SELF-ORIENTED PERFECTIONISM AND STRESS-ENHANCEMENT: PHYSIOLOGICAL AND EMOTIONAL REACTIVITY IN RESPONSE TO AN ACHIEVEMENT-RELATED STRESSOR

by

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ABSTRACT

Previous research has demonstrated that self-oriented perfectionism and achievement stress work together to produce maladjustment and psychopathology. Self-oriented perfectionism may influence an individual's perception of the frequency and intensity of stressors, as well as lead to maladaptive coping styles which prolong stressful experience. In this study, 130 students engaged in challenging time-restricted math and anagram tasks. We hypothesized that self-oriented perfectionists would experience a more intense stress reaction than non-perfectionists. Stress levels were evaluated using a self-report mood questionnaire, heart rate, and salivary cortisol levels. As expected, self-oriented perfectionism was associated with lower self-satisfaction with performance, and increased stress following the achievement task. Furthermore, those who scored high on both the self-oriented perfectionism subscale and a measure of task-oriented coping continued to experience elevated heart rates more than thirty minutes following completion of the task. Results are discussed in terms of a stress-enhancement model of perfectionism.

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INTRODUCTION

For decades, perfectionistic behaviour has been acknowledged as a relevant variable in the development of a variety of psychological problems. Although there has been increasing research conducted on the construct (e.g. Frost, Marten, Lahart & Rosenblate, 1990; Hewitt & Flett, 1991b) much work remains to be done in terms of understanding the mechanism by which perfectionistic behaviour may produce various types of mental and physical health problems.

Recently, perfectionism has been described as a multidimensional construct that involves both interpersonal and intrapersonal trait components. There are three forms of trait perfectionism (Hewitt & Flett, 1991b). Self-oriented perfectionism is the requirement for oneself to be perfect, and includes behaviors such as setting and maintaining unrealistic standards for oneself and self-critical evaluations of behavior to see if it meets those standards. Other-oriented perfectionism involves the same characteristics as self-oriented perfectionism, but the standards and evaluations are directed towards other people; that is, other-oriented perfectionists require others to be perfect. The last type of perfectionism is socially-prescribed perfectionism. This subtype refers to the belief that one cannot meet the perfectionistic expectations that others have for oneself. Hewitt and Flett (1991b) suggested that each dimension is associated uniquely with various facets of psychopathology and maladjustment. For example, whereas self-oriented perfectionism has been hypothesized to be associated with depression, other-oriented perfectionism has been linked to relationship problems.

Numerous studies repeatedly have identified associations between these dimensions of perfectionism and various psychological and physical problems. Depression, eating disorders, anxiety disorders, and personality disorders are just a few of the clinical diagnoses associated with elevations in perfectionism (Flett, Hewitt, Endler & Tassone, 1995; Hewitt, Flett & Ediger, 1995, 1996; Hewitt, Flett & Turnbull-Donovan, 1992). In addition, Type A behaviour, self-control, workaholism, and intensity of migraine headaches appear to be connected with specific elevations in perfectionism dimensions (Flett, Hewitt, Blankstein & Dynin, 1994; Flett, Hewitt, Blankstein & O'Brien, 1991b; Kowal & Pritchard, 1990; Spence & Robbins, 1992). Evidently, this personality trait has far-reaching implications in both the psychological and physiological realm. However, the

mechanism by which perfectionism influences behaviour and psychopathology has yet to be established.

A Diathesis-Stress Model

Hewitt, Flett, and Endler (1993) described a model that addresses such mechanisms. They suggested that perfectionism interacts with stress in several ways to increase the experience of distress symptoms. First, perfectionists may generate ego-involving stressors. For a perfectionist, even a minor shortfall is tantamount to a major failure (Pacht, 1984). No performance is judged to be perfect because they critically evaluate performance, focus on flaws, and experience little satisfaction. This black and white style of evaluating performance tends to permeate all areas of perfectionists' lives (Flett, Sawalzky & Hewitt, 1995). In other words, if they pursue perfectionism in one life domain (e.g., perfect performance at school or work), they will attempt to be perfect in other domains as well (e.g., relationships, manners, organization, etc.). Thus, any less than perfect performance in any aspect of life can be perceived as a stressful failure through the eyes of a perfectionist. As such, these individuals experience a greater number of stressful failures in their lives. These perceptions arise from stringent evaluative criteria for success, low satisfaction with performance (Mor, Day, Flett & Hewitt, 1995), and a tendency to focus on negative aspects of performance. In addition to stress generation through the perception of more stressful failure experiences, certain behaviours of perfectionists may cause them to create stressful situations. For example, self-oriented perfectionists frequently procrastinate on completing tasks (Flett, Blankstein, Hewitt & Koledin, 1992; Flett, Hewitt & Martin, 1994). Such procrastination may cause a student to miss deadlines for school assignments and thereby receive poor grades, creating additional stress in their lives. Thus, perfectionism can generate additional stressors in an individual's life through behaviour, unrealistic evaluation, focusing on performance flaws, and not experiencing feelings of satisfaction.

Secondly, once a stressor or failure situation is encountered, perfectionists may experience failures and stressors more aversively than other people. In other words, perfectionism may be a "stress-enhancer" (Hewitt et al., 1996). As noted by Kanner, Coyne, Schaefer, and Lazarus (1981), the impact of a stressor depends on the meaning the individual attaches to it. Perfectionists

tend to equate self-worth with performance (Hollender, 1965; Pacht, 1984); therefore, perceived failure to meet a standard will result in important negative implications for self-concept and self-esteem (Flett et al., 1991b; Hewitt & Genest, 1990). All events will be seen as important tests of their long-term goal of being perfect. In addition, the distress may be exacerbated further by distorted thinking (Burns & Beck, 1978; Hewitt & Genest, 1990), overgeneralization of failure (Hewitt, Flett, Turnbull-Donovan, & Mikail, 1991), and perfectionistic and negative ruminations about the self (Flett, Hewitt & Blankstein, 1993). Thus, as a result of the personal importance perfectionists assign to performance and maladaptive thought patterns following a failure experience, perfectionists are likely to experience stress episodes more intensely.

A final mechanism involving perfectionism also may influence the frequency or severity of stress. Perfectionists may employ inappropriate coping strategies when confronted with a stressor. For example, it has been well documented that perfectionism is associated with maintaining unrealistic standards, ruminating, engaging in self-blame, and overgeneralizing failures (Hamachek, 1978; Hewitt et al., 1993; Hollender, 1965; Pacht, 1984). Moreover, certain perfectionists employ the contrasting but also maladaptive coping style of focusing on negative affect rather than dealing directly with the stressor (Hewitt et al., 1993). None of these strategies would lead to quick identification and potential resolution of a problem. Instead, they would tend to prolong the stressor itself, or at least the period of time spent worrying about it. In addition, these styles are unlikely to preserve a positive self-image, a function which one would expect from an adaptive coping strategy. Thus, these behaviours could be expected to increase the impact of the stressor by increasing both the intensity of the reaction and its duration (Hewitt et al., 1993).

This model is generally consistent with that proposed by Monroe and Simons (1991) in their work on the association between life stress and depression. Included in their model were three types of association: stress generation, perception of a stressful event, and intensity of the stress response. They suggest that depression can increase stress in each of these ways. Simons and her colleagues (1993) extended this model to two other forms of diathesis: dysfunctional attitudes and attributional style. First, they compared self-report of stressful events with events reported in an interview and rated on severity by the interviewer. Differences in these reports could be explained

partially by scores on the Dysfunctional Attitudes Scale (Weissman & Beck, 1978). That is, individuals who endorsed beliefs making them vulnerable to depression (including statements such as "People will think less of me if I make a mistake" which is similar to perfectionistic thought patterns) perceive events in their lives as being more stressful than do other people. In addition, this study looked at the number of stressful events which could have been influenced by the individual's behaviour. For patients who had experienced only a single episode of depression, attributions of negative events to stable and global factors predicted the number of dependent stress events. This study demonstrates that cognitive beliefs that are quite similar to perfectionism can influence both perception and generation of stressful life events.

Perfectionism, then, can act in three ways to increase stress, which may eventually lead to the myriad of problems discussed earlier. First, perfectionists may generate more stressful situations in their lives than others and may be more likely to interpret situations as being stressful failures. Second, they may experience a more aversive reaction to stressors as a consequence of the value and importance they place on performance. Finally, perfectionists may have a tendency to employ inappropriate coping strategies which would increase the duration of their stress response.

Evidence in Support of this Model

In considering the list presented earlier of problems associated with various facets of perfectionism, one could describe many of them as being the precursors (i.e. workaholism) or outcomes (i.e. depression) of intense stress reactions. There are several studies that provide support for Hewitt and Flett's model linking perfectionism and stress. For example, Hewitt and Dyck (1986) asked 105 university students to complete the Burns Perfectionism Scale (Burns, 1980), which is a measure of self-oriented perfectionistic attitudes, and a measure of stressful life events. They found that the correlation between stressful life events and depression was significantly elevated for only those individuals with above median levels of self-oriented perfectionistic attitudes. In addition, hierarchical multiple regression analyses showed that current levels of perfectionistic thinking predicted current levels of depression beyond the variance explained by prior depression levels. Other papers have suggested that the interaction of perfectionism and stress is a risk factor for suicide (e.g. Callahan, 1993). Hewitt, Flett, and

Weber (1994) reported on two studies of perfectionism and suicide ideation. In the first, both self-oriented and socially-prescribed perfectionism were associated with suicide ideation among a sample of psychiatric in- and out-patients. The second study used a sample of university undergraduates. These subjects completed an additional measure of stressful life events. Once again, self-oriented and socially-prescribed perfectionism predicted higher levels of suicide ideation. In addition, these researchers found that the interactions of each of these perfectionism variables with life stress predicted additional variance in suicide ideation. Those who scored high on the perfectionism scales and who had experienced stressful life events were more likely to consider suicide (see also Hewitt et al., 1992). The interaction between perfectionism and life stress is not only relevant to understanding depression and suicide. In another study of perfectionism and life stress, university undergraduates completed the Burns Perfectionism Scale (Burns, 1980), a measure of life stress, the Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1968), and the Spielberger State-Trait Anxiety Scale (STAI; Spielberger, Gorsuch & Lushene, 1970) (Flett, Hewitt & Dyck, 1989). Self-oriented perfectionism attitudes were correlated significantly with the neuroticism scale of the EPI, and trait anxiety from the STAI. Hierarchical regression analyses revealed that the interaction of perfectionism and life stress predicted higher levels of both neuroticism and trait anxiety. In other words, greater perfectionism and a greater number of stressful life events predict increased neuroticism and trait anxiety. Finally, in a study of women executives, Fry (1995) found that perfectionism interacted with daily life hassles to predict lowered self-esteem, burnout, and decreased physical health as defined by a greater number of reported physical illness symptoms. Together, these studies strongly suggest that perfectionistic beliefs may interact with stress in a variety of ways to produce or exacerbate a multitude of stress-related disorders and problems.

In terms of the specific forms of association proposed to exist between perfectionism and stress, a number of studies have provided tentative support for the diathesis-stress model, although few have studied the association directly or thoroughly. Fry's (1995) study suggests that perfectionists do view stressful events as more important which may increase their perception of the stressfulness of these events. She found that highly perfectionistic women executives gave

larger ratings of "primary centrality", the perception that a stressful event has significant personal consequences, as compared to women scoring lower on the perfectionism measure. A second series of studies further substantiates the claim that perfectionists have inflated perceptions of stressful events. These studies considered the outcome measure of negative affect. Flett, Hewitt, Blankstein, and Koledin (1991a) observed that all three dimensions of perfectionism are correlated with irrational beliefs and cognitions. Such irrational beliefs, particularly those related to extreme standards, are difficult to fulfill and minor stresses consequently lead to strong negative affect (Dance, Kuiper & Martin, 1990). Thus, there is some support for the notion that perfectionists perceive events in their lives as more stressful than do non-perfectionists, and that stressful events are seen as more personally relevant.

Three studies have investigated the potential mediating effect of coping strategies. First, Flett, Hewitt, Blankstein, and O'Brien (1991b) assessed perfectionism and levels of self-control or learned resourcefulness in a sample of university undergraduates. Self-control suggests that individuals are capable of regulating themselves in terms of emotions, and cognitions in order to achieve a target behaviour. As might be expected, self-oriented perfectionism was associated with high levels of self-control. The authors suggest that self-oriented perfectionists may have such desire to achieve certain outcomes that they are particularly likely to initiate coping attempts. This approach to dealing with problems is somewhat like Endler and Parker's (1990a) task-oriented style. In a second study, Hewitt and his colleagues (1993) investigated levels of perfectionism, preferred coping strategies, and depression in a sample of 121 psychiatric in- and out- patients. Self-oriented perfectionism was associated with emotion-oriented coping, but only for the females in the sample. The interaction of self-oriented perfectionism and emotion-oriented coping accounted for a significant portion of the variance in depression scores. Those patients with high levels of self-oriented perfectionism who tended to use emotion-oriented coping strategies suffered from greater levels of depression. Similar tests using task-oriented coping were not significant. In Fry's (1995) study of women executives, she noted that highly perfectionistic women tend to employ coping strategies involving self-restructuring, self-blame, and focusing on the prevention of such mistakes and failures or the avoidance of such stressors in the future. These types of

strategies encompass both task-oriented and emotion-oriented styles as described by Endler and Parker (1990a).

The Specific Vulnerability Hypothesis

In addition to describing the general interaction between perfectionism and stress in producing depression symptoms, Hewitt and his colleagues (Hewitt & Flett, 1993; Hewitt et al., 1996) have proposed a specific vulnerability hypothesis for each facet of trait perfectionism. Several theorists have discussed the importance of events or stressors that represent core or central themes germane to the self (Lazarus, 1990; Oatley & Bolton, 1985). When this concept is applied to perfectionism, Hewitt and Flett suggest that stressors related to the central theme of each subtype of trait perfectionism should be most problematic to individuals with elevated levels of those dimensions. For example, self-oriented perfectionists focus on the attainment of self-related achievement standards (Hewitt & Flett, 1993). Thus, stressors that disrupt the achievement of these self-related goals should be most predictive of depression, and perhaps other stress-related problems, whereas other kinds of stressors should not be predictive. In contrast, socially-prescribed perfectionists, who believe others hold unrealistic standards for them, are most concerned with their needs for approval and belonging, and fear of negative evaluation (Hewitt & Flett, 1991b). Consequently, interpersonal stressors that threaten these needs should produce a greater stress response, and be more likely to lead to pathology in these individuals as compared to other forms of stress.

