An Examination of the Direct and Indirect Effects of Feedback Type on Cortisol Levels

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Erin M. Rabideau

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This dissertation titled
An Examination of the Direct and Indirect Effects of Feedback Type on Cortisol Levels

by

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has been approved for
the Department of Psychology
and the College of Arts and Sciences by

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Assistant Professor of Psychology

Robert Frank
Dean, College of Arts and Sciences
Abstract

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An Examination of the Direct and Indirect Effects of Feedback Type on Cortisol Levels

Director of Dissertation: Peggy M. Zoccola

Although acute increases in levels of the stress-hormone cortisol are part of healthy functioning, prolonged increases in cortisol levels can contribute to the development and exacerbation of multiple chronic medical conditions. Due to the connection between cortisol exposure and adverse health outcomes, it is important to examine the factors that prolong or reduce exposure to cortisol. Performance situations and mental rehearsal of past stressors, or rumination, have been associated with enhanced activation of the stress response. Feedback valence (e.g., praise and criticism) regarding performance stressors has been linked to ruminative thought and other psychosocial processes (e.g., self-esteem, self-compassion) that may influence cortisol levels. However, the current research does not address the physiological effects of feedback valence or the possible role of rumination in the relationship between feedback valence and physiological responses. The goals of the present study were to investigate the association between feedback valence (e.g., praise, criticism, and neutral feedback) and cortisol levels, as well as examine the potential mediating role of rumination in the relationship between feedback valence and cortisol levels.

Healthy undergraduate students (n = 126) were randomly assigned to receive positive (praise), negative (criticism), or neutral scripted feedback in response to an
impromptu speech task (performance stressor). Cortisol levels were collected throughout the experiment to reflect levels at baseline, during the stressor, and during the recovery period after the stressor. State rumination was also measured during the recovery period. Participants rated the praise feedback as most positive followed by the neutral and criticism feedback respectively, indicating that the manipulation was successful. Overall, feedback condition and state rumination were not related to cortisol exposure. Across feedback valence conditions, gender predicted cortisol response patterns, with men exhibiting higher cortisol levels than women. Feedback condition and gender interacted to marginally predicted cortisol trajectory over the course of the study. Although the results of the study generally do not support the hypotheses, marginally significant analyses indicated gender differences in the relationship between verbal performance feedback and cortisol levels, which may warrant further investigation.
Dedication

This dissertation is dedicated to all of the kind, giving people who have helped and inspired me. Most especially, I dedicate this project to my mother, father, sister, and wife, who have been so supportive throughout this process.
Acknowledgments

I would like to acknowledge and thank the mentors and professionals that have contributed to my development over the years, including but not limited to Dr. Julie Suhr, Dr. Christopher France, Dr. Amy Chadwick, Dr. Christine Gydicz, Dr. Michelle Pride, Dr. Kristoffer Berlin, Dr. Debbie Thurneck, Dr. Sarah Smith, Dr. Bernadette Lauber, Dr. John Garsky, and Dr. Bruce Carlson. Your experience and support have been instrumental. I especially would like to thank Peggy M. Zoccola, Ph. D., whose kind encouragement, tireless efforts, and keen knowhow enabled me to complete this milestone. I also want to acknowledge my hardworking lab-mates, without whom I could not have conducted this project, Wilson Figueroa, M.S. and Alex Woody, M.S. Thank you all for everything!
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Chapter 1: Introduction

All human beings throughout history have been subject to stressors over the course of their lives. Healthy humans are able to dedicate resources to physiological processes devoted to responding to stressors to promote survival. Although acute physiological responses to stressors can reflect healthy functioning, prolonged physiological changes have been linked to a range of health problems through a process that has been termed allostatic load. As described by McEwen (1998), allostatic load is “the wear and tear on the body and brain resulting from chronic overactivity or inactivity of physiological systems that are normally involved in adaptation to environmental challenge” (p. 37). In other words, allostatic load reflects the strain and general wear inflicted on the body systems involved in reducing environmental threats when those systems are exposed to prolonged or increased activation or underactivation. Allostatic load has been measured via a number of different biomarkers generated from multiple body systems, including the immune (e.g., interleukin-6, tumor necrosis factor-alpha, C-reactive protein), metabolic (e.g., triglycerides, glycosylated hemoglobin, albumin), cardiovascular/respiratory (e.g., systolic/diastolic blood pressure, pulse), and neuroendocrine systems (e.g., norepinephrine, cortisol; Juster, McEwen, Lupien, 2010).

Cortisol has been used to examine neuroendocrine aspects of allostatic load because of its functions, including conversion of stored fats and proteins into energy, anti-inflammatory and immune suppressive action, modulating blood pressure and heart rate, modulation of limbic and prefrontal regions of the brain, as well as suppression of a number of body systems (e.g., digestive, growth, reproductive systems; Juster et al.,
Cortisol is a hormone called a glucocorticoid that affects cellular metabolism and plays a role in regulating an individual’s immune system. It is also commonly used to gauge activation of the hypothalamic-pituitary-adrenal (HPA) axis, which is stimulated during times of danger in order to help individuals cope with a present threat (Kemeny, 2003; Selye, 1956). A stressor may activate an individual’s HPA axis by stimulating cells in the hypothalamus and the hippocampal structures in the brain. The hypothalamus then releases a hormone, known as corticotrophin-releasing factor (CRF), which in turn stimulates the anterior pituitary to secrete adrenocorticotropic hormone (ACTH) into the bloodstream. ACTH, in turn, activates the release of cortisol and other glucocorticoids by the adrenal glands (located anterior to the kidneys). In other words, they are the mechanisms through which the HPA axis mobilizes energy and affects physiological changes that prepare an individual to react to a stressor (Kemeny, 2003). Cortisol receptors are distributed throughout the body, which allows cortisol to exert influence on functioning across body systems. In healthy individuals, this allows for the appropriate physiological preparations to occur for the individual to minimize a threat (Charmandari, Tsigos, & Chrousos, 2005).

Additionally, elevated cortisol has been related to immune functioning (e.g., McKinnon, Weisse, Reynolds, Bowles, & Baum, 1989; Wiedenfeld, O’Leary, Bandura, Brown, Levine, & Raska, 1990), the development and exacerbation of metabolic disorders (e.g., metabolic syndrome and diabetes), and cognitive dysfunction via changes in the hippocampus (for reviews, see McEwen, 1998; Segerstrom & Miller, 2004). Given the wealth of literature regarding the associations between cortisol levels and the
functioning of the immune, metabolic, and neurological systems, it is critical to conduct research examining the factors related to cortisol excretion. Increased understanding of the factors that influence cortisol exposure and trajectories may help to clarify the dynamics of the relationship between stress and health outcomes, revealing points of intervention.

Although the present study does not directly examine the relationship between cortisol and health outcomes, there is correlational evidence suggesting that the cortisol findings found in a laboratory are indicative of cortisol concentrations found in daily life (e.g., Van Eck, Cicolson, Berkhof, & Sulon, 1996; Kidd, Carvalho, & Steptoe, 2014). Specifically, these studies found positive associations between cortisol concentrations observed in the laboratory and those measured in daily life. Furthermore, results from the Whitehall II Study, a large-scale longitudinal study examining the relationship between stress and health, demonstrate a link between daily diurnal cortisol and mortality (Kumari et al., 2011). Taken together, this work suggests that results of laboratory studies examining cortisol elicitors reflect cortisol patterns in daily life and these cortisol patterns are significantly related to long-term health.

Social Evaluative Threat

One factor that has been shown to impact individuals’ acute cortisol responses is the experience of social evaluative threat (SET), or the perception that one’s performance is evaluated by others. Based on the premise that individuals are intrinsically motivated to maintain positive social standing, Dickerson, Gruenewald, and Kemeny (2004) proposed that individuals experience activation of the HPA axis and increases in cortisol
levels in situations in which SET is present. In other words, situations in which
individuals experience social evaluation may threaten individuals’ central goals of
maintaining good social standing. A number of studies have examined SET as a cortisol
elicitor (e.g., Zoccola, Dickerson, & Zaldivar, 2008; Zoccola, Dickerson, & Lam, 2012;
Gruenewald, Kemeny, Aziz, & Fahey, 2004). Typically, researchers have manipulated
social-evaluative threat by asking participants to complete active, evaluated performance
tasks that target characteristics of intelligence, competence, and/or subjective worth of a
participant. The results in the literature indicate that tasks accessing social evaluative
threat predictably elicit robust, stressor-related cortisol activation (e.g., Dickerson,
Mycek, & Zaldivar, 2008; Gruenewald, Kemeny, Aziz, & Fahey, 2004; Zoccola, Quas, &
Yim, 2010; Dickerson & Kemeny, 2004).

Rumination

An important factor that has been associated with prolonged elevations in cortisol
levels is rumination (Brosschot, Gerin, & Thayer, 2006; Papageorgiou & Siegle, 2003).
Rumination has been defined in a number of ways in the literature, but has widely
described as consisting of repetitive, unwanted, past-oriented thoughts that are negative
in content (Smith, & Alloy, 2009; Watkins, 2008; Zoccola, & Dickerson, 2012). It is
broadly considered to be maladaptive and has been associated with a number of
psychological symptoms, including depressive, social anxiety, and post-traumatic stress
symptoms (e.g., Nolen-Hoeksema, Marrow, & Fredrickson, 1993; Clark, & Wells, 1995;
Michael, Halligan, Clark, & Ehers, 2007). Rumination has both state and trait-like
properties, in that some individuals have a tendency or predisposition for engaging in
ruminative thought. In addition, certain situations or circumstances can elicit state ruminative thought.

Stressors that elicit social evaluative threat, or an individual’s perception of threat to one’s social standing as a result of a socially evaluative experience, have been associated with increased rumination (e.g., Zoccola, Dickerson, & Lam, 2012). Zoccola, Dickerson, and Lam (2012) performed a study comparing the relationship between a socially evaluative stressor versus a non-explicit socially evaluative stressor and state rumination in a sample of 144 undergraduate students (50% female). Whereas those in the non-explicit socially evaluative stressor group delivered impromptu speeches alone in a room or with an inattentive confederate, those in the socially evaluative stressor group delivered the speech in front of a two-member evaluative audience. The results indicated that those in the SET group reported significantly more state rumination following the speech across several time points, 10 minutes, 40 minutes, later that night, and 3-5 days post-stressor. In other words, stressors eliciting SET was associated with greater levels of rumination over time compared to a stressor that does not elicit SET.

Rumination has also been linked to stress-related activation in a number of studies, and has been associated with more robust physiological stress responses and slower recovery of cortisol levels following a stressor (e.g., Zoccola, Dickerson, & Zaldivar, 2008; Zoccola, Quas, & Yim, 2010; Zoccola & Dickerson, 2012; Zoccola, Dickerson, & Lam, 2012). A total of 19 studies to date have examined the relationship between cortisol levels and rumination (for reviews, see Verkuil et al., 2010; Zoccola & Dickerson, and 2012). There is some evidence for negative and null associations
between state or trait rumination and cortisol exposure and trajectory (e.g., Kuehner, Holzhauer, & Huffziger, 2007; Denson Fabiansson, Creswell, & Pedersen, 2009). However, the majority of studies have indicated that both state and trait rumination are positively associated with cortisol exposure (see Zoccola & Dickerson, 2012).

