The Dissertation Committee for Mark William Mallon Certifies that this is the approved version of the following dissertation:

Relationships of Cognitive Appraisal

Committee:

____

Mary Steinhardt, Supervisor

____

Charles Holahan

____

John Bartholomew

____

Alexandra Loukas

____

Christyn Dolbier

Relationships of Cognitive Appraisal

by

Mark William Mallon, B.S.; M.A

Dissertation

Presented to the Faculty of the Graduate School of

the University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

August 2006

Relationships of Cognitive Appraisal

Publication No. ______

Mark William Mallon, Ph.D.
The University of Texas at Austin, 2006

Supervisor: Mary Steinhardt

Cognitive appraisal is a pivotal construct that has been identified in determining the stress response and coping response. Researchers have shown specific physiological outcomes of initial cognitive appraisals that are taken more as a threat or a challenge. Cognitive appraisal is known to fluctuate, but little is known about what influences these cognitive re-appraisals. While it has been theorized that changes in physiological arousal might impact cognitive re-appraisals, there is little support for this return pathway. Performance with the stressor has however been indicated as impacting cognitive re-appraisals. The studies presented here tested the relationships between cognitive appraisal, cognitive re-appraisal, coping response, performance measures, and changes in physiology. A computerized digit-symbol reaction time task presented to participants as "an IQ test" yielded performance measures, while heart rate and mean arterial blood pressure were recorded, as were measures of participants' cognitive appraisal of the stressor. Participants were both male and female undergraduates with 28 in the first study and 71 in the second study. Results from both studies indicate that the initial cognitive appraisal predicted the coping response as self-reported after the task. Initial cognitive appraisal also predicted more than a third of the variance observed in cognitive re-appraisal. The performance measure, percent correct, predicted an additional 15% of the variance. Neither heart rate nor mean arterial pressure was found to influence the cognitive re-appraisal at the end of the task. The second study also had a subjective performance measure and another cognitive re-appraisal after three minutes of rest. Tests indicated that the subjective percent correct predicted over 15% of the variance of cognitive re-appraisal, subsuming the objective measure of percent correct. The second study also found only one physiological measure, the stress response's mean arterial pressure, predicted 4% of the variance of the latter cognitive re-appraisal. Results identify the initial appraisal of, and the perception of performance with a stressful task as the primary targets for interventions promoting more effective coping and positive emotions. Future research is discussed that can address the limitations of these studies and investigate other environmental and personal factors that may influence cognitive appraisals.

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Chapter 1

Introduction

The experience of stress varies between individuals in its occurrence, intensity, and duration. Research has sought to understand these differences by explaining the influence of situational and personal factors in models of stress. Archetypal models begin when a situational event, the stressor, is perceived by an individual to be stressful or not. This perception, a concept central to most models, is known as cognitive appraisal. Cognitive appraisal then determines the coping strategies used to deal with the stress. Another and immediate outcome from cognitive appraisal in stress-to-coping paradigms is the stress response, or changes in physiological arousal. The ensuing changes in physiological arousal mobilize energy reserves in order for the individual to cope with the stress.

Significance

As can be seen by the review conducted by Smith and Gallo (2001) most models of stress depict physiological arousal only as a product of cognitive appraisal. It has been theorized however, that physiological arousal can impact cognitive appraisal (Cohen, Kessler, & Gordon, 1997; Carver & Scheier, 1994; Lazarus & Folkman, 1984). Current empirical research is unclear on what influence physiological arousal may have on cognitive appraisal. Several studies conducted by Tomaka and Blascovich have indicated that there is no influence (Tomaka, Blascovich, Kibler, & Ernst, 1997; Blascovich, Kibler, Ernst, Tomaka, & Vargas, 1994), but a recent study did find that physiological arousal significantly impacted cognitive appraisal (Quigley, Barrett, & Weinstein, 2002).

These experiments have used heart rate and blood pressure as indicators of physiological arousal. These studies have also labeled cognitive appraisals as either threat or challenge appraisals.

To obtain this distinction within cognitive appraisal Tomaka and Blascovich ask two questions. The first question asks an individual to rate how stressful or threatening a situation is. The second question asks the person to rate how well they believe they can cope with it. If the answer to the first question is greater than the answer to the second, the cognitive appraisal is termed a threat appraisal. If the answer to the second question is greater than the first, it is called a challenge appraisal (Tomaka et al., 1997; Blascovich et al., 1994). Stated more plainly, threat appraisals refer to the belief that the stressful situation exceeds one's ability to cope. Challenge appraisals occur when the individual believes their coping resources outweigh the environmental demands. Tomaka, Blascovich and colleagues have used this distinction to categorize individuals as those that are more likely to have a threat appraisal as opposed to a challenge appraisal, with respect to a particular laboratory stressor.

A person's cognitive appraisal, which is based upon the situational and personal factors of the individual, precipitates cognitive and behavioral responses, and physiological responses, which are either detrimental or beneficial for dealing with the stress (Moos & Schaefer, 1993; Vitaliano, DeWolfe, Maiuro, Russo & Katon, 1990; Carver, Scheier, & Weintraub, 1989; Lazarus & Folkman, 1984). The cognitive and behavioral responses are collectively referred to as coping, while the physiological changes are related to the preparation of the body to act.

When cognitive appraisal is operationalized in the manner put forth by Tomaka and Blascovich, both threat and challenge appraisals are correlated with increases in heart rate, but challenge appraisals show a greater increase (Blascovich, Mendes, Tomaka, Salomon, & Seery, 2003; Tomaka, Blascovich, Kelsey, & Leitten, 1993). However, the changes in blood pressure associated with threat and challenge appraisals occur in opposite directions. Threat appraisals have been correlated with slight increases in blood pressure, whereas decreases in blood pressure have been observed with challenge appraisals (Maier, Waldstein, & Synowski, 2003; Blascovich et al., 2003; Tomaka et al., 1997; Tomaka et al., 1993). This means that concurrent with threat appraisals the heart may be pumping faster, but the associated increases in blood pressure literally restrict the efficiency of energy mobilization. In contrast, very efficient energy mobilization is seen with challenge appraisals, with greater increases in heart rate along with decreases in blood pressure. This research on changes in heart rate and blood pressure helps to establish the influence of cognitive appraisals on physiology. Additionally, whether or not there is a recovery from the stress response may influence one's appraisal of the stressor.

This reverse pathway, from changes in physiological arousal to cognitive appraisal, has been theorized (Cohen et al., 1997; Carver & Scheier, 1994; Lazarus & Folkman, 1984), but there is little empirical support for it. Tomaka, Blascovich and colleagues have provided evidence that influence from physiology to cognitive appraisal does not exist (Tomaka et al., 1997; Blascovich et al., 1994). In their studies the researchers manipulated heart rate by use of an ergometer and blood pressure by means of a cold pressor task, where a participant's arm is immersed in very cold water. These studies indicated that there is no so-called peripheral influence from physiological manipulations upon cognitive appraisals.

Building on Tomaka and Blascovich's work, Quigley, Barrett, and Weinstein (2002) predicted no influence from physiological arousal to cognitive appraisals in a repeated measures design. These researchers did not manipulate heart rate and blood pressure by external devices. Rather, the changes in physiological arousal were due to the laboratory stressful situations themselves. The finding that physiological arousal, as measured by heart rate, did significantly impact the cognitive appraisals of the stressful tasks was not expected (Quigley et al., 2002).

Currently it is accepted that physiological arousal is an outcome of cognitive appraisals, and physiological correlates for threat and challenge appraisals have been established. As also mentioned above, several studies have manipulated both heart rate and blood pressure and have not seen their influence upon the initial cognitive appraisal. However, physiological arousal has been observed influencing subsequent cognitive appraisals when the arousal is attributed to the stressor in question. Clarifying the role that physiological arousal might have in the relationships between the stressor, cognitive appraisals, and the coping response would be invaluable in understanding the differences seen between individuals when they experience stress. This understanding might also provide other avenues for stress-reducing interventions.

Another difference between individuals that may serve to change their perception of the stressor, is how an individual handles the stressful situation, in other words, their coping response may indirectly lead to changes in cognitive appraisal. Coping thoughts and behaviors that target the stressor itself in attempts to overcome it are best suited for when an individual does have some control over the stressful situation. In laboratory settings, this control, or interaction with the stressor can easily be termed as their performance within the stressful situation. For Quigley and company, this performance measure was how many attempts, and how many successful completions of counting backwards by seven from a three-digit number, were made. Though they thought they would not find an influence from physiology to cognitive appraisals, they did try to explain that result by determining that how a participant performed at the stressful task was a better predictor of the cognitive appraisals than the physiology. Coping thoughts and behaviors that address how one feels, may also indirectly influence cognitive appraisals in the manners described below.

Theoretical Considerations

One explanation for the impact that physiology might have on cognitive appraisal has to do with the recovery from the stress response. Part of the meaningfulness of a stressor, which is assessed with a cognitive appraisal, can be seen in the intensity of the stress response. In other words, whether a stressor is considered more of a threat or a challenge can be observed in the degree of change in physiological arousal. When the physiological arousal elicited by a stressful event begins to return to levels seen at rest, this may serve to affirm for the individual that the meaning of the stressful situation is changing. Stated another way, physiological arousal could be part of one's internal environment that is continuously assessed by cognitive re-appraisals. Therefore it may be that physiological arousal should not be considered simply as a peripheral outcome, but also as a proximal predictor in stress and coping paradigms.

In a related manner, how an emotion develops may also help clarify the influence physiological arousal has on cognitive re-appraisals. The Schachter-Singer cognitive arousal theory of emotion states that arousal initiates a cognitive assessment of one's situation, and that this leads to the experience of an emotion. "Once we detect bodily arousal we are then motivated to examine our circumstances. On the basis of our cognitive assessment of the situation, we then label the arousal. The labeling of arousal is what determines the emotion we feel." (p. 48, LeDoux, 1996). Viewed in this way, an emotional response to a stressor is composed of both the physiology and the perception of the situation. Though some research has depicted an emotional response to a stressor as an independent construct in models of stress and coping (Smith & Gallo, 2001; Cohen et al., 1997), here emotion is viewed as being embedded in both the physiological arousal and cognitive appraisal.

Conceptual Model

Figure 1.1. Conceptual Model – The relationships between Cognitive Appraisal, Changes in Physiological Arousal, Performance, and the Coping Response.

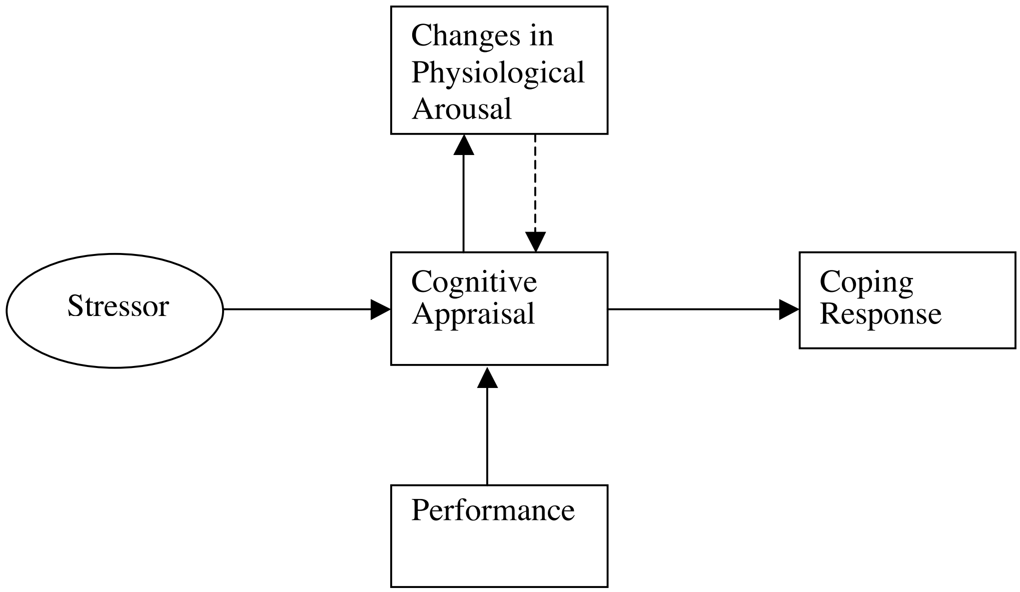


Figure 1.1 is a depiction of the conceptual model for this dissertation. As a stressor is encountered there is a cognitive appraisal that determines the coping response (Smith & Gallo, 2001; Carver et al., 1989; Lazarus & Folkman, 1984). Additionally, the cognitive appraisal prompts changes in physiological arousal so that the individual might mobilize energy reserves. The dotted path in Figure 1 depicts how changes in physiological arousal influence cognitive appraisal (Cohen et al., 1997). This return pathway also indicates how physiological arousal impacts coping as mediated by cognitive appraisal. The proposed pathway, that physiological arousal influences cognitive appraisal, has precedence in the surprise finding of Quigley, Barrett, and

Weinstein (2002). Performance with the stressor also is believed to influence cognitive appraisal.

Purpose

The purpose of this dissertation was to clarify the relationships surrounding cognitive appraisal, and specifically to determine what influences the fluctuating perception of a stressor, that which is called the cognitive re-appraisal. A goal-relevant task to elicit a stress response was used. This laboratory stressor was a learning task that provided performance measures and could be mastered during the time allotted. It was this latter feature that allowed for the possibility of observing the entire duration of a stressful experience, from first contact with the stressor to the situation no longer being stressful. The physiological measures of heart rate and blood pressure were repeatedly recorded, and cognitive appraisal was assessed immediately following the instructions for the goal-relevant task, the initial cognitive appraisal, and afterwards, the cognitive re-appraisal. A questionnaire measuring the coping response was given once the goal-relevant learning task had been completed.

Two studies were used for this dissertation. Study 1 was conducted early in the spring semester, primarily with kinesiology majors, had a smaller sample size than Study 2, and was used to help determine coping items specific to this laboratory stressor. Study 2 was conducted at the end of the spring semester, and also differed from the first study in that participants reported their cognitive appraisal a third time three minutes after the task was over. Those in Study 2 also self-reported how well they thought they did on the task. The measures indicated above were used for the confirmatory analyses outlined in the hypotheses below.

Hypotheses

The first two hypotheses were meant to replicate the established relationships in the stress-to-coping paradigm. Primarily, that the initial cognitive appraisal would determine both the coping response, and the stress response as indicated by changes in heart rate and blood pressure (see Figure 1.2). The rest of the hypotheses tested what influences there were on cognitive re-appraisals. These influences included the initial cognitive appraisal, the performance with the task, and the possibility of a return pathway from changes in physiological arousal back to cognitive appraisal (see Figure 1.3).

Figure 1.2. Statistical Model 1 – Tests of established relationships.

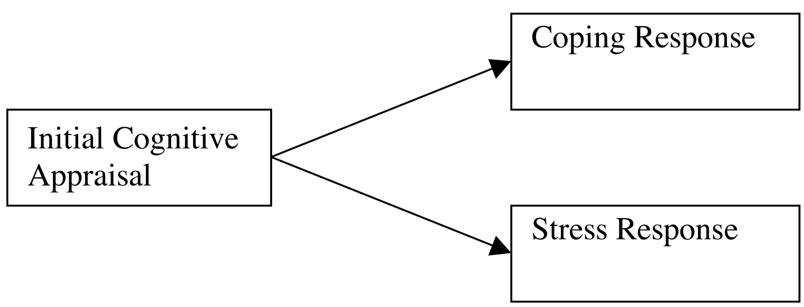
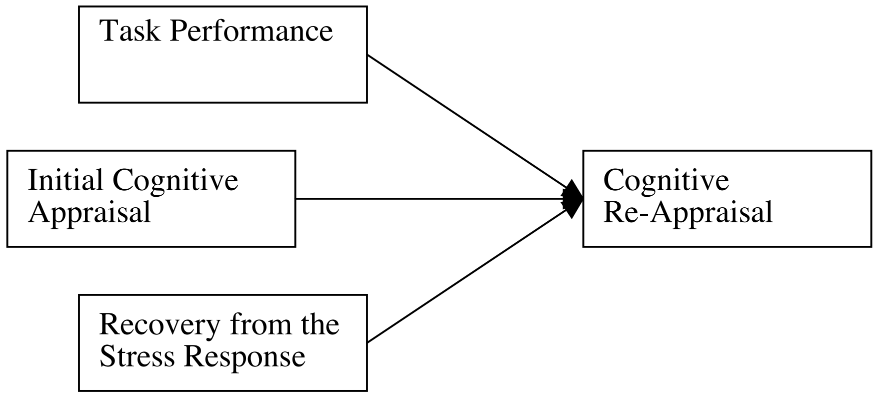


Figure 1.3. Statistical Model 2 – Tests of influences upon Cognitive Re-Appraisal.



Hypothesis 1. The initial cognitive appraisal would predict the coping response recorded at the end of the task, such that more challenge-like appraisals would be associated with a higher percentage of problem-focused coping.

Hypothesis 2. The initial cognitive appraisal would predict the stress response, such that:

2a. More challenge-like appraisals would lead to higher heart rate increases compared to threat-like appraisals.

2b. More threat-like appraisals would lead to higher blood pressure.

Hypothesis 3. The initial cognitive appraisal would predict the cognitive re-appraisal, such that more threat-like initial cognitive appraisals would be associated with more threat-like cognitive re-appraisals.

Hypothesis 4. Performance with the task would predict cognitive re-appraisals, such that:

4a. Faster processing speeds would predict more challenge-like re-appraisals.

4b. Higher percent corrects would predict more challenge-like re-appraisals.

4c (Study 2 only). Higher perceived percent corrects would predict more challenge-like re-appraisals.

Hypothesis 5. Recovery from the stress response would predict cognitive re-appraisals, such that:

5a. Higher heart rates would be associated with more threat-like re-appraisals.

5b. Lower blood pressures would be associated with more challenge-like re-appraisals.

Hypothesis 6 (Study 2). Recovery from the stress response after participants had rested would predict cognitive re-appraisal at that time, such that:

6a. Higher heart rates would be associated with more threat-like re-appraisals.

6b. Lower blood pressures would be associated with more challenge-like re-appraisals.

Definitions of Terms

Definitions for the variables present in the conceptual model are now given. In order, the terms to be defined are the stressor, cognitive appraisals, coping response, changes in physiological arousal, and performance. The related concept of an emotional response is also defined, as literature regarding emotions helps clarify how the other constructs are conceptualized here and related.

Stressor. A stressor is any event in an individual's environment that elicits a physiological response (Smith & Gallo, 2001; Lazarus & Folkman, 1984). The experience of stress from the event, and the responses to it, differ greatly between individuals. Some stressors allow for the individual to affect its course; these are termed active stressors. Others, known as passive stressors, remain out of the control of the individual (Tomaka et al., 1997; Blascovich et al., 1994). The stressor for both of these studies was a computerized digit-symbol reaction time task. Because participants had an interaction with the task it is an active stressor.

Cognitive Appraisals. Cognitive appraisals are the perceptions that an individual has of the stressful event and his or her ability for addressing its effect (Carver et al., 1989; Lazarus & Folkman, 1984). Cognitive appraisals can be divided into threat appraisals, wherein the individual believes the stressor is too taxing, and challenge appraisals, which refer to the perception of an ability to overcome the stressor's effects (Blascovich et al., 2003; Tomaka et al., 1993). Integral to cognitive appraisals is the amount of control an individual believes they have. The more control an individual perceives the more likely a challenge appraisal will result. For both Study 1 and Study 2 there was an initial cognitive appraisal and a cognitive re-appraisal. Study 2 had a third observation of cognitive appraisal, which is also termed a cognitive re-appraisal.

Coping Response. Coping response refers to the thoughts and behaviors used to address the stressful experience (Moos & Schaefer, 1993; Vitaliano et al., 1990; Carver et al., 1989; Lazarus & Folkman, 1984). These thoughts and behaviors can be divided into those that seek to nullify or attenuate the effects of the stress-eliciting event, and those thoughts and behaviors that intend to manage the emotional effects caused by the stressor. This dichotomy of coping responses is referred to as either the difference between problem-focused and emotion-focused coping (Carver et al., 1989), or approach and avoidance coping (Moos & Schaefer, 1993; Vitaliano et al., 1990). For these studies, situational coping items developed specifically for the laboratory stressor were used to determine the percentage of problem-focused coping employed.

Changes in Physiological Arousal. The initial changes in physiology due to an encounter with a stressor are collectively referred to as the stress response. Recovery from the stress response, or lack thereof, can then be used to refer to any subsequent changes in physiology. In the laboratory setting, these changes in physiological arousal were those measured by heart rate and blood pressure monitors. The changes could then be compared to baseline measures of physiological arousal at rest for determining the recovery from the stress response at any given time (Blascovich et al., 2003; Quigley et al., 2002; Tomaka et al., 1997; Blascovich et al., 1994; Tomaka et al., 1993).

