Relation of Adaptive and Maladaptive Perfectionism to Behavioral Activation, Behavioral Inhibition, and Heart Rate Variability

by

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Background: Recent research has indicated that different subtypes of perfectionism are differentially related to stress, coping, and psychophysiology, with individuals who exhibit higher levels of maladaptive perfectionism having increased levels of stress, maladaptive coping, and fatigue, as well as elevated blood pressure and cortisol levels in response to stressful tasks. The opposite pattern has been found to hold true for individuals displaying greater levels of adaptive perfectionism. An additional set of multidimensional personality traits that have been associated with differential psychophysiological outcomes and perfectionism are the behavioral inhibition system and behavioral activation system (BIS/BAS).

Purpose: The current research seeks to understand the possible relations between adaptive and maladaptive perfectionism, BIS/BAS, and cardiac autonomic activity, particularly heart rate variability (HRV).

Methods: 1,214 healthy undergraduate students were asked to complete a series of online self-report inventories related to perfectionism and behavioral approach and avoidance. One hundred and twenty-two eligible students were then asked to complete an initial 10-minute baseline recording of heart rate and blood pressure, followed by a

15-minute anagram stressor task, and then a 10-minute recovery-period recording. Additionally, they were asked to complete a measure of state affect both before and after the electrophysiological recordings.

Results: Results indicated that there was no statistically significant association between perfectionism classification and baseline HRV, nor between perfectionism classification and changes in HRV from baseline, either during the stressor task or during the recovery period. Additional results indicated that male adaptive perfectionists had significantly higher BIS-Total scores than nonperfectionists and maladaptive perfectionists, that female nonperfectionists and adaptive perfectionists had significantly higher BIS-Total scores than maladaptive perfectionists, that both male and female nonperfectionists had significantly higher BAS-Total, BAS-Drive, and BAS-Reward-Responsiveness scores than adaptive and maladaptive perfectionists, and that male nonperfectionists and adaptive perfectionists had significantly higher BAS-Fun-Seeking scores than maladaptive perfectionists. Finally, results indicated that baseline HRV scores could not be significantly predicted by BIS-Total, BAS-Reward-Responsiveness, and BAS-Drive scores.

Discussion: The current research found that there were no significant relations between either perfectionism and HRV, or BIS/BAS and HRV. However, significant relations were found between adaptive and maladaptive perfectionism and BIS/BAS, though not in the hypothesized direction. Instead, it was found that BAS was more related to nonperfectionism and BIS to adaptive perfectionism. As these results appear consistent in light of revised RST, future research on the relations between perfectionism and BIS/BAS should utilize revised RST in theory formulation and measurement.

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CHAPTER I: INTRODUCTION

Perfectionism, that is, the inclination to view anything that is less than perfect as unacceptable, has historically been regarded as a unidimensional construct with purely maladaptive connotations (Flett & Hewitt, 2002). However, with the work of Hamacheck (1978) it began to be acknowledged that perfectionism has multiple subtypes, with both positive and negative associations. For example, different subtypes of perfectionism are not only associated with depression and maladaptive coping, but also with greater levels of positive affect and satisfaction with life (Andrews, Burns, & Dueling, 2014; Enns, Cox, & Clara, 2002; Gnilka, Ashby, & Noble, 2013; Noble, Ashby, & Gnilka, 2014). Current models of perfectionism distinguish between these subtypes using either a dimensional approach or a group-based approach (Stoeber & Otto, 2006). In group-based approaches to perfectionism, the facets of perfectionism are divided into two separate groups, one healthy, which is associated with positive outcomes, and one unhealthy, which is associated with negative outcomes; whichever group of facets one scores higher on determines the type of perfectionism. In dimensional approaches to perfectionism though, the facets of perfectionism are described along two dimensions of perfectionism instead, one labeled high standards and the other discrepancy. High standards are thought to be associated with positive outcomes and discrepancy with negative outcomes, but unlike with group-based approaches, individuals can fall along a continuum in regard to both dimensions, and where an individual falls on both dimensions determines the way in which their perfectionistic characteristics are described (Stoeber & Otto, 2006).

The differentiation of perfectionistic subtypes is supported by both factor analytic

studies and studies of concurrent validity; for example, studies using factor analytic techniques consistently demonstrate the multidimensional nature of perfectionism (Bieling, Israeli, & Antony, 2004; Rice & Slaney, 2002). Additionally, research into the effects of adaptive and maladaptive types of perfectionism has demonstrated that there is a relation between adaptive perfectionism and positive outcomes (e.g., better psychological functioning, greater levels of positive affect, lower levels of psychopathology) and between maladaptive perfectionism and negative outcomes (e.g., poorer psychological functioning, decreased positive affect, increased levels of psychopathology) (Andrews, Burns, & Dueling, 2014).

The different subtypes of perfectionism have also been linked to differential effects on stress and coping and psychophysiology. Individuals with higher levels of maladaptive perfectionism have increased levels of stress, maladaptive coping, and fatigue, as well as elevated blood pressure and cortisol levels in response to stressful tasks; the opposite pattern holds true for individuals displaying greater levels of adaptive perfectionism (Albert, Rice, & Caffee, 2014; Dittner, Rimes, & Thorpe, 2011; Dunkley, Zuroff, & Blankstein, 2003; McGirr & Turecki, 2009).

Another set of multidimensional personality traits that have been associated with differential psychophysiological outcomes and perfectionism are the behavioral inhibition system and behavioral activation system (BIS/BAS), key parts of reinforcement sensitivity theory (RST). RST posits that there are three separate brain systems that determine an individual's motivation and sensitivity to reward and punishment (Gray & McNaughton, 2000). These are the fight-flight-freeze system (FFFS), which mediates a person's reactions to both conditioned and unconditioned

aversive stimuli, the BAS, which mediates an individual's response to both conditioned and unconditioned reward cues, and the BIS, which is responsible for mediating between the conflicting signals of the FFFS and the BAS (Pickering & Corr, 2008).

Several studies have noted that a relation exists between perfectionism and BIS/BAS. Chang (2006a) found that negative self-oriented perfectionism, that is, the tendency to place unrealistic performance demands upon oneself, was positively correlated with BIS sensitivity and that adaptive perfectionism was positively correlated with BAS sensitivity. Additionally, Andrew, Burns, and Dueling (2014) noted that negative perfectionism showed a moderate positive correlation with BIS and a small negative correlation with the BAS-Fun-Seeking scale. Finally, Mautz (2013) found that scores on a measure of BAS successfully predicted personal standards perfectionism (a form of adaptive perfectionism) and scores on a measure of BIS successfully predicted self-evaluative perfectionism (a form of maladaptive perfectionism).

Research has also demonstrated that differential scores on the BIS/BAS scales correlate with differential outcomes on a variety of psychophysiological measures, including measures of the cortisol stress response, heart rate reactivity, vagal tone, the respiratory sinus arrhythmia (RSA), and heart rate variability (HRV). For example, Heponiemi, Keltikangas-Jarvinen, Kettunen, Puttonen, and Ravaja (2004) found that during task situations, BAS sensitivity was correlated with increases in heart rate and RSA withdrawal. Additionally, Movius and Allen (2005) demonstrated that higher BAS reward-responsiveness scores were predictive of higher resting vagal tone, as measured by baseline RSA.

As a result of the differential psychophysiological correlates of the subtypes of perfectionism, the relation between the subtypes of perfectionism and the behavioral inhibition and behavioral activation systems, and the differential effects of BIS/BAS on cardiac autonomic activity, the current research seeks to understand the possible relations between adaptive and maladaptive perfectionism, BIS/BAS, and cardiac autonomic activity, in particular heart rate variability (HRV). HRV is the variation in time between heartbeats and having low HRV (low variation between beats) is associated with a variety of health problems, including putting individuals at an increased risk of cardiac events, such as heart attacks (Tsuji, et al., 1996). HRV is affected by a number of factors, including stress, anxiety, and worry, all of which are correlates of maladaptive perfectionism (Brosschot, Van Dijk, & Thayer, 2007; Dishman, et al., 2000). Therefore, maladaptive perfectionists may be at particular risk for low HRV and the negative physiological sequela that often accompanies it.

CHAPTER II: LITERATURE REVIEW

Perfectionism

History of adaptive and maladaptive perfectionism. The concept of perfectionism, that is, the inclination to view anything that is less than perfect as unacceptable, has existed almost as long as modern Western philosophy; dating back to the 4th century BCE, Aristotle's Value Theory sought to define the ingredients necessary for a perfect human life vis-a-vis human nature (Wall, 2012). The conceptualization of perfectionism as a personality trait is more recent though and up until approximately 40 years ago it was viewed as a unidimensional construct with entirely maladaptive connotations (Flett & Hewitt, 2002). However, with the psychodynamic writings of Hamachek (1978), perfectionism began to be viewed as having both adaptive and maladaptive subtypes.

Hamacheck (1978) labeled his two perfectionistic subtypes normal perfectionism and neurotic perfectionism. Neurotic perfectionists set unachievably high goals for themselves, are never satisfied with their efforts, and are incapable of relaxing their high standards when circumstances necessitate it. Neurotic perfectionism is maladaptive and is the way in which perfectionism has historically been viewed. Alternatively, Hamachek's normal perfectionists set realistic, achievable goals for themselves, feel satisfaction when their hard work pays off, and are capable of relaxing their high standards when the situation calls for it. Normal perfectionism is not necessarily maladaptive and can even be adaptive in some circumstances.

Multidimensional models of perfectionism. It was with this theoretical differentiation of normal perfectionists from neurotic perfectionists that Hamachek

redefined the personality trait of perfectionism as a multidimensional concept and introduced perfectionism researchers to the idea that perfectionism is not inherently negative. Current multidimensional models of perfectionism differentiate the types of perfectionism using two types of frameworks, either a dimensional approach, or a group-based approach. In group-based approaches to perfectionism, the facets of perfectionism are divided into two separate groups, one healthy and one unhealthy. The healthy perfectionism group is thought to be associated with positive outcomes and the unhealthy perfectionism group with negative outcomes. In dimensional approaches to perfectionism, the facets of perfectionism are separated into two different dimensions of perfectionism, one labeled perfectionistic strivings and the other perfectionistic concerns. Perfectionistic strivings are thought to be associated with positive outcomes, and perfectionistic concerns with negative outcomes; however, unlike with group-based approaches, individuals can fall along a continuum in regard to both facets (Stoeber & Otto, 2006).

The two most popular group-based approaches to perfectionism currently in use today are those proposed simultaneously, but separately, by Frost (Frost, Marten, Lahart, & Rosenblate, 1990) and Hewitt and Flett (Hewitt & Flett, 1991a). Both theories conceptualize perfectionism as being composed of multiple facets that can differentiate maladaptive from adaptive perfectionism and have measures of these facets named the Multidimensional Perfectionism Scale (MPS). For clarities sake, Frost's measure is usually identified as the MPS-F and Hewitt and Flett's as the MPS-H (See Table 1).

In Frost's theory, there are six facets that make up perfectionism; these are labeled Concern over Mistakes, Doubts about Actions, Personal Standards, Parental

Expectations, Parental Criticism, and Organization (Frost, Marten, Lahart, & Rosenblate, 1990). Concern over Mistakes describes reacting poorly to making mistakes and perceiving oneself as a failure if mistakes are made. The Doubts about Actions subscale involves doubts about whether or not one has performed satisfactorily. Personal Standards relates to the setting of extremely high standards and tying the meeting of these standards into one's self-evaluation. The Parental Expectations subscale involves the belief that one's parents have high expectations and Parental Criticism is the view of one's parents as overly critical. Finally, the Organization subscale describes an emphasis on the importance of order and organization (Frost, Marten, Lahart, & Rosenblate, 1990). Research has indicated that the Concern over Mistakes and Doubts about Actions subscales are more indicative of negative perfectionism, as they are positively correlated with higher scores on measures of depression. In comparison, Personal Standards and Organization are more related to positive perfectionism, as they are not correlated with depression and are positively correlated with efficacy and positive self-concept (Frost, Marten, Lahart, & Rosenblate, 1990).

In comparison, Hewitt and Flett's multidimensional conceptualization of perfectionism includes three facets: Self-Oriented Perfectionism, Other-Oriented Perfectionism, and Socially Prescribed Perfectionism (Hewitt & Flett, 1991). Self-Oriented Perfectionism is the type of perfectionism that people generally think of when they consider perfectionism; it involves the setting of very high standards for oneself and stringently evaluating one's behavior in order to ensure that it is in keeping with those high standards. Other-Oriented Perfectionism is when an individual has extremely

high standards for their significant others' behavior. Socially Prescribed Perfectionism is when an individual believes that others expect them to be perfect and that these other people are always evaluating them to see if they are living up to that high standard (Hewitt & Flett, 1991). Research on the relations between the two theories of perfectionism has shown that there are significant relations between the MPS-F Total Perfectionism score and the MPS-H Self-Oriented and Socially Prescribed scales, as well as between the MPS-F Personal Standards scale and the MPS-H Self-Oriented Perfectionism scale. In addition, the MPS-F scales of Concern over Mistakes, Parental Expectations, and Parental Criticism are correlated with the MPS-H Socially Prescribed Perfectionism scale (Frost, Heimberg, Holt, Mattia, & Newbauer, 1993). Therefore, despite the fact that Frost (Frost, Marten, Lahart, & Rosenblate, 1990) and Hewitt and Flett (Hewitt & Flett, 1991a) developed their theories of multidimensional perfectionism independently of each other, the two different MPS models are nevertheless very similar at the theoretical level and share a good deal of conceptual overlap.

Although these two group-based approaches to perfectionism held sway as the predominant theories of multidimensional perfectionism for the better part of the 1990's and early 2000's, more recently, dimensional approaches to perfectionism have begun to be more popular, due to their consideration of the dimensional, rather than dichotomous, nature of perfectionistic tendencies in individuals. Group-based approaches historically only allowed for the classification of individuals as either adaptive or maladaptive perfectionists, with no allowances made for intermediary degrees of variability between the two types. Classification was based solely on individuals' highest scores on subscales of measures. For example, if an individual

scored highest on the Other-Oriented or Socially Prescribed perfectionism subscales of the MPS-H, relative to all other subscales, then they would be classified as a maladaptive perfectionist. In contrast, if they scored higher on the Self-Oriented Perfectionism subscale, they would be classified as an adaptive perfectionist. In addition, group-based approaches failed to provide a specific classification group for non-perfectionistic individuals. Alternatively, dimensional approaches acknowledge the fact that individuals can have varying degrees of adaptive and maladaptive perfectionistic traits, or not be perfectionistic at all, and thus allow for description of individual variations along the dimensions of the perfectionistic continuum.

The most widely employed dimensional model of multidimensional perfectionism in use today is Rice and Ashby's (2007) Tripartite Model, which utilizes the Almost Perfect Scale-Revised (APS-R) to describe individuals' adaptive or maladaptive perfectionistic tendencies based on their relative scores along two separate dimensions (Slaney, Rice, Mobley, Trippi, & Ashby, 2001). The APS-R is a revised version of the original Almost Perfect Scale (APS), which was created by Slaney and Johnson (1992) and was comprised of four dimensions: Standards and Order, Relationships, Anxiety, and Procrastination. The patterns created by individuals' scores relative to each other on these four dimensions were used to indicate whether people were non-perfectionists, adaptive perfectionists, or maladaptive perfectionists. However, among other issues, the original APS was found to not measure maladaptive perfectionism adequately, and subsequent exploratory and confirmatory factor analyses led to the three dimensions that currently comprise the APS-R and lend themselves to the current Tripartite model (Slaney, Rice, Mobley, Trippi, & Ashby, 2001).

The Tripartite model's current description process is based on the patterns created by an individual's scores relative to each other on just two of the three dimensions of the current APS-R, High Standards and Discrepancy; the High Standards dimension relates to whether or not individuals have high standards for themselves, while the Discrepancy dimension indicates whether or not one feels that they are meeting their standards for themselves (Slaney, Rice, Mobley, Trippi, & Ashby, 2001). Based upon different combinations of scores on these two dimensions of the APS-R, individuals can be described as Nonperfectionists, Adaptive perfectionists or Maladaptive perfectionists. Individuals who score low on the dimension of High Standards are described as Nonperfectionists. Nonperfectionists have relatively low scores on measures of personal standards, self-criticism, self-doubt, and concerns over making mistakes (Rice & Ashby, 2007) (See Table 2 and Figure 1).

However, individuals who have high scores on the dimension of High Standards are described as perfectionists, but whether they are described as Adaptive or Maladaptive perfectionists depends on their scores on the dimension of Discrepancy; people who have low Discrepancy scores are considered to be Adaptive perfectionists, while those with high scores are thought to be Maladaptive perfectionists (Rice & Ashby, 2007). Adaptive perfectionists tend to have high personal standards and persistently strive for excellence, but are not overly self-punitive or continuously dissatisfied with their performance or themselves. In comparison, Maladaptive perfectionists tend to have excessive concerns about making mistakes, be intensely critical of themselves, feel chronically inadequate, and never feel as though they have attained their goals. In addition, they are primed to experience the results of their

actions as failures and to perceive those failures as devastating, to not view their successes as important or deserved, and to have low self-esteem and feel inferior (Rice & Ashby, 2007) (See Table 2 and Figure 1).

Table 1

Division of Adaptive and Maladaptive Perfectionism by Group-Based Theory

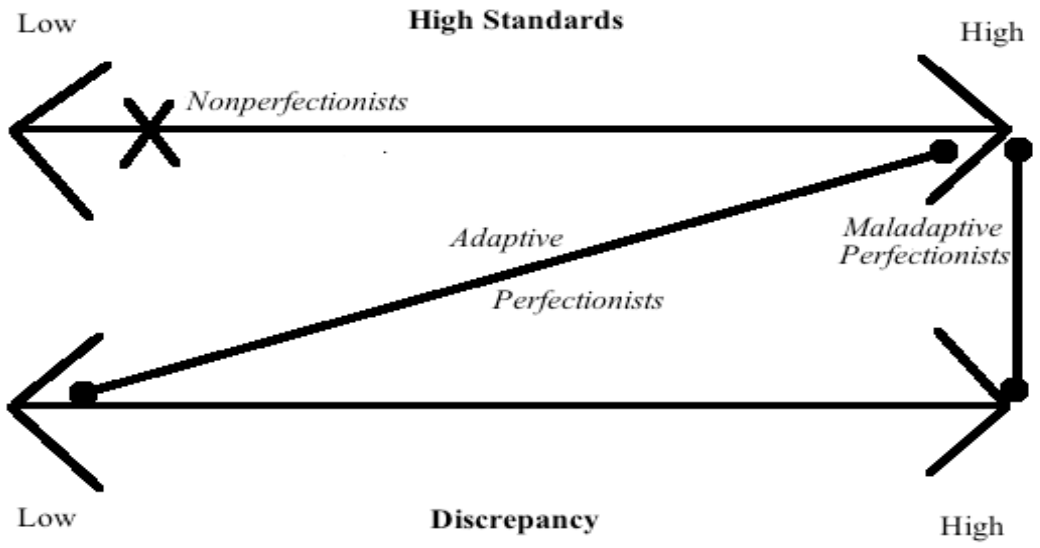
Theory of Perfectionism	Adaptive Perfectionism	Maladaptive Perfectionism
Hamacheck (1978)	-Normal	-Neurotic
Frost, Marten, Lahart, and Rosenblate: Multidimensional Perfectionism Scale (1990)	-Personal Standards -Organization	-Concern over Mistakes -Doubts About Actions
Hewitt and Flett: Multidimensional Perfectionism Scale (1991)	-Self-Oriented Perfectionism	-Socially Prescribed Perfectionism

Table 2

Patterns of Scores on Dimensions of High Standards and Discrepancy seen in Nonperfectionists, Adaptive Perfectionists, and Maladaptive Perfectionists

	Perfectionism according to a Dimensional Approach		
Theory of Perfectionism	Nonperfectionists	Adaptive Perfectionists	Maladaptive Perfectionists
Rice and Ashby: Almost Perfect Scale Revised (2007)	Low Standards	High Standards + Low Discrepancy	High Standards + High Discrepancy

Figure 1. Nonperfectionists, Adaptive Perfectionists, and Maladaptive Perfectionists by Dimensions of High Standards and Discrepancy



Factor analytic research in support of the multidimensional nature of perfectionism. While the group-based and dimensional models of multidimensional perfectionism mentioned above were developed as theoretical constructs, their existence in actuality is supported by factor analytic research. For example, factor and cluster analyses performed by various researchers have consistently demonstrated the multidimensional nature of perfectionism. Frost, Heimberg, Holt, Mattia, and Newbauer (1993) used factor analysis to discern that the scales of Personal Standards, Organization, Self-Oriented Perfectionism, and Other-Oriented Perfectionism clustered together to form a positive perfectionism factor, while the Concern over Mistakes, Parental Criticism, Parental Expectations, Doubts about Actions, and Socially-

Prescribed Perfectionism scales grouped together to form a negative perfectionism factor. Slaney, Ashby, and Trippi (1995), replicated these results, finding that the Standards and Order subscales of the Almost Perfect Scale (APS) loaded onto an adaptive perfectionism factor and that relationships, anxiety, and procrastination loaded onto a maladaptive factor.