For example, Zoccola, Dickerson, and Zaldivar (2008) examined whether a laboratory speech task would be sufficient to elicit increased rumination and prolonged cortisol elevations in a sample of 89 undergraduate students. Participants presented an impromptu speech either in front of two evaluators, in the presence of two inattentive confederate research assistants, or alone in a room. The results indicated that state rumination, across all three conditions, was related to prolonged elevations in salivary cortisol levels. The interaction between state rumination following the task and the quadratic effect of time predicted cortisol trajectories. Stated differently, those with higher state rumination exhibited higher cortisol trajectories over the course of the study. However, the authors found mixed results when examining the relationship between trait depressive rumination and cortisol responses (i.e., greater tendencies to ruminate on depressed mood predicted blunted, or reduced, cortisol responses for those who performed the speech task in front of the evaluative audience and trait depressive rumination was unrelated to cortisol responses in the non-explicitly evaluative conditions).

Likewise, Zoccola, Quas, and Yim (2010) investigated whether state and trait rumination predict higher cortisol release and delayed cortisol recovery in response to a laboratory stressor task. The study was conducted with a sample of 59 undergraduate
students (52.5% female) who completed the in-laboratory stressor task and the returned two weeks later for a surprise interview. The laboratory stressor consisted of a modified version of the Trier Social Stress Test (Kirschbaum et al., 1993), in which the speech task was increased to six minutes and the math task was decreased to four minutes in duration. Participants were assigned to either the supportive or unsupportive interview condition, in which the interviewer was either friendly and engaged or aloof, stern, and neutral throughout the interview. A total of eight salivary cortisol samples were collected pre- and post-stressor task, as well as eight pre- and post-stressor recall (i.e., the interview). Trait rumination predicted greater cortisol reactivity to the stressor task and delayed cortisol recovery. State rumination predicted greater cortisol reactivity in males during the interview in the unsupportive interview condition only. In sum, trait rumination predicted greater cortisol reactivity to the stressor task and delayed cortisol recovery, and state rumination predicted greater cortisol reactivity to the stressor recall interview for men in the unsupportive interview condition.

Though the literature establishes rumination as an impacting factor with regard to cortisol levels, the relationship between rumination and stressor-related cortisol has not yet been conclusively characterized. Inconsistencies in the literature in the relationship between rumination and cortisol levels may be accounted for by the presence or absence of social-evaluative threat. Studies have indicated that rumination related to socially-evaluative tasks is related to increased cortisol levels and/or delayed recovery (Dickerson & Kemeny, 2004). Additionally, stressors eliciting SET have been shown to lead to greater rumination and cortisol (e.g., Dickerson et al., 2008; Zoccola et al., 2008). This
suggests that study procedures that are designed to induce SET are particularly suited for the examination of the relationship between rumination and cortisol levels. A number of circumstances may promote SET, such as critical performance feedback. Conversely, positive performance feedback, or praise, may mitigate the threat of performance feedback and may be associated with changes in state rumination and cortisol levels.

**Performance Feedback**

The verbal feedback people receive in response to stressors may be related to the nature of individuals’ cortisol recovery by affecting the perceived SET of a stressor. Individuals may view criticism as more socially evaluative than praise, possibly prolonging the recovery from the stressor-related cortisol elevation. For example, if individuals view negative performance feedback as more threatening, this SET may, in turn, encourage individuals to ruminate on their performance.

Feedback is used by those in a range of roles, such as individuals acting in evaluator, teacher, facilitator, and gatekeeper capacities (Hyland, & Hyland, 2001; Leki, 1990; Reid, 1994). Feedback is commonly discussed as falling into one of 3 categories: praise, which has been defined as, “…an act which attributes credit to another for some characteristic, attribute, skill, etc., which is positively valued by the person giving feedback” (Holmes, 1988, p. 446; Hyland & Hyland, 2001, p. 186); criticism, which has been defined as, “an expression of dissatisfaction or negative comment” (Hyland, 2000, p. 44); and advice or suggestion (termed neutral feedback in the present study), which has been defined as, “containing an explicit recommendation for remediation, a relatively clear and accomplishable action for improvement” (Hyland & Hyland, 2001, p. 186).
The literature on the effect of feedback valence has been conducted in business, school, and laboratory settings. Several studies also examine the effect of physiological or time-related performance feedback in sport-related contexts (e.g., Wilson, Lane, Beedie, & Farooq, 2012; Beedie, Lane, & Wilson, 2012). However, as the current study is investigating the effect of verbal feedback on physiological responses, the following review of the literature will focus mainly on studies examining the effects of verbal or written performance feedback on relevant affective and cognitive outcomes (e.g., mood, rumination) and cortisol.

**Affective and cognitive outcomes.** Many studies have suggested that positively or negatively valenced feedback elicits psychological outcomes of the same valence. In other words, the literature generally indicates that positive feedback has been associated with reported positive outcomes, such as pride or self-efficacy; whereas negative feedback has been associated with reported negative outcomes, such as disappointment or guilt (e.g., Lazarus, 1991; Belschak, & Den Hartog, 2009), as well as increased state anxiety and state rumination (e.g., Ross, Lepper, & Hubbard, 1975; Podsakoff & Farh, 1989; Nease, Mudgett, & Quiñones, 1999; Daniels & Larson, 2001).

For example, the type of feedback received may affect whether or not an individual ruminates on the outcome of a performance-related situation, which in turn may also influence the physiological stress response. Moulds, Yap, Kerr, Williams, and Kendris (2010) conducted two studies in which the overall goal was to examine whether individuals with high positive beliefs about rumination (e.g., “I need to ruminate about my problems to find answers to my depression”) ruminated more following a forced-
failure anagram task than those who exhibited low positive beliefs about rumination. Those who received positive feedback reported lower levels of rumination than those in both the negative feedback condition and the no-feedback condition (study 2). The results also suggested a significant rumination beliefs group by time interaction predicting sadness ratings. Stated simply, those who received positive feedback reported lower levels of rumination than did those who received negative feedback on their performance. Further, those with high beliefs about rumination tended to exhibit higher levels of rumination over the course of the study and higher sad mood ratings compared to those with low beliefs about rumination.

**Cortisol outcomes.** One study examined the relationship between cortisol and feedback type. Earle, Linden, and Weinberg (1999) studied the effect of critical performance feedback (i.e., harassment) relative to no feedback during a mental math stressor task on salivary cortisol reactivity and recovery. Sixty university students (53% female) were randomly assigned to receive either critical verbal performance feedback or feedback in response to a 12-minute mental arithmetic stressor. During the critical feedback condition, same-gender experimenters delivered harassing statements on a fixed schedule (i.e., at two, six, and ten minutes) during the task Confederates delivered feedback in “a firm, authoritative, but neutral (i.e., not angry) tone of voice,” (p. 128) with comments such as, “You’re obviously not good enough at doing this, now try harder. Keep going!” (p.128). Participants in the control condition received no verbal feedback during the mental stressor task. Salivary cortisol samples were taken at the end of the 12-minute baseline period, immediately after the stressor task, and three samples
were taken during the recovery phase. The control group did not exhibit significant
differences in cortisol levels over the course of the study. However, an interaction
between condition and time predicted salivary cortisol over the course of the study in
both men and women, indicating that both men and women in the harassment condition
had significant increases in salivary cortisol from baseline to the stressor task, with a
more pronounced effect for men. These results indicate that critical verbal feedback or
harassment during a laboratory stressor task significantly enhances cortisol reactivity to
the task compared to no feedback.

**Feedback summary.** In conclusion, feedback regarding performance on a range
of different tasks has demonstrated a fairly consistent effect of feedback on performance
and psychological variables. Praise or positive performance feedback has been linked to
positive psychological outcomes, including increased self-efficacy, as well as decreased
state rumination and state anxiety. In contrast, criticism or negative performance
feedback has been associated with lower self-efficacy, as well as increased state
rumination and state anxiety. Furthermore, one study suggested that negatively valenced
feedback during a stressor task results in an augmented cortisol response. However, it is
worth noting that the performance feedback in this study was delivered during rather than
following the stressor and there was no neutral or no-feedback condition for comparison.
Additional research would be important to clarify the relationship between feedback and
stressor-related physiological activation. The present study sought to extend
understanding of the effect of verbal performance feedback on the cortisol response to a
standardized psychosocial stressor.
Rational and Hypotheses

Given the widely observed positive relationship between the physiological stress response and long-term health outcomes, it is critical to enhance understanding of cortisol elicitors. There has also been evidence in the literature for associations between cortisol exposure and rumination as well as feedback valence, though the findings in these bodies of literature are not yet conclusive. Thus, it is important to further the research examining rumination and feedback valence as cortisol elicitors. The objective of the present study was to examine the relationship between feedback type (i.e., criticism, praise, and neutral feedback), rumination, and cortisol levels in responses to a performance stressor. The aims of the present study were to examine the direct effects of feedback type on cortisol levels and to investigate rumination as a potential mediator in the relationship between feedback type and cortisol levels. Gender was also examined as a covariate and as a moderator of the relationship between feedback valence and cortisol levels since there are frequently reported gender differences in cortisol stress reactivity (Kudielka & Kirschbaum, 2005).

The hypotheses for the present study were as follows: 1) criticism will be associated with higher cortisol levels over the recovery period after exposure to the laboratory stressor than the cortisol levels in the praise or neutral feedback conditions; 2) praise will be associated with lower cortisol levels over the recovery period after exposure to the laboratory stressor than the cortisol levels in the neutral and criticism feedback conditions; and 3) rumination will mediate the relationship between feedback type and cortisol. Specifically, (3a) a positive relationship was hypothesized between
rumination and cortisol levels; (3b) there will be a negative relationship between feedback type (criticism = 0, neutral = 1, praise = 2) and rumination. In other words, rumination levels were predicted to be highest among those who received criticism and lowest among those who receive praise. Men were also expected to exhibit greater cortisol stress responses.
Chapter 2: Method

Participants

The sample for the current study was composed of 126 undergraduate students at a Midwestern university recruited from the student body as a study of “health responses to a laboratory task.” The majority of the sample was female ($n = 64, \text{50.8\%}$), Caucasian ($n = 99, \text{78.6\%}$), and 18-20 years of age ($n = 79, \text{62.7\%, range = 18-45 years of age}$). See Table 1 for sample characteristics. The majority of participants reported a family income of $50,000 or higher ($n = 73, \text{58\%}$). Several attributes of the sample are worth noting. On average, the sample scored above the cut-off of 26 for social phobia on the Social Phobia Scale, indicating the sample exhibited significant social phobia symptoms ($n = 114, M = 31.72, SD = 10.16; \text{Peters, 2000}$). Participants scored below the cut-off of 23 for significant depressive symptoms on the CES-D ($n = 125, M = 9.25, SD = 2.97; \text{Radloff & Locke, 1986}$). Overall, participants fell within the healthy range of body mass index (BMI; $n = 116, M = 23.87, SD = 4.47$).
Table 1.

