INDIVIDUAL DIFFERENCES IN GOAL ADJUSTMENT ABILITY AND MAGNITUDE OF EMOTIONAL AND AUTONOMIC RESPONSES TO AN UNSOLVABLE ANAGRAM TASK

by

Berhane Messay

Bachelor of Science, University of Dayton, 2006

Master of Arts, University of Dayton, 2010

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This thesis was presented

by

Berhane Messay

It was defended on

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and approved by

Tomas Kamarck, Ph.D., Department of Psychology

Peter Gianaros, Ph.D., Department of Psychology

Thesis Advisor: Anna Marsland, Ph.D., Department of Psychology

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Berhane Messay, M.S.

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Individuals differ in their ability to disengage from unattainable goals (referred to as goal disengagement ability, GD ability) and reengage in other potentially more rewarding activities (referred to as goal reengagement ability, GR ability). In theory, these two distinct traits function to buffer individuals from prolonged emotional distress that can accompany persevering with hopeless goals and, thus, may have health benefits. However, to date, studies are limited by cross-sectional design and reliance on self-reported assessment of GD and GR ability. Accordingly, a primary aim of the current study was to conduct an initial examination of whether responses on the widely used Goal Disengagement and Goal Reengagement Scale (Wrosch, Scheier, Miller, Schulz, & Carver, 2003) relate to disengagement behavior during a laboratory unsolvable anagram task. Secondary aims examined whether GD and GR ability relates to baseline and task-related changes in affect and cardiovascular measures.

For these purposes, 90 undergraduate students completed the Goal Disengagement and Goal Reengagement Scale and an anagram solving task under time pressure. Affect and cardiovascular parameters (HR, BP, and HF-HRV) were assessed at baseline, prior to task performance, during the task, and following the task. Results did not show an association between trait GD ability and time spent working on anagrams. In regards to affect and cardiovascular response, some findings were consistent with our expectations while others were not. For instance, we found trait GR ability predicted higher pre-task positive mood. However, persisting longer during unsolvable sets, rather than early disengagement, was associated with smaller reduction in positive mood and feelings of in-control. Similarly, trait GD ability was associated with smaller increases in HR during unsolvable anagrams. However, trait GD was related to higher baseline HR and a significant interaction suggested that individuals who endorsed higher trait GD and GR ability showed an elevated baseline DBP, compared to individuals who were high in GD and low in GR ability. We also did not find any significant associations between self-reported GD and GR ability and baseline or task-related HF-HRV. A number of possible explanations are considered for the unexpected findings and potential future directions are proposed.

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1.0 INTRODUCTION

1.1 DISENGAGEMENT AND RE-ENGAGEMENT ABILITIES: DESCRIPTION AND HISTORICAL BACKGROUND

The idea of evaluating commitment to goals and disengaging as a means of minimizing negative emotional experiences can be traced back to early motivational theorists. For instance, Klinger (1975) purported that when goals are perceived as unattainable, the incentives and values associated with the goal weaken. Eventually, the individual disengages from the goal, oftentimes after experiencing protracted frustration and depressive symptoms. Individual differences in ease of evaluating and adjusting goals may moderate the cost of goal perseverance, with individuals who disengage more quickly from unattainable goals and/or re-engage in more rewarding options experiencing fewer negative emotions than those who prolong disengagement. While personal characteristics such as perseverance can predict success in goal attainment (e.g., Duckworth, Peterson, Matthews, & Kelly, 2007), the judgment of whether a given strategy (i.e., disengage or persevere) is adaptive or not may be highly contextual. In situations where goals are challenging, but ultimately attainable, continued effort may pay off. However, in situations where goals are not achievable despite extended effort, early goal disengagement and reconsideration may be more adaptive.

Goal adjustment ability is proposed to be a dispositional characteristic that assesses ability to shape and pursue goals based on perceived attainability (Wrosch et al., 2003). It is a trait that may provide unique contributions to mood regulation. For instance, unlike constructs such as optimism that measure individuals' general positive outlook in the face of challenge, goal adjustment ability additionally considers individuals' perceived ability to cognitively and behaviorally 'let-go' or disengage when the challenge is insurmountable. Indeed, preliminary evidence suggests that dispositional optimism correlates with goal re-engagement tendencies but not with goal disengagement (Rasmussen, Wrosch, Scheier, & Carver, 2006). In other words, goal adjustment ability not only involves assessing the demands of a given goal, but also disengaging from the goal if it is perceived as unfeasible, and shifting attention and diverting resources to re-engaging in more achievable goals (Wrosch et al., 2003; Wrosch & Scheier, 2003). Thus, goal adjustment ability is understood to be comprised of two somewhat separate traits: goal disengagement (GD) and goal re-engagement (GR) ability.

1.2 MEASUREMENT OF GOAL DISENGAGEMENT AND RE-ENGAGEMENT ABILITY

The primary method of assessing GD and GR ability is through a self-report measure called the "Goal Disengagement and Goal Reengagement Scale," which was developed by Wrosch et al. (2003) (See Appendix A). This 10-item scale includes four items that assess how easily respondents reduce effort and abandon their commitment to a goal (e.g., "it's easy for me to reduce my effort toward the goal") and six items measuring how easily individuals are able to identify and pursue new goals (e.g., "I start working on other new goals"). Prior to providing answers on these ten items on a 5-point Likert-type scale (1=almost never true, 5 = almost always true), respondents are prompted by statements such as "if I have to stop pursuing an important goal…" There is evidence that the two subscales have adequate internal consistency (Cronbach's alpha of .84 for GD and .86 for GR; Wrosch et al., 2003) and factor analyses have confirmed that the subscale items load on the two separate factors (Dunne, Wrosch, & Miller, 2011). In addition, the two constructs do not correlate highly with each other (e.g., $r = .21$; Wrosch et al., 2007), suggesting that GD and GR ability are partially independent.

To date, however, validity of the scale as a measure of goal shifting ability remains to be determined. Although scores on the subscales correlate with other self-reported measures (Wrosch et al., 2003), it remains possible that these associations reflect common method biases and contribution of other factors such as social desirability or dispositional negative affect that systematically impact how individuals respond (Brett et al., 1990; Crowne & Marlowe, 1960; Podsakoff, P., MacKenzie, Jeong-Yeong, & Podsakoff, 2003; Watson & Clark, 1984). Accordingly, the first aim of the current study was to behaviorally validate individuals' self-reported tendency to disengage from goals. In this regard, we examined how closely scores on the GD subscale of the "Goal Disengagement and Goal Reengagement Scale" correlate with how quickly individuals' disengage from unsolvable anagrams in the laboratory.

1.3 GOAL DISENGAGEMENT AND RE-ENGAGEMENT AS ADAPTIVE EMOTIONAL COPING PROCESSES

Recent evidence suggests GD and GR ability relate differently to measures of emotional adjustment. Generally, inability to disengage from unachievable goals is related to more negative emotional experiences (e.g., presence of higher depressive symptoms; Dunne, Wrosch, & Miller, 2011); whereas, ability to reengage in new goals is associated with the experience of positive emotions (e.g., feelings of hopefulness and self-reported purpose in life; Wrosch, Amir, & Miller, 2011). It is proposed that the ability to easily disengage from unachievable goals may minimize the experience of failure and the associated negative emotional consequences (Wrosch & Scheier, 2003). On the other hand, increased ability to shift focus to a new goal (i.e., re-engage) may reduce rumination about failure to succeed and permit a faster recovery, leading to higher feelings of self-mastery and other positive emotions (Wrosch et al., 2003). Hence, increased ability to disengage from old goals and to generate and shift attention to new goals may contribute to effective emotional coping in the face of stressful events. In support of this, recent studies show that goal adjustment ability is associated with more adaptive coping strategies in stressful situations, including increased use of humor, positive reframing, and religion (Wrosch, Amir, and Miller, 2011).

However, to date, it remains unknown whether individual differences in goal disengagement and re-engagement are related to emotional responses during unattainable goal pursuit. Addressing this gap in literature would offer evidence for the contribution of goal adjustment ability to emotional regulation in the face of challenge. Therefore, a secondary aim of the proposed study was to examine associations between perceived goal disengagement and re-engagement and emotional responses to an unsolvable anagram task.

1.4 GOAL DISENGAGEMENT/RE-ENGAGEMENT AND STRESS-RELATED CHANGES IN PHYSIOLOGY: IMPLICATIONS FOR PHYSICAL HEALTH

Consistent evidence shows that prolonged stressful experiences are associated with increased health risk (Chrousos, 2009). It is widely suggested that this connection is mediated by persistent negative affective states such as anxiety and depressive feelings (Cohen, Janicki-Deverts, & Miller, 2007). By moderating negative emotional responses to life’s challenges, it is possible that individual differences in goal adjustment ability may contribute to emotion-related physical health risk. Pathways linking negative emotions to poor health outcomes remain unclear and are likely complex. However, strong evidence suggests that behavioral and psychophysiologic mechanisms play a role.

Behaviorally, emotionally demanding experiences are often accompanied by lifestyle changes such as increased substance abuse, decreased levels of physical activity, dietary changes, and sleep disruptions that may contribute to increased health risk in the face of chronic stress (Segerstrom & Miller, 2004). In this regard, preliminary studies show that GD ability is positively related to self-reported health, better sleep efficiency, subjective well-being (Rasmussen et al., 2006; Scheier et al., 2006; Wrosch et al., 2003) and negatively with substance use and sedentary lifestyle (Wrosch & Sabiton, 2012; Wrosch, Amir, & Miller, 2011).

Negative emotional states are also associated with the activation of peripheral physiological pathways that are linked to increased health risk; though, the extent that negative emotions mediate stress-related changes in physiology has yet to be clearly established. Still, stress is understood to modulate activity of two central to peripheral pathways: (1) The hypothalamic-pituitary-adrenocortical axis (HPA), and (2) The autonomic nervous system (ANS).

1.4.1 The HPA axis.

The few studies that have examined associations of goal adjustment ability with peripheral physiology have focused on levels of cortisol as a marker of HPA axis activation. Cortisol plays a key role in numerous body systems, including the regulation of inflammation by the immune system (Miller, Chen, & Zhou, 2007). Initial evidence shows that individual differences in GD ability are related to the diurnal patterns of cortisol release, with higher GD tendencies being associated with "normative" diurnal patterns of cortisol release and lower GD ability with a more flattened pattern of cortisol secretion (Wrosch et al., 2007). GD ability has also been shown to be inversely associated with direct markers of peripheral inflammation, such as circulating levels of C-reactive protein (CRP; Miller & Wrosch, 2007). Interestingly, associations between trait GR and inflammation have not been observed; providing further support that the two constructs function independently. In sum, early evidence suggests trait GD may be associated with lower levels of HPA activation and reduced circulating markers of inflammation, possibly reflecting decreased health risk since elevations of systemic inflammation have been implicated in the pathogenesis and course of immune-mediated illnesses such as cardiovascular disease (Kemeny & Schedlowski, 2007).

1.4.2 The ANS.

Presently, no studies have examined whether individual differences in goal adjustment ability are related to ANS function. The ANS is classically divided into two subsystems: the sympathetic system (SNS) which prepares the body for action and the parasympathetic nervous system (PsNS) that generally acts to preserve energy. These two systems act in concert to target organ function. At the level of the heart, SNS and PsNS interact to affect the sinoatrial (SA) node. At rest, tonic vagal input (i.e., input from the vagus nerve of the PsNS) on the SA node maintains heart rate at a pace between 60 and 80 bpm. For heart rate to increase and meet potential environmental demands, vagal input is decreased and sympathetic nerves, which also innervate the SA node, are activated.

Under resting conditions, heart rate normally varies in synchrony with respiration, increasing during inhalation and decreasing during exhalation. This is known as respiratory sinus arrhythmia (RSA) and is the result of a complex interplay of central and peripheral mechanisms, including central cardiorespiratory rhythm generators, baroreceptor and chemoreceptor reflexes, cardiac and pulmonary stretch reflexes, and local metabolic factors (Berntson et al., 1993). RSA is widely accepted to correspond to PsNS control over heart rate, with vagal activity decreasing during inspiration and increasing during expiration. Thus, respiration-related variability in heart rate is employed widely as a measure of cardiac vagal control and more broadly as an index of tonic vagal activity.

A primary, non-invasive way of measuring cardiac vagal control is through the assessment of heart-rate variability (HRV). HRV refers to the variation over time of interbeat intervals (IBI) following each heartbeat. Typically, the IBI is identified on an electrocardiogram (ECG) as the distance between each R-spike. One way to quantify HRV is to employ frequency domain analysis, such as the Fast Fourier transform (FFT) technique, which involves decomposing the oscillation of IBI variation within a given time period into its component frequencies. Normal RSA reflects IBI changes that oscillate at a high frequency between .15HZ to .40HZ (9 to 24 times per minute). On the other hand, evidence shows that low frequency (LF) variation in heart rate (i.e. below .15 HZ) reflects the contributions of both SNS activation and PsNS withdrawal. Indeed, vagal withdrawal has been shown to result in a shift from higher to lower frequency HRV (Berntson et al., 1997).

1.4.3 ANS modulation as an index of emotion regulation.

Under conditions of stress, activation of the SNS and withdrawal of the PsNS results in increased blood pressure and heart rate accompanied by decreased RSA (and high frequency (HF)-HRV). This pattern of response is observed in response to acute (e.g., mental arithmetic task or examinations) and prolonged psychological stressors (e.g., Berntson, Cacioppo, & Fieldstone, 1996; Dishman et al., 2000; Lucini, Norbiato, Clerici, & Pagani, 2002; Sloan et al., 1994).

Negative emotions are also related to HRV. For instance, literature reviews show that low levels of HF-HRV accompany affective disorders, such as anxiety and depression (Friedman, 2007; Rottenberg, 2007). Recent studies also show a positive association of HF-HRV with trait positive emotionality (Oveis et al., 2009) and with daily reporting of positive emotions and feelings of social connectedness (Kok & Fredrickson, 2010).