Hewitt and Flett (1993) investigated these proposed associations in samples of unipolar depressed and mixed psychiatric samples. Patients completed measures of trait perfectionism, depression, and daily life hassles. Results with both clinical samples showed that self-oriented perfectionism interacted only with achievement stress to predict levels of depression (Hewitt & Flett, 1993). Findings with socially-prescribed perfectionism were less clear. The unipolar depressed patients demonstrated the expected association of perfectionism and only interpersonal stress predicting depression; whereas depression in the mixed psychiatric sample was best predicted by the interaction between socially-prescribed perfectionism and achievement stress. In another study, Hewitt, Flett, and Ediger (1996) assessed these relationships over time in a sample of 121 patients who reported experiencing depression or mania. Patients completed measures of

trait perfectionism and depression at time one. Four months later, the researchers assessed depression and life events. This study found, again, that only the interaction of self-oriented perfectionism and achievement stress predicted depression levels at time two, even after controlling for prior depression levels. Socially-prescribed perfectionism did not interact with either achievement or social stress to predict depression, although it did predict time two depression after controlling time one depression. Thus, firm support was obtained only for the specific vulnerability of self-oriented perfectionists to achievement stressors. Overall, there is good evidence that achievement-related events are very relevant to self-oriented perfectionism and that together, these are linked to pathology. For this reason, the present study focuses on furthering understanding of this established association by assessing directly the stress enhancing features of self-oriented perfectionism.

Although the findings above are consistent with the idea that self-oriented perfectionism interacts with achievement stress and with the notion that self-oriented perfectionism enhances the aversiveness of achievement stressors, only one study has been conducted to date on self-oriented perfectionism and physiological arousal in response to achievement stress. Roberts and Lovett (1994) studied academically gifted, academic achiever, and "nongifted" junior high students faced with experimentally induced failure in the form of a challenging anagram task. The gifted students reported significantly higher levels of self-oriented perfectionism. They also indicated a more negative change in mood, and greater decrease in digit skin temperature (reflecting physiological arousal) following the failure task. Although this study implies that self-oriented perfectionism is related to an increased stress response, it is impossible to disentangle the relative contributions of perfectionism and "giftedness". That is, it is not clear whether being "gifted" is linked to increased stress during an achievement stressor or whether high levels of self-oriented perfectionism are responsible for this reaction. Furthermore, the study focused on immediate stress reactions but did not assess the students' perceptions of the failure experience, nor the duration of stress response.

In sum, evidence has accumulated providing indirect support for the stress-enhancing properties of self-oriented perfectionism, particularly during achievement stressors. Because no study has investigated stress enhancement mechanisms directly, the present study seeks to do so in

a comprehensive manner by assessing subjects' perceptions of the stressor, subjects' immediate stress response, and the duration of that stress. Finally, the present study will be the first to incorporate three measures for assessing various facets of stress: Self-reported mood, heart rate, and cortisol levels.

Individual Differences in Stress Response

This study strives to fill a gap in the understanding of how perfectionism ultimately may lead to psychopathology and maladjustment. It also answers demands in the stress literature for the identification of personality variables capable of explaining the enormous individual differences in physiological arousal to stress (Berger et al., 1987). The study of such individual differences has received increasing attention as researchers have recognized the benefits and detrimental effects of stress reactions. Some theorists have proposed that there are optimal levels of stress and reactivity (Cloninger, 1987) and studies of different clinical groups seem to support this hypothesis. Low levels of physiological arousal have been associated with impulsivity, substance abuse, conduct disorder, violent acts, and antisocial behavior (Dabbs, Jurkovic & Frady, 1991; King, Jones, Scheuer, Curtis & Zarcone, 1990; Vanyukov, Moss, Plail, Blackson, Mezzich & Tarter, 1993). The correlates of high levels of physiological arousal are equally problematic, if not more so. Numerous investigators have suggested a link between high levels of arousal and cardiovascular disease (Henry, 1983; Troxler, Sprague, Alanese, Fuchs & Thompson, 1977). In addition, patients with severe clinical depression often have higher levels of arousal related hormones (Sachar, 1975) whereas euthymia and early manic stages are associated with decreased physiological arousal (Joyce, Donald & Elder, 1987). Evidently, chronically high or low levels of physiological arousal are related to sub-optimal states. Being able to adjust one's stress level according to environmental demands may be most beneficial (Frankenhaeuser, 1979).

Many authors have commented on the enormous individual differences in stress reactivity. For example, Berger et al. (1987) studied the reactions of their subjects across eight stress situations. Several subjects nearly always scored either above or below the median response, suggesting that there are stable individual differences in reactivity. These observations fueled great interest in understanding the traits which may make some individuals more physiologically responsive.

Mixed results have been found with broad band measures of personality such as the NEO and the MMPI. For example, in a study of truck drivers, high extroversion and low neuroticism predicted greater cortisol reactivity (an indication of greater stress) on non-driving days (Cullen, Fuller & Dolphin, 1979). In contrast, two other research groups studying male university students and Vietnam veterans found that high neuroticism and low extroversion (or low sociability on the MMPI) were linked to cortisol elevations during stressful experiences (Dabbs & Hopper, 1990; Miyabo, Asato & Mizushima, 1979). Investigations of more specific personality variables, such as hostility, and Type A behavior, have shown more promise. High levels of both hostile mood, and trait hostility are linked to higher levels of cortisol at rest (Linden & Long, 1987; Pope & Smith, 1991). Earle et al. (1996) found that induced hostile mood during a harassment task elicited elevated cortisol responses in males only. Another study suggested that Type A characteristics interact with family history of cardiovascular problems to predict cortisol reactivity to stress induced by a subtraction task (Williams, Lane, Kuhn, Melosh, White & Schanberg, 1982). That is, higher scores on measures of Type A characteristics and having a family history for cardiovascular problems predict reactivity of the cortisol response. Therefore, personality characteristics do demonstrate some influence on physiological indices of stress and warrant further investigation especially with personality variables, such as perfectionism, that are hypothesized specifically to have such effects.

Defining Perfectionism and Stress

One issue that has plagued both past perfectionism and past stress research involves the conceptualization, definition, and operationalization of core concepts. In the perfectionism domain, previous conceptualizations have described perfectionism as a unidimensional, cognitive construct that was measured by ratings of attitudes (e.g. Burns, 1980; Ellis, 1962). As described earlier in this paper, recent conceptualizations have described a multidimensional construct including both intrapersonal and interpersonal factors (Frost et al., 1990; Hewitt & Flett, 1991b). This new perspective is consistent with research on the private versus public aspects of the self (Cheek & Briggs, 1982; Fenigstein, Scheier & Buss, 1975; Greenwald & Breckler, 1985; Schlenker, 1980), as well as the idea that both intra- and interpersonal facets of personality are

relevant in the classification and etiology of psychiatric disorder (Kiesler, 1982; Millon, 1981; Sullivan, 1953). In addition to this difference in the dimensionality of the construct, Hewitt and Flett (1991b) have argued that perfectionism is not merely a cognitive factor. Instead, it also incorporates specific behaviours and motivational components. For example, self-oriented perfectionists are thought to be highly motivated to achieve perfection for themselves, which leads to compulsive striving to attain these standards. Similarly, socially-prescribed perfectionists are motivated to attain perfection, but the motivation is extrinsic as they are driven by a need to please others and avoid punishment.

Hewitt and Flett (1991b; Hewitt et al., 1991) have tested their conceptualization meticulously through the use of their self-report questionnaire, the *Multidimensional Perfectionism Scale* (MPS) which was designed specifically to tap independently the three dimensions of self-oriented, other-oriented, and socially-prescribed perfectionism. Initial tests were conducted using a university undergraduate sample (Hewitt & Flett, 1991b). First, they conducted a factor analysis which confirmed the three factor structure. Next, they looked at the associations between these dimensions of perfectionism and a variety of personality measures, performance standards, and a measure of general distress symptoms in order to demonstrate the independence of the dimensions. Results showed distinct clusters of associations for each dimension. For example, self-oriented perfectionism was correlated significantly with high self-standards, self-criticism, narcissism, self-importance of performance and goals, and moderately with all the distress symptoms studied. In contrast, other-oriented perfectionism was related to other-blame, authoritarianism, dominance, narcissism, and only the phobias and paranoia scales of distress. Finally, socially-prescribed perfectionism had strong associations with fear of negative evaluation, approval of others, social importance of goals, and very strong associations with all of the distress subscales. Another study considered associations with negative emotion (Hewitt & Flett, 1991b, study 3). The only significant correlations were found for self-oriented perfectionism and guilt, self-disappointment, and anger, and between socially-prescribed perfectionism and anger. Evidently, the three dimensions were tapping into different aspects of perfectionism which related distinctly with other personality variables and psychopathology. Hewitt and his colleagues (1991) also confirmed this

impression using samples of psychiatric patients. Once again, self-oriented perfectionism was linked most strongly with measures of self-related behaviour, other-oriented perfectionism with personal standards, and socially-prescribed perfectionism with several subscales including parental expectations and criticism. Therefore, there is evidence in both college student and psychiatric samples supporting this multidimensional conceptualization of perfectionism. Moreover, these studies and others (Hewitt, Flett & Turnbull, 1994) support the reliability and validity of the self-report measure of perfectionism (Hewitt & Flett, 1991b).

In the domain of stress, the very term "stress" has had a variety of meanings that, at times, creates confusion. Included among these are: "a characteristic of the environment, [and] the response of the individual" (Rose, 1980,1984). For the purposes of this report, we will attempt to clarify this issue by referring to "stressors" as characteristics of the environment, and "stress" as the response of the individual (Selye, 1974). Stress is influenced by two factors, the individual's perception of the environment or stressor, and his or her ability to cope (Hewitt, Flett & Mosher, 1992).

Measuring Stress

I. *Subjective Ratings.*

Having decided to study the association of perfectionism with heightened arousal to stressful situations, the challenge of choosing appropriate measures of "stress" becomes paramount. When dealing with human subjects, an obvious choice would seem to be subjective mood ratings. Thoughts and feelings often are unobservable and require the use of self-report to probe the subject's perceptions of an event. The use of mood ratings is appropriate because stress states usually are accompanied by an increase in negative emotions including anxiety, depression, and tension (Cox & Ferguson, 1991). In fact, these emotions may serve to define stressful events for the individual experiencing them. Self-report mood measures are easy to administer and inexpensive. For these reasons, numerous measures have been constructed to assess both positive and negative affect (e.g., McAdams & Constantian, 1983; Stone, 1981). Most of these scales have identified general associations between negative affect and self-reported stress and poor coping, and between positive affect and social activity, satisfaction, and the frequency of pleasant

events (e.g., Bradburn, 1969; Clark & Watson, 1986; Kanner, Coyne, Schaeffer & Lazarus, 1981). However, not all scales seem to be pure measures of either positive or negative affect, nor have they all been subjected to psychometric assessment. The most well-developed measure of these constructs is the *Positive and Negative Affect Schedule* (PANAS; Watson, Clark & Tellegen, 1988). This measure was devised through the use of factor analysis and the two factors share only 1-5% of their variance (Watson et al., 1988). Use of the PANAS has shown that negative mood is significantly correlated with ratings of perceived stress (Watson, 1988). Such negative mood ratings also are associated with self-report of physical complaints, although not with frequency of actual illness (Watson, 1988). Thus, mood is significantly related to reports of stressful experiences, and the PANAS negative affect subscale seems to be the most appropriate assessment tool for this construct.

Several studies have reported discrepancies between these self-report ratings and physiological measures of stress (e.g. Curtis, Buxton, Lippman, Nesse & Wright, 1976; Earle et al., 1996). For example, Walsh, Wilding, and Eysenck (1994) asked subjects to rate their stress and arousal in response to the challenge of performing a mental arithmetic task. In addition to these self-report ratings, the researchers assessed heart rate and skin conductance. Surprisingly, the self-report measures were not significantly correlated with the physiological measures, although the physiological measures were strongly correlated with one another. Therefore, to use only mood ratings would be to ignore the breadth of human stress and would risk missing out on important signs of the hypothesized relationship.

Within the domain of physiological measures, there are both short- and long-term signs of stress, and systems which are activated by different types of stressors. Physiological measures of stress generally assess either hormones or body regions which act to prepare the body for a "fight or flight" response. Two stress systems have achieved prominence in this field of research: the sympathetic nervous system adrenal-medullary system, and the pituitary-adrenal cortical system (e.g. Arnetz & Fjellner, 1986; Dienstbier, 1989; Earle et al., 1996).

II. *The Adrenal-Medullary System* (e.g. heart rate)

In this first system, neurons stimulate the adrenal medulla to release adrenaline and noradrenaline. These, in turn, produce cardiovascular reactions which are most commonly associated with stress. These include elevated heart rate, blood pressure, and skin conductance, and diminished peripheral skin temperature. In Dienstbier's (1989) review, he notes that a negative perception of these effects predominates in the literature. That is, 'excessive' cardiovascular response to stress commonly has been and continues to be described as associated with coronary heart disease (Krantz & Manuck, 1984) and pathogenic factors underlying the development of cardiovascular disease (Blascovich & Katkin, 1993). However, in analyzing a number of studies, Dienstbier concluded that an optimal and healthy stress response requires a strong and immediate onset. This response becomes 'excessive' or unhealthy only when it endures for an extended period of time. The half-life for peripheral catecholamines (adrenalin and noradrenalin) is less than three minutes, making it quite easy to study measures such as heart rate deceleration following a stressor.

The work of other researchers supports Dienstbier's conclusions. Arnetz and Fjellner (1986) observed that adrenal-medullary involvement was greatest in subjects who reported low levels of tension, and greater involvement in a task. In a series of studies, Frankenhaeuser and her colleagues reported that adrenalin and noradrenalin were most indicative of effort and involvement, not of distress per se (Frankenhaeuser, 1979; Lundberg & Frankenhaeuser, 1980). Tomaka and his colleagues (1993) described the presence of strong cardiac arousal in the absence of self-reported task stress as occurring during "challenge appraisal". In this type of situation, the individual does not feels threatened and is able to engage in active coping. Higher levels of this form of arousal are associated with improved performance in such varied tasks as academic exam performance (more so for males) and parachute jumping (Rauste-von Wright, von Wright & Frankenhaeuser, 1981; Ursin, Baade, & Levine, 1978). However, studies also support the notion that those whose arousal decreases slowly are less stable psychologically and less efficient in achievement situations than "rapid decreasers" (Frankenhaeuser, 1979). That is, slow return to

baseline indicates an excessive use of resources with potential long term effects on psychological well being and performance.

For the purposes of the present study, we chose to study heart rate as a representative indicator of sympathetic involvement; that is, as an indicator of activation of the cardiovascular system in response to a stressor. Both immediate and extended heart rate levels will be assessed so as to measure effort during the task, and potential harmful effects from enduring arousal. Heart rate can be easily and inexpensively measured with the use of portable exercise monitors.

III. *The Pituitary-Adrenal Cortical System*

In contrast to adrenal-medullary functioning, immediate activation of the pituitary-adrenal cortical system seems to be firmly linked to distress. Elevations in cortisol reflect problems coping (Dienstbier, 1989) whether they occur acutely in response to a specific stressor, or more chronically due to difficulties coping with life in general. Such elevations are associated with physiological stress-related difficulties such as inhibition of the secretion of lymphokines (which ultimately results in suppressed immune function; Calabrese, Kling & Gold, 1987). In addition, high cortisol base rates have been linked to increased symptoms of anorexia (Barnes, 1986), anxiety (Anisman & LaPierre, 1982), and especially, severe clinical depression (Sachar, 1975). The same studies which found adrenal-medullary arousal to be linked to involvement and effort, found that elevated cortisol levels are linked to increased tension (Arnetz & Fjellner, 1986), distress, and lack of control (Frankenhaeuser, 1979; Lundberg & Frankenhaeuser, 1980).