Sample characteristics for total sample (N = 126) and by experimental condition

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
<th>Praise (n = 42)</th>
<th>Criticism (n = 44)</th>
<th>Neutral (n = 40)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (Female)</td>
<td>64 (50.79%)</td>
<td>21 (50.00%)</td>
<td>23 (52.27%)</td>
<td>20 (50.00%)</td>
<td></td>
</tr>
<tr>
<td>Compensation (Credit)</td>
<td>68 (53.96%)</td>
<td>17 (40.48%)</td>
<td>24 (54.55%)</td>
<td>27 (67.50%)</td>
<td></td>
</tr>
<tr>
<td>Racial Background</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>99 (78.57%)</td>
<td>29 (69.05%)</td>
<td>38 (86.36%)</td>
<td>32 (80.00%)</td>
<td></td>
</tr>
<tr>
<td>African American/Black</td>
<td>12 (9.52%)</td>
<td>8 (19.05%)</td>
<td>2 (4.55%)</td>
<td>2 (5.00%)</td>
<td></td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>6 (4.76%)</td>
<td>3 (7.14%)</td>
<td>1 (2.27%)</td>
<td>2 (5.00%)</td>
<td></td>
</tr>
<tr>
<td>Multi-racial/Multi-ethnic</td>
<td>8 (6.35%)</td>
<td>2 (4.76%)</td>
<td>2 (4.55%)</td>
<td>4 (10.00%)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 years</td>
<td>39 (30.95%)</td>
<td>10 (23.81%)</td>
<td>16 (36.36%)</td>
<td>13 (32.50%)</td>
<td></td>
</tr>
<tr>
<td>19 years</td>
<td>40 (31.75%)</td>
<td>9 (21.43%)</td>
<td>17 (38.64%)</td>
<td>14 (35.00%)</td>
<td></td>
</tr>
<tr>
<td>20 years</td>
<td>15 (11.90%)</td>
<td>6 (14.29%)</td>
<td>4 (9.10%)</td>
<td>5 (12.50%)</td>
<td></td>
</tr>
<tr>
<td>21 years</td>
<td>17 (13.49%)</td>
<td>9 (21.43%)</td>
<td>5 (11.36%)</td>
<td>3 (7.50%)</td>
<td></td>
</tr>
<tr>
<td>22 years</td>
<td>10 (7.94%)</td>
<td>5 (11.90%)</td>
<td>1 (2.27%)</td>
<td>4 (10.00%)</td>
<td></td>
</tr>
<tr>
<td>23-45 years</td>
<td>5 (3.97%)</td>
<td>3 (7.14%)</td>
<td>1 (2.27%)</td>
<td>1 (2.50%)</td>
<td></td>
</tr>
</tbody>
</table>

Note: “NxP*” signifies a significant comparison between the Neutral and Praise conditions (p < .05; i.e., more participants in the Praise condition were compensated with cash than those in the Neutral condition).
Eligibility. To be eligible for the study, participants verbally denied the following exclusion criteria: 1) treatment with the following medications: anti-inflammatory medication or immune suppressants, corticosteroids, antidepressants, anti-anxiety medications, or oral contraceptives; 2) pregnancy; 3) chronic psychological and/or medical disorders; 4) regular tobacco use. Anti-inflammatory, immune suppressant, corticosteroid medications have all been shown to influence the HPA axis, resulting in alterations in cortisol levels (Granger, Hibel, Fortunato, & Kapelewski, 2009). Likewise, pregnancy has also been linked to increased cortisol levels (Nolten & Rueckert, 1981). Oral contraceptives have been shown to blunt women’s cortisol responses to stressors (Kirschbaum, Kudielka, Gaab, Schommer, & Hellhammer, 1999). Conversely, antidepressants and anti-anxiety medications have been shown to increase the number of glucocorticoid receptors, heightening the action of the negative feedback loop and dampening overall cortisol levels (Pariante, Thomas, Lovestone, Makoff, & Kerwin, 2004). Benzodiazepines have been shown to reduce cortisol levels through inhibition of the release of CRF (Gram, & Christensen, 1986). Several chronic psychological disorders have been related to cortisol responsivity and have been associated with blunted or heightened cortisol responses to stressors, as in individuals with Major Depressive Disorder or social Phobia, for example (e.g., Davis, Otte, & Mohr, 2005; Furlan, DeMartinis, Schweizer, Rickels, & Lucki, 2001). Chronic medical conditions, such as diabetes, have been shown to be associated with increased inflammation and increased cortisol levels (e.g., Lechin et al., 1994). Lastly, regular
tobacco use has been associated with increased free cortisol levels (Kirschbaum, Wust, & Strasburger, 1992).

**Procedure**

The procedure of the present study is shown in Figure 1. All study appointments were scheduled in the afternoon, beginning between 12:00PM and 5:00PM, in order to control for the diurnal rhythm of cortisol secretions (Pruessner, Wolf, Hellhammer, Buske-Kirschbaum, von Auer, Jobst, Kaspers & Kirschbaum, 1997). Participants were randomly assigned to one of three feedback conditions. This was achieved through use of a random order generator to randomly order 130 of the numbers one, two, and three. Each participant was assigned the next number in the series, which corresponded to one of the 3 conditions. Attempts were made to achieve equal proportions of men and women in each condition. When enough of one gender was recruited in a condition, online recruitment was closed to only accept the other gender.
During the appointment, the researchers began by checking participants for agreement with the eligibility criteria and then discussed the informed consent with participants. After consenting, the participants engaged in a 30-minute rest period, during which they completed set of questionnaires, including scales examining participants’ demographics, health behaviors, mood, emotions, and personality traits. The last 2 minutes of the rest period was used to collect the Pre-Baseline salivary cortisol sample (sample #1). All questionnaires in the study were presented through Qualtrics Survey Research Suite (Qualtrics Labs, Inc., Provo, UT), an online survey program. If participants completed the questionnaires before 30-minute period elapsed, they were allowed to read emotionally neutral magazines provided in the laboratory.

**Speech stressor.** After the first sample was collected, the participants engaged in a performance stressor task, similar to the stressor task used in the study performed by Dickerson, Mycek, and Zaldivar (2008), which was derived from the well-established
Trier Social Stress Test (Kirschbaum, Pirke, & Hellhammer, 1993). This stressor was selected because it has been shown in a number of studies to reliably elicit a robust cortisol response (e.g., Dickerson, Mycek, & Zaldivar, 2008, Zoccola, Quas, & Yim, 2010; Zoccola, Figueroa, Rabideau, & Woody, 2014). Two evaluators (trained research assistants) in white lab coats explained the nature of the task, in which the participants delivered a 5-minute impromptu speech as if they were in a job interview for a job in their field of interest (see Appendix F for the administered speech instructions). During this introduction, the evaluators informed the participants that, after the performance, they would confer and then present him/her with verbal feedback regarding the speech. The evaluators then left the room and the participants completed a questionnaire assessing their initial appraisals of the upcoming speech. The participants were then given 3 minutes to mentally prepare for the speech. Participants delivered the speech in front of the two evaluators, who were trained to remain neutral throughout the task. For example, the evaluators were trained to interact with the participants without non-verbal encouragers (e.g., smiling or nodding) and to only say what was scripted for the interaction (e.g., “please continue” or “you must continue speaking for the whole 5 minutes”). Although this nonverbal presentation is intended to be neutral, participants may interpret the evaluators’ behavior as a negative type of behavior. In order to counteract the possibility of this interpretation, the pre-task instructions informed the participants that the evaluators would remain impassive during the speech task and would present verbal feedback about participants’ performances after the task is complete.
Participants’ speeches were recorded by video cameras in order for performance to be coded for actual performance quality later.

**Study manipulation.** After the speech was complete, the evaluators left the room under the guise of conferring about the participants’ performance and the experimenter asked the participant to provide the second cortisol sample (reflecting the Pre-stressor Baseline period) and complete a post-speech task appraisal questionnaire. After 3 minutes, the evaluators re-entered and verbally delivered the randomly assigned scripted feedback aloud, which was characterized as praise, criticism, or neutral feedback, regarding participants’ performance on the speech task.

Criteria on which the speech was falsely evaluated in the scripted feedback (e.g., eye contact, clarity of speech, body language, facial expression, and clarity of argument) is the same as that which was used in the study performed by Morgan and Banerjee (2008). The procedure for the current study was modeled after that in the study performed by Morgan and Banerjee (2008) because their procedure for providing verbal feedback after a socially evaluated speech task closely mirrored that investigated in the current study (see Appendices G-I for scripts). For example, whereas a statement about eye contact in the criticism condition says, “During a speech, it is important to maintain regular eye contact with your audience. You did not maintain appropriate eye contact with us, the evaluation panel,” (see Appendices G-I) the statement about eye contact in the praise condition was scripted as, “During a speech, it is important to maintain regular eye contact with your audience. You maintained good eye contact with us, the evaluation panel.” The scripted feedback varied minimally between conditions in order to ensure
that any effect observed may be attributed to the nature of the verbal feedback and not inconsistencies in the feedback scripts. Participants in all conditions also received an overall numerical performance score of 6 on a scale of 1 (being the worst) and 10 (being the best). The purpose of providing this score was to enhance the realistic feel of the scripted feedback. A score of 6 was determined to be sufficiently ambiguous to be appropriate for a praise, criticism, and neutral feedback situation, as it can be construed as a low, average, or high score based on the specific verbal feedback presented with it.

The results of a pilot study indicated that the scripts were significantly different from one another in the predicted order of valence, Criticism being the most negative ($M = 1.66, SD = 0.93$) followed by Neutral ($M = 3.55, SD = 0.095$) followed by Praise ($M = 5.57, SD = 0.16$), which was viewed as the least negative and most positive (see Appendix J for additional details on the pilot study).

After the feedback was delivered, the evaluators left the room and the experimenters then asked the participant to fill out a post-feedback performance appraisal questionnaire to assess how participants felt about their performance after receiving feedback. After completing this questionnaire, the participants were given two minutes to rest without magazines, intended to give participants the opportunity to ruminate on their performance. The participant was then asked to provide the third cortisol sample (reflective of the Speech cortisol levels) and complete post-task questionnaires including a state rumination questionnaire to assess any spontaneous rumination on their speech task performance. Participants were then given magazines over the remainder of the study, as the fourth and fifth cortisol samples were taken at intervals approximately 30
and 45 minutes after the speech task (reflective of Post-Feedback and Recovery cortisol levels, respectively). After the participants provided the final cortisol sample, the experimenter debriefed the participant, answered any questions, and provided the participant with mental health service resources in case participants decide they require such services. Participants were compensated for their participation with class credit ($n = 68, 54.0\%$) or paid $20.

**Measures**

**Salivary cortisol.** The primary outcome measure for the present study was salivary cortisol. Salivary cortisol levels have been shown to peak approximately 20 minutes after the onset of a stressor (Dickerson & Kemeney, 2004; Blascovitch, Vanman, Mendes, & Dickerson, 2011). Cortisol was sampled five times over the course of the study, reflecting different key points in the study (e.g., pre-baseline (sample 1), baseline (sample 2), stressor (sample 3), and 2 recovery samples (samples 4, 5); see Figure 1, for a temporal summary of the cortisol sampling procedure). Because of the 15-20 minute time lag between a stressor and peak cortisol values, the pre-baseline saliva samples were not used in the analyses because the cortisol values in these samples are reflective of levels upon arrival to the experimental appointment, which may have been influenced by pre-appointment stressors. Sample 2 is reflective of cortisol values at the end of the 30-minute baseline period. A baseline rest period before commencement of the study activities from 10 to 40 minutes in duration has been shown to be adequate for observing reliable cortisol responses (Blascovitch et al., 2011). A shorter rest period may result in
poorer cortisol responses to stressors and longer rest periods have demonstrated larger
cortisol responses (e.g., Kirschbaum et al., 1993; Dickerson et al., 2008).