Rice and Mirzadeh (2000) conducted similar research using cluster analysis procedures. They found that Personal Standards and Organization were indicative of adaptive perfectionism, and that while maladaptive perfectionists also evidenced high Personal Standards and Order, they exhibited additional self-doubt, excessive concerns over making mistakes, and had overly critical parents. Rice and Slaney (2002) found that a three-cluster solution, representing non-perfectionists, adaptive perfectionists, and maladaptive perfectionists, best explained their data. Two-thirds of their sample fit into the perfectionistic groups, whose members were differentiated from those in the non-perfectionistic group by their relatively higher scores on the High Standards and Order subscales. Additionally, the adaptive and maladaptive perfectionists could be separated from each other by their scores on the Discrepancy subscale, with maladaptive perfectionists having relatively higher subscale scores than adaptive perfectionists.

Finally, Bieling, Israeli, and Antony (2004) found that a model differentiating maladaptive and adaptive perfectionism based on Maladaptive Concerns vs Positive Strivings represented the structure of the MPS-H and MPS-F better than the total scale scores of either measure separately or a unidimensional perfectionism score comprised of all MPS-H and MPS-F subscales combined. Socially prescribed perfectionism,

concern over mistakes, parental criticism, parental expectations, and doubts about actions loaded onto the Maladaptive Evaluative Concerns factor, while self-oriented perfectionism, other-oriented perfectionism, personal standards, and organization loaded onto the Positive Strivings factor.

Concurrent validity research on adaptive and maladaptive perfectionism. Research into the concurrent validity of maladaptive and adaptive perfectionism has also provided support for the multidimensional nature of perfectionism. In particular, there is a great deal of research supporting the idea that adaptive perfectionism is positively related to, and predictive of, enhanced outcomes, and negatively related to deleterious outcomes, while maladaptive perfectionism is predictive of increased negative outcomes and decreased positive outcomes.

Adaptive perfectionism and increased positive outcomes. A variety of studies have demonstrated the relations between adaptive perfectionism and better psychological functioning, finding that individuals high in adaptive perfectionism have greater positive affect, are more satisfied with life and find greater purpose in it, have higher self-esteem, and endorse greater levels of optimism, personal growth, and environmental mastery (Andrew, Burns, & Dueling, 2014; Ashby & Rice, 2002; Chang, 2006b; Chang, Watkins, & Banks; 2004). Additionally, adaptive perfectionists have a greater sense of subjective well-being, perform better academically and on specific tasks, are more socially integrated, utilize adaptive coping to a greater extent, and exercise more than individuals low in adaptive perfectionism (Andrew, Burns, & Dueling, 2014; Chang, 2006a; Noble, Ashby, & Gnilka, 2014; Stoeber & Otto, 2006).

For example, Andrews, Burns, and Dueling (2014) found that positive

perfectionism was significantly positively correlated with both positive affect and optimism, and that these two factors accounted for 13.4% of the variance for the positive perfectionism scale used. Additionally, increased physical exercise, sociality, emotional awareness and acceptance, and joviality affect were all slightly, but significantly, positively correlated with positive perfectionism, and occupational factors were moderately positively correlated to a significant degree. All of these factors were moderated to some extent by optimism and/or positive affect. Chang, Watkins, and Banks (2004) also found that adaptive perfectionism was correlated with increased positive affect and life satisfaction in White women and with decreased suicidal ideation in Black women.

It has also been found that adaptive perfectionists self-report better functioning and psychological adjustment, as well as greater life satisfaction, subjective well-being, personal growth, self-esteem and active task-focused coping (Ashby & Rice, 2002; Chang, 2006b; Gnilka, Ashby, & Noble, 2013; Grzegorek, Slaney, Franze, & Rice, 2004; Noble, Ashby, & Gnilka, 2014; Rice & Ashby, 2006; Rice & Slaney, 2002; Stoeber & Otto, 2006). Park and Jeong (2015) noted in their research that adaptive perfectionists had an increased sense of purpose in life and greater mastery of their environment than maladaptive perfectionists and non-perfectionists. They also endorsed high levels of self-efficacy about their ability to manage the environments in which they found themselves and to exert control over the resources and opportunities they encountered in those environments. Adaptive perfectionists also possessed clearer goals, meaning, and direction in their lives.

Studies have found positive relations not only between adaptive perfectionism and indicators of psychological health, but also between adaptive perfectionism and academic performance. Chang (2006a) found that positive self-oriented perfectionism was positively correlated with higher scores on the Satisfaction with Life Scales (SWLS), the Positive Affect scale of the Positive and Negative Affect Schedule (PANAS), and the Scales of Psychological Well-Being (SPWB). Positive self-oriented perfectionism also accounted for 2.6%-6.3% of the variance for scores on four different exams taken across a semester by college students; this variance was above what was accounted for by intellectual ability alone, indicating that adaptive perfectionism can be a predictive factor for academic achievement, independent of intelligence.

In further support, Stoeber and Otto (2006) conducted research in which they found that adaptive perfectionists had higher perceived academic ability, higher exam scores, better school performance in the last year, better adaptation to academic environments, plans to engage in more studying, rather than less, and were more socially integrated. Stoeber, Hutchfield, and Wood (2008) further corroborated these findings, noting that positive strivings perfectionism was positively correlated with not only positive affect, but also endurance, academic achievement, and test performance. Additionally, positive strivings perfectionists had increased levels of self-efficacy, and higher aspirations before receiving feedback on their performance, and were likely to have increased aspiration levels after receiving feedback that they were successful. Thus, adaptive perfectionists believe that they can do well, and strive to do so, and, upon achieving their academic goals, set their sights even higher.

Even on tasks less complicated than academic endeavors, adaptive

perfectionists show performance advantages over maladaptive perfectionists and non-perfectionists; Stoeber, Chesterman, and Tarn (2010) found that individuals high in perfectionistic strivings performed better on a simple letter-search task. This result was mediated entirely by the increased amount of time the adaptive perfectionists spent on the task, versus the maladaptive and non-perfectionists. These results indicate that students high in adaptive perfectionism do well because they tend to invest more time in completing tasks and view accuracy as more important than completing the tasks as quickly as possible.

Adaptive perfectionism and decreased negative outcomes. Adaptive perfectionists not only experience greater levels of positive mental health factors, but also lower levels of psychopathology (Andrews, Burns, & Dueling, 2014). For example, Gnilka, Ashby, and Noble (2013) found that adaptive perfectionism was negatively correlated with hopelessness, depression, and both anxious and avoidant type adult attachment styles. They noted that adaptive perfectionism mediated the relations between the avoidant adult attachment style and both life satisfaction and hopelessness. They hypothesized that this might be because adaptive perfectionism inhibits individuals with naturally avoidant attachment styles from withdrawing from others, which results in their not suffering the hopelessness that can result from doing so. The increased approach tendencies that result from adaptive perfectionism thus also serve to increase life satisfaction (Gnilka, Ashby, & Noble, 2013).

A variety of additional research supports the idea that adaptive perfectionism serves as a protective factor against depression and is related to decreased hopelessness and suicidal ideation (Chang, Watkins, & Banks, 2004; Enns, Cox, &

Clara, 2002; Noble, Ashby, & Gnilka, 2014; Rice & Ashby, 2007; Stoeber & Otto, 2006). Beyond depression, adaptive perfectionism has been linked to a decrease in a variety of other psychopathologies, maladaptive tendencies, and negative outcomes, including anxiety, pessimism, neuroticism, procrastination, defensiveness, maladaptive coping styles, self-blame, perceived hassles, interpersonal problems, and somatic complaints (Andrews, Burns, & Dueling, 2014; Noble, Ashby, & Gnilka, 2014; Rice & Slaney, 2002; Stoeber & Otto, 2006). Adaptive perfectionists also endorse lower levels of occupational distress (Kung & Chan, 2014).

***Maladaptive perfectionism and decreased positive outcomes*.** Conversely, research also supports the relation of maladaptive perfectionism to poorer psychological functioning, demonstrating that maladaptive perfectionists show decreased levels of positive and joviality affect, emotional awareness, life satisfaction, well-being, self-worth, and self-esteem (Andrews, Burns, & Dueling, 2014; Chang, Watkins, & Banks, 2004; Gnilka, Ashby, & Noble, 2013; Park & Jeong, 2015; Rice & Slaney, 2002). Additionally, they have less secure adult attachment styles, as indicated by their greater anxiety and avoidance in these relationships, and exercise less than individuals lower in maladaptive perfectionism (Andrews, Burns, & Dueling, 2014; Gnilka, Ashby, & Noble, 2013; Rice, Lopez, & Vergara, 2005). Finally, Periasamy and Ashby (2002) have demonstrated that individuals with higher levels of maladaptive perfectionism show less positive locus of control patterns. Maladaptive perfectionists in their study not only demonstrated higher internal loci of control, which adaptive perfectionists had as well, but also higher external loci of control. This means that maladaptive perfectionists perceived that the events occurring in their lives were under the control of powerful

others to a much greater degree than did adaptive perfectionists. Periasamy and Ashby (2002) thus concluded that maladaptive perfectionists strive for perfection as a result of the fear that if they do not attain perfection, they will be unworthy of others' love and affection.

Maladaptive perfectionism and increased negative outcomes. Finally, there is evidence to support the idea that maladaptive perfectionism is related to higher levels of negative affect and psychopathology, particularly depression, anxiety, worry, and rumination (Macedo, Marques, & Pereira, 2014; Noble, Ashby, & Gnilka, 2014; Rice & Slaney, 2002). Additionally, maladaptive perfectionists have poorer coping skills and endorse greater levels of pessimism, neuroticism, attachment avoidance and anxiety, stress, occupational distress, hopelessness and suicide (Andrews, Burns, & Dueling, 2014; Chang, Watkins, & Banks, 2004; Kung & Chan, 2014; Noble, Ashby, & Gnilka, 2014; Rice, Lopez, & Vergara, 2005). Finally, research has demonstrated that maladaptive perfectionists react significantly more poorly in difficult task situations than adaptive perfectionists or non-perfectionists (Lo & Abbot, 2013a). For example, Noble, Ashby, and Gnilka (2014) found that both adaptive and maladaptive perfectionists exhibited significantly higher levels of active task-focused coping than did nonperfectionists, but that maladaptive perfectionists also had significantly elevated usage of avoidant coping strategies, including avoiding anxiety-provoking tasks. The authors concluded that this was because both adaptive and maladaptive perfectionists begin by trying their best to overcome challenges; however, when it begins to appear as though failure might be an option, maladaptive perfectionists begin to give up, procrastinate, and generally attempt to avoid the potentially failure-inducing task. This

avoidance of challenges can lead to depression, as it reduces the possibility of reinforcement in the form of success, and actually increases the likelihood of failure. Indeed, Noble, Ashby, and Gnilka (2014) found in their research that the relation between depression and maladaptive perfectionism was mediated by the increased utilization of avoidant coping strategies.

Multiple other studies have also shown that there is a relation between maladaptive perfectionism, depression, and suicidal ideation (Chang, Watkins, & Banks, 2004; Enns, Cox, & Clara, 2002; Gnilka, Ashby, & Noble, 2013; Park & Jeong, 2015). For example, Rice and Ashby (2007) found that maladaptive perfectionists were extremely depressed, scoring, on average, half a standard deviation above the cutoff score at which clinicians begin to have concerns about significant depression risk on the Center for Epidemiologic Studies Depression (CES-D) scale. In fact, a full 58% of maladaptive perfectionists in Rice and Ashby's (2007) study were at a significant risk for depression, as compared to only 16% of the adaptive perfectionists.

Maladaptive perfectionism has been found to be positively correlated with a variety of other indicators of negative psychological functioning as well, including more negative scores on the Negative Automatic Thoughts Questionnaire (NATQ), the Negative Affect scale of the Positive and Negative Affect Schedule (PANAS), the Beck Depression Inventory (BDI), the Worry Domains Questionnaire (WDQ), the Perceived Stress Scale (PSS), the Inventory of College Students' Recent Life Experiences (ICSRLE), and the nine clinical scales of the Brief Symptom Inventory (BSI), which include Somatization, Obsessive-Compulsive, Interpersonal, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism (Chang, 2006a).

Additionally, there is some evidence to support the idea that maladaptive perfectionism is associated with greater occupational distress; for instance, Kung and Chan (2014) conducted research in which they found that greater levels of negative (i.e., maladaptive) perfectionism were positively correlated with higher levels of vocational, psychological, interpersonal, and physical strain. Maladaptive perfectionism alone accounted for 23% of the variance in these four variables. In addition, maladaptive perfectionism predicted decreased levels of vigor. The researchers noted that this could be because maladaptive perfectionists put forth a great deal of energy to try and avoid failure, which uses up their reserves of energy (Kung & Chan, 2014).

Finally, research has also shown that maladaptive perfectionists tend to show higher levels of both pessimism and neuroticism, with one study finding that these two factors accounted for a full 43.7% of the variance for the negative perfectionism scale used (Andrews, Burns, & Dueling, 2014; Chang, 2006a). Additionally, maladaptive perfectionists suffer from higher levels of anxiety and stress, as compared to adaptive perfectionists; this is particularly true in cases where maladaptive perfectionists perceive that the threat of social evaluation is high (Lo & Abbot, 2013a). For example, Lo and Abbott (2013b) conducted a study in which they presented adaptive and maladaptive perfectionists with two types of task situations. The first task situation was one that the researchers told the participants would be difficult, and thus expected them to do poorly on; this was the low evaluative threat condition. The second task was one that the researches told the participants would be easy, and thus expected them to do well on. This “easy” task was no easier than the “hard” task, as both task situations were

comprised of the same set of anagram tasks both times. However, telling participants that they should do well on the “easy” task created a high evaluative threat situation.

The results of this study showed that under the low evaluative threat condition the maladaptive perfectionists persisted for a significantly longer period of time than did adaptive and non-perfectionists, even on the unsolvable anagram tasks (Lo & Abbott, 2013a). However, in the high evaluative threat condition, the maladaptive perfectionists quit *more* quickly than the adaptive and non-perfectionists. They also endorsed significantly lower levels of mood and self-efficacy and significantly higher levels of negative affect and task anxiety. The authors hypothesized that these seemingly paradoxical findings were the result of the same mechanism at work, but in different ways. In both the high and low threat conditions maladaptive perfectionists worked to avoid failure. In the low evaluative threat condition though, the inferred standard was seen as attainable, and thus the maladaptive perfectionists put forth a great deal of effort in order to ensure that they met the standard, thus avoiding failure. However, in the high evaluative threat condition the maladaptive perfectionists viewed the inferred standard as unattainable, which caused them considerable anxiety and distress. They thus withdrew from the task situation prematurely in order to avoid further feelings of failure (Lo & Abbott, 2013a).

Ultimately, maladaptive perfectionism appears to be so maladaptive because it causes individuals to experience negative affective states when faced with situations involving high evaluative concern. Maladaptive perfectionists then cope with these feelings by withdrawing from such situations, thus attempting to avoid failure. However, this sort of avoidant reaction typically results in just the type of failure it was meant to

protect against. Repeated failure decreases reinforcement, increases further avoidance, and results in depression and further anxiety, creating a vicious circle of negative outcomes for maladaptive perfectionists.

Etiology and maintaining factors of adaptive and maladaptive perfectionism. ***Biological factors.*** There are several theories about what causes the differences seen between adaptive and maladaptive perfectionists. The first of these is that there are biological factors at play, including genetics and neurocognitive correlates (Slade, Coppel, & Townes, 2009; Tozzi, et al., 2004). For example, Tozzi, et al. (2004) conducted a twin study in which they found that perfectionism, as assessed by the three subscales of the Frost Multidimensional Perfectionism Scale (Frost, Marten, Lahart, & Rosenblate, 1990), is moderately heritable, with monozygotic twins showing more highly correlated results with one another on all three composite perfectionism subscales than dizygotic twins. The Concern Over Mistakes subscale showed the greatest pattern of heritability, while Personal Standards and Doubts about Actions served more as indicators of Concern Over Mistakes. Results also indicated that the correlation between Concern Over Mistakes and Personal Standards was likely the result of common genetic factors, while the correlation between Concern Over Mistakes and Doubts About Actions was likely the result of greater shared environmental factors (Tozzi, et al., 2004).

Additionally, Slade, Coppel, and Townes (2009) found that individuals with positive perfectionism, as measured by the Positive and Negative Perfectionism Scale (Terry-Short, et al., 1995), showed superior performance over nonperfectionists and negative perfectionists on neuropsychological assessment measures of both accuracy

alone, and speed and accuracy combined, as well as measures requiring either physical or mental effort. In comparison, negative perfectionists performed more poorly on measures that required both speed and accuracy, and had a more difficult time making trade-offs between the two. In addition, it was found that positive perfectionism was positively correlated with performance on tasks assessing speed and strength of motor function. Performance on these same tasks was not correlated with negative perfectionism; the authors hypothesized that this was because such tasks do not require a trade-off between speed and accuracy (Slade, Coppel, & Townes, 2009).

The authors also found a significant positive correlation between positive perfectionism and performance on the arithmetic and reading subtests of the Wide Range Achievement Test, third edition (WRAT-3), as well as a significant negative correlation between negative perfectionism and the arithmetic subtest of the WRAT-3 (Slade, Coppel, & Townes, 2009). This was as expected, since increased mental effort leads to better scores on the arithmetic and reading subtests and an inability to trade speed for accuracy results in lower arithmetic scores. Results also indicated that positive perfectionists had higher scores on measures of verbal IQ on the Wechsler Adult Intelligence Scales (WAIS-III) and negative perfectionists had lower scores on measures of performance IQ. Again, the authors felt that this was the result of the greater mental effort put forth by the positive perfectionists and the inability of the negative perfectionists to trade accuracy for speed (Slade, Coppel, & Townes, 2009).

Overall, the authors concluded that negative perfectionists performed more poorly on tests of executive functioning and positive perfectionists performed better on tests of working memory (Slade, Coppel, & Townes, 2009). They indicated that these

patterns were the result of individuals with negative perfectionism approaching the test tasks too rigidly and being unable to make the necessary trade-off between speed and accuracy required on performance tasks. This in turn impaired their attention and planning abilities. Additionally, positive perfectionists were seen to have superior performance on tasks involving working memory because of the greater mental resources they were able to bring to bear (Slade, Coppel, & Townes, 2009).

Parenting and attachment style. A second theory about what causes the differences seen between adaptive and maladaptive perfectionists emphasizes the role of parenting and attachment style factors. For example, Enns, Cox, and Clara (2002) found that individuals with maladaptive perfectionism often come from homes in which their parents were both harsh and perfectionistic. Parents of maladaptive perfectionists not only had high expectations for both themselves and their children, but were also critical, over-controlling, had excessive expectations, and showed a lack of care for their children. As a result, individuals with maladaptive perfectionism often had poor attachment relationships with their parents. In comparison, individuals with high levels of adaptive perfectionism typically had secure attachment relationships with their parents. Adaptive perfectionists' caregivers' parenting styles were still characterized by high expectations, for both themselves and others, but they lacked the additional harsh parenting practices found to be correlated with resulting maladaptive perfectionism (Enns, Cox, and Clara, 2002).

Attachment problems resulting from harsh parenting practices in childhood can not only affect perfectionistic children's relationships with their parents, but also perfectionistic adult's relationships with other adults. Gnilka, Ashby, and Noble (2013)

noted that adults high in maladaptive perfectionism also exhibited increased levels of both attachment anxiety and attachment avoidance in their adult relationships. Individuals with adult attachment anxiety report that they experience feelings of rejection and abandonment in their relationships and become overwhelmed by negative emotions easily, while individuals high in adult attachment avoidance feel so uncomfortable being in intimate relationships, and have such a need for independence and self-reliance, that they may avoid intimate adult relationships entirely. In comparison to the results seen for maladaptive perfectionism, adaptive perfectionism was negatively correlated with both adult attachment anxiety and avoidance and positively correlated with a secure adult attachment style (Gnilka, Ashby, & Noble, 2013).

