HAWK AND DOVE STRESS RESPONSE PROFILES IN HUMANS

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Hawk and Dove Biobehavioral Stress Response Profiles in Humans

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The Supervisory Committee certifies that this ***disquisition*** complies with North Dakota State University's regulations and meets the accepted standards for the degree of

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ABSTRACT

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A recent evolutionary theory hypothesizes that there are two primary biobehavioral profiles of stress responding. Labeled "hawk" and "dove," each is characterized by divergent patterns of autonomic nervous system and neuroendocrine system activations in response to stress as well as distinct affective and behavioral tendencies. These profiles are prominent in a number of species, and it has been hypothesized that hawk-like and dove-like responses to stress may, in part, explain variability in stress-related health outcomes. This study is a preliminary investigation of hawk and dove biobehavioral profiles in humans. Participants included 73 Midwestern university students recruited from undergraduate-level psychology classes. Upon completion of a stressor task, participants answered questions regarding their psychological experiences during and immediately following the task and reported their emotions and health-related behaviors over the past several weeks. Physiological measures of cortisol and high frequency heart rate variability reactivity were used to identify relatively hawk-like and dove-like responders. Associations between patterns of physiological responding and emotional and behavioral responses were tested. The results showed mixed support for the existence of hawk and dove biobehavioral profiles in humans.

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AUTHOR'S NOTE

I have also published under my nom de plume, Cali L. Anicha.

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INTRODUCTION

A recent evolutionary theory hypothesizes that there are two primary biobehavioral profiles of stress responding. These profiles have been labeled "hawk" and "dove" (Korte, Koolhaas, Wingfield, & McEwen, 2005). Hawk responses to stress are characterized by sympathetic nervous system (SNS) activation, relatively small neuroendocrine (cortisol) increases, fleeing, fighting, and competitive/aggressive behavior. Dove responses to stress are characterized by parasympathetic nervous system (PSNS) activation, relatively large neuroendocrine (cortisol) increases, freezing, hiding, and avoidance of competition/aggression.

Non-human animal research reviewed by Korte and colleagues (2005) showed that these profiles are prominent in a number of different species. It is hypothesized that hawk-like and dove-like responses to stress may, in part, explain variability in stress-related health outcomes (Korte, et al., 2005). For example, stress has been associated with the development of cardiovascular disease (Treiber, et al., 2003) and diabetes (Wiesli, et al., 2005). Individual differences in response tendencies may help us better understand these variable associations.

Hawk and dove behavioral differences have been found in nonhuman animal research investigating coping styles (Henry & Stephens, 1977; Koolhaas, et al., 1999). Research in birds, rodents, and pigs verifies that active (hawk) versus conservative-withdrawal (dove) response styles are associated with hawk/dove physiological profiles, respectively (Koolhaas, de Boer, Buwalda, & van Reenen, 2007; Koolhaas, et al., 1999; Korte, et al., 2005). However, research confirming the associations between behavioral and physiological stress response patterns (i.e. the hawk and dove biobehavioral profiles) has not yet been accomplished in research with human participants. In this study, associations among individual differences in human physiological stress responding and concomitant psychological, behavioral, and health-related variables are considered according to the hawk-dove parameters discussed by Korte, et al., (2005).

Background

The hawk-dove theory of stress responding as articulated by Korte and colleagues (2005) is grounded in an evolutionary theory originally proposed by Maynard Smith (M. Smith, 1982). In order to explain the often observed individual behavioral differences seen in animals during lab and field studies, Smith's "hawk-dove game" theorized that the fitness of a species is enhanced when equilibrium among two or more behavioral traits is maintained. Thus, over evolutionary time, the development of this hawk-dove dual-response repertoire (versus the singular response model suggested by the traditional stress paradigm) would improve species' survival.

Hawk responding is characterized as quickly, boldly, and superficially exploring environments and novel objects, while dove responding involves slow, cautious, and thorough exploration. Hawk responses tend toward aggression and routine patterns of exploration. Dove responses avoid aggression and show more variability in exploration patterns. Observations of animals in natural habitats have revealed that hawk and dove profiles are differentially adaptive depending on environmental contexts. Hawks have an advantage when population density is high because they are willing to compete/aggress to obtain resources, whereas doves tend to retreat. Doves have an advantage when population density is low because they seek out and form communities in which they are willing to share resources equally with other doves while tending to avoid potentially harmful interactions with hawks. Also, more flexible and thorough dove search strategies provide an advantage when resources are low, a time when alternative resources must be explored.

While hawk-dove biobehavioral responses may improve survival in the short-term, that is, long enough to ensure reproduction, they may not confer long-term health benefits. Extending non-human animal research to humans, Korte and colleagues (2005) suggested that the behavioral tendencies and chronic activation of hawk or dove-like physiological stress responses may lead to different negative health outcomes. To further understand the hawk-dove delineation and links between their stress responses and health we need to consider the physiology of stress responding.

ANS and HPA-axis Stress Responding

While there are myriad physiological changes that occur in response to stress, the focus of this study is on autonomic nervous system (ANS) activation and hypothalamic-pituitary-adrenal (HPA) axis production of the neuroendocrine cortisol. The ANS hosts two primary, interrelated modalities - the SNS and the PSNS. Activation of the SNS causes physiological arousal in a number of systems, increasing blood pressure, heart rate, and respiration, for example. Activation of the PSNS has opposite effects, lowering blood pressure, heart rate, and respiration.

Since the 1900's and the groundbreaking research led by Walter Cannon (Canon, 1915) and later by Hans Selye (Selye, 1956) the human stress response has routinely been characterized as activation of the SNS in readiness for flight or fight accompanied with reciprocal deactivation of the PSNS, and vice versa during recovery (McEwen & Lasley, 2002; Taylor, et al., 2000). Chronic and repeated activation of the SNS has been associated with a number of negative health consequences, especially the development of cardiovascular disease (McEwen & Lasley, 2002; Sapolsky, 2004). In this conventional description of the stress response, the SNS system is immediately activated in preparation for exerting energy. Next, the neuroendocrine system is engaged via the HPA axis. The hypothalamus communicates with the pituitary gland, which sends a message to the adrenal cortex to release cortisol into the bloodstream. Cortisol then acts to maintain a relatively high blood sugar and lipid content in readiness for the metabolic demands of physical fighting or fleeing.

More recent accounts of human stress responding include a behavioral alternative to fleeing or fighting. The "freeze" response is a behavior associated with activation of the PSNS (Bracha, Ralston, Matsukawa, Williams, & Bracha, 2004; McEwen, 1998; Porges, 1995, 2001; Porges & Carter, 2006; Sapolsky, 2004). Current stress research recognizes variable configurations of SNS and PSNS responding within and across individuals (Berntson, et al., 1997; Berntson, Cacioppo, & Quigley, 1993; Cacioppo, Tassinary, & Berntson, 2007). These multi-dimensional responses include the conventional *reciprocal* SNS and PSNS responses with either SNS or PSNS dominance, along with *coactivation* or *coinhibition* of both the SNS and PSNS, and *independent* operating of the SNS and PSNS. It has also been established that HPA responding varies within and across individuals (Dickerson, Gruenewald, & Kemeny, 2004). These more complex accounts of ANS and the HPA axis functioning provide a foundation from which hawk-dove physiological profiles have been conceptualized.

Differences in hawk-dove ANS stress responding can be explained with a metaphor used frequently in the ANS literature in which the SNS represents the accelerator and the PSNS represents the brakes. A number of variables including situational and individual differences determine when the engine is revved by pressing on the accelerator and when the brakes are applied.

Hawks have a tendency to consistently rev the engine (perhaps at too high a speed) and rarely use the brakes, a response in which there may be a reciprocal pattern of SNS activation and PSNS deactivation. Dove tendencies are to apply the brakes or to cautiously increase and decrease speed, perhaps simultaneously revving the engine and "riding the brakes," a response in which there may be coactivation of the SNS and PSNS.

Hawks and Doves: Physiological Pathways to Poor Health Outcomes

The hawk-dove theory incorporates the current multidimensional model of stress responding in search of important insights into the pathways by which stress impacts health. For the purposes of this study, we examined heart rate variability (HRV, an indicator of PSNS) reactivity and cortisol (a product of HPA axis activity) reactivity to a stress task. A hawk-like profile was characterized by relatively low HRV reactivity (PSNS withdrawal) and low cortisol production (less HPA activation) in response to a stressor. A dove-like profile was characterized by relatively high HRV reactivity (PSNS activation) and high cortisol production (more HPA activity) in response to a stressor.

For hawks, repeated or chronic stress responses engaging the SNS result in increased heart rate and blood pressure which, over time, can damage the heart and vasculature (McEwen & Lasley, 2002) putting hawks at risk for various forms of cardiovascular disease

(CVD). Additionally, the hawk response described by Korte, et al. (2005) engages the hypothalamic-pituitary-gonadal (HPG) neuroendocrine pathway resulting in increased plasma testosterone. This hormone has been associated with aggression and impulsivity (Archer, 1991; Olweus, Mattsson, Schalling, & Low, 1980; Ramírez & Andreu, 2006; van Honk, et al., 1999). Aggression has been associated with greater risk of CVD (T. Smith, 1992; T. Smith, Glazer, Ruiz, & Gallo, 2004) and impulsivity may contribute to the development of a variety of poor health outcomes (Kreek, Nielsen, Butelman, & LaForge, 2005). Thus, hawks, with their tendencies toward action, aggression, and high SNS activation are hypothesized to be more vulnerable to CVD including hypertension and cardiac arrhythmias. Hawks also have higher risk of harm from aggression/violence, atypical depression, chronic fatigue, and inflammatory disorders (Korte et al., 2005).

For doves, PSNS activation in response to stress mitigates the impact of chronic SNS activation on the cardiovascular system. However, in a dove scenario the HPA axis mobilizes energy for sustained action by releasing cortisol, even though energy-consuming actions may not occur (e.g., freezing). In addition to mobilizing energy, cortisol inhibits insulin-promoted energy storage. That is, it fosters insulin-resistance resulting in high blood sugar and associated dysregulation of plasma lipids (cholesterol and triglycerides) (Fletcher & Lamendola, 2004).

Sustained high levels of cortisol have been shown to trigger hunger (when insulin is also high) presumably in anticipation of the need to replenish the body's energy stores. Also, food intake is known to lower anxiety (Korte, et al., 2005) and doves may eat in response to negative/anxious moods. Thus doves, with their tendencies toward vigilance, immobilization, high neuroendocrine production (cortisol), and comparatively high PSNS activation, are hypothesized by Korte et al., (2005) to be relatively more vulnerable to metabolic syndromes such as diabetes and at greater risk of anxiety disorders, melancholic depression, psychoses, and acute infections.

Hawks and Doves: Are There Gender Differences?

As noted above, the vast majority of stress response research has focused on the flee-fight response, SNS reactivity, and risk of CVD (Sapolsky, 2004). These studies have not considered the freeze-hide response, PSNS reactivity, and the potential for associated health outcomes (McEwen & Lasley, 2002). This omission may be the product of presumptions that freeze-hide responses are less effective, "last-ditch efforts," helpful only when options to flee or fight are unattainable (Bracha, 2004; Bracha, et al., 2004). Another possibility is that cultural biases favoring stereotypically male active coping strategies have led to neglecting more stereotypically female coping strategies including freeze-hide, retreat, and social networking (tend and befriend) responses (Taylor, et al., 2000).

