

PSYCHOLOGICAL STRESS, APPRAISAL, EMOTION AND CARDIOVASCULAR RESPONSE IN A PUBLIC SPEAKING TASK

PAMELA J. FELDMAN^a, SHELDON COHEN^b,
NATALIE HAMRICK^c and STEPHEN J. LEPORE^{d,*}

^aWorld University Service, United Kingdom; ^bCarnegie Mellon University;
^cFox Chase Cancer Center, ^dDepartment of Health & Behavior Studies, Box 114,
Teachers College, Columbia University, 525 West 120th Street, New York, NY 10027

Forty-three undergraduates (30 males, 13 females) prepared and performed a speech task (stressor) or a reading task (no-stressor control). Preparing to speak led to greater threat appraisal, negative emotion, and cardiovascular (CV) response than preparing to read aloud, particularly in speech anxious individuals. Delivering the speech, however, did not result in an increment in CV response over and above preparation. Although threat appraisals could not explain the effect of stress on CV response during task preparation, negative emotion accounted for over half of the effect. These data support the hypothesis that CV response in these studies is at least partially accounted for by psychological processes (stressor-specific anxiety and negative emotional response) and suggests that these processes may be best studied during a period of stressor anticipation.

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There has been a renewed interest in examining the roles of cognitive appraisal and emotion in bodily responses to stress in one's environment (e.g., Tomaka *et al.*, 1997; Chang, 1998; Feldman *et al.*, 1999). According to the traditional psychological model of stress and disease, individuals appraise whether environmental conditions are threatening or challenging and have concomitant emotional responses (Mason, 1975; Lazarus and Folkman, 1984; Cohn *et al.*, 1995). These emotional responses, in turn, trigger physiological responses that may place individuals at greater risk for disease.

Investigators often examine these processes using acute stress models. The administration of cognitive, social or psychomotor tasks in the laboratory typically elicits changes in cardiovascular (CV), endocrine, and immune parameters (Krantz and Manuck, 1984; Herbert and Cohen, 1993; Feldman *et al.*, 1999). Although it is presumed that appraisal and emotion responses are necessary for these changes to occur, psychophysiologicalists recognize that to some degree behavioral demands of

*Corresponding author. E-mail: lepore@tc.columbia.edu

these tasks also contribute to physiological response (e.g., Obrist, 1981). The present study was designed to assess the extent to which psychological *versus* behavioral demands underlie physiological responses to acute laboratory stressor tasks. We raise three specific issues. First, are psychological components of these tasks sufficient to elicit a CV response independent of behavioral demands? Second, to what degree is the CV response to the psychological components of these tasks mediated by cognitive appraisal and emotional reactions? Third, are these effects accentuated in individuals who report more psychological vulnerability to the stressor?

Are Psychological Components of Tasks Sufficient to Elicit a CV Response?

There are two approaches to isolating the role of psychological *versus* other task components in eliciting physiological response. One is to use tasks that are “pure” psychological stressors with few, if any, behavioral components that can trigger an increase in CV response. The anticipation period prior to a stressor can be viewed as exemplifying this category of tasks. Anticipation of a stressor is sufficient to elicit negative affect and physiological responses comparable to those observed during stressor exposure (Shannon *et al.*, 1963; Baum and Greenberg, 1975; Baum and Koman, 1976; Spacapan and Cohen, 1983; Everson *et al.*, 1996). In fact, some studies find larger physiological responses during anticipation suggesting that anticipation can be more threatening than the stressor itself (Birnbaum, 1964). Similar effects are found for periods of silent task preparation. Elevations in CV response have been shown to occur during the period in which subjects prepare to give public speeches (Saab *et al.*, 1992; Lepore *et al.*, 1993; Baggett *et al.*, 1996). Thus, the speech preparation period may be sufficient to elicit physiological responses similar to those found during the speech task itself.

The second approach to isolating the effects of psychological components of tasks is to use control groups that allow the separation of components that are psychological in nature from that of other task components. Behavioral components of tasks have been associated with patterns of physiological response independent of psychological threat (Schneiderman and McCabe, 1989). For example, the type of physical exertion associated with tasks may lead to a particular pattern of physiological response. Tasks that require isometric (static) exercise generally lead to larger increases in systolic and diastolic blood pressure (SBP, DBP) and heart rate (HR) than those observed with tasks that require isotonic (dynamic) exercise (Asmussen, 1981). Although the physiological effects of speaking may be less obvious artifacts than other behavioral task requirements, vocalization has been found to contribute to increases in CV response independent of psychological stress processes (Linden, 1987; Brown *et al.*, 1988; Tomaka *et al.*, 1994). Vocalization is typically required for cognitive and social laboratory tasks including public speaking and verbal mental arithmetic tasks.