Further research has indicated that whether a maladaptively perfectionistic individual exhibits adult attachment avoidance or adult attachment anxiety is dependent on a combination of parenting factors in childhood and the type of perfectionism an individual's parents modeled for them (Rice, Lopez, & Vergara, 2005). Rice, Lopez, and Vergara (2005) found that a combination of high parental criticism and low socially prescribed perfectionism significantly predicted adult attachment avoidance, while the combined effects of low parental expectations and high parental criticism significantly predicted adult attachment anxiety. In comparison, adaptive perfectionists indicated that their parents were high in parental expectations, but low in parental criticism. The authors concluded that maladaptive perfectionists' poor adult attachment styles were the result of their failure to internalize high and healthy standards as the adaptive perfectionists had. This was due to a relational climate in childhood that promoted striving as a means of avoiding punishment and in which support from parents, and

being deemed worthy by them, was contingent on meeting their performance standards (Rice, Lopez, & Vergara, 2005).

Cognitive-Behavioral models of clinical perfectionism. Other theories of maladaptive versus adaptive perfectionism have utilized cognitive-behavioral models to explain the etiology of the two perfectionism types. For example, Shafran's Information-Processing Biases Model posits that individuals with clinical (i.e., maladaptive) perfectionism not only set extremely high standards for themselves and exercise a high degree of self-control, as do adaptive perfectionists, but also evaluate their performance repeatedly, strictly, and in a biased manner (Shafran, Cooper, & Fairburn, 2002). These biases involve being hypervigilant for errors and paying selective attention only to perceived failures, while discounting successes. Inherent in these biases is an extreme fear of failure and the tying in of the achievement of personal standards to the individual's evaluation of their own self-worth (Shafran, Cooper, & Fairburn, 2002).

As a result of the maladaptively perfectionistic individual having to constantly maintain their varied information processing biases, which taxes mental resources and distracts them from important tasks at hand, maladaptive perfectionists may actually increase their rate of failure (Shafran, Cooper, & Fairburn, 2002). Since individuals with maladaptive perfectionism are extremely failure-adverse, the resulting fear of failure may cause them to engage in procrastination, stop difficult tasks midway through, or avoid tasks that seem likely to result in failure entirely, which all further increase their chances of failing. Maladaptive perfectionists are hypercritical of their performance and self-worth when they do eventually fail to meet their high standards; this only

strengthens the tying in of achievement to self-worth (Shafran, Cooper, & Fairburn, 2002).

Occasionally though individuals who display maladaptive perfectionism do meet their exceedingly high standards, which results in two outcomes (Shafran, Cooper, & Fairburn, 2002). First, immediately after the success, the maladaptive perfectionist experiences a brief elevation in self-evaluation, or at least negative self-evaluation is avoided. Next, however, the recently achieved standard is evaluated as having been too easy and a new, more rigorous, standard is set. This results in the decreased possibility of future success for the maladaptive perfectionist and a vicious cycle is created. The lowered chance of future success, and the resulting decrease in opportunities for positive reinforcement, results in the negative outcomes often associated with maladaptive perfectionism, such as performance anxiety, the narrowing of interests to domains where success is most likely, isolation from other people, exhaustion, depression, and an ever present sense of being a failure (Shafran, Cooper, & Fairburn, 2002).

Other cognitive-behavioral researchers have further theorized about the cognitive factors at work in the formation of maladaptive and adaptive perfectionism. Conroy, Kaye, and Fifer (2007) posited that the extreme fear of failure found in maladaptive perfectionists is the result of the way in which such individuals engage in threat appraisals. Since past failures have resulted in increasingly negative outcomes, maladaptive perfectionists view potential failure as extremely threatening, with concerns related to feeling shamed or embarrassed, experiencing a decrease in self-evaluation, being unsure of the future, having other important people lose interest in them, and

having important people be upset with them. The more likely a maladaptively perfectionistic individual imagines these outcomes to be, the more threatening future failures are appraised to be. This results in increased avoidance behavior and negative outcomes, which again creates a downward behavioral and cognitive spiral (Conroy, Kaye, & Fifer, 2007).

Finally, there is some speculation that the differences found between maladaptive and adaptive perfectionists may be rooted in emotional dysregulation, and that this emotional dysregulation stems from insecure attachments formed in childhood. Based on the differentiation of adaptive and maladaptive perfectionists used in both Hewitt and Flett and Frost's MPS, Aldea and Rice (2006) found that individuals with maladaptive self-critical perfectionism were significantly more likely to experience emotional dysregulation, and the psychological distress that comes with it, while individuals with adaptive personal standards perfectionism were significantly less likely to experience such issues (Aldea & Rice, 2007).

The authors hypothesized that these findings were the result of individuals who displayed maladaptive perfectionism having experienced disturbed emotional connections in their childhood attachment processes, which resulted in their emotional development being stunted (Aldea & Rice, 2007). They were thus unable to cope with daily stress and hassles and became overwhelmed by their negative self-assessments. Conversely, individuals with adaptive perfectionism grew up in homes where they were able to form appropriate attachment bonds, which allowed them to learn appropriate emotional self-soothing and regulatory techniques. This allowed them to regulate any

negative affectivity that they experienced as the result of their perfectionism and served as a protective factor against psychological distress (Aldea & Rice, 2007).

Dual Process Model of perfectionism. In addition to cognitive-behavioral theories of perfectionism, the dual process model of perfectionism is also commonly used to explain the differential etiologies of adaptive and maladaptive perfectionism. Proposed by Slade and Owens (1998), this model posits that there are two entirely separate behavioral processes at work in adaptive and maladaptive perfectionists, although the outcomes may appear to be similar. Adaptive perfectionists are motivated by positive reinforcement; they work hard in order to achieve positive outcomes. Alternatively, maladaptive perfectionists are motivated by negative reinforcement, in the form of avoidance; they work hard in order to avoid failure and the negative sequela associated with it. Thus, adaptive perfectionism is rooted in approach behaviors, such as the pursuit of success, perfection, excellence, approval, the ideal self, satisfaction, pleasure, and euphoria, while maladaptive perfectionism is rooted in avoidance behaviors, such as the avoidance of failure, imperfection, mediocrity, disapproval, the feared self, dissatisfaction, displease, and dysphoria. Additionally, adaptive perfectionists seek out the approval of important others, while maladaptive perfectionists seek to simply not be disapproved of (Slade & Owens, 1998). There is some research evidence in support of this theory; the findings of Santanello and Gardner (2007) indicate that maladaptive perfectionism is, in fact, significantly related to experiential avoidance and attempts to avoid aversive thoughts and feelings.

Relation of adaptive and maladaptive perfectionism to stress and coping. As has been demonstrated, there are significant theoretical and evidence-based

differences between the etiologies of adaptive and maladaptive perfectionism, as well as both factor analytic and concurrent validity research supporting the differentiation between the two subgroups. An additional point of difference that can be found between adaptive and maladaptive perfectionists is the type of coping each type of perfectionist uses and how this affects individual stress levels. For example, Rice, Vergara, and Aldea (2006) found adaptive perfectionism to be positively correlated with improved self-regulation in regards to stress perception, and that maladaptive perfectionists tended to perceive their lives as more stressful. Additionally, the results of Chang's (2006b) research indicated that maladaptive perfectionism, in the form of socially prescribed perfectionism and other-oriented perfectionism, was a contributing factor in creating stress for college age students. Socially-prescribed perfectionism was also found to be negatively correlated with all six of the dimensions of psychological well-being that the author measured, including self-acceptance, positive reactions with others, autonomy, environmental mastery, purpose in life, and personal growth. However, adaptive perfectionism, in the form of self-oriented perfectionism, was not related to stress, and was positively related to the dimensions of purpose in life and personal growth. Ultimately, the results of the study demonstrated that the relations between socially prescribed perfectionism and autonomy, environmental mastery, and purpose in life were fully mediated by stress (Chang, 2006b).

Rice, Leever, Christopher, and Porter (2006) found similar results in their work with college students. Their research indicated that individuals high in discrepancy (i.e., maladaptive perfectionism) or low in high standards (i.e., nonperfectionists) were more negatively affected by stress emotionally than were adaptive perfectionists. Additionally,

adaptive perfectionism seemed to be a positive trait, regardless of stress level. These findings hold true even across racial groups; Chang, Watkins, and Banks (2004) found maladaptive perfectionism to be highly correlated with stress, and adaptive perfectionism to be unrelated to stress, in both White and Black women (Chang, Watkins, & Banks, 2004).

One possible explanation for these results is provided by the work of Dunkley, Zuroff, and Blankstein (2003), who found that the negative affect experienced by self-critical (i.e., maladaptive) perfectionists was fully mediated by hassles and avoidant coping. Additionally, personal standards (i.e., adaptive) perfectionists were not as reactive to daily hassles and did not experience as much psychological distress, which the authors attributed to their higher levels of problem-focused coping. Finally, it was found that even maladaptive perfectionists experienced less distress on days when they did engage in greater levels of problem-focused, versus avoidant, coping. Thus, it would appear that the greater stress levels experienced by maladaptive perfectionists are due to their greater use of avoidant coping. Additionally, the use of problem-focused coping by adaptive perfectionists appears to serve as a protective factor against both psychological distress and stress (Dunkley, Zuroff, & Blankstein, 2003).

Psychophysiological correlates of adaptive and maladaptive perfectionism. That maladaptive perfectionists experience such elevated levels of stress is concerning because of the vast body of existing literature that demonstrates that elevated stress levels can result in increases in psychophysiological risk factors for chronic disease in a variety of populations (Carver & Vargas, 2011). It is doubtful that stressed perfectionists fare any better than stressed individuals in other at-risk populations and there is

evidence to support the claim that stress in maladaptive perfectionists affects several known psychophysiological risk factors, including fatigue, blood pressure, and the cortisol stress response, although the results are mixed as to exactly what direction these effects are in (Dittner, Rimes, & Thorpe, 2011; Albert, Rice, & Caffee, 2014; McGirr & Turecki, 2009).

For example, Dittner, Rimes, and Thorpe (2011) found that even when they controlled for level of fatigue at the beginning of the semester, college students high in maladaptive perfectionism at the start of the term were significantly more fatigued by the end of the semester than non-perfectionists or adaptive perfectionists. In comparison, adaptive perfectionism at the beginning of the semester was negatively correlated with one of the measures of fatigue the researchers used, and uncorrelated with the other. The researchers concluded that maladaptive perfectionism is a significant contributor to fatigue in college students and that adaptive perfectionism may be a protective factor against fatigue. They hypothesized that this relation is mediated by the behavioral and cognitive responses of maladaptive perfectionists, such as working long hours and being obsessed with one's performance, as well as the stress and depression that can result from these actions (Dittner, Rimes, & Thorpe, 2011).

However, negative perfectionism ultimately wound up accounting for only 2% of the variance in fatigue at the end of the semester over fatigue at the beginning of the semester (Dittner, Rimes, & Thorpe, 2011). Thus, there are likely other psychophysiological correlates of maladaptive perfectionism that put perfectionists at greater future risk of negative health outcomes. One such correlate is elevated blood pressure; Albert, Rice, and Caffee (2014) conducted research in which they found that

both adaptive and maladaptive perfectionists, in comparison to non-perfectionists, were less likely to show decreases in blood pressure over time when confronted with a mental arithmetic stressor task, even though all groups had started with similar baseline blood pressure levels. This type of response indicates a blunted cardiovascular response to acute psychological stressors, in both adaptive and maladaptive perfectionists (Albert, Rice, & Caffee, 2014).

What is particularly interesting about this study though is that while both adaptive and maladaptive perfectionists showed continuously elevated blood pressures throughout the set of stressor tasks, adaptive perfectionists only showed elevated systolic blood pressures, while maladaptive perfectionists only showed elevated diastolic blood pressures (Albert, Rice, & Caffee, 2014). Since elevated diastolic blood pressure indicates that an individual's arterial pressure is high even when the heart is not contracting, which is a risk factor for future cardiac problems, the authors concluded that the results of their research indicated that even though both maladaptive and adaptive perfectionists exhibited higher blood pressures in response to stress, maladaptive perfectionists were probably more likely to be at risk for future chronic health problems related to cardiovascular functioning (Albert, Rice, & Caffee, 2014).

However, Besser, Flett, Hewitt, and Guez (2008) conducted similar research but found contradictory findings. Their results indicated that there were no effects of adaptive or maladaptive perfectionism on diastolic blood pressure during a performance task. Additionally, maladaptive perfectionism was related to increased systolic blood pressure following negative performance feedback, rather than increased diastolic blood pressure as Albert, Rice, and Caffee (2014) found in their study. Finally, Besser, Flett,

Hewitt, and Guez (2008) found that adaptive perfectionists had increased systolic blood pressure after doing objectively poorly on a task, regardless of whether that task was easy or difficult. While the contradictory findings of these two studies muddy the waters around what effect stress has on the blood pressure of adaptive and maladaptive perfectionists respectively, the results do appear to indicate, at the very least, that stress has negative impacts on perfectionists' blood pressures and the ability of their cardiovascular systems to recover from stress.

Another possible set of candidates for predicting future chronic health issues in perfectionists are changes in the cortisol stress response and salivary α-amylase, indicators of hypothalamic–pituitary–adrenal (HPA) axis activity and sympathetic nervous system (SNS) activity respectively (Wirtz et al., 2007; McGirr & Turecki, 2009). The HPA axis is a major part of the neuroendocrine system and regulates, among other things, the human stress response. The sympathetic nervous system is primarily responsible for stimulating the body's fight-flight-or-freeze response. Wirtz et al. (2007) examined the relations between general perfectionism and the cortisol stress response in middle-aged men and found that higher levels of perfectionism significantly predicted higher cortisol stress reactivity, with perfectionism accounting for 18% of the total variance in the final regression model (Wirtz et al., 2007).

McGirr and Turecki (2009) explored this relation further by specifically looking at the differences in cortisol response and salivary α-amylase between college-age adaptive and maladaptive perfectionists. Although they found somewhat contradictory results, in that they found no effect of perfectionism on cortisol, they did find a significant effect of maladaptive perfectionism on salivary α-amylase levels, which indicates that

when maladaptive perfectionists are faced with stressful tasks, their bodies respond by trying to fight or run away from the relevant stressor, which is not necessarily adaptive.

Although the studies by Wirtz et al. (2007) and McGirr and Turecki (2009) disagree about the exact effects of maladaptive and adaptive perfectionism on the cortisol stress response, they do both concur that perfectionism results in the elevation of stress responses. In contrast, Richardson, Rice, and Devine (2014) found that a more blunted, rather than reactive, pattern of stress responding was seen with maladaptive perfectionists, with maladaptive perfectionists exhibiting lower levels of cortisol in response to stressor tasks. They argued that this was the result of an over-burdened stress response that eventually became hypo-active from chronic over-arousal. Additionally, the results of Richardson and colleague's research demonstrated that adaptive perfectionists exhibited a moderate level of stress reactivity, with greater cortisol stress responses than maladaptive perfectionists, but not as great as those seen in nonperfectionists (Richardson, Rice, & Devine, 2014).

Correlates of adaptive and maladaptive perfectionism with personality. Thus it can be seen that the results of research on adaptive and maladaptive perfectionist's physiological responses to stress, and the ways in which they might contribute to the potential development of chronic diseases, have proven inconclusive. However, what is clear is that all of the physiological responses to stress that have been demonstrated by research to be present in perfectionists have potentially negative consequences for health outcomes. Therefore, further research is warranted to determine exactly what potentially deleterious physiological processes are occurring in what types of perfectionists and the repercussions that those effects may have for

perfectionist's future physical and mental health. One mechanism by which this might be accomplished is by further exploring other correlates of perfectionism with known physical health outcomes, such as personality.

The relation of adaptive and maladaptive perfectionism to traits in multiple personality theories is well documented; Chang (2006b) investigated the relation of adaptive and maladaptive perfectionism to the personality traits of the NEO Five-Factor Inventory (FFI) (McCrae & John, 1992) and found aspects of maladaptive perfectionism to be positively correlated with neuroticism and pessimism and negatively correlated with agreeableness. He also found aspects of adaptive perfectionism to be positively correlated with extraversion, agreeableness, conscientiousness, and optimism and negatively correlated with neuroticism (Chang, 2006b). Additionally, Stoeber and Otto (2006) found in their review of the literature that individuals high in adaptive perfectionism showed higher levels of both extraversion and conscientiousness (Stoeber & Otto, 2006).

In addition, Rice and Stuart (2002) had college students complete the Almost Perfect Scale-Revised (APS-R), the Minnesota Multiphasic Personality Inventory, 2nd edition (MMPI-2), and the Millon Index of Personality Style Revised (MIPS-R) and found that higher Discrepancy scores (i.e., maladaptive perfectionism) were significantly related to most of the MMPI-2 scales they looked at, which included: Depression, Psychasthenia, Low Positive Emotion, Dysfunctional Negative Emotions, Disconstraint, Negative Emotionality/Neuroticism, Introversion/Low Positive Emotionality, and Low Self-Esteem. Since the MMPI-2 is primarily a measure used to assess psychopathology in clinical populations, this pattern indicates that individuals high in maladaptive

perfectionism are also high in other facets of personality that represent problematic adjustment (Rice & Stuart, 2010).

In comparison, scores of individuals who evidenced High Standards on the APS-R, but not high Discrepancy (i.e., adaptive perfectionists) were inversely related, or at least unrelated, to scores on the MMPI-2 (Rice & Stuart, 2010). This indicates that adaptive perfectionists do not have great enough levels of problematic personality adjustment to have significant scores on the MMPI-2. Adaptive perfectionism did show significant correlations with the Conservation-Seeking and Dutiful-Conforming facets of the MIPS-R though, as well as being positively related to the Clinical Index; these results also suggest that adaptive perfectionists experience superior mental health (Rice & Stuart, 2010).

In regards to maladaptive perfectionism and scores on the MIPS-R, results of Rice and Stuart's (2010) research indicated that while maladaptive perfectionists also had higher scores on the Conservation-Seeking and Dutiful-Conforming facets than non-perfectionists, as did adaptive perfectionists, maladaptive perfectionists had additional elevated scores on the Pain-Avoiding Motivating style facet and lower scores on the Clinical Index. These results indicate that maladaptive perfectionists experience poorer mental health, and also provide support for the positive vs negative reinforcement model of perfectionism, whereby maladaptive perfectionists are driven by avoidance and adaptive perfectionists by approach (Rice & Stuart, 2010).

These findings on the relations between adaptive and maladaptive perfectionism and other models of personality are important because perfectionistic tendencies, like other personality traits, are known to be relatively stable over time; additionally,

research into the effects of personality traits on health have demonstrated that traits associated with adaptive perfectionism, such as conscientiousness, serve as protective factors against disease and illness, while traits associated with maladaptive perfectionism, such as neuroticism, tend to be risk factors for poor health outcomes (Rice & Aldea, 2006; Friedman, 2011).

Reinforcement Sensitivity Theory (RST) and BIS/BAS

Overview of RST and behavioral activation/behavioral inhibition. In addition to maladaptive perfectionists tending to report higher levels of neuroticism, another defining characteristic of their personality and behavior is avoidance, particularly of situations that might induce failure, such that they tend to give up quickly when faced with such situations. In comparison, adaptive perfectionists, who are less neurotic, and more extraverted, tend to engage in behaviors that are more approach driven, and are decidedly less likely to give up in situations that might eventually lead to success. These patterns of approach and avoidance behaviors are very similar to those seen in Gray and McNaughton's (2000) revised Reinforcement Sensitivity Theory (RST). This theory posits that there are three systems at work in determining human behavior and that how active or inactive each of these systems is in an individual determines their personality. The first system is the fight-flight-freeze system (FFFS), which regulates fear responses to both conditioned and unconditioned aversive stimuli and is related to the personality characteristics of fear-proneness and avoidance (Pickering & Corr, 2008).

The second system involved in RST is the behavioral activation system (BAS), which regulates appetitive responses to both conditioned and unconditioned stimuli, as well as the emotions of hope and anticipatory pleasure (Pickering & Corr, 2008). In

addition, the BAS is related to the personality characteristics of optimism, reward-orientation, and impulsiveness. The final system in RST is the behavioral inhibition system (BIS), which is responsible for the resolution of goal conflict between the BAS and FFFS, that is, between an individual's desires to engage in approach or avoidance behaviors. The BIS does this by initially inhibiting behaviors that would result from BAS or FFFS activation; it then resolves the existing goal conflict by engaging in recursive loops of risk assessment and scanning of the individual's environment and memory for relevant information. However, the BIS is biased towards information that could be potentially threatening, and thus favors the FFFS and allowing avoidant responses over approach responses (Mitchell, et al., 2007). The processes of the BIS are experienced by the individual as the emotion of anxiety. The BIS is also related to the personality characteristics of worry-proneness and anxious rumination (Pickering & Corr, 2008).