The hawks-doves hypothesis proposes that environmental pressures placed similar behavioral demands on males and females alike, such that speed and willingness to aggress to obtain resources was adaptive during periods of high population density, and vigilance and sharing of resources was adaptive during periods of low population density regardless of gender (Korte et al., 2005).[1] Nonetheless, we frequently observe behavioral stress response

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[1] Currently, the term "sex" is often used to designate biological status as either male or female while "gender" is more often considered a sociocultural construct. Sex-typing as either male or female ignores the existence of intersex persons and is itself a sociocultural construct rather than a biological reality. Approximately 2% of children born each year are intersexed; a minimum of five sex categories may be warranted (Fausto-Sterling,

gender differences. Indeed, much research supports contentions that males tend to express more anger (L. Ellis, et al., 2008) and physical aggression than females (as reviewed in Burton, Hafetz, & Henninger, 2007) and that females tend to exhibit higher levels of anxiety (Barlow, 2001) and recruitment of social resources (Taylor, et al., 2000) than men.

Taylor et al., (2000) argue that evolutionary pressures have caused females to develop significantly different biobehavioral responses to stress than males. The tend-and-befriend theory (Taylor et al., 2000) contends that for childbearing females, both fight and flee stress responses were ill-advised because vulnerable offspring could be left unattended in either case. More adaptive behaviors would have likely included a freeze response to acute stressors. Becoming less visible to predators would have necessitated the careful tending and silencing of offspring. The development of a social support network (befriending) would have offered safety in numbers as well as assistance in acquiring food and other needed resources (Taylor, et al., 2000). Successful social networking in service to avoidance of harm reasonably entails close attention to social hierarchies. Given this description of a "female stress response", in contrast with a more male fight or flee response, we might expect to see more females embodying dove-like stress responses and more males embodying hawk-like stress responses.

Overview and Hypotheses

In the present study, undergraduates participated in a laboratory stress task. Cortisol and HRV were assessed before and during the task. After the psychological reactions to the

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2000). Recognizing that social awareness and conventions are evolving to more accurately represent sex/gender, the terms male and female, as well sex and gender are used advisedly in the present document.

task were measured, trait measures were completed, followed by a health behaviors questionnaire. Using the HRV and cortisol assessments we examined associations among hawk (relatively low HRV reactivity and low cortisol reactivity) and dove (relatively high HRV reactivity and high cortisol reactivity) physiological profiles and the psychological and health variables reported post task.

Because of their tendencies to be more aggressive we predicted that participants with a relatively hawk-like physiological profile would report greater anger and hostility compared to those with dove-like physiological profiles. In contrast, because doves may be more reliant on social support than hawks, we predicted that doves would report higher levels of social-evaluative concern. Accordingly, we predicted that in response to the stress task physiological doves would experience higher levels of associated nervousness, fear, and anxiety and would appraise the task as more threatening, challenging, and difficult than hawks.

Because doves tend to be more deliberate in their behaviors (Korte et al., 2005) we expected dispositional and general attentiveness to be higher for physiological doves than for physiological hawks. Correspondingly, this relatively enhanced attention in doves may be reflected in more accurate reporting of somatic symptoms (e.g., perception of heart rate) during the stress task. In terms of health behaviors, due to hawks' greater impulsivity, we hypothesized that physiological hawks would report more impulsivity-related negative health behaviors, such as smoking and alcohol use (Granö, Virtanen, Vahtera, Elovainio, & Kivimäki, 2004) than doves. On the other hand, given their immobilization response to stress, doves were expected to report more conservation-withdrawal behaviors (e.g. over-eating, relatively less exercise) than hawks.

We also explored relationships among biological sex, gender identity, and hawk-dove physiological profiles. Hawk characteristics are akin to male competitive/aggressive stereotypes and dove characteristics are akin to female timid/cooperative stereotypes. To examine these issues we first tested the hypothesis that males would be overrepresented as physiological hawks and females would be overrepresented as physiological doves In addition to biological sex, similar analyses were done with gender identity (Bem, 1984; Stets & Burke, 2000).

METHOD

Participants

Undergraduate students (n = 73) recruited from psychology classes participated in exchange for course credit. Thirty participants were female; sixty-five identified as white/Caucasian, six as Asian, one as African American and one as American Indian/Alaskan Native. Participant ages ranged from 18 to 45 years; median age was nineteen. The Institutional Review Board of North Dakota State University approved of all procedures.

Procedure

Students signed up for the study online for course credit. Telephone contact was made the night prior to the participants' scheduled appointment. During this call participants were reminded of their appointment, asked to wear loose fitting clothing to accommodate sensor placement, and were provided directions to the lab (Appendix A).

Participants arrived at the lab individually and were greeted by a single experimenter. The participant was told that the study involved how different people's bodies respond during challenging tasks. Signed consent was obtained (Appendix B). Then the use of the saliva collection device (Salivette) was explained (see below) and a baseline salivary cortisol sample was collected. Next, electrode sensors were applied in standard three-electrode placement for electrocardiogram (EKG) measures. The sensors were attached to a Biopac MP100 which was connected to a PC. This device recorded the EKG data from which high frequency HRV measures were derived.

After the sensors were attached the participant was asked to sit and relax during a ten minute resting baseline period. Participants were left alone in the room during this period to attenuate any effects that orienting to the surroundings and physiological recording equipment might have on the participant.

After the baseline period the experimenter returned and explained that the challenging task the participant was going to perform was a speech task. It was explained that the participant would give a 5-minute speech regarding her/his personal opinion about the practice of euthanasia (Appendix C) to another undergraduate who volunteered to be in the study. The participant was then given 5 minutes alone to mentally prepare the speech.[2]

After the preparation period another undergraduate arrived. The experimenter explained to the new arrival that his/her job was to act as an audience while the other participant gave a speech. The audience was asked to evaluate the speech and was given a clipboard for taking notes during the speech. In order to further increase the evaluative nature and stressfulness of the task the participant was shown a video camera and was told that the entire five minute speech would be recorded for later evaluation by "experts in self-presentation, public speaking, and psychological well-being."

Unknown to the participant, the audience member was actually a confederate of the experiment who was trained to respond during the speech in a way that would increase the stressful nature of the situation. While the participant was giving the speech, the confederate produced nonverbal and mumbled reactions approximately every 30 seconds. These responses appeared evaluative and slightly disapproving, suggesting that the participant may be evaluated negatively (Appendix D). Also, the experimenter stood behind the participant

[2]The final sample included three participants who spoke on the topic "college is a valuable asset." Independent sample t-tests comparing this group of three to the remaining participants across all study variables indicate that significant differences were seen between groups on two measures - concern regarding evaluation by the experimenter and perception of pulse rate; $p = .03$ for each.

and interrupted at 3 minutes 30 seconds into the 5-minute speech, instructing the participant to move on to a different argument or to provide more examples, whichever was more appropriate. This was done to remind the participant that the experimenter was in the room maintaining the evaluative nature of the situation (Hilmert, Kulik, & Christenfeld, 2002).

Immediately after the 5-minute speech task the participant was given a post-task questionnaire. The questionnaires included questions designed to assess the degree to which the task was stressful (Post-Task Questionnaire 1), measures of emotions during the task (Self-Report of Feelings), perceived somatic responses to the task (Somatic Symptoms Report), and questions concerning threat, challenge, and difficulty appraisals of the task (Performance Attribution Questionnaire). After 5 minutes the experimenter excused the confederate and the participant was asked to "sit quietly and try not to move" for an additional 15 minutes. The experimenter left the room for this 15 minute "rumination" period. After this period participants completed questionnaires that assessed rumination about the task during the past 15 minutes (Rumination 1 & 2), affect (Positive Affect Negative Affect Scales-Expanded Form), gender identity (Bem Sex Role Inventory),and attention tendencies (Five Factor Mindfulness Questionnaire), as well as a Demographics and Health Questionnaire.

Meta-analyses have shown that the best time to detect peak cortisol responses to stress is 30-40 minutes after the initiation of the stressor (Dickerson, et al., 2004). Therefore, forty minutes after initiation of the speech and while the participant was completing these questionnaires the experimenter collected a post-task salivary cortisol sample. Finally, the experimenter removed the sensors, debriefed and thanked the participant.

Physiological Measures

PSNS (HRV) reactivity. Fluctuations or variability in heart rate reflect ANS functioning. A measure of HRV known as respiratory sinus arrhythmia (RSA) or high frequency (HF) HRV (0.12 to 0.40 Hz) provides an index of PSNS tone (Berntson, et al., 1997; Berntson, Cacioppo, & Grossman, 2007; Cacioppo, et al., 2007; De Jong & Randall, 2005; Denver, Reed, & Porges, 2007; Porges, 1995; Sztajzel, 2004). Heart rate data (EKG) recorded with a Biopac System (Goleta, CA) was checked for artifacts using Mindware Technologies software (Gahanna, OH). The same software was used to identify beat-to-beat (R-R) intervals from the EKG signal and calculate HF-HRV; computations were completed using recommended procedures (Berntson, et al., 1997).

Baseline HRV was calculated from the last 4 minutes of the ten-minute baseline period and task HRV was the average of the variability recorded during the entire five-minute speech task. PSNS reactivity was calculated as change in HRV from the baseline (task average HRV minus baseline average HRV). HRV data were natural log transformed. A Percent Deviation from the Mean (PDM) calculation was also completed for HRV reactivity data. The use of PDM transform with HRV values has been found to result in more normally and tightly distributed data than the conventionally used logarithmic transformation (Ellis, Sollers, Edelsteinb, & Thayer, 2008)[3] and did show an improved normal distribution compared to the log transformed HRV reactivity data in this study.

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[3] The computation for PDM transform followed the Ellis et al., (2008) transform: [((Speech.HRV minus BaseLine.HRV)-(mean of [Speech.HRV and BaseLine.HRV])/mean of [Speech.HRV and BaseLine.HRV]*100)]

Cortisol reactivity. Salivary cortisol has been shown to be a reliable and valid indicator of HPA activation in response to stress (Kirschbaum, Pirke, & Hellhammer, 1993). Cortisol levels were assessed during baseline and again 30-40 minutes post stressor initiation. All participants were scheduled during afternoon hours (between 1:00-3:00 PM) to control for diurnal variations in cortisol levels. Salivary cortisol samples were collected using a sterile cotton roll (Salivette) that participants placed in their mouths, chewed gently, and then allowed the roll to rest between their cheek and gum for three minutes before returning it to the collection tube. Samples were immediately placed in a freezer at -20°C until sent to a laboratory for analysis.

Salivary samples were processed by Salimetrics, LLC (State College, Pennsylvania). Cortisol levels were assayed from 25-μL samples, using the HS-cortisol High Sensitivity Salivary Cortisol Immunoassay Kit (Salimetrics, LLC, State College, Pennsylvania). Assays were performed in duplicate. Analyses were completed using the average of these duplicated assay results (μg/dL).

As is customary in analyses of salivary cortisol, to achieve normalized distributions reactivity was assessed by adding 1 and log transforming these scores, then subtracting the baseline average log transformed value from the task average log transformed value. One case was deleted due to a baseline cortisol value more than 3 SDs from the mean.

Self-Report Measures

The psychological and behavioral measures used in the study are presented below in the order in which they were completed by participants following the speech task.