In the present study, we examine whether a “pure” psychological stressor, the silent preparation period before public speaking, is sufficient to elicit a CV response. In order to control for components of preparation that are not threat-relevant, we compare the CV response of individuals who are preparing to perform an evaluative speaking task (stressor condition) to those who are preparing to read a pre-prepared speech (no-stressor control condition). We also examine whether public speaking itself *further* accentuates that response. To control for behavioral components of the task, we compare the CV response of individuals who are giving a speech (stressor condition)

to control subjects who are asked to read a pre-prepared speech during the task period (no-stressor control condition).

Do Cognitive Appraisal and Negative Emotion Mediate CV Responses to Tasks?

The stress and coping model (Lazarus and Folkman, 1984) describes the specific psychological processes that intervene between exposure to potentially stressful conditions and physiological activation. First, individuals appraise the extent to which conditions in their environment are threatening (primary appraisal) given their resources for coping (secondary appraisal). To the extent that threat exceeds their resources for coping, they are expected to react with greater negative emotion which, in turn, leads to physiological responses that may influence the onset or progression of disease. Although appraisal and emotion are the key psychological processes involved in physiological response, different types of appraisal and emotion are thought to be relevant during different stages of the stressor (Folkman and Lazarus, 1985). Anticipatory stress is thought to influence physiological response through "threat appraisal" and "threat emotion." Threat appraisal refers to the expectation that personal harm or loss is imminent and threat emotions such as fear and anxiety follow from this appraisal. As the stressor unfolds, "harm appraisal" and "harm emotion" become relevant. Harm appraisal refers to the evaluation that personal harm or loss has already occurred and harm emotions such as anger and frustration follow from this appraisal.

Early studies testing the stress and coping model examined the effects of appraisal-related (intellectualization, denial, or threat-enhancing) instruction sets on affective and physiological responses to disturbing film clips (Lazarus and Alfert, 1964; Speisman *et al.*, 1964; Lazarus *et al.*, 1965). Both intellectualization and denial sets were associated with lower psychological and physiological stress responses during the clips than threat enhancing and no instruction sets. Presumably, the instructional sets led to differences in physiological responses via appraisal, although appraisal was not measured in these studies. Several studies have shown that threat appraisal was associated with greater perceived stress and a distinct pattern of CV activity (moderate cardiac output coupled with an increase in total peripheral resistance) on a mental arithmetic task (Tomaka *et al.*, 1993, 1997). This pattern was found in a study where individuals reported on threat appraisal prior to the task and in a follow-up study in which threat appraisal was manipulated. However, a recent study failed to show an effect of threat appraisal on hemodynamic response during two mental arithmetic tasks (Kline *et al.*, 1999). A possible explanation for these divergent findings is that threat appraisal is not reliably associated with physiological responses during the stressor itself. The stress and coping model predicts that threat appraisal and concomitant emotion are anticipatory in nature and thus are expected to mediate CV response prior to stressor exposure. However, harm appraisal and concomitant emotion would be expected to play a greater role in CV response during the stressor itself. The present study is the first to consider the distinct roles of these types of appraisal and emotion in CV response during the anticipatory and task periods, respectively.

The present study was designed to examine whether distinct cognitive appraisals and emotions mediate physiological responses in persons preparing for and encountering a stressor. To the extent that the preparation period is sufficient to elicit a CV response, we can test whether threat appraisal and threat emotion mediate this response. To the

extent that the public speaking task evokes a further increase in CV response, we can test whether harm appraisal and harm emotion mediate this response.

Does Psychological Vulnerability to the Stressor Lead to Greater CV Response?

Consistent with the psychological approach to stress and coping, it is proposed that an individual will be more responsive to a stressor that is particularly relevant to his or her personality (Bolger and Zuckerman, 1995). Following from this, individuals who report greater psychological vulnerability to an impending stressor are expected to exhibit greater physiological responses (Carver and Matthews, 1989). The model of stress and coping would predict that these individuals exhibit greater physiological responses since they are more likely to appraise the task as threatening or have insufficient coping resources which, in turn, will lead to greater negative emotion (Lazarus and Folkman, 1984). This hypothesis was examined in a previous study which showed that participants who were more speech anxious appraised the speaking task as more threatening and reported greater negative emotion, but exhibited the same levels of CV response as those who were less anxious (Baggett *et al.*, 1996). Since the study did not employ a no-stressor control condition, there may be other aspects of the speech task that contributed to the discrepant findings on psychological and CV response to the task. For example, vocalization may lead to similar levels of CV response across high and low speech anxious individuals independent of group differences in appraisal and emotion. In the present study, we include a no-stressor control condition to examine whether the effects of the stressor (*versus* no-stressor control) condition on CV response are accentuated in individuals who report high levels of speech anxiety.