According to Gray's (1987) original RST, the BAS works through dopaminergic pathways in limbic circuits, while the BIS functions through a set of circuits that involve the hippocampus, subiculum, and septum and related structures. Additionally, the FFFS works through the basolateral and centromedial nuclei of the amygdala, the ventromedial nucleus of the hypothalamus, the central gray region of the midbrain, and the somatic and motor effector nuclei of the lower brain stem (Gray, 1987). Research into molecular genetics has provided support for Gray's original theory; Reuter, Schmitz, Corr, & Henning (2007) investigated the relationship between the BAS and the dopamine D2 receptor (DRD2 TaqIA) polymorphism and the catechol-O-methyltransferase (COMT) polymorphism as a way of gaining a greater understanding of the relation between dopamine receptor density and dopamine catabolism in the

synaptic gap, and thus a greater understanding of their relation to personality (Reuter, Schmitz, Corr, & Henning, 2007).

The authors found that both DRD2 TaqIA and COMT polymorphisms influenced BAS total scores on Carver and White's (1994) BIS/BAS scales, as well as scores on the BAS Fun-Seeking and Drive subscales (Reuter, Schmitz, Corr, & Henning, 2007). Additionally, they found that what was important in predicting high BAS scores was not dopamine receptor density alone, or COMT enzyme activity alone, but a match between the two; that is, a combination of high dopamine receptor density and high COMT enzyme activity predicted high BAS scores. In comparison a mismatch between dopamine receptor density and COMT enzyme activity, for example, low dopamine receptor density and high COMT enzyme activity, or high dopamine receptor density and low COMT enzyme activity, predicted low BAS scores. Further exploration revealed that individuals with a match between dopamine receptor density and COMT enzyme activity also had higher levels of prolactin, which served as an indicator of higher dopamine activity. The authors thus concluded that since individuals with high BAS also had higher levels of dopamine activity, their research provided support for the dopamine hypothesis of BAS in Gray's (1987) original reinforcement sensitivity theory (Reuter, Schmitz, Corr, & Henning, 2007).

Other researchers have further elaborated upon the relations between BIS/BAS and theories of personality. For example, Mitchell et al. (2007) conducted research in which they examined the relation between BIS/BAS and the Five Factor Model (FFM) of personality as measured by the NEO-PI-R (McCrae & John, 1992; Costa & McCrae, 1992). The FFM of personality explains personality in relation to five dimensions:

openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Openness to experience relates to an individual's level of intellectual curiosity and desire for novel experiences. Conscientiousness involves the ability to be organized, self-disciplined, and achievement oriented. Extraversion relates to how outgoing and sociable and individual is. Agreeableness involves the ability to cooperate with others. Finally, neuroticism describes the trait of easily experiencing negative affective states, such as fear, anxiety, and sadness (McCrae & John, 1992).

The results of Mitchell et al.'s (2007) study indicated that BIS was positively correlated with the trait of Neuroticism, particularly the facets of self-consciousness and vulnerability. Additionally, BIS was positively correlated with the traits of Conscientiousness, in particular the facets of competence and self-discipline, and Agreeableness, notably the facets of low trust, high compliance, and modesty. BIS was also negatively correlated with the trait of Extraversion, particularly the facets of gregariousness, assertiveness, and positive emotions. Finally, BIS was negatively correlated with the trait of Openness, in particular the actions facet (Mitchell, et al., (2007).

Mitchell, et al. (2007) also discovered that BAS had relations with Five Factor traits, with it being positively correlated with Extraversion, particularly the excitement seeking facet, and the angry hostility and impulsiveness facets of Neuroticism. Additionally, BAS was negatively correlated with the facet of achievement striving under the trait of Conscientiousness, and negatively correlated with the trait of Agreeableness, particularly the facets of straightforwardness, compliance, and modesty. Finally, BAS was negatively correlated with the feelings facet of Openness (Mitchell, et al., 2007).

Smith and Boeck (2006) further examined the relations between BIS/BAS and the FFM and found results similar, though not identical, to those found by Mitchell et al. (2007). Their results indicated that the FFM trait of Neuroticism was positively correlated with total BIS scores on the Carver and White (1994) BIS/BAS scales and negatively correlated with total BAS scores. The results of their research also indicated that the trait of Extraversion was negatively correlated with total BIS and positively correlated with total BAS, and that the trait of Agreeableness was positively correlated with total BIS and negatively correlated with the BAS Drive subscale. Finally, the trait of Conscientiousness was found to be negatively correlated with the BAS-Fun Seeking subscale (Smith & Boeck, 2006).

Adaptive and maladaptive perfectionism and BIS/BAS. The patterns of results whereby BIS is positively related to the Five Factor trait of Neuroticism, and negatively related to Extraversion, and BAS is positively related to Extraversion, and negatively related to Neuroticism, are similar to those patterns seen for perfectionism, in which maladaptive perfectionism is positively related to Neuroticism, and adaptive perfectionism is positively related to Extraversion and negatively related to Neuroticism (Smith & Boeck, 2006; Chang, 2006a). These patterns might lead one to consider the possibility that maladaptive and adaptive perfectionism and BIS/BAS are related, and there is some evidence to support this, although the evidence as to what exactly the direction of the relation is appears mixed. For example, Chang, et al. (2007) found that BIS was positively correlated with two of the six dimensions of perfectionism they studied, namely personal standards and doubts about actions. In addition, the results of

their research indicated that BAS scores, particularly scores on the BAS-Drive subscale, were positively correlated with perfectionism in college students (Chang, et al., 2007).

Other researchers have focused more specifically on BIS/BAS motives in maladaptive and adaptive perfectionists respectively. For example, Chang (2006a) found maladaptive perfectionism to be positively correlated with BIS scores and adaptive perfectionism to be positively correlated with BAS scores. In addition, Mautz (2013) conducted research in which he successfully predicted personal standards perfectionism (i.e., adaptive perfectionism) from high scores on the BAS-Drive subscale and self-evaluative perfectionism (i.e., maladaptive perfectionism) from high BIS scores. He also found that low scores on the BAS-Fun Seeking subscale were positively correlated with the adaptive form of perfectionism studied (Mautz, 2013). Finally, Turner and Turner (2011) found that high BIS scores were positively related to maladaptive perfectionism.

However, Andrews, Burns, and Dueling (2014) conducted similar research but found that positive perfectionism had a small positive correlation with BIS, and that this relation became greater when variance due to positive affect and optimism was controlled for. They also found that negative perfectionism was positively correlated with BIS and negatively correlated with scores on the BAS Fun-Seeking scale (Andrews, Burns, & Dueling, 2014). Additionally, Flett, Hewitt, Oliver, and Macdonald (2002) found in their work with college students that both adaptive and maladaptive perfectionists had elevated BIS scores and that self-oriented perfectionism (a type of adaptive perfectionism) was positively related to the BAS-Drive and BAS-Reward Responsiveness subscales (Flett, Hewitt, Oliver, & Macdonald, 2002). Randles, Flett,

Nash, McGregor, and Hewitt's (2010) work also provided evidence that self-oriented perfectionism (i.e., adaptive perfectionism) was positively related to BIS, BAS-Drive, and BAS-Reward Responsiveness. Additionally, they found that socially prescribed perfectionism (i.e, maladaptive perfectionism) was positively correlated with elevated BIS scores. It can thus be seen that the research literature clearly indicates that maladaptive perfectionism is related to BIS, but is unclear as to whether adaptive perfectionism is only related to BAS, or both BIS and BAS.

Psychophysiological correlates of BIS/BAS. Although the exact relation of adaptive and maladaptive perfectionism to BIS and BAS may not yet be fully understood, and therefore requires further exploration, it is known that, like adaptive and maladaptive perfectionism, BIS and BAS have distinct neuropsychological and psychophysiological correlates. For example, Coan and Allen (2003) found that individuals high in BAS had relatively greater activation of portions of the brain in the left frontal lobe. Additionally, Knyazev, Slobodskaya, and Wilson (2002) noted that BAS was positively correlated with high delta and theta activity in parietal areas of the brain and BIS was positively correlated with high beta and gamma activity in frontal areas of the brain, as well as low delta and theta activity in temporal, parietal, and left frontal areas. They concluded that these results supported the hypothesis that behavioral activation is correlated with autonomic and cortical under-arousal and behavioral inhibition with cortical over-arousal, particularly in the right hemisphere of the brain (Knyazev, Slobodskaya, & Wilson, 2002).

More applied research conducted by Arnett and Newman (2000) with prison inmates has also provided support for the differentiation of BIS and BAS, as posited to

exist by RST. They presented offenders with a continuous motor task that involved both reinforcers and punishers and found that offenders in the reinforcement (BAS) phase of the task exhibited significantly increased response time and heart rate as compared to when they were in the no-incentive practice phase of the task or an active-avoidance task phase. In addition, offenders showed significantly increased skin conductance responses in the BIS task, when they went from a reward-only task phase to a mixed-incentive task phase and again when they went from the mixed-incentive task phase to a task phase that involved punishment cues (Arnett & Newman, 2000).

Blair, Peters, and Granger (2004) also conducted research on the relationship of BIS and BAS to psychophysiological correlates of stress, but in their research they used children in a Head-Start program and the stressor was interacting with a stranger, as well as having the various psychological and physiological measures administered to them. The results of this study indicated that children with high BAS scores, as reported by their mothers, had higher cortisol levels at the beginning of the session and a greater decrease in cortisol levels over time, greater vagal suppression (the ability of the brain to suppress heart rate to a healthy number of beats per minute), and lower levels of cognitive self-regulation (Blair, Peters, & Granger, 2004).

In comparison, children with high BIS scores had lower cortisol levels at the beginning of the session, but experienced an increase in cortisol levels over time (Blair, Peters, & Granger, 2004). They also experienced decreased vagal suppression and exhibited higher levels of cognitive regulation. Interestingly, children with simultaneously high levels of both BIS and BAS had high initial cortisol levels, exhibited little change in cortisol levels over time, and had low resting vagal tone. As would be expected, these

results indicate that children with greater behavioral avoidance tendencies find social interaction experiences more arousing, or anxiety provoking, than do children with greater levels of behavioral approach tendencies, and these differences are expressed through differential physiologic stress patterns (Blair, Peters, & Granger, 2004).

Another study that involved research on cardiac autonomic reactions during stressor tasks found that high BAS scores were positively correlated with increased heart rate reactivity and greater parasympathetic withdrawal, as evidenced by lower respiratory sinus arrhythmia (which will be defined and discussed in depth in the next section), during stressful situations that involved arithmetic, speech, and a choice-deadline real time tasks (Heponiemi, Keltikangas-Jarvinen, Kettunen, Puttonen, and Ravaja, 2004). However, BAS scores were unrelated to pre-ejection period (PEP) reactivity or baseline measures of heart rate, RSA, or PEP (Heponiemi, Keltikangas-Jarvinen, Kettunen, Puttonen, and Ravaja, 2004).

The researchers noted that the increased heart rate activity seen in their participants with high BAS scores appeared to be mediated by the greater parasympathetic withdrawal seen during the appetitive, versus aversive, tasks; the researchers posited that this response pattern indicated that individuals with high BAS levels demonstrated appropriate responses to stress, characterized by physiological flexibility, and would therefore experience fewer negative physiologic effects of stress (Heponiemi, Keltikangas-Jarvinen, Kettunen, Puttonen, and Ravaja, 2004). In support of this hypothesis, Movius & Allen (2005) also found that subjects with higher BAS scores, particularly on the BAS-Reward Responsiveness subscale, had greater resting vagal tone, as measured by baseline RSA, which would indicate greater overall cardiac

functioning. Overall, the results of research on the psychophysiological correlates of BIS and BAS appear to suggest that individuals high in BAS experience improved physiological flexibility, and, possibly as a result, reduced physiologic stress and improved cardiac functioning. However, it remains unclear as to what effects, if any, BIS has on cardiac reactivity.

Adaptive and Maladaptive Perfectionism and Heart Rate Variability

While a variety of differential psychophysiological correlates of adaptive and maladaptive perfectionism have been studied, the differences in cardiovascular reactivity between adaptive and maladaptive perfectionists have yet to be investigated. However, the previously postulated relation between perfectionism and BIS/BAS, and the tentatively supported differential cardiac reactivity correlates of BIS and BAS respectively, suggest that it would be worthwhile to investigate differential cardiac reactivity in the two types of perfectionists. One psychophysiological process of particular interest to study among adaptive and maladaptive perfectionists would be the respiratory sinus arrhythmia, or more generally, heart rate variability (HRV). HRV is a measurement of the variation in the amount of time between heart beats and is primarily influenced by innervation of the heart through the vagus cranial nerve (Acharya, Joseph, Kannathal, Lim, & Suri, 2006). Higher HRV indicates that an individual's heart is capable of adapting to changing environmental circumstances by quickly modifying its rate in response to external stimuli. Since HRV is regulated by the parasympathetic nervous system (PNS) and sympathetic nervous system (SNS) working in a balanced manner, higher HRV also serves as an indicator of healthy nervous system functioning

and its ability to appropriately modulate heart rate in response to stress (Acharya, Joseph, Kannathal, Lim, & Suri, 2006).

Using spectral analysis of the inter-beat intervals, HRV can be measured at several different frequencies, which represent the contributory effects of various bodily processes. The lowest frequencies are the ultra-low frequencies (ULF), which have a cycle length of >5-h and are affected by the circadian rhythm (Stauss, 2003). Next are the very low frequencies (VLF), which have a cycle length of >25-s, and are affected by temperature regulation processes and humoral systems. The low frequencies (LF), which have a cycle length of >6-s, are affected by changes in sympathetic and parasympathetic nervous activity in the cardiac system. Finally, the high frequencies (HF), which have a cycle length of 2.5-s to 6.0-s, are affected by parasympathetic innervation of the heart and are tied to breathing rhythm (Stauss, 2003).

The HF band is the most commonly researched frequency of HRV because it is thought to be related to the respiratory sinus arrhythmia, which is the variation in beat-to-beat intervals due to respiration and is a marker of cardiac vagal tone (Stauss, 2006). Vagal tone represents the ability of the parasympathetic nervous system, which is responsible for processes related to relaxation and repair, to influence the heart through the vagus nerve and regulate heart rate. This is important because poor cardiac vagal tone has been related to a variety of negative health outcomes. For example, low HRV is frequently found in adults with hypertension, and may put them at a greater risk of poor health outcomes than high blood pressure alone (Acharya, Joseph, Kannathal, Lim, & Suri, 2006). This reduced HRV, and the resulting risk of increased negative outcomes, is due to a number of structural and functional changes to the cardiovascular

system that are found in individuals with hypertension, including left ventricular hypertrophy (LVH) and strain. Additionally, baroreflex sensitivity, which influences cardiac vagal nerve activity, is reduced in individuals with hypertension, which results in lower amplitude respiratory sinus arrhythmia, and has also been correlated with cardiac LVH (Acharya, Joseph, Kannathal, Lim, & Suri, 2006).

Decreased HRV has also been associated with congestive heart failure, renal failure, increased risk of sudden infant death syndrome in premature babies, and diabetes (Acharya, Joseph, Kannathal, Lim, & Suri, 2006). Specifically, as in individuals with hypertension, patients with diabetes are at an increased risk for sudden cardiac death due to ventricular tachyarrhythmias, because of their low HRV and LVH (Kataoka, Ito, Sasaki, Yamane, & Kohno, 2004). Additionally, studies have shown that decreased HRV is associated with diabetic neuropathy, and can, in fact, predict the onset of later neuropathy in diabetic patients with tests of autonomic function that are currently normal (Pfeifer, et al., 1982).

Finally, low HRV after a myocardial infarction has also been shown to raise patients' risk for additional cardiac events in the future (Acharya, Joseph, Kannathal, Lim, & Suri, 2006). This is due to a decrease in parasympathetic cardiac control over the heart through the vagus cranial nerve, which results in an increase in sympathetic control (Rothschild, Rothschild, & Pfieifer, 1988). This decrease in parasympathetic control and predominance of sympathetic control results in a decrease in the threshold at which ventricular fibrillation and ventricular tachyarrhythmias can occur, which increases an individual's chances of suffering further cardiac events (Schwartz, La Rovere, & Vanoli, 1992).

A number of other factors have been shown to have negative impacts on HRV, including drug and alcohol use and poor sleeping patterns (Acharya, Joseph, Kannathal, Lim, & Suri, 2006). In addition, stress, anxiety, and worry have all been shown to have negative impacts on HRV. For example, Brosschot, Van Dijk, and Thayer (2007) found that prolonged periods of stress and worry were positively related to increased heart rate and decreased HRV, not only when their subjects were awake, but also when they were sleeping. In addition, the results of Dishman et al.'s (2000) research indicated that perceived emotional stress during the past week was negatively correlated with normal HRV in the HF component. This relationship was found regardless of participant's age, gender, level of trait anxiety, or cardiorespiratory fitness level and indicates that individuals who experienced greater stress had decreased vagal tone (Brosschot, Van Dijk, & Tayer, 2007). Pieper, Brosschot, van der Leeden, and Thayer (2007) corroborated these results with their findings that worry episodes and stressful events both independently predicted higher heart rate and lower HRV. An additional finding of interest from their research was that worries about the future resulted in greater decreases in HRV than worries about the past or present. Worries about work also resulted in greater HRV decreases than worries about other aspects of life (Pieper, Brosschot, van der Leeden, & Thayer, 2007).

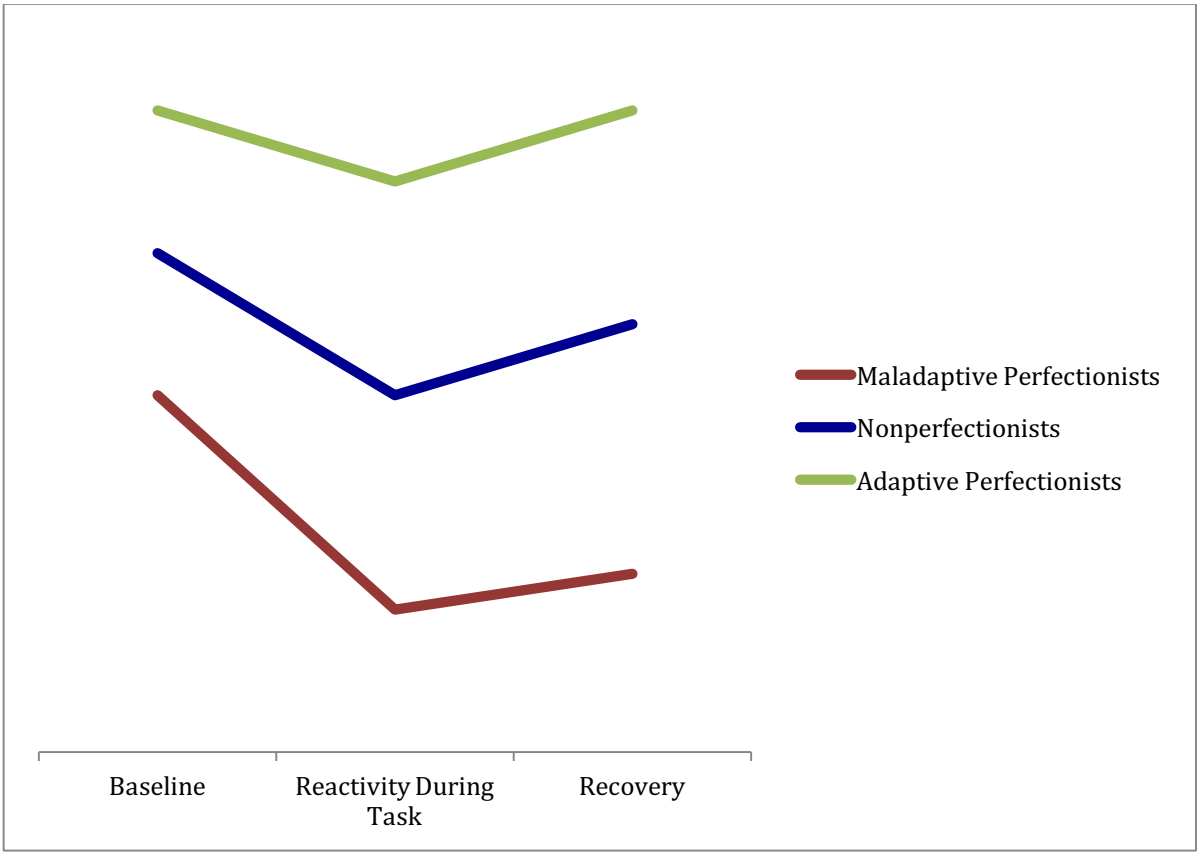
Finally, it has also been found that HRV is affected by three main neural structures in the brain; interestingly enough, some of these structures may also be related to perfectionism and BIS/BAS through emotional processing pathways (Thayer, Ahs, Fredrikson, Sollers III, & Wager, 2012). The three brain areas of interest in the control of HRV are located in the medial prefrontal cortex (MPFC) and include the right

pregenual cingulate (BA 24/32), the right subgenual cingulate (BA 25), and the left sublenticular extended amygdala/ventral striatum. The brain area of particular interest in relation to not only perfectionism, but BIS/BAS as well, is the right rostral MPFC (BA 10/32), as it evidences significant activation in response to increases in HRV due to emotion. The specific area of interest in this brain area is the anterior rostral region, which is centered on the dorsomedial prefrontal cortex (DMPFC)/medial Brodmann's Area 9 (Thayer, Ahs, Fredrikson, Sollers III, & Wager, 2012).