In preparation for, or during stress, cortisol is released following direct activation of the adrenal cortex by either hormones or neurons. For example, Hellhammer, Kirschbaum & Belkien (1987) noted two peaks in cortisol concentration in their study following a stressful movie. The first, more immediate peak may have been activated by corticotrophin-releasing hormone (CRF) initiating neuronal stimulation of the adrenal cortex whereas the second peak, occurring after about 15 minutes, may reflect a pituitary activated hormonal system. The hormonal route is as follows: CRF is secreted from the posterior hypothalamus and causes the release of adrenocorticotropic hormone (ACTH) which in turn activates the adrenal cortex to release cortisol (Moore-Ede, Sulzman & Fuller, 1982).

Cortisol is one form of glucocorticoid which means its primary role is in maintaining and activating carbohydrate reserves. In response to reduced blood sugar, cortisol inhibits protein synthesis in muscle and lymphoid tissues, releasing amino acids into the blood stream. These amino acids are added to an enhanced flow of glucose precursors and glycogen-forming enzymes to form usable precursors of carbohydrate. However, gluconeogenesis is not cortisol's sole responsibility; it also participates in other activities designed to help an organism handle adverse conditions. Because cortisol travels freely through the circulatory system, it can produce varied effects on the numerous tissues with which it comes in contact. The impact of cortisol is far ranging; yet, the precise effect of increased cortisol concentrations following stressors is not well understood. (Goodman, 1988)

Cortisol is a good measure of distress because it responds only to certain types of psychological stressors. Mason (1968) suggested that cortisol is most likely to be released in response to stressors involving novelty, unpredictability, and suspenseful anticipation. Later studies have supported this hypothesis, and have proposed several other aspects of potent stressors including lack of control over a situation (i.e. Frankenhaeuser, 1979), and weakened psychological defenses (e.g. Sachar, Mackenzie, Binstock & Mack, 1967; Curtis, Fogel, McEvoy & Zarate, 1970).

In sum, these studies indicate that cortisol is released in response to particular types of psychological stressors. Thus, in choosing an appropriate physiological measure of stress, neither cortisol nor adrenal-medullary related measures are, in and of themselves, sufficient to measure stress. Cortisol seems to be responsive to a limited types of stressors; lack of response does not necessarily reflect lack of experienced distress. The alternative, an adrenal-medullary measure, does not suggest maladaptive stress simply by its intensity but by the duration of the response. Therefore, studies wishing to assess human stress response to psychological stressors are best to use a comprehensive approach with three different types of measures in their design: self-report of mood, an adrenal-medullary measure, and a measure of the pituitary-adrenal cortical system.

Methodological Considerations in Stress Assessment

Having decided to assess three indices of stress in this study, particular methodological issues were raised, especially for physiological measurement. Choices had to be made concerning the means of testing cortisol levels, whether through serum, urine, or saliva. In addition, the factors of circadian rhythms and gender had to be understood and evaluated.

Methods of Cortisol Measurement

Early studies of cortisol relied on blood plasma and urinary sampling. These techniques lead to a variety of problems and complications including sampling difficulties, expense of the procedures, and the stressfulness inherent in obtaining samples (e.g., venipuncture; Riad-Fahmy, Read, Walker & Griffiths, 1982; Landon, Smith, Perry & Al-Ansari, 1982; Vining & McGinley, 1985). Recently, a technique has been developed that simplifies procedures by sampling cortisol levels in saliva. Kirschbaum, Strasburger, Jammers, and Hellhammer (1989) noted that assays for salivary cortisol are highly reliable, and subjects can provide samples by merely spitting into small containers; a process which is stress-free. This ease of sampling means that many samples can be taken within a relatively short period of time which is ideal for studies involving multiple assessments.

Circadian Rhythms in Cortisol Secretion

The circadian rhythm of cortisol arises from changes in the frequency of discrete secretory episodes throughout the day, as opposed to changes in the quantity of cortisol secreted at any one time. The majority of secretory episodes occur between hours five to eight of sleep and the first hour of waking. Fewest cortisol secretion episodes occur just before sleep-onset. (Weitzman, Fukushima, Nogeire, Roffwarg, Gallagher & Hellman, 1971) Cortisol is considered to have a "high-amplitude rhythm" meaning that the concentration of this hormone can vary plus or minus 100% from the mean throughout the day (Moore-Ede et al., 1982). As a result, it is essential to take the time of testing into consideration when assessing data on cortisol levels. A measure of whether testing occurred during the morning or the afternoon was used in the present study as a control variable in all regression equations involving cortisol.

Gender and Physiological Arousal

Studies using a variety of physiological measures of stress frequently have reported that males are more reactive than females. For example, Linden (1991) found that males showed greater cardiovascular reactivity in response to a math task in two of his three studies. Many researchers propose that gender differences vary according to the type of stressor. For example, achievement tasks, such as the math task used by Linden (1991) may stimulate only men, as they are more threatening to the masculine self-esteem (Burns, 1995). Lash and colleagues (1991) manipulated the gender relevance of a task by using instructions suggesting males would be more successful or gender-neutral instructions. Males experienced greater heart rate elevations than females only in the gender-biased condition.

Similarly, research on gender differences in cortisol response to achievement tasks has found greater response in males. In an early study of matriculation examination stress, cortisol levels were elevated among only the male students (Frankenhaeuser, Rauste-von Wright, Collins, von Wright, Sedvall & Swahn, 1978). In their next study, this research group looked at the responses of male and female engineering students enrolled in traditionally male subject areas (ones in which less than 5% of the class was female) (Collins & Frankenhaeuser, 1978). Although males still showed a greater increase in cortisol reactivity, the females in this sample did experience an increase in cortisol during the task. Therefore, females in traditionally-male roles may show similar physiological reactivity to males. What these studies suggest is that achievement stressors have traditionally been more relevant to males and consequently have produced greater physiological arousal among members of this gender. However, as females take on traditionally-male roles, they may come to place similar importance on these stressors and react to them in an aroused fashion.

The only study to investigate the association of perfectionism and physiological arousal did not report any gender differences in their results (Roberts & Lovett, 1994). However, self-oriented perfectionism interacts with achievement stress to predict depression in both men and women (Hewitt & Flett, 1993; Hewitt et al., 1996). Thus, it may be that both men and women who are high on self-oriented perfectionism will show greater stress during the achievement task. On the

other hand, Hewitt et al. (1993) found that only the female patients in their sample showed a significant correlation between self-oriented perfectionism and emotion-oriented coping, which is generally seen as maladaptive. Therefore, they suggested that women may respond or cope less adaptively then men to perfectionistic self-standards. No clear expectations regarding gender differences arise from the above research. As a consequence, gender differences will be investigated in this study, although no a priori predictions are made.

Coping and Stress

It has been proposed that the preferred coping strategies of perfectionists may influence the duration of the stress response. Thus, it is essential to understand first how coping relates to stress in general. Bohnen, Nicolson, Sulon, and Jolles (1991) studied cortisol and coping in women during continuous mental tasks. They found that the use of comforting cognitions, and to a lesser extent, seeking social support correlated negatively with stress levels during the tasks. In another study, stress levels in males were found to be negatively correlated with flexible goal adjustment, and positively correlated with tenacious goal pursuit. While it is somewhat difficult to compare different coping measures because they employ different labels of coping styles, these studies seem to imply that focusing on the task and doggedly continuing towards one's goal is associated with increasing levels of stress, whereas avoidance and more emotion-based coping, such as comforting thoughts or goal adjustment, do not produce such an increase.

Several studies have proposed that work or task involvement may be associated with cortisol reactivity. Although these studies did not intend to study coping, task involvement could be interpreted as a type of task-oriented coping. In a study of cardiac catheterization patients, patients were described as anxious-engaged, anxious-not engaged, depressed, or calm (Greene, Conron, Schalch & Schreiner, 1970). Both of the anxious groups experienced increases in cortisol, whereas the other groups did not. The anxious-engaged group would seem to have employed task-oriented coping, and the anxious-not engaged group may have tried to use some other type of coping, but must not have been very successful if they were still anxious. Thus, both task-oriented coping and failed coping strategies lead to raised cortisol. In another study using a modified Stroop colour-word task as the stressor, increase in pulse and diastolic blood pressure

was associated with a lack of tension at the end of the task (Arnetz & Fjellner, 1986). The authors suggested that these subjects were more involved with the task (task-oriented coping) and therefore experienced less subjective tension. All of these studies raise the possibility that task-oriented coping may be associated with stress reactivity, but this relationship has yet to be directly investigated.

Task-oriented type coping styles are associated with self-oriented perfectionism. In a study of constructive thinking and perfectionism, Flett, Russo, and Hewitt (1994) found that self-oriented perfectionism was associated with the "positive behavioural coping styles" of action orientation and conscientiousness. Although "positive" in the sense that they may serve to directly address a problem, these behaviours could lead to augmented stress response as described in the above studies. In addition to these styles of coping, self-oriented perfectionists also endorsed feelings of low self-acceptance which the authors describe as characterizing an inability to tolerate failure. However, those feelings also imply that the coping strategies being employed by self-oriented perfectionists are failing to preserve or enhance a positive self-image. These studies certainly imply that ineffective or inappropriate coping strategies may play some role in creating more aversive stress events for self-oriented perfectionists.

The present study

The present study investigates the association between self-oriented perfectionism and stress following an achievement-related test. Based on the notion that self-oriented perfectionism influences the stressfulness of achievement events, it is hypothesized that:

I. *Those scoring high on the perfectionism scale should be less satisfied with their performance after controlling for actual performance, than those scoring low.*

II. *Self-oriented perfectionism should predict the intensity of the stress response.*

a) Self-oriented perfectionism should predict a greater increase in negative mood following the test.

b) Self-oriented perfectionism should predict more elevated heart rate during the test.

c) Self-oriented perfectionism should predict a greater increase in cortisol levels following the test.

III. *Self-oriented perfectionism should predict a greater duration of stress response.*

a) Self-oriented perfectionism should predict greater negative mood at recovery.

b) Self-oriented perfectionism should predict more elevated heart rate at recovery.

c) Self-oriented perfectionism should predict more elevated cortisol levels at recovery.

IV. *Self-oriented perfectionism should be positively associated with emotion and task-oriented coping styles.*

V. *The interaction of self-oriented perfectionism and both emotion and task-oriented coping styles should predict enduring stress.*

Hypotheses II, III, and V should be maintained even after controlling for the use of specific coping strategies, perceived life stress, and test anxiety.

METHOD

Participants

Participants for this study were 131 volunteers from the undergraduate psychology subject pool at the University of British Columbia. According to Green (1991), this number should be sufficient to find a medium-sized effect using as many as ten predictors. One subject was excluded because he copied another subject's responses during the achievement task. The average age was 19.5 years (range from 16 to 28, SD=1.93), and all subjects had between 13 and 21 years of education (M=13.85, SD=1.18). Sixty-six subjects were white Caucasians, 31 Chinese, and the remainder were of other Asian, African, Middle Eastern or 'Other' ethnic backgrounds. There was a fairly even gender split with 56.2% of the sample being male and 43.8% female. Six subjects reported taking medications which could potentially influence heart rate, and five were taking medications judged to influence cortisol[1]. However, as the first six subjects did not show significantly different heart rates from the other participants at either baseline or relaxation time

[1]Judgements were made by two licensed pharmacists. One pharmacist identified only three subjects whose medications might impact cortisol reactivity. The second pharmacist agreed with these judgements, but also identified other subjects whose medication use might impact heart rate or cortisol baselines even slightly. We used the more conservative evaluation of the second pharmacist to ensure that medication use was not influencing our results. Use of oral contraceptives was investigated separately and is reported in the results section.

periods, they were left in the analyses[2]. Similarly, the six subjects taking medications which potentially could influence cortisol levels had comparable baseline cortisol levels to the other subjects[3]. Therefore, these subjects also were left in the analyses. Participants were awarded credits towards their course grade in return for time spent in the studies.

Materials

At specific times during the study, subjects completed the following measures.

Predictors

Multidimensional Perfectionism Scale (MPS; Hewitt & Flett, 1991b). This scale assesses the three trait dimensions of perfectionism. Subjects are asked to make seven-point ratings on how much they agree with each of 45 statements such as: "When I am working on something, I cannot relax until it is perfect" (self-oriented perfectionism), "I have high expectations for people who are important to me" (other-oriented perfectionism), and "I feel that people are too demanding of me" (socially-prescribed perfectionism). Higher scores indicate greater endorsement of perfectionistic items. This measure has good reliability and validity (Hewitt & Flett, 1991b). For example, the self-oriented perfectionism scale coefficient alpha was reported at .86. This subscale was not significantly correlated with social desirability, but scores did correlate with ratings made either by people close to the subjects, or by clinicians. Furthermore, test-retest reliability over a three month period was .88 for self-oriented perfectionism, demonstrating that this scale measures a stable personality trait.

Coping Inventory for Stressful Situations (CISS; Endler & Parker, 1990a). This inventory was developed to tap individuals' preferred coping styles which are employed across a variety of situations (Endler & Parker, 1990b). The 48-item measure asks subjects to rate the frequency with

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[2]During the baseline period, $t_{(127)}=.67$, $p>.50$, and during the relaxation period $t_{(127)}=.70$, $p>.45$. In addition, regression analyses were conducted to assess the impact of medication use on heart rate reactivity at each of the five time periods. The use of medications did not explain variation in heart rate at any of the time periods.

[3]During the baseline period, the difference between those taking medications and those who were not was not significant ($t_{(124)}=.15$, $p>.50$). In addition, regression analyses were conducted to predict post-test and follow-up cortisol levels. First, baseline cortisol, body mass index, and time of testing were entered into the equation followed by use of medications. The use of medications did not explain a significant portion of variance in cortisol reactions at either time period.

which they engage in different activities following a difficult, stressful, or upsetting situation. The three major strategies included in this instrument are task-oriented coping (e.g., "Work to understand the situation"), emotion-oriented coping (e.g., "Become very tense"), and avoidance. The avoidance subscale can be broken down into distraction (e.g., "Treat myself to a favorite food or snack) and social diversion (e.g., "Spend time with a special person"). This scale reportedly has solid reliability and validity (Endler & Parker, 1990b). For example, internal alpha reliabilities for the three subscales reportedly range from .77 to .91. Correlations between these factors and those on the popular though methodologically weak Ways of Coping Questionnaire (Folkman & Lazarus, 1988) converged and diverged in a meaningful fashion. Finally, these factors were associated differentially with various forms of psychopathology. For example, use of the emotion-oriented coping style was associated most strongly with depression and anxiety scores.

Covariates

As both general life stress and test anxiety could heighten subjects' reactivity to the achievement task, measures of these constructs were included in the study. By doing so, we could ensure that any effect of self-oriented perfectionism on stress was not due to these factors.

Perceived Stress Scale (PSS; Cohen, Kamarck & Mermelstein, 1983). This scale was formulated from the perspective that distress is a function not only of the frequency and presence of stressful experiences but also of one's perceived ability to handle those experiences (i.e. their controllability and predictability). Thus, the PSS does not assess reactions to specific events, but rather the subject's overall impression of stress in his or her life. Ratings are made on a 0-4 scale indicating the frequency with which they have experienced 14 feelings and thoughts about stress. Scores can be divided into two factors: perceived distress, and perceived coping ability (Hewitt et al., 1992). This scale has been shown to have good reliability and validity (Cohen et al., 1983; Hewitt et al., 1992). For example, both papers report coefficient alpha levels of .80 to .86. The predictive validity of the measure has been demonstrated as scores on the PSS correlate with levels of depression.