Performance. The laboratory stressor used in these studies was an active stressor, allowing participants an interaction with it. From this amount of control came the performance measures of processing speed and percent correct. For both studies, processing speed referred to the amount of time it took an individual to decide what the correct response should be. Percent correct is how many correct responses were made out of all attempted. For Study 2 the additional subjective performance measure of their perception of percent correct was also measured.

Emotional Response. The emotional response to a stressor is determined by both the physiological state and the perception of the situation. For conceptual reasons, the emotional response is therefore referred to as a combination of both the changes in physiological arousal and the concurrent cognitive appraisal (LeDoux, 1996).

Delimitations

There were two delimitations of this dissertation related to issues of external validity. The first involves the type of stressor, and the second the coping response.

This dissertation was delimited to the study of goal-relevant learning tasks. The laboratory stressor was a motivated performance task, and was therefore an active stressor. Findings with the use of this type of laboratory stressor may not be generalizable to other types of stressors, particularly passive stressors wherein individuals have no control. For example, it may be that the findings in this dissertation would not be related to stress responses of a different magnitude.

Another delimitation of this study was that the coping response was only being measured once, after the task was completed, and then only so that it would be paired with the initial cognitive appraisal measured before the task began. Therefore the coping response was assessed only for how it was perceived by the participant after the testing is over, and not while it was ongoing. However, even an abbreviated situational coping response questionnaire would have been too disruptive if given any time during the task, and would most certainly have influenced any subsequent measures of the coping response.

Limitations

Issues of internal validity that could have had an impact on the findings are now presented. One limitation of this dissertation was the use of self-report for participants' responses, for example with the coping response and the cognitive appraisal measures. While observational data could be used for some coping behaviors, self-report is currently the only means for obtaining a participant's thoughts about their coping, and their perceptions of the stressor.

Another limitation of this dissertation was that participants would have a stress response to the laboratory stressor. Because the goal-relevance of the task was related to learning and intelligence, it was believed that most participants, as college students, would respond to the learning task stressor (Hughes, 2001). Additionally, the instructions were modeled after the scripts used by Tomaka and Blascovich that emphasized speed and accuracy (Tomaka et al., 1997; Blascovich & Tomaka, 1996; Tomaka et al., 1993). However, if a participant's changes in physiology were not indicative of a stress response because they did not perceive any goal-relevance of the task, then the internal validity of stress response measure would be compromised.

Chapter 2

Review of Literature

Chapter 2 begins with a description of the central component in stress-to-coping paradigms, which is also in each hypothesis, cognitive appraisal. The relationship between cognitive appraisal and the coping response is then discussed. Following that is a description of how cognitive appraisal leads to changes in physiological arousal. A theoretical perspective on how an emotional response to stress occurs is then reviewed. Once these concepts and relationships have been established the rationale for a return pathway from changes in physiological arousal to cognitive appraisal is discussed in more detail. Then a possible association between cognitive re-appraisal and performance on a stressful task is discussed. An explanation of appropriate laboratory stressors will be given, followed by a brief overview of concepts related to those tested in the hypotheses.

Cognitive Appraisal

A universal component to models of stress and coping is the interaction between a person and their environment. These primary actors are engaged in a dynamic and reciprocating relationship. Following Lazarus and Folkman's transactional model of stress and coping (1984), the collective influence each has is first realized within the construct of cognitive appraisal. At any one point in time cognitive appraisal is a perception of the current environmental situation, and how an individual believes it affects them. In other words, cognitive appraisal is influenced by both environmental and personal factors (Lazarus, Lazarus & Campos, 2006; Lazarus & Folkman, 1984).

As changes occur within both the environment and the person, the cognitive appraisal fluctuates. The process is iterative, and often researchers simply refer to a re-evaluation of the stressful situation as a cognitive re-appraisal (Lazarus, 1999; Lazarus & Folkman, 1984). The composition of a cognitive re-appraisal however, does not differ from that of an initial cognitive appraisal.

It is cognitive appraisal that determines whether an event is stressful or not. Stress is experienced when an individual believes an event is personally relevant, and that it taxes or exceeds their personal resources (Schneider, 2004; Kibler & Lyons, 2004; Lazarus & Folkman, 1984). In this way, the cognitive appraisal of a stressful event is determined by both how significant the event is, and by how they can cope with its occurrence. Lazarus and Folkman therefore divide cognitive appraisal into two components that represent these criteria for a stressful experience, namely primary and secondary appraisal.

Primary appraisal is defined as the individual's perception that the event is relevant to their well-being. Lazarus and Folkman describe three types of primary appraisal: irrelevant, benign-positive, and stressful (1984). Irrelevant primary appraisals occur when the event has no bearing on their life. Benign-positive primary appraisals occur when they perceive that the end result of an event will improve their well-being. For any event that can negatively affect their welfare, a stressful primary appraisal ensues.

Stressful appraisals are further subdivided into harm/loss, challenge, or threat appraisals. Harm/loss appraisals refer to events whereby an individual's well-being has already been detrimentally affected. Challenge appraisals are perceptions that the stressful situation is an opportunity for success and growth (Skinner & Brewer, 2002). Threat appraisals indicate that the individual expects to be harmed either physically or psychologically by the stressful event (Schneider, 2004; Skinner & Brewer, 2002). According to Lazarus and Folkman (1984) challenge and threat appraisals can be seen at the same time in response to a single stressful event, as they are not mutually exclusive. They are also distinct from the harm/loss primary appraisal, in that both challenge and threat mobilize one's efforts to cope with the ongoing stressful event.

Secondary appraisal is defined as the individual's perception of their ability to cope with the situation, taking into account three considerations. Lazarus and Folkman do not name these subparts as they did for the primary appraisals, rather they just list them as 1) the availability of their resources, 2) what options they have, and 3) how successful they think they will be. Along with primary appraisals, each of these aspects of secondary appraisal influence what level of control an individual believes they have with regard to a stressful situation (Lazarus, 1999; Peacock & Wong, 1990). Additionally, Lazarus and Folkman emphasize that primary and secondary appraisals occur at the same instant, and that they are interdependent and likely influence one another (Lazarus, 1999; Lazarus & Folkman, 1984).

Developed from the theory put forth by Lazarus and Folkman, Tomaka and Blascovich have defined challenge and threat appraisals as a combination of both primary and secondary appraisals (Blascovich et al., 2003; Herrald & Tomaka, 2002; Blascovich & Tomaka, 1996; Tomaka et al., 1997; Tomaka et al., 1993). Specifically, cognitive appraisal is defined as the ratio of primary appraisal to secondary appraisal. By doing so, these researchers have included the individual's perception of their ability to cope with the situation, aspects of Lazarus and Folkman's secondary appraisal, into both challenge and threat appraisals.

Tomaka and Blascovich ask two questions to obtain the distinction between cognitive appraisals that are labeled as either threat or challenge. For measuring primary appraisal, an answer to how threatening or stressful the situation is to a person is sought (Tomaka et al., 1993; Quigley et al., 2002). For measuring secondary appraisal, how able a person believes they can cope with the situation is required. When the answer to the first question is greater than the second, the cognitive appraisal is labeled as a threat appraisal. When they believe their ability to cope is greater than the level of threat perceived, it is considered a challenge appraisal (Schneider, 2004; Blascovich et al., 2003; Quigley et al., 2002; Herrald & Tomaka, 2002; Tomaka et al., 1993). By subtracting the value of the second question from the first, a difference score can also be used to obtain Tomaka and Blascovich's distinction between threat and challenge appraisals. Having determined whether a person feels more threatened or challenged, researchers then look at the outcomes from cognitive appraisal.

Coping Response

A primary outcome from cognitive appraisal is the coping response. The coping response is defined as the mental strategies and behaviors used in reply to a stressful event or situation (Lazarus & Folkman, 1984). Researchers often classify these responses into either problem-focused and emotion-focused coping (Carver et al., 1989), or approach and avoidance coping (Moos & Schaefer, 1993; Vitaliano et al., 1990). In a general sense, problem-focused coping and approach coping share the same purpose: to actively deal with the stress-eliciting event itself in an attempt to nullify or attenuate its effect. Examples of these thoughts and behaviors include focusing on dealing with the problem, and trying to come up with a strategy about what to do. A similarity also exists between emotion-focused coping and avoidance coping in that they are meant to manage the emotional effects that arise from a stressful situation. Examples of these thoughts and behaviors include making fun of the situation, and expressing one's negative feelings about the stressful experience.

Just like challenge and threat appraisals, the two general types of coping response are not mutually exclusive either. An individual is able to employ a variety of coping responses that could be categorized under both distinctions (Moos & Schaefer, 1993; Vitaliano et al., 1990). One example of this is positive reframing, which refers to the attempt of seeing a stressful event in a different light. Positive reframing can be emotion-focused coping in that in doing so the feelings elicited by the stressor should abate. Positive reframing can also be problem-focused coping in that having viewed the stressor different might yield purposeful ways of dealing with it.

Several researchers have used factor analysis in order to determine which items from their coping inventories can be assigned to distinct subscales (Olff, Brosschot & Godaert, 1993; Carver et al., 1989; Folkman, Lazarus, Dunkel-Schetter, DeLongis & Gruen, 1986; Folkman & Lazarus, 1985). In 1997, Carver greatly simplified a longer version of a previous coping scale by using only two items for each of 14 subscales.

Items from this scale can easily modified for measuring dispositional coping or situational coping behaviors in response to a specific stressor such as recovery from a hurricane (Carver, 1997).

In their transactional model, Lazarus and Folkman have stated that cognitive appraisal of a stressor continually mediates which coping responses are employed (1984). In accordance with the fluctuating nature of cognitive appraisal, the coping response is therefore not static either. The strategies initially employed in response to a stressor, specifically those meant to manage the emotional effects, may not be as necessary when the level of stress has diminished. Conversely, certain coping responses, like those targeting the stress-eliciting event itself, may be employed more as the stressful experience is overcome (Skinner & Brewer, 2002; Carver & Scheier, 1994; Lazarus & Folkman, 1985). The fluctuating amount of the emotion-focused or avoidance coping responses may also be associated with changes in physiological arousal.

Changes in Physiological Arousal

Cognitive appraisal also determines changes in physiology. The changes in physiology are indicative of heightened arousal, such as increases in heart rate, respiration, and perspiration. Termed the stress response by Hans Selye, the increases in physiological arousal elicited by a stressful event signify the mobilization of energy necessary for the "fight or flight" response as coined by Walter Cannon (LeDoux, 1996).

Studies conducted by Tomaka and Blascovich have clarified the changes in physiological arousal specifically due to cognitive appraisals that are challenge and threat appraisals (Blascovich et al., 2003; Herrald & Tomaka, 2002; Tomaka et al., 1993).

These researchers manipulated the physiological changes by using instructional sets to influence participant's cognitive appraisals towards either challenge or threat for a mathematical task (Tomaka et al., 1997; Tomaka et al., 1993). For example, in order to increase the likelihood of a challenge appraisal, the participants would be told to think of themselves as someone capable of meeting the challenge of the mathematical task. In order to elicit threat appraisals, the instructions emphasized the importance of speed and accuracy with the task.

Tomaka and Blascovich found that stress appraisals, both challenge and threat appraisals, lead to increases in heart rate (Blascovich et al., 2003; Herrald & Tomaka, 2002; Tomaka et al., 1997; Tomaka et al., 1993). The greatest increase in heart rate is seen with challenge appraisals. Challenge appraisals were also associated with a decrease in blood pressure that signifies very efficient energy mobilization (Blascovich et al., 2003, Tomaka et al., 1997). Conversely, the increase in heart rate for a threat appraisal is only moderate, and is often coupled with a slight increase in blood pressure (Tomaka et al., 1997). Increases in both heart rate and blood pressure indicate a less efficient mobilization of energy.

Not all research has replicated Tomaka and Blascovich's findings. Recently, Gramer conducted a study wherein participants engaged in several tasks including a mental arithmetic task and a speech performance task (2003). This researcher found that how well one believes they can cope with that task (secondary appraisal) did in part determine their stress response, such that those who believe they can effectively cope with the stressful task experienced less vascular reactivity, in other words, more efficient energy mobilization. However, Gramer cautions that this relationship was not observed with appraisals of how difficult, or stressful (primary appraisal) the task would be (Gramer, 2003), which is not consistent with the cognitive appraisal findings put forth by Tomaka and Blascovich.

Other researchers have replicated the finding that cognitive appraisal is predictive of changes in blood pressure and heart rate (Schneider, 2004; Maier, Waldstein, & Synowski, 2003). Schneider studied the role of neuroticism with the relationships between cognitive appraisals and the stress response. Heart rate and vascular resistance were consistent with Tomaka and Blascovich's assertions that challenge appraisals have higher increases in heart rate than threat appraisals, and that lower vascular resistance is observed with challenge appraisals compared to the slight increases seen with threat appraisals (Schneider, 2004). Maier and colleagues investigated the connection between cognitive appraisal of the task and cardiovascular functioning and mood. In addition to supporting the aforementioned influence cognitive appraisal has upon blood pressure, the results from this study also indicate that cognitive appraisal has a strong predictive ability with how one feels about the stressful experience, such that individuals that report more challenge-like appraisals are likely to experience more positive emotions (Maier et al., 2003).

An Emotional Response

Concurrent with a physiological change due to a stressor is an emotional response. Several studies indicate that emotion appears alongside a stress appraisal (Lazarus et al., 2006; Tong et al., 2005; Schneider, 2004; Gross & D'Ambrosio, 2004;

Harrald & Tomaka, 2002; Lazarus, 1999; Blascovich & Tomaka, 1996; Lazarus & Folkman, 1984; Leventhal & Nerenz, 1985; Leventhal, Meyer & Nerenz, 1980). Many of these studies have utilized self-report measures like the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) in order to observe the feelings experienced by participants in their studies. With respect to the distinction made by Tomaka and Blascovich, challenge appraisals are associated with positive emotions like eagerness and exhilaration, and threat appraisals are associated with negative emotions like fear and anxiety (Harrald & Tomaka, 2002; Blascovich & Tomaka, 1996).

One theory on the origin of emotions helps clarify why certain emotions are experienced in response to a stressor, and suggests a connection from physiological arousal to cognitive appraisal. Addressing the critiques of the earlier theories of emotion put forth by William James and Walter Cannon, theorists proposed that an emotional response begins with physiological arousal (Scherer, 2004; LeDoux, 1996; Frijda, Kuipers & ter Schure, 1989). This then leads to an assessment of the arousal within the social context. From here the arousal state is labeled and a specific emotion is experienced. The important aspect of this theory is the evaluation of the arousal and the social context, and because Daniel Schachter and Jerome Singer independently proposed this aspect, it is called the Schachter-Singer cognitive appraisal theory (Scherer, 2004; LeDoux, 1996; Frijda, Kuipers & ter Schure, 1989). According to this theory, cognitive appraisals take into account physiological arousal as well as the outside environmental context in order to determine the meaning for the individual. The type and degree of changes in physiological arousal therefore influence the cognitive appraisal, or re-appraisal, and serve to identify the emotional experience.

If this cognitive appraisal theory is correct, then recovery of the stress response and ongoing cognitive re-appraisals would suggest that the emotions change during the course of experiencing a stressor. These changes in emotions have been seen with respect to the stress of college exams. In 2002, Skinner and Brewer investigated the emotional state and coping strategies of college students around the time of an exam. Consistent with earlier findings (discussed below) these researchers found that challenge appraisals were associated with positive emotions, like eagerness and excitement. Furthermore they found that these positive emotions increased with the greater amount of problem-focused coping that is also associated with challenge appraisals (Skinner & Brewer, 2002).

Carver and Scheier (1994) also observed the coping response and feelings associated with cognitive appraisals before an exam, after the exam but before grades were announced, and after grades had been announced. These researchers observed changes in the coping response and the concurrent emotional state, such that those students who engaged in more problem-focused coping had more positive emotions at that time.

Similarly, Lazarus and Folkman (1985) observed the coping and emotional responses of undergraduate students facing an examination. The authors measured the coping behaviors and the emotions associated with the students' cognitive appraisals of the exam prior to the test, after the test but before grades were posted, and after grades were posted. Results indicate that the coping behaviors employed by students fluctuated over time, as did their emotions, also in line with the cognitive appraisal theory.

Rationale for Feedback from Physiological Arousal

The influence that physiological arousal may have on cognitive appraisals is reasoned from the theoretical physiological component to emotion, and the iterative nature of the appraisal process. Stress and coping models are referred to as recursive in part because certain coping responses, such as denial and venting, target the emotions one has experience (Lazarus et al., 2006; Lazarus, 1999; Leventhal & Nerenz, 1985; Lazarus & Folkman, 1984; Leventhal et al., 1980). These coping strategies are attempts at emotion regulation in that they try to alleviate the anxious feelings aroused from the stressful event. These coping strategies tend to occur earlier in response to a stressor when the physiological stress response is greatest, or when the only control one has regarding the stressful experience is how they feel (Lazarus et al., 2006; Folkman & Lazarus, 1985; Carver & Scheier, 1994). Emotions that arise when there are longer, sustained durations of the stress response, such as frustration and despair, then necessitate the use of more avoidance or emotion-focused coping responses in order to regulate those emotions.

Cognitive appraisal is a perception that evaluates not only the external environmental demands, but also a perception of how threatened one feels. While a stress appraisal leads to an adaptive physiological response, this in turn changes the internal environment, which is part of one’s personal information that will be assessed during cognitive re-appraisal. Lazarus and Folkman have postulated that an outcome of cognitive appraisal, such as physiological arousal, can become an antecedent variable in the iterative process (1984). With respect to emotional reactions they have said that, "…emotions once generated can then affect the appraisal process." (p. 278).

Lazarus and Folkman are not the only researchers who have theorized that information from one's own physiological response can elicit cognitive re-appraisals. Mandler (1992) theorized that arousal and meaningful cognitions create emotion, and that continuous feedback allows for cognitive re-appraisal of the situation. Similarly, Cohen and colleagues have alluded to theoretical pathways from physiological arousal to appraisal, one of which is mediated by an emotional reaction (Cohen et al., 1997). However, despite the call for determining what influence emotions and changes in physiology may have upon cognitive re-appraisal (Carver & Scheier, 1994) very few studies have addressed this pathway in stress and coping literature. The studies conducted by Tomaka and Blascovich comprise the majority of work in this line of research.

Tomaka and Blascovich initially utilized instructional sets in order to bias cognitive appraisals towards either threat or challenge appraisals. They have found that challenge appraisals tend to be reported when the instructions given reassure participants of their ability to accomplish the laboratory task. Threat appraisals are more likely reported with instructional sets that emphasized speed and accuracy from the participants (Herrald & Tomaka, 2002; Blascovich & Tomaka, 1996; Tomaka et al., 1993). Added to this work, the researchers have also addressed the possible peripheral influence of physiological arousal on cognitive appraisal.

Based on the physiological changes that are observed with stress appraisals, Tomaka, Blascovich and colleagues have artificially manipulated physiological arousal in order to determine if it can influence appraisal. Participants whose heart rates are increased because of having pedaled an ergometer do not show any increase in threat appraisals (Blascovich et al., 1994). Similarly, use of a cold pressor task to increase blood pressure has not lead to an increase of threat appraisals either (Tomaka et al., 1997; Blascovich et al., 1994). Their series of laboratory manipulations of physiology provide evidence that changes in heart rate and blood pressure do not influence stress appraisals. The stress experienced by participants is however easily attributed to the physiological manipulation.

Following Tomaka and Blascovich's work, Quigley, Barrett and Weinstein (2002) also sought to determine the nature of the relationship between changes in physiological arousal and cognitive appraisal. To do this, the authors had participants complete four mental arithmetic tasks back to back while appraisal was measured pre-task and post-task for each one. The mental arithmetic tasks each lasted only four minutes with cardiac measures taken during the first and last minute of each task. Consistent with the previous findings of Tomaka, Blascovich and colleagues, the authors report that more challenge-like cognitive appraisals pre-task predicted faster heart rates during the first minute of the task.

The researchers also predicted that the cardiac measures taken during the last minute of each task would not predict the post-task appraisal of that task. However, the results indicated that increased heart rates in the last minute of a mental arithmetic task predicted post-task threat appraisals, and furthermore, decreased heart rates during the last minute of the task predicted challenge appraisals post-task (Quigley et al., 2002). This finding of an influence from physiological arousal to cognitive re-appraisal was unexpected, and was also in the opposite direction of that observed for the first minute of the task.

Task Performance

Quigley, Barrett, and Weinstein (2002) discuss the influence of task performance upon post-task cognitive re-appraisal as a possible reason for the difference. This explanation relies upon the recovery from the initial stress response for the differences observed between the first and last minute of a mental arithmetic task. If an individual has mastered the task and no longer views it as stressful, then the physiological measures of the stress response will begin to return to those levels seen at rest. Conversely, for someone that continues to struggle with the task at its end, the stress response persists, and there is a continued or increased inefficiency in energy mobilization (Quigley et al., 2002). Even if recovery from the stress response is not the cause, the authors' results are evidence that changes in physiological arousal influence subsequent cognitive appraisal.