Aims and Hypotheses

Maladaptive perfectionists experience greater levels of anxiety, worry, and stress, and thus they may be at particular risk for the low HRV and the negative consequences that come with it (Chang, Watkins, & Banks, 2004; Lo & Abbott, 2013b; Macedo, Marques, & Pereira, 2014). Additionally, since adaptive perfectionists experience reduced levels of these risk factors, they may be at a reduced risk for low HRV and the resulting negative consequences. Therefore, the **first aim** of the current research was to investigate the differential relation of HRV, as measured by the HF component, between nonperfectionists, adaptive perfectionists, and maladaptive perfectionists. It was hypothesized (*hypothesis 1*) that adaptive perfectionists would have higher HRV at baseline, show less HRV reactivity during a stressor task, and demonstrate greater HRV recovery than nonperfectionists or maladaptive perfectionists. Additionally, it was hypothesized (*hypothesis 2*) that maladaptive perfectionists would have lower HRV at baseline, show greater HRV reactivity during a stressor task, and demonstrate less HRV recovery than nonperfectionists and adaptive perfectionists (See Figure 2).

Figure 2. Hypothesized HRV by Study Stage for Maladaptive Perfectionists, Nonperfectionists, and Adaptive Perfectionists



The extant literature tentatively suggests that maladaptive perfectionism is related to BIS, but is inconclusive as to whether or not adaptive perfectionism is related to BAS, or BIS and BAS (Andrews, Burns, & Dueling, 2014; Chang, 2006a; Chang, et al., 2007; Flett, Hewitt, Oliver, & Macdonald, 2002; Mautz, 2013; Randles, Flett, Nash, McGregor, & Hewitt, 2010; Turner & Turner, 2011). Since BIS and BAS could possibly serve as discriminative indicators for those perfectionists who might be either at an increased risk for negative psychological and physical outcomes, or be protected against such negative outcomes, it would be beneficial to more clearly understand the exact relations that exist between the two sets of constructs. Therefore, the **second aim**

of the current research was to explore the differential relations between BIS and BAS and maladaptive and adaptive perfectionism. It was hypothesized that maladaptive perfectionists would have higher BIS-Total scores, as well as lower BAS-Total scores, than adaptive perfectionists or nonperfectionists *(hypothesis 3)*, and that adaptive perfectionists would have higher BAS-Drive and BAS-Reward-Responsiveness subscale scores, and lower BAS-Fun-Seeking subscale scores, than maladaptive perfectionists or nonperfectionists (*hypothesis 4*).

Additionally, perfectionism might serve as a moderating variable in the relation seen between BIS/BAS and HRV; if this is the case, level of adaptive versus maladaptive perfectionism could help to explain the disparate findings in the literature on the exact effects BIS has on HRV. Therefore, the **third**, exploratory, **aim** of this study was to understand the relations of BIS and BAS to HRV, as well as the role that perfectionism might play in moderating these relations. Thus, it was hypothesized (*hypothesis 5*) that BIS-Total scores would be negatively correlated with HRV at baseline, and that BAS-Reward Responsiveness and BAS-Drive scores would be positively correlated with HRV at baseline. Additionally, it was hypothesized (*hypothesis 6*) that maladaptive perfectionism and BIS would interact such that BIS-Total scores would predict lower HRV at baseline, but only among maladaptive perfectionists, not among adaptive perfectionists or nonperfectionists. Finally, it was hypothesized (*hypothesis 7*) that adaptive perfectionism and BAS would interact, such that BAS-Reward Responsiveness and BAS-Drive would predict increased baseline HRV, but only among adaptive perfectionists, not among maladaptive perfectionists or nonperfectionists (See Table 3).

Table 3

Hypothesized Interaction Model for BIS, BAS, and Type of Perfectionism

	Maladaptive Perfectionism	Nonperfectionism	Adaptive Perfectionism
BIS-Total	**Decreased HRV**	No effect	No effect
BAS-Reward Responsiveness	No effect	No effect	**Increased HRV**
BAS-Drive	No effect	No effect	**Increased HRV**

CHAPTER III: METHODS

Participants

Participants were 1,214 undergraduate students at East Carolina University enrolled in the ECU Psychology Department Experimentrak subject pool for their Introductory Psychology courses. Additionally, participants needed to be at least 18 years of age, not have any history of, or current, heart conditions, and not be taking any drugs for cardiovascular conditions (i.e., hypertension), or psychotropic medications. Participants also needed to refrain from exercising at least 24 hours before testing and from ingesting products containing tobacco or caffeine for at least 12 hours before testing. As compensation for their participation, participants earned research credit for their Introductory Psychology course.

Psychosocial Measures and Questionnaires

Demographic and medical history questionnaire. Participants were asked to provide basic demographic information, as well as their current GPA. Additionally, they were asked for health information pertinent to determining if they met study inclusion criteria. (See Appendix A)

Revised Almost Perfect Scale (APS-R). The Almost Perfect Scale Revised (APS-R) is a 23 item self-report measure of perfectionism with three subscales, Standards, Discrepancy, and Order, which discriminate between nonperfectionists, adaptive perfectionists, and maladaptive perfectionists (Slaney, Rice, Mobley, Trippi, & Ashby, 2001). The Standards subscale measures whether or not individuals set high standards for themselves, the Discrepancy subscale indicates whether or not individuals are meeting the standards they have set for themselves, and the Order subscale

measures how much order and organization individuals feel they need in their lives. Each item is ranked on a seven-point Likert scale, from 1=Strongly Disagree to 7=Strongly Agree, for a total possible score of 49 points on the High Standards subscale, 84 points on the Discrepancy subscale, and 28 points on the Order subscale. Scores of less than 42 points on the High Standards subscale indicate that an individual is a nonperfectionist and scores greater than or equal to 42 points on the subscale indicate that an individual is a perfectionist (Rice & Ashby, 2007). Furthermore, scores of less than 42 points on the Discrepancy subscale indicate than an individual is an adaptive perfectionist, while scores greater than or equal to 42 points indicate that an individual is a maladaptive perfectionist. Scores on the Order subscale are irrelevant for classification (Rice & Ashby, 2007).

The APS-R is the revised version of the original Almost Perfect Scale (APS), which was published in 1992 and, among other issues, was not thought to measure maladaptive perfectionism adequately (Slaney, Rice, Mobley, Trippi, & Ashby, 2001). Exploratory and confirmatory factor analyses were used to arrive at the three dimensions comprising the APS-R, and structure coefficients were adequate, ranging from 0.42 to 0.88. Additionally, reliability was tested and also found to be acceptable, with Cronbach's alphas ranging from 0.82 to 0.92 for the subscale scores. Finally, construct validity was investigated by comparing the APS-R with the MPS-H and the MPS-F (Frost, Marten, Lahart, & Rosenblate, 1990; Hewitt & Flett, 1991a). Results indicated that the High Standards subscale, which measures adaptive perfectionism, showed 0.64 and 0.55 correlations with the Self-Oriented Perfectionism subscale of the MPS-H in the two tested samples. Additionally, the APS-R Discrepancy subscale

showed 0.31 and 0.23 correlations with the Self-Oriented Perfectionism subscale of the MPS-H and 0.43 and 0.45 correlations with the Socially Prescribed Perfectionism subscale (Slaney, Rice, Mobley, Trippi, & Ashby, 2001).

Further exploration indicated that the High Standards subscale of the APS-R had a .64 correlation with the Personal Standards subscale of the MPS-F (Slaney, Rice, Mobley, Trippi, & Ashby, 2001). Additionally, the Discrepancy subscale of the APS-R had a 0.55 correlation with the Concern Over Mistakes subscale of the MPS-F and a 0.62 correlation with the Doubts About Actions subscale. Overall, these results indicate that the APS-R correlates adequately with other commonly utilized measures of perfectionism, although there was some discrepancy. This was expected to be the case since the MPS-H and MPS-F measure different conceptualizations of perfectionism than does the APS-R (Slaney, Rice, Mobley, Trippi, & Ashby, 2001). Additional research has also indicated that the APS-R is a culturally valid measure of adaptive and maladaptive perfectionism in African American college students specifically (Mobley, Slaney, & Rice, 2005). (See Appendix B)

Behavioral Inhibition/Behavioral Activation Scales (BIS/BAS). Carver and White's (1994) BIS/BAS Scales are comprised of 24 self-report items that indicate the degree to which individuals engage in either behavioral approach (BAS) or behavioral avoidance (BIS). The scales are comprised of four subscales: BAS-Drive, BAS-Fun-Seeking, BAS-Reward-Responsiveness, and BIS. The BAS-Drive scale provides insight into individuals' willingness to pursue their goals, the BAS-Fun-Seeking scale provides knowledge about their tendency to seek out exciting and novel stimuli, the BAS-Reward-Responsiveness scale indicates how responsive to reward they are, and the

BIS scale provides an indication of how they respond to potentially punishing events. Each test item is ranked on a four point Likert scale, from 1=*Very true for me*, to 4=*Very false for me* (Carver & White, 1994).

Reliability for the BIS/BAS scales has been shown to be adequate, with alpha coefficients ranging from 0.66 to 0.76 (Carver & White, 1994). Additionally, the scales have been shown to have sufficient test-retest reliability, with test-retest coefficients ranging from 0.68 to 0.72 (Sutton & Davidson, 1997). Tests of reliability have shown similar results in clinical samples (Campbell-Sills, Liverant, & Brown, 2004). Further research has also demonstrated that the BIS/BAS scales have appropriate convergent and concurrent validity. For example, Campbell-Sills, Liverant, and Brown (2004) found that BIS scores were positively correlated with both anxiety and depression, while BAS scores were positively correlated with positive affectivity. Additionally, Smits and Boeck (2006) noted that BIS was positively related to the personality trait of neuroticism, while BAS was positively related to the trait of extroversion. This provides evidence for the idea that the underlying constructs of BIS and BAS are trait-like in nature, rather than merely being temporary states. (See Appendix C)

Anagram stressor task. The anagram stressor task consisted of the presentation of three sets of five anagrams; two of the sets were solvable, although one set was easy and one set was difficult, and the other set was unsolvable (Lo & Abbott, 2013a). The task was presented as three separate pencil-and-paper measures, with participants being allowed a total of 15 minutes to complete the task, with five minutes allowed for each set. In an attempt to create a situation of high-evaluative threat, which hopefully elicited perfectionism, and the physiological responses that accompany it,

participants were told that all of the sets of anagrams were solvable and that most other people had found them simple to complete. Anagrams were chosen based on lists compiled and utilized in the previous research of Gribben (1970) and MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002). (See Appendix D)

Positive and Negative Affect Schedule (PANAS). The PANAS is a 20 item self-report questionnaire that gauges an individual's levels of positive and negative affect at various points in time, ranging from the current moment to within the past month; the current study utilized the momentary assessment version (Watson, Clark, & Tellegen, 1988). Ten of the items on the PANAS assess positive emotional states; these comprise the Positive Affectivity subscale. The other ten items assess negative emotional states and make up the Negative Affectivity subscale. Participants are asked to rate each emotional state on how strongly they are currently experiencing it, from 1=Very slightly or not at all, to 5=Extremely (Watson, Clark, & Tellegen, 1988).

Research into the reliability of the PANAS has indicated that it has adequate internal reliability, with alpha coefficients ranging from 0.84 to 0.90, depending upon the time period assessed (i.e., in the moment versus in the past week) (Watson, Clark, & Tellegen, 1998). In addition, research has indicated that the PANAS also has acceptable divergent, convergent, and concurrent validity; scores on the Positive Affectivity subscale have been shown to be negatively correlated with scores on the Beck Depression Inventory, the State Anxiety Scale of the State-Trait Anxiety Inventory, and the Hopkins Symptom Checklist, and scores on the Negative Affectivity subscale have been shown to be positively correlated with these measures (Watson, Clark, & Tellegen, 1998). (See Appendix E)

Physiological Measures

Heart rate recording. Participants had their heart rates monitored continuously throughout the stressor task, as well as during the 10-minute baseline and recovery periods. This was done using a Lead II ECG via a Biopac Systems ECG100C Electrocardiogram Amplifier (Biopac Systems, Inc. n.d.a). At the beginning of the testing session, each participant had electrodes applied to both of their legs, just above their ankles, and their right arm. The electrode attached to the participant's left leg was the positive lead, the electrode attached to the right leg was the ground lead, and the electrode attached to the right arm was the negative lead. Once these electrodes were attached, the participant was asked to sit upright in a chair and hold as still as possible.

Heart rate variability (HRV) was calculated from these recordings using a frequency domain measure computed by the Acqknowledge software suite (Biopac Systems, n.d.b). The frequency domain measure examines frequencies of various wave components found in the ECG signal and computes estimates of power for the VLF, LF, HF, and VHF components; the frequency domain measure was used in particular because its utilization is well supported in the existing literature on HRV (Goldstein, Bentho, Park, & Sharabi, 2014; Kleiger, Stein, & Bigger, 2005; Task Force of the European Society of Cardiology and The North American Society of Pacing and Electrophysiology, 1996). The level of HF component power found in the ECG signal ultimately determined HRV.

Blood pressure recording. Participants had their systolic and diastolic blood pressures recorded continuously throughout the stressor task, as well as during the 10-minute baseline and recovery periods. This was done using a calibrated Biopac

Systems, NIBP 100D-1 Noninvasive Blood Pressure Amplifier (Biopac Systems, Inc., n.d.c). At the beginning of the testing session, participants had finger cuffs placed on the index and middle fingers of their left hand. Additionally, an arm cuff was placed around their left arm, directly above the elbow; this arm cuff was utilized in the calibration of finger cuff measurements. Participants were then asked to sit upright in a chair and hold as still as possible for the duration of testing.

Procedures

After signing up for the study, participants completed the first portion of it online. This section of the study began with the informed consent document, a demographic questionnaire, the Almost Perfect Scale Revised (APS-R) and the Behavioral Inhibition/Behavioral Activation Scales (BIS/BAS) (Carver & White, 1994; Slaney, Rice, Mobley, Trippi, & Ashby, 2001; Watson, Clark, & Tellegen, 1988).

The second portion of the study was conducted face-to-face in the Cardiovascular Psychophysiology Laboratory, located in the Psychology department at East Carolina University. It began with another informed consent process, during which participants were asked what they knew about the study and what they had heard about it from other participants. As this study utilized deception, such questioning helped to insure that the integrity of the experimental tasks remained intact. Additionally, during this informed consent process, participants were asked not to disclose information about the study to other potential participants.

Next, each participant was administered the PANAS. Then, each participant had his or her baseline heart rate and blood pressure recorded for 10 minutes. During baseline recordings, participants were asked to sit as still as possible with their feet flat

on the floor. Following this, each participant was asked to complete the anagram stressor task, while continuing to have their heart rate and blood pressure continuously monitored. The anagrams were presented as three separate pencil-and-paper measures, with the easy set of words presented first, followed by the difficult set, and finally by the unsolvable set. After five minutes on each set of anagrams, participants were provided with the next set. After this, participants had their heart rate and blood pressure measured for an additional 10-minute recovery period, again during which they were asked to sit still and relax. Finally, participants were asked to complete the PANAS a second time and fill out the post-experimental questionnaire, which included a manipulation check and a question about what participants had heard from others about the study (See Appendix G) (Watson, Clark, & Tellegen, 1988).

Finally, participants were debriefed; this included an explanation of the nature of the study and a disclosure of the deception involved in the unsolvable anagram task; this took the form of a statement indicating that although participants had been informed that the anagrams were simple to complete, and that everybody had been able to solve them with ease thus far, the three sets of anagrams actually became progressively more difficult and nobody had solved the third set. Additionally, a reminder requesting their confidentiality in not disclosing information about the study to other potential participants was included in the debriefing, as well as a referral to further services if they endorsed continuing distress.

Statistical Analyses

The first and second hypotheses, that adaptive perfectionists would have higher HRV at baseline, show less HRV reactivity to a stressor task, and demonstrate better

HRV recovery than nonperfectionists or maladaptive perfectionists, and that maladaptive perfectionists would have lower HRV at baseline, show greater HRV reactivity during a stressor task, and demonstrate less HRV recovery than nonperfectionists and adaptive perfectionists, was tested with a 3X3 repeated measures analysis of variance (ANOVA) (See Figure 2). The first independent variable was the type of perfectionist, with three levels of perfectionist: nonperfectionists, adaptive perfectionists, and maladaptive perfectionists. The second independent variable was time period, with levels of baseline, during the stressor task, and recovery. The dependent variable was HRV during each time period.

An a priori power analysis was conducted with G*Power and indicated that in order for a medium effect size to be found, with 80% power, at the .05 level of significance, 93 participants would be required. This analysis also indicated that 31 nonperfectionists, 31 adaptive perfectionists, and 31 maladaptive perfectionists would be required in order to have equal sample sizes for all three levels of the independent variable (See Appendix F).

The third and fourth hypotheses, that maladaptive perfectionism would be positively correlated with BIS, and negatively correlated with BAS-Total, and that adaptive perfectionism would be positively correlated with the BAS-Drive and BAS-Reward Responsiveness scales, negatively correlated with the BAS-Fun Seeking scale, and unrelated to BIS, was tested with two Two-Way Multivariate Analyses of Variance (MANOVAs). The independent variable was again type of perfectionism, with levels of nonperfectionist, adaptive perfectionist, and maladaptive perfectionist. The two dependent variables for the first MANOVA were BIS-Total and BAS-Total. The three

dependent variables for the second MANOVA were BAS-Drive, BAS-Reward Responsiveness, and BAS-Fun Seeking. Follow-up analyses in the form of Tukey's HSD were conducted to further explore significant results.

The fifth hypothesis, that the BIS and BAS subscales would be correlated with HRV, was tested with a regression, which allowed for the variable of sex to be controlled for. As the overall results were not significant, the sixth and seventh exploratory hypotheses were not tested.

CHAPTER IV: RESULTS

Statistical analyses were conducted using SPSS 22.0 statistical software package. Heart rate variability recordings were inspected for low quality data that had been impacted by signal interference or loss, and survey data for missing or aberrant values. The normality of the data distribution was also assessed and the HRV data had a logarithmic transformation performed upon it in order to reduce skewness and kurtosis, as is commonly observed in the literature (Farah, et al., 2016; Tsuji, et al., 1994). There were 1,428 participants who originally took part in the online portion of the study (See Figure 3). Of these, 214 were excluded from the analysis because of incomplete perfectionism classification or BIS/BAS score data, which left 1,214 participants whose perfectionism classification and BIS/BAS scores were used. Of the total number of original participants who took part in the online portion of the study, 122 self-selected into the in-lab portion of the research by signing up for the study via the online subject pool management system, and therefore also had their heart rate variability data included in the analyses. Thirty-one of these participants were excluded from the final analysis either due to failure to complete all necessary survey data forms (n = 20), or for not passing built in validity measures (n = 6); these consisted of questions with obviously correct answers (“Did you ride a giraffe to school today?”) or where the answer was provided in the question (“Please select ‘Always true for me’”). An additional five participants were also excluded because their in-lab self-reports of meeting study inclusion criteria (not taking any stimulant medications, being free of heart conditions) did not match up with their self-reports from the online survey). Data from the remaining 91 participants (66 women and 25 men) were included in the final

analysis of perfectionism classification, BIS/BAS scores, and heart rate variability (See Figure 3). The mean age of the participants in this in-lab sample was 18.67 (*SD* = 2.24) and 64 participants (70.33%) identified themselves as Caucasian (See Tables 4 and 5).