To manipulate psychological stress, participants in the present study were assigned either to perform an evaluative speaking task (stressor condition) or to read a pre-prepared speech (no-stressor control condition). We hypothesized that those individuals preparing to present a speech would exhibit greater CV response than those individuals preparing to read a pre-prepared speech. Similarly, we hypothesized that those individuals presenting a speech would exhibit greater CV response than those individuals simply reading a pre-prepared speech. To the extent that psychological task components are sufficient to elicit a CV response during preparation and the task, we hypothesized that cognitive and emotion would mediate this response. Furthermore, we hypothesized that individuals high in speech anxiety in the stressor condition would exhibit greater CV response (During preparation and the task) than individuals relatively low in speech anxiety due to appraisal and emotion processes.

METHOD

Participants

Forty-three undergraduate students (30 males, 13 females) participated in a study entitled, "Reactions to Making Presentations" to fulfill a course requirement. Participation was restricted to individuals who were not taking heart medication and did not have blood pressure or heart problems. Twelve percent of the sample reported having a family history of blood pressure or heart problems. The sample was 51%

Caucasian, 26% Asian-American, 5% Latin-American, and 18% of other ethnic backgrounds. The mean age of the sample was 19.5 years ($SD = 2.28$).

Design

Participants were randomly assigned to either the stressor condition ($n = 21$; 14 males, 7 females), in which they engaged in an evaluative speech task, or the no-stressor control condition ($n = 22$, 16 males, 6 females), in which they read written passages aloud.

Procedure

We instructed participants to abstain from food, caffeine, tobacco products, alcohol, and vigorous exercise for at least 3 h and from medications for at least 8 h prior to their laboratory visit. When they came into the laboratory, we confirmed eligibility criteria and obtained informed consent to participate. Then an occluding cuff was placed on their nondominant arm for the automated measurement of heart rate (HR), systolic and diastolic blood pressure (SBP, DBP). After placement of the blood pressure cuff, participants viewed a 15 min nature video to induce relaxation and we assessed their CV function at 2, 4, 12, and 14 min (resting baseline period). At the end of the rest period, they completed a questionnaire that assessed their current emotional state.

Next, participants received instructions about the task. The experimenter informed participants in the stressor condition that they would have to prepare and present a speech in which they were to argue for and against the use of animals for sport, food, and research purposes (Lepore *et al.*, 1997). The experimenter placed a video camera approximately 2 ft in front of these participants and informed them that they would be filmed and observed during the task. They also were told that their speech was going to be evaluated on several criteria, e.g., speaking clearly. The experimenter told participants in the no-stressor control condition that their task was to simply read written passages aloud, which would present arguments for and against the use of animals for sport, food, and research purposes. There was neither a video camera nor evaluative instructions. In both conditions, the experimenter told participants that they would have 5 min to prepare for (preparation period) and 5 min to complete the task (task period). The experimenter was not present in the room during the preparation and task periods. It is possible of course that some participants experienced a nominal amount of stress in the control condition, simply due to being in a laboratory and not knowing what to expect. There was, however, no obvious discomfort and subsequent results suggest stress was at a minimum in the control condition.

Next, the experimenter instructed participants via intercom to spend 5 min mentally preparing a speech (stressor condition) or silently reading the written passages (no-stressor control condition). Participants in the stressor condition received a list of arguments for and against the use of animals for sport, food, and research that were intended to increase the amount of content available for the speech. Participants in the no-stressor control condition received the written passages that they were going to read aloud during the task period. The experimenter wrote these passages to correspond with arguments briefly outlined in the material given to participants in the stressor condition. During the preparation period, we measured CV function at 30 s, 2.5 min, and at 4.5 min. At the end of the preparation period, participants received

questionnaires that assessed their appraisals and emotions about the task they were about to perform.

Next, participants had 5 min to present their speech (stressor condition) or read the written passages aloud (no-stressor control condition). Participants in the stressor condition first presented arguments for the use of animals for 2.5 min and then presented arguments against the use of animals for 2.5 min. Participants in the no-stressor control condition first read the written passage containing arguments for the use of animals for 2.5 min and then read the written passage containing arguments against the use of animals for 2.5 min. During the task period, we measured CV function at 30 s, 2.5 min, and at 4.5 min. At the end of the task period, participants received questionnaires that assessed appraisal and emotion during the task. They were then asked to sit quietly, but were allowed to read a magazine, during a 5 min recovery period. After this period, participants completed the speech anxiety scale.