While Quigley and company sought to explain cognitive appraisals at the end of a task by how an individual performed during the task, others have in a more direct manner observed an association between an initial cognitive appraisal and task performance. Sawyer and Hollis-Sawyer (2005) tested the transactional model of coping to predict the variance in cognitive ability test scores. They found that cognitive appraisals were associated with task performance, such that more threat-like appraisals were associated with decreased cognitive ability. Similarly, in the study exploring how neuroticism influences responses to stress, Schneider (2004) also found an association between task performance and cognitive appraisal. This association too was that more threat-like appraisals were linked with poorer task performance with the stressful task. Schneider had participants count backwards by seven from a four-digit number and observed that those who had threat appraisals gave fewer responses and had a lower percentage of correct responses than individuals that perceived the task as a challenge. In addition to the relationship between cognitive appraisal and task performance, Schneider's results also replicated independently of Tomaka and Blascovich their findings that cognitive appraisal determines the physiological changes due to a stressor.

Laboratory Stressors

One clear distinction between Tomaka and Blascovich's work and that of Quigley, Barrett and Weinstein is that the physiological changes in the latter study are due to the stressful task itself. Inducing changes in heart rate and blood pressure, by use of an ergometer and a cold pressor task respectively, are easily attributed by the participant as external influences on their body. The same could be said for chemically manipulating physiological arousal. When however, physiological changes occur as part of a stress response then any subsequent cognitive re-appraisal will likely perceive that physiological arousal as part of one's internal or emotional state.

In order to increase the likelihood of recovery from the stress response, and therefore presumably less stress appraisals, another important component for a laboratory stressor is that the task itself be something that can be mastered. While use of a mental arithmetic task repeated over and over does allow for several measures of appraisal (Quigley et al., 2002), one's ability to continually subtract a 3-digit number by seven is relatively static. In the experimental setting, preparing and giving a speech certainly does elicit a stress response (Gramer, 2003; Steiner, Ryst, Berkowitz, Gschendt & Koopman, 2002; Egloff, Wilhelm, Neubauer, Mauss & Gross, 2002) but mastery over that task is not likely to be observed with only one speech given.

A digit-symbol substitution task is one wherein a participant is given a legend that matches up novel symbols with a single digit number counterpart. The object of the task is for the individual to respond with the correct number when presented with one of the symbols. This type of task can be mastered when the individual has learned the legend and no longer has to look to it in order to respond. Automating this task via a computer program means that reaction times as well as error rates can be observed, and allows for stress appraisal measures to be easily obtained along with the task. Computerized versions have been in use for decades (McLeod, Griffiths, Bigelow & Yingling, 1982) most notably for determining a person's cognitive processing speed and accuracy, or percent correct (Mackay, Tiplady & Scholey, 2002; Parkin & Java, 1999). A computerized digit-symbol reaction time task is an appropriate laboratory stressor for studying physiological influences on cognitive appraisal because 1) it can elicit a stress response (Feldman, Cohen, Hamrick, & Lepore, 2004; Clements & Turpin, 2000), 2) the source of the arousal is attributed to the task itself, and 3) one can overcome or master the task while physiological and psychological measures are being observed. These attributes compliment the hypotheses regarding cognitive appraisals, the stress response, and recovery from the stress response.

Review Summary

This chapter has introduced cognitive appraisal as the key component in stress to coping paradigms. Lazarus and Folkman's stress appraisal has been reworked and operationalized by Tomaka and Blascovich. The response to two questions is used to determine if a cognitive appraisal is more of a threat appraisal or a challenge appraisal. This review then discussed how the type of cognitive appraisal determines the strategies and behaviors of the coping response. Though overlap exists, most cognitions and behaviors of coping can be termed as either emotion-focused coping, where the attempt to alleviate how the stressor makes one feel is made, or problem-focused coping, which describes strategies that approach the stressor itself in order to minimize its effect.

The other established outcome from cognitive appraisal, the stress response – changes in physiological arousal, was then examined. Distinct changes in physiological arousal are seen between challenge appraisals and threat appraisals. For both there is an increase in heart rate, with the greatest increase seen with challenge appraisals. Also related to the efficiency of energy mobilization like heart rate, there are changes in blood pressure. Blood pressure decreases for challenge appraisals, and there is a slight increase in blood pressure for threat appraisals. An explanation of how these changes in physiological arousal might in turn have an influence upon cognitive re-appraisals was then discussed. Following the cognitive appraisal theory on the development of an emotional response, physiological arousal instigates an evaluation of that arousal in the social context. Just as cognitive appraisals are an assessment of the external environment, one's physiological state is also likely to be examined and have an impact during cognitive re-appraisal.

The chapter also discussed the differences between findings of a return pathway from physiological arousal seen in empirical studies. Tomaka, Blascovich and colleagues have repeatedly shown that manipulating one's physiological state does not impact subsequent cognitive appraisals. However, when Quigley and others allowed the laboratory stressor alone to affect physiological arousal, an influence from physiological arousal to cognitive appraisal was observed, such that higher heart rates were associated with more threat-like cognitive re-appraisals. Following this was a discussion of an association between cognitive appraisal and task performance, which Quigley and colleagues used to explain their unexpected results. The next section of this chapter then discussed what type of laboratory stressor would be best for determining an influence from the changes in physiological arousal on cognitive re-appraisal. A learning task that could be mastered and allowed for repeated measures of cognitive appraisals and changes in physiological arousal was emphasized.

Chapter 3

Methods

This chapter describes the methodologies used by both Study 1 and Study 2. Because the two studies are very similar, each section in this chapter will clarify the differences between Study 1 and Study 2 as needed. For example, the Data Collection section will describe what information was collected for both studies, then state what information was collected that was unique to Study 1 or to Study 2.

Participants

Participants for both studies were a convenience sample of undergraduates from the University of Texas at Austin. Both males and females were invited to participate in this research. Appointments for conducting the studies were one-hour sessions at a time decided upon by both the researcher and volunteer via e-mail or phone conversations. Written consent was obtained from participants just prior to their involvement (see Appendix A). All participants were informed that their responses would remain completely confidential and that they could discontinue their involvement at any time without repercussion.

The sample for Study 1 (N=28) was obtained early in the spring semester, before first exams had been given. Participants were recruited primarily from upper-division Kinesiology classes via flyers and classroom announcements. The average age of participants in Study 1 was 21 years. Females outnumbered males 4:3 and the majority of participants were Caucasian (see Table 3.1 below).

Table 3.1 - Gender and racial make-up of Study 1 participants (N=28)

	African-American	Asian	Caucasian	Hispanic	total
Female	2	2	9	3	16
Male	2	0	7	3	12
total	4	2	16	6	28

The sample for Study 2 (N=71) was obtained at the end of the spring semester after the last exams for classes were being taken. Participants for this study were recruited via classroom announcements in a lower-division Kinesiology course that is often taken by majors other than kinesiology. Participants in Study 2 were compensated with extra credit for their involvement in this research. The average age for participants in Study 2 was also 21 years. Females outnumbered male 5:2 and the majority of participants were Caucasian (see Table 3.2 below).

Table 3.2 - Gender and racial make-up of Study 2 participants (N=71)

	African-American	Asian	Caucasian	Hispanic	total
Female	4	9	27	11	51
Male	2	5	9	4	20
total	6	14	36	15	71

Data Collection

The demographic information described above was obtained along with physiological and psychological measurements during each participant's session. All data were collected and recorded in a way to ensure the confidentiality of the participants in the studies. This was done by using code numbers for each participant and for all pieces of data collected.

The demographic information was collected using a paper and pencil survey at the end of each session. The physiological information that was observed was each participant's heart rate and blood pressure. A monitor that records both heart rate and blood pressure began taking measures soon after consent was obtained and continued until the end of the session.

Psychological information was obtained via paper and pencil surveys, namely for situational coping and perceived stress. Additionally, cognitive appraisals, reaction times, and error rates were recorded by means of two computer programs. The reaction times and error rates lead to the performance measures of processing speed and percent correct. For Study 2, the computer program also recorded the perception of correct responses from each participant.

Procedures

Participants had individual daytime appointments for both studies that were conducted in a quiet campus setting. Each session took just under one hour and could be divided into three parts termed *pre-task*, *task*, and *post-task*. The procedures, which were approved by the university's institutional review board, were as follows:

Pre-task. Once consent was obtained, the experimenter explained each part of the study in turn. Participants were informed that the physiological measures of heart rate and blood pressure would be monitored throughout the entire study. Heart rate and blood pressure were measured four times during *pre-task* while the participant rested at a computer console. Three minutes would elapse between observations in order for the arteries to return to their normal state. The total time for the procedures in *pre-task* took approximately 12 minutes.

Task. Following the resting measures of their physiology, each participant was then told that they would be taking “an IQ test”, and that they would know their IQ score immediately following the test. They were also informed that their IQ score, and their physiological responses, would be compared to the others taking the IQ test at the University of Texas, as well as the national norms that came with “the IQ testing packet”. It is believed that the description of the task as psychologically meaningful to the participant would elicit a noticeable physiological stress response (Hughes, 2001).

The task itself was a computerized version of the symbol-digit substitution subscale of the Wechsler Adult Intelligence Scale. For this task each participant would learn a set of symbols by their number counterpart, and the computer would record their reaction times and error rates. The instructions for this task took about four minutes and involved the participant reading three computer screens and notifying the experimenter (“the proctor”) when they had finished each screen. Just prior to beginning the task each participant confirmed a checklist about “the IQ test” which emphasized the difficulty of the task, the need to respond quickly and accurately, and how their scores would be compared to others. (See Appendix B for the script of the instructions and the accompanying screenshots from the computer program.)

Immediately following the instructions a participant would begin “the IQ test” by answering two questions individually presented on the computer screen, in order to assess their initial cognitive appraisal (see Appendix C). At the same time their heart rate and blood pressure was measured. After 140 symbol presentations (the same symbols presented in the same order for both studies, with no feedback) the two questions assessing their cognitive re-appraisal of the test were asked again. On average the time elapsed between the questions for cognitive appraisal was 7 minutes, the amount of time it took to respond to the 140 symbol presentations. The physiological measures were again taken while they answered these questions. After they answered, the program informed them that "the IQ testing" was then over.

For Study 2, participants were asked to wait three minutes after which time they answered the cognitive appraisal questions a third time, with heart rate and blood pressure measured again. Following this, participants in Study 2 also answered a question measuring how well they thought they did on the test, in terms of their percent of correct answers (see Appendix D).

Post-task. After participants were told that the test was over they completed a paper and pencil questionnaire that measured their situational coping with the task they just undertook. Participants were then given a debriefing form and told how the computer task is not correlated with intelligence and that how they did, and responded physiologically, would not be compared to others (see Appendix E). The reason for how and why the study was conducted was then fully explained and the participant was given the opportunity to ask any questions regarding it. Included in the full disclosure of the purpose of the study was the need for each participant to complete a short and simple reaction time task on the computer in order to have baseline measures for each individual's reaction times and error rates. Participants provided demographic information at the end of their session.

Instrumentation

Heart Rate and Mean Arterial Pressure. Participants' heart rate and blood pressure were recorded using an OMRON Automatic Blood Pressure Monitor (model HEM-780). This device utilized an arm cuff especially designed for quick and accurate automatic inflation for measuring blood pressure, along with heart rate, at the press of a button.

The measures for blood pressure include both systolic and diastolic blood pressure. Mean arterial pressure was calculated by using the formula: [systolic + (2*diastolic)]/3 (Meaney, Alva, Moguel, Meaney, Alva, & Weber, 2000).

The experimenter began recording each participant's heart rate and mean arterial pressure while they were resting and sitting at the computer console. Four times, every three minutes during this rest period, heart rate and mean arterial pressure were observed. Heart rate and mean arterial pressure would also be measured when the two individually presented psychological measures for cognitive appraisal were repeatedly recorded during the computer tasks.

The final three measures of heart rate and mean arterial pressure taken during the rest period in *pre-task*, which took approximately 7 minutes, were averaged and used as baseline measures for physiological arousal (Tomaka et al., 1997; Blascovich & Tomaka, 1996). The heart rates and mean arterial pressures that were recorded before and after the 140 symbol presentations were used as multiple physiological arousal measures (Quigley et al., 2002). The baseline measure was used as comparisons for the initial stress response (Tomaka et al., 1997; Blascovich & Tomaka, 1996) and for recovery from the stress response, with Study 2 having two recovery times.

Cognitive Appraisal. Cognitive appraisal refers to the perception an individual has of a specific stressor in their life. For both studies appraisal was defined by how the participant answered two questions during the stressful task. The two questions were derived from Quigley, Barrett and Weinstein (2002) and were, “How stressful is this IQ test to you right now?” and “How able are you cope with this IQ test right now?” For both of these questions participants responded by using the mouse to place a mark on a horizontal line anchored by the phrases *not very much* on the left and *very much so* on the right.

The placement of a hash mark by a participant on the answer bar for each question determined its raw value, with the far left representing the lowest value and the right end of the bar the highest. When the value for the first question: “how stressful is this” was greater than that of the second question: “how able are you to cope” the cognitive appraisal was considered more of a threat-like appraisal. When the value for the first question was lower than that of the second question, the cognitive appraisal was considered to have had a more challenge-like valence. Stated another way, a positive difference score represented a cognitive appraisal of threat, a negative score indicated a challenge appraisal, and a score of zero represented a neutral cognitive appraisal. Because the far left of the answer bar was at a horizontal pixel location of 200, and the far right of the answer bar was at 600 horizontal pixels, the cognitive appraisal score has a range between -400 and +400.

The cognitive appraisal assessed immediately prior to the start of the learning task was the initial cognitive appraisal. The cognitive appraisal assessed after the symbol presentations was a participant's cognitive re-appraisal. When the value of the re-appraisal became more positive compared to the initial cognitive appraisal, then that individual perceived "the IQ test" to be more threatening after having experienced it, compared to only having been instructed about it. For Study 2, an additional cognitive re-appraisal was recorded three minutes after the conclusion of the computer task.

Situational Coping. Situational coping refers to the behaviors or strategies an individual engaged in because of the stressful task. Participants were asked how much they engaged in 12 coping strategies and behaviors while taking "the IQ test". Many of these items originated from the Brief Coping Orientations to Problems Experienced scale (BriefCOPE) by Carver (1997) that was modified to fit the laboratory stressor in these studies. The other items were derived through observation and the use of focus groups to determine the most viable coping behaviors specific to the task undertaken in Study 1 and Study 2 (see Appendix F).

The responses for each of the 12 items were given on a Likert scale that ranges from 1 = *not at all* to 4 = *a lot*. The number responses to every third item were summed to create a problem-focused coping score. The other eight responses were totaled to create an emotion-focused coping score. These two values were then used to calculate the percent problem-focused coping specific to the stressful situation used in Study 1 and

Study 2. A percent score reflects the contribution of both emotion and problem-focused coping (Vitaliano, Maiuro, Russo & Becker, 1985). The percent problem-focused coping from these 12 items has a possible range of 11.11 % to 66.67 %.

Processing Speed. Processing speed refers to how quickly an individual can make a decision. In the case of these studies processing speed is determined by the difference in reaction times between a digit-symbol reaction time task and a simple number reaction time task. Reaction time means how quickly a participant responds to a stimulus given by the computer program. For the stress task in both studies this was how quickly they keyed a number on the keyboard after a symbol was presented. For the simple reaction time task, how quickly a participant pressed a number on the keypad after the program presented a number on the screen became the reaction time. Reaction time was measured in seconds by the program and because of the computer monitor refresh rate it could be inaccurate by as much as 20 milliseconds. The reaction time measure maintained reliability however as the refresh rate did not change during the course of both studies. The reaction times for correct responses to the 140 symbol presentations were averaged, as were the reaction times for correct responses to the simple reaction time task. Subtracting the reaction time average of the simple task from the reaction time average of the symbol task yielded the performance measure of processing speed.

Percent Correct. Percent correct refers to how accurate a participant was in their responses to the digit-symbol reaction time task. Each time a participant pressed a number on the keypad a value representing either correct or incorrect was added to their data file. However, no feedback was presented to the participant that would have made them aware of how they were doing. The percent correct was calculated by how many correct responses there were out of 140. Like processing speed, percent correct is a measure of task performance.

Perceived Percent Correct. In addition to the objective measure of percent correct tabulated by the computer program, each participant was asked, "What percent of correct responses did you give for the entire IQ test?" As with the cognitive appraisal questions, participants responded by using the mouse to place a hash mark on an answer bar. This bar was anchored on the left with *0 %* and on the right with *100 %.*

Demographic Information. Using a paper and pencil survey, participants indicated their age, race, and gender.

Data Analysis

Hypothesis 1. The initial cognitive appraisal would predict the coping response recorded at the end of the task, such that more challenge-like appraisals would be associated with a higher percentage of problem-focused coping.

A bivariate correlation between the initial cognitive appraisal and the percent of problem-focused coping was used to test this hypothesis. The coefficient of determination (r^2) stated the amount of variance accounted for, and Pearson's r explained the strength and direction of that relationship.

Hypothesis 2. The initial cognitive appraisal would predict the stress response.

Two hierarchical regressions were used to test this hypothesis, the first for heart rate (Hypothesis 2a) and the second for mean arterial pressure (2b). For each regression the baseline physiological measure was controlled for, the physiological measure for the stress response was used as the dependent variable, and the influence of the initial cognitive appraisal was tested. With each regression, the coefficient of multiple determination (R^2) indicated the amount of variance accounted for, the R^2 change signified the amount attributed to the initial appraisal, and the beta coefficients explained the strength and relationship of the independent variables.

Hypothesis 3. The initial cognitive appraisal would predict the cognitive re-appraisal, such that more threat-like initial cognitive appraisals would be associated with more threat-like cognitive re-appraisals.

A bivariate correlation between the initial cognitive appraisal and the cognitive re-appraisal was used to test this hypothesis. The coefficient of determination (r^2) stated the amount of variance accounted for, and Pearson's r explained the strength and direction of that relationship.

Hypothesis 4. Performance with the task would predict cognitive re-appraisals.

Three hierarchical regressions were used to test this hypothesis, the first for testing processing speed (Hypothesis 4a), the second for testing percent correct (4b), and another for testing perceived percent correct (4c, Study 2). For each regression the initial cognitive appraisal was controlled for, the cognitive re-appraisal was the dependent variable, and the influence of the performance measure was tested. With each regression, the coefficient of multiple determination (R^2) indicated the amount of variance accounted for, the R^2 change signified the amount attributed to the performance measure, and the beta coefficients explained the strength and relationship of the independent variables.

For Hypothesis 4c (Study 2 only), both the initial cognitive appraisal and the objective percent correct were controlled for.

Hypothesis 5. Recovery from the stress response would predict cognitive re-appraisals.

Two hierarchical regressions were used to test this hypothesis, first for heart rate (Hypothesis 5a) and also for mean arterial pressure (5b). For each regression the initial cognitive appraisal, the baseline physiological measure (time 0), and the physiological measure at time 1 were all controlled for. The cognitive re-appraisal was used again as the dependent variable, and the physiological measure from time 2 was then tested in order to determine its impact on cognitive re-appraisal. With each regression, the coefficient of determination (R^2) indicated the amount of variance accounted for, and the R^2 change indicated the amount attributed to physiological measures. The beta coefficients explained the strength and relationship of all the independent variables with cognitive re-appraisal.

Hypothesis 6 (Study 2). Recovery from the stress response after participants had rested would predict cognitive re-appraisal at that time.

Two hierarchical regressions were used to test this hypothesis, one for heart rate (Hypothesis 6a) and a second for mean arterial pressure (6b). As with Hypothesis 5, for each regression the initial cognitive appraisal, the baseline physiological measure (at time 0), and the physiological measure at time 1 were all controlled for. The cognitive re-appraisal was used again as the dependent variable, and the physiological measure from time 3 was then tested in order to determine its impact on cognitive re-appraisal. With each regression, the coefficient of determination (R^2) indicated the amount of variance accounted for, and the R^2 change indicated the amount attributed to physiological measures. The beta coefficients explained the strength and relationship of all the independent variables with the cognitive re-appraisal.

In addition to the statistics reported above, tolerance values were also computed for each regression. Tolerance is used to assess the multicollinearity between independent variables being tested. The lower the value for tolerance the greater the likelihood that multicollinearity exists, which would make the standard errors larger and the beta coefficients less stable. Tolerance values less than .20 would be considered problematic (Tabachnick & Fidell, 2001). If multicollinearity were found, one way to handle the problem would be to combine the variables in question into a composite variable, based on theory. For example, a reactivity score indicating a stress response would merely be the change in heart rate from baseline to just prior to the start of the task (Quigley et al., 2002).