Psychological reaction to the task. Immediately after the speech task, participants completed several questionnaires designed for this study to assess psychological reactions to the task. On the Post Task Questionnaire 1, participants were asked to rate their nervousness during the task, concern regarding performance evaluations by the experimenter, and the stressfulness of the speech task. Each item was reported using a 5 point scale (1 = Not at all, 5 = Very much). On the Performance Attribution Questionnaire participants rated how threatening, challenging, difficult they thought the speech task was. Ratings were made on a 7-point scale with 1 = Not at all true, 4 = Somewhat true, and 7 = Very true. Cronbach's alpha for these 6 items = .82; mean scores for the 6 items were averaged to produce a Stress Index score used in task validation analysis. Several items were also considered separately in hypothesis testing.

Self-report of feelings questionnaire (SRF). Next, participants rated sixteen emotion words (e.g. afraid, anxious, engaged, happy) by circling the number that best described the greatest amount of the emotion they felt during the task. Each word was rated on an 8-point scale with 1 = did not feel even the slightest bit and 8 = Most you have ever felt in your life. This questionnaire has been found to be a reliable and valid indicator of emotional reactions (Gross & Levenson, 1993). Selected items relevant to study hypotheses were considered separately (Angry, Afraid, Nervous, Anxious)

Somatic symptom report (SSR). A subset of the participants (n = 33) then rated the magnitude of their somatic responses to the task. Items included ratings of how sweaty their hands were, how much their heart was pounding, how tense their stomach felt, how heavily they were breathing, how fast their pulse felt, how warm their hands felt, and how tense their muscles felt. These ratings were made on 9-point scales with higher numbers indicating greater sensations. This scale has been used in numerous studies employing the Trier Social Stress Test which involves giving a speech to an audience (Kirschbaum, et al., 1993). To assess whether hawks or doves provided more accurate ratings, an accuracy score was computed based on SSR ratings of how fast their pulse felt compared with (actual) average heart rate during the speech task.

Assessment of audience questionnaires. Next, participants were asked to rate the degree to which they felt accepted by the audience. Greater amounts of acceptance were indicated with higher values on a 7-point scale. This measure was designed for this study.

Rumination. Responses on the rumination assessment were either open-ended (Rumination 1) or made on a 7-point scale (Rumination 2). Rumination 1 open ended answers to the question, "What did you think about during the last 15 minutes?" were coded by trained assistants for frequency of negative speech related thoughts. Also, two items representing the incidence and intensity of rumination from the Rumination 2 form were analyzed in this study ("I thought about the task after it was over", "I couldn't stop thinking about the task"). Because these items represent unique aspects of rumination they are examined separately.

Positive affect negative affect scales-expanded form (PANAS-X). This scale, developed by Watson and Clark (1994), is a 60-item measure of general affective experience. Participants responded to the stem, "Indicate to what extent you have felt this way during the past few weeks." Ratings were made on a 5-point scale with 1=Very slightly or not at all and 5 =extremely. This is a standard and frequently used assessment of affect. The following standard subscales scores were computed by averaging the relevant items and were reliable: Hostility (6 items, $\alpha = .78$) and Attentiveness (4 items, $\alpha = .80$).

The Bem sex role inventory (BSRI). The BSRI includes independent masculinity scales (MS) and femininity scales (FS). Validity for the BSRI was assessed relatively recently and although social gender roles have changed since it was originally developed in 1974, it continues to validly assess gender role identity (Holt & Ellis, 1998). The BSRI asked each participant to rate how well 60 adjectives describe the participant using a seven-point scale that ranged from 1 ("Never or almost never true") to 7 (Always or almost always true"). The items included 20 stereotypically feminine words comprising the FS, 20 stereotypically masculine words comprising the MS, and 20 neutral adjectives. Examples are “loves children” (FS), “independent” (MS), and “sincere” (neutral). In this sample Cronbach’s alphas for MS and FS were .90 and .85, respectively. FS and MS indices were created by averaging the 20 items associated with each scale.

Five factor mindfulness questionnaire (FFMQ). Mindfulness is generally defined as an uncritical awareness of one’s immediate experience (Bishop, et al., 2004; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008). The FFMQ is a 39 item self-report measure that identifies 5 independent scales representing unique aspects of mindfulness (Baer, et al., 2008). Example items from the two factor scales used in this study include, “I notice the smells and aromas of things” (*Observing*) and “I find myself doing things without paying attention” (*Acting with awareness* reverse scored). In a recent empirical study assessing construct validity of the FFMQ Cronbach’s alphas ranged from .75 to .91 (Baer, et al., 2008). The two indices reported in this study showed scores with small to moderate internal reliability, Observing (8 items, $\alpha = .29$) and Acting with Awareness (5 items, $\alpha = .64$). Despite the small alphas found in the current sample, given the reliability found for previous larger samples, the indices were created by calculating average scores for each scale.

Demographics and health questionnaire. Finally, data regarding basic demographic and health behaviors were collected. Health behaviors were surveyed regarding both the past 24 hours and the week prior to the experiment. The following items relevant to the current study were included in analyses: Use of (amount and frequency) cigarettes, alcohol, and recreational drugs other than alcohol; Type and duration of aerobic and anaerobic physical activities; Frequency of eating behaviors including significant restrictions in food intake and intake of unusually large quantities of food in short periods (binging) within the week prior to the experiment. These items were analyzed separately.

Analyses

A validation check to determine if the speech task was perceived as stressful was completed by comparing post task stress ratings with a no stress (one) rating. Demographic characteristics of hawks and doves were compared using t-tests and chi-square analyses. Next, correlations among the study variables were reviewed.

Paired samples t-tests were completed using log transformed values to compare normative changes in HRV (baseline to speech task) and cortisol (baseline to post-task) across all participants. Average changes between baseline and task were not statistically significant for cortisol (M=0.002, SD=0.12), t(71)=0.11 p=.92; nor for HRV (M=0.010, SD =0.84), t(68)=1.00, p=.32. However, separate paired samples t-tests for both hawks and for doves assessing changes from baseline to task did show significant differences in both variables. Differences between average baseline and speech cortisol values were statistically significant for hawks (M= 0.08, SD=0.07), t(12)=3.66, p=.003 and for doves (M=-0.09, SD =0.09, t(14)=-4.08, p=.001. Differences between average baseline and speech HRV values were also statistically significant for both hawks (M=0.83, SD=0.47, t(12)=6.33, $p < .001$, and for doves (M=-0.53, SD=0.33, t(14)=-6.21 $p < .001$.

Regression analyses were performed using continuous measures of HRV and cortisol reactivity. In the first step of the regressions sex of the participant was entered to account for cortisol variability known to be associated with gender (Kirschbaum, Kudielka, Gaab, Schommer, & Hellhammer, 1999). In the second step, HRV and cortisol reactivity were entered independently. Finally, the HRV reactivity by cortisol reactivity interaction variable was entered in a third step. Interactions with a p value $\leq .10$ were followed by simple slopes analyses (Aiken & West, 1991), and an estimated effect size calculation (Rudolph, Troop-Gordon, & Granger, 2010) described next.

There is no standard way to calculate a statistical test of the difference between two predicted values from the dependent variable (DV) value at low independent variable $(IV)_1$/low IV_2 to high IV_1/high IV_2. Therefore, to compare hawks (low cortisol/low HRV reactivities) and doves (high cortisol/high HRV reactivities) in regression analyses a SD difference value, that is, the difference between the predicted values for hawks and doves divided by the SD for the outcome variable, was calculated. This provides an approximation of an effect size of the difference between the two DV values, given in SDs of the DV (Rudolph, et al., 2010). Inclusion of effect size values for primary outcome variables is considered a best practice according to the APA Task Force on Statistical Inference (Wilkinson, 1999).

Also, to further test differences between hawks and doves, median splits were performed on HRV and cortisol reactivity. Those in the high HRV, high cortisol reactivity group were classified as doves (n = 15) and those in the low HRV and low cortisol reactivity group were classified as hawks (n = 13). Analyses of covariance (ANCOVAs) controlling for gender, and Chi-square analyses were used to compare hawks and doves on the variables of interest to this study.

RESULTS

Demographics

Demographic information for study participants characterized as physiological hawks or doves by means of cortisol reactivity and HRV reactivity median splits (*n*= 28) are reported in Table 1. Comparisons made using *t*-tests showed no significant differences between hawks and doves for age or body mass index (BMI; $p > .10$). Chi Square tests showed no significant differences in ethnicity/race or in gender between hawks and doves (Table 1).

Table 1 Hawks and Doves Demographics

Demographic	**Hawks (n = 13)**	**Doves (n = 15)**	***p*-value**
Age M(SD)	21.27(5.36)	19.92(2.23)	.43
BMI M(SD)	23.79(3.67)	23.04(3.72)	.60
Ethnic/Cultural Background	White/Caucasian 92% Asian 0% Black/African American 7.7%	White/Caucasian: 80% Asian: 20% Black or African American 0%	.14
Gender	7 Male 6 Female	10 Male 5 Female	.38

Note: Mean and (standard deviation) are presented unless otherwise noted.

Bivariate Correlations

Bivariate correlations among study variables are found in Table 2. Several items representing negative affect were significantly correlated with one another including SRF angry, afraid, and anxious, as well as the PANAS-X hostility scale. Females and individuals with relatively high BSRI femininity scores endorsed higher levels of post-task SRF anxious and afraid. Positive correlations were observed among cortisol reactivity, anger, and hostility; correlations among attention items were positive and significant. Also, there were significant positive correlations between attention items and hostility.

Table 2 Correlations for Primary Study Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13
	Participant Characteristics													
1	Gender													
2	Cortisol Reactivity	.38												
3	HRV Reactivity	.21	.14											
4	Hawk/Dove	.51	.00[a]	.00[a]										
	Affective Variables													
5	SRF Angry	.09	.04[b]	.47	.08									
6	SRF Afraid	.01[a]	.13	.15	.11	.00[a]								
7	SRF Anxious	.03[b]	.13	.06	.04[b]	.01[a]	.00[a]							
8	PANAS-X Hostility Scale	.84	.05[b]	.06	.29	.00[a]	.40	.39						
	Attention													
9	PANAS-X Attention Scale	.83	.19	.99	.13	.06	.98	.69	.05[b]					
10	FFMQ Observe	.92	.57	.95	.17	.14	.37	.73	.01[a]	.35				
11	FFMQ Act w/Awareness	.06	.01[b]	.57	.04[b]	.40	.91	.95	.01[b]	.05	.58			
	Gender Identity													
12	Bem Masculinity Scale	.11	.66	.88	.44	.10	.30	.29	.76	.00[a]	.54	.60		
13	Bem Femininity Scale	.15	.94	.20	.67	.72	.01[a]	.11	.77	.64	.79	.85	.07	

Note: [a]$p<.01$; [b]$p<.05$; gender codes – females= 1, males = 0

Table 2 Correlations for Primary Study Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13
	Participant Characteristics													
1	Gender													
2	Cortisol Reactivity	.38												
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5	SRF Angry	.09	.04[b]	.47	.08									
6	SRF Afraid	.01[a]	.13	.15	.11	.00[a]								
7	SRF Anxious	.03[b]	.13	.06	.04[b]	.01[a]	.00[a]							
8	PANAS-X Hostility Scale	.84	.05[b]	.06	.29	.00[a]	.40	.39						
	Attention													
9	PANAS-X Attention Scale	.83	.19	.99	.13	.06	.98	.69	.05[b]					
10	FFMQ Observe	.92	.57	.95	.17	.14	.37	.73	.01[a]	.35				
11	FFMQ Act w/Awareness	.06	.01[b]	.57	.04[b]	.40	.91	.95	.01[b]	.05	.58			
	Gender Identity													
12	Bem Masculinity Scale	.11	.66	.88	.44	.10	.30	.29	.76	.00[a]	.54	.60		
13	Bem Femininity Scale	.15	.94	.20	.67	.72	.01[a]	.11	.77	.64	.79	.85	.07	

Note: [a]$p<.01$; [b]$p<.05$; gender codes – females= 1, males = 0

Stress Task Validation

A one-sample t-test comparing the Stress Index with a value of one (no stress) revealed that the Stress Index ratings were significantly greater than one ($p <.001$) suggesting that participants were stressed by the task.