1.4.4 Goal disengagement and re-engagement and acute ANS modulation.

Factors that contribute to individual differences in tonic and phasic ANS activation in response to stress remain to be determined. However, it is possible that individual differences in disengagement and re-engagement play a role. In support of this, studies show that individuals who report an increased ability to disengage from frustrating goals and focus on new goals ruminate less, recover faster emotionally from challenges, and experience more positive emotions (Wrosch & Scheier, 2003; Wrosch et al., 2003). For instance, a study by van Randenborgh, HÜffmeier, LeMoult and Joormann (2010) showed that tendency to ruminate was negatively associated with behavioral disengagement and positively associated with self-reported experience of negative affect.

Physiologically, individuals who have high ruminative tendencies (i.e., difficulty in emotional and cognitive disengagement from a stressor) display higher negative emotional and cardiovascular arousal at rest and following a stressor, when compared to their less ruminative counterparts (e.g., Gerin et al., 2006; Glynn, Christenfeld, & Gerin, 2002, Ottaviani et al., 2009). There is also some evidence that positive emotional experiences reduce cardiovascular recovery time following a stressor (i.e., "undo" the effects of negative emotions; Fredrickson, Mancuso, Branigan, & Tugade, 2000). Together, these findings suggest GD and GR ability may relate to cardiovascular reactivity and recovery. Thus, a third aim of the current study was to examine the association of perceived ability to disengage from unattainable goals and re-engage in new goals with baseline as well as task-related changes in cardiovascular reactivity (including HF-HRV) and recovery during and following an unsolvable anagram task.

1.5 AIMS AND HYPOTHESES.

To summarize, the current study has three specific aims. The first aim is to validate the trait GD subscale of the Goal Disengagement and Reengagement Scale (Wrosch et al., 2003) using laboratory-based behavioral methods. It is hypothesized that individuals who report greater tendency to disengage will disengage faster from unsolvable anagrams (i.e., would be less likely to persist) when compared to individuals who perceive themselves as less able to disengage (hypothesis 1). The second aim of the study is to examine whether GD and GR abilities differentially relate to emotional responses to an unattainable goal. It is hypothesized that higher perceived GD ability and early behavioral disengagement will be associated with less negative responses and GR ability will be associated with more positive responses to the task (hypothesis 2). The third aim of the study is to investigate whether GD and GR abilities are related to the magnitude of cardiovascular reactivity to an unsolvable anagram task. Here, we conducted an initial examination of associations between both GD and GR ability and a) baseline HR, BP, and HF-HRV, b) baseline to task-related changes in HR, BP, and HF-HRV, and c) post-task recovery of these measures. Given existing evidence linking GD ability to reduced negative emotions, it was predicted that it would also relate to lower cardiovascular reactivity. Similarly, recent evidence suggests that GR ability is associated with more positive emotions and faster emotional recovery following challenge. Thus, it was predicted that higher scores on the GR subscale would relate to faster cardiovascular recovery. Specifically, it was hypothesized that a) higher GD ability and lower time-to-disengage from unsolvable anagram sets would be associated with lower HR and BP, and higher HF-HRV at baseline (hypothesis 3), b) higher perceived GD ability and lower time-to-disengage would be associated with smaller task-related changes in cardiovascular measures (hypothesis 4), and c) higher perceived GR ability would be associated with faster cardiovascular recovery to baseline levels following the anagram task (hypothesis 5).

To be comprehensive in our conceptualization of goal disengagement, we used the variable of time-to-disengage as a measure of behavioral disengagement. We also examined participants' perception of re-engagement and disengagement ability at the state level, which we operationalized as participants' perceived ease in disengaging and re-engaging during the anagram task. Therefore, in the present study, both goal disengagement and reengagement ability were measured at the trait and state level, and goal disengagement ability was additionally evaluated at the behavioral level.

The current project also considers several exploratory aims. The first aim is to check that the association between goal adjustment ability and emotional and cardiovascular measures are independent of individual differences in negative affectivity (i.e., trait negativity) or in stress perception (i.e., self-report on stressfulness of the task). Secondly, initial evidence suggests that individuals who endorse both high GD ability and low GR ability may be more susceptible to experience distress in the face of challenge than individuals who endorse different goal adjustment abilities (Wrosch et al., 2003). For instance, a noteworthy study by O'Connor, Fraser, Whyte, MacHale, and Masterton (2009) showed that among individuals who made suicide attempts, risk of future suicide attempts was greatest among those high in goal disengagement but low in goal reengagement tendencies. This suggests that the two constructs may interact in important ways to predict psychological and health consequences. As such, in addition to testing the main effects of GD and GR, we explored the possibility that these two factors interact in the prediction of emotional and cardiovascular reactivity and recovery. Lastly, the current project also examines the role of psychological factors that may be theoretically related to goal adjustment ability, such as post-task rumination and coping strategies. In regard to the latter factor, trait GD and GR have been shown to relate to more adaptive coping strategies in samples of older adults (e.g., Wrosch & Sabiston, 2012; Wrosch et al, 2011). The proposed project attempts to replicate this finding in a younger population.

2.0 METHOD

2.1 PARTICIPANTS

Participants were recruited from the introductory psychology subject pool of a large Mid-Atlantic university. Participants were included if they were between the ages of 18-25, did not report a history of diseases known to affect the cardiovascular system, and had no current significant psychiatric illness. Criteria for exclusion included a resting blood pressure above 150/90 mmHg and noncompliance of study restrictions, which included not drinking caffeinated beverages for at least four hours, not smoking or eating for at least two hours, and not exercising and drinking for at least 24 hours prior to their scheduled session. Participants received class credits for their participation and were eligible to win a prize (a one hundred dollar iTunes gift card) at the end of the study. The study was also approved by the Institutional Review Board of the University of Pittsburgh.

2.2 PROCEDURE

Laboratory sessions were scheduled during mid- to late- afternoons. For each participant, signed informed consent was obtained and adherence to study restrictions was verified before starting the session. Participants then completed a battery of questionnaires assessing demographic and health history, use of coping strategies, personality factors, trait goal disengagement/re-engagement ability, and current mood. Once escorted to the psychophysiological testing chamber, three disposable electrodes, using a modified lead II configuration, were placed on participants' chests and a respiration belt was fitted for the assessment of HRV (MindWare Technologies, LTD, Gahanna, OH). An occluding cuff was also placed on participants' non-dominant arm for automated measurement of systolic and diastolic BP (Critikon Dinamap 8100). Participants remained seated in the chamber for the duration of the study.

The study protocol consisted of a 20 minute baseline (habituation), a 5 minute paced breathing protocol (with pacing set at the average respiration rate of 12 breaths per minute), an anagram completion task (maximum 20 minutes), and a 30 minute recovery period. Participant's affective state during the experimental periods was evaluated using paper and pencil as well as pictorial assessment methods (see 'instrument/measurement' section for more details). Following the task, participants rated the difficulty of the task and reported on how easily they were able to disengage and re-engage during the anagram task. Following the recovery period, the extent participants ruminated about the task during their recovery was assessed using a short questionnaire. Lastly, participants completed a 10 minute paper-and-pencil standardized anagram task that determined their expertise in solving anagrams. At the end of the session, participants were given a form that partially explained the nature of the study. Information regarding the insolvability of some of the anagrams was concealed until the end of the study when participants were contacted for a full debriefing. A summary timeline of the protocol is provided in Appendix F.

2.3 DESCRIPTION OF ANAGRAM TASK

To assess behavioral disengagement, participants were asked to complete a series of 16 five-letter anagrams, presented in sets of four, under a 20 min time pressure (adapted from Aspinwall & Richter, 1999). The task presentation was modified to allow for cardiovascular and affect measurement at the end of each set. The first anagram set presented was solvable and the other three were counterbalanced to minimize potential order effects. To motivate participants, they were reminded of their eligibility to win a prize based on performance prior to starting the task. To minimize movement that could result in artifacts in the HRV data, participants were prompted and given time to write down their responses at the end of each anagram set. The amount of time participants spent on each anagram set was tracked using event markers (using MindWare Biolab software, Version 3.0.8 version). Average time devoted to unsolvable and solvable sets was calculated separately.

2.4 INSTRUMENTS/MEASUREMENTS

2.4.1 Health history and demographic information.

Participants completed a brief questionnaire assessing demographics, smoking status, and personal history of psychiatric and medical illness (Appendix B). Second paragraph.

2.4.2 Goal Adjustment Ability.

Trait GD and GR were determined using the 10-item Goal Disengagement and Goal Re-engagement Scale (Wrosch et al., 2003). The scale includes 4 items assessing perceived trait GD and 6 items assessing GR. Consistent with prior findings, the subscales showed adequate reliability in the current sample, with Cronbach's alpha values of .82 for the GD subscale and .87 for the GR subscale. Further, performing a factor analysis with varimax rotation of the ten items also confirmed that items loaded on 2 subscale factors. Consistent with findings reported by Wrosch et al., 2003, GD items loaded on one factor with correlations ranging from .72 to .86 and GR items loaded on a second factor with values ranging from .67 to .87.

For the purposes of this study, at the end of the anagram task, participants completed an abbreviated version of Goal Disengagement and Goal Re-engagement scales that evaluated state GD and GR. Two items from each scale were selected to assess perceived ability to disengage from one set of anagram task and re-engage in another set (see Appendix A for actual items).

2.4.3 Cardiovascular and heart-rate variability assessment.

Electrocardiograph (ECG), breathing belt, and oscillometric blood pressure (BP) recording equipment were used to assess cardiovascular reactivity and respiration rate. ECG was recorded continuously throughout the baseline, task, and recovery periods. Signals were sampled at the recommended digitization rate of 1000 Hz for adequate resolution to conduct HRV analysis (Berntson et al, 1997). BP was recorded every two minutes. BP recording began 10 minutes into the baseline period (five baseline measurements), 1 minute into the paced breathing (three paced breathing measurements), and anagram sets (three measurements per anagram set). Magnitude of cardiovascular responses was determined by averaging data collected during baseline, paced breathing task, unsolvable anagrams, solvable anagrams, and recovery period.

2.4.4 Mood assessment.

Participants' mood at baseline and at the end of the task period was evaluated using a short form of the POMS (McNair et al., 1981). This measure is widely used to assess individuals' transient negative and positive moods. Twelve items from this measure, drawn from a factor analytic study of mood adjectives (Usala & Hertzog, 1989) were employed to assess mood states. This measure includes 8 positive affect items associated with 3 subcategories of positive affect: vigor (active, intense, lively, enthusiastic), well-being (happy, cheerful), and calm (calm, relaxed) and 4 negative affect items associated with two subcategories of state negative affect: anxiety (jittery, nervous) and depression (unhappy, sad). Each adjective was rated on a scale of 0 (not at all accurate) to 4 (extremely accurate) according to how much that word reflected how the participant felt at that time. This abbreviated mood measure has alpha coefficients ranging from .71 to .95 (Usala & Hertzog, 1989).

Participants' mood during the task was evaluated using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994). SAM is a pictographic method of assessing the valence and intensity of emotional responses during tasks. More specifically, participants were able to quickly and nonverbally rate on a scale of 1 (low) to 9 (high) the extent they felt physically excited, in-control, and in a positive mood. SAM has been shown to correlate highly with paper-and-pencil report of emotional response (Bradley & Lang, 1994). The 'manikin' pictures were displayed at the beginning of the task and following each anagram set to assess emotional reactivity that was specific to the solvable and unsolvable anagram sets.

2.4.5 Measures of psychological factors of interest.

To address our exploratory aims, we assessed trait negative affect, task difficulty appraisal, coping strategies, and post-task rumination.

2.4.5.1 Trait negative affect.

To examine whether associations of goal adjustment ability with baseline and task-related mood and cardiovascular parameters are independent of trait negative affectivity, an 88-item adjective rating scale was used to measure personality factors, including trait negative affect. The adjective list is a composite of selected subscales assessing trait negative affect that are taken from four well-validated instruments: anxiety and depression from the Profile of Moods States (POMS) Affect Scale (Usala & Hertzog, 1989), emotional stability from Goldberg's Big-5 factor Scales (Goldberg, 1992, 1993), activated unpleasant and unpleasant affect from the Larsen and Diener Circumplex model (Larsen & Diener, 1992), and positive loading for stress from the Mackay Circumplex (Mackay et al., 1978). For each item, participants were required to rate accuracy of trait descriptions on a 5-point Likert scale ranging from 0 (not at all accurate) to 4 (extremely accurate). A principal component factor analysis with varimax rotation of the six scales was performed. Positive loading for stress (.90), unpleasant affect (.81), activated unpleasant (.83), anxiety (.91), depression (.84), and neuroticism (.95) loaded on a single factor. Using SPSS software package for Windows (SPSS Inc., Chicago, IL), a trait negativity variable that averaged the appropriate standardized scores and equally weighed each factor was created.

2.4.5.2 Task difficulty appraisal.

To ascertain if associations between goal adjustment ability and emotional as well as cardiovascular measures are independent of individual difference in perception of task difficulty, subjective ratings of task difficulty and stressfulness were assessed following the anagram task using a Likert-type response scale (Appendix C). Item questions were adapted from Segerstrom and Solberg Nes (2007). This six-item task appraisal scale has shown adequate inter-consistency (alpha reliability value of .81; Sergerstrom & Solberg Nes, 2007). Higher scores indicate increased perception of task difficulty.

2.4.5.3 Coping strategies.

Participants completed the Brief COPE, a multidimensional inventory of coping strategies (Carver, Scheier, & Weintraub, 1989; Carver, 1997). This measure has been extensively used in the literature and has been shown to have good psychometric properties. Furthermore, Wrosch and colleagues (2011) have used this scale and found differential associations of coping strategies with goal disengagement and re-engagement abilities in an older population. The Brief COPE contains 14 scales. Two items per scale evaluate respondents' endorsement of a given strategy based on a response scale of 1 ("I don't do this at all") to 4 ("I do this a lot").