MEASURES

Appraisal and Emotion

Primary Appraisal

We created measures of threat and harm appraisal using items from the Stress Appraisal Measure (SAM; Peacock and Wong, 1990) (see Appendix). To measure threat appraisal, three items assessed whether participants anticipated that the task would result in negative outcomes during the preparation period (see Appendix). To measure harm appraisal, we phrased the same items in the past tense to assess whether participants felt, in retrospect, that the task had negative outcomes during the task period. At the end of the task period, participants responded to the items on a 5-point scale anchored by 1 (*strongly disagree*) and 5 (*strongly agree*). The threat appraisal scale was reliable during the preparation period ($\alpha = 0.81$) and the harm appraisal scale was reliable during the task period ($\alpha = 0.88$).

Secondary Appraisal

We created a measure of secondary appraisal that assessed general feelings of control over the task (see Appendix). Four items assessed whether participants anticipated having control over the upcoming task during the preparation period. We phrased the same items in the past tense to measure whether participants felt, in retrospect, they had control over the task. At the end of the task period, participants responded to these items on a 5-point scale anchored by 1 (*strongly disagree*) and 5 (*strongly agree*). The secondary appraisal scale was reliable during the preparation period ($\alpha = 0.80$) and the task period ($\alpha = 0.71$).

Appraisal Ratio

We created appraisal ratio scores to examine the degree to which individuals appraised the task as threatening in the context of their perceived ability to cope with the task (see Tomaka *et al.*, 1993). Psychological stress theory (Lazarus and Folkman, 1984) predicts that individuals perceive themselves as under stress when the primary appraisal of threat exceeds the secondary appraisal of coping resources. The correlation

between threat appraisal and appraisal of coping resources was $r = -0.62$ ($p < 0.01$). The average ratio of threat appraisal to appraisal of coping resources during preparation was 0.73 ($SD = 0.39$) with a possible range from 0.20 (no threat/high coping) to 5.0 (high threat/no coping). The correlation between harm appraisal and appraisal of coping resources during the task was $r = -0.61$ ($p < 0.01$). The average ratio of harm appraisal to the appraisal of coping resources during the task period was 0.62 ($SD = 0.29$). Thus, appraisals of coping resources, on average, exceeded appraisals of threat and harm. The correlation between threat and harm appraisal ratios was $r = 0.59$ ($p < 0.01$).

Negative Emotion

We created measures of threat and harm emotion based on those used in a study on examination stress (Folkman and Lazarus, 1985). To assess threat emotion, we asked participants to indicate the extent to which they felt overwhelmed, nervous, worried, and fearful. To assess harm emotion, we asked participants to indicate the extent to which they felt angry, sad, frustrated, disappointed, and embarrassed. At baseline, we measured both types of emotion and asked participants to report "how they feel right now." During the preparation period, we measured threat emotions again and asked participants to report "how they feel about the upcoming task." During the task period, we measured harm emotions again and asked participants to report "how they felt during the task." Participants responded to these adjectives on a 5-point scale anchored by 0 (*not at all*) and 4 (*extremely*). The threat emotion scale was reliable at baseline ($\alpha = 0.87$) and during the preparation period ($\alpha = 0.95$). The harm emotion scale was reliable at baseline ($\alpha = 0.72$) and during the task period ($\alpha = 0.69$). There was a positive association between threat and harm emotions, $r = 0.72$ ($p < 0.01$).

Speech Anxiety

To measure feelings of anxiousness related to speaking in front of others, participants completed the Audience Anxiousness Scale (Leary, 1983). This scale is a 12-item measure containing statements indicating how anxious individuals feel making public presentations such as "I usually get nervous when I speak in front of a group," and "When I speak in front of others, I worry about making a fool out of myself." Participants were asked to indicate the, "...degree to which each item is characteristic or true of you," on a 5-point scale anchored by 1 (*not at all*) to 5 (*extremely characteristic*). This scale was reliable ($\alpha = 0.94$). We used the median on this scale (2.67) to divide the sample into high speech anxious ($n = 20$) and low speech anxious individuals ($n = 23$).

CV Response

We assessed HR (beats per minute; bpm), SBP and DBP (millimeters of mercury; mmHg) via a Critikon Dinamap XL 8100 operated from a control room adjacent to the laboratory. Since we were interested in change in CV response over the course of the stressor, we measured CV response first at baseline and again during the preparation and task periods. To calculate baseline CV response, we took the average of the last two HR, SBP and DBP readings during the baseline rest period.

To calculate preparation CV response, we took the average of the three HR, SBP, and DBP readings during the preparation period. To calculate task CV response, we took the average of the three HR, SBP, and DBP readings during the task period.