Reactions to Tests (Sarason, 1984). The RTT questionnaire evaluates four-dimensions of test anxiety: tension (e.g., "I feel jittery before tests."), worry (e.g., "Before tests, I feel troubled about

what is going to happen."), test-irrelevant thinking (e.g., "During tests, I think about recent past events."), and bodily reactions (e.g., "My stomach gets upset before tests."). Each subscale is evaluated by ten such statements that the subject rates on a four-point scale according to how typical each is for them. This scale was constructed through the use of factor analysis. The overall alpha coefficient was .78 and subscale alphas ranged from .68 to .81. Support for the usefulness of distinguishing between the four dimensions was provided in a study showing that worry is the factor most associated with cognitive interference and lowered performance.

Dependent Measures

Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). This questionnaire was used to obtain a self-report measure of the subject's mood. The scale measures both positive and negative affect. Subjects rate how much they have experienced each of 20 mood-related adjectives on a 5-point scale (1=very slightly or not at all; 5=felt very much). Only the negative subscale scores are reported here, as the positive subscale includes adjectives such as alert, determined, active, and attentive which may be confounded with active involvement with a task. Indeed, Watson (1988) reported that only the negative subscale is correlated with ratings of perceived stress. Higher scores on this subscale are indicative of greater negative mood. Watson et al. (1988) report that these scales are reliable, sensitive to fluctuations in mood, and show convergent and discriminant validity.

Heart Rate. In addition to measuring stress with subjective mood ratings, heart rate was recorded throughout the study. The four monitors were Polar Beat™ models produced by Polar Electro Inc., Port Washington, NY. Each monitor consists of a chest strap with grooved electrode areas that is placed just below the breasts against the skin. This unit transmits the heart rate reading to a watch style receiver. These receivers were taped to the back of each subject's chair to facilitate recording for the experimenters and to eliminate any distress subjects may have experienced by watching their own heart rates fluctuate. The receivers can operate up to three feet away from the transmitter. Therefore, the receivers were placed as far away from other subjects as possible to minimize interference.

Experimenters recorded heart rates at the following times:

Minutes 4 and 8	during the initial baseline period
Minutes 16, 21, and 26	during the relaxation tape
Minutes 31 and 35	during the math task
Minutes 40, 44-45, and 50	during the anagram task
Minutes 56, 61, 66, 71, 76, and 81	during the recovery or evaluation period.

These readings then were averaged into seven time intervals: baseline, relaxation, math task, anagrams, recovery 1 (mean of minutes 56 and 61), recovery 2 (mean of minutes 66 and 71), and recovery 3 (mean of minutes 76 and 81).

Salivary Cortisol. Following saliva collection, samples from this study were taken to a lab and frozen at -20°C within 24 hours (see Riad-Fahmy et al., 1982). The freezing process is important for improving the viscosity of the saliva sample. Oral fluid contains bacteria, and leucocytes, particularly after stimulation such as chewing (Ferguson, 1984). Mucus also makes analysis difficult. Freezing denatures the mucin (Vining & McGinley, 1985) and traps debris in the proteins (Ferguson, 1984). These substances then can be centrifuged out for two minutes at 3000 r.p.m. before conducting the cortisol assays (Kirschbaum et al., 1989). Assays were conducted using the modified Magic Cortisol ^{125}I radioimmunoassay kit (CIBA- Corning Diagnostics Corps., Medfield, MA) as described by Kirschbaum et al. (1989). This kit was designed originally for use with serum but can be adjusted for use with saliva by diluting the serum standards 1:10 with phosphate-buffered saline (pH 8.0). This procedure takes into account that salivary cortisol concentrations represent the free unbound cortisol concentrations in serum which are about 8-10% of the total serum cortisol concentration (Brien, 1980; Umeda et al., 1981). Each sample was run in duplicate and the intra-assay coefficient of variation was 7%.

Performance Evaluation. In order to assess students' levels of self-satisfaction following the test period, they were asked to answer the following questions on a 7-point scale ranging from "not at all satisfied" to "extremely satisfied".

"How satisfied are you with your performance?" (meeting self-set expectations)

"How satisfied do you think others who are important to you would be with your performance?" (meeting socially-set expectations)

These questions verify perfectionistic thought patterns and address the first hypothesis, whether perfectionists are more likely to perceive this event as being a stressful failure experience than other subjects. Ratings of low satisfaction represent a failure to meet self-set or other-imposed expectations.

Stimuli

"The University of British Columbia Verbal Intelligence Test". This bogus test included two parts, a five minute mental arithmetic section and a fifteen minute anagram task. During pilot studies, the two part test produced greater stress responses than anagrams alone. Mental arithmetic tasks have been described as choice stressors because they are short (which prevents habitualization), demanding, and engaging (Walsh et al., 1994). Math tasks also are better than anagrams for eliciting heart rate response (Gramer & Huber, 1994). However, the anagram task is more difficult and runs for a longer stretch of time which is important in creating an imperfect performance and in allowing the cortisol response to occur[4]. Thus, both forms of test were included, but increase in heart rate arousal was expected primarily during the math task, whereas negative mood and cortisol elevations were expected to accompany the completion of both test sections. A final advantage to the combined test was that together, the two tests produce better face validity and may enhance students' concern with their performance. Students were told that these two sections can measure a variety of different abilities including verbal skills, spatial skills, and analytical reasoning. These statements served to increase students' ego-involvement with the tasks. This type of statement has been used in other studies to increase the degree of importance which subjects associate with the task (i.e. Roberts & Lovett, 1994). The mental arithmetic section consisted of thirty basic arithmetic problems which were announced on an audio tape every ten seconds. Subjects were permitted to write down only their answers. During this five minute interval, the experimenter paced behind students' chairs and looked at their papers, presumably to

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[4]Kirschbaum and Hellhammer (1989) reported that salivary cortisol peaks 20-30 minutes after the onset of a mild laboratory stress. Linden, Dadgar & Earle (1994) conducted a meta-analysis on stressors involving "active coping" (independent achievement tasks) or that were "dyadic" (involving other subjects). The present study implicitly involved competition with other students and appraisal by the experimenters. Therefore, we hypothesized that cortisol peaks would occur between the averages reported by Linden et al.; that is, at about 20 minutes post-test onset.

ensure that they were not writing down the questions, but also to make the students' performances more public.

The anagram task consisted of 25 anagrams which, based on norms from Tresselt and Mayzner (1966), should take the average person over one hour to complete. Students had 15 minutes to complete the task. When they were ready to move from the first page of nine anagrams to the second page, they were asked to inform the experimenter, who then would tell them how many they got correct on the first page and would give them the answers to any that they got wrong or missed. This exercise served two purposes. First, it made the student's performance more public, particularly because the number correct was announced loudly enough for other students in the room to hear. Secondly, it proved that the anagrams were all possible and increased the face validity of the test. If students did not volunteer to move on to the second page, the experimenter would announce between minute 44 and 45, that their time was half over and that their answers would be checked so they could attempt the next page.

Manipulation Check

The credibility of the experimental manipulation was tested by asking:

"How well do you think scores on this test represent people's academic performance?" Subjects responded by making a rating on a 7-point scale ranging from "very poorly" to "very well". Those who believed that this was a valid test of academic performance were assumed to be more ego-involved with the task.

Procedure

Subjects were contacted by telephone and asked to participate in a study of personality and salivary cortisol levels. Volunteers were scheduled for an appointment in the lab and were instructed not to smoke, eat, drink, exercise, or brush their teeth for at least one hour before their appointment, and not to floss their teeth for twelve hours prior to the appointment (Hellhammer et al., 1987; Landon, 1982; Vining & McGinley, 1985). Participants were excluded if they failed to meet these pre-sampling instructions or if they had any medical condition which could influence their heart rate or cortisol response. Such conditions include: high blood pressure, Cushing's

Syndrome, adrenal insufficiency caused by Addison's disease or Sheehan's syndrome, liver disease, or hyperthyroidism (Brien, 1980).

When subjects arrived, they listened to a brief description of the study, and were asked to rinse their mouths thoroughly with one cup of water to clear extraneous substances such as food particles (Al-Ansari et al., 1982; Landon, 1982). For the following nine minutes, subjects began filling out a small number of questionnaires. This period of relaxation and lack of gross muscle movement was needed before sampling, because exercise can produce physiological arousal.

Among these initial questionnaires were participant information forms which asked for basic demographic information such as age, sex, education, ethnicity, height, and weight (to calculate body mass index[5], as body mass is inversely related to cortisol levels; Rose et al., 1982), as well as medical history and medications use. Women also were asked whether they use oral contraceptives and the stage of their menstrual cycle (including pregnancy). Oral contraceptives and pregnancy only seem to influence concentrations of protein-bound cortisol (Al-Ansari et al., 1982; Kirschbaum et al., 1989; Vining & McGinley, 1985), although there are reports of slight elevations in salivary cortisol too (Vining, McGinley, Maksvytis, & Ho, 1983). For that reason, we collected information regarding these factors so as to rule out their contribution to cortisol changes. The impact of menstrual phase is poorly understood at this point and thus, must be controlled. During this time interval, subjects also completed the MPS (Hewitt & Flett, 1991b).

After nine minutes, subjects engaged in a fifteen minute version of Jacobson's Progressive Muscle Relaxation (Barlow & Craske, 1994) in order to attempt to equate subjects' levels of stress for the baseline phase. Following a brief introduction to the technique, subjects listened to a fifteen minute tape which instructed them to tense then relax various muscle groups. Other researchers have found this technique to be effective in decreasing autonomic tonus and in inducing feelings of relaxation (Arnetz, Fjellner, Kallner & Eneroth, 1985). Pilot studies indicated that a relaxation exercise was necessary during the baseline period as most subjects were quite anxious when they arrived to participate in the study, presumably because it was a novel situation and they did not

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[5]Body mass index = Weight (kg) / [Height (m)]^2.

know what to expect[6]. Immediately after the tape was finished, subjects completed the PANAS (Watson et al., 1988).

At 28 minutes and fifteen seconds, subjects were advised to start collecting saliva in their mouths, and at minute 29 were shown how to spit into a small container. This forty-five second warning period before each sampling allowed students to produce an adequate sample in a shorter period of time. Analyses require 3 ml saliva samples. Previous studies have indicated that subjects have little difficulty in producing this quantity (Riad-Fahmy et al., 1982; Vining, 1982). However, some researchers have found that anxiety produces a decrease in salivary flow (Ben-Aryeh et al., 1985). For this reason, all subjects were told to suck their cheeks and lips to increase saliva production (Landon, 1982). If this was insufficient, citric acid swabs were available for subjects to touch against their tongues. Citric acid has been found to increase salivary flow from .5 ml/min to 5-10 ml/min without altering salivary cortisol concentrations (Riad-Fahmy et al., 1982; Vining & McGinley, 1985). This sample represented baseline cortisol levels.

Subjects had two minutes to produce the required amount of saliva. At thirty minutes, the experimenter introduced "The University of British Columbia Verbal Intelligence Test". Experimenters explained that this test "is a good predictor of students' academic achievement and future successes". At minute 51, students provided a second salivary sample (the "post-test" sample) and completed the PANAS again. They also were asked to evaluate their performance and rated the credibility of the experimental manipulation. Students then were interviewed and completed questionnaires, although these two tasks were carried out in varied orders for each group of subjects. Only three of the questionnaires are relevant to this study: the CISS (Endler & Parker,1990a), the PSS (Cohen, Kamarck & Mermelstein, 1983), and the RTT (Sarason, 1984).

Most students were able to complete the questionnaires with ten or fifteen minutes remaining before the last saliva sampling. These students were given a choice of magazines to read. At one hour and twenty-two minutes into the study, the final salivary sample was taken to represent the "recovery" phase. Students were asked to complete another PANAS, and then were debriefed.

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[6]A t-test showed that heart rate during the relaxation period was lower than at baseline ($t_{(128)}=3.72$, $p<.001$).

RESULTS

Before conducting tests of specific hypotheses, the data were examined using the following procedures based on Tabachnick and Fidell (1989). First, missing data were identified and in most cases replaced by subscale means (unless more than 10% was missing from that set in which case the cell was considered missing). Next, distributions of variables with significant skew and kurtosis were transformed in an attempt to normalize their distributions and eliminate outliers. The following transformations successfully normalized the shape of the distributions and removed outliers: using 1/x: body mass index, PANAS-A negative subscale, and PANAS-C negative subscale; and using LN(x+1): cortisol at baseline, post-test, and recovery. A limit of plus or minus three standard deviations from the mean was used to identify remaining outliers. Several outliers remained for the cortisol variables following transformations (3 data points each for baseline and post-test cortisol levels, and 2 for recovery cortisol) and these were eliminated from the analyses.

The means, standard deviations, and coefficients Alpha for each self-report measure can be found in Table 1. All scales demonstrated adequate internal consistency. The means of these self-report measures are roughly equivalent to other work with the scales (e.g. Endler & Parker, 1990; Hewitt & Flett, 1991b; Sarason, 1984; Watson et al., 1988). However, the mean level of task-oriented coping was slightly higher than that in Endler and Parker's (1990) sample[7], perhaps reflecting a strong achievement orientation among students at the University of British Columbia. The mean level of perceived stress in this sample ($\underline{M}$=27.30), although lower than Hewitt et al.'s (1992) clinical sample ($\underline{M}$=29.07), was higher than Cohen et al.'s (1983) college samples ($\underline{M}$=23.18 and 23.67). This difference was significant ($t_{(574)}=5.34$, $p<.001$), suggesting that the present sample was reporting somewhat higher levels of distress than previous college samples.

[7]As reported in Endler and Parker (1990b), the mean for females was 3.54 (SD=0.63), and for males was 3.53 (SD=0.57). T-tests were conducted to assess the difference between the overall sample mean and that obtained in the present study ($t_{(687)}=2.54$, $p<.02$).

Self-oriented perfectionism was not significantly associated with any of the three baseline stress measures[8].

Hypothesis I: Perceptions of Failure.

To assess whether high levels of self-oriented perfectionism were associated with decreased levels of self-satisfaction following the test, a regression analysis was conducted on ratings of self-satisfaction with performance. On the first step, performance on both the math and anagram portions of the test were entered into the equation in order to partial out their impact on the satisfaction ratings. This accounted for a significant portion of the variance (for math performance, β=21, and for anagrams, β=.27, together $F_{(2,127)}=11.41$, $p<.0001$). This was followed by the second step, addition of self-oriented perfectionism. Perfectionism explained a significant portion of the variance in self-satisfaction ratings (β=-.34, $F_{(3,126)}=19.67$, $p<.0001$). In addition, self-oriented perfectionism explained a significant portion of the variance in students' ratings of how satisfied others would be with their performance even after actual performance was entered into the equation (β=-.35, $F_{(3,126)}=20.67$, $p<.0001$).[9] These findings indicate that while controlling for actual performance, subjects with elevated perfectionism tended to perceive their performance as less satisfactory.