2.4.5.4 Post-task rumination.

Post-task rumination was assessed following the rest period using a Likert-type response scale created for the purpose of this study (Appendix D). Higher scores reflected general difficulty in cognitively disengaging from the task.

2.4.6 Potential covariates.

We also measured potential demographic, physical, and personal covariates.

2.4.6.1 Participant demographic characteristics.

Common covariates that are related to cardiovascular reactivity were examined. For instance, BP, HR, HRV vary as a function of age, race, gender, and activity level (e.g., Antelmi et al., 2004; Jennings, Hutcheson, Obrist, Turpin, 1981; Shapiro et al., 1996). As a result, preliminary analyses examined the associations of these demographic/lifestyle factors and body mass index (BMI; kg/m2) with tonic or phasic cardiovascular measures.

2.4.6.2 . Expertise in anagram solving.

Participants' individual differences in past exposures to anagrams or their expertise in solving anagrams was assessed using a paper-and-pencil word construction task standardized with student populations (adapted from Hicks et al., 1969; Appendix F). The multi-solution anagram task is comprised of 34 anagrams with multiple solutions that undergraduate students (N =870) typically complete in twenty minutes. For the purposes of this study, 15 of the most frequently solved anagrams were selected and participants were given ten minutes to generate solutions. The total number of words generated was indicative of anagram solving ability (ASA).

2.5 DATA ANALYSES

All statistical analyses were performed using SPSS, version 20 (SPSS Inc., Chicago, IL).

2.5.1 Preliminary analyses.

Prior to hypotheses testing, several preliminary data analyses were performed. First, bivariate correlations were conducted to examine associations between possible covariates and variable of interests. Second, collected data were evaluated for outliers (> +/- 3 standard deviation from the mean) and skewness and kurtosis values were calculated. Natural log transformations were performed when necessary. Lastly, repeated measures analysis of variance (ANOVA) and paired sample t-tests were performed to confirm that the task induced significant within subject changes in the cardiovascular parameters assessed.

2.5.2 Goal disengagement ability and behavioral disengagement (hypothesis 1).

To examine whether trait GD is positively related to behavioral disengagement, partial correlations were performed.

2.5.3 Goal adjustment ability and emotional reactivity (hypothesis 2).

To investigate the possibility that perceived goal adjustment ability relates to post-task affective responses, multiple regression analyses were conducted. For these analyses, two measures of emotional response were examined. First, changes in emotional states from baseline to post-task on the POMS were calculated. Second, average emotional responses following the solvable and unsolvable anagrams were assessed separately using participants' SAM ratings and E-Prime software (E-Data Aid, version 2.0, Psychology Software Tools, Inc.). Next, change in SAM ratings was calculated (SAM rating immediately before starting the anagram task minus rating for valence/intensity during unsolvable/solvable sets).

2.5.4 Goal adjustment ability and cardiovascular reactivity (hypothesis 3 and 4).

Prior to scoring HRV, the ECG files were evaluated for presence of artifacts. Artifacts have been shown to impact HRV values (e.g., Berntson & Stowell, 1998); thus, HRV data were edited by deleting extra beats and/or inserting missing beats on R-spikes or using the Midbeat function of the MindWare software. Further, if within a 1 min segment there are too many artifacts—that is, more than 5 seconds of noise, or 3 or more arrhythmias, then that segment was not retained.

In order to decompose total variability of collected heart-rate periods into frequency associated with parasympathetic input (i.e., high frequency =.15-.40 Hz), fast-fourier transform (FFT) technique, using the software MindWare Version 2.5 (MindWare Technologies LTD., Gahanna, OH), was employed. Event-markers were used to denote task transitions. HRV values for each study period were determined by averaging edited and analyzed time segments within each period. For instance, to facilitate the editing and assessment of HRV, the 20 min baseline period was divided into four 5 min (300s) segments, the 5 min paced breathing into one 5 min (300s), and the first 15 minutes of recovery into five 3 min (180s) segments. For the task, we intended to examine 2 min segments for optimal HRV assessment. However, in order to retain data for participants who disengaged from solvable anagram sets before 2 min elapsed (N=26), HRV during each anagram set was evaluated using 60s and 120s segments. Segments of 1 min are deemed sufficient to provide an estimate of HF component of HRV (Task force, 1996).

To control for the effect of respiration rate on HRV, for each participant, we regressed within subject fluctuations in respiratory rate and HF-HRV data for each experimental epoch and obtained standardized residual scores. Regression analyses were used to examine if goal disengagement ability predicted baseline-to-task changes in HR, BP, and HRV. Prior to their inclusion in regression models, cardiovascular change scores were baseline-corrected by obtaining residuals.

2.5.5 Goal re-engagement ability and cardiovascular recovery (hypothesis 5).

Cardiovascular recovery, or the extent participants returned to baseline after a 30 minute recovery period was determined by calculating change scores (mean baseline magnitude – magnitude of cardiovascular parameter at 30 min recovery); smaller values signified a faster recovery. Multiple regressions, controlling for significant covariates and for magnitude of reactivity during the task, was used to evaluate the extent trait GR predicted faster recovery.

2.5.6 Exploratory analyses.

To parcel out the unique association of goal adjustment ability with emotional and cardiovascular measures, multiple regression models were conducted including trait negativity and task difficulty appraisal as potential covariates. Similarly, to examine whether goal disengagement and re-engagement ability interact in predicting affect and cardiovascular reactivity and recovery, we conducted multiple regression analyses focusing on the unique contribution of the interaction term (i.e., controlling for main effects of GD and GR ability). The interaction term was created after centering values for both GD and GR subscales, and obtaining the cross product of the two centered variables. We subsequently related the interaction term to affective and cardiovascular reaction and recovery variables. When the interaction was significant, we further probed the interaction to identify patterns that may be driving the observed effects. Finally, to examine if perceived GD and GR tendencies, or the product of the two variables, are related to post-task rumination or adaptive coping strategies, separate regression analyses were performed.

3.0 RESULTS

A total of 90 healthy participants aged 18 to 25 (Mean = 19.24, SD =1.34) were recruited. Participants were predominantly non-smokers (93.4%). Female participants (59.3%) outnumbered and were older than male participants (i.e., age and gender were significantly correlated, $r = .30$, $p < .05$). In terms of racial or ethnic background, 75.8% of participants were Caucasian (followed by Asian or Pacific Islander, 14.3%, African-American, 5.5%, and 4.4% Latino/a or other). See Table 1 for a summary of the demographic characteristic of the sample. Seven participants' task data were excluded from analyses. Reasons for exclusion included: 1) two participants' time-to-disengage and one participant's HF-HRV data points were identified as outliers (+/- 3 SD from the mean), 2) two participants were deemed not proficient in English, 3) one participant dropped out following the baseline period due to feeling unwell, and 4) one participant's task data was not saved properly. In addition, due to mechanical issues with the Dinamap equipment, BP data was not obtained for four participants. Thus, the final sample size was 83 for most variables and 79 for BP.

3.1 PRELIMINARY FINDINGS

3.1.1 Covariates and study variables.

Bivariate correlations between study variables and covariates are presented in Table 2. Age, gender, race, BMI, and anagram solving ability (ASA) were considered as standard covariates and were statistically controlled in all subsequent analyses. The association of smoking status with study variables was not examined due to the limited number of participants that identified themselves as smokers. We also examined the correlation between GD and GR. Consistent with existing literature (e.g., Wrosch et al., 2003), scores on the GD and GR subscales were moderately correlated ($r = .24$, $p < .05$ and $r = .29$, $p < .01$, for trait and state GD/GR ability, respectively), suggesting participants who endorse higher GD ability also endorse higher GR ability.

3.1.2 Normal distribution of data.

Prior to computing change scores, anxiety and depression ratings of the POMS were log transformed to better approximate a normal distribution. In terms of cardiovascular data, HR and BP scores were normally distributed. However, HF-HRV scores were significantly skewed. Excluding one outlier and natural log transforming the data effectively brought skewness and kurtosis values within acceptable range.

3.1.3 Task validity.

Preliminary analyses confirmed that the task induced significant changes in emotional and cardiovascular parameters. On the POMS, paired sample t-tests show a task-related increase in depressed affect ($t = 3.00$, $p<.01$) and a decrease in vigor, well-being, and anxiety ($t = -11.69$, $p<.01$; and, $t= -9.12$, $p <.01$, $t = -3.72$, $p<.01$, respectively). The task-related decrease in anxiety was unexpected and may reflect the inflation of pre-task levels by anticipatory anxiety. Compared to pre-task levels, SAM ratings of arousal increased following both solvable ($t =10.957$, $p<.01$) and unsolvable sets ($t =10.602$, $p <.01$). Ratings of positive mood decreased following solvable ($t = -4.70$, $p <.01$) and unsolvable sets ($t = -11.84$, $p < .01$). Feelings of being in-control decreased but only significantly following unsolvable sets (solvable: $t= -1.48$, $p =.142$; unsolvable: $t = -8.96$, $p <.01$). Pre- and post-task average emotional ratings on the POMS and SAM are shown in Figures 1 and 2.

Repeated measures ANOVA analyses also confirmed significant within subject changes in all cardiovascular parameters from baseline to post-task [HR: $F(1,72) = 22.348$, $p<.01$; SBP: $F(1,71) = 19.277$, $p<.01$; DBP: $F(1,71) = 24.712$, $p <.01$; HF-HRV (60s segments): $F(1,72)$

=6.504, p <.05]. Furthermore, paired sample t-tests showed that compared to baseline, HR and BP increased significantly during both solvable (HR: t = 4.01; SBP: t = 6.34; DBP: t = 6.76, p <.01) and unsolvable (HR: t = 5.47; SBP: t =5.58; DBP: t =5.72, p <.01) anagram sets. Surprisingly, BP response tended to be larger in response to solvable than unsolvable sets (SBP: t= 1.76, p = .082, DBP: t= 2.15, p<.05). It is possible that this reflects our collection of BP for the first 5 minutes of the task periods and not for the full time, which was longer for unsolvable than solvable sets. In regards to HF-HRV, compared to baseline, average HF-HRV was significantly lower during solvable and unsolvable anagram sets (t= -2.94, p <.05 and t = -2.285, p <.05, respectively). Average HR, BP, and HF-HRV during baseline, task, and recovery periods are illustrated in Figures 4, 5, and 6.

3.2 GOAL ADJUSTMENT ABILITY AND BEHAVIORAL DISENGAGEMENT (HYPOTHESIS 1)

3.2.1 Goal disengagement ability and behavioral disengagement.

Hypothesis 1 proposed a negative association between perceived GD ability and average time to disengage from unsolvable anagram sets. Results are presented in Table 3. Contrary to expectations, trait GD was not significantly associated with average time to disengage from unsolvable sets.

3.2.2 Goal reengagement ability and behavioral re-engagement.

An unexpected positive relationship between trait GR and average time to disengage from unsolvable sets (r =.27, p <.05) was found, suggesting that higher perception of general ability to reengage in new goals was related to persisting longer on unsolvable anagram sets. Interestingly, however, the opposite pattern was observed on analysis of state GR, which assesses participant's perceived ease in re-engaging during the anagram task. Here, we found state GR was associated with shorter time to disengage during unsolvable sets ($r = -.23$, $p < .05$).

3.3 GOAL ADJUSTMENT ABILITY AND EMOTIONAL RESPONSES (HYPOTHESIS 2)

3.3.1 Goal disengagement ability and emotional responses.

It was hypothesized that higher perceived GD would associate with lower negative emotional responses. Results of multiple regression analyses, controlling for standard covariates, are presented in Table 4. Trait GD was not significantly related to baseline negative affective states, as measured by the POMS. However, on examination of pre- to post-task changes in SAM emotional ratings, trait GD predicted smaller declines in feelings of being in-control following unsolvable anagram sets ($\beta = -.26$, $p < .05$). Similarly, state GD, or greater perceived ability to disengage from anagram sets, was associated with smaller declines in feeling of in-control ($\beta = -.28$, $p < .05$) and positive mood ($\beta = -.26$, $p < .05$).

3.3.2 Behavioral disengagement and emotional responses.

In examining associations between behavioral disengagement (i.e., time-to-disengage during anagram sets) and emotion measures, we found that tendency to persist during unsolvable sets was associated with higher pre-task positive mood ($\beta = .29$, $p < .05$) whereas tendency to persist during solvable sets trended to associate with lower pre-task positive mood ($\beta = -.21$, $p =. 091$). In terms of task-related changes in emotional response, there was a tendency for persistence on both solvable and unsolvable anagrams to be associated with increased perceived arousal ($\beta = .25$, $p < .05$ and $\beta = .21$, $p = .070$, respectively). Interestingly, however, tendency to persist during unsolvable sets predicted smaller decline in positive mood ($\beta = -.31$, $p < .01$) and trended to predict smaller changes in feelings of being in-control ($\beta = -.21$, $p = .068$) following unsolvable sets.

3.3.3 Goal reengagement ability and emotional responses.

It was hypothesized that higher perceived GR would be associated with more positive emotional responses to the anagram task. Consistent with expectations, we found trait GR was positively and significantly related to baseline feeling of well-being ($\beta =.25$, $p <.05$) and to pre-task ratings of positive mood ($\beta = .33$, $p < .01$) and of feeling in-control ($\beta = .25$, $p <.05$). Trait GR was also significantly associated with smaller decline in positive mood following solvable ($\beta = -.26$, $p <.05$) and unsolvable anagram sets ($\beta = -.23$, $p <.05$). Taken together, these findings suggest that individuals who perceive themselves as having an easier time disengaging from a given goal and re-engaging in an alternative goal are more likely to report higher positive affect and/or feeling of being in control during an unsolvable challenge. Behaviorally, persisting during unsolvable tasks resulted in increased emotional arousal level; however, it was also associated with smaller decrease in positive emotional response.