Chapter 4

Results

This chapter is divided into three sections. The first two sections refer to Study 1 and Study 2 respectively. In both of these sections the observations of the variables pertinent to each study's hypotheses are described. The tests of the hypotheses are then presented in turn. The third section of this chapter presents a comparison between Study 1 and Study 2.

Study 1

There were three observations of the physiological measures of heart rate (HR) and mean arterial pressure (MAP) in Study 1. Time 0 indicates the resting baseline measure, time 1 was immediately before a participant begins the computer task (after the instructions had been given), and time 2 was at the end of the task, but before a participant knew that the test was over. A number placed after each variable name indicates which observation it is, for example, MAP0 indicates the mean arterial pressure at baseline. Table 4.1 lists the descriptives of the physiological observations. Paired t-tests indicate that there were significant differences between the baseline physiological measures and those at time 1 for both HR ($t = 4.380$, $p < .05$) and MAP ($t = 3.697$, $p < .05$).

Table 4.1 - Descriptives of Study 1 physiological measures (N=28)

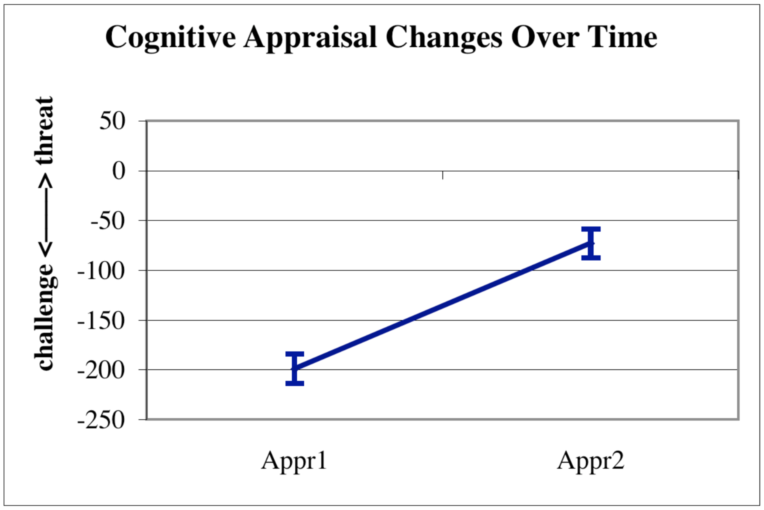
	HR0	HR1	HR2	MAP0	MAP1	MAP2
Mean	69.63	77.50	77.53	86.29	90.98	90.15
SD	10.28	11.85	12.09	8.02	10.24	9.36
SEM	1.94	2.24	2.28	1.52	1.94	1.77
Minimum	50.33	55	58	72.78	70.67	74.67
Maximum	93.00	100	100	102.78	107.33	113.67

There are two times that cognitive appraisal (Appr) was measured in Study 1. The initial cognitive appraisal (Appr1) was assessed immediately prior to the symbol presentations of the computer task. The cognitive re-appraisal (Appr2) was recorded by the computer program after the cessation of the symbol presentations. The responses participants gave to the reaction time tasks yielded the performance measures of processing speed and percent correct. A paper and pencil survey provided the measure of the percentage of problem-focused coping (pPFC12). Table 4.2 lists the descriptives for these variables and graph 4.3 depicts the change in cognitive appraisal with the standard error of the mean used to display error bars. A paired t-test on the cognitive appraisal measures indicates that there was a significant difference between time 1 and time 2 ($t = 4.346$, $p < .05$).

Table 4.2 - Descriptives of Study 1 cognitive measures (N=28)

	Appr1	Appr2	Processing Speed	Percent Correct	pPFC12
Mean	-199.18	-73.14	1.26	59.95	40.95
SD	155.72	177.47	0.33	10.21	9.02
SEM	29.43	33.54	0.06	1.93	1.70
Minimum	-397	-326	0.88	40.70	17.20
Maximum	120	327	2.52	84.30	59.10

Graph 4.3 - Cognitive appraisal immediately prior to and after the computer task



Hypothesis 1 for Study 1 posited that the initial cognitive appraisal (Appr1) measured before the task begins would predict the coping used during the testing (pPFC12) as self-reported immediately following the task. This relationship was approaching significance ($p = .069$) with the initial cognitive appraisal explaining 12.18 percent of the variance of the coping behaviors ($r^2 = .122$). The correlation between these variables indicated a trend that higher values for the initial appraisal (more threat-like) were associated with a lower percentage of problem-focused coping ($r = -.349$).

The second hypothesis for Study 1 was that the initial cognitive appraisal (Appr1) would be predictive of the stress response, as measured by changes in heart rate (HR) and mean arterial pressure (MAP) from baseline to immediately prior to engaging in the task, the duration of which was approximately 4 minutes. For heart rate, a significant direct relationship between HR0 and HR1 existed ($R^2 = .409$, $\beta = .639$, $p < .05$). While controlling the influence of the baseline measure of heart rate, the influence of the initial cognitive appraisal was tested. Both HR0 and Appr1 showed significant direct relationships with HR1 ($R^2 = .672$, $\beta = .697$, $p < .05$), however the influence of Appr1 was not in the predicted direction ($\beta = .516$, $p < .05$), but rather signified that more threat-like initial cognitive appraisals were associated with higher increases in heart rate. A significant direct relationship between MAP0 and MAP1 also existed ($R^2 = .571$, $\beta = .756$, $p < .05$). While controlling for baseline mean arterial pressure, the initial appraisal was entered into the model. As was the case with heart rate, both MAP0 and Appr1 indicated significant direct relationships with MAP1 ($R^2 = .637$, $\beta = .713$, $p < .05$, $\beta = .261$, $p < .05$) such that more threat-like appraisals led to higher mean arterial pressure. See tables 4.4 and 4.5 for a summary of these findings along with the t-values, and the tolerance of the tested variable.

Table 4.4 - Test of Hypothesis 2a; initial cognitive appraisal predicting HR1 (N=28)

	R^2	ß	t	p	tolerance
HR0	.409	.697	6.045	.000	
Appr1	.672	.516	4.475	.000	.99

Table 4.5 - Test of Hypothesis 2b, initial cognitive appraisal predicting MAP1 (N=28)

	R^2	ß	t	p	tolerance
MAP0	.571	.713	5.832	.000	
Appr1	.637	.261	2.134	.043	.97

Hypothesis 3 for Study 1 was that the initial cognitive appraisal would predict the cognitive re-appraisal. This relationship was significant ($p < .05$) with Appr1 explaining 33.94 % of the variance in Appr2 ($r^2 = .339$). The correlation between these variables indicates that higher values for the initial appraisal (more threat-like) were associated with higher values at the re-appraisal ($r = .583$).

The fourth hypothesis for Study 1 was that cognitive re-appraisal would also be influenced by task performance, as measured by processing speed and by percent correct. With the influence of the initial appraisal controlled for, each of the performance measures was tested. Processing speed was not found to be a significant predictor of Appr2, above and beyond what Appr1 can predict ($\beta = .042$, $p > .05$). However, when the objective measure of percent correct was tested, while taking into account the influence of Appr1, it did have a significant inverse relationship with Appr2, ($R^2 = .508$, $\beta = .584$, $p < .05$, $\beta = -.410$, $p < .05$) such that higher percent corrects predicted more challenge-like re-appraisals.

Hypothesis 5 for Study 1 posited that recovery from the initial stress response, as measured by changes in both heart rate and mean arterial pressure, would also influence the cognitive re-appraisal. Controlling for the influence of the initial appraisal, and for baseline heart rate and HR1, the variable to be tested, HR2, was entered into the model. Though the model was still statistically significant ($R^2 = .419$, $p < .05$), there was no significant association for HR0 ($\beta = .338$, $p > .05$), HR1 ($\beta = -.425$, $p > .05$), or HR2 ($\beta = -.108$, $p > .05$). Similarly, baseline mean arterial pressure and MAP1 were controlled for, along with the known influence of the initial appraisal, then MAP2 was entered into the model. The model remained significant ($R^2 = .381$, $p < .05$) but no significant association was found for MAP0 either ($\beta = .005$, $p > .05$), MAP1 ($\beta = .108$, $p > .05$), or MAP2 ($\beta = -.277$, $p > .05$).

Table 4.6 summarizes the results of the hypotheses regarding what influences changes in cognitive re-appraisal. The R^2 for the first row indicates the coefficient of determination for the initial cognitive appraisal predicting the cognitive re-appraisal. The subsequent R^2s are the coefficients of multiple determination with the other variables added in for each hypothesis. Italicized variables were controlled for along with Appr1.

Table 4.6 - Summary of hypothesized predictors of cognitive re-appraisal for Study 1

		R^2	ß	t	p	tolerance
Hypothesis 3	Appr1	0.339	0.583	3.654	0.001*	1.00
Hypothesis 4a	Processing Speed	0.341	0.042	0.256	0.800	.99
Hypothesis 4b	Percent Correct	0.508	-0.410	-2.925	0.007*	1.00
Hypothesis 5a	*HR0*	0.341	0.338	1.143	0.265	
	HR1	0.417	-0.425	-1.295	0.208	
	HR2	0.419	-0.108	-0.311	0.759	.21
Hypothesis 5b	*MAP0*	0.363	0.005	0.012	0.991	
	MAP1	0.369	0.108	0.393	0.698	
	MAP2	0.381	-0.277	-0.757	0.456	.20

* denotes only significant predictors of Appr2

Study 2

For Study 2 there were four observations of the physiological measures of HR and MAP. In addition to time 0 (the baseline), time 1 (start of test), and time 2 (end of test), time 3 indicates the observation that occurred three minutes after participants were told that the testing was over. Again, a number placed after each variable name indicates which observation it is, for example, HR3 indicates the heart rate measured at time 3 as described above. Table 4.7 lists the descriptives of the physiological observations for

Study 2. Paired t-tests indicate that there were significant differences between the baseline physiological measures and those at time 1 for both HR ($t = 8.267$, $p < .05$) and MAP ($t = 8.981$, $p < .05$).

Table 4.7 - Descriptives of Study 2 physiological measures

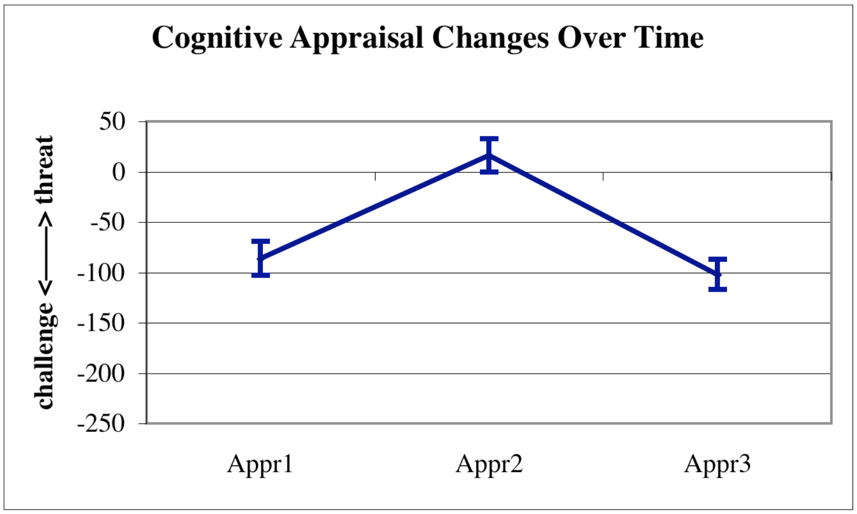
	HR0	HR1	HR2	HR3	MAP0	MAP1	MAP2	MAP3
N	71	71	71	68	71	71	71	68
Mean	72.15	79.61	78.18	73.75	83.71	89.80	87.79	85.37
SD	9.13	12.21	10.80	9.62	7.50	9.39	8.15	8.06
SEM	1.08	1.45	1.28	1.17	0.89	1.11	0.97	0.98
Minimum	50.67	55.00	58.00	53.00	68.00	62.67	68.00	66.00
Maximum	96.00	130.00	117.00	98.00	101.22	104.33	105.00	101.00

Cognitive appraisal of the stressful task was measured three times in Study 2. In addition to the initial cognitive appraisal (Appr1) and a cognitive re-appraisal (Appr2), another re-appraisal (Appr3) was measured after a three-minute rest period. As with Study 1, the performance measures of processing speed (PS) and percent correct were recorded by the computer programs, as was each participant's perception of their percent correct (Perceived %Correct). Percent problem-focused coping (pPFC12) was again obtained by a paper and pencil questionnaire. Table 4.8 lists the descriptives for these variables and graph 4.9 depicts the changes in cognitive appraisal with the standard error of the mean used to display error bars. A paired t-test on the cognitive appraisal measures indicates that there was a significant difference between time 1 and time 2 ($t = 6.906$, $p < .05$).

Table 4.8 - Descriptives of Study 2 cognitive measures

	Appr1	Appr2	Appr3	PS	Percent Correct	Perceived %Correct	pPFC12
N	69	71	71	70	71	71	71
Mean	-86.01	16.28	-101.97	1.18	59.06	37.56	37.06
SD	139.96	139.39	124.92	0.18	11.46	15.59	8.36
SEM	16.85	16.54	14.83	0.02	1.36	1.85	0.99
Min.	-373	-337	-376	0.83	26.40	5.50	22.60
Max.	236	388	194	1.71	87.10	65.30	62.50

Graph 4.9 - Initial cognitive appraisal and cognitive re-appraisals



The first hypothesis for Study 2 stated that the initial cognitive appraisal would predict the percentage of problem-focused coping. A significant relationship was found between Appr1 and pPFC12 with the initial cognitive appraisal explaining 16.8 percent of the variance of the coping behaviors ($r^2 = .168$, $p < .05$). As predicted, the correlation between Appr1 and pPFC12 indicated an inverse relationship between the two constructs ($r = -.410$).

Hypothesis 2 for Study 2 posited that Appr1 would predict the stress response as indicated by changes in HR and MAP. With heart rate, a significant direct relationship was found between HR0 and HR1 ($R^2 = .614$, df = 70, $\beta = .784$, $p < .05$). Controlling for this influence from HR0, the initial cognitive appraisal was tested. The overall model remained significant ($R^2 = .626$, df = 68, $p < .05$) and HR0 stayed significant predictor of HR1 ($\beta = .790$, $p < .05$) while Appr1 was approaching significance ($\beta = -.128$, $p = .096$), indicating a trend that more challenge-like appraisals led to higher heart rate increases compared to threat-like appraisals. For mean arterial pressure, a significant direct relationship was seen between MAP0 and MAP1 ($R^2 = .629$, df = 70, $\beta = .793$, $p < .05$). The influence from MAP0 was controlled for, and Appr1 was tested. The overall model was still significant ($R^2 = .642$, df = 68, $p < .05$) but only MAP0 had a significant influence upon MAP1 ($\beta = .795$, $p < .05$, $\beta = -.023$, $p > .05$). See tables 4.10 and 4.11 for a summary of the tests for hypothesis 2 including the t-values, and the tolerance of the tested variable.

Table 4.10 - Test of Hypothesis 2a, initial cognitive appraisal predicting HR1 (N=69)

	R^2	ß	t	p	tolerance
HR0	.609	.790	10.463	.000	
Appr1	.626	- .128	-1.688	.096	.99

Table 4.11 - Test of Hypothesis 2b, initial cognitive appraisal predicting MAP1 (N=69)

	R^2	ß	t	p	tolerance
MAP0	.641	.795	10.485	.000	
Appr1	.642	-.023	-.298	.766	.94

The third hypothesis for Study 2 is that Appr1 would predict Appr2. A significant relationship was found between these two measures of cognitive appraisal with the initial appraisal predicting 36.20 % of the variance in the re-appraisal ($r^2 = .362$). The correlation between Appr1 and Appr2 indicated that higher values for the initial cognitive appraisal (more threat-like) were associated with higher values at the re-appraisal ($r = .601$).

Hypothesis 4 for Study 2 posited that Appr2 would also be influenced by the objective performance measures of processing speed and percent correct, as well as by the perception of percent correct. Processing speed was not found to be a significant predictor of Appr2 when controlling for Appr1 ($\beta = -.152$, $p > .05$). The objective measure of percent correct did show a significant inverse relationship with Appr2, when controlling for Appr1 ($R^2 = .422$, $\beta = .614$, $p < .05$, $\beta = -.247$, $p < .05$), indicating that higher percent corrects predicted more challenge-like re-appraisals. When testing the influence of the subjective percent correct, it subsumed the predictive ability of the objective percent correct and predicted a total of 15 % above and beyond the predictive ability of Appr1 ($R^2 = .515$, $\beta = -.047$, $p > .05$, $\beta = -3.528$, $p < .05$).

The fifth hypothesis for Study 2 states that recovery from the initial stress response (changes in HR and MAP) would predict Appr2. While controlling for Appr1, HR0, and HR1, the variable to be tested, HR2, was added to the model. The model was statistically significant ($R^2 = .373$, $p < .05$) however, there was no significant influence detected for HR0 ($\beta = .124$, $p > .05$), HR1 ($\beta = -.020$, $p > .05$), or HR2 ($\beta = .487$, $p > .05$). While also holding the initial cognitive appraisal constant, MAP0 and MAP1 were controlled for as MAP2 was tested. Again no significant influence beyond that which Appr1 provided was indicated for MAP0 ($\beta = .758$, $p > .05$), MAP1 ($\beta = .419$, $p > .05$), or MAP2 ($\beta = .456$, $p > .05$).

Hypothesis 6 for Study 2 speculated that with increased time to recover from the initial stress response, physiology would influence a cognitive re-appraisal. The initial appraisal was controlled for, as were the heart rate measures that signified the initial stress response (HR0 and HR1), while HR3 was tested for its influence upon Appr3. The model was statistically significant ($R^2 = .295$, $p < .05$) however, there was no significant influence detected for HR0 ($\beta = .221$, $p > .05$), HR1 ($\beta = -.099$, $p > .05$), or HR2 ($\beta = .198$, $p > .05$). With the initial appraisal held constant, the mean arterial pressure measures (MAP0 and MAP1) were also controlled as MAP3 was added to the test. No significant influence on Appr3 was found for MAP0 ($\beta = -.171$, $p > .05$), or MAP2 ($\beta = -.283$, $p > .05$) but MAP1 was seen to have a predictive ability for the cognitive re-appraisal that came after three minutes of rest ($\beta = .498$, $p < .05$) indicating that higher blood pressures at time 1 predicted more threat-like appraisals three minutes after the testing was over. See tables 4.12 and 4.13 for a summary of the tests for hypothesis 6.

Table 4.12 - Test of Hypothesis 6a, HR extended recovery predicting Appr3 (N=66)

	R^2	ß	t	p	tolerance
Appr1	.276	.525	4.695	.000	
HR0	.276	.221	1.032	.306	
HR1	.282	-.099	-.558	.579	
HR3	.295	-.198	-1.080	.285	.34

Table 4.13 - Test of Hypothesis 6b, MAP extended recovery predicting Appr3 (N=66)

	R^2	ß	t	p	tolerance
Appr1	.276	.524	4.886	.000	
MAP0	.276	-.171	-.867	.390	
MAP1	.317	.498	2.273	.027	
MAP3	.333	-.283	-1.201	.341	.20

Table 4.14 summarizes the findings pertinent to the tested predictors of the first cognitive re-appraisal (Appr2). The R^2 for the first row indicates the coefficient of determination for the initial cognitive appraisal predicting Appr2. The subsequent R^2s are the coefficients of multiple determination when the other variables are added for each hypothesis. Italicized variables were controlled for along with Appr1.