Analysis Plan

To address the question of whether psychological components of tasks are sufficient to elicit a CV response, we examined whether individuals in the stressor condition exhibit greater CV response during preparation and the task than those in the no-stressor control condition. We ran MANCOVA models to test the effects of condition and speech anxiety on CV response (SBP, DBP, HR) during preparation and the task. These models also allowed us to address the question of whether the effects of being in the stressor condition are accentuated in individuals who are high in speech anxiety.

To the extent that psychological components of tasks evoked a greater CV response during preparation and/or the task, we wanted to address the question of whether appraisal and emotion mediated this response. To examine whether the data were consistent with mediation, we followed several steps (Baron and Kenny, 1986). First, we examined whether there were effects of the independent variables on the hypothesized mediators in the study. Thus, we ran ANOVA models to test the effects of condition and speech anxiety on appraisal and emotion. Second, we examined whether the effects of the independent variables on the dependent variables were attenuated after controlling for the hypothesized mediators. Thus, we re-ran the original MANCOVA models on CV response and added appraisal and emotion as covariates to the models. Support for mediation is obtained if the effects of the independent variables on the dependent variables are attenuated with the mediators added to the model. Thus, we examined changes in the size of the original effects with mediators added to the model.

RESULTS

Do Psychological Components of Tasks Elicit a CV Response?

Preparation Period

To assess the effects of condition and speech anxiety on CV response during preparation, baseline CV response (SBP, DBP, and HR) was entered as a covariate in the model. There was a multivariate main effect of condition on CV response during preparation, $F(3, 34) = 6.38$, $p < 0.01$. There were also univariate effects of condition on SBP, $F(1, 36) = 5.94$, $p < 0.05$, DBP, $F(1, 36) = 8.91$, $p < 0.01$, and HF, $F(1, 36) = 10.59$, $p < 0.01$. In all cases, participants in the stressor condition exhibited greater CV response than those in the no-stressor control condition.¹ The multivariate interaction effect of condition by speech anxiety was marginally significant, $F(3, 34) = 2.80$, $p = 0.06$. There were also univariate interaction effects of condition by speech anxiety on SBP,

¹To examine the direction of this effect, a repeated-measures MANOVA was used to test the effect of condition on within-subjects increases in CV response from baseline to preparation. There was a main effect of time, $F(1, 41) = 59.23$, $p < 0.01$, and an interaction effect of condition by time, $F(1, 41) = 14.5$, $p < 0.01$. There were increases in CV response from baseline to preparation in both conditions. However, participants in the stressor condition exhibited greater increases in CV response than those in the no-stressor control condition.

TABLE I Effects of condition and speech anxiety on CV response

	<i>Control condition</i>		<i>Stressor condition</i>	
	<i>Low speech anxious</i> (<i>N</i> = 12)	<i>High speech anxious</i> (<i>N</i> = 10)	<i>Low speech anxious</i> (<i>N</i> = 11)	<i>High speech anxious</i> (<i>N</i> = 10)
Baseline				
SBP	109 (3.08)	113 (3.38)	111 (3.22)	112 (3.38)
DBP	63 (2.01)	65 (2.20)	65 (2.10)	66 (2.20)
HR	70 (2.55)	73 (2.79)	69 (2.66)	75 (2.79)
Preparation				
SBP	116 (1.82)	113 (1.98)	116 (1.90)	122 (2.00)
DBP	67 (1.05)	65 (1.13)	69 (1.09)	71 (1.15)
HR	74 (1.48)	72 (1.61)	77 (1.54)	79 (1.64)
Task				
SBP	126 (3.14)	116 (3.41)	127 (3.27)	138 (3.46)
DBP	76 (2.20)	72 (2.39)	77 (2.30)	81 (2.43)
HR	82 (2.22)	77 (2.40)	86 (2.31)	84 (2.44)

Note: Adjusted (for baseline) means are reported during preparation and task period. Standard errors are reported in parentheses.

$F(1, 36) = 5.90$, $p < 0.05$, and on DBP, $F(1, 36) = 4.13$, $p < 0.05$. Examination of simple effects showed that high speech anxious participants experienced greater SBP responses than low speech anxious participants in the stressor condition, $F(1, 36) = 5.57$, $p < 0.05$ (see Table I). There were no differences in SBP response based on speech anxiety in the no-stressor control condition. None of the pairwise tests for group differences in DBP response were significant. Since women and men may differ in CV responses to laboratory stressors (Saab, 1989), we also tested the effects of gender on CV response during preparation, but found no differences.

To compute the size of the effects of condition and speech anxiety on CV response during preparation, the F -value for each effect was converted into a correlation coefficient (r) (Rosenthal, 1991). The main effect of condition accounted for 16% of the variance in CV response and the interaction effect of condition by speech anxiety accounted for an additional 8% of the variance in CV response during preparation.