Psychological Responses to the Stress Task

The results of the following hypothesis tests are outlined in Table 5 Summary of Results for Hawks and Doves.

Anger. Hawks were predicted to respond to the stress task with more anger than doves. Hierarchical regressions showed that women tended to report more anger in response to the task (SRF Angry) (p = .07) and had greater cortisol reactivity (p = .08), though these results were statistically marginal. There was also a statistically significant HRV reactivity X cortisol reactivity interaction, β=-.30, ΔR2=0.09, p =.01 predicting SRF Anger. This interaction is plotted in Figure 1 SRF Angry.

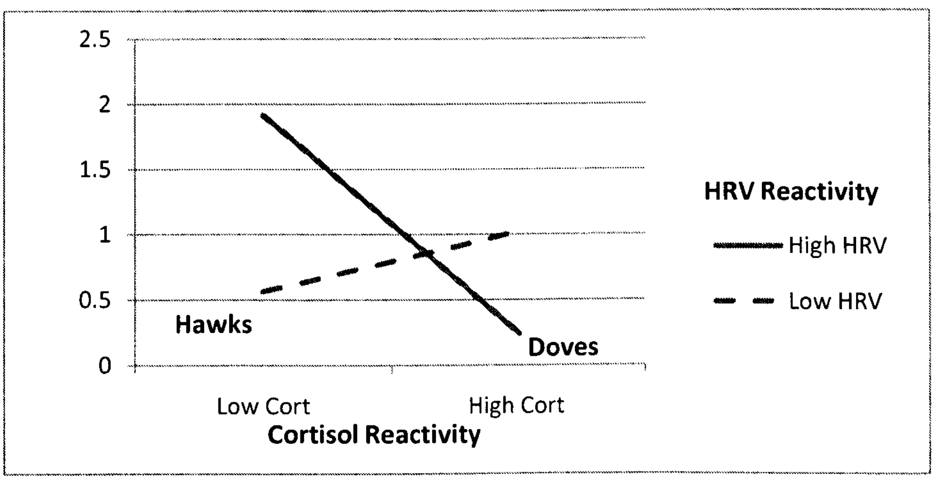

Figure 1. SRF Angry. This figure graphs the HRV reactivity X cortisol reactivity interaction predicting SRF Anger.

Visual inspection of the graph indicates that individuals with a dove physiological profile (+1SD HRV, +1SD cortisol) showed slightly lower ratings of anger than did individuals with a hawk physiological profile (-1SD HRV, -1SD cortisol). To assess an approximate effect size of the difference between predicted means for these individuals SD difference values were calculated. Participants with relatively high HRV reactivity and high cortisol reactivity (doves) had SRF Angry scores 0.19 *SD*s lower than participants with relatively low HRV reactivity and low cortisol reactivity (hawks), suggesting an essentially minimal effect of hawk vs. dove physiology. Results of an ANCOVA comparing hawk and dove categorical variables showed a marginally statistically significant difference, with hawks reporting more post-task anger than doves $F(1, 25) = 2.71, p = .11$, $\eta p2 = .098$. See Table 3 for Means and SD values.

Unexpectedly, individuals with relatively high HRV reactivity and low cortisol reactivity had the highest SRF Anger ratings (Figure 1). Simple slopes confirmed that individuals with relatively high (+1SD) HRV reactivity and low (-1SD) cortisol reactivity were angrier immediately post task than doves, $\beta = -.56$, $R2=0.18$ $p = .001$ and hawks, $\beta = 0.40$, $R2=0.18$ $p = .02$. No other statistically significant results were found.

The same regression and ANCOVA analyses run on the PANAS-X Angry variable revealed no significant associations ($p > .10$).

Hostility. Hawks were predicted to report more hostility than doves. Regression analyses showed marginally statistically significant main effects for both cortisol reactivity ($p < .07$) and HRV reactivity ($p < .09$) with more hostility being associated with less cortisol reactivity and greater HRV reactivity. A statistically significant HRV reactivity X cortisol reactivity interaction effect was seen for PANAS-X Hostility Scale scores, β= -.35, $\Delta R2=0.11$, $p = .004$. This interaction is plotted in Figure 2 PANAS-X Hostility Scale.

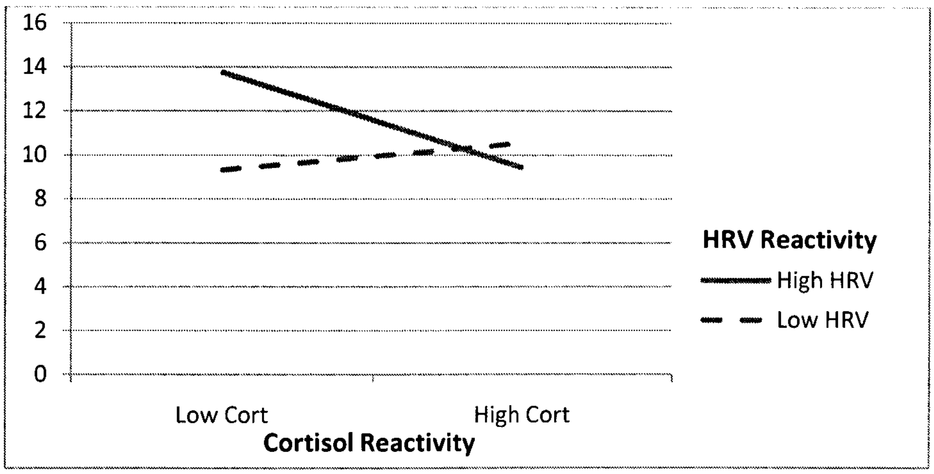

Figure 2. PANAS-X Hostility Scale. This figure graphs the HRV reactivity X cortisol reactivity interaction for PANAS-X Hostility Scale scores

In Figure 2 it appears that hawks and doves had similar PANAS-X hostility ratings and the SD difference estimate of effect size was 0.03 suggesting essentially no differences between the hostility of hawks and doves. Also, ANCOVA tests indicated no statistically significant differences in hawk and dove hostility (Table 3).

However, similar to the previous analysis it appears that low cortisol reactivity combined with high HRV reactivity was associated with the most hostility. Simple slopes confirmed that individuals with relatively high (+1SD) HRV reactivity and low (-1SD) cortisol reactivity reported feeling more hostility over the past several weeks than doves, β= -.56, R2=0.18 $p = .001$ and hawks, β= 0.57, R2=0.18 $p = .02$. No other statistically significant results were found.

Nervousness, fear, anxiety. Doves were predicted to report higher nervousness, fear, and anxiety than hawks. Regression findings showed no statistically significantly predictions of post-task SRF nervous, afraid, or anxious or PANAS-X afraid or nervous (all *ps* > .15). ANCOVAs comparing hawks and doves revealed that there was a statistically significant difference in SRF anxious, $F(1, 25) = 4.08, p = .05$, ηp2 = .140 and PANAS-X nervous was marginally statistically different, $F(1, 25) = 3.77, p = .06$, ηp2 = .131, though not in the predicted direction. Hawks tended to report more SRF anxiety and PANAS-X nervousness than doves (Table 3). There were no other statistically significant results here.

Rumination. Doves were predicted to report more rumination about the speech task than hawks. No statistically significant regression effects were found for the four items assessing rumination (all *ps* > .50). ANCOVA results for number of negative thoughts and proportion of negative thoughts, were not statistically significant (*ps* > .05). ANCOVA findings for ratings of "I thought about the task after the experimenter left the room," revealed a marginally significant hawk vs. dove difference, $F(1, 25) = 3.36, p = .08$, ηp2 = .119, and ratings of "I could not stop thinking about the task," were significantly different, $F(1, 25) = 6.62, p = .02$, ηp2 = .209. Means and SDs for both items indicated that hawks were ruminating about the task more than doves (Table 3).

Task appraisals.

Appraisal of threat, challenge, and difficulty. Doves were predicted to report appraising the stress task with higher levels of threat, challenge, and difficulty than hawks. Results of the hierarchical regressions showed that gender ($p = .02$) accounted for a significant amount of variance in appraisal of the task as threatening with females giving higher ratings. Also there was a marginally statistically significant HRV reactivity by cortisol reactivity interaction associated with perception of threat, β= -.20, ΔR2= 0.04, p = .10. Visual inspection of predicted means for perception of threat (Figure 3 Perception of Threat) indicates higher ratings of threat for doves relative to hawks. Computation of the SD difference score showed a small estimated effect size of .18 SDs. ANCOVA results were not statistically significant for any of the three items ($p > .15$).

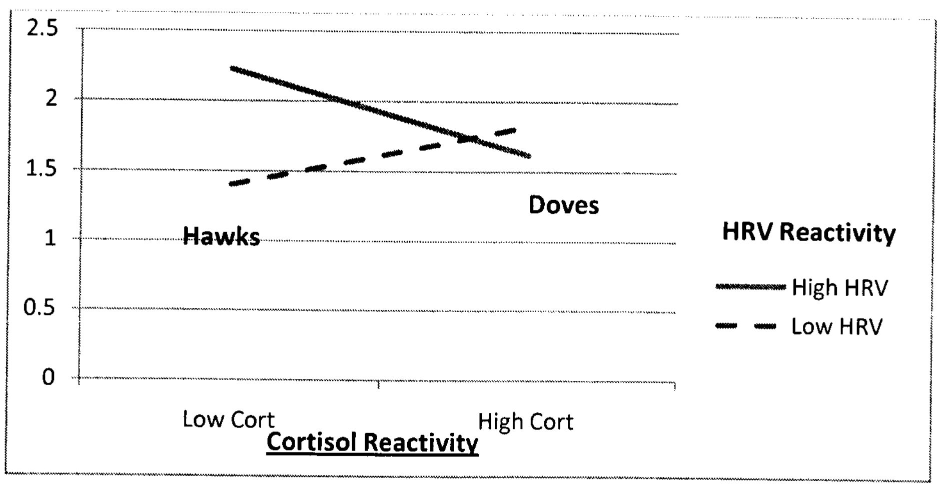

Figure 3. Perception of Threat. This figure graphs the HRV reactivity X cortisol reactivity interaction for Perception of Threat scores.

Social evaluative concern. Doves were predicted to report higher levels of social evaluative concern than hawks. Regressions showed a marginally statistically significant cortisol by HRV reactivity interaction predicting the degree to which participants thought the audience was accepting of them, β=-.36, ΔR2=0.11, p = .07 (Figure 4 Belief that Audience was Accepting). SD difference calculations for estimated hawk vs. dove effects size was .81 SDs with doves feeling more accepted by the audience than hawks. Regression results for concern with the experimenter evaluating their performance and the degree to which the audience made them more nervous than doing the task alone were statistically nonsignificant ($ps > .20$).