Table 4.14 - Summary of hypothesized predictors of Appr2 for Study 2

		R^2	ß	t	p	tolerance
Hypothesis 3	Appr1	0.362	0.601	6.161	0.000*	1.00
Hypothesis 4a	Processing Speed	0.389	-0.152	-1.553	0.125	.99
Hypothesis 4b	Percent Correct	0.423	-0.247	-2.633	0.011*	1.00
Hypothesis 4c	% Correct	0.423	-0.005	-0.047	0.963	
	Perceived % Correct	0.515	-0.393	-3.528	0.001*	.60
Hypothesis 5a	*HR0*	0.371	0.025	0.124	0.902	
	HR1	0.371	-0.003	-0.020	0.984	
	HR2	0.373	0.088	0.487	0.628	.30
Hypothesis 5b	*MAP0*	0.366	0.056	0.309	0.758	
	MAP1	0.368	-0.159	0.814	0.419	
	MAP2	0.373	-0.148	-0.750	0.456	.25

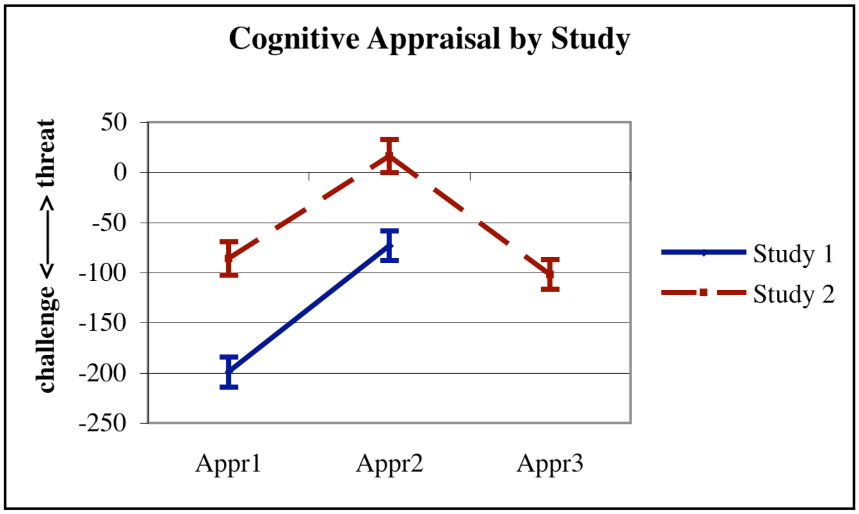
* denotes only significant predictors of Appr2

The larger sample size for Study 2 allowed for a meaningful power analysis to be conducted. With respect to Hypothesis 5, the R^2, sample size, and number of independent variables controlled for and tested, were all inputted in order to determine how large an influence from physiology to cognitive re-appraisal would have to be in order to be observed with power being above the .80 criterion. For both heart rate and mean arterial pressure Study 2 could detect an influence that would account for 7 % or more of the variance in cognitive re-appraisal. This means that there may be a significant influence from physiology upon cognitive re-appraisal not seen by Study 2, but it would be less than half as potent as the influence from perceived percent correct, which is more than 15 %.

Study 1 and Study 2

The differences between Study 1 and Study 2 included changes in the protocol, different convenience samples, and the sessions being conducted early in the semester versus at the end. The improvements in protocol made between the studies, which included a revised script meant to emphasize more sternly the importance of doing well on the task, may have contributed to there being more threat-like initial cognitive appraisals for Study 2. This elevated perception of threat increased for participants in the second study as it had for those in Study 1. Though there was no third cognitive appraisal measure for Study 1, participants from that group were significantly less threatened by the "IQ" test at both the initial cognitive appraisal ($t = -3.492$, $p < .05$) and at the cognitive re-appraisal ($t = -2.391$, $p < .05$). Graph 4.15 illustrates this difference between the studies.

Graph 4.15 - Cognitive appraisal differences between Study 1 and Study 2



It may be that those in Study 1 who participated at the beginning of the semester were able to handle one more stressor more easily than those in Study 2 who were already preparing for, and taking final examinations. Not surprisingly, t-tests did determine a significant difference in the percentage of problem-focused coping between the two studies with Study 1 participants having a significantly higher percentage of problem-focused coping compared to Study 2 participants ($t = 2.04$, $p < .05$). Though it is not certain as to the cause, or causes of the differences between the cognitive appraisals of Study 1 versus Study 2, they should be considered when interpreting both the inconsistent, and consistent findings between the two studies.

Chapter 5

Journal Chapter
(following the guidelines for submission to the journal Anxiety, Stress & Coping
http://www.tandf.co.uk/journals/authors/gascauth.asp)

Initial Cognitive Appraisal, Recovery from the Stress Response, and

Task Performance: Determinants of Cognitive Re-Appraisal

Abstract

Cognitive appraisal is a pivotal construct in stress and coping models, yet little is known about what influences cognitive re-appraisals. This study tested the relationships between initial cognitive appraisal, physiology, task performance, and cognitive re-appraisal. Seventy-one male and female undergraduates participated in the study. A computerized digit-symbol reaction time task presented to participants as “an IQ test” yielded performance measures while measures of heart rate and mean arterial blood pressure were recorded, as were participant’s cognitive appraisals of the stressor. Initial cognitive appraisal and the objective performance measure of percent correct independently predicted over 40% of the variance in cognitive re-appraisal. Subjective percent correct mediated the influence from the objective performance measure and with initial cognitive appraisal predicted over 50% of the variance. Neither physiological measure was found to influence the cognitive re-appraisal at the end of the task. The implications for future research and application are discussed.

Keywords: cognitive appraisal, cognitive re-appraisal, stress response, task performance, physiological recovery

Initial Cognitive Appraisal, Recovery from the Stress Response, and Task Performance: Determinants of Cognitive Re-Appraisal

COGNITIVE APPRAISALS AND CHANGES IN PHYSIOLOGY

Cognitive appraisal is a perception that evaluates not only the external environmental demands, but also a perception of how threatened one feels (Lazarus, Lazarus & Campos, 2006; Lazarus, 1999; Lazarus & Folkman, 1984). As changes occur within both the environment and the person, the cognitive appraisal fluctuates. The process is iterative, and often researchers simply refer to a re-evaluation of the stressful situation as a cognitive re-appraisal (Lazarus, 1999; Lazarus & Folkman, 1984).

Currently it is accepted that cognitive appraisal determines changes in physiological arousal, also known as the stress response. While a stress appraisal leads to an adaptive physiological response, this changes the internal environment, which is part of one's personal information that can be assessed during cognitive re-appraisal. Lazarus and Folkman (1984) have postulated that an outcome of cognitive appraisal, such as physiological arousal – the stress response, can become an antecedent variable in the iterative process. Others have also theorized that changes in physiology may influence cognitive re-appraisal, as part of a continuous feedback pathway (Cohen, Kessler & Gordon, 1997; Carver & Scheier, 1994; Mandler, 1992).

Developed from the theory put forth by Lazarus and Folkman (1984), Tomaka and Blascovich ask two questions to obtain a distinction between cognitive appraisals that are labeled as either threat or challenge (Blascovich, Mendes, Tomaka, Salomon, &

Seery, 2003; Herrald & Tomaka, 2002; Blascovich & Tomaka, 1996; Tomaka, Blascovich, Kelsey, & Leitten, 1993). When cognitive appraisal is operationalized in this manner, both threat and challenge appraisals are correlated with increases in heart rate, with challenge appraisals show a greater increase (Blascovich et al., 2003; Tomaka et al., 1993). However, the changes in blood pressure associated with threat and challenge appraisals occur in opposite directions. Threat appraisals have been correlated with slight increases in blood pressure, whereas decreases in blood pressure have been observed with challenge appraisals (Maier, Waldstein, & Synowski, 2003; Blascovich et al., 2003; Tomaka, Blascovich, Kibler, & Ernst, 1997; Tomaka et al., 1993). This research on the changes in heart rate and blood pressure helps to establish the influence that cognitive appraisals have on physiology. The research has also been used as evidence that there is no reverse pathway between these variables.

Tomaka, Blascovich and colleagues (Tomaka et al., 1997; Blascovich, Kibler, Ernst, Tomaka, & Vargas, 1994) have provided evidence that influences from physiology to cognitive appraisals do not exist. In their studies the researchers manipulated heart rate by use of an ergometer, and blood pressure by means of a cold pressor task. These studies indicated that there is no so-called peripheral influence from physiological manipulations upon cognitive appraisals. There is however a significant limitation in their methodology. Inducing changes in heart rate and blood pressure by use of an ergometer and a cold pressor task respectively, are easily attributed as external influences on the body, not as part of a psychological stressor. The same could be said for chemically manipulating physiological arousal. When physiological changes occur as part of a stress response any subsequent cognitive re-appraisal may perceive the arousal as part of one's internal state. Changes in physiology that are due to a stressful task itself then become necessary in order to determine if any influence on cognitive re-appraisals exists.

Building on Tomaka and Blascovich's work, Quigley, Barrett, and Weinstein (2002) predicted no influence from physiological arousal to cognitive appraisals in a repeated measures design wherein participants continually subtracted a three-digit number by seven. However, the results indicated that increased heart rates in the last minute of the mental arithmetic task predicted post-task threat appraisals. Furthermore, decreased heart rates during the last minute of the task predicted challenge appraisals post-task. These findings contrast those provided by Tomaka and Blascovich that indicated no influence from physiology onto cognitive appraisal. Quigley et al. (2002) discuss the influence of task performance upon cognitive re-appraisals as a possible reason for finding an influence from physiology. This explanation however was limited in that it relied upon ad hoc performance measures related to an arithmetic task.

A laboratory stressor used when studying the influences of cognitive re-appraisals should not only yield established performance measures, but it should also be a task that can be mastered. While use of a mental arithmetic task repeated over and over does allow for several measures of cognitive appraisal (Quigley et al., 2002), one's ability to continually subtract a three-digit number by seven is relatively static. In another experimental setting, preparing and giving a speech certainly does elicit a stress response (Gramer, 2003; Steiner, Ryst, Berkowitz, Gschendt & Koopman, 2002; Egloff, Wilhelm, Neubauer, Mauss & Gross, 2002) but mastery over that task is not likely to be observed with only one speech given. With an active stressor, with which the individual interacts, performance with the task is more likely to impact cognitive re-appraisals as mastery over the task can occur.

An active stressor that can be mastered will also increase the likelihood that there is recovery from the stress response. This increased likelihood is not possible with arithmetic tasks or artificial manipulation of physiology, indicating another limitation with the tasks used in Quigley et al. (2002) and Tomaka, Blascovich and colleagues (Tomaka et al., 1997; Blascovich et al., 1994). It may be that the changes in physiology that influence cognitive re-appraisals are those that occur as part of the recovery from the stress response. Part of the meaningfulness of a stressor, which is assessed with a cognitive appraisal, can be seen in the intensity of the stress response (Maier et al., 2003; Blascovich et al., 2003; Tomaka et al., 1997; Tomaka et al., 1993). If an individual continues to struggle with the task at its end, the stress response persists. Conversely, for someone that has mastered the task and no longer views it as stressful, then the physiological arousal of the stress response will begin to return to those levels seen at rest, and subsequent cognitive re-appraisals might be affected.

CURRENT STUDY

Collectively, the previous research is a reminder of the important components for studying the possible influence that changes in physiology may have upon cognitive re-appraisals. The first of these is that physiological changes indicating a stress response should be due to the stressful task. The stressful task should also be an active stressor that provides established performance measures. Additionally, the task should be one that can be overcome, thus increasing the likelihood that there is a recovery from the stress response. By doing so, the entire course of a stressor can be observed, from first exposure to no longer stressful.

In order to test for the most likely influences upon cognitive re-appraisal, a goal-relevant task eliciting a stress response was used. A computerized digit-symbol coding task was presented to participants as an IQ test. This active stressor is a reaction time task that provides objective performance measures, and cognitive appraisals were assessed along with physiological measures. In order to allow for more recovery time post-task, after three minutes elapsed there was another observation for cognitive re-appraisal and physiology. After this, participants reported how well they thought they did, for a subjective performance measure. This design allows one to assess the influences upon cognitive re-appraisal from the initial appraisal, task performance, and recovery from the stress response.

The first influence hypothesized with this study was that the initial cognitive appraisal would predict the cognitive re-appraisal. It was expected that more threat-like initial cognitive appraisals would be associated with more threat-like cognitive re-appraisals.

It was also postulated that performance with the task would predict cognitive re-appraisal. The first performance measure calculated by the computer program from each participant's reaction time is processing speed. It was expected that faster processing speeds would predict more challenge-like re-appraisals. The second performance measure from the reaction time task is the percent of correctly identified symbols. Higher percent corrects were hypothesized to predict more challenge-like re-appraisals. In addition to these performance measures, there was also the self-reported percent correct provided by the participant. Higher subjective perceived percent corrects were expected to predict more challenge-like re-appraisals.

It was also believed that recovery from the stress response would predict cognitive re-appraisals at the end of the stressful task. Higher heart rates would be associated with more threat-like re-appraisals, and lower blood pressures would be associated with more challenge-like re-appraisals. These expectations were also hypothesized for the cognitive re-appraisal observed after three minutes of rest.

METHODS

Participants

Participants were a convenience sample of male and female undergraduates enrolled in a upper-division Kinesiology course. All participants (N=71) received extra credit in that class in return for their involvement. Appointments were one-hour sessions that were conducted in the final weeks of the spring semester. The average age of participants was 20.5 years (standard deviation = 2.2) and there were more females (78%) than males (28.2%). Over half of the participants identified themselves as Caucasian (50.7%), 21.1% as Hispanic, 19.7% as Asian, and only 5.6% as African-American.

Procedures

One-hour sessions were conducted with individual participants in a quiet campus setting. During this time heart rate (HR) and mean arterial blood pressure (MAP) were repeatedly recorded via a monitor. Computer programs were used to administer the stressful task as well as record cognitive appraisals, reaction times, error rates, and perception of percent correct. The demographic information was collected at the end of each session. The procedures, which were approved by the institutional review board, had three parts: pre-task, task, and post-task.

Pre-task. Once consent was obtained, the experimenter explained each part of the study in turn. Participants were informed that HR and MAP would be monitored throughout the entire study. HR and MAP were measured four times during pre-task while the participant rested at a computer console. Three minutes elapsed between observations in order for arteries to return to their normal state. The total time for the procedures in pre-task took approximately 12 minutes.

Task. Following the resting measures of HR and MAP, each participant was then told that they would be taking "an IQ test", and that they would know their IQ score immediately following the test. They were also informed that their IQ score, and their HR and MAP, would be compared to others taking the IQ test at the university, as well as the national norms that came with "the IQ testing packet".

The task itself was a computerized version of the symbol-digit substitution subscale of the Wechsler Adult Intelligence Scale. For this task each participant would learn a set of symbols by their number counterpart, and the computer would record their reaction times and error rates. The instructions for this task took about four minutes and involved the participant reading three computer screens and notifying the experimenter ("the proctor") when they had finished each screen. Just prior to beginning the task each participant confirmed a checklist about "the IQ test" which emphasized the difficulty of the task, the need to respond quickly and accurately, and how their scores would be compared to others.

Immediately following the instructions a participant would begin the "IQ test" by answering two questions individually presented on the computer screen in order to assess their initial cognitive appraisal. At the same time their HR and MAP were measured. After 140 symbol presentations (the same symbols presented in the same order for each participant) the two questions assessing their cognitive re-appraisal of the test were asked again. On average the time elapsed between the cognitive appraisal measures was 7 minutes, the amount of time it took to respond to the 140 symbol presentations. HR and MAP were taken again while participants answered the two cognitive re-appraisal questions. After they answered, the program informed them that "the IQ testing" was over.

Participants were asked to wait three minutes after which time they answered the two cognitive appraisal questions a third time, with HR and MAP measured again. Before the three-minute wait period was over, participants also answered a question measuring how well they thought they did on the test in terms of percent of correct answers.

Post-task. Participants were given a debriefing form and told that the digit-symbol reaction time task is not correlated with intelligence and that how they performed, and responded physiologically would not be compared to others. The purpose of the study was then fully explained and the participant was given the opportunity to ask questions. Included in the full disclosure was the need for each participant to complete a simple reaction time task in order to calculate processing speed. For this participants keyed the number pad as quickly as possible for individually presented numbers on the computer screen. Lastly, each participant provided demographic information on a brief paper and pencil survey.

Instrumentation

Heart rate and mean arterial pressure. Participants' HR and blood pressure were recorded using an OMRON Automatic Blood Pressure Monitor (model HEM-780). This device utilized an arm cuff especially designed for quick and accurate automatic inflation for measuring blood pressure, along with HR, at the press of a button. MAP was calculated by using the formula: [systolic + (2*diastolic)]/3 (Meaney, Alva, Moguel, Meaney, Alva, & Weber, 2000).

The final three measures of HR and MAP taken during the rest period in pre-task, which took approximately 7 minutes, were averaged and used as baseline measures for physiological arousal (Tomaka et al., 1997; Blascovich & Tomaka, 1996). The HR and MAP measures that were recorded before and after the 140 symbol presentations were used as multiple physiological arousal measures (Quigley et al., 2002). The baseline measure was used as comparisons for the initial stress response (Tomaka et al., 1997; Blascovich & Tomaka, 1996) and for recovery from the stress response immediately after completing the task and after a three-minute rest period.

Cognitive appraisal. Cognitive appraisal refers to the perception an individual has of a specific stressor in their life. Cognitive appraisal was defined by how each participant answered two questions during the stressful task. The two questions were derived from Quigley et al. (2002) and were, “How stressful is this IQ test to you right now?” and “How able are you cope with this IQ test right now?” For both of these questions participants responded by using the mouse to place a mark on a horizontal line anchored by the phrases *not very much* on the left and *very much so* on the right.

When the value for the first question: “how stressful is this” was greater than that of the second question: “how able are you to cope” the cognitive appraisal was considered a more threat-like appraisal. When the value for the first question was lower than that of the second question, the cognitive appraisal was considered to have had a more challenge-like valence. The placement of a hash mark on the answer bar for each question determined its raw value expressed in the number of horizontal pixels from the left side of the computer screen. Because the far left of the answer bar was at a horizontal pixel location of 200, and the far right of the answer bar was at 600 horizontal pixels, the cognitive appraisal score has a range between -400 and +400.

The cognitive appraisal assessed immediately prior to the start of the learning task was the initial cognitive appraisal. The cognitive appraisal assessed after the symbol presentations was a participant’s cognitive re-appraisal. When the value of the re-appraisal became more positive compared to the initial cognitive appraisal, then that individual perceived “the IQ test” to be more threatening after having experienced it, compared to only having been instructed about it. An additional cognitive re-appraisal was recorded three minutes after the conclusion of the computer task.

Processing speed. Processing speed refers to how quickly an individual can make a decision. Processing speed is determined by the difference in reaction times between a digit-symbol reaction time task and a simple number reaction time task. Reaction time means how quickly a participant responds to a stimulus given by the computer program. For the stressful task this was how quickly a participant keyed a number on the keyboard after a symbol was presented. For the simple reaction time task, how quickly a participant pressed a number on the keypad after the program presented that number on the screen became the reaction time. Reaction time was measured in seconds by the program and because of the computer monitor refresh rate it could be inaccurate by as much as 20 milliseconds. The reaction time measure maintained reliability however as the refresh rate did not change during the course of the study. The reaction times for correct responses to the 140 symbol presentations were averaged, as were the reaction times for correct responses to the simple reaction time task. Subtracting the reaction time average of the simple task from the reaction time average of the symbol task yielded the performance measure of processing speed.

Percent correct. Percent correct refers to how accurate a participant was in their responses to the digit-symbol reaction time task. Each time a participant pressed a number on the keypad a value representing either correct or incorrect was added to their data file. However, no feedback was presented to the participant that would have made them aware of how they were doing. The percent correct was calculated by how many correct responses there were out of 140. Like processing speed, percent correct is a measure of task performance.

Perceived percent correct. In addition to the objective measure of percent correct tabulated by the computer program, each participant was asked, "What percent of correct responses did you give for the entire IQ test?" As with the cognitive appraisal questions, participants responded by using the mouse to place a hash mark on an answer bar. This bar was anchored on the left with *0 %* and on the right with *100 %*. The raw value for this measure expressed in horizontal pixel number was converted into a percent.

Demographic information. Using a paper and pencil survey, participants indicated their age, race, and gender.

RESULTS

Table 1 lists the descriptives of all the physiological measures. Paired t-tests indicate that there were significant differences between the baseline physiological measures and those at time 1 for both HR ($t = 8.267$, $p < .05$) and MAP ($t = 8.981$, $p < .05$).

{insert Table 1 here – descriptives of all HR and MAP measures}

The performance measures of processing speed and percent correct were recorded by the computer programs, as was each participant's perception of their percent correct (Perceived %Correct). Table 2 lists the descriptives for these variables and graph 3 depicts the changes in cognitive appraisal with the standard error of the mean used to display error bars. A paired t-test on the cognitive appraisal measures indicates that there was a significant difference between time 1 and time 2 ($t = 6.906$, $p < .05$).

{insert Table 2 here – descriptives of cognitive measures}

{insert Graph 3 here – initial cognitive appraisal and cognitive re-appraisals}

A zero order correlation was used to test the first hypothesis that the initial cognitive appraisal (Appr1) would predict the cognitive re-appraisal at the end of the task (Appr2). A significant relationship was found between these two measures of cognitive appraisal with the initial appraisal predicting 36.2% of the variance in the re-appraisal ($r^2 = .362$). The correlation between Appr1 and Appr2 indicated that higher values for the initial cognitive appraisal (more threat-like) were associated with higher values at the re-appraisal ($r = .601$).