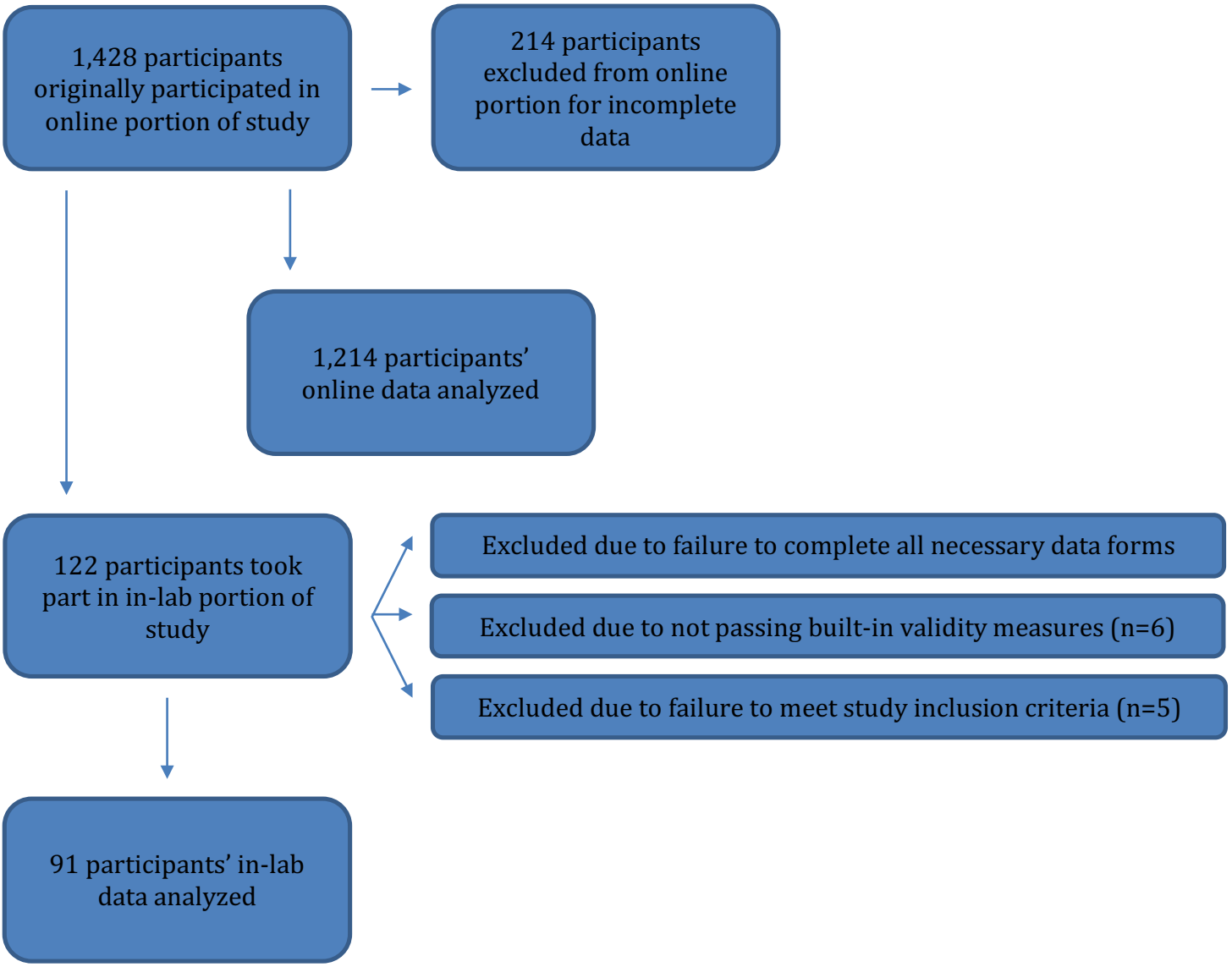


Figure 3. Participant Recruitment and Retention Across Online and In-Lab Study Portions

Table 4

Demographics for Online Participants by Perfectionism Classification

	Nonperfectionists (n = 353)	Adaptive Perfectionists (n = 397)	Maladaptive Perfectionists (n = 462)	Total (n = 1212)
Biological Sex				
Male	134 (38.0%)	121 (30.5%)	118 (25.5%)	373 (30.8%)
Female	219 (62.0%)	276 (69.5%)	344 (74.5%)	839 (69.2%)
Gender				
Male	135 (38.2%)	121 (30.5%)	120 (26.0%)	376 (31.0%)
Female	216 (61.2%)	274 (69.0%)	340 (73.6%)	830 (68.5%)
Genderqueer	1 (0.3%)	1 (0.3%)	2 (0.4%)	4 (0.3%)
Transgender	1 (0.3%)	1 (0.3%)	0 (0.0%)	2 (0.2%)
Race				
Caucasian	266 (75.4%)	278 (70.0%)	344 (74.5%)	888 (73.3%)
Black	33 (9.3%)	76 (19.1%)	61 (13.2%)	170 (14.0%)
White Hispanic	19 (5.4%)	15 (3.8%)	14 (3.0%)	48 (4.0%)
Black Hispanic	0 (0.0%)	1 (0.3%)	2 (0.4%)	3 (0.2%)
Native American	3 (0.8%)	5 (1.3%)	1 (0.2%)	9 (0.7%)
Asian	10 (2.8%)	0 (0.0%)	8 (1.7%)	18 (1.5%)
Multicultural	15 (4.2%)	15 (3.8%)	17 (3.7%)	47 (3.9%)
Other	7 (2.0%)	7 (1.8%)	15 (3.2%)	29 (2.4%)
Age				
Mean (SD; range-range)	18.52 (0.90; 18.0-23.0)	18.45 (1.48; 18.0-36.0)	18.31 (0.93; 18.0-27.0)	18.41 (1.15; 18.0-36.0)

Table 5

Demographics for Lab Participants by Perfectionism Classification

	Nonperfectionists (n = 16)	Adaptive Perfectionists (n = 48)	Maladaptive Perfectionists (n = 32)	Total (n = 96)
Biological Sex				
Male	4 (25.0%)	13 (27.1%)	6 (18.8%)	23 (24.0%)
Female	12 (75.0%)	35 (72.9%)	26 (81.3%)	73 (76%)
Gender				
Male	4 (25.0%)	13 (27.1%)	6 (18.8%)	23 (24%)
Female	11 (68.8%)	35 (72.9%)	26 (81.3%)	72 (75%)
Transgender	1 (6.3%)	0 (0.0%)	0 (0.0%)	1 (1%)
Race				
Caucasian	10 (62.5%)	34 (70.8%)	22 (68.8%)	66 (68.8%)
Black	2 (12.5%)	8 (16.7%)	3 (9.4%)	13 (13.5%)
White Hispanic	2 (12.5%)	2 (4.2%)	2 (6.3%)	6 (6.3%)
Black Hispanic	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Native American	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Asian	1 (6.3%)	0 (0.0%)	1 (3.1%)	2 (2.1%)
Multicultural	0 (0.0%)	1 (2.1%)	2 (6.3%)	3 (3.1%)
Other	1 (6.3%)	3 (6.3%)	2 (6.3%)	6 (6.3%)
Age				
Mean (SD; range-range)	18.27 (0.47; 18.0-19.0)	19.06 (3.06; 18.0-36.0)	18.26 (0.53; 18.0-20.0)	18.64 (2.17; 18.0-36.0)

Aim One

The first aim of the current research was to investigate the differential relation of HRV, as measured by the HF component, between nonperfectionists, adaptive perfectionists, and maladaptive perfectionists. It was first hypothesized that adaptive perfectionists would have the highest baseline HRV of the three groups and that maladaptive perfectionists would have the lowest. To test this, a repeated-measures ANOVA was conducted to compare baseline HRV between nonperfectionists, adaptive perfectionists, and maladaptive perfectionists. Mauchley's test indicated that the assumption of sphericity had not been violated ($\chi^2(2) = 5.60$, $p = 0.06$), therefore degrees of freedom were not corrected. Results indicated that there was no statistically significant association between perfectionism classification and baseline HRV, $F(4,188) = 0.55$, $p = 0.69$; therefore, the first hypothesis was not supported.

As part of aim one, it was also hypothesized that during a stressor task adaptive perfectionists would show the least amount of HRV reactivity of the three perfectionism classifications, and that maladaptive perfectionists would display the greatest amount. Additionally, it was hypothesized that adaptive perfectionists would demonstrate the greatest degree of HRV recovery after the stressor task was completed and that maladaptive perfectionists would have the least degree of recovery. To this end, a repeated-measures ANOVA was conducted to compare changes in HRV from baseline to during a stressor task, and subsequent recovery period, between nonperfectionists, adaptive perfectionists, and maladaptive perfectionists. Mauchley's test indicated that the assumption of sphericity had been violated ($\chi^2(5) = 44.30$, $p = 0.01$), therefore a Greenhouse-Geisser correction was used. Results indicated that there were no

statistically significant associations between perfectionism classification on changes in HRV from baseline either during the stressor task, or during recovery $F(2.261, 176.33) = 1.05$, $p = 0.36$; therefore, the second hypothesis was also not supported.

Aim Two

The second aim of the current research was to explore the differential relations between BIS and BAS and maladaptive and adaptive perfectionism among the survey sample. It was first hypothesized that maladaptive perfectionists would have higher BIS-Total scores, as well as lower BAS-Total scores, than adaptive perfectionists or nonperfectionists. To test this, a two-way multivariate analysis of variance (two-way MANOVA) was conducted to compare BIS-Total and BAS-Total scores between male and female nonperfectionists, adaptive perfectionists and maladaptive perfectionists. Results indicated that there was a statistically significant interaction effect between perfectionism classification and biological sex on the combined dependent variables, $F(4, 2410) = 2.81$, $p = 0.0005$, Wilks' $\Lambda = 0.99$.

Further analyses were therefore conducted separately for men and women and results indicated that for men there was a statistically significant main effect for perfectionism classification ($F(4, 738) = 15.58$, $p < 0.001$, Wilks' $\Lambda = 0.85$), with both BIS-Total scores ($F(2, 370) = 8.21$, $p < 0.001$) and BAS-Total scores ($F(2, 370) = 23.26$, $p < 0.001$) being significant. Post-hoc analyses using Tukey's HSD indicated that male adaptive perfectionists had significantly higher BIS-Total scores ($M = 14.37$, $SD = 2.93$) than nonperfectionists ($M = 13.21$, $SD = 2.99$) ($HSD(2, 369) = 3.08$, $p = 0.006$) and maladaptive perfectionists ($M = 12.88$, $SD = 3.10$) ($HSD(2, 369) = 3.83$, $p = <0.001$) (See Figure 4). In addition, male nonperfectionists had significantly higher BAS-Total

scores (*M* = 24.52, *SD* = 5.98) than adaptive perfectionists (*M* = 21.14, *SD* = 4.46) (*HSD*(2, 369) = 5.07, *p* = <0.001) and maladaptive perfectionists (*M* = 20.21, *SD* = 5.35) (*HSD*(2, 369) = 6.41, *p* < 0.001) (See Figure 5).

For women, there was also a significant main effect for perfectionism classification (*F*(4, 1670) = 25.35, *p* < 0.001, Wilks' Λ = 0.89), with both BIS-Total scores (*F*(2, 836) = 31.96, *p* < 0.001) and BAS-Total scores (*F*(2, 836) = 16.26, *p* < 0.001) being significant. Post-hoc analyses indicated that female nonperfectionists (M = 11.37, SD = 2.91) (*HSD*(2, 835) = 5.31, p < 0.001) and adaptive perfectionists (M = 11.82, SD = 3.04) (*HSD*(2, 835) = 7.69, *p* < 0.001) had significantly higher BIS-Total scores than maladaptive perfectionists (M = 10.07, SD = 2.62) (See Figure 4). In addition, female nonperfectionists had significantly higher BAS-Total scores (M = 23.12, SD = 4.80) than adaptive perfectionists (M = 21.08, SD = 4.74) (*HSD*(2, 835) = 4.59, *p* < 0.001) and maladaptive perfectionists (M = 20.82, SD = 5.11) (*HSD*(2, 835) = 5.42, *p* < 0.001) (See Figure 5). Therefore, the hypothesis that maladaptive perfectionists would have higher BIS-Total scores than adaptive perfectionists and nonperfectionists was not supported, for men or women. However, the hypothesis that maladaptive perfectionists would have lower BAS-Total scores than adaptive perfectionists and nonperfectionists was supported, for both men and women.

It was also hypothesized that adaptive perfectionists would have higher BAS-Drive and BAS-Reward-Responsiveness subscale scores, and lower BAS-Fun-Seeking subscale scores, than maladaptive perfectionists or nonperfectionists. A two-way MANOVA was again conducted in order to compare BAS-Drive, BAS-Reward-Responsiveness, and BAS-Fun-Seeking between male and female nonperfectionists,

adaptive perfectionists, and maladaptive perfectionists. Results indicated that there was a statistically significant interaction effect between perfectionism classification and biological sex on the combined dependent variables ($F(6, 2408) = 2.75$, $p = 0.011$, Wilks' $\Lambda = 0.99$), and results for men and women were therefore once again investigated separately.

Further analyses indicated that for men there was a significant main effect for perfectionism classification ($F(6, 736) = 14.69$, $p < 0.001$, Wilks' $\Lambda = 0.80$), with BAS-Drive ($F(2, 370) = 17.93$, $p < 0.001$), BAS-Fun-Seeking ($F(2, 370) = 6.79$, $p = 0.001$), and BAS-Reward-Responsiveness ($F(2, 370) = 34.12$, $p < 0.001$), all being significant. Post-hoc analyses using Tukey's HSD indicated that male nonperfectionists had significantly higher BAS-Drive scores ($M = 8.54$, $SD = 2.67$) than adaptive perfectionists ($M = 7.11$, $SD = 2.12$) ($HSD(3, 368) = 4.72$, $p < 0.001$) and maladaptive perfectionists ($M = 6.86$, $SD = 2.41$) ($HSD(3, 368) = 5.48$, $p < 0.001$) (See Figure 6). In addition, male nonperfectionists ($M = 7.59$, $SD = 2.34$) ($HSD(3, 368) = 3.60$, $p = 0.001$) and adaptive perfectionists ($M = 7.30$, $SD = 2.14$) ($HSD(3, 368) = 2.49$, $p = 0.034$) had significantly higher BAS-Fun-Seeking scores than maladaptive perfectionists ($M = 6.58$, $SD = 2.11$) (See Figure 7). Finally, male nonperfectionists ($M = 8.40$, $SD = 2.14$) had significantly higher BAS-Reward-Responsiveness scores than adaptive perfectionists ($M = 6.74$, $SD = 1.45$) ($HSD(3, 368) = 7.16$, $p < 0.001$) and maladaptive perfectionists ($M = 6.76$, $SD = 1.85$) ($HSD(3, 368) = 7.0$, $p < 0.001$)(See Figure 8).

For women, there was also a statistically significant main effect for perfectionism classification ($F(6, 1668) = 12.95$, $p < 0.001$, Wilks' $\Lambda = 0.91$), with both BAS-Drive scores ($F(2, 836) = 16.89$, $p < 0.001$) and BAS-Reward-Responsiveness scores ($F(2,$

836) = 27.28, $p < 0.001$), but not BAS-Fun-Seeking scores ($F(2, 836) = 0.856$, $p = 0.425$), being significant. Post-hoc analyses indicated that female nonperfectionists had significantly higher BAS-Drive scores ($M = 8.5$, $SD = 2.12$) than adaptive perfectionists ($M = 7.38$, $SD = 2.35$) ($HSD(3, 834) = 5.28$, $p < 0.001$) and maladaptive perfectionists ($M = 7.48$, $SD = 2.48$) ($HSD(3, 834) = 5.02$, $p < 0.001$) (See Figure 6). In addition, female nonperfectionists also had significantly higher BAS-Reward-Responsiveness scores ($M = 7.33$, $SD = 1.78$) than adaptive perfectionists ($M = 6.51$, $SD = 1.70$) ($HSD(3, 834) = 5.47$, $p < 0.001$) and maladaptive perfectionists ($M = 6.29$, $SD = 1.54$) ($HSD(3, 834) = 7.27$, $p < 0.001$) (See Figure 8). Such results therefore indicate that the hypothesis that adaptive perfectionists would have higher BAS-Drive and BAS-Reward-Responsiveness subscale scores, and lower BAS-Fun-Seeking subscale scores, than maladaptive perfectionists or nonperfectionists, was not supported, either for men or women.