Task Period

To assess the effects of condition and speech anxiety on CV response during the task, baseline CV response (SBP, DBP, and HR) was entered as a covariate in the model. There was a multivariate main effect of condition, $F(3, 34) = 3.94$, $p < 0.05$. There were also univariate main effects of condition on SBP, $F(1, 36) = 11.71$, $p < 0.01$, DBP, $F(1, 36) = 4.88$, $p < 0.05$, and HR, $F(1, 36) = 5.31$, $p < 0.05$. In all cases, participants in the experimental condition exhibited greater CV response than those in the control condition.² There was a multivariate interaction effect of condition by speech

²To examine the direction of this effect, a repeated-measures MANOVA was used a test the effect of condition on within-subjects increases in CV response from preparation to the task. There were main effects of condition, $F(1, 41) = 6.02$, $p < 0.05$, and time $F(1, 41) = 108.2$, $p < 0.01$. Participants in the stressor condition exhibited greater CV response than those in the no-stressor control condition. There were increases in CV response from preparation to the task in both conditions. However, participants in the stressor condition did not exhibit greater increases in CV response during the task than those in the no-stressor control condition.

anxiety, $F(3, 34) = 3.65$, $p < 0.05$. There was also a univariate interaction effect of condition by speech anxiety on SBP, $F(1, 36) = 10.46$, $p < 0.01$, and a marginally significant interaction effect on DBP, $F(1, 36) = 4.88$, $p < 0.10$. Examination of simple effects showed that high speech anxious participants exhibited greater SBP responses than low speech anxious participants in the experimental condition, $F(1, 36) = 5.20$, $p < 0.05$ (see Table I). Examination of simple effects also showed that low speech anxious exhibited greater SBP responses than high speech anxious participants in the control condition, $F(1, 36) = 4.97$, $p < 0.05$ (see Table I). None of the pairwise tests for group differences in DBP response were significant. In addition, there were no effects of gender on CV response during the task.

To examine whether group differences in CV response during the task were any greater than those found during preparation we entered both baseline and preparation CV response (SBP, DBP, and HR) as covariates in the model. There were no longer effects of condition and/or speech anxiety on CV response during the task. Thus, CV response during preparation accounted for group differences in CV response that occurred from the baseline to the task period.

Do Cognitive Appraisal and Negative Emotion Mediate CV Response During Preparation?

Since the task itself did not elicit further group differences in CV response after accounting for those found during preparation, the following analyses examine whether the data were consistent with mediation during the preparation period only. First, we examined whether the data suggest that the effects of condition and speech anxiety on CV response during preparation were mediated by threat appraisal. Then we examined whether the data suggest that the effects were mediated by threat emotion. Although we also measured harm appraisal and harm emotion, they were only expected to mediate CV response during the task period.

Threat Appraisal

Participants in the stressor condition appraised the task as more threatening given their general coping resources during the preparation period than those in the no-stressor control condition, $F(1, 39) = 5.35$, $p < 0.05$ (see Table II). There was also an interaction effect of condition by speech anxiety, $F(1, 39) = 4.55$, $p < 0.05$. Examination of simple effects showed that high speech anxious participants were more likely to appraise the task as threatening ($M = 0.94$, $SD = 0.11$) given their general coping resources than low speech anxious participants ($M = 0.54$, $SD = 0.10$) in the stressor condition, $F(1, 39) = 7.27$, $p < 0.05$. There were no differences based on speech anxiety in the

TABLE II Mean differences in appraisal and emotion

	<i>Control condition (N = 22)</i>	<i>Stressor condition (N = 21)</i>	<i>Low speech anxious (N = 23)</i>	<i>High speech anxious (N = 20)</i>
Threat appraisal	0.50 (0.07)	0.74 (0.07)	0.53 (0.07)	0.71 (0.08)
Threat emotion	0.57 (0.14)	1.51 (0.14)	0.65 (0.14)	1.43 (0.15)

Note: Adjusted (for baseline) means are reported for threat emotion. Standard errors are reported in parentheses.

no-stressor control condition between low speech anxious ($M=0.52$, $SD=0.10$) and high speech anxious ($M=0.48$, $SD=0.11$) individuals. Thus, the pattern of effects found with threat appraisal was consistent with those found in CV response suggesting threat appraisal may be mediating these effects.