Hypothesis II: Intensity of Stress Response.

All three measures of stress, subjective mood ratings, heart rate, and cortisol, were used to address this issue. A series of hierarchical multiple regression analyses were used to control for individual differences in initial levels of the dependent measures. Baseline measures were entered into the equations on the first step, followed by self-oriented perfectionism on the second step.

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[8]With self-reported negative mood (after inverse transformation $r_{(129)}=-.12$, $p>.10$), with relaxation heart rate ($r_{(130)}=-.14$, $p>.10$), and with baseline cortisol levels (after transformation $r_{(126)}=-.03$, $p>.50$).

[9]It is important to note that those rated high on self-oriented perfectionism did not perform differently on the two tests from those scoring low on this dimension (for the math task $r_{(128)}=.11$, $p>.20$, and for the anagrams $r_{(128)}=.05$, $p>.50$). This finding counters the arguments of some authors who have tried to suggest that some forms of perfectionism are good, providing those individuals with the motivation to achieve more (e.g. Terry-Short, Owens, Slade & Dewey, 1995). In fact, this study indicates that self-oriented perfectionists do not have superior achievement.

As can be seen in the top panel of Table 2, baseline negative mood accounted for a significant portion of the variance in negative mood following the test. Next, self-oriented perfectionism was added to the equation and predicted additional variance in post-test negative mood. Higher levels of perfectionism were associated with greater increases in negative mood from baseline to post-test.

Evaluation of heart rate response is in the middle panel of Table 2 and followed a similar pattern. Heart rate during relaxation was used instead of baseline levels, as the former were lower and had a smaller standard deviation. Heart rate during relaxation accounted for a significant portion of variance in post-test heart rate. However, additional variance was predicted by self-oriented perfectionism for the math task, but not for the anagram task. Once again, higher levels of perfectionism were associated with greater stress, this time in the form of heart rate elevation.

To assess cortisol response, cortisol during baseline was entered first into the equation along with the controls of body mass index and time of testing. As discussed previously, body mass index is inversely related to cortisol levels (Rose et al., 1982), and due to the circadian rhythm of cortisol, time of testing must be considered (Weitzman et al., 1971). Together these factors predicted a significant portion of the variance in post-test cortisol levels. Perfectionism entered the equation last, and was not a contributing factor to post-test cortisol levels (see the last panel of Table 2).

In order to control for possible confounds, these regression analyses were redone using the same first steps as before, but with additional covariates entered into the equation on the second step and self-oriented perfectionism on the third. This procedure permitted an assessment of the unique variance accounted for by perfectionism. The covariates included: the CISS (emotion-oriented, task-oriented, and avoidance subscales), the PSS total score, and the RTT total score. Total scores are appropriate for the latter two scales as they measure one unitary characteristic (perceived stress and test anxiety respectively). However, the CISS subscales do not sum together to measure a single construct; it does not make sense to discuss use of coping strategies in general.

For subjective ratings of negative mood, both baseline negative mood and the block of the covariates predicted significant variance in post-test negative mood. However, self-oriented

perfectionism no longer was a significant predictor of post-test negative mood (top panel of Table 3).

Heart rate during the math and anagram tasks was significantly predicted by relaxation heart rate but not by the block of the covariates. Perfectionism continued to predict nearly significant variance in heart rate during the math task ($p<.10$), and also during the anagram task ($p<.10$; middle panel of Table 3).

One additional covariate was added for the analysis on cortisol. As depression is associated with elevated cortisol, baseline mood ratings were added to the equation. Menstrual phase and use of contraceptives were not added to the equation because they did not significantly influence cortisol reactivity[10]. Similar to the results with heart rate, the first step of covariates including baseline cortisol, body mass index, and time of testing explained significant variance in post-test cortisol, although the block of the covariates did not. As in the equation without control measures, perfectionism failed to demonstrate significant predictive power for post-test cortisol (bottom panel of Table 3). Therefore, self-oriented perfectionism was a unique predictor of variance only for heart rate elevation following the test.

Hypothesis III: Duration of Stress Response.

Once again, all three measures of stress were used to evaluate the maintenance of the stress response. Regression analyses used the same first steps as before, followed by self-oriented perfectionism on a second step. These analyses are displayed in Table 4.

As would be expected, baseline negative mood was a significant predictor of recovery negative mood. However, self-oriented perfectionism did not predict additional variance for the mood measure. For heart rate, relaxation levels continued to predict heart rate at all three recovery intervals. Self-oriented perfectionism predicted some variance at recovery 1 ($p<.10$), was not

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[10]The impact of menstrual phase and oral contraceptive use on cortisol responsivity was evaluated among female subjects. Although menstrual phase did not affect baseline measures of cortisol ($F_{(4, 47)}=.332$, $p>.50$), use of contraceptives did relate to moderately lower baseline cortisol levels ($t_{(51)}=-1.97$, $p<.10$). Further regression analyses were conducted to assess whether these two measures were associated with cortisol reactivity either at post-test or at follow-up. Neither measure predicted significant variance in cortisol response for either time period. As a result, analyses were conducted on all subjects, regardless of menstrual phase or use of oral contraceptives in female participants.

significant at recovery 2, but did explain significant variance in heart rate during the final recovery interval. Higher levels of perfectionism consistently were associated with higher heart rate at these times. Finally, baseline cortisol, body mass index, and time of testing in sum predicted significant variance in recovery cortisol levels. As with negative mood, perfectionism was not a significant predictor for cortisol during this time period.

As before, these results were redone with the addition of covariates (CISS subscales, PSS and RTT, and for cortisol, baseline negative mood). As with the post-test regression equations, these control measures only explained significant variance in recovery subjective negative mood ratings. Perfectionism did not provide additional predictive power for recovery mood, although it did continue to predict heart rate during the first and third recovery intervals at almost statistically significant levels ($p=.10$, and $p=.13$ respectively, Table 5). Again, perfectionism failed to explain variance in recovery cortisol levels.

Hypothesis IV: Preferred Coping Strategies.

Correlations were calculated between self-oriented perfectionism and endorsement of the use of various coping strategies assessed by the CISS. Significant positive correlations were found for both emotion-oriented coping ($r_{(128)}=.28$, $p<.001$) and task-oriented coping ($r_{(128)}=.27$, $p<.002$), but not for the use of avoidance ($r_{(128)}=-.02$, $p>.50$).

Hypothesis V: Impact of Coping on Enduring Stress.

Regression analyses were conducted to assess the influence of the interaction between self-oriented perfectionism and these two preferred coping strategies on the third recovery heart rate measure. The regression analyses proceeded as follows: On the first step, the usual baseline measures were entered; on the second step, self-oriented perfectionism and the particular coping strategy were entered; and finally the interaction between perfectionism and that coping strategy was forced into the equation. Only the interaction of perfectionism and task-oriented coping was significant ($\beta=1.32$, $R^2=0.158$, $F_{(4,125)}=5.97$, $p<.016$). The sample then was divided into those one standard deviation above and below the mean level of perfectionism. Figure 1 shows the regression lines for these two groups on the association between task-oriented coping and enduring heart rate elevations. For those low in perfectionism, task-oriented perfectionism relates to lower

heart rate at final recovery, whereas the same coping strategy when used by those scoring high in perfectionism is linked to more elevated heart rate. The interaction of perfectionism and emotion oriented coping was not significant (β=-0.50, R^2=0.004, $F_{(4,125)}$=1.45, p>.20). These findings were maintained even after control variables were partialled out (for emotion-oriented: β=-0.47, R^2=0.003, $F_{(8,119)}$=1.26, p>.25; and for task-oriented: β=1.17, R^2=0.012, $F_{(8,119)}$=4.59, p<.034).

In sum, these results suggest that those reporting high levels of self-oriented perfectionism and higher levels of task-oriented coping do experience enduring heart rate elevations following the test.

Gender Differences.

To determine whether males and females required separate analyses, interaction terms were computed between gender and self-oriented perfectionism. A series of hierarchical multiple regressions were conducted using the usual first steps, adding self-oriented perfectionism and gender on the second step, and adding the interaction term of perfectionism and gender in a final step (Tables 6 and 7). Pedhazur (1982) recommends that a relaxed alpha level of .10 to .25 be used for interaction terms to prevent type II error. However, as nine such tests were being conducted, an alpha of .05 was considered significant, and alphas up to .25 were interpreted as trends. The only trends were found for heart rate during the anagram task (p<.25), and for cortisol levels at post-test (p<.20). To interpret these trends, separate regression analyses were calculated for each gender looking at perfectionism and these two dependent measures (Table 8). For heart rate during the anagram task, males showed a positive association between perfectionism and heart rate, although this was not significant. Females showed no relation between perfectionism and heart rate for this variable. For cortisol at post-test, the reverse was true. Females showed a non-significant positive association between perfectionism and cortisol levels, whereas males showed a mildly negative association. However, these findings do not impact previous conclusions, that self-oriented perfectionism does not significantly predict heart rate during the anagram task, or cortisol at post-test regardless of gender. As no significant gender differences appeared to be

present, subsequent analyses continued to be conducted on the entire sample rather than on each gender separately.

Supplementary Analyses

In order to assess whether extraneous factors associated with the experiment were influencing the results, we conducted several supplementary analyses.

Social Context.

Having other subjects in the room could cause participants to become either less reactive due to perceived social support, or more reactive as their performance becomes more public. The interaction between having others in the room (0 versus 1-3 other subjects) and perfectionism was assessed for each dependent variable. Results indicated that there was no difference in subject reactions as a result of having others participating in the study at the same time.[11]

Experimenter Differences.

Five assessors were involved in this study, four females and a male. Further regression analyses were conducted to test whether a male experimenter made a difference. The interaction between gender of experimenter and perfectionism showed only a trend for heart rate during the math task (β=.55, R^2=.010, $F_{(4,125)}$=2.83, p<.10). The few individuals tested by the male experimenter reacted slightly more than those tested by females. However, because only one male experimenter was used, we can not assume that this reflects a difference in reaction to male experimenters; it may simply be a reaction to the male experimenter in this study.

Credibility of the Test.

Subjects rated the ability of the test to assess "people's academic performance" on a seven point scale. The mean response was 3.08 with a standard deviation of 1.58. Considering that the students generally were dissatisfied with their own performance, this rating shows substantial belief in the value of the test. Because the credibility of the test may influence subjects' ego-involvement with the task, and thereby influence their stress response, analyses were conducted to assess the impact of subject perceptions of the test on the association between perfectionism and

[11]The interaction neared significance for one variable, post-test negative mood (b=-.93, $F_{(4,124)}$=2.70, p=.103). This suggests that perfectionists experienced a slightly greater increase in negative emotion when they were the only subjects in the room.

the three dependent measures during and immediately after the test. The analyses were conducted such that the usual baseline measures were entered into the equation first, followed by self-oriented perfectionism and ratings of test credibility, and finally the interaction between perfectionism and ratings of test credibility. No relation was found for subjective negative mood ratings (β=-.20, R^2=0.001, $F_{(4,124)}$=0.17, p>.50).

The interaction of self-oriented perfectionism and ratings of test credibility for heart rate during the math task was significant (β=-.72, R^2=0.015, $F_{(4,125)}$=4.03, p<.05). Separate equations were computed for those who rated the test as good or very good (6 and 7 on the scale) as compared to those who rated it as poor or very poor (1 or 2 on the scale). The strong association between perfectionism and heart rate was present only for those who thought it was a poor test (Table 9). In order to fully comprehend this interaction, figure 2 was constructed to show the relation between perfectionism and change in heart rate during the math task according to belief in the validity of the test. All those who thought the test was valid experienced elevations in heart rate, whereas among those who did not believe the test was valid, only subjects reporting high levels of self-oriented perfectionism experienced such heart rate elevations. The interaction between test credibility and perfectionism was not significant for heart rate during the anagram task (β=.10, R^2=.000, $F_{(4,125)}$=0.12, p>.50).

The interaction between self-oriented perfectionism and ratings of test credibility predicted variance in post-test cortisol levels (β=.61, R^2=.011, $F_{(6,118)}$=4.01, p<.05). Separate regression analyses were conducted for those who rated the test as good or very good (5 to 7 on the scale, 5 was added to provide sufficient subjects for using extra control measures with cortisol) and those who rated it as poor or very poor (1 and 2; Table 10). Figure 3 shows these results pictorially. Although the regression line for those who believed the test was invalid appears to show a positive cortisol response, this line is not significantly different from zero. In other words, those who did not believe the test was valid showed no cortisol response regardless of levels of self-oriented perfectionism. Among those who did believe in the test, those scoring low in self-oriented perfectionism showed lower levels of cortisol than other subjects, whereas those high in self-oriented perfectionism experienced cortisol elevations.

As two of these supplementary variables seemed to impact heart rate during the math task, a final regression analysis was conducted controlling for gender of the experimenter and ratings of the credibility of the test. Perfectionism continued to significantly predict heart rate during the math test (β=.14, R^2=0.020, $F_{(4,125)}$=5.49, p<.021).

DISCUSSION

This study investigated whether self-oriented perfectionism predicted increased stress following an achievement related task. First, it was hypothesized that individuals high in self-oriented perfectionism would perceive the achievement situation as more stressful because they tend to interpret any performance that is less than perfect as a failure. Second, self-oriented perfectionists should experience more intense stress responses to such failures because they equate their self-worth with their performance. Third, it was expected that self-oriented perfectionists should experience more enduring stress responses. Fourth, self-oriented perfectionism was predicted to be associated with both emotion and task-oriented coping. Finally, the interaction between these coping styles and self-oriented perfectionism was expected to explain enduring stress. In general, our results support these hypotheses. Individuals high in self-oriented perfectionism gave much lower ratings of self-satisfaction with performance than did other subjects, indicating that they were more likely to perceive their performance as a failure. They also experienced more intense stress responses than their fellow subjects both during and immediately following the test. They reported greater increases in negative mood, and experienced greater heart rate elevations. Although cortisol levels were not elevated for all individuals high in self-oriented perfectionism following the test, perfectionism among those who believed the test was valid did predict higher levels of cortisol post-test. Finally, those high in self-oriented perfectionism continued to experience more elevated heart rate than those low in self-oriented perfectionism at recovery and this difference was especially strong for those who reported using task-oriented coping strategies.

The finding that self-oriented perfectionists were less satisfied with their performance on the test than other subjects, despite no differences in actual performance, is consistent with the idea

that self-oriented perfectionists frequently are less satisfied with their performance in life and thereby experience more numerous episodes of stressful failure. Further, it also is consistent with findings by other researchers. For example, Mor et al. (1995) found that self-oriented perfectionists have stringent evaluative criteria for success, and low satisfaction with performance. In addition, Frost and Marten (1990) reported that highly perfectionistic subjects perceived a writing task as being more important than did low-perfectionistic subjects, and thought they should have done better than they did on the task to a greater extent than others. However, perfectionistic subjects in their sample did not show lower satisfaction ratings, perhaps because they failed to look specifically at self-oriented perfectionism which relates to the evaluation of personal performance. Support for this first hypothesis suggests that self-oriented perfectionists are more likely to interpret their performance as being a failure, and therefore may experience a greater number of stressors in their daily lives. Further confirmation that self-oriented perfectionists perceive more stress in their lives comes from the correlation between this form of perfectionism and the perceived distress subscale of the PSS ($r_{(127)}=.33$, $p<.001$). This correlation shows that self-oriented perfectionists report having more stressful events in their daily lives than do other subjects. Of course, it is not clear whether perfectionists have caused this additional stress themselves, either through their own behaviour or through their perceptions of situations. Although our findings demonstrate that self-oriented perfectionists did perceive this particular situation as being more stressful, future studies will need to determine whether this occurs frequently in their daily lives.

