mean squared differences between successive RR intervals
PNS Index	Parasympathetic nervous system activity
SNS Index	Sympathetic nervous system activity
Stress Index	Square root of Baevsky's stress index (Baevsky & Chernikova, 2017)
HF Power (ms^2 log)	HRV frequency band (0.15-0.4 Hz)
LF Power (ms^2 log)	HRV frequency band (0.04-0.15 Hz)
RESP (Hz)	Respiration rate

Appendix B. Demographic Questionnaire

Height (in.):_________ Weight (lbs.):_________

Please provide your email address so that we can contact you for part 2 of the study:

____

Your Information:

Age _______ yrs. (please respond in numerical form, e.g., 18)

What is your gender identity?

- ○ Female
- ○ Male
- ○ Transgender
- ○ Nonbinary/fluid queer/gender queer
- ○ Not listed (please specify if you choose): ___________
- ○ I prefer not to answer

Are you Hispanic, Latino, or of Spanish origin?

- ○ No, not of Hispanic, Latino, or Spanish origin
- ○ Yes, Mexican, Mexican American, Chicano
- ○ Yes, Puerto Rican
- ○ Yes, Cuban
- ○ Yes, another Hispanic, Latino, or Spanish origin (please indicate) ____________

Race (check all that apply)

- ○ White
- ○ Black or African American
- ○ American Indian or Alaska Native

○ Asian

○ Native Hawaiian or Other Pacific Islander

○ Other (please indicate) _______________

What is the highest level of education you have completed to date?

○ High school

○ 1 year of college

○ 2 years of college

○ 3 years of college

○ 4 or more years of college

What is your intended major(s) at WVU? ________________________________

Please describe any cardiovascular related illness that you may have, including high blood pressure (if none, please write “N/A”):

____

Have you ever been diagnosed with a sleep-related disorder such as insomnia, narcolepsy, obstructive sleep apnea, parasomnia, etc.? If yes, please describe:

____

Please list any other medical, psychiatric, or mental health problems that you have:

____

Please list any major surgeries and medical, or psychiatric illnesses you have had *in the past year*: ____

Females: Are you currently pregnant?

○ Yes

○ No

Females: Are you currently on birth control (contraceptives).

○ Yes

○ No

If yes, what type of birth control are you taking? __________________________

Please list any drugs (legal or otherwise) that you are currently taking including: birth control (contraceptives), heart medications, cold or allergy medications, over the counter medications, asthma medications, Beta-Blockers (i.e., Inderal, Tenormin), psychoactive drugs (i.e. Adderall, Xanax, Haldol, Lithium, Prozac), or diet pills: ____

Have you used tobacco products in the last month?

○ Yes

○ No

If yes, which tobacco products have you used? (Select all that apply)

○ Cigarettes

○ Electronic/e-cigarettes

○ Smokeless tobacco/chew

○ Vape (with nicotine)

If you use tobacco products, how often do you use them?

○ 0-5 days per month

○ 6-10 days per month

○ 11-30 days per month

How often do you drink alcohol?

○ Never

○ Infrequently (a few drinks per year)

○ Occasionally (1-2 drinks per month)

○ Weekly (1-3 drinks per week)

○ Weekly (3-6 drinks per week)

○ Daily (1-2 drinks per day)

○ Daily (more than 2 drinks per day)

How many cups of **caffeinated** coffee, tea, soda, or energy drinks (e.g., Red Bull, 5-hr Energy) do you have on a typical day?

○ None

○ 1-2 cups per day

○ 3-4 cups per day

○ 5-6 cups per day

○ 7-8 cups per day

○ Greater than eight cups per day

How many times per week do you engage in aerobic physical activity?

○ Never

○ 1-2 times

○ 3-6 times

○ 7 or more times

For how long do you typically exercise on each occasion?

○ 5-10 minutes

○ 11-15 minutes

○ 16-30 minutes

○ 31-60 minutes

○ More than 60 minutes

Family Information:

Imagine a ladder that represents where people stand in the United States. At the **top** of the ladder are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At the **bottom** are the people who are the worst off – who have the least money, least education, and the least respected jobs or no job. The higher up you are on this ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom.

On which rung of the ladder (1 being the lowest rung and 10 being the highest rung) would you place your family?

1……….2……….3……….4……….5……….6……….7……….8……….9……….10

Is your father currently living?