3.4 GOAL ADJUSTMENT ABILITY AND CARDIOVASCULAR REACTIVITY (HYPOTHESIS 3 AND 4)

3.4.1 Goal disengagement ability and cardiovascular response.

It was hypothesized that higher GD ability would be associated with lower baseline HR and BP, and higher resting HF-HRV (hypothesis 3). It was also hypothesized that higher perceived GD ability would be related to lower HR and BP increases and HF-HRV decreases in response to the anagram task (hypothesis 4). Here, multiple regression analyses included standard covariates and examined associations of GD with baseline-residualized changes in cardiovascular parameters. Results are presented in table 5.

Contrary to expectations, baseline HR was significantly and positively related to trait GD independently of the standard covariates ($\beta = .25$, $p <.05$). However, trait GD was not associated with the other baseline cardiovascular parameters (i.e., SBP, DBP, or paced or baseline HF-HRV). Examining cardiovascular reactivity scores showed a tendency for trait GD to be negatively associated with HR reactivity during unsolvable sets ($\beta = -.22$, $p = .080$). Thus, individuals who perceived themselves as more able to disengage from goals showed higher baseline HR, but tended to show smaller increase in HR during the unsolvable anagram task. There were no other significant main effects of GD with BP reactivity or with task-related changes in HF-HRV.

3.4.2 Behavioral disengagement and cardiovascular response.

Persisting longer during unsolvable anagram sets was associated with lower baseline HR ($\beta = -.23$, $p =.051$) and higher HF-HRV during the paced breathing protocol ($\beta =.30$, $p <.05$). In addition, longer time to disengage from the unsolvable anagrams was related to lower task-related DBP reactivity ($\beta = -.27$, $p <.05$), with a similar trend on analysis of HF-HRV reactivity ($\beta =-.22$, $p = .066$). Based on these findings, it appears that individuals who persist longer during unsolvable sets were less likely to show an increase in DBP or a decrease in HF-HRV during unsolvable anagram sets.

3.4.3 Goal reengagement ability and cardiovascular response.

Consistent with our expectations, we did not find trait or state GR ability related to baseline or task-related cardiovascular responses.

3.5 GOAL ADJUSTMENT ABILITY AND CARDIOVASCULAR RECOVERY (HYPOTHESIS 5)

Initial repeated measures ANOVA analyses showed that at minutes 25-30 of the recovery, average HR was significantly lower than baseline levels [$F(1, 81) = 4.21$, $p<.05$] and HF-HRV was not significantly different from baseline [$F(1, 79) = .26$, $p = .61$]. In contrast, mean SBP and DBP remained significantly higher than baseline levels at min 30 [$F(1, 74) = 6.06$, $p < .05$, and $F(1, 74) = 5.53$, $p < .05$, respectively]. To examine whether goal adjustment ability was related to post-task recovery, regression analyses were run controlling for standard covariates and for magnitude of reactivity during the task (average change across both solvable and unsolvable sets). Results are shown in Table 6.

3.5.1 Goal disengagement ability and recovery.

There were no significant associations between trait measures of GD and recovery scores. However, surprisingly, trait GD trended to predict smaller difference in HR between baseline and recovery at min 25-30 ($\beta = -.22$, $p = .078$). Given that average HR was significantly lower at min 25-30 of recovery than at baseline, this finding suggests that individuals who endorsed having an easier time disengaging from goals were less likely to show a decrease in HR at min 25-30 of recovery. When we examined state measures of GD, higher perception of ease in disengaging during the anagram task was associated with return to baseline DBP ($\beta = -.30$, $p<.05$).

3.5.2 Behavioral disengagement and recovery.

No associations were observed between behavioral disengagement from the unsolvable anagrams and recovery scores.

3.5.3 Goal reengagement ability and recovery.

It was hypothesized that higher perceived GR ability would be associated with cardiovascular recovery to baseline levels following the anagram task. There were no significant associations between trait GR and recovery scores. However, state GR tended to positively relate to SBP (β=.22, p=.09) and DBP (β=.24, p=.05) recovery at min 25-30. These findings suggest that individuals who reported greater ease in disengaging from anagram sets (i.e., higher state GD) recovered faster, whereas participants who reported greater ability at re-engaging in alternate anagram sets (i.e., higher state GR) were more likely to have elevated BP at the end of recovery.

3.6 EXPLORATORY FINDINGS

3.6.1 Interaction between GD and GR.

Our results revealed that GD and GR ability interacted in the prediction of pre-task ratings of positive mood (($\beta = .26$, $p < .05$). Specifically, as illustrated in Figure 3, the effect of trait GD on positive mood depended on level of trait GR, with the combination of high trait GD and GR being associated with higher pre-task positive mood than the combination of high trait GD and low trait GR. This finding suggests that individuals who report general higher disengagement ability but lower reengagement ability endorse lower levels of pre-task positive mood, whereas individuals who were high on both traits presented with more positive mood prior to the task.

Our results also showed that GD and GR ability interacted to predict baseline and task-related changes in BP. A significant interaction of trait GD and GR was observed in the prediction of baseline DBP ($\beta = .32$, $p < .01$). As illustrated in Figure 7, the association between trait GD and DBP was moderated by trait GR, with a pattern of high trait GD and high trait GR related to higher DBP and a pattern of high trait GD and low trait GR resulted in lower DBP. This finding is contrary to our expectations. However, in a manner that aligns with our expectations, trait GD and GR interacted significantly in the prediction of increases in SBP, but not in DBP, in response to solvable (β=.38, p<.01), and unsolvable anagram sets (β=.23, p <.05). As shown in Figure 8, trait GR moderated the association between trait GD and SBP change, with individuals who were low in trait GD and GR showing greater increases in SBP than those who were low in trait GD but high in trait GR. These findings suggest trait GD and GR interact differently to predict baseline and task-related changes in BP. Interestingly, in examining state measures, we found there was a significant interaction between state GD and GR in the prediction of DBP recovery, with individuals high in GD and GR recovering more slowly than those with high GD and low GR (β=.32, p <.05; see Figure 9).

3.6.2 Trait negativity, task difficulty appraisal, and GD and GR ability.

Preliminary correlational analyses between covariates and goal adjustment ability measures showed that trait GR was negatively correlated with trait negativity (r = -.21, p <.05), signifying that individuals endorsing general negative affectivity were also more likely to endorse having difficulty re-engaging in goals. Further, both state GD and GR ability were positively correlated with perception of task difficulty (r = .41, p <.01 and r = .27, p <.05, respectively). This suggests that individuals who perceived that they easily disengaged and re-engaged during the anagram task were also more likely to endorse finding the task more difficult and stressful.

As a consequence of these correlations, we reran regression models examining the associations of goal adjustment ability with emotional and cardiovascular responses and included trait negativity and perception of task difficulty as covariates. All significant associations between cardiovascular measures and goal adjustment ability were maintained. However, there were some exceptions when we examined emotional measures. When trait negativity was included as a covariate, the association between baseline well-being and trait GR was no longer significant (β = .19, p =.198). Similarly, when perception of task difficulty was included in models, longer time-to-disengage from unsolvable sets no longer related to increase in arousal rating during solvable (β =.21, p =.08) and unsolvable sets (β = .16, p >.10). These results suggest that perception of ease in re-engaging and disengaging from goals influences cardiovascular and most emotional responses independent of perception of task difficulty or trait negative affectivity.

3.6.3 Rumination, coping strategies, and GD and GR ability.

As part of our exploratory aims we also examined whether GD and GR ability related to coping strategies and post-task rumination. In a model that included standard covariates and trait negativity (trait negativity was correlated with greater likelihood to ruminate; r =.22, p <.01), there were no significant independent associations of post-task rumination with behavioral disengagement or trait measures of GD and GR. However, both state GD and GR were positively associated with tendency to ruminate during recovery (state GD: β=.40, p <.01; state GR: β = .21, p <.05). In other words, reporting an easier time disengaging and re-engaging during the anagram task predicted increased likelihood of engaging in ruminative thoughts following the task.

Higher scores on trait negativity were also correlated with greater likelihood of endorsing "maladaptive" coping strategies (r =.33, p <.01), and lower likelihood of engaging in "adaptive" strategies, (r =-.29, p <.01). Therefore, to explore the associations between goal adjustment measures and coping strategies, a regression model, including standard covariates and trait negativity, was analyzed. We found trait GR trended to be associated with adaptive coping strategies (β=.20, p =.077). This finding suggests that individuals who perceived themselves as being easily able to re-engage in goals tended to endorse engaging in more adaptive coping strategies. We did not find any significant associations between engagement in adaptive/maladaptive coping strategies and state measures of GD and GR or behavioral disengagement.

4.0 DISCUSSION

4.1 VALIDATION OF THE GOAL DISENGAGEMENT SUBSCALE

A growing literature suggests that perception of ability to disengage from unachievable goals and re-engage in new goals relates to better emotional functioning (e.g., Dunne, Wrosch, & Miller, 2011; Wrosch, Amir, & Miller, 2011). Accordingly, recent research has started examining the potential health implications of these attributes (e.g., Wrosch et al., 2007). To date, the primary method of assessing goal adjustment ability is a paper and pencil questionnaire, called the Goal Disengagement and Goal Re-engagement scale (Wrosch et al., 2003). However, this scale has not been behaviorally validated. Hence, the present study investigated whether the trait goal disengagement subscale of the measure is related to time to disengage from an unsolvable anagram task. Findings did not provide support for an association of self-reported perception of GD ability with time to behaviorally disengage.

There are several possible explanations for our failure to support criterion-related validity of the trait GD subscale. First, while the subscale seems to show internal reliability (Wrosch et al., 2003; also replicated with the current sample), it is possible that what is being measured is not the ability to disengage from goals. In fact, our finding that trait GR ability was associated with greater likelihood of persisting when confronted with an impossible goal, raises the possibility that the scale may be measuring other facets of positive disposition that relate to goal perseverance. In support of this possibility, a growing number of studies have shown that positive traits, such as conscientiousness or optimism, predict persistence behavior in real life and in a laboratory setting (Ozer &Benet-Martinez, 2006; Segerstrom, 2007; Solberg Nes, Carlson, Crofford, de Leeuw, & Segerstrom, 2011). It is theorized that positive traits may maintain positive emotional experience during goal pursuit and have a global effect of motivating individuals to persevere (Solberg Nes et al., 2011). Consistent with this assumption, in the current study, we found that individuals who persisted during unsolvable anagram sets tended to experience a smaller reduction in positive mood while working on the task.

A second possible explanation for our inability to behaviorally validate the GD subscale may be the laboratory setting of the study. It is possible that situational factors that accompany being in a laboratory setting may have overshadowed the influence of trait goal adjustment ability. For instance, it is possible that participants' knowledge that they are being observed or social desirability factors (i.e., a "good" participant will display continuous effort on a task they are required to complete for college credit), may have been more poignant in influencing participants' goal perseverance in the laboratory. It is also possible that the laboratory anagram solving task is qualitatively different from goals pursued by individuals in 'real-life'. Finally, it is also possible that scores on the scale are unrelated to goal adjustment behavior. Regardless of these possibilities, our failure to behaviorally validate the widely-used goal disengagement measure should be taken into consideration in the interpretation of the current findings and those of others who examine this construct.

4.2 GOAL ADJUSTMENT ABILITY AND EMOTIONAL RESPONSE TO AN UNATTAINABLE GOAL

Existing literature suggests that GD and GR ability relate differently to measures of emotional adjustment, with GD relating more generally to lower negative emotions (e.g., depressive symptoms and lower general perceived stress) and GR to higher positive emotions (e.g., greater feeling of hopefulness and purpose in life; Wrosch et al., 2003, 2007; Wrosch, Amir, & Miller, 2011). Based on this, we hypothesized that GD ability would relate inversely to baseline negative affective measures and level of distress during the anagram task, whereas GR ability would relate to more positive emotional responses. Contrary to our expectations, perceived GD ability did not significantly relate to negative affect at baseline or in response to the task. One explanation for this null finding is that levels of self-reported anxiety were higher at baseline than during the recovery period, raising the possibility that anticipatory anxiety may have minimizing our ability to differentiate baseline negative responses. Still, our baseline measure of affect (using the abbreviated POMS) did include a depression subscale, comprised of low-activated negative emotions such as feeling ‘sad’ and ‘unhappy’, and we still did not observe a significant association with GD ability. This further underlines the concern raised earlier regarding the validity of scale. However, it is possible that the reason we did not find GD ability related to negative emotional response to the unsolvable task is that we did not have a sensitive enough measure of negative affect or a measure that separately examined negative emotional responses to the unsolvable and solvable anagram sets. In contrast, we employed a momentary pictorial assessment method to evaluate perceived arousal, feelings of being in control, and positive affect following each anagram set. Future studies would benefit from adapting these methods to examine negative emotional responses within the task.

In line with our expectations, we did observe that GR ability was positively associated with baseline feelings of well-being and with feelings of positive mood prior to the task and during the unsolvable anagram trials. Interestingly, we also found GD ability was positively related to feeling of being in control and positive mood during the unsolvable sets. The fact we found both GD and GR ability related with positive emotions lends further support to the idea that these attributes may be measuring an underlining positive disposition. In addition, we observed a significant interaction between trait GR and GD that suggested individuals who endorsed higher tendency to disengage from goals but lower tendency to re-engage in alternative goals showed lower positive affect prior to starting the task. This finding is consistent with existent evidence that high GD ability paired with low GR ability predicts more symptoms of distress (Wrosch et al., 2003) and recurrent suicidality among past suicide attempters (O'Connor et al., 2009). It is possible that individuals who report easily disengaging from goals but struggle with re-engaging in alternative goals experience increased negative emotions due to absence of positive emotional consequences that comes from pursuing new meaningful goals (Wrosch & Scheier, 2003).