It is interesting to note that self-oriented perfectionists in the present study also believed that others who were important to them would be less satisfied with their performance. It might be argued that this type of pattern would be more typical of socially-prescribed perfectionists, those who believe others hold perfectionistic standards for them. This finding may result from significant positive correlations between self-oriented and socially-prescribed perfectionism ($r_{(130)}=.49$, $p<.001$). Indeed, when socially-prescribed perfectionism is partialled out, the correlation between self-oriented perfectionism and ratings of others' satisfaction drops to -.17

(df=127, p<.056). Another possible explanation is that these subjects may believe that their expectations are normal and reasonable, and that others would have similar expectations for them.

The second hypothesis, that self-oriented perfectionism predicts more intense stress responses, was supported by results from all three measures of stress. First, individuals high in self-oriented perfectionism reported greater increases in negative mood following the test. This finding is similar to the results of Dance et al. (1990). These researchers reported that irrational beliefs, such as those held by perfectionists (Flett et al., 1991), cause minor stressors to lead to strong negative affect. This relation was not robust when the control measures of perceived life stress, test anxiety, and preferred coping strategies were added. This does not mean that self-oriented perfectionism is irrelevant as a predictor of subjective distress. Rather, it implies that self-oriented perfectionism does not provide significant unique variance in this equation; the association between self-oriented perfectionism and the control variables of coping styles, perceived life stress, and test anxiety is sufficient to explain the portion of the variance in mood accounted for by perfectionism.

These results, showing that self-oriented perfectionism predicts negative mood following an achievement stressor, provide a key to understanding the mechanism by which self-oriented perfectionism interacts with stress to produce depression. Numerous studies already have noted the association between self-oriented perfectionism and stress predicting depression scores and even suicide ideation (e.g. Hewitt & Dyck, 1986; Hewitt et al., 1994). Fry's (1995) study of women executives demonstrated that self-oriented perfectionism interacted with daily life hassles to predict lowered self-esteem, which often is linked to depression. Other studies have considered the specific vulnerability hypothesis, that self-oriented perfectionism interacts with achievement-related stressors in particular to predict psychopathology. As discussed earlier, Hewitt and Flett (1993) reported that this interaction predicted depression in both student and psychiatric samples, and Hewitt, Flett, and Ediger (1996) found that self-oriented perfectionism interacted with achievement stress over a three month period to predict depression at time two even after controlling for initial depression levels. Furthermore, Joiner and Schmidt (1995) replicated findings of self-oriented perfectionism interacting with stress (although of both achievement and interpersonal types) to predict depression. Interestingly, this study used the perfectionism subscale

of the Eating Disorders Inventory to classify subjects, although they attempted to discriminate between self-oriented and socially-prescribed perfectionism. Their lack of support for the specific vulnerability hypothesis may be due to the use of this less psychometrically validated scale. Results from the present study provide a "missing piece" to the perfectionism-stress puzzle. Other authors have shown that during achievement stress, self-oriented perfectionists may believe that their performance is of greater personal importance (Frost & Marten, 1990; Fry, 1995). Here, we have demonstrated that self-oriented perfectionists experience less satisfaction with their performance, and more negative mood following an achievement stressor. Repeated episodes of stress would lead to frequent feelings of low mood and critical evaluation of performance, both of which are aspects of depression symptomatology.

The physiological dependent measures provided additional evidence that self-oriented perfectionism was linked to increased stress. Heart rate elevations during the test, in particular during the math task, were greatest for those scoring high on self-oriented perfectionism. Unlike the findings with subjective mood ratings, this relation continued to be significant when controlling for other measures in the equation. Thus, self-oriented perfectionism accounted for unique variance in heart rate response. To our knowledge, only one other study has considered the impact of self-oriented perfectionism on heart rate arousal to an achievement stressor. In a community sample, Habke, Hewitt, and Flett (1996) found that those scoring high on this perfectionism dimension also experienced larger heart rate elevations during a computerized "IQ test". Similarly, Roberts and Lovett's (1994) study of gifted, academic achiever, and "non-gifted" junior high students provides further support, albeit indirect, that perfectionism is related to greater stress. In their study, they reported that gifted students had higher levels of self-oriented perfectionism and that these students also showed greater decreases in digit skin temperature (a sign of increased stress) following a failure task than did the other students. Therefore, the present study's heart rate results are consistent with limited previous research and support the hypothesis that self-oriented perfectionists experience a more intense stress response when experiencing achievement-related stressors.

One can speculate on what this finding actually means for self-oriented perfectionists. Heart rate response during a task is described as indicating strong effort and task involvement (e.g. Arnetz & Fjellner, 1986). Therefore, it appears that self-oriented perfectionists are trying more actively to succeed on this task than other subjects. This would be consistent with reports that they take such tasks more seriously, or perceive them as being more important (Frost & Marten, 1990; Fry, 1995). Feelings of such intense physiological arousal also may cause these individuals to interpret the situation as more anxiety provoking and distressing. This perspective harkens back to the James-Lange theory of emotion, in which emotion stems from the perception of physiological arousal (Oatley & Jenkins, 1996). Thus, greater heart rate elevations during the task suggest that self-oriented perfectionists may be putting more (and perhaps excessive) effort into their performance, and this level of arousal may cause them to interpret the situation as more distressing.

Post hoc tests of interactions between perfectionism and ratings of test credibility or validity produced the interesting observation that the link between self-oriented perfectionism and increased post-test heart rate existed only for those who thought that the test was invalid. Although at first this result may seem counter-intuitive, inspection of the graph provides an exciting potential explanation. All subjects who thought the test was valid experienced elevated heart rate, regardless of their levels of perfectionism. It was only among those who thought the test was poor that those low on self-oriented perfectionism experienced little heart rate acceleration whereas those scoring high did show a strong response. Recalling that heart rate increases generally reflect increased effort or involvement with a task (e.g., Frankenhaeuser, 1979; Lundberg & Frankenhaeuser, 1980), one would expect that individuals who believe their intelligence truly is being tested should show strong effort, and hence, increased heart rate during the task. However, if an individual believes they are completing a fake or irrelevant task, they should not expend much effort, nor should they show a heart rate response. Given this context, the unusual finding was that self-oriented perfectionists showed signs of continued strong effort even in testing situations which they did not believe to be valid. It appears that such perfectionists may be unable, or unwilling, to moderate their effort according to the value of a task. This is similar suggestions that perfectionists attempt to be perfect in most or all of their tasks (Flett et al., 1995). As a result, one would expect

these individuals to expend undue effort and energy in many situations in daily life, even those that are not particularly important. This could increase the frequency of perceived stressors and the magnitude of the stress response leading to long term consequences for both physical (e.g., cardiovascular disease and hypertension; Krantz & Manuck, 1984) and mental health (e.g., depression and suicide; Hewitt & Flett, 1993; Hewitt et al., 1995).

The third dependent measure used to assess intensity of the stress response was salivary cortisol elevations. Contrary to our hypothesis, high levels of self-oriented perfectionism were not associated with elevated salivary cortisol following the test. However, it is important to note that there was a significant interaction between perfectionism and ratings of validity of the test. Among those who thought the test was valid, self-oriented perfectionism predicted higher levels of cortisol at post-test. In general, there was little change in cortisol levels following the test. However, those who thought the test was valid and had low levels of self-oriented perfectionism experienced a decline in cortisol levels. This decline is consistent with other studies (e.g., Frankenhaeuser, Lundberg & Forsman, 1980) which report lower cortisol levels and raised catecholamine levels following a stressor which can be controlled or coped with effectively by the subject. This implies that the stressor in this study was not sufficiently distressing, or uncontrollable to induce cortisol elevations in the subjects. Yet, there is a trend for perfectionists to experience an increase in cortisol despite their obvious involvement in the task as demonstrated by their ratings of negative mood and elevated heart rate. This suggests that those high on self-oriented perfectionism may have felt less able to cope with the test than other highly-involved subjects. This result is extremely important in understanding the link between the self-oriented perfectionism and achievement stress interaction, and the development of clinical depression. Raised cortisol levels are linked to depression of neural activity in the brain and mood changes associated with depression (Barnes, 1986). If self-oriented perfectionists experience higher cortisol levels than others in response to stress, it would provide a rationale for why they frequently suffer from depression. In addition, knowledge of the link between cortisol and inability to cope with a stressor (Frankenhaeuser et al., 1980) generates the possibility that teaching effective coping skills

to self-oriented perfectionists may resolve some of their difficulties. Future studies with less controllable stress stimuli will be needed replicate and strengthen these findings.

The last three hypotheses concerned the association of self-oriented perfectionism and durability of the stress response. Although perfectionism was not related to subjective ratings of negative mood or cortisol levels at recovery, it did predict elevated heart rate during the last recovery period and this effect was moderated by the use of task-oriented coping. Although the test was over, and there was little they could do about their performance, many self-oriented perfectionists showed continued elevated heart rate, possibly due to ruminating about the test and evaluating their performance (Hamachek, 1978; Hewitt et al., 1993; Hollender, 1965; Pacht, 1984). This behaviour may have made it difficult for them to relax during the recovery period and would continue the distressing nature of the task.

This association between stress and task-oriented coping is consistent with other studies. For example, Bohnen et al. (1991) found a negative relation between the use of "comforting cognitions" (a form of emotion-oriented coping) and cortisol response during mental stress. Houtman and Bakker (1991) theorized that the effectiveness of any particular coping strategy depends on the stressor's amenability to change. For those stressors which can be changed, task-oriented strategies are most effective, whereas emotion-oriented strategies are most appropriate when the stressor cannot be changed. Given that the test for the present study was designed to be difficult and was not a valid test of academic performance, emotion-oriented strategies ought to have been most adaptive. This suggests that self-oriented perfectionists may be using task-oriented coping strategies indiscriminately, regardless of whether the stressor can be changed. It is interesting to note that during the first and second recovery periods, perfectionism did not predict higher heart rate, possibly because all subjects were completing questionnaires and an interview. These activities may have acted as a forced distraction task and allowed the reduction of heart rate and stress. During the final recovery period, most subjects had completed their questionnaires and spent time reading magazines and relaxing. Thus, it was only during this last period that differences in coping strategies became most evident.

Together, these findings have important implications for both the study of perfectionism and stress research as a whole. In the field of perfectionism, this study provides support for the concept that many of the problems associated with perfectionism may result from the experience of more frequent, intense, and enduring stress episodes. Strong evidence already has been accumulated indicating that self-oriented perfectionism is a vulnerability factor for clinical depression (e.g. Hewitt & Flett, 1991; Hewitt, Flett & Ediger, 1996). As described by Dienstbier (1989), two facets of stress response have negative effects on health: first, the presence of any cortisol response, and second, enduring cardiovascular response. In the present study, both of these responses occurred more frequently in those high on self-oriented perfectionism. To list just a few potential health consequences, cortisol elevations are associated with a myriad of physiological and psychological problems including coronary atherosclerosis (Troxler, Sprague, Albanese, Fuchs, & Thompson, 1977), coronary heart disease (Henry, 1983), inhibition of the secretion of lymphokines (which ultimately suppresses immune function; Calabrese, Kling & Gold, 1987) and increased incidence of anorexia (Barnes, 1986), anxiety (Anisman & LaPierre, 1982), and severe clinical depression (Barnes, 1986; Sachar, 1975). The current results are consistent with Hewitt and Flett's model that perfectionism produces increased stress that influences depression and symptomatology. Furthermore, if self-oriented perfectionism truly does influence the stress response, then there should be many other negative outcomes for those high in this perfectionism dimension.

The present study also suggests that increased stress might be due, in part, to the use of coping strategies that do not alleviate or cope with the situation effectively. These findings provide indirect support for Houtman and Bakker's (1991) argument that different coping strategies can be adaptive in different situations. This position contrasts with previously held beliefs that task-oriented coping strategies are healthiest, whereas emotion-oriented coping is maladaptive (Endler & Parker, 1990b). In the present study, task-oriented coping appears to have maintained elevated heart rate in self-oriented perfectionists following the test. However, emotion-oriented coping also was strongly endorsed by these perfectionists, as it was by self-oriented perfectionists in two other studies by Hewitt and his colleagues (1991a, 1993). According to Houtman and Bakker's

description (1991), flexibility in using different coping styles in different situations is advantageous. However, as coping styles usually show strong temporal stability even across problem types (Hewitt & Flett, 1996), it appears that few people demonstrate such flexibility. Although self-oriented perfectionists appear to have both task and emotion-oriented strategies in their repertoire, they may be applying them inappropriately or indiscriminately. Perhaps the intense distress, which the present study has demonstrated they experience during an achievement stressor, causes them to employ both types of coping strategies. While focusing efforts on an appropriate style for the specific situation might otherwise help to cope, the additional use of maladaptive strategies may serve to nullify any positive coping influences and even exacerbate the stress response. Although this is speculative, it provides an interesting avenue for future research.

The strong association between perfectionism and stress irrespective of gender provides an important addition to the stress literature. Most studies on personality and stress have focused on Type A personality, and more specifically on hostility. These variables tend to be more relevant to stress in males than in females (e.g., Earle et al., 1996). Other researchers have suggested that women may not be as reactive as men to achievement stress (Frankenhaeuser et al., 1978). In addition, one study on self-oriented perfectionism found interactions between perfectionism and stress leading to depression for males only (Joiner & Schmidt, 1995). However, Hewitt, Flett, and Endler (1993) presented significant correlations, for women only, between self-oriented perfectionism and emotion-oriented coping, which generally is considered maladaptive. They proposed that women may have greater difficulty than men coping with stress resulting from self-imposed expectations of perfection. The present results indicate that self-oriented perfectionism influences stress response in both males and females. In contrast to previous stress research, our results suggest that certain subgroups of women, such as self-oriented perfectionists, do experience strong stress responses to achievement tasks. Women experience many of the same pathological consequences of stress as men. For example, of the women over forty years of age in any medical practice, 50% will die from cardiovascular disease (Wenger, Speroff & Packard, 1993). Obviously then, it is critical for researchers to develop a better understanding of risk factors that are relevant for both genders.

The present study represents only the beginning of research into understanding links between perfectionism, stress and coping, and pathology - both physical and psychological. Its use of three distinct measures of stress has provided a more complete view of how perfectionism may relate to stress, and use of this multifaceted approach in future studies is strongly recommended. However, this study has not come close to tapping the full complexity of perfectionism's role in the stress response. Its limitations provide critical directions for future studies.