○ yes

○ no

Approximately how old is your father? _________

Did/does your father have high blood pressure (hypertension)?

○ yes

○ no

How certain are you that he did, or did not, have high blood pressure (hypertension)?

○ Absolutely (100%) certain

○ Almost (75%) certain

○ Not sure at all (25%)

○ No information by which to judge (0%)

Did/does your father have any heart problems such as angina (chest pains), a heart attack, or coronary heart disease?

○ yes

○ no

If yes, please specify if you are able: ____.

How certain are you that he did, or did not, have a heart problem as indicated above?

○ Absolutely (100%) certain

○ Almost (75%) certain

○ Not sure at all (25%)

○ No information by which to judge (0%)

Is your mother currently living?

○ Yes

○ No

Approximately how old is your mother? _________

Did/does your mother have high blood pressure (hypertension)?

○ Yes

○ No

How certain are you that she did, or did not, have high blood pressure (hypertension)?

○ Absolutely (100%) certain

○ Almost (75%) certain

○ Not sure at all (25%)

○ No information by which to judge (0%)

Did/does your mother have any heart problems such as angina (chest pains), a heart attack, or coronary heart disease?

○ Yes

○ No

If yes, please specify which problem(s) (if unsure, write “Unsure”):

____.

How certain are you that she did, or did not, have a heart problem as indicated above?

○ Absolutely (100%) certain

○ Almost (75%) certain

○ Not sure at all (25%)

○ No information by which to judge (0%)

Appendix C. Post-Active Coping Task Questionnaire

Instructions: Please select the response option below that most accurately describes your answer to the question.

1. How stressful did you find the task?

    a. Not at all stressful

    b. Minimally stressful

    c. Neutral

    d. Fairly stressful

    e. Extremely stressful

2. How difficult did you find the task?

    a. Not at all difficult

    b. Minimally difficult

    c. Neutral

    d. Fairly difficult

    e. Extremely difficult

3. How much effort did you put in to completing the task?

    a. None

    b. Minimal effort

    c. Neutral

    d. Fair amount of effort

    e. A lot of effort

4. How would you rate your performance on the task?

    a. Extremely poor

b. Somewhat poor

c. Unsure

d. Somewhat well

e. Extremely well

5. How would you rate your persistence in completing the task?

a. Not at all persistent

b. Minimally persistent

c. Neutral

d. Fairly persistent

e. Extremely persistent

6. How upset are you about your performance on the task?

a. Not at all

b. Minimally upset

c. Neutral

d. Fairly upset

e. Extremely upset

f. Not applicable, I rated my performance as extremely well

7. How difficult would it have been for you to engage in this task for another 3 minutes if asked?

a. Not at all difficult

b. Minimally difficult

c. Neutral

d. Fairly difficult

e. Extremely difficult

Appendix D. Post-Passive Coping Task Questionnaire

Instructions: Please select the response option below that most accurately describes your answer to the question.

1. How stressful did you find the task?

    a. Not at all stressful

    b. Minimally stressful

    c. Neutral

    d. Fairly stressful

    e. Extremely stressful

2. How difficult did you find the task?

    a. Not at all difficult

    b. Minimally difficult

    c. Neutral

    d. Fairly difficult

    e. Extremely difficult

3. How difficult would it have been for you to engage in this task for another 3 minutes if asked?

    a. Not at all difficult

    b. Minimally difficult

    c. Neutral

    d. Fairly difficult

    e. Extremely difficult

Appendix E. Script for Task Instructions

Active Coping Speech Task

In a moment, I will be showing you words on the computer screen. Please read each word and talk about it for as long as possible. For example, if I showed you the word "dog", I would want you to talk for as long as you can about the word "dog". As you talk, I will be recording you via the web cam in the computer. Please maintain eye contact with the camera while you speak. I will tell you when you can stop. Are you ready to begin?

If participant stops talking even after a new word has been shown, prompt with: Please continue telling me about the word.

If participant has not responded after 3 s, prompt with: Move to the next word.

Active Coping Raven's Progressive Matrices Task

On the following slides are several pattern problems with a piece missing. You must choose which of the pieces below the pattern is the correct one to complete the pattern. Each slide with a pattern problem on it will be shown for a period of 15 seconds. After 15 seconds, a slide with the word "Answer" on it will appear. When you see the screen that says "Answer," call out the number of the piece that correctly completes the pattern on the previous page. Do you have any questions?