Saliva was collected using Salivette® sampling devices (Sarstedt, Newton, North
Carolina), which consists of a sterile cotton roll, which is placed in the mouth for
approximately 2 minutes or until saturated with saliva. The samples were then stored at
-20 degrees Celsius until they were sent out for processing. The salivary samples were
mailed to the laboratory of Dr. Clemens Kirschbaum at the Technical University of
Dresden, Germany, to be assayed. Cortisol levels at each time point in the study were
determined using the enzyme-linked immunosorbent assay procedure (IBL-International,
Hamburg, Germany). The assay’s lower limit of sensitivity is 0.015 µg/dl, with inter-
and intra-assay coefficients of covariance of less than 10%. All cortisol values were
natural log transformed (log_e) in the analyses to account to the cortisol results being
positively skewed. A total of 107 (84%) participants had cortisol data for all 5 time
points. Reasons for missing data included the sample evaporating because of improper
sealing of the Salivette container and insufficient saliva in the cotton roll for the assays.
There was no statistical difference between the sample sizes of individuals with complete
versus incomplete cortisol data among the three conditions (\( \chi^2 = 2.20, p = .33 \)).

**Demographics and health behaviors (Appendix A).** Participants completed a
demographics questionnaire, requesting information such as individuals’ age, gender, and
ethnicity. Recent health behaviors were also assessed to re-confirm participant eligibility
(e.g., smoking status, use of prescription medication). Participants were also queried
regarding their height, weight, exercise, sleep, menstrual cycles (females), caffeine
consumption, and nicotine use, as all have been shown to influence cortisol concentrations (Rask, Olsson, Söderberg, Andrew, Livingstone, Johnson, & Walker, 2001; Kirschbaum, Kudielka, Gaab, Schommer, Hellhammer, 1999; Leproult, Copinschi, Buxton, & Van Cauter, 1997; Supnicki, & Obminski, 1992; Gilbert, Dibb, Plath, & Hiyane, 2000; Steptoe, & Usher, 2006).

**Menstrual phase.** Whether a woman is in her **follicular** or **luteal** phase of her menstrual cycle at the time of measurement has been related to salivary cortisol values (e.g., Duchesne, & Preussner, 2013). The follicular phase has been defined as the period during which oocytes develop into follicles, and a woman tends to exhibit reduced concentrations of follicle-stimulating hormone (FSH) and increased concentrations of luteinizing hormone (LH), which promotes increased steroidogenesis (Becker et al., 2005). With regard to salivary cortisol levels, women in the luteal phase of their cycle tend to reflect similar cortisol patterns compared to males. However, women in the follicular phase of their cycles tend to exhibit dampened stress-related salivary cortisol responses compared to males (Kudielka, & Kirschbaum, 2005). As a result, we approximated menstrual cycle phase via self-report and examined this variable as a potential covariate. It is important to acknowledge the documented limitations of using self-reported menstrual cycle data, as the accuracy of self-reported menstrual cycle has been shown to be consistently poor (e.g., Jukic, et al., 2007; Small, Manatunga, & Marcus, 2007). Small, Manatunga, and Marcus (2007) found that 398 women aged 19 to 41 years of age overestimated their menstrual cycles by more than 2 days over their mean length. Similarly, Jukic and colleagues (2008), found that 352 women between the ages
of 37 and 39 overestimated their menstrual cycle duration by 0.7 days (95% Confidence Interval = 0.3-1.0). Hence, self-reported menstrual cycle may reflect reporting errors and may not be consistent with sex hormone concentrations. While not an ideal measure of menstrual cycle phase or duration, self-reported menstrual cycle was used in the present study to explore potential covariation with the variables of interest. Further study using hormonally determined menstrual cycle phase and duration would help to support or clarify the findings investigated in the present study.

Menstrual cycles have been shown to last between 25-35 days, and the luteal phase typically lasts between 13-15 days. The follicular phase has varied more widely depending on the length of an individual’s menstrual phase (Becker et al., 2005). For the current study, the follicular phase was defined as the last 14 days of an individual’s cycle, and the remaining days in the cycle were defined as the follicular phase, as was performed in Armbruster, Strobel, Kirschbaum, and Brocke (2014). The duration of each woman’s menstrual cycle was determined by participant self-report. Individuals whose menstrual cycle duration fell outside the normal range from 25 to 35 days were excluded from the analyses. Those women whose self-reported menstrual cycle indicated they fell in the follicular phase at the time of the study were coded as 0 ($n = 19$; 35% of women); those determined to be in the luteal phase were coded as 1 ($n = 27$; 49% of women); and those whose menstrual cycle duration fell outside the average 25 to 35 day duration were coded as 2 ($n = 9$; 16% of women).

Pre-speech appraisals (Appendix B). After hearing the speech instructions, but prior to the speech task, participants reported their impressions about the upcoming
speech task on a 6-point rating scale (e.g., “How threatening do you expect the upcoming
speech task to be?” 1 = Not at all, 6 = Very much). The 13-item questionnaire was
divided into a series of 3-item or 4-item subscales, including Pre-task Apprehension
(items: 1, 2, 3; Cronbach’s alpha = .87), Expected Performance (items: 4, 5, 6, 7;
Cronbach’s alpha = .89), Perceived Importance of Performance (items: 8, 9, 10;
Cronbach’s alpha = .86), and Expected Reception of Performance (items: 11, 12, 13;
Cronbach’s alpha = .88).

Post-speech appraisals (Appendix C). Participants evaluated their performance on the speech task and provide post-stressor appraisals on 7-point rating scale (e.g.,
“Overall, I thought the task was a good CHALLENGE;” 1 = Not at all, 7 = Very much)
scale using a 15-item questionnaire immediately following the speech task and before receiving feedback. The questionnaire was divided into a series of 3-item subscales,
including Task Effort (items: 1, 2, 3; Cronbach’s alpha = .64), Task as a Challenge
(items: 4, 5, 6; Cronbach’s alpha = .64), Task as Threat (items: 7, 8, 9; Cronbach’s alpha
= .84), and Post-Task Perceived Performance (items: 13, 14, 15; Cronbach’s alpha = .92).

Post-feedback task appraisals (Appendix D). In order to check the
effectiveness of the feedback manipulation, or to ensure that the scripted feedback
participants received was effectively perceived as praise, criticism, and neutral feedback
as intended, participants were asked to complete a questionnaire in which they rated their
feedback experience. This questionnaire was created by the researchers, and was composed of statements which asked participants to rate their feedback experience according to a 5-point rating scale. For example, statements included, “Overall, the
feedback I received was,” (1=very negative, 5=very positive), and “How much of the time were you able to focus on the feedback?” (1=not at all, 5=all of the time). The questionnaire was divided into a series of 3-item subscales, including Perceived Feedback Valence (items: 1, 2, 3; Cronbach’s alpha = .92), Perceived Feedback as Threat (items: 4, 5, 6; Cronbach’s alpha = .84), Perceived Feedback as Challenge (items: 7, 8, 9; Cronbach’s alpha = .95), Perceived Feedback Accuracy (items: 10, 11, 12; Cronbach’s alpha = .87), and Attention to Feedback (items: 13, 14, 15; Cronbach’s alpha = .86).

Psychological symptoms. Psychological symptoms that have been associated with cortisol levels were assessed to describe the sample and potentially include in the analyses as covariates. Depressive symptoms were examined due to previous findings indicating Major Depressive Disorder is associated with blunted cortisol responses to stressors (e.g., Davis, Otte, & Mohr, 2005). A measure of symptoms of Social Phobia was included because individuals with social phobia exhibited higher cortisol response to stressors than healthy controls (Furlan, DeMartinis, Schweizer, Rickels, & Lucki, 2001). Lastly, a measure of trait rumination was included because differential results have been found among studies examining the relationships between cortisol and state or trait rumination. Results concerning the relationship between \textit{state} rumination and cortisol values have observed primarily positive associations, while those studies examining the relationship between \textit{trait} rumination and cortisol values have found more mixed findings (e.g., Zoccola, Dickerson, & Zaldivar, 2008; Kuehner, Holzhauer, & Huffziger, 2007; for review see Zoccola, & Dickerson, 2012).
Depressive symptoms. Depressive symptoms were measured once at baseline using the 20-item Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). A score over 23 has been shown to indicate significant depression (Radloff & Locke, 1986). The CES-D has been found to have good reliability in samples of the general population (coefficient alpha = 0.85; Goodnick, Kumar, Buki, & Goldberg, 1997). The results from the current study indicated the CES-D had an internal consistency of .73. The CES-D has demonstrated good convergent validity, correlating highly with patient self-reported depression symptoms on the Symptom Checklist-90 in a non-clinical adult sample (SCL-90; r = .83; Radloff, 1977). The CES-D was also highly correlated with the Beck Depression Inventory II in a college age sample (r = .86; Shean & Baldwin). Furthermore, the CES-D demonstrated good predictive validity, predicting current, lifetime, and past year depressive symptoms as measured by the Diagnostic Interview Schedule-IV (DIS-IV; all β’s above = .55, all p’s < 0.001; Shean & Baldwin).

State rumination. State rumination was assessed using the 14-item negative thoughts subscale of the Thoughts Questionnaire (Edwards, Rapee, & Franklin, 2003). Participants completed the state rumination measure approximately 3 minutes after receiving the feedback. The instrument queries how often each participant has thought about given statements after the speech stressor task. Participants were asked to respond to the items on a 5-point scale from 0 (never) to 4 (very often). Example statements include: “How often did you think about how bad your speech was?” and “How often did you think that you must have looked stupid?” The negative thoughts subscale demonstrated good internal consistency in the present study with a Cronbach’s alpha of
The Thought Questionnaire has demonstrated good predictive validity, in that it predicted elevated cortisol responses to acute stressors (Zoccola, Dickerson, & Zaldivar, 2008), and socially evaluative stressors predicted greater state rumination using the measure immediately and several days post-stressor (Zoccola, Dickerson, & Lam, 2012).

**Trait rumination.** The Rumination-Reflection Questionnaire is a 24-item questionnaire assessing an individual’s trait tendency to ruminate and reflect (RRQ; Trapnell & Campbell, 1999). The trait rumination subscale is measured using the first 12 items of the questionnaire. The results from the current study demonstrated internal consistency of the RRQ (Cronbach’s alpha = .87). The rumination subscale of the RRQ demonstrated fair convergent validity in correlating moderately with the self-reflectiveness subscale of the Private Self-Consciousness Scale ($r = .53$; Trapnell, & Campbell, 1999).

**Social anxiety.** Fear of public scrutiny or performance-based fears will be assessed using the 20-item Social Phobia Scale (SPS; Mattick & Clarke, 1998). A cut-off score of 26 on the Social Phobia Scale indicates significant symptoms of social phobia (Peters, 2000). The results of the present study demonstrated internal consistency of the SPS (Cronbach’s alpha = .89). The SPS demonstrated adequate convergent validity with the Social Interaction Anxiety Scale in a college student population (SIAS; $r = .77$; Gore, Carter, & Parker, 2002) and with the Liebowitz Social Anxiety Scale in patients with social anxiety disorder (L-CA; $r = .72$; Fresco et al., 2001). The SPS also demonstrated sensitivity in correctly identifying 76% of patients with social phobia (Brown et al., 1997).
**Observer-rated performance (Appendix E).** Two research assistants who did not serve as evaluators for a given participant and were blind to participant feedback condition coded each digital recording of the speeches to obtain ratings of participants’ performances. These observers were trained to evaluate the performances according to 5 performance categories: 1) eye contact, 2) clarity of speech, 3) body language, 4) facial expression, and 5) clarity of argument. The video evaluators took these dimensions of performance into account when deciding on an overall performance rating. Overall performance was then coded a 7-point rating scale (1=very poor to 7= excellent). The ratings from the two video evaluators were averaged for a composite performance score. An intraclass correlation analysis indicated that the 2 raters’ scores of overall participant performance were in agreement (Average Measures Intraclass Correlation = .85).