4.3 GOAL ADJUSTMENT ABILITY AND CARDIOVASCULAR RESPONSE TO AN UNATTAINABLE GOAL

Recent evidence suggests that by minimizing negative emotional experience, goal disengagement ability may decrease physiological responses to stressful situations (Wrosch et al., 2007). It was therefore hypothesized that GD ability would associate with lower resting HR and BP, higher resting HF-HRV, and lower cardiovascular reactivity to the unsolvable anagram solving trial. We observed that trait GD was associated with higher resting HR but a tendency towards lower increases in HR during unsolvable anagram sets, possibly reflecting reduced effort. We also observed an interaction of trait GD and GR in the prediction of SBP reactivity, with individuals who endorsed being low on both GD and GR showing higher SBP responses during solvable and unsolvable anagram trials than those who were low on GD, but high on GR. This pattern was not observed on examination of baseline DBP response. Indeed, for baseline DBP, the pattern was contrary to expectations with individuals who perceived themselves to be high on GD and GR showing higher DBP at rest than those who were high on GD, but low on GR. Our finding that trait GD and GR related in an expected manner with task-related changes but not with baseline measures is difficult to explain. Perhaps individuals who report higher trait

GD or GR ability experience activating, but not necessarily negative, emotions in anticipation of the task; which would result in higher magnitude in cardiovascular parameters at baseline. In support of this possibility, in the current study, we assessed baseline anxiety using the POMS which is a composite of participants' average reporting of feeling "nervous," "intense," and "jittery." These are largely activated negative states that may drive physiological arousal. Thus, the greater HR observed at baseline among individuals with higher trait GD could reflect the influence of activating emotional states. However, reactivity scores are baseline-corrected and, therefore, effects of anticipatory anxiety would have been removed prior to hypothesis testing. Perhaps, this explains why the associations of GD and GR ability with HR and SBP reactivity scores are more in line with theory, while that was not the case with baseline HR and DBP. It is also unclear why GD and GR ability would at times relate to DBP, but not SBP, or vice-versa. This inconsistency is not unusual since blood pressure, in general, is the result of complex interplay of several mechanisms, including central circuitry, baroreceptor and chemoreceptor reflexes, renal afferents, and other metabolic factors.

Contrary to our expectations, we did not find significant associations of trait or state measures of GD or GR ability with HF-HRV. This was surprising given current conceptualizations of HF-HRV as a physiological index of emotion regulation ability (Applehans & Luecken, 2006; Thayer & Lane, 2007). Unlike HR and BP, which are influenced by levels of activation along both branches of the autonomic nervous system, HF-HRV provides a clearer index of PsNS activity. It is possible that the lack of association between GD and GR ability and HF-HRV is due to the age and/or the relatively high social economic status (SES; median annual parental income was between 100,000-120,000 dollars) of our participants. It is theorized that the ability to disengage from unattainable goals and reengage in alternative goals minimizes the negative emotional experience that can accompany failure and other stressful life experiences. It is likely that the bulk of participants' in this study have yet to experience opportunities to engage in self-regulation of significant life goals and/or the physiologic consequences of cumulative impact of ineffective handling of goal pursuit. Therefore, it is possible that the influence of GD/GR ability on HF-HRV would be more pronounced in an older population where difficulties with disengaging and re-engaging from goals have been present for a longer period of time, which in turn may have more critical functional implications across physiological systems, including autonomic functioning (Cohen, Janicki-Deverts, & Miller, 2007; Chrousos, 2009; Porges, 1995). Consistent with this possibility, in the current study, we found trait GR tended to associate with self-reported engagement in adaptive coping strategies and, was inversely associated with trait negativity ($r = -.215$, $p < .05$). It is conceivable that engaging in effective coping, which may involve generating and engaging in new goals, maintains feelings of mastery and control, and thus minimizes protracted negative emotional experiences, particularly in the context of aging (Folkman & Moskowitz, 2000).

4.4 GOAL ADJUSTMENT ABILITY AND CARDIOVASCULAR RECOVERY FROM AN UNATTAINABLE GOAL

It is theorized that individuals higher in re-engagement tendencies may be less likely to ruminate and recover faster from distressing situations, such as failing to accomplish a set goal (Wrosch & Scheier, 2003). Consequently, we hypothesized that individuals who endorsed higher levels of goal reengagement ability would show faster cardiovascular recovery. We did not find significant associations between trait GR and recovery scores. However, our findings indicated that individuals who endorsed being able to disengage from anagrams easily were more likely to show baseline levels of DBP by 30 minutes following the task than those who endorsed greater difficulty disengaging. This is consistent with what we would expect to see, especially given that state GD was associated with a smaller decrease in feeling of in-control and positive mood. Further, easily disengaging from unattainable goals, such as unsolvable anagram sets, would suggest an effective self-regulation of effort during goal pursuit, which should result in a faster physiologic recovery. In contrast, individuals who endorsed being more able to reengage in alternate anagram sets during the session were more likely to have elevated SBP and DBP at the end of recovery than individuals who indicated more difficulty re-engaging during the task. In addition, there was a significant interaction with individuals high in state GD and GR recovering more slowly than those endorsing higher state GD and lower state GR ability. In other words, higher GD ability results in greater likelihood of BP recover by min 30 following the task whereas the opposite pattern was observed for GR ability. One possible explanation for this pattern of findings, which is contrary to expectations, is that individuals who endorse higher state GR ability evaluate their performance more poorly or continue to mentally solve the anagrams during recovery. Interestingly, we did find that both state GR and GD were positively associated with tendency to ruminate during recovery. Our finding that only state GR ability predicted slower recovery raises the possibility that the nature of this rumination differed as a function of state GD or GR, with GD ability relating to a favorable outcome. It is also possible that individuals who continued to reengage in anagram sets throughout the session exerted greater effort, and thus would take more time to recover.

In sum, some findings from this study aligned with our hypotheses. For instance, trait GR ability was positively associated with baseline and smaller task-related reduction in positive mood. Individuals who endorsed both high trait GD ability and low trait GR ability did report lower positive mood prior to the task, than those who were high on both traits. Trait GD trended to relate to smaller increases in HR during the unsolvable anagram sets. Further, individuals who endorsed low trait GD and GR ability showed higher SBP responses during solvable and unsolvable anagram trials compared to individuals who endorsed higher tendencies on both traits. Other findings from this study were unexpected (i.e., were not part of our initial hypotheses), but may still align with how GD and GR ability theoretically relate to emotional and cardiovascular measures. For example, trait and state GD ability predicted smaller reduction in feelings of in-control and positive mood. State GD was also related to greater likelihood of returning to baseline BP level at the end of the recovery period. However, there were several findings that were contrary to expectations and inconsistent with current goal adjustment theory. These findings raise questions about the validity of the Goal Disengagement and Goal Re-engagement scale (Wrosch et al., 2003) and, even potentially, the relevancy of the goal adjustment ability construct in predicting emotional and physical functioning. First, we did not observe an association between trait GD ability and behavioral disengagement during the unsolvable task, and in fact, we found trait GR ability was associated with persisting during unsolvable tasks. Second, we did not observe a significant association between trait GD ability and baseline or post-task negative affective measures. Third, we observed persistence, rather than early disengagement, was associated with positive emotional experience and smaller decreases in DBP and HF-HRV. Finally, state GR ability was associated with a lower likelihood of returning to baseline levels at the end of recovery. While it is possible that demographic and measurement issues may have contributed to results that were contrary to expectations, the lack of a clear pattern in our findings suggests a need for future studies to further examine methodological and theoretical aspects of goal adjustment ability.

4.5 LIMITATIONS AND FUTURE DIRECTIONS

The present study had several limitations that provide additional opportunity for future research in this area. First, our sample was primarily comprised of healthy, young, predominantly Caucasian adults from middle to high SES households, which limits our ability to generalize our findings to other populations. A possibility for future studies is to examine if the association of GD and GR ability with behavioral disengagement, affect, and cardiovascular makers (in particular, HF-HRV) would differ using a different demographic. Second, behavioral validation was tested for the disengagement scale only. Given that disengagement and re-engagement may be distinct factors, it is entirely possible a behavioral paradigm to examine re-engagement scale may show construct validity. In this regard, it is possible that a better way to validate the scale is to use observational methods in real life setting, rather than an experimental laboratory paradigm; the former may allow for a more accurate assessment of individuals' behavior during goal pursuit. Third, the present study did not include a state measure of negative affective states and a comprehensive rumination scale. It is also possible that the consideration of other positive dispositional characteristics, such as trait positive affectivity, may be helpful in understanding the unique contribution of trait goal disengagement and re-engagement to emotional and cardiovascular reactivity. Fourth, in the current study, we did not find HF-HRV was associated with our measures. Including cardiac markers of sympathetic activity (e.g., pre-ejection period, PEP), may provide a more complete picture of how GD/GR ability relates to autonomic functioning. Lastly, while all our analyses were guided by a priori hypotheses, the number of variables and thus, analyses conducted, were numerous. Given that we did not adopt a stringent criterion for statistical significance, the risk of finding significance due to chance is high. Despite these limitations, this study adds to the first steps in understanding the health implications of individual differences in self-regulation of goals.

Table 1. Participant characteristics

Mean Age in years (SD)	19.24 (1.34)
Mean BMI in kg/m^2 (SD)	23.88 (3.24)
Mean Parental /household annual income (Median)	\$128,012 (\$110,000)
Gender	59.3% female
Smoking Status	93.4% non-smoker
Race	75.8% Caucasian
Year in School	65.9% Freshman

Table 2. Pearson product correlations between study variables and covariates

Study variables	Age	Gender	Race	NA	ASA	TDA	BMI
Trait GD	-.016	.085	-.141	.033	-.153	**.193** ~	-.120
State GD	-.020	.172	-.105	.137	-.053	**.451****	.035
Trait GR	-.084	.022	-.150	**-.215***	.152	.103	.037
State GR	-.093	**.210** ~	.104	.096	-.120	**.271***	-.157
BD (T_SA)	**.188** ~	-.024	.107	-.140	-.096	.116	-.085
BD (T_UA)	-.122	-.031	.068	-.041	**-.448****	.059	-.023
B_Anxiety	-.038	-.099	.047	**.423****	-.112	**.239***	**.249***
B_Depression	-.008	.011	-.153	**.436****	-.158	.177	.005
B_Vigor	-.029	-.099	.097	-.152	.031	.006	.122
B_Well-being	-.082	.066	.115	**-.254***	.112	.174	.102
B_Calmness	-.003	.016	-.041	**-.361****	**.219***	.071	-.058
B_SAM arousal	-.167	**.189**~	-.123	**.288****	**-.241***	.129	.120
B_SAM control	-.018	-.077	.134	-.148	.055	**-.194**~	-.024
B_SAM P mood	-.119	-.026	.114	**-.219***	.106	.001	.034
B_HR	-.084	-.012	-.018	.027	.024	.047	**.205**~
B_SBP	.132	**-.601****	-.006	-.151	-.124	.113	**.242***
B_DBP	**.231***	.040	-.182	-.019	.098	-.025	-.113
B_HF-HRV^{ln,resp}	-.133	**.168**~	-.131	.101	.084	.060	-.084
T_SA_ΔSAM arousal	-.154	**.202**~	.127	.100	-.008	**.318****	-.048
T_SA_ΔSAM control	.051	.002	-.163	-.091	.060	-.181	.140
T_SA_ΔSAM P mood	.140	-.110	-.112	-.056	.033	**-.466****	.042
T_SA_ΔHR^{bc}	-.180	-.112	-.154	.096	.104	.078	.101
T_SA_ΔSBP^{bc}	-.016	-.089	.053	-.020	-.052	-.156	-.050
T_SA_ΔDBP^{bc}	.030	-.078	-.031	-.027	.119	-.070	**-.215**~
T_SA_ΔHF-HRV^{ln,bc,resp}	-.121	.008	.042	-.076	-.086	-.074	-.054
T_UA_ΔSAM arousal	-.095	**.239***	.063	-.024	.126	**.399****	-.044
T_UA_ΔSAM control	.099	-.165	-.188	-.108	-.044	**-.297****	-.003
T_UA_ΔSAM P mood	.097	**-.316****	-.044	-.072	.015	**-.549****	.066
T_UA_ΔHR^{bc}	-.046	.057	**-.199**~	.132	-.031	**.215**~	.054
T_UA_ΔSBP^{bc}	.093	-.161	-.015	.045	.118	-.033	-.031
T_UA_ΔDBP^{bc}	-.134	.056	-.073	.143	**.290****	-.046	-.174
T_UA_ΔHF-HRV^{ln,bc,resp}	.090	-.042	.212	-.165	-.109	-.062	-.062
R_ΔAnxiety	-.155	**.283***	.112	-.100	.027	.149	-.193
R_ΔDepression	.002	.084	**.239***	.094	-.016	**.207**~	.019
R_ΔVigor	-.074	-.029	-.049	.051	-.043	-.062	-.101
R_ΔWell-being	-.114	-.055	.016	.048	-.106	**-.189**~	-.056
R_ΔCalmness	-.039	-.122	.009	**.192**~	-.080	**-.242***	.045
R_Δ SBP (@ min25-30)	.053	.185	-.002	.183	-.143	.080	**-.237***
R_Δ DBP (@ min25-30)	-.074	.114	.074	.169	-.085	-.057	**-.242***
Rumination	**-.184**~	**.228***	-.011	**.216***	-.030	**.318****	-.043
Adaptive CS	-.090	.054	-.141	**-.293****	.002	.038	.041
Maladaptive CS	-.001	**.361****	-.004	**.330****	**-.224***	**.197**~	.001

Abbreviations used: BD (behavioral disengagement time), T_SA (solvable anagram sets), T_UA (unsolvable anagram sets), NA (trait-negativity), ASA (anagram solving ability), and TDA (task difficulty appraisal), P mood (positive mood), CS (coping strategies), BMI (Body Mass Index); Assigned values for gender: 1=male, 2=female; Assigned values for race: 1=Caucasian, 2=Asian/pacific Islander, 3=African American, 4=latino, 5=other
~ = $p < .10$, *= $p < .05$, **=$p < .01$, ^{ln}=natural log transformed, ^{bc}=baseline-corrected, ^{resp}=respiration controlled

Table 3. Partial correlations of time to disengage from solvable and unsolvable anagrams and measures of goal adjustment ability, controlling for standard covariates (i.e., age, gender, race, BMI, and ASA)

Average time to disengage (in sec)	**GD**		**GR**		
	Trait	**State**	**Trait**	**State**	***Mean (SD)***
Solvable sets	-.092	.059	.050	-.043	118.70 (64.10)
Unsolvable sets	.020	.025	**.272***	**-.229***	330.37 (125.65)
Mean (SD)	9.53 (3.19)	5.62 (2.00)	22.48 (4.17)	5.27 (1.64)	—

*= p <.05

Table 4. Associations (expressed using Beta values) between affect on the POMS and SAM, and measures of goal adjustment ability, including behavioral disengagement (BD), for solvable sets (S sets) and unsolvable sets (U sets).