ANCOVA results for feeling that the audience was accepting were statistically significant, $F(1, 14) = 4.84, p = .05$, ηp2 = .10 with doves feeling more acceptance than hawks (Table 3). ANCOVA results for the remaining two items were not statistically significant ($ps > .40$).

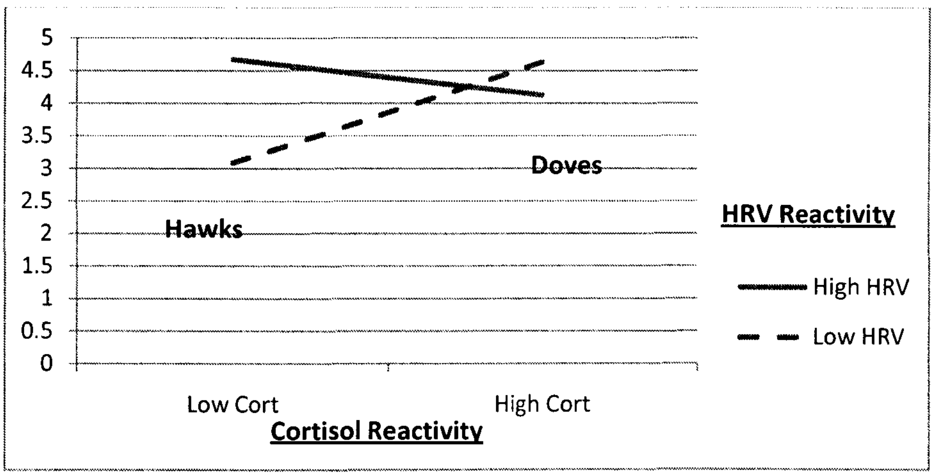

Figure 4. Belief that Audience was Accepting. This figure graphs the HRV reactivity X cortisol reactivity interaction for Audience was Accepting scores.

Attention Outcomes

Doves were predicted to report more attentiveness than hawks. Regression analyses showed marginally statistically significant associations for the HRV reactivity by cortisol reactivity interaction and PANAS-X Attention Scale values, β= -.23, ΔR2=0.05, $p = .08$. Visual inspection of Figure 5 indicates that doves gave moderately higher ratings of attention than did hawks. Examining the SD difference, doves had PANAS-X Attention Scale scores 0.36 *SDs* higher than hawks.

Individuals with relatively low HRV reactivity and high cortisol reactivity had the highest PANAS-X Attentiveness Scale ratings (Figure 5 PANAS-X Attention Scale). Simple slopes confirmed that the individuals with relatively low (- 1SD) HRV reactivity and high (+ 1SD) cortisol reactivity reported more attentiveness over the past few weeks than doves, $\beta = -1.19$, $R2=0.18$, $p = .04$. No other statistically significant regression results were found.

Statistically significant differences were seen in ANCOVA results for the Act with Awareness factor of the FFMQ, $F(1, 23) = 4.89$, $p = .04$, $\eta p2 = .125$, and for the PANAS-X concentrating item, $F(1, 25) = 5.14$, $p = .03$, $\eta p2 = .171$. Doves reported higher levels of attention and concentration than hawks (Table 3). ANCOVA results for the PANAS-X Attention Scale and the Observe factor of the FFMQ were not statistically significant (*ps* > .10).

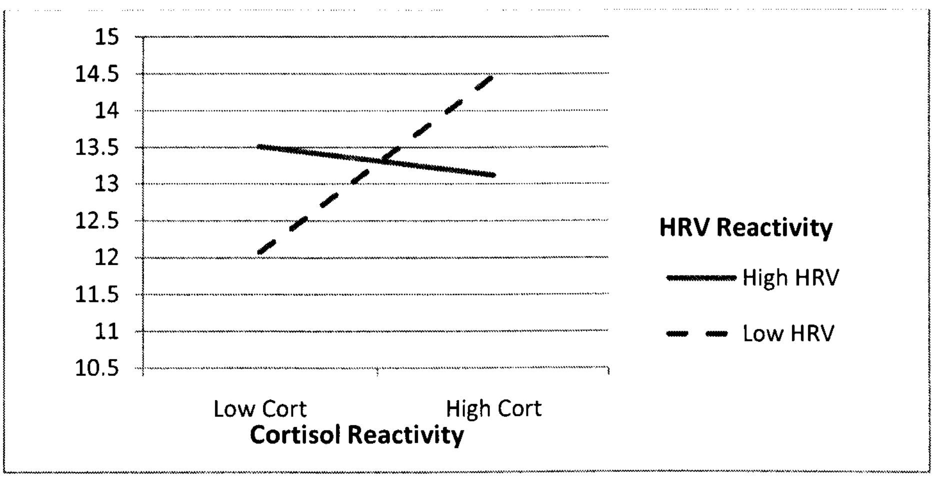

Figure 5. PANAS-X Attention Scale. This figure graphs the HRV reactivity X cortisol reactivity interaction for PANAS-X Attention Scale scores.

Somatic Variables

Because doves were hypothesized to be more attentive than hawks, doves were predicted to notice their somatic reactions to the stress task and thus to more accurately report those reactions than hawks. An outcome variable representing accuracy of self-reported pulse tempo was created by calculating the difference between actual pulse tempo and self-reported pulse tempo (standardized speech task average heart rate minus standardized self-reported pulse tempo). Regression and ANCOVA results indicated no statistically significant hawk vs. dove differences in the accuracy of reporting somatic reactions to the stress task.

Health Behavior Variables

Hawks were predicted to report more impulsivity-related health behaviors. Doves were predicted to report more withdrawal-related health behaviors. Regression results were not predictive of alcohol consumption, use of cigarettes, frequency of aerobic or anaerobic exercise over the previous week, nor restriction of food intake and events of binge eating (*p*s > .15).

ANCOVA results for average daily alcohol consumption were marginally statistically significant with Hawks reporting higher daily alcohol consumption over the past week compared with doves, $F(1, 25) = 3.36$, $p = .08$, $\eta p2 = .12$ (Table 3). No other statistically significant results were found (*p*s > .15)

Sex and Gender Identity

Male participants and those who endorsed predominantly masculine gender identities were predicted to be more likely to demonstrate a hawk physiological profile. Female

Table 3 ANCOVA Means and SDs for Hawks and Doves

Dependent Variable	Hawks (n= 10-13)	Doves (n= 5-15)	*p* values
Threat/Challenge/Difficulty Appraisal			
Felt threatened by speech task	1.92(0.95)	1.87(1.12)	*p* = .91
Felt challenged by speech task	5.85(0.55)	5.27(1.49)	*p* = .22
Felt the speech task was difficult	5.54(0.52)	4.73(1.91)	*p* = .13
Social Evaluative Concerns			
Concerned with Experimenter Eval	2.92(1.19)	3.20(1.32)	*p* = .42
Felt accepted by audience	3.30(1.34)	5.00(1.41)	*p* = .05
Audience made them nervous	3.25(1.14)	3.07(1.69)	*p* = .81
Rumination			
Thought about task after (z-scores)	.44(.75)	-.03(.70)	*p* = .08
Couldn't stop thinking about task (z-scores)	.57(.69)	-.23(.90)	*p* = .02
Negative Affect			
Self-Reported Feeling Angry	1.54(1.39)	0.60(1.35)	*p* =.11
Self-Reported Feeling Nervous	5.62(1.50)	4.27(2.46)	*p* =.11
Self-Reported Feeling Afraid	3.38(1.80)	2.20(1.93)	*p* =.15
Self-Reported Feeling Anxious	5.15(1.82)	3.67(1.88)	*p* =.05
PANAS-X Angry	1.62(.77)	1.80(0.94)	*p* =.76
PANAS-X Nervous	2.77(1.09)	2.00(0.93)	*p* =.06
PANAS-X Afraid	1.69(0.75)	1.40(0.63)	*p* =.28
PANAS-X Hostility Scale	10.69(3.59)	9.40(2.75)	*p* =.22
Attention			
PANAS Attentive	2.92(1.12)	3.47(0.64)	*p* =.14
PANAS Concentrating	2.46(1.20)	3.27(0.70)	*p* =.03
PANAS Attentiveness Scale	11.31(3.80)	13.13(2.33)	*p* =.16
FFMQ Act with Awareness	26.17(5.97)	30.64(4.31)	*p* =.04
FFMQ Observe	25.66(6.05)	22.56(6.26)	*p* =.16
Health Behaviors			
Daily average # alcoholic drinks this week	4.08(4.13)	1.73(2.25)	*p* =.08

Note: ANCOVA Mean (standard deviation) and *p* values presented. Not every participant responded to all items/questionnaires so ns vary across study variables.

participants and those who endorsed predominantly feminine gender identities were predicted to be more likely to demonstrate a dove physiological profile. A Chi-square test showed no statistically significant differences in the sex of hawks vs. doves.

Regression results with physiological profile predicting the BSRI Masculinity Scale (MS) and the Femininity Scale (FS) were not significant ($p > .60$). ANCOVA results showed that hawks and doves did not differ on the MS or the FS ($p > .50$). Inspection of the mean scores for each grouping (male, female, hawk, dove) revealed that females tended to endorse traits on both the MS and FS at roughly equivalent levels whereas mean scores for males showed lower endorsements on the FS. The same patterns are repeated in hawks' and doves' mean scores with hawks endorsing roughly equivalent MS and FS traits (as did females) and doves demonstrating a 10 point spread between average endorsements of MS and FS traits (as did males; (Table 4).

Table 4 Bem Gender Identity Mean Scores by Hawk Dove Category and by Sex

BSRI DV's	**Hawks M (SD) N=13**	**Doves M (SD) N = 15**	**Males M (SD) N=40**	**Females M (SD) N = 30**
Masculinity Score	92.31(16.01)	97.20(17.13)	98.54(14.45)	92.93(14.64)
Femininity Score	91.15(16.94)	88.73(13.14)	88.98(12.71)	93.23(11.94)
Sex/Gender	7M 6F	10M 5F	7H 10D	6H 5D

Note: Mean and (standard deviation) are presented. M-male, F-female, H-hawk, D-dove.

DISCUSSION

The results of this preliminary study of biobehavioral hawk and dove profiles in humans had mixed results (Table 5 Summary of Results for hawks and doves). Consistent with the hypotheses, hawks reported somewhat more anger in response to the stress task than doves, and may have been slightly more likely to report higher alcohol consumption over the prior week. Also as predicted, doves reported higher levels of attentiveness than hawks.

Contrary to predictions, doves reported lower levels of anxiety than hawks. Doves appraised the speech task as less threatening, challenging, and difficult than did hawks. Doves were less nervous regarding the audience, and more positive than hawks when asked how much the audience liked and accepted them. Doves ruminated less than hawks and reported lower levels of nervousness and fear than did hawks on both task-related and trait measures.

Considering all of these results may lead to a characterization of physiological doves being individuals who are more comfortable than hawks in social contexts. While doves' concern with experimenter evaluation and nervousness about the audience was equivalent to hawks', doves gave higher ratings of being accepted by the audience. Additionally, doves consistently rated the task more positively than did hawks. Taken together, such findings may signal a more positive sense of social engagement. This may be construed as support for polyvagal theory in which increased high frequency HRV is expected when an individual feels safe (Porges, 2007; Porges, Doussard-Roosevelt, & Maiti, 1994).