The second hypothesis posited that Appr2 would also be influenced by the objective performance measures of processing speed and percent correct, as well as by the perception of percent correct. Hierarchical regression analysis was used for this test. Processing speed was not found to be a significant predictor of Appr2 when controlling for Appr1 ($\beta = -.152$, $p > .05$). The objective measure of percent correct did show a significant inverse relationship with Appr2, when controlling for Appr1 ($\beta = -.247$, $p < .05$), indicating that higher percent corrects predicted more challenge-like re-appraisals. This model accounted for 42.2% of the variance of Appr2. When testing the influence of the objective percent correct and the perception of percent correct together, above and beyond the predictive ability of Appr1, the perception of percent correct mediated the influence from the objective performance measure and directly predicted Appr2 ($\beta = -.393$, $p < .05$). This model accounted for 51.5% of the variance of Appr2.

Hierarchical regression analysis was also used to test the third hypothesis that recovery from the initial stress response (changes in HR and MAP) would predict Appr2. While controlling for Appr1, HR0, and HR1, the variable to be tested, HR2, was added to the model. The model was statistically significant, however there was no significant influence detected for HR0, HR1, or HR2. While also holding the initial cognitive appraisal constant, MAP0 and MAP1 were controlled for as MAP2 was tested. Again no significant influence beyond that which Appr1 provided was indicated for MAP0, MAP1, or MAP2.

Table 4 summarizes the findings pertinent to the tested predictors of the first cognitive re-appraisal, Appr2. The R^2 for the first row indicates the coefficient of determination for the initial cognitive appraisal predicting Appr2. The subsequent R^2s are the coefficients of multiple determination when the other variables are added for each hypothesis. Italicized variables were controlled for along with Appr1.

{insert Table 4 – summary of hypothesized predictors of Appr2}

The fourth hypothesis speculated that with increased time to recover from the initial stress response, physiology would influence a cognitive re-appraisal. Following the same procedures for the hierarchical regression analysis used with the third hypothesis, HR3 and MAP3 were tested for their influence upon Appr3. The model was statistically significant, however there was no significant influence detected for HR0, HR1, or HR2. No significant influence on Appr3 was found for MAP0, or MAP2 but MAP1 was seen to have a predictive ability for the cognitive re-appraisal that came after three minutes of rest ($\beta = .498$, $p < .05$) indicating that higher blood pressures at time 1 predicted more threat-like appraisals three minutes after the testing was over. See tables 4 and 5 for a summary of the tests for this hypothesis.

{insert Table 5 - test of 4th hypothesis part a - HR extended recovery predicting Appr3}

{insert Table 6 - test of 4th hypothesis part b - MAP extended recovery predicting Appr3}

The results presented here were used to calculate the power of this study. With respect to the third hypothesis, the R^2, sample size, and number of independent variables controlled for and tested, were all inputted in order to determine how large an influence from physiology to cognitive re-appraisal would have to be in order to be observed with power being above the .80 criterion. For both HR and MAP this study could detect an influence that would account for 7% of the variance in cognitive re-appraisal. This means that there may be a significant influence from physiology upon cognitive re-appraisal not seen here, but it would be less than half as potent as the influence from perceived percent correct, which is more than 15%.

DISCUSSION

The design of this study addressed limitations in methodology from previous research. The digit-symbol reaction time task used was an active stressor that provided performance measures and also elicited a significant stress response. The stressful task was easily mastered, and the possibility of recovery from the stress response was increased by having an additional observation time.

The results from this study implicate a few significant predictors of cognitive re-appraisal. Consistent with previous findings, the initial cognitive appraisal of the stressor and task performance influenced subsequent cognitive re-appraisals of the stressor. Additionally, the perception of task performance was a better predictor of cognitive re-appraisal than the objective task performance with the stressful task. Physiology however was not found to have a strong impact upon cognitive re-appraisals, coherent with the results from Tomaka, Blascovich and colleagues.

Cognitive Appraisal and Re-Appraisal

How one initially appraises a stressor is the primary influence upon cognitive re-appraisal, predicting over a third of the variance of the re-appraisal. This is similar to previous research that repeatedly measured cognitive appraisal (Quigley et al., 2002; Carver & Scheier, 1994; Lazarus & Folkman, 1985). This means that how one perceives a stressor in their life tends towards how they initially appraised it. It should be noted that the cognitive re-appraisal at the end of the task was relatively more threat-like than the initial cognitive appraisal. A result that indicates that the knowledge gained by actually performing the task impacted the perception of it.

Task Performance

The performance measure of processing speed, how quickly a participant was able to choose the correct key to press, was not found to be an influence of cognitive re-appraisal. It seems likely that processing speed was merely a trait of the individual, and not a personal factor related to perceptions of stress. However, how one actually performed on the test, how many symbols they correctly responded to, did in fact contribute significantly to the cognitive re-appraisal. This is consistent with prior research relating task performance with cognitive appraisal. Sawyer and Hollis-Sawyer (2005) tested the transactional model of coping to predict the variance in cognitive ability test scores. They found that cognitive appraisals were associated with task performance, such that more threat-like appraisals were associated with decreased cognitive ability.

Similarly, in a study exploring how neuroticism influences responses to stress, Schneider (2004) also found an association between cognitive appraisal and task performance on a mental arithmetic task (similar to Quigley et al., 2002). Individuals who perceive an active stressor as more threatening are more likely to perform poorly with the stressful task than those who construe the stressor as a challenge.

This relationship was made more clear when it was seen that how one thinks they did at the task, their perception of percent correct, had a direct influence upon cognitive re-appraisal, which mediated the influence from the objective performance measure. These results indicate that over half of the variance of cognitive re-appraisal can be predicted by the initial cognitive appraisal and how well an individual believes they have done on the task. Perception of performance has been associated with the perception of the task in other areas of research. In the field of educational psychology, Eccles and colleagues have observed that how one believes they can perform on a scholastic skill is predictive of how important they believe that skill to be (Simpkins, Davis-Kean & Eccles, 2006; Eccles & Wigfield, 2002; Roeser, Eccles, & Sameroff, 2000). Termed the expectancy/value theory, this parallels the findings from this study when viewing the subjective percent correct and the cognitive re-appraisal as an expectancy and a value, respectively. The strength of this relationship is even greater than the actual grades received (Simpkins et al., 2006; Roeser et al., 2000), which is similar to this study's objective measure of performance.

Changes in Physiology

As per the impact that changes in physiology might have upon cognitive re-appraisal, neither HR or MAP were found to have a significant influence at the end of the task, in contrast to the observation made by Quigley et al. (2002), but consistent with Tomaka, Blascovich and colleagues (Blascovich et al., 2003; Tomaka et al., 1997; Blascovich et al., 1994). As the power analyses indicated, this study had enough participants to detect a significant influence from the physiological measures if they predicted an additional 7 % of the variance in cognitive re-appraisal, but none was found. This may be because there was no significant recovery from the stress response for HR or MAP at the end of the task (see table 2).

It was for this reason that an additional observation time was added three minutes after the stressful task had ended, in order that physiological arousal would return to levels seen at baseline. Again no influence was found for HR, and recovery in MAP after three minutes rest did not influence cognitive re-appraisal either. However, it was observed that MAP, as part of the stress response, contributed to the perception of the stressor after it had been over, such that individuals with greater increases in MAP were more likely to indicate a threat-like appraisal of the task. Though the timing between the effective physiological measure and the cognitive measure was not the same as with Quigley et al. (2002), this is the only evidence that an increase in MAP can influence a cognitive re-appraisal. This finding suggests that how reactive a person is with respect to blood pressure influences cognitive re-appraisals after a stressor has ended, and there is no previous research that suggests this relationship.

Strengths and Limitations

A strength of this study was the combination of psychological and physiological measures in order to better understand an important, yet understudied construct in stress and coping theory. The determinants of cognitive re-appraisal have been made clearer by simple and quick measurement of cognitive appraisals, observing changes in physiology, and recording performance with the stressful task.

Another strength of this study was the combination of objective and subjective performance measures. Testing both how a participant actually performed and how they believed they did provided insight into the strongest determinants of cognitive re-appraisals.

Limitations of this study include the sample size, the convenience of the sample, the type of stressor, and the recording equipment used. A greater number of subjects would have allowed for the detection of significant but smaller influences from physiology to cognitive appraisal. Also, the sampling was convenient and results here may not be found in those who are not undergraduates, or of a different age range or socioeconomic status. These differences change the environmental and personal factors that are assessed when making a cognitive appraisal. It may be that one or all of these factors could drastically change the results found with this population.

The active stressor used, the "IQ test", did not provoke threat-like initial cognitive appraisals. It may be that a different type of stressor that did elicit a threat appraisal initially might yield findings indicating that physiology does impact cognitive re-appraisals. It should also be considered that the findings presented here may not be generalizable to real-life stressors outside the laboratory. As with the previous limitation real-life stressors necessarily change the environmental factors assessed during a cognitive appraisal.

Another limitation is that the gross measures of HR and MAP may not be sensitive enough. The use of electrodes attached to the torso may be more invasive, but they yield the additional cardiovascular measures of preejection period, stroke volume, cardiac output, basal transthoracic impedance, and the first derivative of basal impedance (Herrald & Tomaka, 2002; Quigley et al., 2002; Tomaka et al., 1997; Blascovich et al., 1994). It could be that a significant influence on cognitive re-appraisal would be detected from one of these physiological measures.

Application and Future Directions

These findings indicate that the greatest influences upon the changing nature of cognitive re-appraisals are the initial cognitive appraisal itself and how well a person believes they have performed with the stressor. The direct influence that the initial perception of the stressor has upon cognitive re-appraisal has been observed in this and other studies (Quigley et al., 2002; Carver & Scheier, 1994; Lazarus & Folkman, 1985). Therefore an emphasis should be placed upon encouraging individuals to have more challenge-like perceptions of a new stressor. This would then lead to more effective coping strategies and behaviors (Skinner & Brewer, 2002; Carver & Scheier, 1994; Carver et al., 1989; Lazarus & Folkman, 1985, 1984) and also better performance with the task (Sawyer & Hollis-Sawyer, 2005; Schneider, 2004; Quigley et al., 2002).

Engaging in a stressful task should be emphasized because actual performance with the task also influenced cognitive re-appraisals. This association has been observed before (Sawyer & Hollis-Sawyer, 2005; Schneider, 2004; Quigley et al., 2002). Furthermore, the perception of how one performs with a stressful task impacts cognitive re-appraisals. Considering no significant influence from changes in physiology predicted even half the amount of one's perception of performance in this study and others (Blascovich et al., 2003; Tomaka et al., 1997; Blascovich et al., 1994), interventions whose purpose it is to promote healthier cognitive appraisals of stress should emphasize the initial cognitive appraisal, and how well the individual addresses the stressor itself.

The single finding that MAP did had a small influence on cognitive re-appraisals, a result that warrants replication, indicates a relationship between physiology and the perception of a stressor over time. An application of this finding would be to raise awareness that being less reactive in response to stress will likely lead to perceiving the stress as more of a challenge later on. These more challenge-like appraisals would then lead to more effective coping behaviors (Lazarus et al., 2006; Smith & Gallo, 2001; Lazarus & Folkman, 1984; Carver et al., 1989). The more challenge-like cognitive appraisal would also lead to more positive emotions (Skinner & Brewer, 2002; Carver & Scheier, 1994; Lazarus & Folkman, 1985).

While clarifying the roles that the initial cognitive appraisal and the perception of performance have upon cognitive re-appraisals, more research is needed in order to verify what influence may exist from changes in physiology. The use of electrodes for electrocardiography and impedance cardiography could provide more insight into what influence, if any physiology has upon cognitive re-appraisal. Future research into what influences the recurring perception of stress could also address another limitation mentioned earlier by having a larger sample size in order to observe smaller significant influences from physiology. Future studies could test a different population, and even use another type of stressor that may be more threat provoking. A simple addition would be to have a confederate taking the "IQ test" at the same time and reportedly doing very well.

Along with these changes, the flexibility of this research design allows for more observations to be explored. As previously discussed cognitive re-appraisals after the task began were more threat-like than initial cognitive appraisals, signifying that experiencing the task provides information that significantly influences cognitive appraisal. Another cognitive re-appraisal measure during the task itself would help determine if recovery after the additional knowledge of having actually interacted with the stressor is taking place, and if subsequent cognitive re-appraisals are impacted by those physiological changes.

Taken together these additions to the design could make clearer what environmental and personal factors continue to influence cognitive appraisal over time (Lazarus et al., 2006; Skinner & Brewer, 2002; Quigley et al., 2002; Carver & Scheier, 1994; Carver et al., 1989; Lazarus & Folkman, 1985, 1984). Factors that could be easily tested for their contribution to cognitive appraisal include fitness level, gender, resiliency, optimism, and general perceptions of stress. Regardless of the role these personal factors may play, the results reported here indicate that how one initially appraises a stressor, even before any direct interaction with it, along with the perception of how one performed on the stressful task, contribute significantly to subsequent perceptions of the stressor. By addressing these influences of cognitive re-appraisal, individuals can increase their amount of effective coping strategies, perform better with the stressful task, and experience more positive emotions.

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Table 1 – Discriptives of All HR and MAP Measures

	HR0	HR1	HR2	HR3	MAP0	MAP1	MAP2	MAP3
N	71	71	71	68	71	71	71	68
Mean	72.15	79.61	78.18	73.75	83.71	89.80	87.79	85.37
*SD	9.13	12.21	10.80	9.62	7.50	9.39	8.15	8.06
*SEM	1.08	1.45	1.28	1.17	0.89	1.11	0.97	0.98
Minimum	50.67	55.00	58.00	53.00	68.00	62.67	68.00	66.00
Maximum	96.00	130.00	117.00	98.00	101.22	104.33	105.00	101.00

There were four observations of the physiological measures of HR and MAP. Time 0 indicates the baseline composite measure, time 1 is just before beginning the task, time 2 is at the end of the task, and time 3 indicates the observation that occurred three minutes after participants were told that the testing was over. A number placed after each variable name indicates which observation it is.

* SD denotes the standard deviation; SEM indicates the standard error of the mean

Table 2 – Descriptives for Cognitive Measures

	Appr1	Appr2	Appr3	Processing Speed	Percent Correct	Perceived %Correct
N	69	71	71	70	71	71
Mean	-86.01	16.28	-101.97	1.18	59.06	37.56
*SD	139.96	139.39	124.92	0.18	11.46	15.59
*SEM	16.85	16.54	14.83	0.02	1.36	1.85
Minimum	-373	-337	-376	0.83	26.40	5.50
Maximum	236	388	194	1.71	87.10	65.30

Cognitive appraisal of the stressful task was measured three times. Appr1 indicates the initial cognitive appraisal measured at time 1, Appr2 is the cognitive re-appraisal at time 2, and Appr3 is the cognitive re-appraisal at time 3.

* SD denotes the standard deviation; SEM indicates the standard error of the mean

Graph 3 – Initial Cognitive Appraisal and Cognitive Re-Appraisals

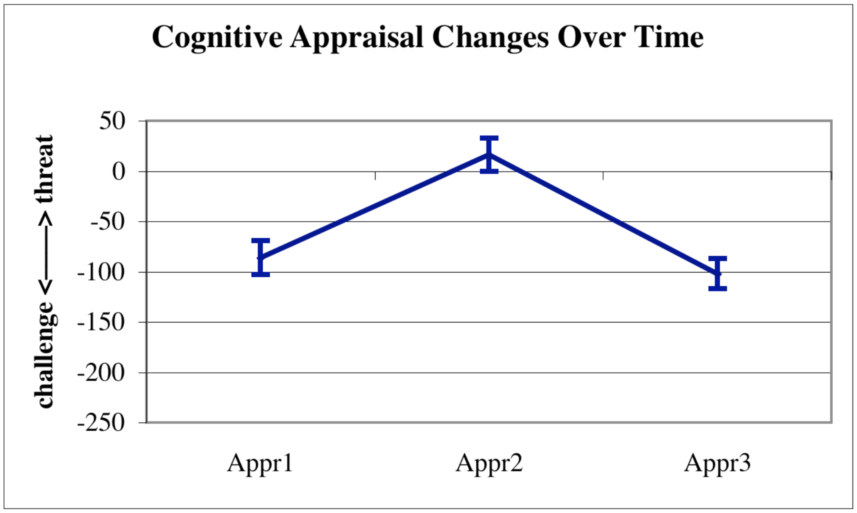


Table 4 – Summary of hypothesized predictors of Appr2

		R^2	ß	t	p	tolerance
1[st] hypothesis	Appr1	0.362	0.601	6.161	0.000*	1.00
2[nd] hypothesis part a	Processing Speed	0.389	-0.152	-1.553	0.125	.99
2[nd] hypothesis part b	% Correct	0.423	-0.247	-2.633	0.011*	1.00
2[nd] hypothesis part c	% Correct	0.423	-0.005	-0.047	0.963	
	Perceived % Correct	0.515	-0.393	-3.528	0.001*	.60
3[rd] hypothesis part a	*HR0*	0.371	0.025	0.124	0.902	
	HR1	0.371	-0.003	-0.020	0.984	
	HR2	0.373	0.088	0.487	0.628	.30
3[rd] hypothesis part b	*MAP0*	0.366	0.056	0.309	0.758	
	MAP1	0.368	-0.159	0.814	0.419	
	MAP2	0.373	-0.148	-0.750	0.456	.25

* denotes significant predictors of Appr2

Table 5 – Test of fourth hypothesis, part a – HR extended recovery predicting Appr3

	R^2	ß	t	p	tolerance
Appr1	.276	.525	4.695	.000	
HR0	.276	.221	1.032	.306	
HR1	.282	-.099	-.558	.579	
HR3	.295	-.198	-1.080	.285	.34

Table 6 – Test of forth hypothesis, part b – MAP extended recovery predicting Appr3

	R^2	ß	t	p	tolerance
Appr1	.276	.524	4.886	.000	
MAP0	.276	-.171	-.867	.390	
MAP1	.317	.498	2.273	.027	
MAP3	.333	-.283	-1.201	.341	.20

Chapter 6

Discussion

This chapter begins by discussing relevant differences between Study 1 and Study 2, and then addresses the tests of the hypotheses. Other findings are discussed and then how these results might be applied is given. The chapter then addresses the limitations with these studies and points towards future research directions.

Differences between Study 1 and Study 2

Graph 4.15 illustrates an important difference between Study 1 and Study 2. The hypotheses put forth for both studies hinge upon the initial cognitive appraisal and cognitive re-appraisals of taking “an IQ test”. Note that for both studies the cognitive appraisals tend towards more challenge-like appraisals. This is especially true for Study 1 for which the cognitive appraisals are significantly more challenge-like than their counterparts in Study 2. This was part of the reasoning for conducting Study 2 and attempting to elicit more threat-like appraisals. While cognitive appraisals for Study 2 were relatively more threat-like, it is doubtful that for these college students taking an IQ test would render them unable to cope. It may be that in order to see significant influences from physiology to cognitive re-appraisals that perception of the stressor would need to elicit threat appraisals, wherein participants did not believe they could cope with the task.

The differences in cognitive appraisals may be due to the different times during the semester in which the studies were conducted. Study 1 was administered early in the spring semester, before most first exams had been given. In contrast, Study 2 was conducted at the very end of the spring semester, when cumulative exams were being taken. Preoccupation with final exams may have been an external influence on how participants perceived yet another stressor in their life. It is also possible that the changes made in the protocol for Study 2 were effective in promoting more threat-like cognitive appraisals, and that difference between the samples influenced the relationship between the initial cognitive appraisal and the stress response.

Cognitive Appraisal

While the test of the first hypothesis for both studies did indicate the established relationship between the initial cognitive appraisal and the coping response as seen in previous research (Skinner & Brewer, 2002; Carver & Scheier, 1994; Lazarus & Folkman, 1985), the findings for Hypothesis 2 did not. In Study 1 the stress response as indicated by MAP was influenced by the initial cognitive appraisal as has been seen before (Maier et al., 2003; Blascovich et al., 2003; Tomaka et al., 1997; Tomaka et al., 1993). This was true for HR as well, however it was found that those with a more threat-like initial cognitive appraisals had higher heart rates, which was the opposite direction of the hypothesis. It may be that the individuals in Study 1 that were the most unthreatened by the task at the start, felt no compulsion for their HR to increase, thereby allowing for the increased HR in others, who were more threatened by the task, to dictate the relationship between the initial cognitive appraisal and the stress response. Study 2 did find the correct direction for HR, but it was only marginally significant. In addition to this, the initial cognitive appraisal was not related to a stress response as indicated by changes in MAP for Study 2, therefore not replicating previous findings (Blascovich et al., 2003; Tomaka et al., 1997; Tomaka et al., 1993). It is not clear why the initial cognitive appraisal did not lead to changes in blood pressure in Study 2.