	GD		GR		GDXGR		BD		
	Trait	**State**	**Trait**	**State**	**Trait**	**State**	**S sets**	**U sets**	***Mean (SD)***
B_Anxiety	-.061	.085	.016	.119	.035	.110	.004	-.114	.83 (.76)
B_Depression	.071	-.046	-.135	-.035	.063	-.052	-.040	-.099	.36 (.60)
B_Vigor	-.174	.097	.169	-.029	.106	.062	-.017	.101	1.90 (.99)
B_Well-being	-.060	**.216**~	**.255***	-.124	.004	.016	-.129	.173	2.38 (.87)
B_Calmness	.063	-.119	.153	-.113	.144	.020	-.027	.168	2.73 (.88)
B_Arousal	-.025	.098	-.163	.107	-.060	.125	.079	-.065	2.86 (1.54)
B_In-Control	.119	-.108	**.259***	-.087	.032	-.182	-.075	.003	5.68 (1.76)
B_P_Mood	.029	-.086	**.332****	-.124	**.257***	.030	**-.215**~	**.286***	6.17 (1.27)
ΔAnxiety	**.210** ~	.065	.040	.028	-.016	-.023	-.148	.136	-.15(.38)
ΔDepression	-.114	.069	.078	.051	.030	.186	.092	-.020	.11 (.37)
ΔVigor	.192	.003	-.016	-.072	-.019	.011	**-.260** ~	-.001	-1.03 (.83)
ΔWell-being	.042	-.127	-.041	-.050	.137	-.098	-.125	.127	-.73 (.76)
ΔCalmness	NC	NC	NC	NC	NC	NC	NC	NC	.05 (1.13)
T_SA_ΔArousal	-.023	.165	.089	.030	-.031	-.150	.015	**.248***	1.76 (1.51)
T_SA_ΔIn-Control	NC	NC	NC	NC	NC	NC	NC	NC	-.22 (1.65)
T_SA_ΔP_Mood	.051	-.175	**-.263***	-.056	.137	-.115	-.180	-.053	-.71 (1.43)
T_UA_ΔArousal	.061	.128	.054	.175	-.017	-.079	.057	**.208**~	2.46 (2.17)
T_UA_ΔIn-Control	**-.295***	**-.278***	-.059	.032	-.001	.005	.092	**-.214**~	-1.99 (2.08)
T_UA_ΔP_Mood	-.099	**-.262***	**-.230***	-.057	-.065	-.135	-.021	**-.307****	-2.13 (1.68)

* = p <.05,**= p <.01,~ = p<.10
NC = Beta values not computed b/c baseline to task values were not significantly different, P_Mood = positive mood of SAM, B_ (baseline), T_SA (solvable anagram sets), T_UA (unsolvable anagram sets), [ln]=natural log transformed
Covariates in models include age, gender, race, BMI, and ASA

Table 5. Associations (expressed using Beta values) between baseline and task-related changes in cardiovascular measures and measures of goal adjustment ability.

	GD		GR		GDXGR		BD		
	Trait	**State**	**Trait**	**State**	**Trait**	**State**	**S sets**	**U sets**	***Mean (SD)***
B_HR	**.250***	-.001	-.100	.097	.009	-.111	.086	**-.231~**	70.57 (10.62)
B_SBP	-.104	.020	.126	.050	.156	.024	.181	-.003	104.93 (10.47)
B_DBP	.183	.080	.171	-.115	**.321****	-.048	.099	.006	58.07 (7.78)
B_HF-HRV^{ln,resp}	-.142	.101	-.059	-.149	.062	.097	.004	-.086	--
PB_HR	.135	.014	-.103	.097	.063	-.123	.060	**-.309****	75.45 (11.58)
PB_HF-HRV^{ln}	-.017	-.004	-.046	.066	-.029	.154	-.074	**.297***	7.26 (.93)
T_SA_ΔHR ^{bc}	-.138	.204	.045	-.009	.047	.187	.052	.117	--
T_SA_ΔSBP ^{bc}	-.109	-.147	-.071	.031	**.381****	.060	-.181	.081	--
T_SA_ΔDBP ^{bc}	.036	-.071	.025	-.002	-.061	.077	.154	-.080	--
T_SA_ΔHF-HRV$^{ln, bc,resp,60s}$	.118	-.022	-.018	-.088	-.158	-.122	-.018	.118	--
T_SA_ΔHF-HRV$^{ln, bc,resp,120s}$	.197	-.027	-.104	-.180	-.152	-.157	-.101	.054	--
T_UA_ΔHR ^{bc}	**-.218**~	.103	.009	-.077	.040	.134	.156	.180	--
T_UA_ΔSBP ^{bc}	-.053	-.090	-.117	.117	**.231~**	.102	-.051	-.012	--
T_UA_ΔDBP ^{bc}	.122	.013	-.121	.043	-.048	.011	.163	**-.272***	--
T_UA_ΔHF-HRV$^{ln, bc, resp,60s}$	.052	.036	.001	.103	.015	-.167	.208	-.177	--
T_UA_ΔHF-HRV$^{ln, bc,resp,120s}$	.031	.029	-.008	.118	-.026	-.150	.151	**-.223** ~	--
BMI	--	--	--	--	--	--	--	--	24.16 (3.31)

* = p <.05, ** = p <.01, ~ = p<.10
Covariates included in models include age, gender, race, BMI and ASA
B_(baseline), PB_ (paced breathing), T_SA (solvable anagram sets), T_UA (unsolvable anagram sets)
^{ln}= natural log transformed; ^{resp}=respiration controlled; ^{bc}=baseline-corrected; 60s = using 60s segments; 120s=using 120s segments.,

Table 6. Associations (expressed using Beta values) between return-to-baseline recovery scores and measures of goal adjustment ability

Return-to-baseline change scores	GD		GR		GDXGR		BD	
	Trait	**State**	**Trait**	**State**	**Trait**	**State**	**S sets**	**U sets**
HR @25-30min⁺	**-.223**~ (p=.078)	.065	-.096	.039	.056	.183	.137	-.165
HF-HRV@ 25-30 min ln, resp,+	.023	-.156	.017	.150	-.031	.053	-.066	.064
SPB@25-30min+	-.001	-.026	-.112	**.221** ~ (p =.09)	.136	.037	-.066	-.134
DBP@25-30min+	-.019	**-.302***	-.157	**.238** ~ (p=.050)	.005	**.320****	-.145	.040

$^{+}$ =controlling for magnitude of reactivity during the task; ^{ln}= natural log transformed; ^{resp}=respiration controlled

Covariates included in models are age, gender, race, ASA, and BMI

* = p <.05, **= p <.01 , ~ = p <.10

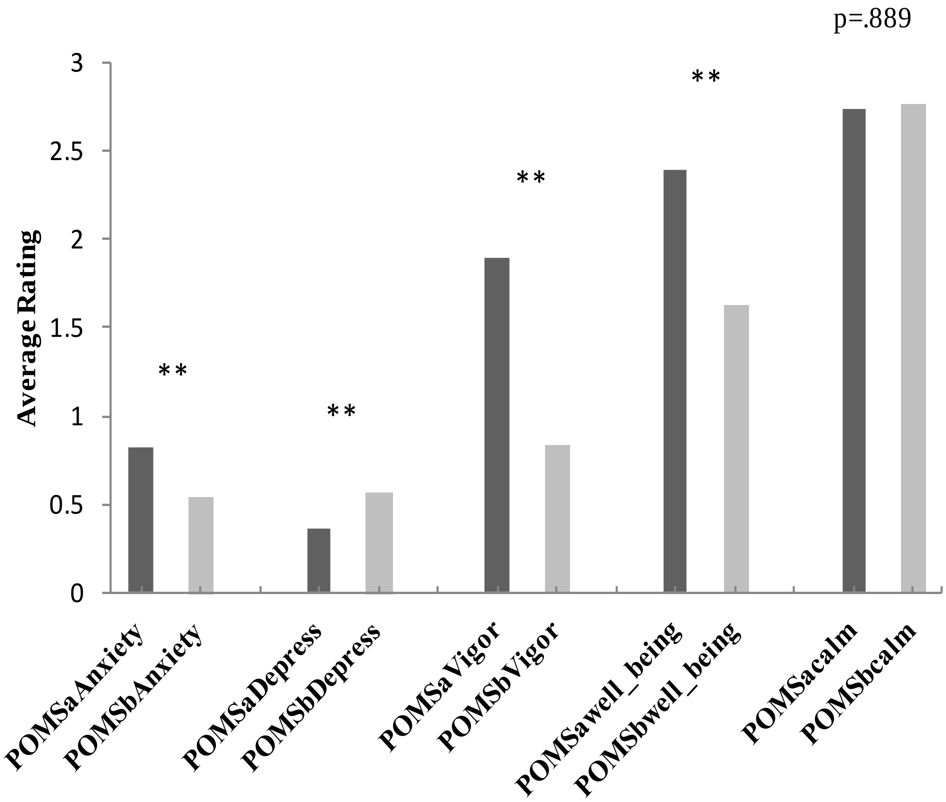


Figure 1. Baseline (POMSa) and post-task (POMSb) average rating for POMS subscales of anxiety, depression, vigor, well-being, and calmness (=significant mean difference, p<.01). From baseline to post-task, feelings of anxiety, vigor, and well-being decreased, feelings of depression increased, and no significant difference was found in feelings of calmness.**

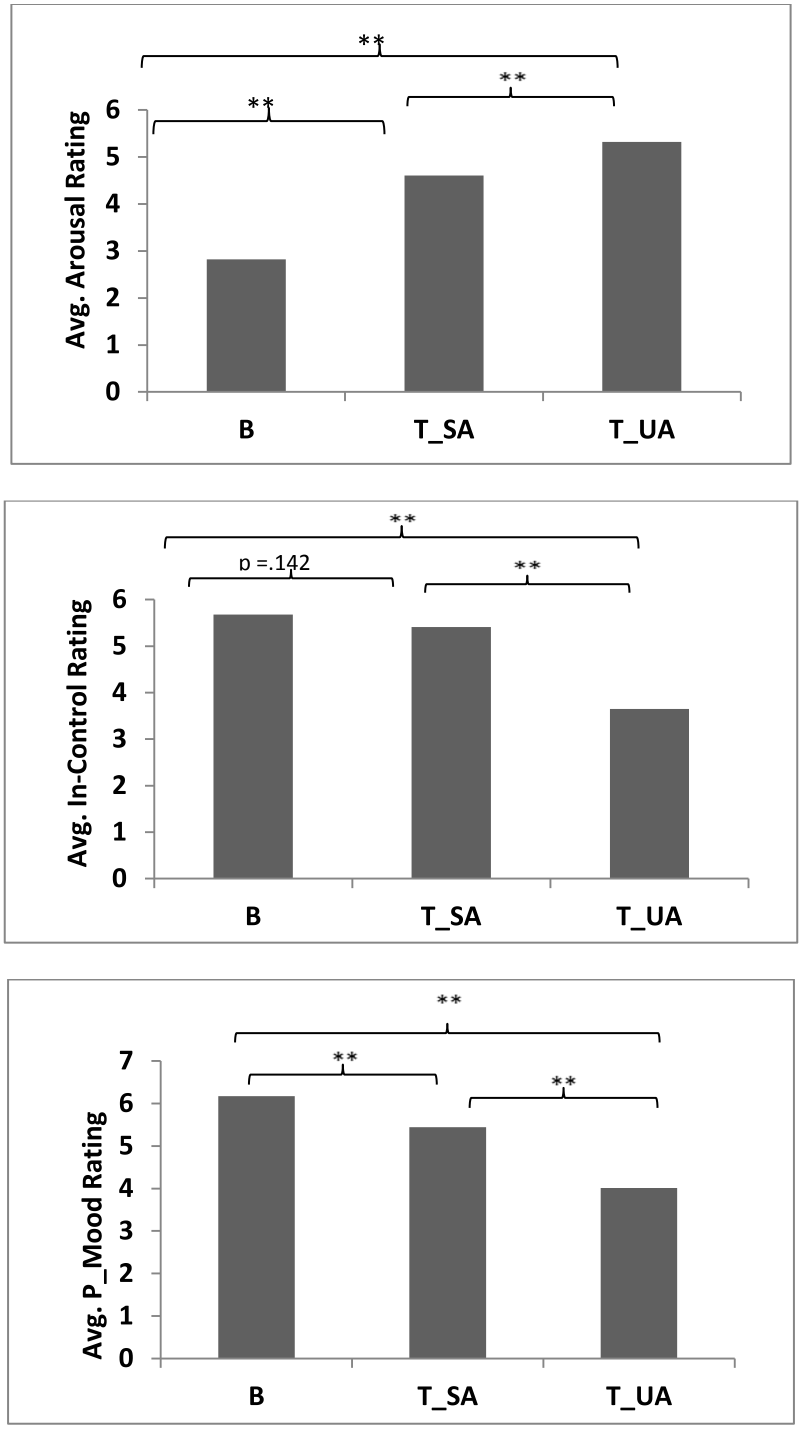


Figure 2. Pre-task (B), post solvable anagram set average (T_SA), and post unsolvable anagram set average (T_UA) SAM ratings of feelings of arousal, in-control, and positive mood (P_mood). Average SAM arousal ratings increased and average SAM rating of in-control and positive mood decreased from baseline to following solvable and unsolvable sets. **=significant mean difference, p <.01