On the other hand, physiological hawks appeared to experience more distress than doves both in terms of their immediate response to the stress task (SRF Anger) and in regards

Table 5 Summary of Results for Hawks and Doves

Outcome Measure	**Hypothesis**	**Results**	**(ANCOVA *p*)**
SRF Anger	Hawks > Doves	Hawks ≥ Doves	.11
Hostility Scale	Hawks > Doves	Hawks = Doves	.22
Attention	Doves > Hawks		
Act w/Awareness		Doves > Hawks	.04
Concentration		Doves > Hawks	.03
Emotional Responses	Doves > Hawks		
Nervous		Doves = Hawks	.11
Anxious		Doves < Hawks	.05
Afraid		Doves = Hawks	.15
Rumination			
Ruminated After	Doves > Hawks	Doves < Hawks	.08
Couldn't Stop	Doves > Hawks	Doves < Hawks	.02
Task Appraisals	Doves > Hawks		
Threat		Doves = Hawks	.91
Challenge		Doves = Hawks	.22
Difficulty		Doves = Hawks	.13
Social evaluative concern	Doves > Hawks		
Experimenter Evaluation		Doves = Hawks	.42
More nervous w/audience		Doves = Hawks	.81
Felt accepted by audience		Doves > Hawks	.05
Accurate somatic report	Doves > Hawks	Doves = Hawks	.37
Impulse health behavior	Hawks > Doves	Hawks ≥ Doves	.08
Withdraw health behavior	Doves > Hawks	Doves = Hawks	.43
	Gender and Gender Identity		
Males	Hawks > Doves	Hawks = Doves	Chi Square ns
masculine scale	Hawks > Doves	Hawks = Doves	.51
Females	Doves > Hawks	Doves = Hawks	Chi Square ns
feminine scale	Doves > Hawks	Doves = Hawks	.77

Note: Results reported are hawk/dove median split ANCOVA *p* values.

to affect reportedly experienced over the past several weeks (PANAS-X Hostility). However, hawk and dove physiological profiles were not associated with some of the worst outcomes. That is, participants with "mixed" physiological profiles reported the highest ratings on several study variables (SRF Angry, PANAS-X Hostility Scale, Perception of

Threat). Individuals with relatively high HRV reactivity and relatively low cortisol reactivity endorsed the highest levels of anger, hostility, and perception of threat. If cortisol reactivity is an indicator of engagement in a social task (Dickerson & Kemeny, 2003) then it is possible that a stress response that involves high HRV and low cortisol reactivities is associated with reactance in the form of task disengagement or low effort accompanied by an aggressive psychological response.

Individuals with relatively low HRV reactivity and relatively high cortisol reactivity had the second highest ratings of SRF Angry, PANAS-X Hostility, and Perception of Threat. These individuals also endorsed higher levels of attention than any other participants. It is possible that high cortisol and low parasympathetic activation (possibly deactivation) may reflect attempts to actively cope with the stressor but while experiencing negative, perhaps in this case, motivating emotions. This biobehavioral profile is consistent with the traditional fight or flee stress response. These mixed physiology associations suggest that hawk-dove biobehavioral profiles may be the more adaptive profiles in that relatively less distress is reported by individuals with hawk or dove profiles compared to individuals with mixed physiological profiles. This would explain why hawk and dove profiles persist and are identifiable in non-human animals and perhaps humans.

Task appraisals were consistently different for those with hawk and dove profiles and thus may be an important indicator of biobehavioral profiles in humans (Lazarus & Folkman, 1984; Quigley, Feldman-Barrett, & Weinstein, 2002). Doves reported feeling more liked by the audience and found the speech task less challenging and difficult than hawks. Perhaps individuals characterized as doves had more easy-going personalities and thus demonstrated higher HRV/PSNS reactivity because they found the speech task to be less alarming than did their more high-strung, hawk peers. This is consistent with the idea that doves' higher cortisol is indicative of active social engagement and social concern (Broom, 2001; Dickerson, et al., 2004; Mason, 1971; Veissier & Boissy, 2007).

The use of the high-frequency band of HRV (0.12-0.40Hz) was adopted because that is the frequency range most clearly identified as reflecting PSNS status. This frequency band is also known as RSA (respiratory sinus arrhythmia) due to an overlap of frequencies with those generated by respiration rate. Because speaking affects respiration rate and some participants had trouble speaking for the entire 5 minute speech while others spoke for the entire session, this variability in performance might have led to significant variability in how much respiration rate contributed to the HRV measurement (Beda, Jandre, Phillips, Giannella-Neto, & Simpson, 2007; Song & Lehrer, 2003). Such variability in respiration influence could have obscured hawk-dove differences.

Future research could include a stationary and non-oral stressor along with explorations of patterns observed in basal HRV status before and after the stressor task. Also, it may also be fruitful to explore other HRV bandwidths such as a mid-frequency range. Clinically-oriented research suggests that a mid-frequency range of HRV may reflect more of the health protective factors associated with PSNS activation (Hassett, et al., 2007; Lehrer, Sasaki, & Saito, 1999; Lehrer, et al., 2007; Sowder, Gevirtz, Shapiro, & Ebert, 2010). Investigations of this HRV frequency band may be particularly warranted in longitudinal research assessing possible health implications of hawk and dove biobehavioral profiles.

One imporant limitation of the current study includes the small number of participants. Thus we view our findings with some caution. On the other hand, considering that we had such a small N, the evidence we did find for hawk and dove profiles may indicate significant promise for future studies with a larger sample aimed at identifying divergent biobehavioral profiles. An additional limitation concerns the fact that this study includes only one experimental instance of a stress response. The responses observed in this context may be specific to the type of stressor (Linden, Gerin, & Davidson, 2003; Schwartz, et al., 2003) thus, a biobehavioral stress response profile cannot be confidently determined. However, some research does suggest individual difference reliability for both of the physiological measures used in this study (Burleson, et al., 2003).

The ethnicity/race demographics of the current sample were largely homogeneous with nearly 90% of participants identified as Caucasian. While no statistically significant differences were seen based on ethnicity/race on any of the study variables, social and behavioral norms do vary by cultural background. Attention to possible implications for cultural and even geographic regional influences may be warranted in participant samples that include sufficient diversity in ethnic/racial or regional demographics.

Future investigations of hawk and dove biobehavioral stress response profiles may be benefited by including additional individual difference measures in order to more precisely characterize the psychological aspects of those profiles. Analyses that integrate the biologically based behavior motivation theory articulated by Gray (1987), a theory which includes both a behavioral approach system (BAS) and a behavioral avoidance/inhibition system (BIS), may be particularly fruitful in developing insight into potential psychopathologies associated with hawk, dove, or "mixed" biobehavioral profiles.

The current study sought to test a biobehavioral theory of stress responding that includes both fight/flight, *and* freeze behaviors with concomitant physiological activation patterns. Conventional stress theory includes only fight/flight behaviors with concomitant SNS activation; freeze behaviors are anticipated only when a fight/flee response is deemed unachievable. The hawks and doves theory of stress responding originally proposed by Smith (1982) suggests that in addition to the instinctive action-oriented responses to fight or flee with SNS activation, there is also an innate immobilization stress response in which freeze behaviors are accompanied by PSNS activation. Korte and colleagues (2005) further propose that these two divergent biobehavioral stress response profiles are more evolutionarily adaptive than a singular stress response pattern could be and thus would be observed in modern humans.

Evidence available in this study does provide tentative preliminary support for the predicted existence of distinguishable hawk and dove biobehavioral stress response patterns in humans. Although the estimated effect sizes of the differences found for hawks and doves were generally small, the cumulative effects of small physiological differences may be significant (Linde & Sexton, 2010).

Moreover, patterns of self-reported affect indicated that hawk and dove physiological profiles were associated with less perceived stress than was reported by individuals with "mixed" physiological profiles. Further research may be important because the confirmation of two inherent stress response profiles would herald a significant paradigm shift in stress and health research. Furthermore, if hawk and dove biobehavioral profiles were determined to be more adaptive than "mixed" profiles, such research would contribute to the emerging interdisciplinary field of social neuroscience which seeks to integrate the complex relationships and influences among biological and social/behavioral systems (Cacioppo, Berntson, & Decety, 2010).

The union of autonomic and neuroendocrine patterns of stress responding, paired with overt behavioral and affective response tendencies, may prove superior to the use of isolated behavioral, autonomic, or neuroendocrine responses in predicting health-related risk factors and disease outcomes. Korte and colleagues (2005) proposed that chronic activation of a hawk or dove stress response is differentially associated with poor health outcomes. To our knowledge, no theories have been forwarded thus far regarding the health outcomes of "mixed" PSNS/HRV stress responses, which were found to be associated with many of the most adverse factors in this study. Biobehavioral profiling may be an important next step in understanding the pathogenesis of chronic disease. Improved knowledge of disease pathways may lead to more efficient and effective health interventions – a worthy goal indeed.

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APPENDIX A. DAY BEFORE PHONE CALL SCRIPT

"Hi. Is ____________ there? Hi __________________. My name is ___________ and I am a graduate student in Psychology at NDSU. I'm just calling to remind you of your appointment tomorrow at __________________. The experiment will be located in Room 211 at the NDSU Graduate Center. Do you know where that is located?"

If not----"The address is 1201 12th Ave N. It is the tan building behind Loaf n Jug and the Bison Turf."

If **female** participant—"Just to let you know, we will be putting some electrodes on you tomorrow, so it would probably be more comfortable for you if you wore a sports bra and a button-up or loose fitting shirt."

If **male** participant—"Just to let you know, we will be putting some electrodes on you tomorrow, so it would probably be more comfortable for you if you wore a button-up or loose fitting shirt."

"Do you have any questions?" (IF SO, TRY TO ANSWER W/O GIVING EXPERIMENT AWAY).

If not—"Alright. I will see you tomorrow at _______________ at the Graduate Center. Have a good evening."

APPENDIX B. CONSENT FORM

CONSENT TO PARTICIPATE IN RESEARCH

Tell Me Your Opinion

Research Study
You are invited to participate in research about the factors which may influence blood pressure, heart rate, cortisol, and additional cardiovascular measures that is being conducted by Dr. Clayton Hilmert, Assistant Professor of Psychology at NDSU and his colleagues.

Basis of Selection
You have been selected to participate because you are enrolled in a Psychology class at North Dakota State University. You must be at least 18 years of age to participate in this study.

Purpose of Study
The purpose of this study is to determine how different tasks and circumstances are related to physiological responses. At the end of the study, you will be fully informed about the purpose and rationale behind this investigation.

Explanation of Procedures
In this experiment, you will have your heart rate, blood pressure, and cortisol levels assessed using a blood pressure cuff, six electrodes, and a dental roll of cotton while you perform a challenging task. You will also be asked to fill out questionnaires to assess how you felt about the experiment.

Potential Risks, Discomforts, and Benefits
Participation in this experiment may make you more aware of how your body's physiological systems respond to different tasks. You may experience some fatigue and nervousness from having to complete the requested challenging task. You may find the equipment that automatically collects blood pressure and pulse data to be somewhat distracting. Participation in this study may potentially benefit you academically as it will give you a chance to learn more about how research is conducted.