Cognitive Re-Appraisal

Consistent in both studies is the finding that cognitive appraisal, as measured by the questions developed by Tomaka and Blascovich and others, did reliably measure how participants perceived the stressful task at different times in the studies. The test for Hypothesis 3 confirmed that how one initially appraises a stressor is the primary influence upon cognitive re-appraisal, predicting over a third of the variance of the re-appraisal, similar to previous research which repeatedly measured cognitive appraisal (Quigley et al., 2002; Carver & Scheier, 1994; Lazarus & Folkman, 1985). At this point it should be noted that for both studies the cognitive re-appraisal at the end of the task was relatively more threat-like than the initial cognitive appraisal. This indicates that the knowledge gained by actually performing the task impacted the perception of it. Stated another way, actually engaging in the task provides information that influences cognitive appraisal. The rest of the hypotheses tested the other likely influence of cognitive re-appraisal, namely the performance measures and physiological recovery from the stress response.

The first part of the test for Hypothesis 4 found that the performance measure of processing speed did not influence cognitive re-appraisal. It seems likely that processing speed was merely a trait of the individual that was unrelated to perceptions of stress. However, both studies did find that how one actually performed on the test, how many symbols they correctly responded to, did in fact contribute significantly to the cognitive re-appraisal. This is consistent with prior research relating task performance with cognitive appraisal (Sawyer & Hollis-Sawyer, 2005; Schneider, 2004; Quigley et al., 2002). Individuals who perceive an active stressor as more threatening are more likely to perform poorly with the stressful task than those who construe the stressor as a challenge. With Study 2 this relationship was made more clear when it was seen that how one thinks they did at the task, their perception of percent correct, is what has a direct influence upon cognitive re-appraisal. This means that over half of the variance of cognitive re-appraisal can be predicted by the initial primary and secondary appraisals (the two questions asked before the task begins) and how well an individual believes they have done on the task.

The tests for a return pathway from physiology to cognitive appraisal were not fruitful. Neither study provided evidence that HR or MAP had a significant influence on cognitive re-appraisal at the end of the task, in contrast to the observation made by Quigley and company (2002), but consistent with Tomaka, Blascovich and colleagues (Blascovich et al., 2003; Tomaka et al., 1997; Blascovich et al., 1994). As the power analyses indicated, Study 1 with only 28 participants would have been able to detect a significant influence with HR or MAP if they predicted an additional 15 % of the variance in the cognitive re-appraisal. For this reason, over twice the number of participants were collected for Study 2 in order to improve power. Study 2 had enough participants to detect a significant influence from the physiological measures if they predicted an additional 7 % of the variance in cognitive re-appraisal, but none was found. This may be because there was no significant recovery from the stress response for HR or

MAP at the end of the task (see tables 4.1 and 4.7). This was the reasoning behind having an additional observation time in Study 2 after three minutes of rest, in order that physiological arousal would return to levels seen at baseline.

For both studies there were significant increases in HR and MAP from baseline to time 1. In Study 2, there was sufficient recovery from the stress response, such that at time 3 measures for HR and MAP were not significantly different from baseline observations (see table 4.7 again). Given this, Hypothesis 6 again tested for a physiological influence upon cognitive re-appraisal. No influence was found for HR, and recovery in MAP after three minutes rest did not influence cognitive re-appraisal either. However, it was observed that MAP1 significantly predicted Appr3, such that individuals with greater increases in MAP as part of their stress response were more likely to indicate a threat-like appraisal of the task after a three minute rest period. Though the timing between the effective physiological measure and the cognitive measure was not the same as with Quigley, Barrett, and Weinstein's study (2002), this is the only evidence that an increase in MAP can influence a cognitive re-appraisal. This finding suggests that how reactive a person is with respect to blood pressure influences cognitive re-appraisals after a stressor has ended.

Limitations

Limitations of these studies are found in the areas of the sample size and convenience, the type of stressor, and the recording equipment used. A greater number of subjects, such as 230, would have allowed for the detection of a significant 4 % influence from physiology to cognitive appraisal. Also, the sampling was convenient and results here may not be found in those who are not undergraduates at this university, or of a different age range or socioeconomic status.

The active stressor used with these studies, "an IQ test", did not provoke threat-like initial cognitive appraisals. It may be that a different type of stressor that did elicit a threat appraisal initially might yield findings indicating that physiology does impact cognitive re-appraisals. Another consideration is that the findings presented here may not be generalizable to real-life stressors outside the laboratory.

It may also be that the gross measures of HR and MAP are not sensitive enough. The use of electrodes attached to the torso may be more invasive, but they yield the additional cardiovascular measures of preejection period, stroke volume, cardiac output, basal transthoracic impedance, and the first derivative of basal impedance (Herrald & Tomaka, 2002; Quigley et al., 2002; Tomaka et al., 1997; Blascovich et al., 1994). It may be that a significant influence on cognitive re-appraisal could be detected from one of these physiological measures.

Application and Future Directions

The findings from both studies indicate that the greatest influences upon the changing nature of cognitive re-appraisals are the initial cognitive re-appraisal itself and how well a person performs with the stressor. The direct influence that the initial perception of the stressor has upon cognitive re-appraisal has been observed in these and other studies (Quigley et al., 2002; Carver & Scheier, 1994; Lazarus & Folkman, 1985). Therefore an emphasis should be placed upon encouraging individuals to have more challenge-like perceptions of a new stressor. This would then lead to more effective coping strategies and behaviors (Skinner & Brewer, 2002; Carver & Scheier, 1994; Carver et al., 1989; Lazarus & Folkman, 1985, 1984) and also better performance with the task (Sawyer & Hollis-Sawyer, 2005; Schneider, 2004; Quigley et al., 2002).

Because actual performance with the task also influenced cognitive re-appraisals, and because this association has been observed before (Sawyer & Hollis-Sawyer, 2005; Schneider, 2004; Quigley et al., 2002) an emphasis on engaging the stressful task in order to overcome it should be maintained by those experiencing the stress. Furthermore, as Study 2 showed, it is the perception of how they performed on the stressful task that truly impacts cognitive re-appraisals. Considering no significant influence from changes in physiology predicted even half the amount of one's perception of performance in these studies and others (Blascovich et al., 2003; Tomaka et al., 1997; Blascovich et al., 1994), interventions whose purpose it is to promote healthier cognitive appraisals of stress should emphasize the initial cognitive appraisal, and how well the individual addresses the stressor itself.

The single finding from Study 2 that physiology did had a small influence on cognitive re-appraisals, a result that warrants replication, indicates that smaller increases in blood pressure as part of a stress response would lead to healthier perceptions of a stressor over time. The application of this finding is to raise awareness that smaller blood pressure changes in response to stress will likely lead to perceiving the stress as a challenge. These more challenge-like appraisals would then lead to more effective coping behaviors (Lazarus et al., 2006; Smith & Gallo, 2001; Lazarus & Folkman, 1984;

Carver et al., 1989) and more positive emotions (Skinner & Brewer, 2002; Carver & Scheier, 1994; Lazarus & Folkman, 1985).

While clarifying the roles that the initial cognitive appraisal and the perception of performance have upon cognitive re-appraisals, more research is needed in order to verify what influence may exist from changes in physiology. The use of electrodes for electrocardiography and impedance cardiography could provide more insight into what influence, if any, physiology has upon cognitive re-appraisal. Future research into what influences the recurring perception of stress could also address other limitations mentioned earlier by having a larger sample size in order to observe smaller significant influences from physiology. Future studies could test a different population, and even use another type of stressor that may be more threat provoking, perhaps a confederate taking the "IQ test" at the same time and reportedly doing very well.

In addition these changes, the flexibility of this research design allows for more observations to be explored. As previously discussed cognitive re-appraisals after the task began were more threat-like than initial cognitive appraisals, signifying that experiencing the task provides information that influences cognitive appraisal. Another cognitive re-appraisal measure during the task itself would help determine if recovery after the additional knowledge of having actually interacted with the stressor is taking place, and if subsequent cognitive re-appraisals are impacted by those physiological changes.

Taken together these additions to the design presented in this dissertation could make clearer what environmental and personal factors continue to influence cognitive appraisal over time (Lazarus et al., 2006; Skinner & Brewer, 2002; Quigley et al., 2002; Carver & Scheier, 1994; Carver et al., 1989; Lazarus & Folkman, 1985, 1984). Factors that could be easily tested for their contribution to cognitive appraisal include fitness level, gender differences, resiliency, optimism, and general perceptions of stress. Regardless of the role these personal factors may play, the results found from both of these studies indicate that how one initially appraises a stressor, even before any direct interaction with it, along with the perception of how one performed on the stressful task, contribute significantly to subsequent perceptions of the stressor. By addressing these influences of cognitive re-appraisal, individuals can increase their amount of effective coping strategies, perform better with the stressful task, and experience more positive emotions.

Appendix A

Consent Form

APPROVED BY IRB ON: 05/03/2006 *EXPIRES ON: 03/08/2007*

Title: The Relationships between Physiological and Psychological Measures
*IRB# _2004-11-0096_*

Conducted by: Mark Mallon
Of the University of Texas at Austin: HED / BEL 410 Telephone: 232-5486

You are being asked to participate in a research study. This form provides you with information about the study. The person in charge of this research will also describe this study to you and answer all of your questions you might have before deciding whether or not to take part. Your participation is entirely voluntary. You can refuse to participate without penalty or loss of benefits to which you are otherwise entitled. You can stop your participation at any time and your refusal will not impact current or future relationships with UT Austin or participating sites. To do so simply tell the researcher you wish to stop participation. The researcher will provide you with a copy of this consent form for your records.

The purpose of this study is to better understand how one's physiology and psychology relate to one another. To do this 80 participants will have physiological measures taken at the same time psychological measures are taken. Statistical analyses will then provide insight to any interactions between the body and the mind.

If you agree to be in this study, we will ask you to do the following things: During the study you will have your heart rate, blood pressure, and galvanic skin response observed. Also, using a combination of "paper and pencil" and computerized questionnaires, your psychological state will be observed, on such things like how optimistic you are and how you generally feel.

Total estimated time to participate in this study is expected to take less than one hour.

Risks of being in this study may arise from two sources:

- The three physiological measures of heart rate, blood pressure, and galvanic skin response are measured by electrodes that are placed next to the skin, an armband cuff that squeezes, and a clip that is place on the end of one's finger. Every effort will be made so that these measures cause minimal discomfort.

- The questions that are used to understand your psychological state have the possibility of causing mental stress. If you are uncomfortable with anything that is asked of you, you do not have to respond. Additionally, the faculty advisor, Mary Steinhardt, is a certified counselor and available to you if you have any concerns. Her number is 232-3535. Also, eligible University students may be treated at the usual level of care with the usual cost for services at the Counseling and Mental Health Center, 471-3515.

Benefits of this study include:

- One you have completed your participation in this study, the principle investigator will share with you what is currently known about the relationships between body and mind, which includes the psychological measures you'll have answered. This information may give you a better understanding of the connections between body and mind and how to apply it to your own life.

Compensation:

- There is no monetary compensation for your participation in this study. However, you will receive extra credit for your KIN 333 class with Dr. Peterson.

Confidentiality and Privacy Protections:

- All data is recorded and stored using numbers to distinguish between participants. Your name will not be found alongside the data you provide.
- The data resulting from your participation may be made available to other researchers in the future for research purposes not detailed within this consent form. In these cases, the data will contain no identifying information that could associate you with it, or with your participation in any study.

The **records** of this study will be stored securely and kept confidential. Authorized persons from The University of Texas at Austin, members of the Institutional Review Board, and (study sponsors, if any) have the legal right to review your research records and will protect the **confidentiality** of those records to the extent permitted by law. All publications will exclude any information that will make it possible to identify you as a subject. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

APPROVED BY IRB ON: 05/03/2006 *EXPIRES ON: 03/08/2007*

Contacts and Questions:

If you have any questions about the study please ask now. If you have questions later, want additional information, or wish to withdraw your participation call the researchers conducting the study. Their names, phone numbers, and e-mail addresses are at the top of this page. If you have questions about your rights as a research participant, complaints, concerns, or questions about the research please contact Lisa Leiden, Ph.D., Chair of The University of Texas at Austin Institutional Review Board for the Protection of Human Subjects, (512) 471-8871 or email: orsc@uts.cc.utexas.edu.

You will be given a copy of this information to keep for your records.

Statement of Consent:

I have read the above information and have sufficient information to make a decision about participating in this study. I consent to participate in the study.

Signature:______________________________________ Date: __________________

____ Date: ___________________
Signature of Person Obtaining Consent

Signature of Investigator:__________________________ Date: __________________

Appendix B

Script and Screenshots for Instructing Participants about the "IQ test"

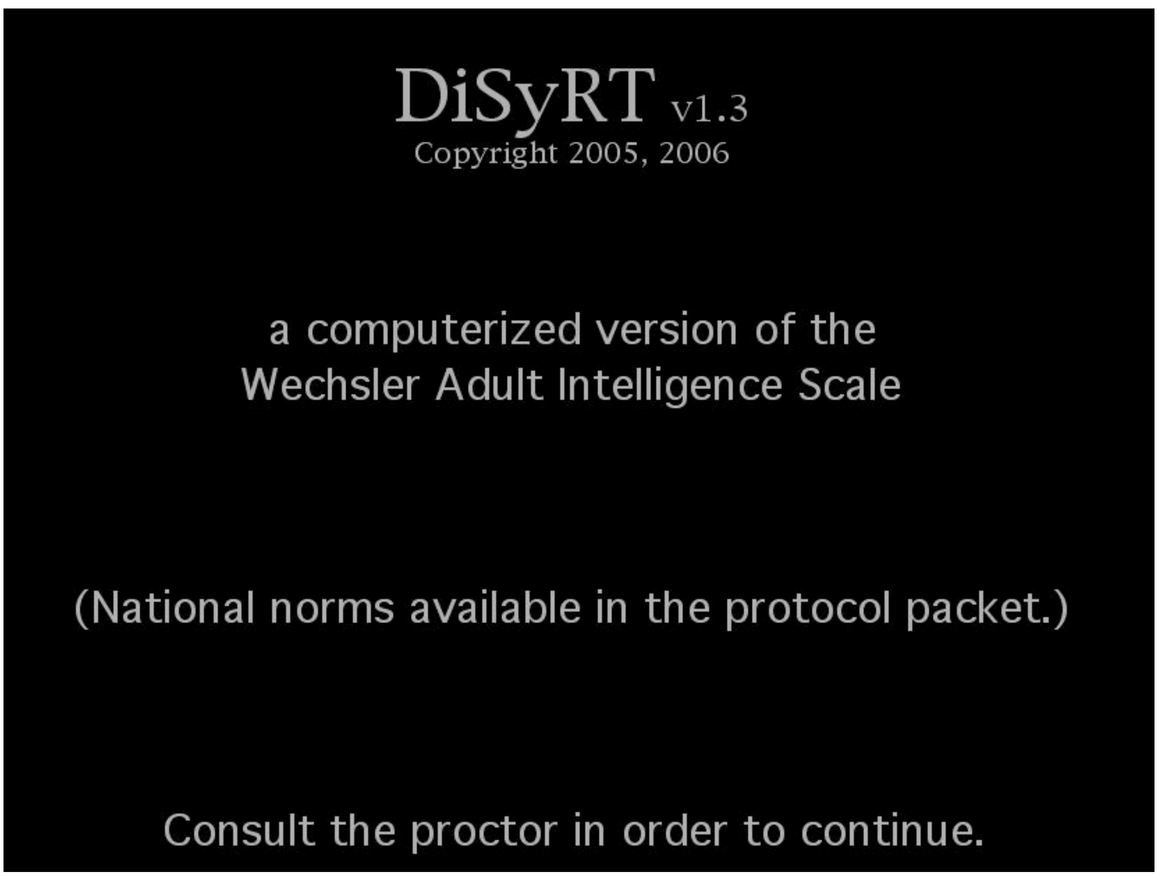
Screen 1: blank (pre-title screen)

"Continuing with work that was begun in psychology, what we are interested in today is intelligence. To that end, you are going to take an IQ test now."

"The IQ score you get on this test is going to be compared to the others that are taking it here, and to the national norms for this IQ test. Also, with this department being Kinesiology, your physiology during this IQ test will be compared to the others taking this exam, and to the national norms for heart rate and blood pressure for your age group."

"Go ahead and press the 7 key on the numeric keypad and we'll get started."

Screen 2: Title screen



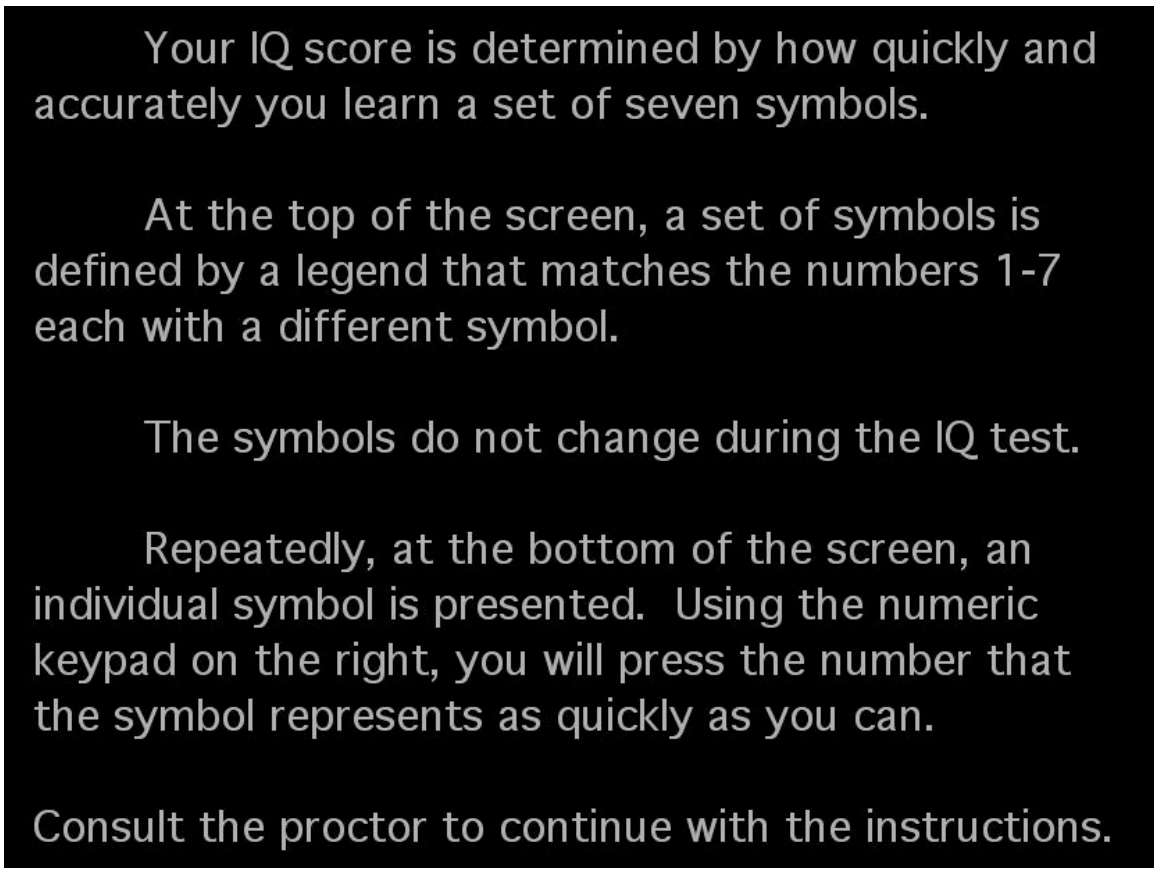
“As you can see, this IQ test comes from the Wechsler Adult Intelligence Scale, the WAIS, which is a prominent test given in psychological studies.”

“The program that runs the IQ test comes with this protocol which we will now follow. For it, I am the proctor and you are the test-taker.”

“What is now going to happen is that you’ll read the instructions for the IQ test on the computer screen, and when you’re done reading you let me know and I’ll tell you how to go to the next screen. Okay?”

“Press 4 for the first of three screens of instructions.”