Passive Coping Speech Recording Task

I will be showing you the recording I took of you speaking earlier. Please pay attention as I play this recording and watch the screen the entire time. I will tell you when you are able to stop. Are you ready to begin?

Appendix F. Supplemental Tables

Table F-1. *Normality of Variables*

Variable	Pre-Transformation				Post-Transformation			
	Mean	SD	Skew	Kurtosis	Mean	SD	Skew	Kurtosis
Adapt SBP	116.62	10.66	1.10	0.79				
Adapt DBP	67.56	5.68	0.62	-0.76				
Speech SBP	134.92	15.05	0.69	0.57				
Speech DBP	81.37	9.44	-0.10	-0.88				
Passive Rest SBP	119.60	13.30	0.64	-0.46				
Passive Rest DBP	69.94	6.80	0.55	0.11				
Passive SBP	119.94	13.03	0.87	0.23				
Passive DBP	71.00	7.62	0.13	-0.53				
Active Rest SBP	120.29	11.32	0.95	1.70				
Active Rest DBP	69.82	5.80	0.40	-0.78				
Active SBP	120.52	13.21	0.76	0.16				
Active DBP	70.89	7.40	-0.05	-1.09				
Adapt Mean RR	774.13	114.39	0.20	-0.44				
Adapt Mean RMSSD *	47.10	41.32	2.54	8.56	1.55	0.30	0.34	-0.14
Adapt PNS Index	-0.54	1.64	1.69	4.56				

Adapt Mean HR	79.13	11.76	0.35	-0.77				
Adapt Stress Index	12.30	5.44	0.64	-0.39				
Adapt SNS Index	1.33	1.64	0.48	-0.56				
Adapt LF Power (log)	6.61	0.89	0.02	-1.08				
Adapt HF Power (log)	6.28	1.45	0.36	-0.25				
Adapt RESP (Hz)	0.25	0.07	0.47	-0.11				
Speech Mean RR	707.65	101.24	0.35	0.18				
Speech Mean RMSSD *	39.57	35.93	3.15	12.03	1.50	0.26	1.00	1.40
Speech PNS Index *	-1.11	1.42	2.24	7.32				
Speech Mean HR	86.55	12.43	0.37	-0.27				
Speech Stress Index	12.32	4.44	0.01	-0.49				
Speech SNS Index	1.87	1.49	0.08	-0.49				
Speech LF Power (log)	7.09	0.99	0.49	-0.65				
Speech HF Power (log)	6.19	1.05	1.40	2.46				
Speech RESP (Hz)	0.19	0.04	0.82	0.68				

Passive Rest Mean RR	773.03	92.05	0.73	0.84				
Passive Rest Mean RMSSD *	44.09	32.39	2.40	7.33	1.57	0.24	0.72	0.37
Passive Rest PNS Index	-0.65	1.29	1.97	5.52				
Passive Rest Mean HR	78.58	8.93	-0.11	-0.53				
Passive Rest Stress Index	11.15	4.03	0.29	-0.74				
Passive Rest SNS Index	1.13	1.15	-0.06	-0.47				
Passive Rest LF Power (log)	7.02	0.89	-0.26	-0.78				
Passive Rest HF Power (log)	6.30	1.24	0.57	0.13				
Passive Rest RESP (Hz)	0.24	0.05	0.90	0.88				
Passive Mean RR	818.81	101.73	0.69	0.64				
Passive Mean RMSSD	47.67	34.03	2.36	7.43	1.59	0.24	0.47	0.80
Passive PNS Index	-0.28	1.37	1.83	4.99				
Passive Rest Mean HR	74.35	8.87	0.05	0.08				
Passive Stress Index	11.92	5.47	1.74	4.81				
Passive SNS Index	0.91	1.37	1.14	3.39				