**Analytic Plan**

The sample size estimates for the current study were determined *a priori* through a power analysis conducted with the results of the pilot study and consideration of relevant past literature (Earle et al., 1999). Statistical significance for two-tailed analyses was defined as \( p < .05 \), and marginal significance was defined as any \( p > .05 \) and \( p \leq .10 \). Differences in degrees of freedom in analyses occurred due to missing data across variables. Those participants with missing data were only removed from analyses that involved the variables of which that participant was missing data. Otherwise those participants were included in analyses.

Outliers were defined across variables as z-scores greater than or equal to ±3.0. One individual had an outlying depression score. Two individuals had outlying body
mass index scores. Two individuals had outlying social phobia symptoms scores. Six
individuals exhibited outlying cortisol data at any time-point. Each condition contained
two individuals with outlying cortisol data. All analyses were conducted with and without
outliers. The results did not change depending on whether or not the outliers were
included. Thus, the analyses reported in the results section included all cases.

Preliminary analyses DESCRIPTIVE analyses were conducted with Chi-squares,
ANOVAs, and paired \( t \)-tests. MANOVA’s were conducted to test the success of random
assignment, manipulation checks, and to identify covariates in the relationship between
feedback condition and cortisol levels. As suggested by previous findings of gender
differences in cortisol levels, gender was examined as both a covariate and a moderator
of the relationship between feedback valence and cortisol levels (e.g., Kirschbaum,
Kudielka, Gaab, Schommer, Hellhammer, 1999). BMI, menstrual cycle phase, social
phobia symptoms, and trait rumination were not significant predictors of cortisol levels
across time points or cortisol trajectory. Hence, they were not used as covariates in the
analyses. Please see Appendices K-L for bivariate correlations among key variables of
interest and potential covariates.

The hypotheses for the present study were examined using a two-pronged analytic
approach. Hypotheses 1-3 were tested using area under the curve (AUC) measures of
cortisol as well as multilevel models to predict cortisol response patterns. Both
procedures were used in order to capitalize on the strengths and compensate for the
limitations of each individual technique. The two techniques tested the general outcome
(i.e., cortisol responses), but each contribute different information related to the influence
of feedback valence and state rumination on cortisol levels. Although total cortisol exposure is important to capture, AUC analyses do not allow one to understand the cortisol response trajectory. Understanding patterns of cortisol responses (e.g., magnitude and rate of reactivity and recovery) for the different groups may also be important for understanding HPA axis functioning (e.g., Travison, O’Donnell, Araujo, Matsumoto, & McKinlay, 2007; Walker, Söderberg, Lindahl, & Olsson, 2000). Hence, multilevel analyses were conducted to capture cortisol levels associated with different parts of the stress reactivity and recovery processes. Due to the temporal nature of the cortisol samples, the direct and indirect relationships between feedback type and cortisol levels, and potential mediation by state rumination scores during the recovery period after the stressor were analyzed using multilevel modeling procedures (e.g., Singer & Willet, 2003). This method of analysis allows for examination of both within and between subject variability and allows for the investigation of change patterns in cortisol responses over time.

Area under the curve (AUC) calculations reflected overall cortisol exposure from the Baseline through the Recovery time-points (Cortisol Samples #2-5; for formula, see Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). AUC with respect to ground (AUCg) analyses yield a gross estimation of cortisol exposure across the four samplings after the pre-baseline period by calculating the area below the data points on a graph of individuals’ cortisol levels at each time point (Linden, Earle, Gerin, & Christenfeld, 1997). This procedure was selected due to its use in previous studies examining cortisol and health outcomes, as well as the large number of studies linking
total cortisol exposure to adverse health outcomes (e.g., Reynolds, Syddall, Walker, Wood, & Phillips, 2003; Ferrari, Firavanti, Magri, & Solerte, 2000; Pruessner, Pruessner, Hellhammer, Pike, & Lupien, 2007). The calculated AUC₉ values were then compared using a step-wise ordinary least squares regression analysis with three steps to examine the relationships among feedback valence, state rumination, gender, and cortisol exposure. Cortisol AUC₉ was identified as the dependent variable and gender was included as a predictor. The steps for predictor inclusion were defined as follows: 1) gender, 2) dummy coded condition membership, and 3) state rumination. Only individuals with complete cortisol data (n = 105) were included in the AUC₉ analyses.

The multilevel modeling analyses were completed using the SAS 9.3 (SAS Institute Inc., Cary, NC) PROC MIXED procedure. A level-one submodel examined within-subject differences in cortisol levels over the course of the experiment; and a level-two submodel examined the between-subjects variability among patterns of change in cortisol levels over the course of the study. The time points in the study that were used in analyses were defined as follows: 0 minutes = Baseline Cortisol (sample #2), 15 minutes = Stressor Cortisol (sample #3), 30 minutes = Post-feedback Cortisol (sample #4), 45 minutes = Recovery Cortisol (sample #5). Feedback type, gender (male=1), and state rumination were entered into the models as level-two predictors of overall cortisol exposure (i.e., no interaction with time) and predicted cortisol response patterns (e.g., linear, quadratic slopes). A maximum likelihood random coefficients model was used in all multilevel modeling analyses in order to allow individual intercepts to vary, as is suggested for best model fit (Littell, Pendergast, & Natarajan, 2000). All continuous
variables included in the multilevel models were centered on the mean in order to avoid the inherent multicollinearity involved in examining interaction terms in higher order models (e.g., quadratic models). All analyses were computed with an unstructured model type, which allows a model to be determined by the data rather than forcing it into a predetermined pattern. Analyses investigating interaction terms also included the corresponding lower order terms (i.e., both time and condition were included when examining the interaction of time by condition).

If direct effects for feedback condition and state rumination are found, mediation analyses discussed in hypothesis 3 would be performed according to the standards outlined by Preacher and Hayes (2008) and Bauer, Preacher, and Gill (2006) for the multi-level mediation analyses. This set of analyses would test state rumination as a potential mediator in the relationship between feedback valence and cortisol levels in response to an evaluative stressor. The independent indirect effects of feedback valence on cortisol levels through state rumination would be examined using bootstrapping methods (Preacher & Hayes, 2008).
Chapter 3: Results

Equivalence of Groups

In order to evaluate the success of random assignment to the experimental groups on a number of key factors, MANOVAs were used to test for equivalence between groups (see Table 2). One MANOVA examined the relationship between condition assignment and baseline variables: BMI, baseline cortisol levels, social phobia symptoms, depressive symptoms, trait rumination, participant wake time before the experiment, overall self-reported health, and the session start time. All variables, with the exception of depressive symptoms, were not significantly related to condition assignment ($F$s < 2.17, $p$s > .12). Depressive symptom scores were significantly related to condition assignment ($F(2, 94) = 4.35, p = .04$, partial $\eta^2 = 0.07$). Specifically, a Tukey’s test revealed that those in the Praise condition exhibited significantly higher levels of depressive symptoms than those in the Neutral feedback condition ($Mean\ Difference = 1.80, SE = 0.69, p < .03$). A separate analysis revealed that the three feedback conditions marginally differed by compensation type ($\chi^2 = 6.08, p = .05$), with a majority of those in the Praise condition compensated with cash (Praise: Cash = 25, Credit = 17) and a majority of those in the Neutral condition compensated with credit (Neutral: Cash = 13, Credit = 27; Criticism: Cash = 19, Credit = 24). A follow-up analysis revealed that compensation type was not significantly related to cortisol exposure. Hence, compensation type was not included as a covariate in subsequent analyses.
Table 2.

Descriptive statistics for demographic and psychological variables.

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<th>Baseline Cortisol</th>
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<td>3.66</td>
<td>2.14</td>
</tr>
<tr>
<td>Neutral</td>
<td>n</td>
<td>35</td>
<td>35</td>
<td>29</td>
<td>34</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>24.30</td>
<td>4.17</td>
<td>8:26AM</td>
<td>11.19</td>
<td>44.83</td>
<td>9.95</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>4.43</td>
<td>0.79</td>
<td>1:31</td>
<td>8.05</td>
<td>3.68</td>
<td>3.43</td>
</tr>
<tr>
<td>Total</td>
<td>n</td>
<td>115</td>
<td>115</td>
<td>102</td>
<td>111</td>
<td>121</td>
<td>122</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>23.86</td>
<td>4.14</td>
<td>8:25AM</td>
<td>11.42</td>
<td>44.46</td>
<td>9.27</td>
</tr>
<tr>
<td></td>
<td>SD</td>
<td>4.49</td>
<td>0.74</td>
<td>1:45</td>
<td>7.69</td>
<td>3.67</td>
<td>2.97</td>
</tr>
</tbody>
</table>

*Note.* Perceived overall health was rated on a scale in which 1 = very poor and 5 = excellent.
Table 3.

*Descriptive statistics for stressor-related variables.*

<table>
<thead>
<tr>
<th></th>
<th>Stressor</th>
<th>Perceived Effort of Stressor</th>
<th>Perceived Challenge of Stressor</th>
<th>Perceived Threat of Stressor</th>
<th>Perceived Stressor Evaluation</th>
<th>Participant Perceived Performance</th>
<th>Video Rater Perceived Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cortisol</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Praise</td>
<td>$n$</td>
<td>35</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
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<td></td>
<td>$M$</td>
<td>13.17</td>
<td>10.93</td>
<td>11.18</td>
<td>9.13</td>
<td>10.00</td>
<td>7.20</td>
</tr>
<tr>
<td></td>
<td>$SD$</td>
<td>7.26</td>
<td>2.47</td>
<td>3.96</td>
<td>4.27</td>
<td>2.86</td>
<td>5.28</td>
</tr>
<tr>
<td>Criticism</td>
<td>$n$</td>
<td>40</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>$M$</td>
<td>12.25</td>
<td>11.12</td>
<td>10.86</td>
<td>11.07</td>
<td>11.07</td>
<td>6.67</td>
</tr>
<tr>
<td></td>
<td>$SD$</td>
<td>8.90</td>
<td>2.07</td>
<td>3.59</td>
<td>4.84</td>
<td>2.42</td>
<td>4.57</td>
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<tr>
<td>Neutral</td>
<td>$n$</td>
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<td>39</td>
<td>39</td>
<td>39</td>
<td>39</td>
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<td>$M$</td>
<td>12.93</td>
<td>10.44</td>
<td>10.47</td>
<td>10.10</td>
<td>9.69</td>
<td>6.95</td>
</tr>
<tr>
<td></td>
<td>$SD$</td>
<td>7.98</td>
<td>2.48</td>
<td>4.08</td>
<td>5.04</td>
<td>3.33</td>
<td>4.52</td>
</tr>
<tr>
<td>Total</td>
<td>$n$</td>
<td>112</td>
<td>121</td>
<td>121</td>
<td>121</td>
<td>121</td>
<td>121</td>
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<td>10.83</td>
<td>10.83</td>
<td>10.12</td>
<td>10.27</td>
<td>6.93</td>
</tr>
<tr>
<td></td>
<td>$SD$</td>
<td>8.05</td>
<td>2.34</td>
<td>3.85</td>
<td>4.76</td>
<td>2.92</td>
<td>4.77</td>
</tr>
</tbody>
</table>


A second MANOVA was conducted to examine relationships between condition assignment and stressor-related variables (see Table 3). Null findings were expected in this series of analyses because each participant across conditions was exposed to the same stressor task procedure and the feedback manipulation occurred after the stressor. The first analysis examined whether condition assignment predicted observer-rated speech performance, participant-determined overall performance appraisals, peak stressor cortisol levels, and/or participant-perceived effort during the stressor task, as well as to what degree participants perceived the stressor task as challenging, threatening, and evaluative. There were no significant differences between assigned feedback conditions for any of these variables ($F$s < 1.70, $p$s > .20).