First, this study used a laboratory stressor. Although this permitted the fabrication of a failure experience, such a task is unlikely to produce significant ego-involvement in subjects, despite the use of descriptions of how the test predicts "academic achievement and future success". Moreover, although the manipulation check which asked whether students believed that the test was valid was an important component of the design, it may have been confounded with emotion-focused coping strategies. Indeed, the correlation between ratings of test credibility and emotion-oriented coping was significant ($r_{(130)}=.22$, $p<.02$). This correlation implies that subjects who use emotion-oriented coping reported greater belief that the test was valid. As these subjects also reported greater negative mood following the test, perhaps because of a tendency to focus on negative affect, they may have rated the test as credible to validate their emotional experience. Thus, this check may not have provided a clear measure of the importance students placed on their performance. A second study has been planned which will investigate the same dependent measures of stress response before, during, and after a real course examination. This type of study will have better ecological validity as the stressor will be of greater importance to the subjects.

A second limitation is that coping was assessed using the CISS (Endler & Parker, 1990a) which asks about preferred coping styles in the subjects' daily lives. We then had to assume that these styles were used by the subject to cope with stress induced by the experiment. It is important for future studies to assess the type of coping strategies actually used after particular stressful events. This type of methodology will provide much stronger support for theories of specific coping styles being more or less appropriate in certain situations. It also is essential for testing the

hypothesis that self-oriented perfectionists fail to discriminate between different situations and instead use excessive levels of both emotion and task-oriented coping techniques.

A third criticism which might be levelled against this study is that the primary predictor variable, self-oriented perfectionism, was assessed using only the MPS (Hewitt & Flett, 1991b) self-report measure. However, we are quite comfortable basing our study on this measure as it has well-detailed reliability and validity in both student (Hewitt & Flett, 1991b) and psychiatric samples (Hewitt et al., 1991c). Future studies might consider adding the newly developed *Interview of Perfectionistic Behaviour* (IPB; Hewitt, Flett, Flynn & Nielsen, 1996), which permits assessment of trait dimensions of perfectionism using a multi-method approach. Use of both the self-report questionnaire and the interview would ensure that assessment is as accurate as possible, and also would reduce method variance when relating perfectionism scores to other interview measures.

One final area which needs to be addressed through future research is the entire specific vulnerability hypothesis. Although the present study indicates that self-oriented perfectionism increases the experience of achievement-related stress, it did not test whether this type of perfectionism relates only to achievement stress, and not to interpersonal stress. Likewise, socially-prescribed perfectionism was not tested, and according to the specific vulnerability hypothesis, this facet of perfectionism should relate more to interpersonal than achievement stressors. Future studies should incorporate both types of stressor and test these hypotheses. In addition, future studies might consider the types of stress perfectionists create through their behaviours. The specific vulnerability hypothesis could be tested by determining whether self-oriented perfectionists are more likely to generate achievement-related stressors, whereas socially-prescribed perfectionists generate more interpersonal stressors.

The present study is particularly exciting because it demonstrates that three different domains of stress response are affected by self-oriented perfectionism: mood, heart rate, and cortisol levels. This finding has important implications for understanding the physical and mental health of perfectionists. This is also one of the few studies to identify a personality variable that influences physiological arousal in both men and women which should make perfectionism an essential

variable in the study of cardiovascular disease. As one of the first investigations into perfectionism and the stress response, many more questions have been raised than answers provided. However, one thing is clear. Self-oriented perfectionism is associated with stress in several ways. Given the variety of pathology already linked to perfectionism, we would do well to further our understanding of this mechanism in hopes of eventually providing early interventions for these individuals.

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TABLE 1: Means, standard deviations, and coefficient Alpha's for the self-report measures.

MEASURE (items)		**MEAN**	**ST. DEV.**	**ALPHA**
Self-oriented perfectionism (15)		69.80	13.02	0.88
PANAS Negative Subscale (10)				
	Baseline	12.33	2.81	0.71
	Post-test	20.86	8.38	0.92
	Recovery	13.37	4.20	0.85
CISS (48)				
	Task-Oriented (16)	3.68	0.52	0.87
	Emotion-Oriented (16)	2.90	0.71	0.91
	Avoidance (16)	2.84	0.57	0.81
PSS (14)		27.30	7.79	0.84
	Perceived Distress (7)	14.53	5.09	0.84
	Perceived Coping Ability (4)	6.13	2.72	0.76
RTT (40)		80.93	19.47	0.94

PANAS: Positive and Negative Affect Schedule
CISS: Coping Inventory for Stressful Situations
PSS: Perceived Stress Scale
RTT: Reactions to Tests

TABLE 2: Multiple regression analyses for self-oriented perfectionism as a predictor of stress intensity at post-test as measured by subjective mood ratings, heart rate, and cortisol levels.

Variable		*Beta*	*R^2 change*	*R^2 total*	*F*	
Subjective Mood Ratings				*.076*	*5.16*	***
Step 1:	baseline negative mood ^	-.21	.045		6.03	*
Step 2:	perfectionism	.18	.030		4.14	**
Heart Rate						
Math task				*.517*	*68.01*	****
Step 1:	relaxation heart rate	.70	.495		125.30	****
Step 2:	perfectionism	.15	.022		5.91	**
Anagrams				*.590*	*90.62*	****
Step 1:	relaxation heart rate	.76	.584		178.64	****
Step 2:	perfectionism	.07	.005		1.67	
Cortisol ^				*.659*	*58.02*	****
Step 1:			.550		48.44	****
	baseline cortisol level ^	.81				
	body mass index ^	.05				
	time of testing	.00				
Step 2:	perfectionism	.02	.0002		0.08	

^ = transformed variable

* = p<.10 ** = p<.05 *** = p<.01 **** = p<.001

NB: The valence of the betas for baseline negative mood predicting post-test negative mood, and for body mass index predicting cortisol levels are reversed because these variables have been transformed using the inverse transformation. That is, greater baseline negative mood was associated with greater post-test negative mood, and increased body mass was associated with lower cortisol levels at recovery.

TABLE 3: Multiple regression analyses for self-oriented perfectionism as a predictor of stress intensity at post-test as measured by subjective mood ratings, heart rate, and cortisol levels after control variables are partialled out.

Variable	*Beta*	R^2 *change*	R^2 *total*	*F*	
Subjective Mood Ratings			*.301*	*7.31*	****
Step 1: baseline negative mood ^	-.21	.045		5.94	**
Step 2:		.253		8.66	****
CISS emotion-oriented coping	.41				
CISS task-oriented coping	-.00088				
CISS avoidance	-.013				
PSS	.12				
RTT	.04				
Step 3: perfectionism	.05	.002		0.54	
Heart Rate					
Math task			*.540*	*20.09*	****
Step 1: relaxation heart rate	.70	.495		125.35	****
Step 2:		.030		1.53	
CISS emotion-oriented coping	.19				
CISS task-oriented coping	.06				
CISS avoidance	-.04				
PSS	-.16				
RTT	.12				
Step 3: perfectionism	.14	.015		3.88	*
Anagrams			*.600*	*25.48*	****
Step 1: relaxation heart rate	.76	.584		178.83	****
Step 2:		.008		.48	
CISS emotion-oriented coping	.09				
CISS task-oriented coping	-.05				
CISS avoidance	-.03				
PSS	-.05				
RTT	.009				
Step 3: perfectionism	.10	.007		2.13	*

TABLE 3 (cont'd)

Variable		*Beta*	R^2 *change*	R^2 *total*	*F*	
Cortisol ^				*.672*	*23.19*	****
Step 1:			.659		77.28	****
	baseline cortisol level ^	.81				
	body mass index ^	.05				
	time of testing	.00				
Step 2:			.011		.61	
	CISS emotion-oriented coping	-.01				
	CISS task-oriented coping	-.06				
	CISS avoidance	-.07				
	PSS	-.03				
	RTT	-.01				
	baseline negative mood ^	.03				
Step 3:	perfectionism	.06	.003		.95	

^ = transformed variable

* = p<.10 ** = p<.05 *** = p<.01 **** = p<.001

NB: The valence of the betas for baseline negative mood predicting negative mood at post test and for body mass index, and baseline negative mood in predicting cortisol levels are reversed because these variables have been transformed using the inverse transformation. That is, higher initial negative mood was associated with more negative mood at post-test, increased body mass was associated with lower cortisol levels at post-test, and greater baseline negative mood was associated with higher cortisol levels at recovery.

TABLE 4: Multiple regression analyses for self-oriented perfectionism as a predictor of stress duration as measured by subjective mood ratings, heart rate, and cortisol levels.

Variable	*Beta*	*R^2 change*	*R^2 total*	*F*	
Subjective Mood Ratings ^			*.181*	*13.66*	****
Step 1: baseline negative mood ^	.42	.178		26.98	****
Step 2: perfectionism	-.06	.003		0.46	
Heart Rate					
Recovery 1			*.670*	*129.07*	****
Step 1: relaxation heart rate	.81	.584		178.64	****
Step 2: perfectionism	.09	.008		3.18	*
Recovery 2			*.595*	*93.26*	****
Step 1: relaxation heart rate	.77	.590		184.57	****
Step 2: perfectionism	.07	.004		1.39	
Recovery 3			*.653*	*119.73*	****
Step 1: relaxation heart rate	.80	.640		227.48	****
Step 2: perfectionism	.12	.014		4.95	**
Cortisol ^			.557	*37.03*	****
Step 1:			.550	48.44	****
baseline cortisol level ^	.73				
body mass index ^	-.03				
time of testing	-.05				
Step 2: perfectionism	-.08	.007		1.81	

^ = transformed variable

* = p<.10 ** = p<.05 *** = p<.01 **** = p<.001

NB: The valence of the beta for body mass index is reversed because this variable has been transformed using the inverse transformation. That is, increased body mass was associated with higher cortisol levels at recovery

TABLE 5: Multiple regression analyses for self-oriented perfectionism as a predictor of stress duration as measured by subjective mood ratings, heart rate, and cortisol levels at recovery after control variables are partialled out.

Variable		*Beta*	R^2 *change*	R^2 *total*	*F*	
Subjective Mood Ratings ^				*.282*	*6.63*	****
Step 1:	baseline negative mood ^	.42	.178		26.76	****
Step 2:			.280		3.37	***
	CISS emotion-oriented coping	-.24				
	CISS task-oriented coping	-.05				
	CISS avoidance	-.04				
	PSS	-.12				
	RTT	.01				
Step 3:	perfectionism	.06	.003		0.47	
Heart Rate						
Recovery 1				*.680*	*36.35*	****
Step 1:	relaxation heart rate	.81	.662		246.78	****
Step 2:				.010	.74	
	CISS emotion-oriented coping	.08				
	CISS task-oriented coping	-.03				
	CISS avoidance	-.06				
	PSS	-.01				
	RTT	.006				
Step 3:	perfectionism	.10	.007		2.80	*
Recovery 2				*.610*	*26.84*	****
Step 1:	relaxation heart rate	.77	.590		181.69	****
Step 2:			.018		1.12	
	CISS emotion-oriented coping	.13				
	CISS task-oriented coping	-.01				
	CISS avoidance	-.07				
	PSS	-.04				
	RTT	.05				
Step 3:	perfectionism	.05	.002		.49	
Recovery 3				*.670*	*34.88*	****
Step 1:	relaxation heart rate	.80	.640		223.92	****
Step 2:			.024		1.73	
	CISS emotion-oriented coping	.16				
	CISS task-oriented coping	.05				
	CISS avoidance	-.10				
	PSS	-.10				
	RTT	.08				
Step 3:	perfectionism	.09	.006		2.36	

Table 5 (cont'd)

Variable		*Beta*	R^2 *change*	R^2 *total*	*F*	
Cortisol ^				*.596*	*16.55*	****
Step 1:			.550		48.44	****
	baseline cortisol level ^	.73				
	body mass index ^	-.03				
	time of testing	-.05				
Step 2:			.045		2.09	*
	CISS emotion-oriented coping	.11				
	CISS task-oriented coping	-.07				
	CISS avoidance	-.07				
	PSS	-.10				
	RTT	-.14				
	baseline negative mood ^	.08				
Step 3:	perfectionism	-.05	.002		0.46	

^ = transformed variable

* = p<.10 ** = p<.05 *** = p<.01 **** = p<.001

NB: The valence of the betas for body mass index, and baseline negative mood in predicting cortisol levels are reversed because these variables have been transformed using the inverse transformation. That is, increased body mass was associated with higher cortisol levels at recovery, and greater baseline negative mood was associated with lower cortisol levels at recovery.

TABLE 6: Multiple regression analyses for interactions between self-oriented perfectionism and gender of the student for each dependent variable at post-test.

Variable		*Beta*	*R^2 change*	*R^2 total*	*F*	
Subjective Mood Ratings				*.107*	*3.70*	***
Step 1:	baseline negative mood ^	-.21	.045		6.03	**
Step 2:			.060		4.16	**
	perfectionism	.15				
	gender	.17				
Step 3:	perfectionism x gender	.24	.002		0.24	
Heart Rate						
Math task				*.526*	*34.63*	****
Step 1:	relaxation heart rate	.70	.495		125.30	****
Step 2:			.029		3.88	**
	perfectionism	.14				
	gender	.08				
Step 3:	perfectionism x gender	-.23	.002		.44	
Anagrams				*.595*	*45.63*	****
Step 1:	relaxation heart rate	.76	.584		178.65	****
Step 2:			.006		1.01	
	perfectionism	.07				
	gender	.03				
Step 3:	perfectionism x gender	-.38	.004		.34	§
Cortisol ^				*.665*	*39.00*	****
Step 1:			.659		77.93	****
	baseline cortisol level ^	.81				
	body mass index ^	.05				
	time of testing	.00				
Step 2:			.001		.12	
	perfectionism	.02				
	gender	-.02				
Step 3:	perfectionism x gender	.41	.005		1.81	§

^ = transformed variable

* = p<.10 ** = p<.05 *** = p<.01 **** = p<.001

for interaction terms § = p<.25

NB: The valence of the betas for baseline negative mood predicting negative mood at post test and for body mass index in predicting cortisol levels are reversed because these variables have been transformed using the inverse transformation. That is, higher initial negative mood was associated with more negative mood at post-test and increased body mass was associated with lower cortisol levels at post-test.

TABLE 7: Multiple regression analyses for the interaction between self-oriented perfectionism and gender as a predictor of stress duration for each dependent variable at recovery.

Variable		*Beta*	*R^2 change*	*R^2 total*	*F*	
Subjective Mood Ratings ^				*.182*	*6.80*	****
Step 1:	baseline negative mood ^	.42	.178		26.98	****
Step 2:			.005		.35	
	perfectionism	-.05				
	gender	-.04				
Step 3:	perfectionism x gender	.01	.000		0.00	
Heart Rate						
Recovery 1				*.674*	*64.56*	****
Step 1:	relaxation heart rate	.81	.662		250.70	****
Step 2:				.009	1.79	
	perfectionism	.09				
	gender	.03				
Step 3:	perfectionism x gender	-.28	.002		.95	
Recovery 2				*.604*	*47.68*	****
Step 1:	relaxation heart rate	.77	.590		184.57	****
Step 2:			.010		1.59	
	perfectionism	.06				
	gender	.08				
Step 3:	perfectionism x gender	-.34	.003		1.10	
Recovery 3				*.658*	*60.27*	****
Step 1:	relaxation heart rate	.80	.640		227.48	****
Step 2:			.018		3.26	
	perfectionism	.11				
	gender	.06				
Step 3:	perfectionism x gender	-.18	.001		.35	
Cortisol ^				*.559*	*24.49*	****
Step 1:			.550		48.44	****
	baseline cortisol level ^	.73				
	body mass index ^	-.03				
	time of testing	-.05				
Step 2:			.008		.99	
	perfectionism	-.08				
	gender	.03				
Step 3:	perfectionism x gender	.23	.001		.41	

^ = transformed variable

* = p<.10 ** = p<.05 *** = p<.01 **** = p<.001

NB: The valence of the betas for body mass index in predicting cortisol levels is reversed because this variable has been transformed using the inverse transformation. That is, increased body mass was associated with higher cortisol levels at recovery.