Passive LF Power (log)	6.59	1.03	-0.09	-0.11				
Passive HF Power (log)	6.45	1.22	0.38	0.23				
Passive RESP (Hz)	0.26	0.06	0.37	-0.98				
Active Rest Mean RR	779.26	98.98	0.59	-0.10				
Active Rest Mean RMSSD	44.85	34.77	1.93	4.21	1.56	0.27	0.54	-0.09
Active Rest PNS Index	-0.59	1.39	1.49	2.68				
Active Rest Mean HR	78.22	9.60	-0.06	-0.28				
Active Rest Stress Index	11.55	4.39	0.18	-0.87				
Active Rest SNS Index	1.16	1.31	0.08	-0.44				
Active Rest LF Power (log)	6.82	0.88	-0.28	-0.34				
Active Rest HF Power (log)	6.15	1.38	-0.02	-0.51				
Active Rest RESP (Hz)	0.25	0.05	1.11	1.18				
Active Mean RR	791.39	92.60	0.59	0.15				
Active Mean RMSSD *	46.51	32.22	2.47	7.94	1.60	0.23	0.63	0.39
Active PNS Index	-0.47	1.26	2.00	5.50				

Active Mean HR	76.74	8.74	-0.04	-0.26				
Active Stress Index	11.36	3.95	0.54	0.35				
Active SNS Index	1.01	1.12	0.01	-0.08				
Active LF Power (log)	6.78	0.88	0.47	-0.20				
Active HF Power (log)	6.48	1.20	0.44	0.12				
Active RESP (Hz)***	0.25	0.05	-0.12	0.22	0.26	0.05	-0.01	-0.22
Adapt PANAS Positive Affect	24.55	9.23	0.44	-0.74				
Adapt PANAS Negative Affect ****	12.55	5.51	4.41	21.80	1.08	0.09	1.52	2.20
Speech PANAS Positive Affect	24.55	9.23	0.44	-0.74				
Speech PANAS Negative Affect	15.58	5.38	1.93	4.65	1.17	0.12	0.91	0.97
Passive PANAS Positive Affect	22.03	9.65	0.86	-0.03				
Passive PANAS Negative Affect ****	13.81	5.55	2.60	8.09	1.12	0.12	0.72	-0.55
Active PANAS Positive Affect	26.35	9.45	0.54	-0.49				
Active PANAS Negative Affect	14.55	3.45	0.96	0.73	1.16	0.10	0.17	-0.73
Speech Post Task Questionnaire 1	2.52	0.93	0.89	0.53				

Speech Post Task Questionnaire 2	2.32	1.08	0.32	-1.10				
Speech Post Task Questionnaire 3	3.77	0.76	-0.55	0.47				
Speech Post Task Questionnaire 4	3.06	0.85	0.56	-0.04				
Speech Post Task Questionnaire 5	3.74	0.58	-1.08	1.85				
Speech Post Task Questionnaire 6	2.10	1.22	1.10	1.68				
Speech Post Task Questionnaire 7	2.35	1.28	0.50	-1.17				
Active Post Task Questionnaire 1	2.97	0.98	-0.61	-0.59				
Active Post Task Questionnaire 2	3.52	0.81	-1.66	2.08				
Active Post Task Questionnaire 3	4.29	0.64	-0.34	-0.59				
Active Post Task Questionnaire 4	2.74	1.03	-0.02	-1.30				
Active Post Task Questionnaire 5	3.97	0.55	-0.03	0.74				
Active Post Task Questionnaire 6	2.16	0.97	0.36	-0.81				
Active Post Task Questionnaire 7	2.45	1.21	0.61	-0.54				
Passive Post Task Questionnaire 1	1.84	1.16	1.58	2.01				
Passive Post Task Questionnaire 2 *	1.42	1.03	2.61	6.04	0.09	0.21	1.99	2.52

Passive Post Task Questionnaire 3	1.68	1.19	1.81	2.41				
SADS Total Score **	4.95	3.23	0.41	-1.04	0.60	0.33	-0.57	-0.70

** Log transformed due to normality violations*
*** Log transformed due to homoscedasticity violation*
**** Winsorized due to outliers*
***** Log transformed and winsorized*

Table F-2. *Summary Tables of Stress Task Reactivity for Physiological Parameters*