Taken together, these results suggest that random assignment was generally successful, albeit with the exception of the results regarding depressive symptoms. Based on these results, depressive symptom scores were considered as a covariate in all analyses. However, the inclusion of depressive symptoms did not meaningfully or statistically alter the results. Hence, the results reported below do not include depressive symptoms in the models to allow for greater ease of understanding.

**Manipulation Checks**

**Cortisol stress reactivity.** A repeated measures ANOVA was conducted in order to test that participants exhibited peak cortisol levels during the stressor task that were statistically higher than cortisol levels observed at baseline. Across all groups, individuals’ stressor-related cortisol levels ($M = 12.70$, $SD = 8.04$) were higher than baseline cortisol ($M = 11.38$, $SD = 7.66$), and this difference was statistically significant.
according to a repeated measures ANOVA \((F(1, 107) = 10.81, p = .001, \text{partial } \eta^2 = 0.09)\), which included both the Baseline (sample #2) and Stressor cortisol (sample #3) values. This result indicates that the stressor was successful in activating the HPA axis.

**Feedback appraisals.** The effect of feedback condition on participant feedback appraisals were examined using a MANOVA, including whether participants perceived the feedback as threatening, challenging, accurate, as well as the degree to which they attended to the feedback and the perceived feedback valence (i.e., positive or negative). As shown in Table 4, main effects of feedback condition were found for all appraisal variables (all \(Fs > 3.74, ps < .03\)). Specifically, pairwise comparisons revealed that the feedback in the Praise condition was perceived as more positive than the Neutral (\(\text{Mean Difference} = 5.64, SE = 0.35, p < .001\)) or Criticism conditions (\(\text{Mean Difference} = 9.90, SE = 0.35, p < .001\)) respectively, which was consistent with expectations for the experimental manipulation. The feedback in the neutral condition was also rated as more positively valenced than that in the Criticism condition (\(\text{Mean Difference} = 4.26, SE = 0.35, p < .001\)). In other words, the feedback valence manipulation was successfully perceived as intended. Likewise, participants perceived the feedback in the Criticism condition as more threatening than the Neutral (\(\text{Mean Difference} = 1.52, SE = 0.56, p = .02\)) or Praise (\(\text{Mean Difference} = 3.90, SE = 0.56, p < .001\)) conditions respectively. The Neutral condition also rated the feedback as more threatening than those in the Praise condition (\(\text{Mean Difference} = 2.38, SE = 0.57, p < .001\)). Those in the Praise condition perceived the feedback to be more helpful for the future than those in the Criticism condition (\(\text{Mean Difference} = 2.24, SE = 0.82 p < .02\)). Those in the Criticism feedback
Table 4.

*Differences in post-feedback appraisals by condition.*

<table>
<thead>
<tr>
<th>Condition</th>
<th>Praise Mean (SD)</th>
<th>Neutral Mean (SD)</th>
<th>Criticism Mean (SD)</th>
<th>Tukey’s Pairwise Comparisons</th>
</tr>
</thead>
</table>
| Feedback as threatening          | 1.70 (1.77)      | 4.08 (2.79)       | 5.60 (3.24)         | Praise vs. Neutral, *p < .01*  
Praise vs. Criticism, *p < .01*  
Criticism vs. Neutral, *p < .05* |
| Perceived valence of feedback    | 10.93 (1.40)     | 5.28 (1.62)       | 1.02 (1.67)         | Praise vs. Neutral, *p < .01*  
Praise vs. Criticism, *p < .01*  
Criticism vs. Neutral, *p < .01* |
| Feedback as challenging          | 9.63 (2.41)      | 8.31 (3.64)       | 7.38 (4.57)         | Praise vs. Neutral, *NS*  
Praise vs. Criticism, *p < .05*  
Criticism vs. Neutral, *NS* |
| Perceived accuracy of feedback   | 6.10 (3.14)      | 8.08 (2.54)       | 8.36 (3.42)         | Praise vs. Neutral, *p = .01*  
Praise vs. Criticism, *p < .01*  
Criticism vs. Neutral, *NS* |
| Perceived ability to attend to feedback | 10.78 (1.46) | 8.72 (2.53)       | 9.26 (3.07)         | Praise vs. Neutral, *p < .01*  
Praise vs. Criticism, *p < .05*  
Criticism vs. Neutral, *NS* |
condition viewed the feedback as more accurate than those in the Praise condition (Mean Difference = 2.26, SE = 0.68, p = .003). Those in the Neutral condition viewed feedback as more accurate than those in the Praise condition (Mean Difference = 1.98, SE = 0.69, p < .02). Lastly, those in the Praise condition were better able to attend to the feedback than those in the Criticism (Mean Difference = 1.51, SE = 0.54, p < .02) or Neutral conditions (Mean Difference = 2.06, SE = 0.55, p = .001) respectively. Please see Table 9 for bivariate correlations among feedback appraisals, overall performance ratings, and state rumination scores.

A separate MANOVA was conducted to examine the differences in feedback appraisals by gender. Additionally, there was a main effect of gender on whether participants perceived the feedback as threatening (F(1, 119) = 14.04, p < .001, partial η² = 0.11) and the degree to which they were able to attend to the feedback (F(1, 119) = 4.975, p = .03, partial η² = 0.04). Specifically, women rated the feedback as more threatening (Men: M = 2.82, SE = 0.38; Women: M = 4.83, SE = 0.38) and reported attending less to the feedback than men (Men: M = 10.10, SE = 0.33; Women: M = 9.07, SE = 0.33). The interaction between gender and condition assignment was a non-significant predictor of the feedback-related variables (F’s < 1.75, p’s > .18). There were no other significant gender differences in feedback appraisals and gender, and condition assignment did not interact to predict any of the feedback-related appraisals (F’s < 1.75, p’s > .18).
Main Outcomes

Multilevel model and area under the curve (AUC) analyses were conducted to test the hypotheses that: (1) criticism would be associated with higher cortisol levels maintained over the recovery period; 2) praise would be associated with lower cortisol levels maintained over the recovery period; and 3) rumination would mediate the relationship between feedback type and cortisol.

State rumination. A one-way ANOVA was conducted to establish the relationship between feedback valence and state rumination following feedback delivery. As expected (Hypothesis 3b), the results indicated that feedback valence significantly predicted state rumination levels ($F(2, 117) = 7.57, p = .001$, partial $\eta^2 = 0.115$). In line with expected trends, pairwise comparisons demonstrated that those in the Criticism condition reported more state rumination following feedback delivery than those in the Praise condition ($Mean$ $Difference = 5.01, SE = 1.31, p = .001$) or the Neutral condition ($Mean$ $Difference = 3.38, SE = 1.33, p = .03$). There was no statistically significant difference between the Praise and Neutral conditions regarding state rumination. Stated simply, those in the Criticism condition reported the most state rumination followed by those in the Neutral and Praise conditions.

There was also a main effect of gender on state rumination, with women reporting greater state rumination than men ($F(1, 114) = 10.41, p < .01$; Women: $M = 7.47, SD = 6.96$; Men: $M = 3.92, SD = 4.98$). Gender and condition did not interact to predict state rumination.
**Multilevel models.** As anticipated, the cortisol response patterns were best fit overall by a quadratic model, which indicate a peaked cortisol response, or reactivity, time X time \( b = -0.00025, SE = 0.000052, t(320) = -4.78, p < .001 \). As shown in Figure 2, the peak cortisol concentration fell between the second and third time points, or approximately 15 minutes after the stressor. An examination of slope coefficients centered at the second and third time points also indicate a change in trajectory. Specifically, the coefficient at the second time point was positive indicating that cortisol levels were increasing \( b = 0.005964, SE = 0.00245 \). At the third time point the coefficient was negative \( b = -0.00149, SE = 0.001054 \), indicating cortisol levels were decreasing.

Across feedback valence conditions, gender was a significant predictor of cortisol trajectory over time \( F(1,320) = 6.34, p = .01 \). Specifically, and significantly greater quadratic cortisol trajectories relative to women \( b = 0.000259, SE = 0.000103, t(320) = 2.52, p = .01 \); see Figures 3 and 4). In other words, men had more peaked cortisol response patterns than women.
In contrast to hypotheses 1 and 2, there was no significant main effects of feedback condition cortisol levels across time points or over time regardless of whether time was modeled as linear or quadratic effect (all $F$’s < 1.5, all $p$’s > .20). These results did not change with the inclusion for stressor cortisol levels as a covariate, controlling for reactivity. However, gender and condition interacted to marginally predict cortisol over time ($F(2,320) = 2.91, p = .06$). Exploratory follow-up analyses were conducted to examine the effect of feedback on men’s and women’s cortisol trajectories separately to guide future research. For men, the cortisol response pattern in the Criticism condition
differed significantly from the Praise condition ($\beta = -0.00045$, $SE = 0.000216$, $t(154) = -2.06$, $p = .04$). None of the other contrasts performed were significant for men or women.

**Figure 3.** Raw cortisol values for men only across feedback conditions. Error bars represent standard errors of group cortisol means at each time point.
Figure 4. Raw cortisol values for women only across feedback conditions. Error bars represent standard errors of group cortisol means at each time point.

There was no direct effect of state rumination on cortisol trajectory when state rumination was entered into the model with time alone ($F(1,312) = 0.55, p = .46$) or on cortisol levels across time points when it was entered into model with feedback valence condition and gender ($F(1,110) = 0.25, p = .62$). Thus, hypothesis 3a was not supported. Given that there was no significant main effect of feedback condition on cortisol and no significant effect of state rumination on cortisol, state rumination was not further examined as a mediator.
**Area under the curve (AUC) analyses.** Area under the curve analyses using linear regressions were conducted to examine the impact of feedback type on overall cortisol exposure from baseline (sample #2) through recovery (sample #5). Gender was also examined as a covariate and as a moderator. With gender included as a covariate, the results indicated that feedback condition did not significantly account for variability in the area under the curve ($F(2, 95) = 1.19, p = .31, r^2 = .07$). In other words, condition assignment was not related to cortisol exposure over the course of the study, consistent with the results of the multi-level model analyses. When gender was examined as a moderator (i.e., interaction between gender and condition), results remained non-significant ($F(2, 100) = 0.07, p = .93, r^2 = .03$). Additionally, the results of the regression analyses did not change after controlling for baseline cortisol. Because Hypotheses 1 and 2 were not supported, mediation analyses regarding the role of state rumination in the relationship between condition assignment and cortisol exposure were not conducted.

A post hoc power analysis of the linear regression model with the gender, condition, and state rumination as predictors and cortisol exposure (i.e., area under the curve) as the dependent variable indicated that the current study exhibited adequate power of 71% (GPower Statistical Power Analysis program version 3.1.9.2.; Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, & Lang, 2009).

**Exploratory analyses.** Exploratory correlational analyses were performed in an effort to better understand the relationships between state rumination, feedback appraisals, and cortisol exposure. See Table 5 for bivariate correlations among overall observer-rated performance, state rumination, cortisol exposure (AUC), perceived
feedback valence, threatening feedback rating, challenging feedback rating, feedback accuracy, and attention to feedback. Several correlation coefficients are worth noting. First, none of the variables were related to total cortisol exposure. Certain feedback appraisal domains were related to state rumination. Specifically, greater threat and increased perceived accuracy of feedback predicted greater state rumination ($r = .37$ and $r = .28$, respectively). In addition, observer-rated performance was negatively related to state rumination ($r = -.31$). This indicates that participants who exhibited greater performance on the speech stressor also tended to ruminate less after it was over.
Table 5.