Compensation for Participation
You will be given 1 extra credit point for every 15 minutes that you are engaged in this study. You should receive 4-5 extra credit points for participating in this research session due to this session lasting approximately one hour to one hours and 15 minutes. Participation is just one way to gain extra credit in your courses. See your course syllabus or instructor for

descriptions of other ways of gaining extra credit. If you choose to withdraw from this study, you will be awarded extra credit points for how many minutes you were in the study.

Assurance of Confidentiality

Videotapes of this session may be used by coders to make ratings of aspects of your non-verbal behavior or of personal characteristics that you provide information about during the study. You have the right to review, edit, or erase the research tapes of your participation in whole or in part.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law.

Confidentiality will be maintained by means of storage in a locked file cabinet in the Principal Investigator's office. In addition, there will be no identifiers, other than a code number, on any of the materials.

Statement of Injury or Special Costs: None.

Voluntary Participation and Withdrawal From the Study

Your participation is voluntary. Your decision whether or not to participate will not affect your grade or present or future relationship with NDSU and any other benefits to which you are otherwise entitled. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time.

Offer to Answer Questions

You should feel free to ask questions now or at any time during the study. If you have questions about this study, you can contact Dr. Clayton Hilmert in the Psychology Department in 115 Minard (phone: 231-5148). If you have questions about the rights of human research participants, or wish to report a research-related injury, contact the NDSU IRB Office, (701) 231-8908.

Consent Statement

By signing this form, you are stating that you have read and understand this form and the research project, and are freely agreeing to be a part of this study. If there are things you do not understand about the study, do not sign this form. You will be given a copy of this consent form to keep.

Printed Name of Participant | Signature of Participant | Date

Class/Section | Instructor

Printed Name of Investigator | Signature of Investigator | Date

ID#

APPENDIX C. SPEECH TOPIC DESCRIPTION

Speech Topic: Euthanasia

- Euthanasia (also called "mercy killing") is the practice of intentionally ending the life of another person at the request of the person or his/her family.

- Euthanasia would most likely be requested when an individual has a terminal and often painful medical condition.

- Euthanasia can be carried out by lethal injection, drug overdose, or the withdrawal of life support.

This is a controversial issue because some people think it should be allowed and others think it is wrong. *In your 5-minute speech you need to state what you think about euthanasia and explain why you feel that way. It's important that you express yourself clearly. Exactly what you say and how you say it is completely up to you. You will have five minutes to think about what you want to say in your speech. Then you will give a five-minute speech. It is very important that you speak for the entire five minutes*

APPENDIX D. CONFEDERATE NO-SUPPORT INSTRUCTIONS

DURING:

- 0-:30
    - Neutral expression
    - Lean back in chair, but sit up straight
- :30-1:00
    - Continued expression
- 1:00-1:30
    - Look over their head or off to the side of their head
    - Shift SLIGHTLY in chair
- 1:30-2:00
    - Look over their head or off to the side of their head
    - SUBTLY look at your watch (or wrist if you don't have a watch)
- 2:00-2:30
    - Look over their head or off to the side of their head
- 2:30-3:00
    - SUBTLY look around room
    - Then look over their head or off to the side of their head
- 3:00-3:30
    - SLIGHTLY Shift in seat
    - Small Sigh
- 3:30-4:00
    - Look over their head or off to the side of their head
    - Look bored
- 4:00-4:30
    - SUBTLY look at your watch
    - Look over their head or off to the side of their head
- 4:30-5:00
    - Look bored

AFTER:

- 0-5:00
    - Neutral expression
    - Work on questionnaires
    - Don't look up or look at participant
    - Every once in awhile, look around room and look at watch
    - Look bored & disinterested

APPENDIX E. POST-TASK MEASURES

Post-Task Questionnaire 1. Please answer all of the following questions as honestly as you can using the scale below. Circle the number which best indicates how you feel:

Not at all **Very Much**

1 2 3 4 5

	Not at all				**Very Much**
I was nervous during the task	1	2	3	4	5
The task was pleasant	1	2	3	4	5
The task was stressful	1	2	3	4	5
During my task, I was concerned with how the experimenter would evaluate my performance.	1	2	3	4	5
The presence of the camera during my task made me more nervous than if it had not been there.	1	2	3	4	5

Performance Attribution Questionnaire. Presented below are a number of questions regarding your opinion of the speech task you participated in. Please respond to each question using the scale provided.

Overall, on the speech task I thought I performed:

1	2	3	4	5	6	7
Extremely poor						Extremely well

My performance on the speech task was due to MY ABILITY

1	2	3	4	5	6	7
Not at all			Somewhat			Very

true			true			true

My performance on the speech task was due to MY EFFORT

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

My performance on the speech task was due to DIFFICULTY OF THE TASK

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

My performance on the speech task was due to LUCK

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

Overall, I thought the speech task was THREATENING

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

Overall, I thought the speech task was CHALLENGING

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

Overall, I thought the speech task was DIFFICULT

1	2	3	4	5	6	7
Not at all true			Somewhat true			Very true

Self-Report of Feelings (SRF). Please circle the number on the scale below that best describes the greatest amount of emotion you felt during the previous tasks. On this scale, 0 means that you did not feel even the slightest bit of emotion and 8 means that you felt an emotion more strongly than you have ever felt in your life.

	0	1	2	3	4	5	6	7	8
	did not feel even the slightest bit								most you have ever felt in your life
Afraid	0	1	2	3	4	5	6	7	8

Angry	0	1	2	3	4	5	6	7	8
Anxious	0	1	2	3	4	5	6	7	8
Contemptuous	0	1	2	3	4	5	6	7	8
Disgusted	0	1	2	3	4	5	6	7	8
Downhearted	0	1	2	3	4	5	6	7	8
Engaged	0	1	2	3	4	5	6	7	8
Fearful	0	1	2	3	4	5	6	7	8
Frustrated	0	1	2	3	4	5	6	7	8
Gleeful	0	1	2	3	4	5	6	7	8
Happy	0	1	2	3	4	5	6	7	8
Interested	0	1	2	3	4	5	6	7	8
Irritated	0	1	2	3	4	5	6	7	8
Nervous	0	1	2	3	4	5	6	7	8
Repulsed	0	1	2	3	4	5	6	7	8
Sad	0	1	2	3	4	5	6	7	8

Somatic Symptoms Report (SSR). Please describe how you are feeling at this moment.

1 2 3 4 5 6 7 8 9
No sweaty hands Sweaty hands

1 2 3 4 5 6 7 8 9
No pounding heart Pounding heart

1 2 3 4 5 6 7 8 9
No tense stomach Tense stomach

1 2 3 4 5 6 7 8 9
No heavy breathing Heavy breathing

1	2	3	4	5	6	7	8	9
Slow pulse								Fast pulse

1	2	3	4	5	6	7	8	9
Cold hands								Warm hands

1	2	3	4	5	6	7	8	9
Muscles relaxed								Muscles tense

Assessment of Audience Questionnaire. Your opinions regarding the audience:

1. Did you like the audience?

1	2	3	4	5	6	7
Not at all			Somewhat			Very much

2. Do you think the audience liked you?

1	2	3	4	5	6	7
Not at all			Somewhat			Very much

3. Do you think the audience accepted you?

1	2	3	4	5	6	7
Not at all			Somewhat			Very much

4. How do you think the audience would rate your performance overall?

1	2	3	4	5	6	7
Very poor			Average			Very excellent

APPENDIX F. POST-RECOVERY MEASURES

PANAS-X. This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you have felt this way during the past few weeks. Use the following scale to record your answers:

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

_____cheerful	_____sad	_____active	_____angry at self
_____disgusted	_____calm	_____guilty	_____enthusiastic
_____attentive	_____afraid	_____joyful	_____downhearted
_____bashful	_____tired	_____nervous	_____sheepish
_____sluggish	_____amazed	_____lonely	_____distressed
_____daring	_____shaky	_____sleepy	_____blameworthy
_____surprised	_____happy	_____excited	_____determined
_____strong	_____timid	_____hostile	_____frightened
_____scornful	_____alone	_____proud	_____astonished
_____relaxed	_____alert	_____jittery	_____interested
_____irritable	_____upset	_____lively	_____loathing
_____delighted	_____angry	_____ashamed	_____confident

_____inspired	_____bold	_____at ease	_____energetic
_____fearless	_____blue	_____scared	_____concentrating
_____disgusted with self	_____shy	_____drowsy	_____dissatisfied with self

Rumination-1. What **specific** thoughts went through your mind after the audience left the room? Please note, we are not asking you to tell how you felt here, we are asking what you were thinking about.

Rumination open-ended items coding instructions:

1. Count the number of thoughts for each participant's response.
2. Determine whether each separate thought is speech-related or unrelated to the speech.
3. If the thought is related to the speech, code it as positive, negative, or neutral.
    a. Positive: any thought that suggests a positive affect or experience (ex. easy)
    b. Negative: any thought that suggests a negative affect or thought (ex. stressed, sad, "that sucked")
    c. Neutral: any thought that is not easily distinguished as positive or negative in nature; also any thought saying "I'm glad that's over"; a thought that is speech related but does not have any affect or emotion in it

Rumination-2.

Rate your overall performance on the task

1	2	3	4	5	6	7
horrible			average			excellent

2. I thought about the task after the experimenter left the room

1	2	3	4	5	6	7
a little			somewhat			a lot

3. I could not stop thinking about the task

1	2	3	4	5	6	7
disagree		somewhat disagree		somewhat agree		agree

4. It felt good to think about the task after it was over

1	2	3	4	5	6	7
disagree		somewhat disagree		somewhat agree		agree

5. I could have done better on the task

1	2	3	4	5	6	7
disagree		somewhat disagree		somewhat agree		agree

Bem Sex Role Inventory (BSRI). Answer questions as the term best fits you according to the following scale:

1 = Never or almost never true
2 = Usually not true
3 = Sometimes but infrequently true
4 = Occasionally true
5 = Often true
6 = Usually true
7 = Always or almost always true

Questions

___1. Acts as a Leader ___31. Has leadership abilities

___2. Adaptable ___32. Moody

___3. Affectionate

___4. Conceited

___5. Aggressive

___6. Cheerful

___7. Ambitious

___8. Conscientious

___9. Childlike

___10. Conventional

___11. Analytical

___12. Compassionate

___13. Assertive

___14. Friendly

___15. Does not use harsh language

___16. Happy

___17. Athletic

___18. Eager to soothe hurt feelings

___19. Competitive

___20. Helpful

___21. Feminine

___22. Inefficient

___23. Defends own beliefs

___24. Flatterable

___33. Loves children

___34. Reliable

___35. Independent

___36. Loyal

___37. Individualistic

___38. Secretive

___39. Sensitive to the needs of others

___40. Sincere

___41. Makes decisions easily

___42. Shy

___43. Masculine

___44. Solemn

___45. Soft-spoken

___46. Tactful

___47. Self-reliant

___48. Sympathetic

___49. Self-sufficient

___50. Theatrical

___51. Tender

___52. Truthful

___53. Strong personality

___54. Understanding

___25. Dominant

___26. Jealous

___27. Gentle

___28. Likable

___29. Forceful

___30. Gullible

___55. Willing to take a stand

___56. Unpredictable

___57. Warm

___58. Unsystematic

___59. Willing to take risks

___60. Yielding

Five Factor Mindfulness Questionnaire (FFMQ). Instruction: Please **circle the answer** that best describes the extent to which the statement is true for you.