Variable Pair	Paired Differences				Significance
	Mean	*SD*	*t*	*df*	*p*
Speech Task Reactivity					
Speech SBP - Adaptation SBP (mm Hg)	17.93	11.47	9.63	37	<.001***
Speech DBP - Adaptation DBP (mm Hg)	14.57	7.13	12.60	37	<.001***
Speech Mean RR - Adaptation Mean RR (ms)	-61.83	64.58	-6.13	40	<.001***
Speech RMSSD (log) - Adaptation RMSSD (log)	-0.05	0.18	-1.89	40	.03*
Speech PNS Index - Adaptation PNS Index	-0.52	0.72	-4.67	40	<.001***
Speech Mean HR - Adaptation Mean HR (bpm)	6.85	8.29	5.29	40	<.001***
Speech Stress Index - Adaptation Stress Index	-0.04	4.31	-0.06	40	0.95
Speech SNS Index - Adaptation SNS Index	0.49	1.16	2.71	40	.010**
Speech LF Power (ms^2 log) - Adaptation LF Power (ms^2 log)	0.47	1.04	2.87	40	.006**
Speech HF Power (ms^2 log) - Adaptation HF Power (ms^2 log)	-0.07	0.83	-0.51	40	0.62
Speech RESP (Hz) - Adaptation RESP (Hz)	-0.06	0.08	-4.71	40	<.001***

Variable Pair	Paired Differences				Significance
	Mean	*SD*	*t*	*N*	*p*
Passive Task Reactivity					
Passive SBP - Passive Rest SBP (mm Hg)	-0.21	7.06	-0.19	40	0.85
Passive DBP - Passive Rest DBP (mm Hg)	0.78	4.28	1.17	40	0.25
Passive Mean RR - Passive Rest Mean RR (ms)	41.44	35.27	7.52	40	<.001***
Passive RMSSD (log) - Passive Rest RMSSD (log)	0.02	0.12	1.30	40	0.20
Passive PNS Index - Passive Rest PNS Index	0.31	0.47	4.20	40	<.001***
Passive Mean HR - Passive Rest Mean HR (bpm)	-3.93	3.82	-6.59	40	<.001***
Passive Stress Index - Passive Rest Stress Index	0.61	3.65	1.07	40	0.29
Passive SNS Index - Passive Rest SNS Index	-0.21	0.71	-1.91	40	0.06
Passive LF Power (ms^2 log) - Passive Rest LF Power (ms^2 log)	-0.41	1.00	-2.64	40	.012*
Passive HF Power (ms^2 log) - Passive Rest HF Power (ms^2 log)	0.10	0.58	1.08	40	0.29
Passive RESP (Hz) - Passive Rest RESP (Hz)	0.02	0.06	2.44	40	.019*

Variable Pair	Paired Differences				Significance
	Mean	*SD*	*t*	*N*	*p*
Active Task Reactivity					
Active SBP - Active Rest SBP (mm Hg)	0.53	7.58	0.43	38	0.67
Active DBP - Active Rest DBP (mm Hg)	1.21	5.36	1.40	38	0.17
Active Mean RR - Active Rest Mean RR (ms)	15.90	49.22	2.07	40	.045*
Active RMSSD (log) - Active Rest RMSSD (log)	0.03	0.14	1.43	40	0.16
Active PNS Index - Active Rest PNS Index	0.13	0.55	1.46	40	0.15
Active Mean HR - Active Rest Mean HR (bpm)	-1.78	5.33	-2.14	40	.039*
Active Stress Index - Active Rest Stress Index	0.08	2.70	0.19	40	0.85
Active SNS Index - Active Rest SNS Index	-0.13	0.70	-1.18	40	0.25
Active LF Power (ms^2 log) - Active Rest LF Power (ms^2 log)	-0.17	0.93	-1.15	40	0.26
Active HF Power (ms^2 log) - Active Rest HF Power (ms^2 log)	0.23	0.89	1.68	40	0.10
Active RESP (Hz) - Active Rest RESP (Hz)	0.01	0.06	1.11	40	0.27

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table F-3

Summary Tables of Stress Task Reactivity for Affective Parameters

Variable Pair	Paired Differences				Significance
	Mean	*SD*	*t*	*df*	*p*
Positive Affect					
Speech - Adaptation	0.12	3.66	0.21	40	0.83
Passive - Adaptation	-2.76	5.44	-3.24	40	.002**
Active - Adaptation	1.24	6.14	1.30	40	0.20
Negative Affect (log)					
Speech - Adaptation	0.09	0.11	5.03	40	<.001***
Passive - Adaptation	0.04	0.15	1.85	40	0.07
Active - Adaptation	0.08	0.11	4.53	40	<.001***