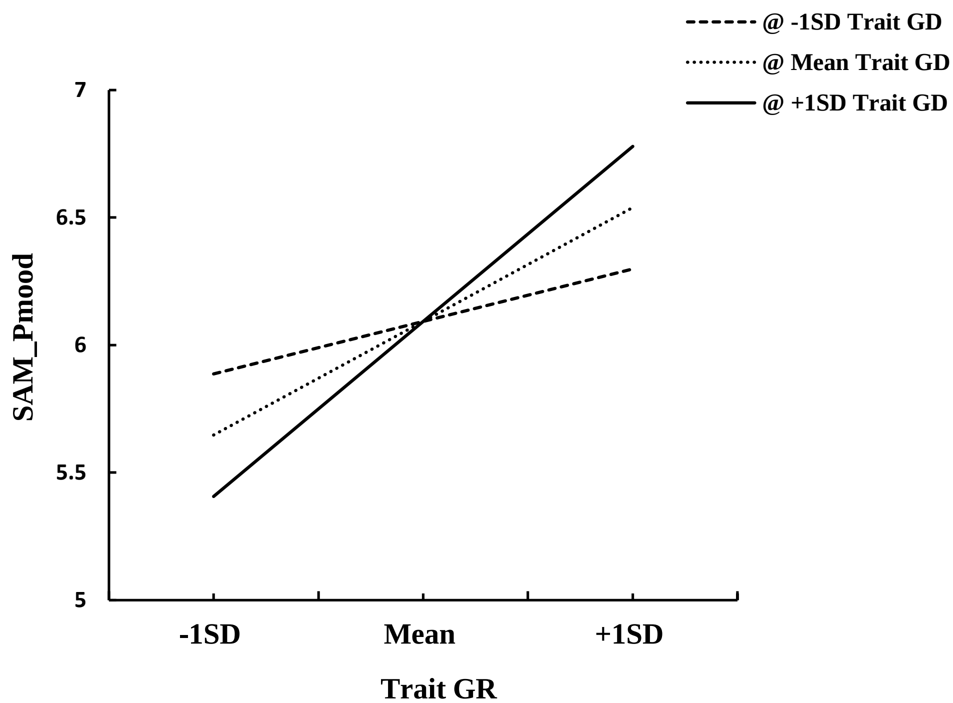


Figure 3. SAM positive mood rating as a function of trait GD and GR interaction. High trait GR x Low trait GD = highest positive mood; Low trait GR x High trait GD = lowest positive mood

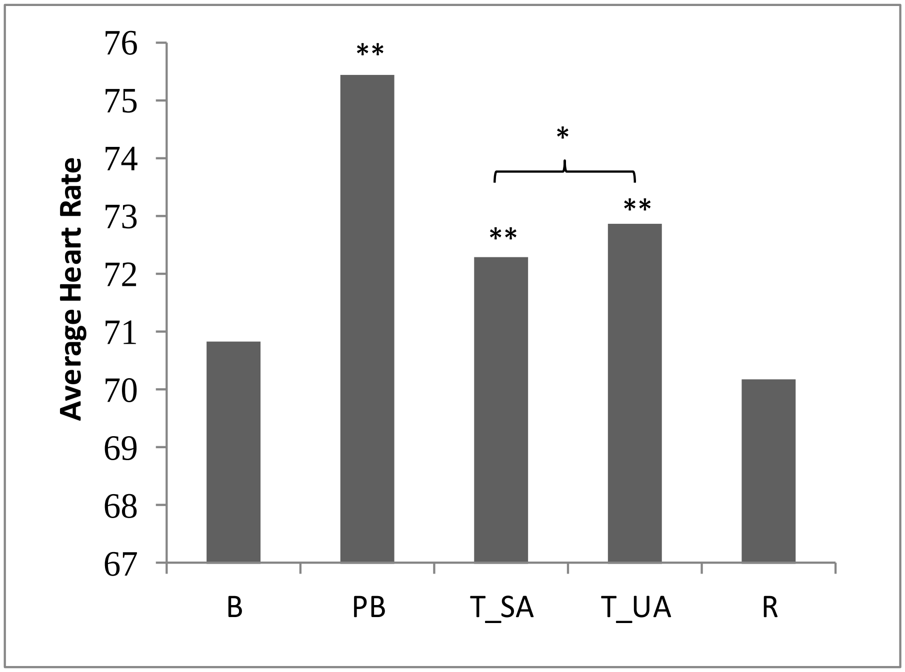
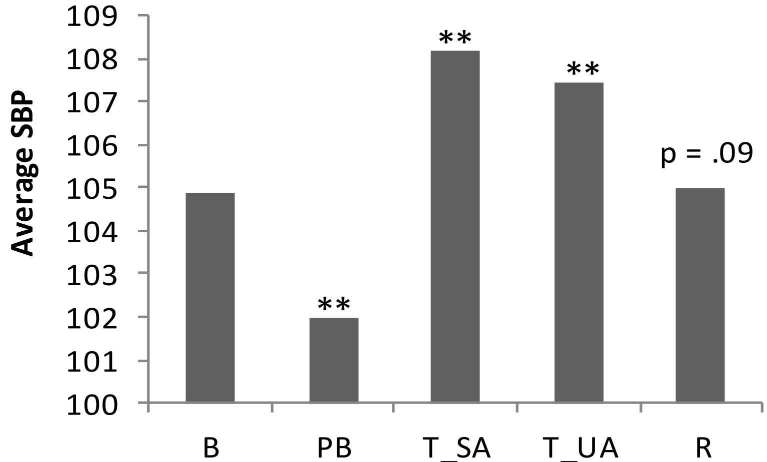
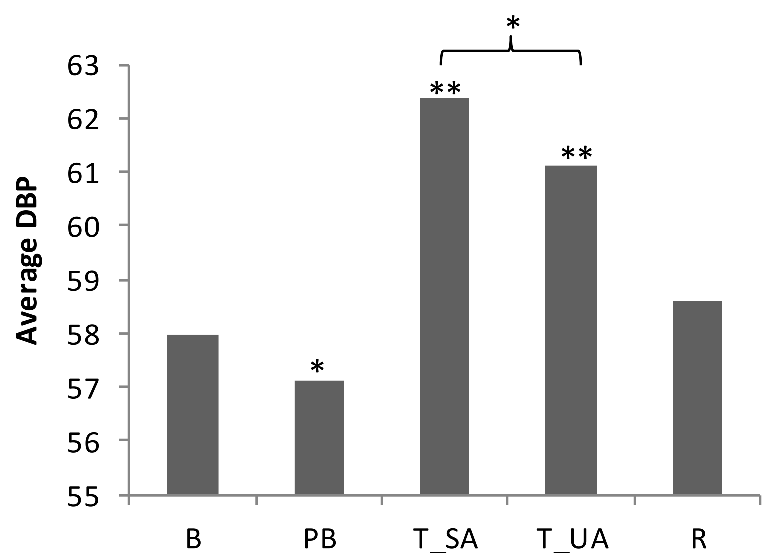


Figure 4. Average heart rate during baseline (B), paced-breathing (PB), solvable anagram task (T_SA), unsolvable anagram task (T_UA) and recovery (R) for *N* = 83 participants. Comparisons with baseline and between T_SA and T_UA (*in bracket*) are presented. **=significant mean difference, p <.01, * = significant mean difference, p <.05



(Figure 5a)



(Figure 5b)

Figure 5. Average systolic (5a) and diastolic (5b) blood pressure (SBP, DBP) during baseline (B), paced-breathing (PB), solvable anagram task (T_SA), unsolvable anagram task (T_UA) and recovery (R) for *N* = 79 participants. Comparisons with baseline and between T_SA and T_UA (*in bracket*) are presented. **=significant mean difference, p <.01, * = significant mean difference, p <.05

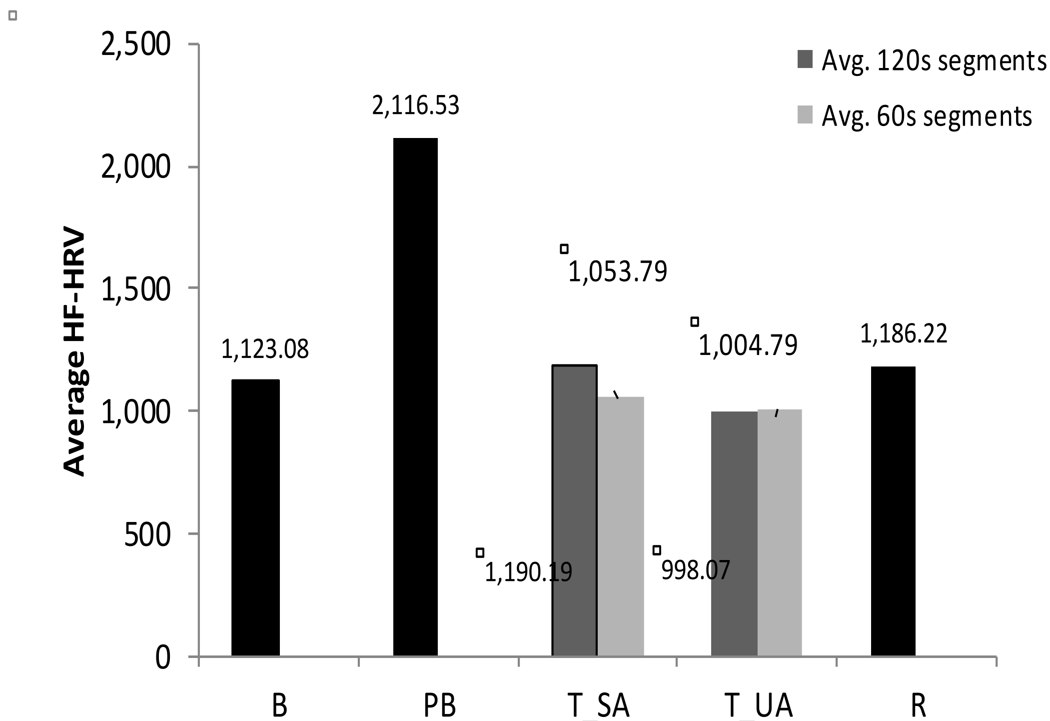


Figure 6. Average HF-HRV during baseline (B), paced-breathing (PB), solvable anagram task (T_SA), unsolvable anagram task (T_UA) and recovery (R). Average HF-HRV data for the task were averaged for solvable and unsolvable sets across 60s (*N*=77 and *N*=82, respectively) and across 120s (*N*=57, *N*=82). Comparisons with baseline are presented. There wasn't a significant difference in HF-HRV between T_SA and T_UA or between baseline and recovery. **=significant mean difference, p <.01, * = significant mean difference, p <.05

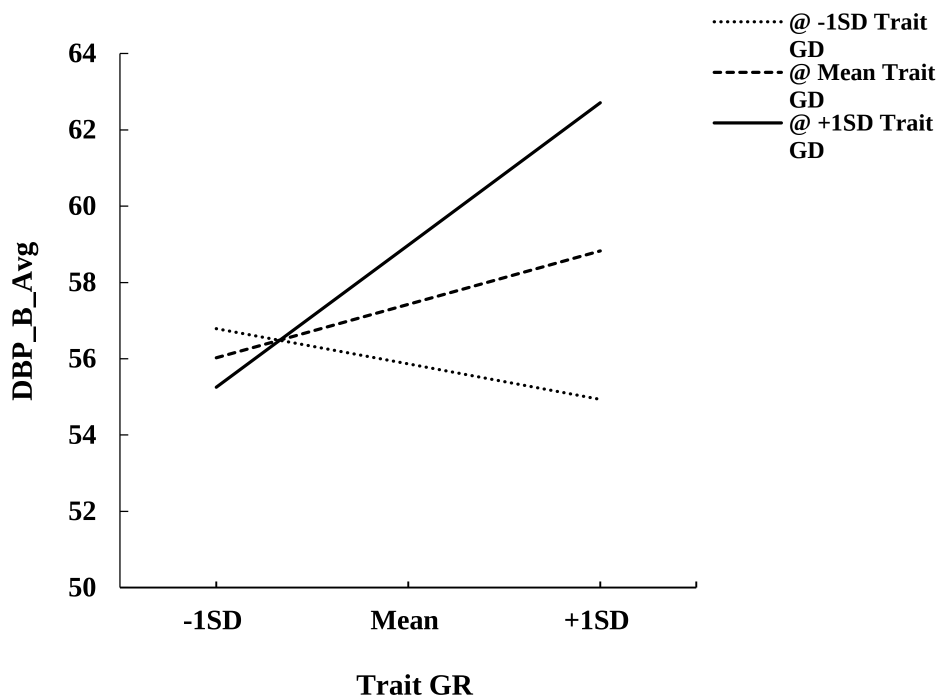


Figure 7. Baseline DBP (DBP_B_Avg) as a function of trait GD and GR interaction. High trait GR x High trait GD = highest DBP; High trait GR x Low trait GD = lowest DBP.