To further assess whether the data were consistent with mediation, we re-ran the original MANCOVA adding threat appraisal as a covariate. We found a multivariate main effect of condition even after controlling for threat appraisal, $F(3, 33)=5.36$, $p<0.01$. Condition accounted for 14% of the variance in CV response after controlling for appraisal. We subtracted this effect size from the original effect size and then divided by the original effect size to calculate the percent of the original effect of condition that is accounted for by appraisal. Threat appraisal accounted for only 13% ($(16-14)/16$) of the original main effect of condition on CV response. There was no multivariate interaction effect of condition by speech anxiety after controlling for threat appraisal. However, appraisal accounted for only 25% ($(8-6)/8$) of the original interaction effect of condition by speech anxiety in CV response.

Threat Emotion

Participants in the stressor condition reported greater threat emotion during the preparation period than those in the no-stressor control condition $F(1, 38)=21.22$, $p<0.01$ (see Table II). High speech anxious participants reported greater threat emotion than those low in speech anxiety $F(1, 38)=13.96$, $p<0.01$ (see Table II). There was a marginally significant interaction effect of condition by speech anxiety, $F(1, 38)=3.51$, $p<0.07$. Examination of simple effects revealed that high speech anxious participants reported greater threat emotion ($M=2.08$, $SE=0.21$) than low speech anxious participants ($M=0.93$, $SE=0.20$) in the stressor condition, $F(1, 38)=15.47$, $p<0.01$. There were no differences based on speech anxiety in the no-stressor control condition between low speech anxious ($M=0.37$, $SE=0.19$) and high speech anxious individuals ($M=0.77$, $SE=0.21$). Thus, the pattern of effects found with threat emotion was consistent with those found in CV response suggesting threat emotion may be mediating these effects.

To assess whether the data were consistent with mediation, we re-ran the original MANCOVA adding baseline and preparation threat emotion as covariates. There was no multivariate main effect of condition after controlling for increases in threat emotion. Increases in threat emotion accounted for 56% ($(16-7)/16$) of the effect of condition on CV response during preparation. There was also no multivariate interaction effect of condition by speech anxiety after controlling for increases in threat emotion. However, increases in threat emotion accounted for only 25% ($(8-6)/8$) of the original interaction effect of condition by speech anxiety in CV response.

DISCUSSION

The present study found that a “pure” psychological stressor, the silent preparation period prior to a task, was sufficient to elicit a CV response. This response was accentuated in individuals who reported greater dispositional vulnerability to the upcoming stressor. Contrary to our expectations, there were no additional effects

of performing a standard stressor task on CV response above and beyond those found during preparation. As predicted, individuals who were preparing to perform a speech, particularly those who reported greater speech anxiety, appraised the upcoming task as more threatening and reported greater threat emotion during the preparation period. We found that threat emotion accounted for 56% of the effect of condition on CV response while threat appraisal played a small role in CV response. Although there was some evidence that the moderating effect of speech anxiety on CV response was mediated by both threat appraisal and threat emotion, our ability to test mediation of this effect may be limited by the sample size. We will discuss the implications of this study's findings for the traditional psychological model of stress and disease, as well as models that emphasize characteristics of stressors that influence physiological response independent of appraisal and emotion.

Psychological Models of Stress and Disease

This study provides further evidence that stressor anticipation is sufficient to elicit physiological response that are comparable to or exceed those typically observed during stressor exposure (also see Mendes *et al.*, 2002). The anticipation period may be particularly threatening since individuals are aware that they will be faced with a stressful task, yet there is ambiguity surrounding the nature of the task and their ability to cope with the stressor is limited (Folkman and Lazarus, 1985). Anticipation may evoke emotional and concomitant physiological responses before any exposure occurs, and therefore may need to be examined as a stressor in and of itself. That anticipation is important to examine as a stressor is underscored by finding that individuals who exhibit greater anticipatory CV response are at greater risk of developing hypertension (Everson *et al.*, 1996).

Unlike previous studies, we examined the specific psychological factors that may underlie physiological responses during the anticipation period. Consistent with the notion that negative emotions trigger these responses (Lazarus and Folkman, 1984), we found that negative emotions accounted for a substantial amount of the effect of preparing for a speech on increases in CV response. That anticipatory emotions such as fear may underlie CV response is consistent with the argument that the adaptive function of negative emotion is to mobilize physiological resources for coping with threatening conditions in the environment (Cannon, 1932). Negative emotions also account for a large part of the relation between anticipatory stress and salivary cortisol response to naturalistic daily stressors (Smyth *et al.*, 1998). In contrast to these findings, a meta-analysis of studies examining the effects of acute stress on CV response suggested that there was a limited association between negative emotion and CV response to standard stressor tasks (Feldman *et al.*, 1999). It appears that negative emotions may be more strongly linked to physiological responses during the period prior to the stressor than during task performance. It is important to note that there was substantial variance in anticipatory CV response that was *not* explained by negative emotion, but may be explained by other psychological factors. For example, the degree of active coping or mental effort exerted during speech preparation may also contribute to CV response (Obrist, 1981).