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Table F-4

Summary Table of Order Effects for Physiological Parameters

Variable	*F*	*p*	η^2	Mean	SD
SBP (mm Hg)					
Condition	0.00	0.99	0.00		
Condition 1					
Active				124.26	13.88
Passive				124.35	13.42
Condition 2					
Active				116.92	8.82
Passive				115.24	8.27
Task Type	0.68	0.42	0.02		
Condition X Task Type	1.01	0.32	0.03		
DBP (mm Hg)					
Condition	0.34	0.56	0.01		
Condition 1					
Active				71.83	8.89
Passive				72.80	8.36
Condition 2					
Active				71.42	7.10
Passive				70.16	7.02
Task Type	0.05	0.82	0.00		
Condition X Task Type	0.80	0.38	0.02		
Mean HR (bpm)					
Condition	0.05	0.82	0.00		
Condition 1					
Active				74.48	8.29
Passive				73.43	8.88
Condition 2					
Active				78.50	8.76
Passive				75.75	7.88
Task Type	3.93	0.001**	0.27		
Condition X Task Type	2.79	0.10	0.07		

(Table continues on next page)

Variable	*F*	*p*	η^2	Mean	SD
Mean RR (ms)					
Condition	0.00	0.96	0.00		
Condition 1					
Active				814.00	92.78
Passive				827.71	102.33
Condition 2					
Active				774.05	90.00
Passive				801.80	90.31
Task Type	17.12	0.00***	0.31		
Condition X Task Type	2.01	0.16	0.05		
RMSSD (ms log)					
Condition	0.46	0.50	0.01		
Condition 1					
Active				1.63	0.26
Passive				1.59	0.28
Condition 2					
Active				1.57	0.20
Passive				1.59	0.19
Task Type	0.55	0.46	0.01		
Condition X Task Type	3.62	0.07	0.09		
PNS Index					
Condition	0.01	0.91	0.00		
Condition 1					
Active				-0.24	1.39
Passive				-0.23	1.47
Condition 2					
Active				-0.67	0.98
Passive				-0.49	1.00
Task Type	2.62	0.11	0.06		
Condition X Task Type	1.92	0.17	0.05		

(Table continues on next page)

Variable	F	p	η^2 or η_p^2	Mean	SD
SNS Index					
Condition	0.40	0.53	0.01		
Condition 1					
Active				0.79	1.24
Passive				0.88	1.52
Condition 2					
Active				1.18	0.96
Passive				0.98	0.95
Task Type	0.40	0.53	0.01		
Condition X Task Type	2.47	0.13	0.06		
Stress Index					
Condition	0.79	0.38	0.02		
Condition 1					
Active				10.88	4.62
Passive				11.98	6.19
Condition 2					
Active				11.80	2.94
Passive				11.83	3.37
Task Type	1.66	0.21	0.04		
Condition X Task Type	1.26	0.27	0.03		
HF Power (ms^2 log)					
Condition	0.62	0.43	0.02		
Condition 1					
Active				6.66	1.24
Passive				6.40	1.33
Condition 2					
Active				6.30	0.93
Passive				6.40	0.90
Task Type	0.69	0.41	0.02		
Condition X Task Type	4.97	0.03*	0.12		
F tests for Simple Main Effects (see Figure A-1)					
Condition (Active Task)	0.07	0.80	0.00		
Condition (Passive Task)	1.71	0.20	0.04		
Task Type (Condition 1)	4.15	0.06	0.18		
Task Type (Condition 2)	2.40	0.14	0.12		
Exploratory repeated measures ANCOVAs					
Active Rest versus Task (Condition 1)	1.05	0.32	0.05		

(Table continues on next page)

Variable	*F*	*p*	η^2 or η_p^2	Mean	SD
Active Rest versus Task (Condition 2)	1.74	0.20	0.08		
Passive Rest versus Task (Condition 1)	0.07	0.79	0.03		
Passive Rest versus Task (Condition 2)	3.06	0.10	0.14		
Rest to task excluding Passive Condition 1	5.20	0.03*	0.08		
LF Power (ms^2 log)					
Condition	0.20	0.66	0.01		
Condition 1					
Active				6.92	0.98
Passive				6.62	1.07
Condition 2					
Active				6.56	0.70
Passive				6.55	0.91
Task Type	0.90	0.35	0.02		
Condition X Task Type	1.78	0.19	0.04		
RESP (Hz)					
Condition	0.11	0.74	0.00		
Condition 1					
Active				0.25	0.05
Passive				0.27	0.06
Condition 2					
Active				0.26	0.06
Passive				0.27	0.06
Task Type	2.29	0.14	0.06		
Condition X Task Type	0.06	0.80	0.00		

*$p < .05$; **$p < .01$; ***$p < .001$

Note. Condition 1 refers to participants who completed the passive (viewing) task first, whereas condition 2 refers to participants who completed the active (Ravens) task first.