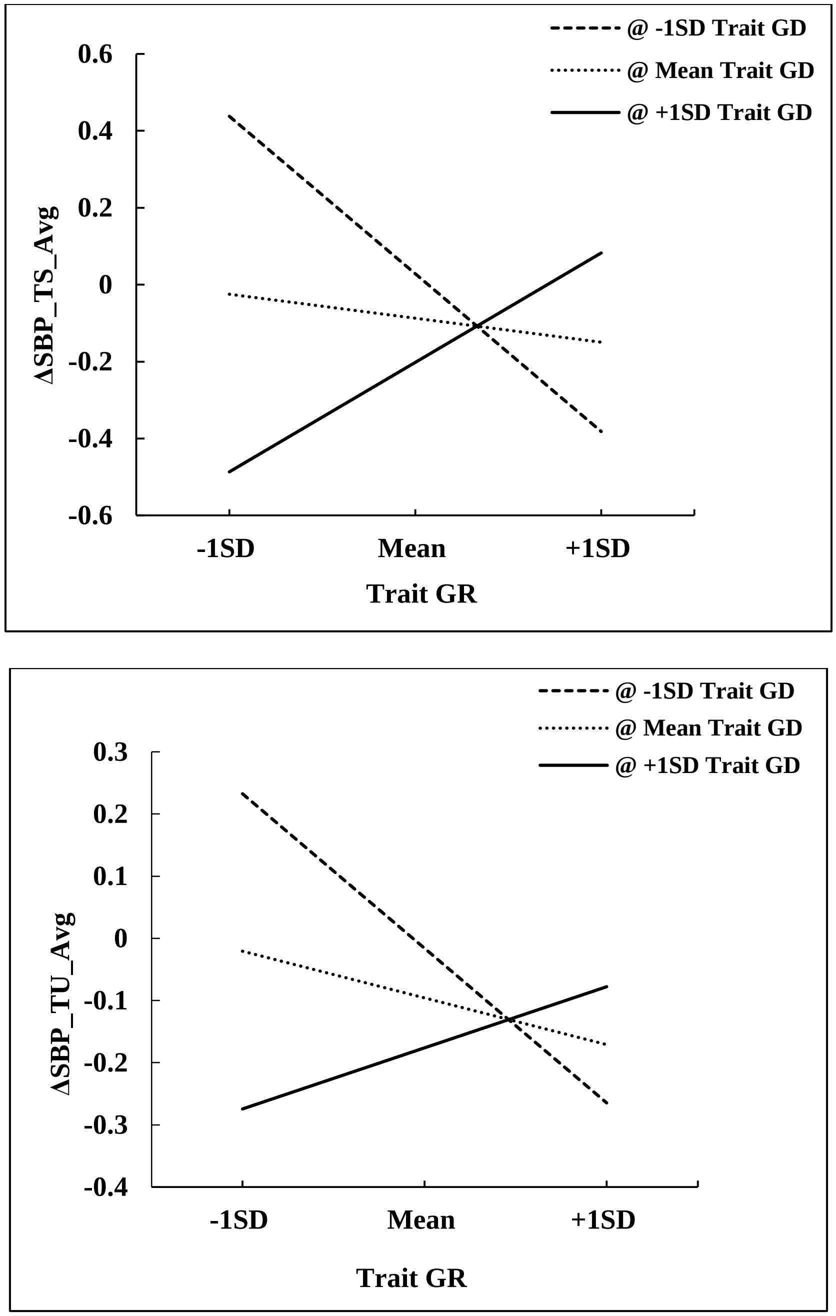


Figure 8. Baseline-correlated, baseline to solvable task (top figure), and baseline to unsolvable task (bottom figure) SBP change scores as a function of trait GD and GR interaction. Low trait GR x Low trait GD = highest magnitude of change; High trait GR x Low trait GD = lowest magnitude of change.

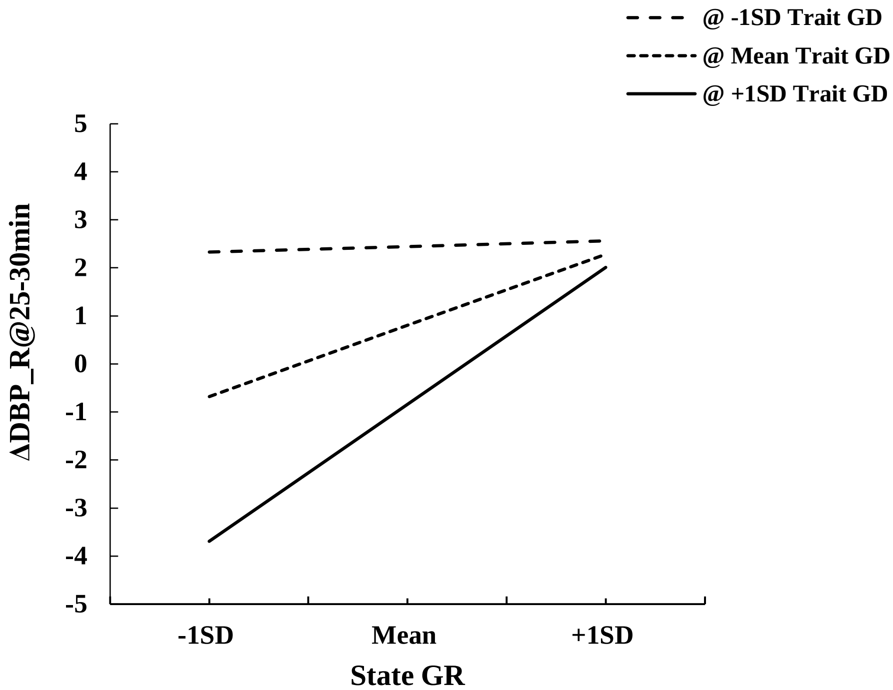


Figure 9. Return to baseline DBP recovery scores as a function of interaction between state GD and GR. High GR x High GD = elevated DBP at min 25-30; Low GR x high GD = closer to baseline DBP at min 25-30.

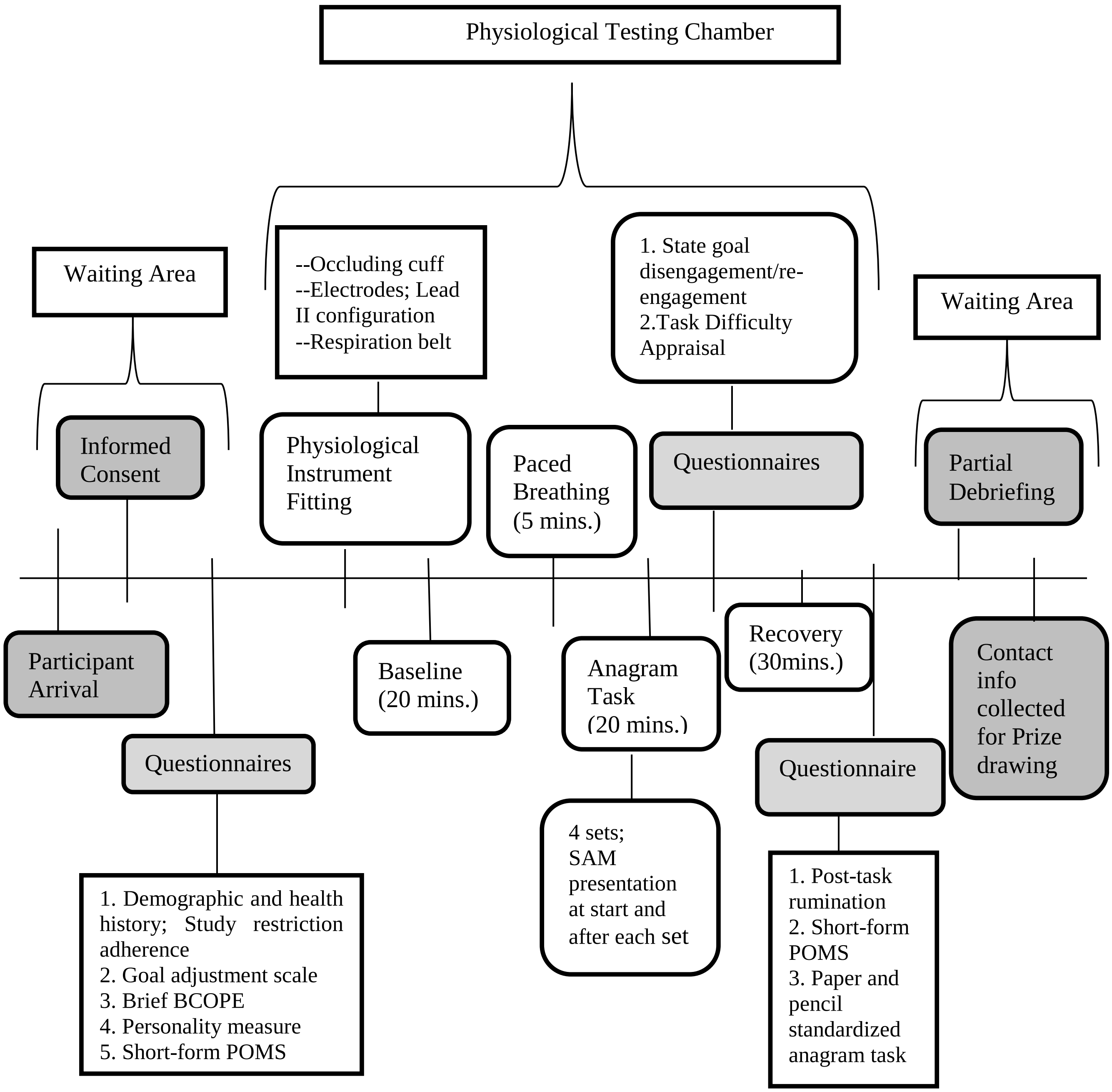


Figure 10. Summary timeline of study protocol

APPENDIX A

GOAL DISENGAGEMENT AND GOAL REENGAGEMENT SCALE

(Wrosch et al. 2003)

Trait goal adjustment ability

Sample situation: "If I have to stop pursuing an important goal in my life, . . . "

Goal disengagement

1. It's easy for me to reduce my effort toward the goal.
2. I find it difficult to stop trying to achieve the goal. (–)
3. I stay committed to the goal for a long time; I can't let it go. (–)
4. It's easy for me to stop thinking about the goal and let it go.

Goal reengagement

5. I think about other new goals to pursue.
6. I seek other meaningful goals.
7. I convince myself that I have other meaningful goals to pursue.
8. I tell myself that I have a number of other new goals to draw on.
9. I start working on other new goals.
10. I put effort toward other meaningful goals.

NOTE: (–) = items were reversed prior to scale computation. All items will be answered using 5-point Likert-type scales (anchored at 1 = *almost never true*, 5 = *almost always true*).

State goal adjustment ability
Perceived ability to disengage and re-engage during the anagram task

Please answer the questions referring to the anagram solving task you just completed using the below rating scale

1	2	3	4	5
Extremely Easy	Somewhat Easy	Neutral	Somewhat Hard	Extremely Hard

Perceived disengagement ability

1. How easy was it for you to move on from one set of anagrams to another?
2. How easy was it for you to stop thinking about the previous set of anagrams once you moved on to the next?

Perceived re-engagement ability

3. How easy was it for you to put an equal effort to each new set of anagrams presented?
4. How easy was it for you to remind yourself that you have another set of anagrams to solve to keep maximizing your chances to win the prize?

APPENDIX B

DEMOGRAPHIC/BACKGROUND INFORMATION

ID #: Date of session: Time of session:

Please complete the following questionnaire. When appropriate, Place a check next to or circle your response. All of your responses will remain confidential. Please do not place your name on this questionnaire.

1. Age: _______

2. Gender: Male ____ Female ____

3. Year in school: 1 2 3 4 Other (please specify): ___________

4. Race: ____ Caucasian ____ Asian or Pacific Islander

 ____ African American _____Latino/a ____Native American

 ______________Other (Specify)

5. Do you currently smoke? ____Yes ____No

6. When was the last time you ate something? __________

7. When was the last time you drank any other liquid except water?_________

8. When was the last time you drank coffee or other caffeinated beverages?___________

9. When was the last time you had an alcoholic beverage? _____________

10. When did you last exercise or engage in strenuous activity? ______________

11. Do any of the following apply to you (past or current):

- Cancer ________
- Arthritis ________
- Diabetes ________
- Heart Disease _______
- Auto-Immune disorders (Multiple Sclerosis, Lupus, Myasthenia Gravis, Grave's disease)__________
- Major Depression/Anxiety______
- Current Psychiatric Disorder______
  - If yes, please specify ________________________
- Hypertension__________

12. Currently taking prescription drugs?_______
 If yes, please specify ______________________________

APPENDIX C

TASK DIFFICULTY APPRAISAL

(adapted from Segerstrom & Solberg Nes, 2007)

The following questionnaire asks what you thought about the task that you just completed.

1. It was difficult
2. It was stressful
3. It required a lot of effort
4. I had to concentrate on the task
5. I had to force myself to keep going
6. I wanted to stop before it was over

All items will be answered using 5-point Likert-type scales (anchored at 1 = *completely disagree*, 3= *neutral*, 5 = *completely agree*).

APPENDIX D

RUMINATION MEASURE

The following questionnaire asks how much you thought about the tasks you just completed during the time that you have been sitting here resting.

1. To what extent did you think about the tasks you completed in the time since you completed them?
2. To what extent did you criticize yourself about not doing well on the tasks?
3. How much did you think about other past situations where you were evaluated?
4. To what extent did you think about the anxiety you felt while doing the tasks?

All items will be answered using 7-point Likert-type scales (anchored at 1 = *Not at all* 4= *neutral*, 7 = *all the time*).

APPENDIX E

MULTI-SOLUTION ANAGRAM TASK

This is a task in which you will construct every possible word you can from a string of letters. Each string of letter has multiple solutions. Try to give as many solutions as possible. You will have 10 minutes for this task.

1. apres
2. selat
3. netso
4. palse
5. ospre
6. maste
7. idset
8. aslev
9. tesim
10. sneir
11. ursec
12. prasc
13. stoac
14. rilef
15. miesl

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