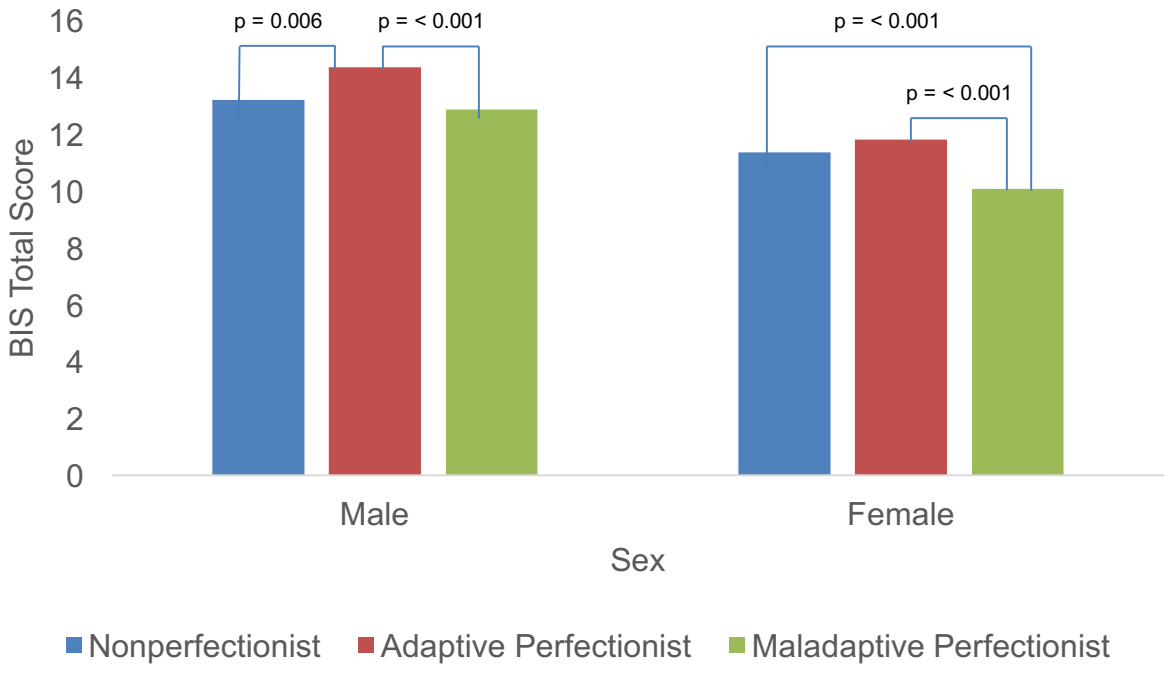


Figure 4. BIS Total Mean Scores by Sex and Perfectionism Classification

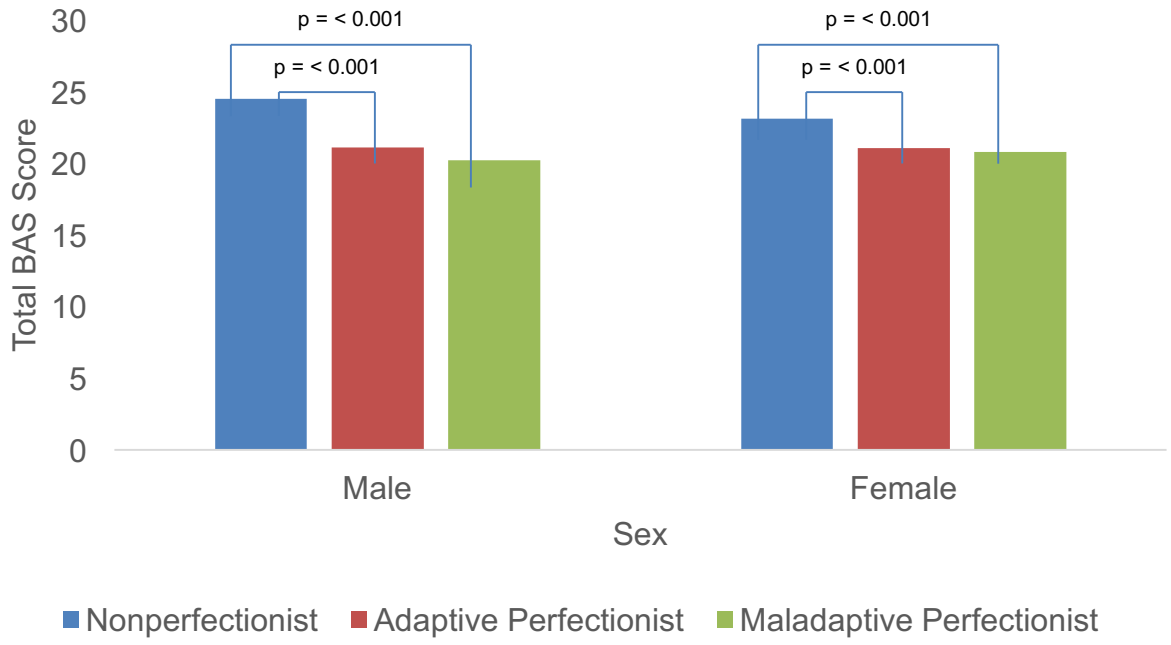


Figure 5. BAS Total Mean Scores by Sex and Perfectionism Classification

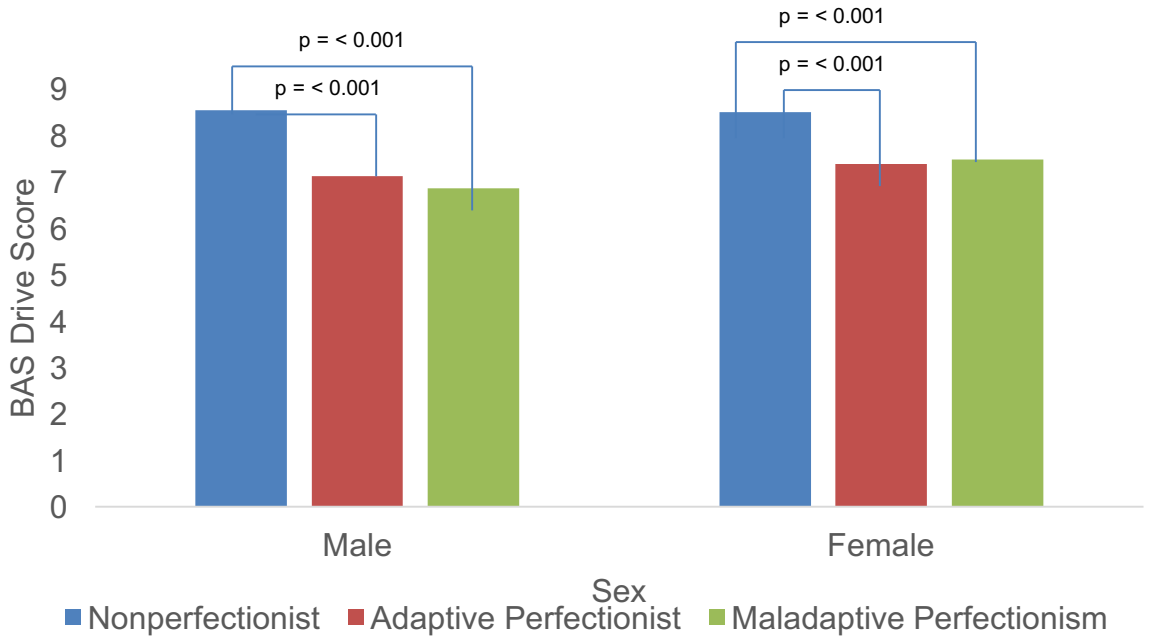


Figure 6. BAS Drive Means Scores by Sex and Perfectionism Classification

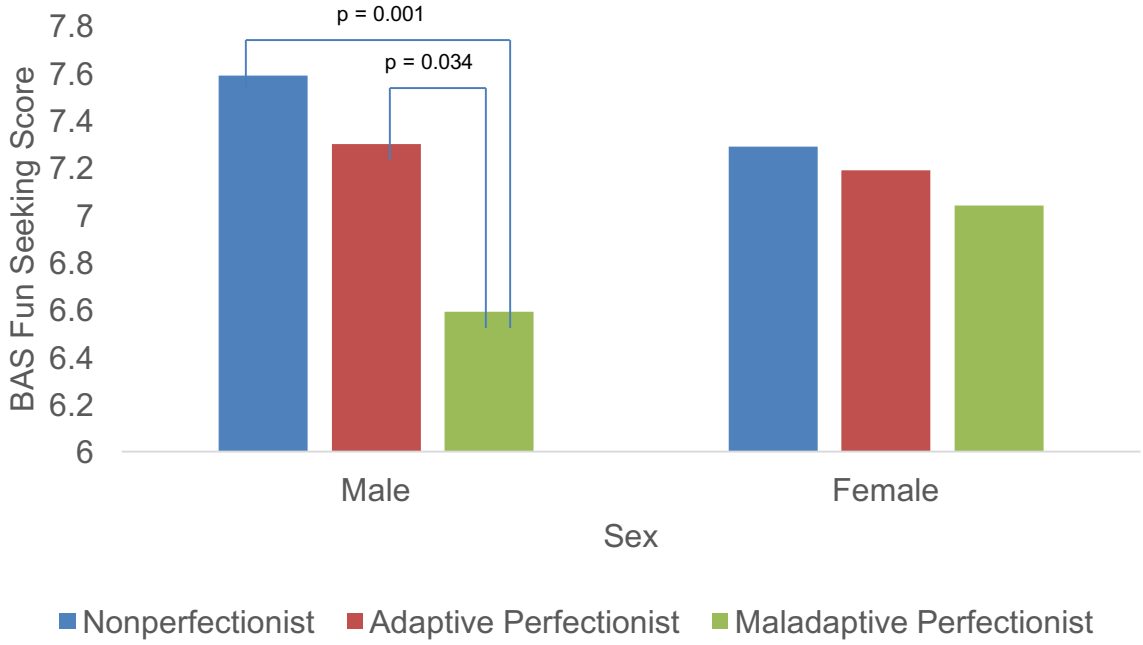


Figure 7. BAS Fun Seeking Mean Scores by Sex and Perfectionism Classification

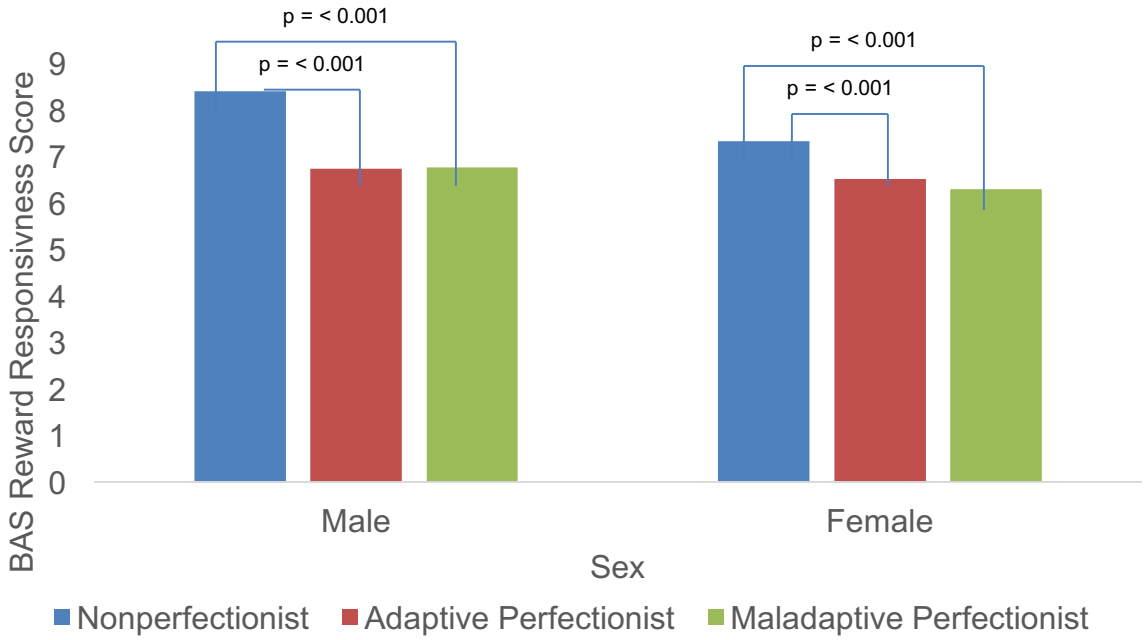


Figure 8. BAS Reward Responsiveness Mean Scores by Sex and Perfectionism Classification

Aim Three

The third, exploratory, aim of this study was to understand the relations of BIS and BAS to HRV, as well as the role that perfectionism might play in moderating these relations. It was hypothesized that BIS-Total scores would be negatively correlated, and BAS-Reward-Responsiveness and BAS-Drive scores positively correlated, with HRV at baseline. A simple linear regression was therefore calculated to predict baseline HRV scores based on BIS-Total scores, BAS-Reward-Responsiveness scores, and BAS-Drive scores. A nonsignificant regression equation was observed ($F(4, 80) = 0.95$, $p = 0.442$), with an R^2 of 0.045, indicating that the initial component of the exploratory moderation hypothesis was not supported. Thus, no further exploration of potential moderation effects was conducted.

CHAPTER V: CONCLUSION

Discussion

The purpose of this study was three-fold: 1) to investigate the differences in heart rate variability (HRV) between nonperfectionists, adaptive perfectionists, and maladaptive perfectionists; 2) to explore the relations between BIS and BAS and maladaptive and adaptive perfectionism; and 3) to understand the relations of BIS and BAS to HRV, as well as the role that perfectionism might play in moderating these relations.

Summary of Results and Relevant Implications

Differential Relation of HRV by Perfectionism Classification. The first set of hypotheses, that adaptive perfectionists would have the highest baseline HRV, the least amount of HRV reactivity during a stressor task, and the greatest degree of HRV recovery after the stressor task, and that maladaptive perfectionists would have the lowest baseline HRV, the greatest amount of HRV reactivity during a stressor task, and the least degree of HRV recovery after the stressor task, were not supported. Specifically, heart rate variability was unrelated to perfectionism classification, regardless of stressor task stage.

One possible explanation for these null findings could be the age characteristics of participants in the current research, as they differed substantially from those of previous studies that have found significant relations between HRV and psychosocial variables. For example, in the sample utilized by Brosschot, Van Dijk, and Taylor (2007) to explore the relation between HRV and daily worry, the participants' mean age was 33.8 (*SD* = 13.9). A similar study conducted by Pieper, Brosschot, van der Leeden, and

Thayer (2007) also had a sample with substantially different age characteristics from those found in the present research, with a mean participant age of 46.7 (*SD* = 9.5). In comparison, the participants who took part in the current study had a considerably lower mean age of 18.67, as well as a more restricted age range (*SD* = 2.24). Previous research has noted the link between age and cardiovascular functioning, specifically the way in which aging individuals tend to experience a decrease in heart rate variability, likely due to declining physical health and associated baroreflex sensitivity (Laitinen et al., 1998). Therefore, it seems likely that the sample utilized in the current research, with its low mean age and restricted age range, also had relatively little variability in health status and baroreflex sensitivity, regardless of perfectionism classification, which contributed to the lack of differences seen in heart rate variability (Baseline HRV: *M* = -3.90, *SD* = 0.389). As this problem has been encountered before with a virtually identical sample (Loveless, 2015), future research should seek to recruit a participant sample from a population with a more diverse age range.

A second possible explanation for these null findings is that they may have been the result of the stressor task that was used to try and elicit physiological arousal related to perfectionism. While the anagram stressor task was chosen in an attempt to tap into perfectionism related to performance on academic tasks in participants, it is possible that subjects did not consider it to be as important as, for example, achieving good grades in an actual academic setting. If this was the case, the anagram task may not have elicited perfectionistic feelings for participants, and thus would not have caused subjects to experience as great a degree of physiological arousal as a performance task that was directly tied to their achievement in school. Therefore, it is possible that the

physiologic measurements obtained in this study did not accurately portray the degree and direction of cardiovascular responsiveness seen in perfectionistic individuals undergoing perfectionism-related stress in the real world. Future research might therefore utilize a task with greater real-world applicability, or consider priming participants to think in a perfectionistic manner before a lab task, by asking them to consider situations in their daily life that cause them to feel or behave perfectionistically.

Finally, it may be that perfectionism, as it is currently understood and conceptualized, is simply not related to heart rate variability; if this is the case, then the null findings of this study are not necessarily the result of error, but rather a reflection of the current state of knowledge around perfectionism as a construct. Such a conclusion is not unlikely, as the results of previous research on the psychophysiological correlates of adaptive and maladaptive perfectionism have proven far from conclusive, with highly mixed findings on the nature and direction of possible relations. For example, Albert, Rice, and Caffee (2014) found that during a stressor task, adaptive perfectionists only showed elevated systolic blood pressure and maladaptive perfectionists elevated diastolic blood pressure. However, Besser, Flett, Hewitt, and Guez (2008) found no effects of adaptive or maladaptive perfectionism on diastolic blood pressure during a stressor task, and noted that maladaptive perfectionism was related to increased systolic blood pressure following negative performance feedback, rather than increased diastolic blood pressure as in the Albert, Rice, and Caffee (2014) study.

There have also been mixed findings in regards to the relation of perfectionism to the cortisol stress response. For example, Wirtz et al (2007) found that higher levels of perfectionism significantly predicted higher cortisol stress reactivity, while McGirr and

Turecki (2009) found no effect of perfectionism on cortisol, and Richardson, Rice, and Devine (2014) found that maladaptive perfectionists actually exhibited lower levels of cortisol in response to a stressor task. It can thus be seen that the conclusions of the existing literature base regarding the relations between perfectionism and various psychophysiological correlates are already inconclusive at best, indicating that perhaps the results of this study are simply in keeping with this trend. Going forward, it may therefore be advisable to seek a more precise and thorough understanding of the etiology and expression of the psychosocial construct of perfectionism before researchers further try and relate it to physiological measures.

Differential Relations Between BIS and BAS and Perfectionism Classification. The first hypothesis in the second research question, that maladaptive perfectionism would be more positively related to BIS-Total than adaptive perfectionism or nonperfectionism, was not supported. For men, adaptive perfectionists had significantly higher BIS-Total scores than nonperfectionists or maladaptive perfectionists, while for women, both adaptive perfectionists and nonperfectionists had higher BIS-Total scores than maladaptive perfectionists.

The second hypothesis, that maladaptive perfectionism would be more negatively related to BAS-Total than adaptive perfectionism or nonperfectionism, was partially supported. For both men and women, nonperfectionists had significantly higher BAS-Total scores than adaptive perfectionists and maladaptive perfectionists. Although it was the case that maladaptive perfectionists had the lowest BAS-Total scores of the three perfectionism classifications, for both men and women, these scores were only

significantly lower statistically than those of nonperfectionists, not adaptive perfectionists.

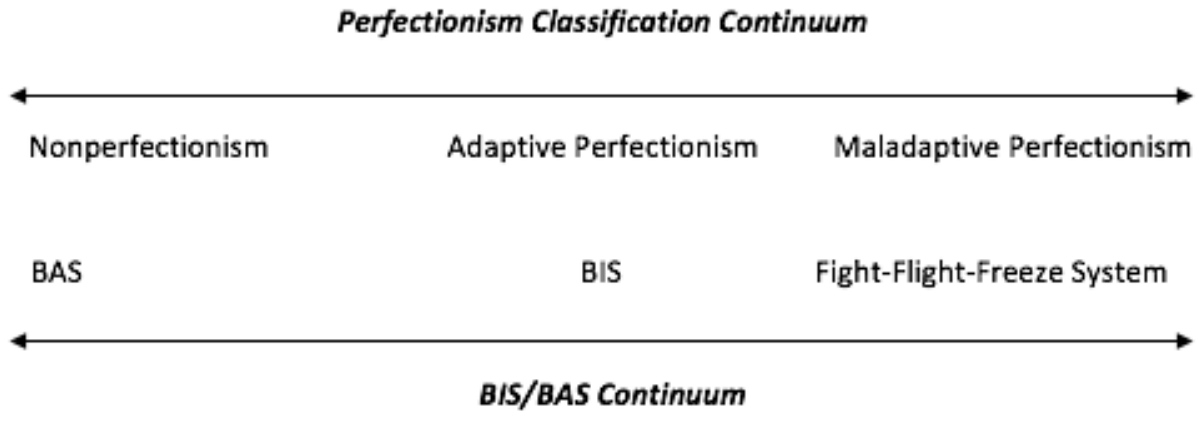
The third hypothesis, that adaptive perfectionism would be more positively related to scores on the BAS-Drive and BAS-Reward-Responsiveness subscales, and more negatively related to scores on the BAS-Fun-Seeking subscale, than maladaptive perfectionism or nonperfectionism, was not supported. For both men and women, nonperfectionists had significantly higher BAS-Drive and BAS-Reward-Responsiveness subscale scores than either adaptive or maladaptive perfectionists. In regards to BAS-Fun-Seeking subscale scores, male nonperfectionists and adaptive perfectionists had significantly higher scores than maladaptive perfectionists, while BAS-Fun-Seeking scores were not significantly related to perfectionism classification for women at all.

Although it was initially hypothesized that maladaptive perfectionism would be more related to BIS, and adaptive perfectionism more related to BAS, in order to map the study's hypotheses onto the Carver and White BIS/BAS scales, this measure is unfortunately based off of the original Reinforcement Sensitivity Theory (RST), as opposed to the revised theory (Carver & White, 1994; Gray & McNaughton, 2000). Therefore, one explanation for the findings of the current research may be that they are better encompassed by revised RST; rather than attempting to map perfectionism classification onto the dichotomy that Carver and White's scales represent, with the two ends of the scale being represented by BIS and BAS, it may be the case that the three perfectionism classifications, which lie on a continuum before being trichotomized by the Revised Almost Perfect Scale, match up more precisely with the BIS/BAS continuum posited by revised RST. In this model, the BAS and Fight-Flight-Freeze System (FFFS)

represent the two ends of the continuum, and the BIS mediates between them in the middle (Gray & McNaughton, 2000).

Using this paradigm, the findings from the current study, which indicate that adaptive perfectionism relates most closely to BIS, and nonperfectionism most closely to BAS, appear more sensible. Unfortunately, the Carver and White BIS/BAS scales do not measure the FFFS, but given that maladaptive perfectionists generally scored the lowest of the three perfectionism groups on both BIS- and BAS-Total, it seems plausible that maladaptive perfectionism might relate to the lower end of the revised RST continuum, represented by the FFFS (See Figure 9). Utilizing this model, individuals who are characterized by high levels of BIS, and corresponding adaptive perfectionism, are best able to moderate the drives coming from the BAS (related to nonperfectionism) and the FFFS (potentially related to maladaptive perfectionism).

Figure 9. Plausible Perfectionism-BIS/BAS Correlates Based Off of Revised RST



Although no stand-alone measure currently claims to accomplish the goal of accurately differentiating between BAS, BIS, and the FFFS as they are put forth in the revised Reinforcement Sensitivity Theory outright, Smillie, Pickering, and Jackson

(2006) found that the items comprising the BIS scale of the Carver and White BIS/BAS scales in fact already measure a mixture of two separate constructs, BIS-Anxiety and punishment responsivity (labeled FFFS-FEAR). Heym, Ferguson, and Lawrence (2008) investigated this phenomenon further and found the specific item split by which the current BIS scale supports this two factor structure. The first factor, BIS-Anxiety, encompasses four of the current BIS scale items: “Criticism or scolding hurt me quite a bit,” “I feel pretty worried or upset when I think or know someone is angry with me,” “I feel worried when I think I have done poorly at something important,” and “I worry about making mistakes” (Carver & White, 1994). The second factor, FFFS-Fear, encompasses the remaining three items from the current BIS scale: “Even if something bad is about to happen to me I rarely experience fear or nervousness,” “If I think something unpleasant is going to happen I usually get pretty worked up,” and “I have very few fears compared to my friends” (Carver & White, 1994).

Utilizing this factor structure to separate out BIS-Anxiety from FFFS-Fear, the post-hoc hypothesis from the current research, that adaptive perfectionism would be most strongly related to BIS-Anxiety and maladaptive perfectionism to FFFS-Fear, was tested, but found to be only partially supported. For both men and women, adaptive perfectionists did have significantly higher scores on BIS-Anxiety than maladaptive perfectionists or nonperfectionists. However, in regards to scores on FFFS-Fear, there were no significant group differences for men, and for women, maladaptive perfectionists had significantly lower, rather than higher, scores than both adaptive perfectionists and non-perfectionists. It may therefore be the case that the Reinforcement Sensitivity Theory paradigm cannot explain maladaptive perfectionism

as well as it does adaptive perfectionism and non-perfectionism. One possible cause for this may be that another, more complex, contributing factor, such as depression, is having a greater impact on the presence or absence of maladaptive perfectionism than simple approach and avoidance tendencies can explain. Further research is therefore needed to explore the factors that make maladaptive perfectionism unique from adaptive perfectionism and non-perfectionism.