*Bi-variate correlations among feedback- and stressor-related variables.*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tbody>
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<td>1. Overall Performance</td>
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<td></td>
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<tr>
<td>2. State Rumination</td>
<td>-.31**</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3. Perceived Feedback Valence</td>
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<td>-.35***</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Perceived Feedback as Threatening</td>
<td>-.08</td>
<td>.37***</td>
<td>-.56***</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>5. Perceived Feedback as a Challenge</td>
<td>.13</td>
<td>-.05</td>
<td>.27**</td>
<td>-.18*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Perceived Feedback Accuracy</td>
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<td>.28**</td>
<td>-.26**</td>
<td>&lt;.01</td>
<td>.32***</td>
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<tr>
<td>7. Attention to Feedback</td>
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<td>-.12</td>
<td>.28**</td>
<td>-.28**</td>
<td>.47***</td>
<td>.09</td>
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<tr>
<td>8. Cortisol Exposure (AUC)</td>
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<td>.05</td>
<td>&lt;.01</td>
<td>-.05</td>
<td>-.02</td>
<td>-.01</td>
<td>.02</td>
</tr>
</tbody>
</table>

*Note.* *** p < .001; ** p < .01; * p < .05
Chapter 4: Discussion

The primary aim of this study was to examine the relationship between performance feedback valence and cortisol recovery following a speech stressor. Criticism was expected to be associated with higher recovery cortisol (Hypothesis 1) and Praise was expected to be associated with lower recovery cortisol (Hypothesis 2). Additionally, state rumination following the receipt of feedback was expected to mediate the relationship between feedback type and cortisol exposure and trajectory (Hypothesis 3). Specifically, we expected a positive relationship between state rumination and cortisol levels (Hypothesis 3a) and an inverse relationship between state rumination and feedback valence (criticism = 0, neutral = 1, praise = 2; Hypothesis 3b).

Overall, the hypotheses were not supported. Individuals in the Praise condition did not exhibit lower cortisol exposure or lower cortisol over the recovery period, and those in the Criticism condition did not exhibit higher cortisol exposure or higher cortisol over the recovery period. However, the results suggested a marginally significant effect of feedback type on cortisol trajectory in men only. Specifically, men in the criticism condition exhibited higher cortisol trajectories than those in the Praise condition. Given the non-significant direct effects, the mediating role of state rumination in the feedback-cortisol association (Hypothesis 3) was not tested. However, Hypothesis 3b was supported, consistent with expectations.

A number of factors may have contributed to these null findings and are worth considering. In particular, the robustness of the cortisol response to the stressor task, the robustness of the feedback valence manipulation, differences in feedback appraisals,
differences in state rumination by condition, gender differences in cortisol, and gender differences in state rumination.

**Cortisol Responses**

The relationship between cortisol output and feedback valence was null in the current study, inconsistent with the previous study conducted by Earle and colleagues (1999), which found that negative feedback or harassment during a mental arithmetic task enhanced individuals’ cortisol responsivity compared to those who were not exposed to negative verbal feedback. One key difference in the current study over that performed by Earle and colleagues (1999) is that they delivered feedback during the stressor itself rather than following the performance, which may have boosted the robustness of responsivity to the stressor.

A related explanation for this finding may be limited robustness of the mean cortisol response to the speech stressor. The results illustrate that the speech stressor was associated with an increase from baseline salivary cortisol, which was followed a decrease in salivary cortisol over the recovery period, 30 minutes after the peak cortisol value was observed. However, the difference between Baseline and peak Stressor cortisol levels fell below an empirically derived cut-off regarding a sufficient cortisol reactivity to be considered cortisol responders versus non-responders, which has been validated by Miller, Plessow, Kirschbaum, and Stalder (2013) at either a 1.5nmol/L or 15.5% increase from baseline to peak stress-induced cortisol levels. The difference between baseline and peak cortisol values for the total current sample fell short of those cut-offs at 1.3nmol/L, or a 12% increase from baseline. Hence, the limited robustness of
the cortisol response to the stressor in the current study may have interfered with participants’ physiological responses to the study manipulation. It is worth noting that the study conducted by Miller and colleagues (2013) utilized the full TSST as the stressor, which included both the speech and arithmetic components, which is different from the stressor used in the current study.

Alternatively, it is possible that the feedback manipulation was not robust enough to overcome the social evaluative threat stressor, which may have overshadowed the subtler differences between the three feedback scripts. The feedback was presented approximately only two minutes after the stressor task, which may have been too short a period for participants to recover from the SET of the speech stressor task before receiving the feedback. The speech stressor itself may have been perceived as so socially evaluative that all the feedback conditions were experienced as evaluative by proximity to the stressor task.

Future studies might enhance the potency of the stressor by asking participants to perform the full TSST rather than the speech stressor task alone (e.g., Miller et al., 2013; Kirschbaum et al., 1993). Additionally, it may improve the robustness of the feedback if participants were provided an extended rest period following the speech stressor in order to separate the evaluative effect of the stressor from the experience of receiving feedback. This would also allow researchers to examine the unique cortisol responses to the different types of performance feedback.
**Effect of Condition on Cortisol in Men**

The results of the current study suggested men in the Criticism condition exhibited higher cortisol trajectories than those in the Praise condition. This finding was in the hypothesized direction, but limited only to men. This may suggest that the performance feedback manipulation delayed cortisol recovery from the stressor in men in the Criticism condition compared to men in the Praise condition. However, the exact nature of this relationship and the mechanisms remain unclear. Gender differences in feedback appraisals and physiological reactivity may provide additional explanation for the marginal finding for men in the Criticism condition. As the effect of feedback valence on cortisol concentrations in men were only marginally significant in the current sample, these post-hoc analyses were not attempted.

**Gender and feedback appraisals.** One explanation for why this pattern was found in men and not women may be related to gender differences in the feedback appraisals. Men and women exhibited two key differences with regard to their appraisals of the feedback. Women rated the feedback, across conditions, as more threatening than men, and also rated their ability to attend to the feedback lower than men. It is possible that women reported lower attention to feedback because they found it to be more threatening. According the findings by Nease and colleagues (1999), individuals receiving criticism were more likely to discount the feedback. Hence, the women in this study may have found it more difficult to attend to the feedback because they perceived it as more threatening than did men. Future research may investigate further into the
mechanisms underlying the gender differences in feedback appraisal, as it may also influence physiological reactions to the stressor and/or manipulated factors.

**Gender and cortisol.** In addition to the differences in feedback appraisals, gender differences in cortisol reactivity in the current study may partially explain the marginal elevation of cortisol trajectory in men in the Criticism condition. Men also have been shown to exhibit greater cortisol reactivity to performance tasks (for review, see Dedovic, Wadiwalla, Engert, & Pruessner, 2009). This finding in the literature is consistent with the findings in the current study, in which men exhibited significantly higher peak cortisol than women. Additionally, both evaluators in the speech task and the feedback delivery were female. This may have contributed to a differential cortisol response by gender because men were exposed to evaluators of the opposite sex while women were exposed to evaluators of the same sex.

Further, monthly hormone fluctuations associated with a woman’s menstrual cycle can influence the magnitude of a woman’s cortisol response to stress (Kirschbaum, Ku¨dierka, Gaab, Schommer, Hellhammer, 1999). Although the present study excluded women using birth control medication and women in either menstrual phase were evenly distributed among the conditions, this data was based on self-reported cycle duration and date of the first day of individuals’ last menstruation. Additionally, menstrual phase was not hormonally tested, which would reduce the potential error inherent in self-report data. Research has shown that women in the luteal phase of the menstrual cycle tend to exhibit salivary cortisol responses to stressors similar to men, and women in the follicular phase tend to exhibit attenuated or blunted salivary cortisol responses (e.g., Dedovic et al.,
Self-reported menstrual cycle has displayed limited accuracy in the literature (e.g., Jukic, et al., 2007; Small, Manatunga, & Marcus, 2007). Hormone testing for menstrual phase would vastly improve measurement accuracy and allow for menstrual phase to be examined as a potential covariate of cortisol response patterns. Future studies examining cortisol and verbal feedback might both exclude women taking birth control medication and include only women who hormonally test within the luteal stage of their cycles.

**Null Effect of State Rumination on Cortisol**

State rumination did not significantly relate to cortisol exposure or affect the relationship between feedback valence and cortisol exposure and/or trajectories. This finding contrasts with other studies that have found an association between state rumination and cortisol. Specifically, a number of studies have demonstrated a positive relationship between state rumination and cortisol levels (e.g., McCullough et al., 2007; Zoccola et al., 2010; Gianferante et al., 2014; Zoccola et al., 2014). Conversely, a number of studies have also found mixed or null results with regard to the relationship between state rumination and cortisol levels (e.g., Denson et al., 2009; Kuehner et al., 2009; Zoccola et al., 2011).

One consideration for these null rumination-cortisol results may lie in the study design. Participants were given two minutes alone in a silent room after completing post-feedback questionnaires, with no instruction other than they were allowed to rest for two minutes. Although there were differences in state rumination between experimental groups in the expected direction, it is possible that this was not enough time to influence
the HPA axis sufficiently to reflect differences among the conditions in participants’ spontaneous rumination on their performance and the feedback. Zoccola and colleagues (2008) provided a 10 minute period to allow for spontaneous rumination and found a relationship in the social evaluative threat condition between post-task rumination and cortisol concentrations.

Another explanation for the null rumination-cortisol results may lie in the ordering of when participants completed the post-feedback appraisals. Glynn, Christenfeld, and Gerin (2002) suggest that completing questionnaires may distract participants from engaging in rumination in response to a stressor. In the present study, participants completed the post-feedback appraisals immediately after receiving feedback and were provided a two minute rest period afterward in order to allow opportunity for spontaneous rumination. Researchers examining state rumination in response to a stressor may design future studies to be more conducive to eliciting rumination. That may entail providing a longer period during which participants may spontaneously ruminate, avoiding distraction with questionnaires, or incorporating other factors that may influence a person’s likelihood to ruminate. In sum, future studies may provide participants with more time to spontaneously ruminate about their feedback with as few distractions as possible in order to enhance the potential to detect an effect of state rumination on cortisol concentrations.

**Gender and rumination.** The results of the current study indicated a significant relationship between gender and rumination, with women reporting greater state rumination than men after the stressor and feedback delivery. This is in line with
previous findings, which have observed small to moderate gender differences in rumination levels with women exhibiting higher stressor-related rumination scores (e.g., Butler, & Nolen-Hoeksema, 1994; Rydstedt, Cropley, Devereux, & Michalianou, 2009; Thomsen, Mehlsen, Viidik, Sommerlund, & Zachariae, 2005; Nolen-Hoeksema, Larson, & Grayson, 1999; Nolen-Hoeksema, & Aldao, 2011; Tamres, Janicki, & Hegelson, 2002). Furthermore, some studies suggest that women tend to use more emotion regulation strategies in general than men, including rumination as well as more adaptive coping strategies (Nolen-Hoeksema & Aldao, 2011; Tamres, Janicki, Hegelson, 2002). In a study conducted by Nolen-Hoeksema and Aldao (2011), in which the emotion regulation strategies of young, middle age, and older men and women were examined in relation to depressive symptoms, gender differences in emotion regulation strategies remained even after accounting for self-reported depressive symptoms. This suggests that the relationship between gender and emotion regulations strategies is not solely reflective of higher depressive symptom rates in women (e.g. Nolen-Hoeksema & Aldao, 2011; Radloff, 1975; Radloff, & Rae, 1979; Tamres, Janicki, Hegelson, 2002). Although higher levels of rumination are associated with higher depressive symptom report, the relationship between gender and rumination found in the current study may be indicative of an expected gender difference rather than a hallmark of the presence of depressive symptoms.