Screen 3: 1st screen of instructions



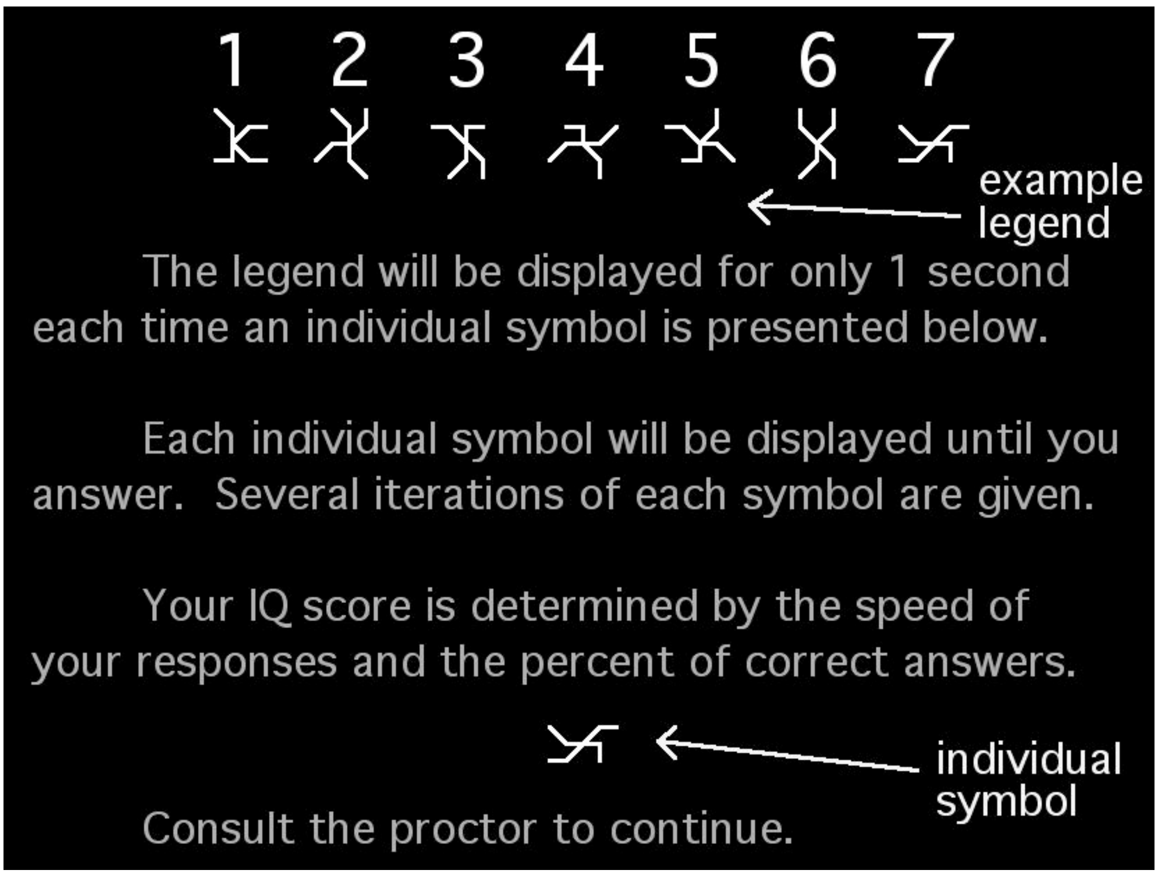
“Okay. What the next screen is going to show you is an example of the legend and the symbols. The symbols in this example <u>will not be</u> the ones you will receive for your IQ test, but they will look similar to them.”

"The example is given in order to show you exactly where the legend will appear on the screen as well as where the individual symbols presented will be."

"The next screen also describes the IQ test some more."

"Press 1 to continue and let me know when you have finished reading the next screen."

Screen 4: 2nd page of instructions



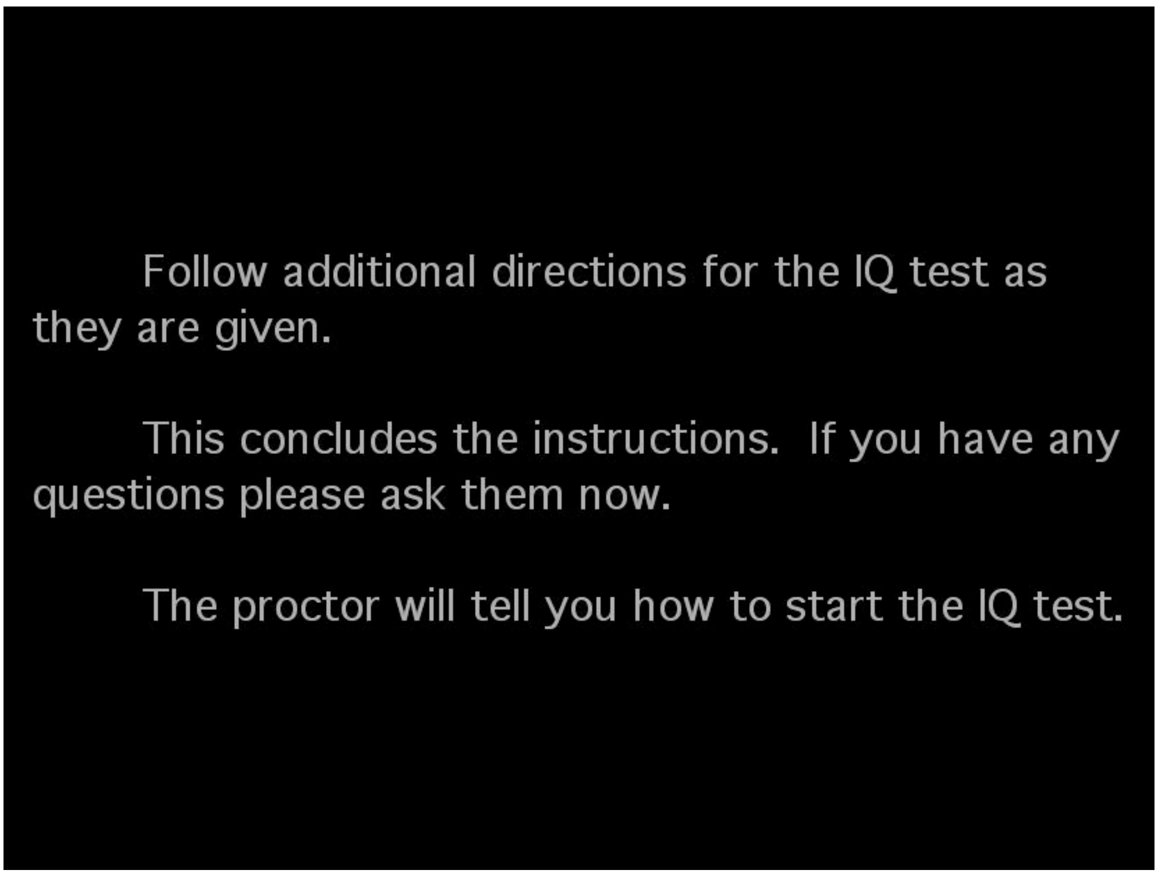
"The next thing you will be shown is an example of the timing of each presentation; of exactly how quickly the legend disappears each time."

"While you are watching the screen, press 3 on the keypad."

Screen 5; Example of the timing of the legend's disappearance (after the legend is gone) "So that's how fast the legend will disappear each time."

"And now here is the last page of instructions."

Screen 6: 3rd and final screen of instructions



"Do you have any (more) questions?"

Answer questions.

“The protocol we’re following has a checklist of four statements. What we’ll now do is that I will read each statement, and you tell whether you understand it or if you need any clarification.”

“First, you understand that the symbols you will get will stay the same for the entire IQ test, they will not change?”

“Second, you understand that the legend that defines each symbol will only be displayed for one second each time a symbol is presented?”

“Third, you understand that how fast and accurately you press the number keys are used to calculate your IQ score?”

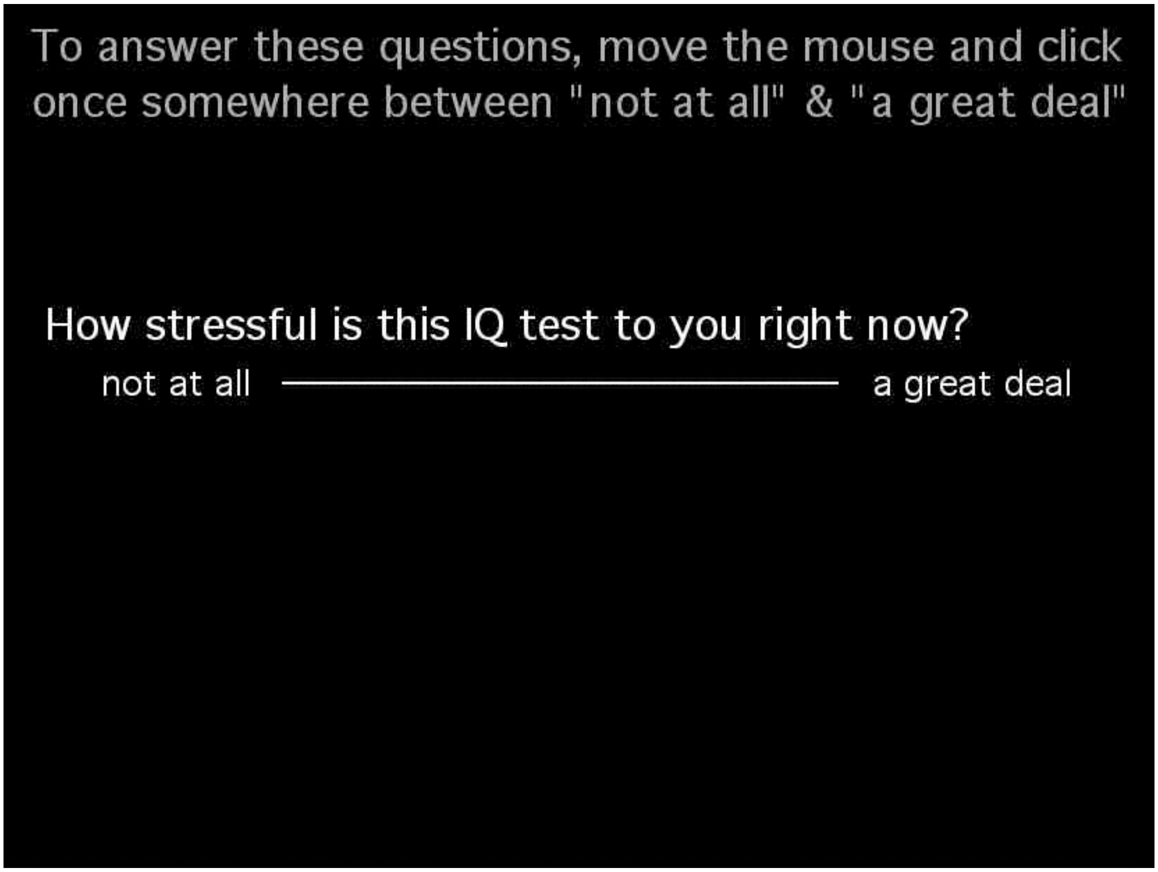
“and last, you understand that your IQ score will be compared to the national norms, as well as your heart rate and blood pressure to the national norms, and to those taking the IQ test here?”
“Okay. Keep your left arm still while the physiological measures are being recorded.”

“I will tell you how to begin once the blood pressure cuff has finished inflating.”

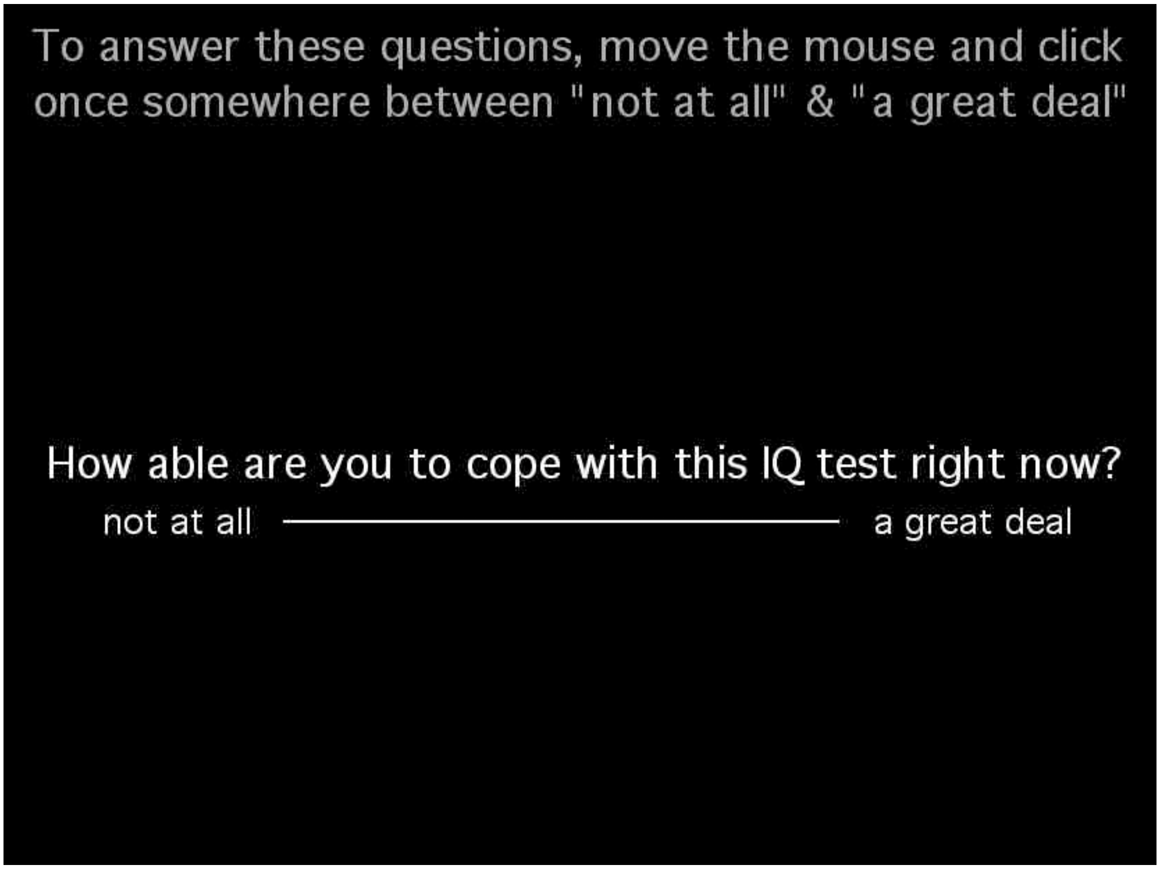
“Ready your right hand on the numeric keypad, and press 5 to begin.”

Appendix C

Screenshot of First Cognitive Appraisal Question

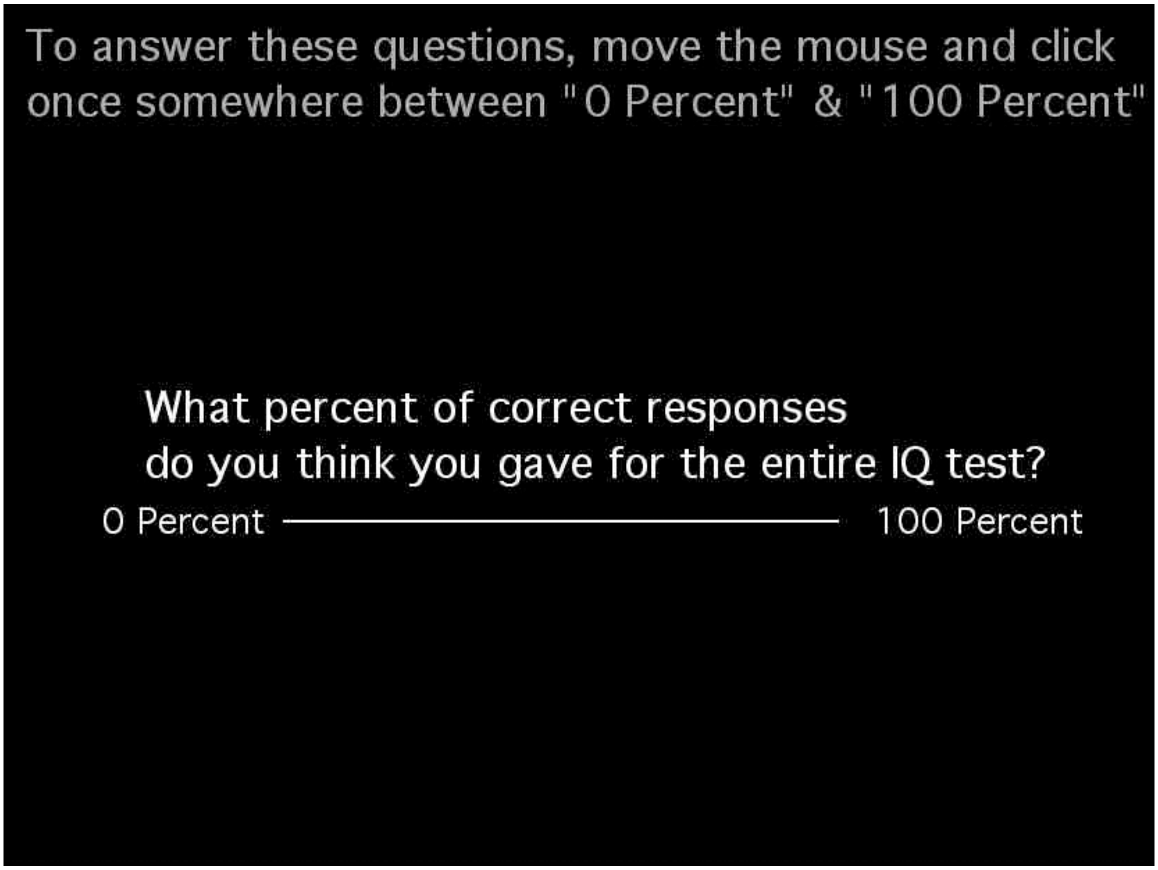


Screenshot of Second Cognitive Appraisal Question



Appendix D

Screenshot of Perceived Percent Correct Question



Appendix E

Debriefing Form

Thank you very much for your participation in this research. The data collected here will be used for my dissertation and your participation is greatly appreciated.

The main purpose of this research is to further our understanding of how a potentially stressful situation elicits changes in one's mental and physiological processes over time, and also one's behavioral responses. To that end, you were led to believe that the computer task you've just undertaken is an IQ test, and that your performance was being videotaped. Neither is true. This was done in order that the task might become more meaningful for you. While the computer task is a subscale of an actual intelligence quotient exam, it has not been seen to correlate well with standard IQ tests (see Block & Kremen, 1996) and will not be looked at as such.

Having you perform an "IQ test" was chosen because you are in college and therefore your intelligence probably has some meaning to you. This deception was necessary in order that the situation might be perceived as stressful, but it is not believed to be any more stressful than what you are likely to have when taking a quiz or exam, writing a paper, or even studying. These are all tasks that you perform on a daily basis the outcomes of which are often associated with your intelligence.

The physiological measures of heart rate, and blood pressure will be looked at over time along with the answers you gave to the questions during the computer task. These along with your questionnaire responses will be used to determine what, if any, relationship exists between your ability to calm down after being confronted with a stressful situation and how you coped with it. Integral to any such relationship is how you appraised it; what your perception of the task was. And that is what the questions during the "IQ test" were meant to assess.

The answers you gave with paper and pencil measure the concepts of perception of stress, and coping. The computer task simply measured how quickly you could learn a set of symbols. This yielded reaction times that can be used to determine a learning curve. In order to do so, you will need to complete a simple reaction time task (taking less than two minutes) wherein you will see the number on the computer screen that you should key as quick as possible. This can be done as soon as you finish reading this.

If you now believe that you do not want any of your information to be used in this study, that too is your right and I will respect it.

If you have any questions about any aspect of this study, including how each questionnaire you answered fits in, feel free to ask that now or get in touch when you think of it. Additionally, if you'd like to know what the final results are you can call or e-mail and I will be glad to discuss what the study has found.

Again, I want to thank you for helping me out, and I would also appreciate it if you would not share the intricacies of this study with fellow students as that information might spoil another potential participant for this study.

Feel free to keep this form with my contact information on it in case you have any questions. Also, if you have any concerns about this study but would like to discuss it with someone else, you may contact Dr. Mary Steinhardt at 232-3535 whose office is in BEL506.

Now that you have been fully informed about the nature and purpose of the study, are you willing to include your responses in the analysis of the study?

______ Yes, I am willing to have my responses used in the study.

______ No, I do not want my responses used in the study.

________________ ________________ _______________

printed name signature today's date

Thank you for your participation

Sincerely,
Mark Mallon mw.mallon@mail.utexas.edu 232-5486 BEL 410

Appendix F

Situational Coping Scale
(an asterisk indicates an item developed specifically for these studies)

The questions below refer to what you did, and how you may have felt while taking the computerized IQ test.

	Indicate what you did and felt while taking the IQ test.	NOT AT ALL	A LITTLE BIT	A MEDIUM AMOUNT	A LOT
1.	I cursed aloud or silently.*	1	2	3	4
2.	I laughed at myself.*	1	2	3	4
3.	I tried to come up with a strategy about what to do.	1	2	3	4
4.	I sighed.*	1	2	3	4
5.	I blamed myself for things that happened.	1	2	3	4
6.	I tried hard to prevent other things from interfering with my efforts at dealing with the situation.	1	2	3	4
7.	I criticized myself.	1	2	3	4
8.	I made fun of the situation.	1	2	3	4
9.	I focused on dealing with the problem, and when necessary let other things slide a little.	1	2	3	4
10.	I got angry at myself.*	1	2	3	4
11.	I made jokes about it.	1	2	3	4
12.	I tried to see it in a different light, to make it seem more positive.	1	2	3	4

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