Although participants in the stressor condition appraised the upcoming task as more threatening than those in the control condition, threat appraisal did not appear to play a role in CV response during preparation. Our ability to examine the role of appraisal in

these responses may be limited to some extent, by issues related to the conceptualization and measurement of appraisal (Monroe and Kelly, 1995). It has been suggested that there are two different modes of appraisal, "...one which is conscious, deliberate, and under volitional control, and the other automatic, unconscious, and uncontrollable" (Lazarus, 1991, p. 153). To the extent that unconscious appraisals underlie physiological response during preparation, they may be impossible to measure (for a discussion of indirect evidence for unconscious appraisals, see Blascovich and Mendes, 2000). However, it may be that conscious appraisals are involved, yet were not adequately measured in this study. The appraisal ratio scores did not reflect a high degree of threat suggesting that we may need to tap more specific threats associated with the upcoming task such as the anticipated loss of self-respect and social approval (e.g., Folkman and Lazarus, 1980). Participants may be more likely to appraise the task as threatening when they are asked about specific negative outcomes *versus* being asked to report on general expectancies that negative outcomes will occur. It is also possible that the timing of our threat appraisal measures (after the preparation period) limited our ability to examine the role of appraisal in CV response. Once upcoming efforts are initiated, the degree of threat associated with the upcoming stressor is likely to be limited. Thus, greater evidence for the role of appraisal in CV response may be found when more specific threats are measured at an earlier point in the course of the stressor.

The findings on speech anxiety suggest that the effects of situation-specific psychological factors on physiological responses to stressors may be modified by dispositional factors. Individuals who reported more psychological vulnerability to the stressor appraised the stressor as more threatening, reported larger increases in emotional response, and exhibited larger increases in CV response. Although our ability to test mediation of CV response in the high speech anxious-stressor condition was limited by the sample size, the strongest evidence for mediation may be found with this group of individuals. Given their expectancies and prior experience with the stressor, it is likely that their appraisal and emotional responses to the stressor may be more strongly related to their physiological responses. A limitation of our study was that we measured speech anxiety after the speech task making it possible that speech anxiety scores were based on experiences during preparation and the task rather than the opposite relation. We also had one anomalous finding in which low speech anxious participants in the control condition exhibited significantly greater SBP than high speech anxious participants in the same conditions.

Alternate Models of Stress and Physiology

This study's findings also point to the important role that task characteristics play in CV response. For example, task characteristics that may contribute to distinct patterns of CV response include the use of active *versus* passive coping (Obrist, 1981), dynamic *versus* static exercise (Asmussen, 1981), and vocalization (Linden, 1987; Brown *et al.*, 1988; Tomaka *et al.*, 1994). That both giving and reading the speech resulted in increases in CV response during the tasks suggests that vocalization was driving CV responses during the task period. These findings point to the importance of including a no-stressor control group to control for the influence of behavioral artifacts on physiological outcomes

Based on a meta-analysis of acute stress studies, we proposed that negative emotion plays a limited role in CV response to standard stressor tasks and the contribution of task demand characteristics needs to be examined (Feldman *et al.*, 1999). Our analysis was based on correlations between change scores that reflected baseline to task changes in negative emotion and CV response. It was suggested there might not be enough reliable variability in stressor-task induced changes in negative emotion to detect a strong relationship between changes in negative emotion and CV response, but the use of a no-stressor control group would provide an appropriate test of this relationship (Schwartz, 1999). Using an experimental design in the current study, we found that psychological factors played a small role in CV response during the stressor task as the meta-analysis found. However, they did appear to play an important role during the period prior to the task.

CONCLUSION

Consistent with psychological models of stress and disease, our findings suggest that negative emotions may underlie CV response during the anticipation or preparation period prior to a stressor. There was less evidence that appraisal played a role in anticipatory CV response, although methodological issues may need to be addressed to adequately assess this relation. In addition, greater evidence for appraisal and emotion as mediators of anticipatory CV response may be provided in individuals who report greater dispositional vulnerability to the stressor. Finally, studies using the acute stress paradigm need to more carefully examine the contribution of appraisal and emotion *versus* behavioral demands to physiological response during standard stressor tasks.

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APPENDIX

Primary Appraisal

“I feel that this task may be a negative experience for me.”

“I feel that this task will result in negative outcomes.”

“I feel that this task is going to have a negative impact on me.”

Secondary Appraisal

“I can handle the demands of the task.”

“I have a sense of control over the task.”

“Others have control over the task.”

“I can’t cope with the task.”

Note: All items are placed on scale from 1 (*strongly disagree*) to 5 (*strongly agree*).