Differential Relations of BIS and BAS to HRV. Regarding the final purpose of this study, it was hypothesized that BAS-Reward-Responsiveness and BAS-Drive subscale scores would be positively correlated with HRV at baseline and that BIS-Total scores would be negatively correlated with HRV at baseline. This hypothesis was not supported, as a nonsignificant regression coefficient was found between BIS and BAS subscales and HRV. As previous research has found that higher BAS scores are positively correlated with increased heart rate reactivity (Heponiemi, Keltikangas-Jarvinen, Kettunen, Puttonen, and Ravaja, 2004), greater resting vagal tone (Movius & Allen, 2005), and greater vagal suppression during a stressor (Blair, Peters, & Granger, 2004), and that higher BIS scores are related to decreased vagal suppression during a stressor task (Blair, Peters, & Granger, 2004), it appears likely that the explanation for these results is the same as for those from the first set of hypotheses; the age of participants in the current research was both lower, and more truncated in range, than that of adult participants in previous research where significant relations between HRV and other psychosocial variables have been found.

Limitations and Future Directions

There are several limitations in regards to the design of the current study that should be addressed in future research on perfectionism, BIS/BAS, and HRV, if greater knowledge is to be gained about the relations between these three factors.

Limitations Due to the Present Sample. There were two main limitations in regards to the sample of individuals who participated in this study. First, the low mean age and truncated age range of the participant sample may have resulted in limited variability between participants in regards to their heart rate variability, as such inter-individual differences are likely to become apparent only as the result of age and health induced cardiovascular changes. Secondly, there was an imbalanced sex ratio in both the in-lab and online portions of this study, with 25 men being compared to 66 women in the in-lab portion, and 373 men being compared to 839 women in the online portion. This makes drawing meaningful conclusions about the sex differences that appeared in relation to perfectionism and BIS/BAS difficult, as it is unknown what differences may have been due to the unequal samples sizes, as opposed to any real, meaningful differences between men and women. In addition, there may be certain characteristics of non-participant men that might have led to different results, but which could not be evaluated in this study due to their non-participation. Future studies should therefore attempt to utilize a sample with greater age variability, so as to capture the effects of age-related cardiovascular changes, as well as having a more balanced participant sex ratio.

Limitations Due to the Present Methodology. The use of Carver and White's (1994) BIS/BAS Scales in their original format is another limitation of the present study.

As is the case with the majority of the scales available that attempt to measure BIS, Carver and White's scales are based on the original Reinforcement Sensitivity Theory, and therefore do not appropriately differentiate between the BIS and the FFFS as revised RST posits them to exist (Gray & McNaughton, 2000; Smillie, Pickering, & Jackson, 2006). Therefore, future studies should attempt to utilize a measure that accurately differentiates between BAS, BIS, and the FFFS, as they are put forth in the revised Reinforcement Sensitivity Theory. Although no stand-alone measure currently claims to accomplish this goal outright, Heym, Ferguson, and Lawrence (2008) have found that the current BIS scale already supports a two-factor structure, with a split between items representing BIS-Anxiety and punishment responsivity (FFFS-FEAR). By utilizing this factor structure to separate out BIS-Anxiety from FFFS-Fear, future researchers will ideally be able to measure BIS and BAS in a way that is more consistent with the most up-to-date Reinforcement Sensitivity Theory, and therefore be able to map other psychosocial variables onto BIS, BAS, and FFFS more accurately.

A second methodological limitation of this study had to do with the use of the Almost Perfect Scale-Revised to measure adaptive vs maladaptive perfectionism. Although the researchers considered the APS-R to be superior to other available measures of perfectionism, as it takes into account the dimensional nature of perfectionism, its use was still not ideal because the scoring process required the trichotomization of a continuous variable. While such trichotomization is statistically suspect, because it causes a loss of variance and thus explanatory power, the current study utilized such a technique because it is standard practice in the study of perfectionism to do so, and allowed us to understand where our results fit in with the

extant literature. Additionally, the researchers were unable to find any truly continuous measure of perfectionism.

A final possible limitation of this study was related to the anagram stressor task. Firstly, it was determined mid-way through data collection that a mistake had been made in the creation of the anagram task and that one of the words in the first, supposedly “easy”, set was spelled incorrectly. This resulted in both the first and third sets of anagram puzzles being unsolvable. Although not ideal, it was decided not to correct the mistake upon its discovery, since the point of the overall anagram task was to create stress, and because retaining the incorrect word throughout the duration of the study allowed for continuity of task for all participants.

In addition, although the anagram task was mainly chosen in an attempt to elicit perfectionism related to performance on academic tasks in participants, it is possible that it lacked sufficient ecological validity to garner the desired perfectionistic response from subjects. If this was the case, the anagram task may not have caused perfectionistic subjects to experience any greater amount of physiological arousal than that caused by simply participating in an action that requires the active use of cognitive abilities. Although the anagram stressor task was chosen because of its past utilization in studies of perfectionism, future studies might benefit from the incorporation of a stressor task with more real-world applicability, such as giving students a test that purportedly can tell the researcher how academically high-performing the student participant is.

Concluding Remarks

In conclusion, the current research found that there were no significant relations between either perfectionism and heart rate variability, or BIS/BAS and heart rate variability. However, significant relations were found between adaptive and maladaptive perfectionism and BIS/BAS, though not in the hypothesized direction. Rather than BAS being more related to adaptive perfectionism, and BIS being more related to maladaptive perfectionism, as was hypothesized based off of original Reinforcement Sensitivity Theory, it was found that BAS was more related to nonperfectionism and BIS to adaptive perfectionism. As these results appear consistent in light of revised Reinforcement Sensitivity Theory, future research on the relations between perfectionism and BIS/BAS should utilize revised Reinforcement Sensitivity Theory in theory formulation and measurement.

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APPENDIX A: IRB APPROVAL LETTER

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · **www.ecu.edu/irb**

Notification of Initial Approval: Expedited

From: Social/Behavioral IRB
To: Ansley Taylor Corson
CC:
Matthew Whited
Date: 7/15/2015
Re: UMCIRB 15-000964
Perfectionism, BIS/BAS, and Heart Rate Variability

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 7/15/2015 to 7/14/2016. The research study is eligible for review under expedited category # 4, 7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

The approval includes the following items:

Name	Description
BDI-II.pdf	Surveys and Questionnaires
Corson_Thesis Proposal.docx	Study Protocol or Grant Application
Debriefing .docx	Debriefing Statement
lab consent.doc	Consent Forms
Measures.docx	Surveys and Questionnaires
online consent.doc	Consent Forms
Thesis Advertisement.docx	Recruitment Documents/Scripts

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

APPENDIX B-DEMOGRAPHIC AND MEDICAL HISTORY QUESTIONNAIRE

- Date of Birth/Age
- Sex: Male, Female
- Gender: Male, Female, Genderqueer/Androgynous, Transgender, Other
- Race: White, Black, Asian, White Hispanic, Black Hispanic, Native American, Pacific Islander, Multiracial, Other
- Primary language English?
- Height
- Weight
- Do you have a current or past history of any of the following medical/psychiatric concerns: High blood pressure, Low blood pressure, Coronary heart disease, Heart attack, Angina (chest pain), Abnormal heart rhythm, Chronic obstructive pulmonary disorder, Shortness of breath, Diabetes, Stroke, Tuberculosis, Kidney disease, Liver disorder, Ulcers, Obesity, Hernia, Chronic Pain, Dizziness/Fainting, Seizures, Paralysis, Blood disorder, Sleep disorders, Eating disorders, Depression, Anxiety disorders, Schizophrenia, Post Traumatic Stress Disorder, or any other severe illness?
- Have you ever had any major surgeries? If so, for what?
- Are you currently taking any of the following medications:
    - Pain medications (Codeine, Oxycontin, Hydrocodon, Morphine, etc)
    - Antihypertensive (Propanolol, Clonidine, Metoprolol, Diuretics, etc)
    - Anti-anxieties (Ativan, Xanax, Klonopine, Valium, etc)
    - Mood elevators/stabilizers (Paxil, Zoloft, Celexa, Lithium, etc)

    - ADHD medications (Adderall, Ritalin, Amphetamine Salts, etc)
    - Sleep aids (Lunesta, Ambien, Trazodone, etc)
    - Anti-Psychotics (Thorazine, Haldo, Resperdal, Geodon, etc)
    - Illegal drugs (heroine, cocaine, methamphetamine, etc)
- GPA

APPENDIX C-ANAGRAM STRESSOR TASK

Easy Anagrams:

RISTW (wrist)

RNAHC (ranch)

OTRAS (roast)

ITRGE (tiger)

IHERA (chair)

Difficult Anagrams:

HREAFT (father)

CEENRYEGM (emergency)

PPSORALO (proposal)

TRNTHEGS (strength)

OSLURDEH (shoulder)

Unsolvable Anagrams:

KDNITE

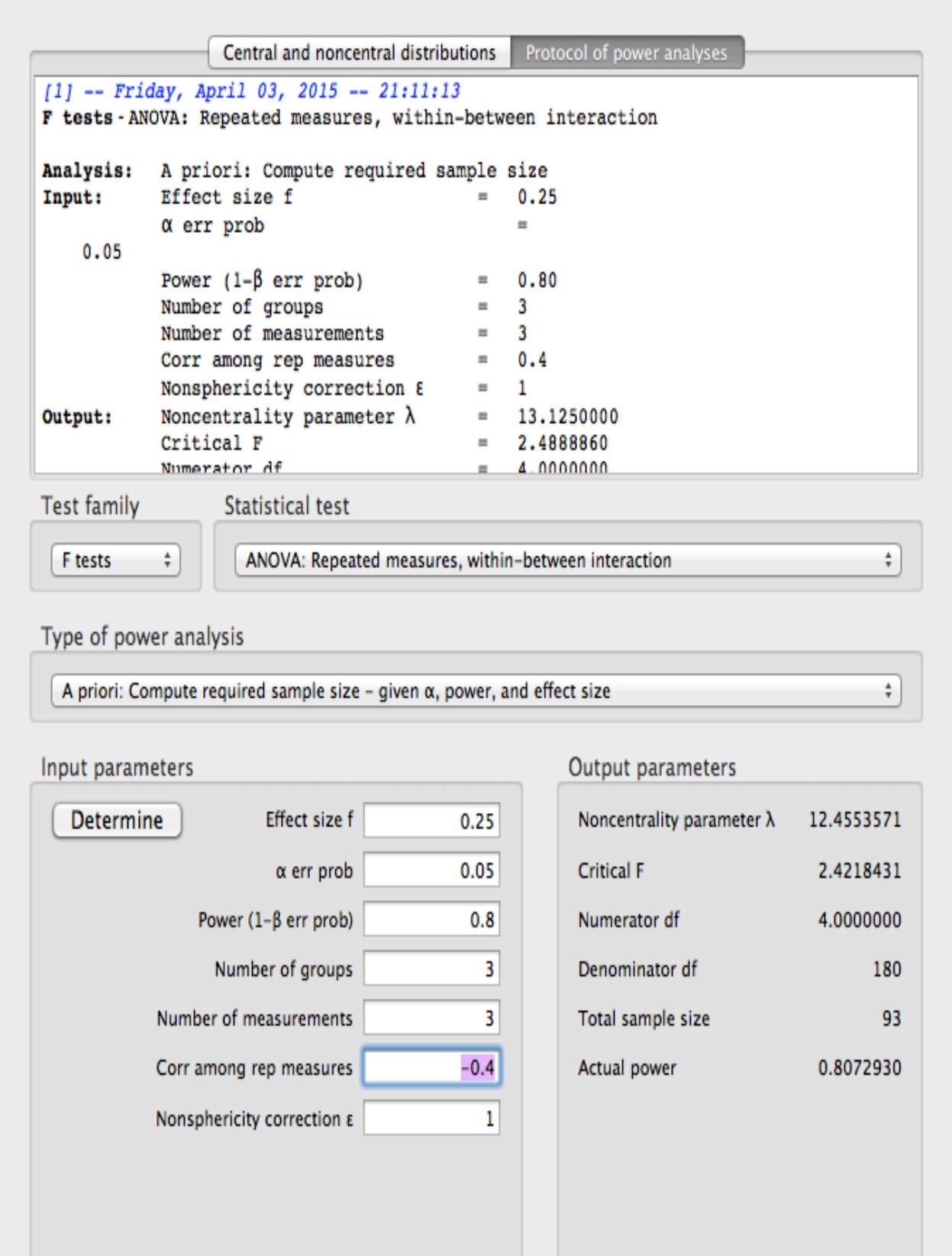
VDAOCO

GEIDLH

ALLRGON

UTAFIE

APPENDIX D-POWER ANALYSIS



Central and noncentral distributions | Protocol of power analyses

```
[1] -- Friday, April 03, 2015 -- 21:11:13
F tests - ANOVA: Repeated measures, within-between interaction

Analysis:   A priori: Compute required sample size
Input:      Effect size f                  =   0.25
            α err prob                     =
    0.05
            Power (1-β err prob)           =   0.80
            Number of groups               =   3
            Number of measurements         =   3
            Corr among rep measures        =   0.4
            Nonsphericity correction ε     =   1
Output:     Noncentrality parameter λ      =   13.1250000
            Critical F                     =   2.4888860
            Numerator df                   =   4.0000000
```

Test family: F tests

Statistical test: ANOVA: Repeated measures, within-between interaction

Type of power analysis: A priori: Compute required sample size – given α, power, and effect size

Input parameters

Determine

Effect size f	0.25
α err prob	0.05
Power (1-β err prob)	0.8
Number of groups	3
Number of measurements	3
Corr among rep measures	-0.4
Nonsphericity correction ε	1

Output parameters

Noncentrality parameter λ	12.4553571
Critical F	2.4218431
Numerator df	4.0000000
Denominator df	180
Total sample size	93
Actual power	0.8072930

APPENDIX E-POST EXPERIMENTAL QUESTIONNAIRE

- Was this study enjoyable? Yes No
- Would you recommend this study to a friend? Yes No
- Did you read all of the survey questions and answer them honestly? Yes No
- What had you heard from others about this study before participating? Free Response
- Do you consider yourself to be more introverted or extroverted? Introverted Extroverted
- Are you a trustworthy friend? Yes No
- Are you respectful to your parents? Yes No
- Do you regularly ride a giraffe to school? Yes No
- Do you always turn in your homework on time? Yes No
- Do you always study for tests? Yes No

APPENDIX F: INFORMED CONSENT FOR ONLINE PORTION OF STUDY

East Carolina University

Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: Perfectionism, BIS/BAS, and Heart Rate Variability
Principal Investigator: Ansley Taylor Corson, B.A.
Institution/Department or Division: Psychology
Address: 237 Rawl
Telephone #: (252)-328-1069

Researchers at East Carolina University (ECU) study problems in society, health problems, environmental problems, behavior problems and the human condition. Our goal is to try to find ways to improve the lives of you and others. To do this, we need the help of volunteers who are willing to take part in research.

Why am I being invited to take part in this research?
The purpose of this research is to explore the possible relationship between perfectionism, sensitivity to reward and punishment, and heart rate variability, which is a measure of how well your heart is working. You are being invited to take part in this research because you are an ECU student who is at least 18 years old, and in good physical and mental health. The decision to take part in this research is yours to make. By doing this research, we hope to learn more about the ways in which perfectionism relates to other measures of mental and physical health, in particular cardiovascular health.

If you volunteer to take part in this research, you will be one of about 120 people to do so.

Are there reasons I should not take part in this research?
You should not participate in this research if you are under 18 years of age, if you have any history of, or current, heart conditions, if you are taking any medications for cardiovascular conditions, or if you are taking any psychotropic medications.

What other choices do I have if I do not take part in this research?
You can choose not to participate. If you are seeking credit for one of your classes during Spring and Fall semesters, you can fulfill your research requirement in Introduction to Psychology by participating in any of a number of available research studies which are listed on the Sona website (http://ecu.sona-systems.com). You can also participate in alternative activities to research to fulfill this requirement. The primary research alternative is reading articles and completing knowledge quizzes on these articles. Times when you can sign up to complete these

knowledge quizzes are also listed on the Sona website. During Summer sessions, your instructor will provide you with information about ways to fulfill any research requirement in Introduction to Psychology. If you are enrolled in another Psychology course, your instructor can provide you with information about alternatives to participating in this research.

Where is the research going to take place and how long will it last?
This research will take place online. The total amount of time you will be asked to volunteer for this study is approximately 30 minutes. After you complete this online study, you will be permitted to volunteer for a second part of the study, if you choose. This second part will take place on campus and will consist of measuring physical data (blood pressure and heart rate). This second part will take approximately 60 minutes and will occur in Rawl 237.
What will I be asked to do?
You will be asked to do the following: You will be asked to fill out some questionnaires regarding demographic, behavioral, physical, and mental health factors in your life.

What might I experience if I take part in the research?
We don't know of any risks (the chance of harm) associated with this research. Any risks that may occur with this research are no more than what you would experience in everyday life. We don't know if you will benefit from taking part in this study. There may not be any personal benefit to you but the information gained by doing this research may help others in the future.

Will I be paid for taking part in this research?
We will not pay you for the time you volunteer while being in this study. You will receive 0.5 hours of research credit for your Introduction to Psychology course (if research is required). If you are enrolled in another Psychology course, please contact your instructor to determine what credit you can receive for participating, if any. Even if you do not wish to acquire research credit, you are welcome to participate in this study.

What will it cost me to take part in this research?
It will not cost you any money to be part of the research.

Who will know that I took part in this research and learn personal information about me?
ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- Any agency of the federal, state, or local government that regulates human research. This includes the Department of Health and Human Services (DHHS), the North Carolina Department of Health, and the Office for Human Research Protections
- The University & Medical Center Institutional Review Board (UMCIRB) and its staff have responsibility for overseeing your welfare during this research and may need to see research records to identify you.

How will you keep the information you collect about me secure? How long will you keep it?
Data collected from this study will be kept securely for seven years. All identifying information (your name and email address) will be separated from responses. Data collected solely for the

purposes of providing class credit will be disassociated with your identifying information as soon as credit is granted.

What if I decide I do not want to continue in this research?
You can stop at any time after it has already started. There will be no consequences if you stop and you will not be criticized. You will not lose any benefits that you should normally receive.

Who should I contact if I have questions?
The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator, Ansley Taylor Corson at corsona14@students.ecu.edu or at (252)-328-1069 anytime.

If you have questions about your rights as someone taking part in research, you may call the Office of Research Research Integrity & Compliance (ORIC) at 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the ORIC, at 252-744-1971

I have decided I want to take part in this research. What should I do now?
Read the following and if you agree, you should consent to participate:

- I have read all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By consenting to participate, I am not giving up any of my rights.
- I can print a copy of this consent document, and it is mine to keep.

By checking this box and clicking continue, you are consenting to participate in this research:

"Continue"
"Do NOT Continue"

APPENDIX G: INFORMED CONSENT FOR LAB PORTION OF STUDY

East Carolina University

Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: Perfectionism, BIS/BAS, and Heart Rate Variability
Principal Investigator: Ansley Taylor Corson, B.A.
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Telephone #: (252)-328-1069

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Will I be paid for taking part in this research?
We will not pay you for the time you volunteer while being in this study. You will receive 1.0 hours of research credit for your Introduction to Psychology course (if research is required). If you are enrolled in another Psychology course, please contact your instructor to determine what credit you can receive for participating, if any. Even if you do not wish to acquire research credit, you are welcome to participate in this study.

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Who will know that I took part in this research and learn personal information about me?
ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- Any agency of the federal, state, or local government that regulates human research. This includes the Department of Health and Human Services (DHHS), the North Carolina Department of Health, and the Office for Human Research Protections
- The University & Medical Center Institutional Review Board (UMCIRB) and its staff have responsibility for overseeing your welfare during this research and may need to see research records to identify you.

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If you have questions about your rights as someone taking part in research, you may call the Office of Research Research Integrity & Compliance (ORIC) at 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the ORIC, at 252-744-1971

I have decided I want to take part in this research. What should I do now?
The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

_____ _____

Participant's Name (PRINT) Signature Date

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

_____

Person Obtaining Consent (PRINT) Signature Date