		Never or very rarely true	Some-times true	Un-sure	Usually true	Almost always or always true
1	I perceive my feelings and emotions without having to react to them.	1	2	3	4	5
2	I'm good at finding the words to describe my feelings.	1	2	3	4	5
3	When I do things, my mind wanders off and I'm easily distracted.	1	2	3	4	5
4	I criticize myself for having irrational or inappropriate emotions.	1	2	3	4	5
5	I can easily put my beliefs, opinions, and expectations into words.	1	2	3	4	5

		Never or very rarely true	Some-times true	Un-sure	Usually true	Almost always or always true
6	Usually when I have distressing thought or images, I judge myself as good or bad, depending on what the thought/image is about.	1	2	3	4	5
7	I watch my feelings without getting lost in them.	1	2	3	4	5
8	I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5
9	When I'm walking, I deliberately notice the sensations of my body moving.	1	2	3	4	5
10	I can usually describe how I feel at the moment in considerable	1	2	3	4	5

		Never or very rarely true	Some-times true	Un-sure	Usually true	Almost always or always true
	detail.					
11	In difficult situations, I can pause without immediately reacting.	1	2	3	4	5
12	I tell myself that I shouldn't be feeling the way I'm feeling.	1	2	3	4	5
13	When I take a shower or a bath, I stay alert to the sensations of water on my body.	1	2	3	4	5
14	It's hard for me to find the words to describe what I'm thinking.	1	2	3	4	5
15	It seems I am "running on automatic" without much awareness of what I'm doing.	1	2	3	4	5
16	I believe some of my thoughts are abnormal or bad and I shouldn't think that way.	1	2	3	4	5

		Never or very rarely true	Some-times true	Un-sure	Usually true	Almost always or always true
17	I notice how foods and drinks affect my thoughts, bodily sensations, and emotions.	1	2	3	4	5
18	I have trouble thinking of the right words to express how I feel about things.	1	2	3	4	5
19	I rush through activities without being really attentive to them.	1	2	3	4	5
20	I make judgments about whether my thoughts are good or bad.	1	2	3	4	5
21	I pay attention to sensations, such as the wind in my hair or sun on my face.	1	2	3	4	5
22	When I have a sensation in my body, it's difficult for me to describe it because I can't find	1	2	3	4	5

		Never or very rarely true	Some-times true	Un-sure	Usually true	Almost always or always true
	the right words.					
23	I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted.	1	2	3	4	5
24	Usually when I have distressing thoughts or images, I am able just to notice them without reacting.	1	2	3	4	5
25	I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.	1	2	3	4	5
26	Even when I'm feeling terribly upset, I can find a way to put it into words.	1	2	3	4	5

		Never or very rarely true	Some-times true	Un-sure	Usually true	Almost always or always true
27	I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5
28	I tell myself that I shouldn't be thinking the way I'm thinking.	1	2	3	4	5
29	I notice the smells and aromas of things.	1	2	3	4	5
30	Usually when I have distressing thoughts or images, I feel calm soon after.	1	2	3	4	5
31	I find myself doing things without paying attention.	1	2	3	4	5
32	I think some of my emotions are bad or inappropriate and I shouldn't feel them.	1	2	3	4	5
33	I notice visual elements in art or	1	2	3	4	5

		Never or very rarely true	Some-times true	Un-sure	Usually true	Almost always or always true
3	nature, such as colors, shapes, textures, or patterns of light and shadow.					
34	My natural tendency is to put my experiences into words.	1	2	3	4	5
35	Usually when I have distressing thoughts or images, I "step back" and am aware of the thought or image without getting taken over by it.	1	2	3	4	5
36	I disapprove of myself when I have irrational ideas.	1	2	3	4	5
37	I pay attention to how my emotions affect my thoughts and behavior.	1	2	3	4	5
3	I am easily distracted.	1	2	3	4	5

		Never or very rarely true	Some-times true	Un-sure	Usually true	Almost always or always true
8						
39	Usually when I have distressing thoughts or images, I just notice them and let them go.	1	2	3	4	5

Health Questionnaire. Demographic Information:

Your Background

1. What is your gender?

____ male

____ female

2. What year are you in school?

____ 1st year

____ 2nd year

____ 3rd year

____ 4^{th} year

____ 5^{th} year

____ Other________________________

3. Are you a full-time or part-time student?

____ full-time

____ part-time

4. Expected graduation date: ____________

5. What is your ethnicity/cultural background (check all that apply)?

____ Hispanic or Latino

____ American Indian/Alaska Native

____ Asian

____ Native Hawaiian or Other Pacific Islander

____ Black or African American

____ White/Caucasian

Other________________________

Health Behaviors:

Instructions: The present investigation will provide measurements of heart rate, blood pressure, and periodic saliva samples, and therefore we want to identify factors which may affect these responses during the investigation. Please answer the following questions. All information that you provide will remain confidential, and feel free not to answer any questions that you feel uncomfortable in completing. If you have any questions as you go along, please ask the experimenter for clarification. Thank you.

Please answer the following questions regarding your behavior TODAY and THIS PAST WEEK, as indicated in the question:

1. **So far today**, how many cups of coffee (or 8-12 oz. serving of another caffeinated drink, i.e. cola) did you have? (indicate the number below)

_____cups of coffee or cola

2. In the **past HOUR**, have you had a cup of coffee (or 8-12 oz. serving of another caffeinated drink, i.e. cola)?

YES NO

3. Over the **past 7 days**, how many cups of coffee (or 8-12 oz. serving of another caffeinated drink, i.e. cola) have you had per day, on average?

_____ ups of coffee or cola

4. **So far today**, how many cigarettes have you smoked?

_____cigarettes

5. Over the **past 7 days**, how many cigarettes have you smoked per day, on average?

_____cigarettes

6. **So far today**, how many drinks containing alcohol (beer, wine, a mixed drink) have you consumed?

_____drinks containing alcohol

7. How often **over the past 7 days** have you had a drink containing alcohol (beer, wine, a mixed drink, any kind of alcoholic beverage)?

_____days

8. On days this **past week (7 days)** when you drank alcoholic beverages, how many drinks did you have all together on an average day? (By a drink, we mean a can or glass of beer, a 4-ounce glass of wine, a 1½ ounce shot of liquor, or a mixed drink with that amount of liquor).

_____drinks containing alcohol.

9. What was the most you had to drink in any **given 24-hour period** over the **past 7 days**?

_____drinks containing alcohol

10. **Today**, have you engaged in physical exercise, such as running, swimming, bicycling, tennis, fast walking, yoga, baseball, stretching?

1. No

2. Yes, for under 30 minutes

3. Yes, 30 minutes or more

11. Over the **past 7 days**, how many days did you engage in aerobic exercise: vigorous and continuous activity such as running, swimming, bicycling?

0	1	2	3	4	5	6	7

12. Over the **past 7 days**, how many days did you engage in anaerobic exercise: short burst of activity such as tennis, fast walking, yoga, baseball, stretching?

0	1	2	3	4	5	6	7

13. How many hours did you sleep **LAST NIGHT**?

Less than 1	1	2	3	4	5	6	7	8	9	10	11	12	More than 12

14. Over the **past 7 days**, how many hours of sleep did you get each night, on average?

Less than 1	1	2	3	4	5	6	7	8	9	10	11	12	More than 12

15. Over the **past 7 days**, how many nights did you get less sleep than you needed?

0	1	2	3	4	5	6	7

16. Did you greatly restrict your food intake over the **past 7 days**?

YES NO

If yes, how many days this week did you restrict your food intake?

0 1 2 3 4 5 6 7

17. Did you binge at any time over the **past 7 days** (eat unusually large quantities of food in a very short period of time)?

YES NO

If yes, how many days this week did you binge eat?

0 1 2 3 4 5 6 7

18. **Today**, have you taken any prescription drugs (including birth control)?

YES NO

If yes, please list below:

19. Have you taken any prescription drugs during the **past 7 days** (including birth control)?

YES NO

If yes, please list below:

20. **Today**, have you taken any non-prescription drugs (for example, aspirin, vitamins) or any recreational drugs (such as marijuana)?

YES NO

If yes, please list below:

21. **DURING THE PAST 7 DAYS**, have you taken any non-prescription drugs (for example, aspirin, vitamins) or any recreational drugs (such as marijuana)?

YES NO

If yes, please list below:

22. **DURING THE PAST 7 DAYS**, how many days did you eat breakfast?

_____days this week

23. Did you eat breakfast **today**? YES NO

24. **DURING THE PAST 7 DAYS**, how many days have you eaten fruit.

_____days this week

25. Have you eaten fruit **today**? YES NO

26. **DURING THE PAST 7 DAYS**, how many days have you eaten vegetables?

_____days this week

27. Have you eaten vegetables **today**? YES NO

28. In the past **HOUR**, have you eaten any chips? YES NO

29. In the past **HOUR**, have you had any dairy products (milk, yogurt, cheese, etc.)?

YES NO

30. How tall are you? ___________

31. How much do you weigh? _________

32. Do you have any of the following medical conditions? Please read the list below and then answer yes if you have any of the conditions below. You do not need to indicate which of these conditions you have, just answer yes if anything on the list applies to you. If you do not have any of these conditions, please answer no.

YES NO

An endocrine disorder, such as Cushing's syndrome or Addison's disease

An autoimmune disorder, such as lupus, rheumatoid arthritis, or multiple sclerosis

A severe immune disease, such as HIV infection or AIDS

A metabolic disease, such as adult diabetes, hypoglycemia, or hyperglycemia

Chronic Fatigue Syndrome

A diagnosed anxiety or depressive disorder (within last 6 months)

A chronic infectious disease, such as hepatitis, tuberculosis, mononucleosis, etc.

Any form of cancer or tumor

A blood disease such as hemophilia or leukemia

Serious allergies or asthma as an adult

A cardiovascular condition, such as hypertension

If you have been pregnant or breastfed in the last 6 months

APPENDIX G. PARTICIPANT DEBRIEF

Participant Debrief

E: "So now we are finished and I'd like to ask you a couple questions and give you some more information about the study you just took part in."

What do you think this study was about? Can you put it in your own words?

THE EXP SHOULD CAREFULLY PROBE TO MAKE SURE THE S WAS NOT SUSPISCIOUS OF THE CONFED.

Okay, next I have to read you a paragraph and then we'll be finished. Before I do read it to you I need to ask you to **Please not talk about this experiment with other students. It would ruin the point of the experiment of people knew about it before they came here. Is that okay?**

GET A VERBAL AGREEMENT FROM THE SUBJECT

READ:

Thank you for participating in our study.

When people are under stress, they undergo several important physiological changes that help prepare them to deal with the stressful situation. For instance, blood pressure, heart rate and hormone levels may all be affected. Some studies indicate that the type of feedback a person receives when they are in a stressful situation has an impact on the physiological changes they experience. In this experiment, we are looking at two different types of feedback and the timing of this feedback to see how they affect blood pressure, heart rate, autonomic nervous system activity, and hormone levels. We asked you to do a public speech task in order to simulate a stressful experience while your audience responded to you as we instructed him/her to. We put you through these challenging tasks so that we can see how your body responds to stress. Specifically, we are interested in how your heart rate and blood pressure are affected, as well as how certain stress hormones change during the experience. We also asked you to fill out questionnaires to gain insight into your emotional states. We are also looking at how receiving support during the stressful compared to after the stressful situation affects the changes in a person's physiological responses to stress.

Do you have any questions?

Thanks for your participation.

GIVE CREDIT, THANK, AND EXCUSE THE PARTICIPANT.