Table F-5

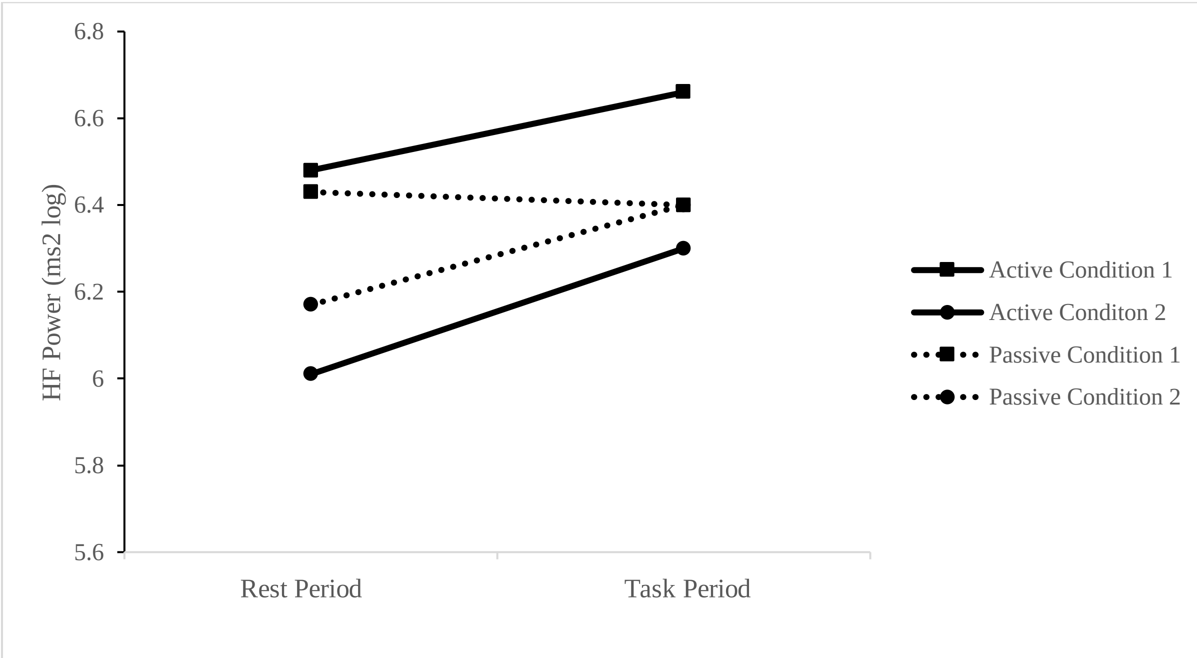
Summary Tables for Order Effects of Affective Parameters

Variable	*F*	*p*	η_p^2	Mean	SD
Positive Affect					
Condition	0.35	0.56	0.01		
Condition 1					
Active				25.05	7.55
Passive				20.62	7.90
Condition 2					
Active				27.30	10.49
Passive				23.75	10.12
Task Type	3.23	0.08	0.08		
Condition X Task Type	0.14	0.72	0.00		
Negative Affect (log)					
Condition	1.08	0.30	0.03		
Condition 1					
Active				1.16	0.09
Passive				1.14	0.12
Condition 2					
Active				1.17	0.11
Passive				1.12	0.14
Task Type	0.15	0.71	0.00		
Condition X Task Type	0.60	0.45	0.02		

*$p < .05$

Figure F-1

HF Power (ms^2 log) Condition by Task Type Interaction



Note. This figure demonstrates the significant interaction between condition and task type for HF Power (ms^2 log). Simple main effects analyses revealed no significant mean differences. However, when examining HF Power (ms^2 log) for rest versus task periods excluding the passive task during condition one, results revealed a significant difference, F (1, 60) = 5.20, p = 0.03, η_p^2 = 0.08. Results show that HF Power (ms^2 log) did not change for the viewing task in condition one, however, reactivity seen across all other task and order means shows a significant increase in HF Power (ms^2 log) (see Table A-4).