TABLE 8: Regression analyses for self-oriented perfectionism predicting heart rate during the anagram task, and cortisol levels post-test according to gender.

Variable		*Beta*	*R^2 change*	*R^2 total*	*F*	
Heart rate during the Anagram Task						
Males				*.542*	*40.90*	****
Step 1:	relaxation heart rate	.73	.529		78.57	****
Step 2:	perfectionism	.12	.014		2.05	
Females				*.687*	*59.18*	****
Step 1:	relaxation heart rate	.83	.687		120.56	****
Step 2:	perfectionism	.00	.000		0.00	
Cortisol at Post-test						
Males				*.688*	*36.38*	****
Step 1:			.686		48.70	****
	baseline cortisol level ^	.84				
	body mass index ^	.05				
	time of testing	.08				
Step 2:	perfectionism	-.05	.002		0.51	
Females				*.648*	*22.06*	****
Step 1:			.636		28.58	****
	baseline cortisol level ^	.75				
	body mass index ^	.08				
	time of testing	-.10				
Step 2:	perfectionism	.11	.011		1.54	

^ = transformed variable

* = p<.10 ** = p<.05 *** = p<.01 **** = p<.001

NB: The valence of the betas for body mass index are reversed because this variable has been transformed using the inverse transformation. That is, negative betas represent positive associations, whereas positive betas indicate inverse relations.

TABLE 9: Self-oriented perfectionism as a predictor of heart rate during the math task according to credibility of the test.

Variable	*Beta*	*R^2 change*	*R^2 total*	*F*	
Rated as a Good Test					
			.610	*15.65*	****
Step 1: relaxation heart rate	.77	.598		31.31	****
Step 2: perfectionism	-.11	.011		0.60	
Rated as a Poor Test					
			.488	*36.70*	****
Step 1: relaxation heart rate	.67	.445		62.45	****
Step 2: perfectionism	.22	.043		6.52	**

TABLE 10: Self-oriented perfectionism as a predictor of post-test cortisol according to credibility of the test.

Variable	*Beta*	*R^2 change*	*R^2 total*	*F*	
Rated as a Good Test					
			.901	*19.43*	****
Step 1:		.760		20.00	****
baseline cortisol levels ^	.88				
body mass index ^	-.04				
time of testing	.06				
Step 2: perfectionism	.25	.052		5.02	**
Rated as a Poor Test					
			.593	*15.65*	****
Step 1:		.591		21.21	****
baseline cortisol levels ^	.76				
body mass index ^	.04				
time of testing	-.07				
Step 2: perfectionism	-.04	.002		0.17	

^ = transformed variable

* = p<.10 ** = p<.05 *** = p<.01 **** = p<.001

NB: The valence of the betas for body mass index are reversed because this variable has been transformed using the inverse transformation. That is, negative betas represent positive associations, whereas positive betas indicate inverse relations.

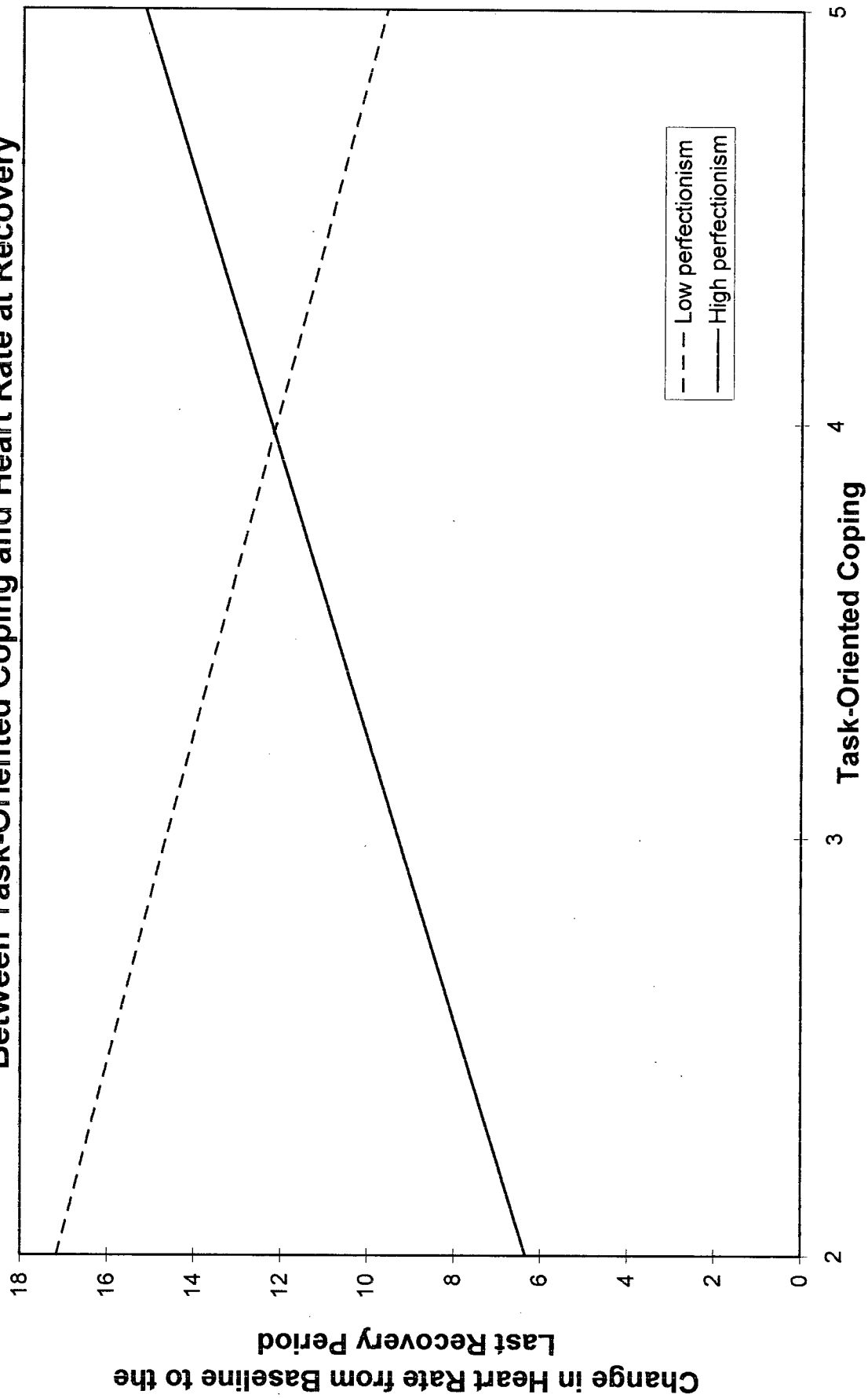

Figure 1: Impact of Self-oriented Perfectionism on the Association Between Task-Oriented Coping and Heart Rate at Recovery

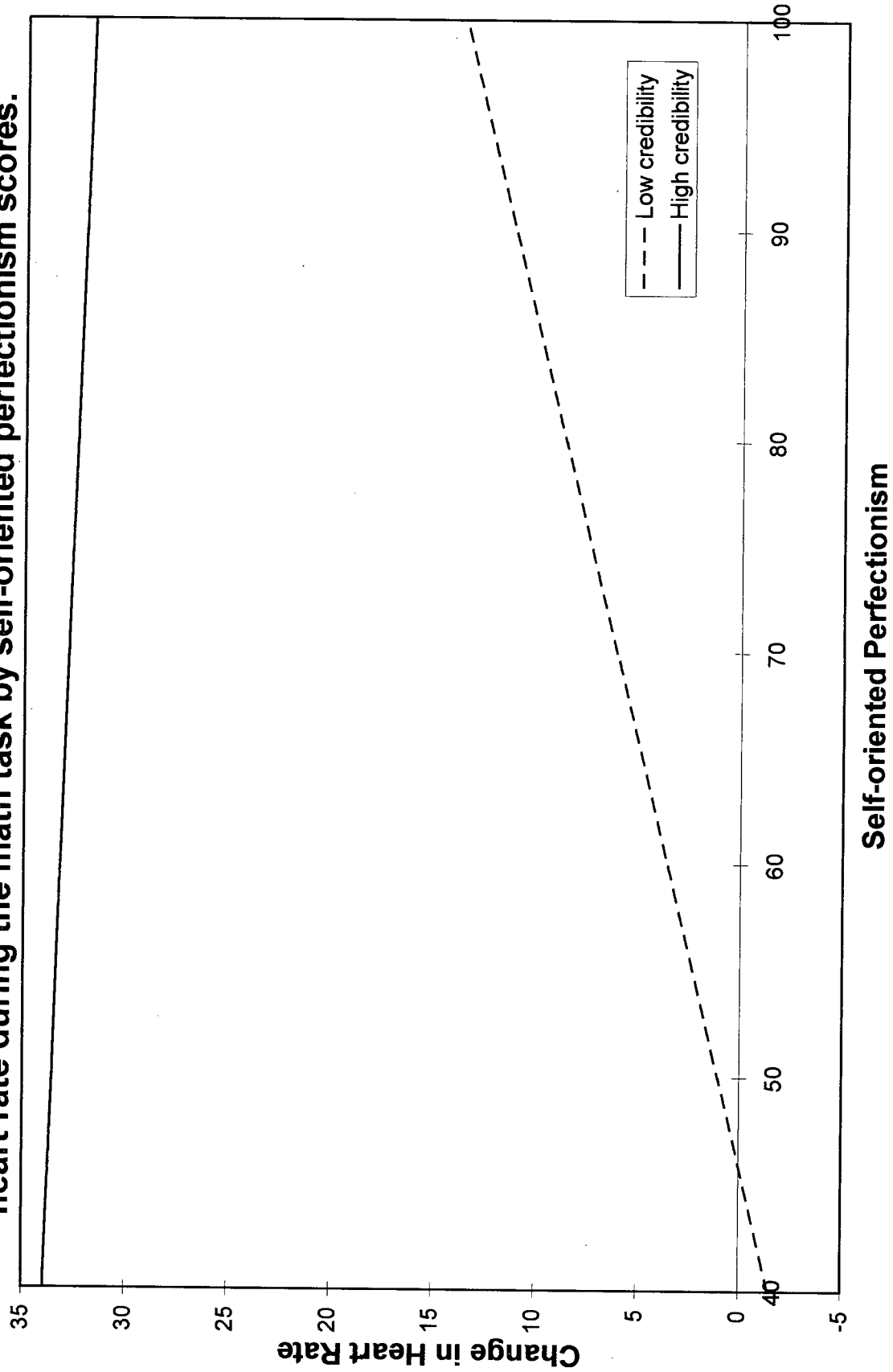

Figure 2: Impact of belief in the validity of the test on predictions of heart rate during the math task by self-oriented perfectionism scores.

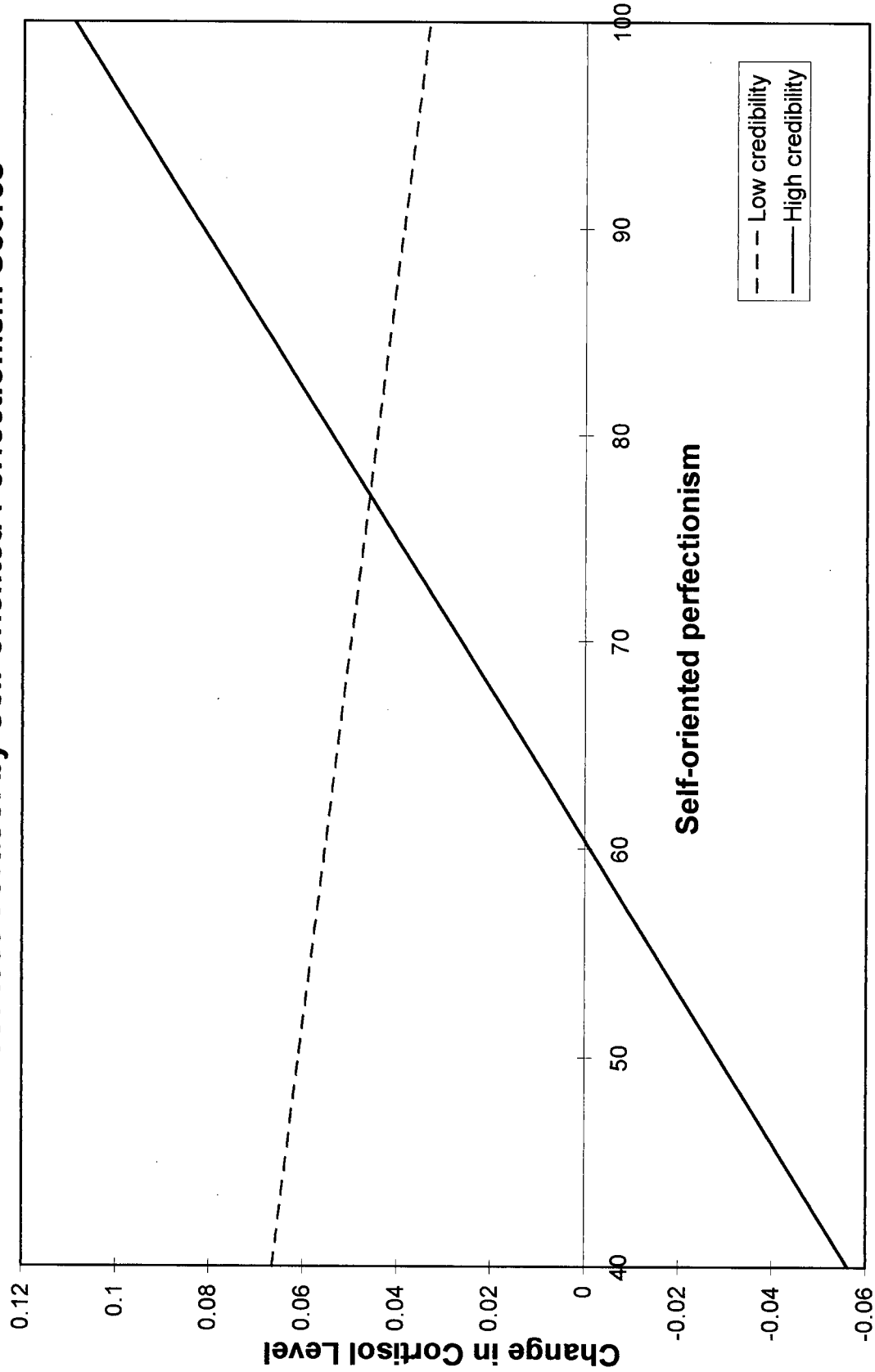

Figure 3: Impact of Belief in the Validity of the Test on Predictions of Post-test Cortisol by Self-oriented Perfectionism Scores