**Reactions to Feedback**

Although participants’ perceived accuracy of feedback was not associated with cortisol exposure, the current results indicated a difference in perceived accuracy of
feedback between groups. Namely, participants in the Criticism and Neutral conditions viewed the feedback as more accurate than those in the Praise condition. This finding may suggest that the speech stressor is a fairly difficult and negative experience, as participants are only provided a few minutes to prepare a speech to be delivered to aloof evaluators. Thus, the accuracy ratings may reflect the participants’ perception of their performance as poorly prepared and executed.

Another explanation of this result may be gleaned from the work by Nease, Mudgett, and Quiñones (1999) examining the relationships between feedback valence, self-efficacy, and a participants’ acceptance of performance feedback. These researchers investigated self-efficacy as a moderator in the relationship between feedback valence and acceptance of feedback following a computer-based laboratory, Air Defense simulation task over three trials. Participants were presented with randomly assigned positive or negative text feedback on the computer regarding their performance on the task. Their results indicated that those with high self-efficacy who received repeated, negative performance feedback showed decreased acceptance of that feedback, whereas those with low self-efficacy did not change in their acceptance over time. In other words, those who reported high self-efficacy and experienced critical performance feedback reported less acceptance of the feedback. This result was different from those in the same condition who reported low self-efficacy, whose acceptance of the feedback did not change. Hence, self-efficacy may play a role in whether or not individuals are able to accept critical performance feedback. Although, the results of the current study indicated that those in the Criticism and Neutral feedback condition reported the feedback to be
more accurate than those in the Praise condition, contrary to the results found by Nease
and colleagues (1999).

However, participant self-efficacy about the speech stressor task may have
affected the perceived accuracy of the feedback. The elevated scores on social phobia
symptoms indicate that the participants in this sample may react differently to the
socially-evaluative stressor task and the verbal feedback in the current study than would a
sample without significantly elevated social phobia symptoms. The participants in
general sample of the current study may have, overall, had lower self-efficacy about the
socially-evaluative stressor task than a sample with lower scores on social phobia
symptoms. If individuals had lower self-efficacy regarding their ability to be successful
with the speech task, then the Criticism or Neutral feedback may have felt more accurate
than Praise. Future studies examining the impact of feedback on the stress response
might include self-efficacy as a potential moderator.

Strengths and Limitations

The current study served to augment the limited body of literature examining the
effect of performance feedback on cortisol concentrations. The findings also add to the
literature investigating the effect of rumination on cortisol reactivity to a stressor.
Strengths include the relatively large sample size for examining cortisol responses and
experimental manipulation of the performance feedback valence. However, some
limitations to the current study ought to be considered. First of all, the limited robustness
of the cortisol response to the laboratory stressor may have attenuated the impact of the
feedback manipulation on cortisol recovery and exposure. Furthermore, female
participants’ menstrual phase was not assessed hormonally but was assessed via self-report. If the phase data were inaccurate, the natural blunting effect in the cortisol response to a stressor common during the follicular phase in women may have influenced the strength of the relationships between cortisol levels and key outcome variables.

Additionally, the current sample was fairly homogenous, in that it was composed solely of undergraduate students. Future studies might examine other samples, such clinical and more culturally diverse samples. Further work might also explore other types of socially evaluative stressors, such as those encountered in daily life or the work environment.

**Conclusions**

The results of the current study did not support a direct relationship between feedback valence and cortisol exposure or trajectory following a speech stressor. However, the results hint at a potential gender difference in how men and women respond to different types of verbal performance feedback. Additional exploration into how perceptions of performance feedback are different among men and women may help clarify the effect of gender on physiological reactions to verbal feedback. State rumination did not mediate the relationship between feedback valence and cortisol exposure or trajectory regardless of gender. Further exploration would be important to determine if this remains true in clinical samples or in studies comparing high ruminators with low ruminators. In addition, future studies may benefit from the employment of a more salient stressor. Regardless, the current study is the first to examine the physiological impact of different types of verbal performance feedback, and though not
conclusive, the results suggest further exploration into the relationship between feedback valence and cortisol outcomes might be important.
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Appendix A: Demographics Questionnaire

Demographics

1. Age: _______________

2. Gender: M   F

3. What year are you in school? _______________

4. Are you a full-time or part-time student?   ____ Full-time   ____ Part-time

5. Expected graduation date (MM/YYYY): _______________

6. What is your ethnicity/cultural background (check all that apply)?
   ___ White/Caucasian
   ___ African American/Black
   ___ Asian/Pacific Islander
   ___ East/Asian Indian
   ___ Middle Eastern
   ___ Hispanic, Chicano/a, or Latino/a
   ___ American Indian, Aleutian, Native Hawaiian, or Native Alaskan
   ___ Multi-racial or multi-ethnic
   ___ Other ______________________

7. Do you have children?   Y   N

9. Please check all lines that describe your current citizenship status:
   ___ United States citizen
   ___ Permanent resident (green card)
   ___ Citizen of another country (specify ______________________)
   ___ Other status (specify ________________________________)

10. If your father is employed, please state his occupation:

     ______________________________

12. Estimated family income (of your parents’ household): (check one)
   ___ $ 15,000 or less/ year
   ___ $ 15,000 - $ 25,000/ year
   ___ $ 25,000 - $ 35,000/ year
   ___ $ 35,000 - $ 50,000/ year
   ___ $ 50,000 - $ 75,000/ year
   ___ $ 75,000 - $ 100,000/ year
13. Are you currently employed?
   ____ No
   ____ Yes (20 hours per week or less)
   ____ Yes (more than 20 hours per week)

Health behaviors

Do you have any current, chronic physical health problems?
   ____ NO       ____ YES
If yes, describe:
________________________________________________________________________
________________________________________________________________________

Are you on any prescription medication right now for any reason?
   ____ NO       ____ YES
If yes, describe the medication, the reasons for taking the medication, and
the length of time you need to take the medication (e.g., if for a few
weeks):
________________________________________________________________________
________________________________________________________________________

Are taking any non-prescription medication or supplements?
   ____ NO       ____ YES
If yes, describe the medication, the reasons for taking the medication, and
the length of time you need to take the medication (e.g., if for a few
weeks):
________________________________________________________________________
________________________________________________________________________

How would you describe your overall physical health on the following scale?
In general, how would you describe your general sleep quality?

Very Poor             Excellent

How much do you weigh? ____________________________

How tall are you? ________________________________

What time did you wake up this morning? ______________________

How many hours did you sleep LAST NIGHT? ________________

Describe how much of the following substances you have had since you woke up today.

<table>
<thead>
<tr>
<th>Substance Consumed</th>
<th>Amount Consumed</th>
<th>This is… (please check box)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee/ Tea</td>
<td>Number of cups:</td>
<td>☐ …typical.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ …more than usual.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ …less than usual.</td>
</tr>
<tr>
<td>Caffeinated Beverages (Sodas)</td>
<td>Number of cans:</td>
<td>☐ …typical.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ …more than usual.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ …less than usual.</td>
</tr>
<tr>
<td>Alcoholic Beverages Specify types:</td>
<td>Number of glasses:</td>
<td>☐ …typical.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ …more than usual.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ …less than usual.</td>
</tr>
<tr>
<td>Cigarettes</td>
<td>Number:</td>
<td>☐ …typical.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ …more than usual.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>☐ …less than usual.</td>
</tr>
</tbody>
</table>

Since you woke up this morning, how long did you do the following activities? Write hours and minutes. So, if you played soccer for 1 hour 30 minutes, write 1 in the hour column, and 30 in the minute column.

<table>
<thead>
<tr>
<th>Light Physical Activity. Examples of these might include standing, walking, light chores)</th>
<th>Hours</th>
<th>Minutes</th>
</tr>
</thead>
</table>
**Medium Physical Activity.**
Examples of this might include yard work, playing outside, and moderate sports

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**Hard Physical Activity.**
Examples of this activity might include things like jogging, soccer game, and stuff like that

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</table>

**Compared to how much you do on most days, in terms of today’s activities, it was…**
(please check the appropriate box)

- [ ] …a typical day.
- [ ] …a day when I did more activity than usual.
- [ ] …a day when I did less activity than usual.

**Did you experience any stressful events today?**

- [ ] Yes
- [ ] No

If yes, describe briefly:

________________________________________________________________________
________________________________________________________________________

**In terms of stress, has your day so far been…**

- [ ] …a typical day?
- [ ] …more stressful than usual?
- [ ] …less stressful than usual?

For females:

13. Using the calendar provided*, when was the first day of your last menstrual period? Please give your best estimate.

Date: __________________________

14. Often, women's cycles are about 28 days, but this widely varies. Approximately how many days is your cycle? Note, this is different from the number of days of your period.

_____ days

**Appendix B: Pre-Speech Appraisals**

**Pre-Speech Appraisals**

1. How threatening do you expect the upcoming speech task to be?

* Calendars of current and prior month provided.
2. I feel:  
1  2  3  4  5  6  
not at all anxious  very anxious

3. Regarding the speech task, I feel:  
1  2  3  4  5  6  
not at all worried  very worried

4. How able are you to cope with this task?  
1  2  3  4  5  6  
not at all  very much

5. I expect to perform:  
1  2  3  4  5  6  
very poorly  very well

6. I feel:  
1  2  3  4  5  6  
not at all confident  very confident

7. Regarding the speech task, I feel:  
1  2  3  4  5  6  
very incompetent  very competent

8. My performance on this task is important to me:  
1  2  3  4  5  6  
not at all  very true of me

9. My performance on this task is not important to me:  
1  2  3  4  5  6  
not at all  very true of me

10. I don’t care about my performance on this task.  
1  2  3  4  5  6  
not at all  very true of me
11. I think the panelists will positively evaluate my performance:
   1  2  3  4  5  6
   not at all              very much

12. I think the panelists will negatively evaluate my performance:
   1  2  3  4  5  6
   not at all              very much

13. I think the evaluators will like my performance.
   1  2  3  4  5  6
   not at all              very much
Appendix C: Post-Speech Appraisals

Post-Speech Appraisals
Please indicate your impressions of the speech task you just completed.

1. This task was:
   1 2 3 4 5 6 7
   Not very Difficult
   Very Difficult

2. During the task, I:
   1 2 3 4 5 6 7
   Tried hard Didn’t try hard

3. I wanted to give up during the task.
   1 2 3 4 5 6 7
   Not at all Very much

4. During the task, I felt:
   1 2 3 4 5 6 7
   Not at all Confident
   Very Confident

5. Overall, I thought the task was a good CHALLENGE.
   1 2 3 4 5 6 7
   Not at all Very much

6. I found the task mentally stimulating.
   1 2 3 4 5 6 7
   Not at all Very much

7. Overall, I thought the task was THREATENING.
   1 2 3 4 5 6 7
   Not at all Very much

8. Overall, I thought the task was STRESSFUL.
   1 2 3 4 5 6 7
   Not at all Very much

9. I felt relaxed during the task.
   1 2 3 4 5 6 7
   Not at all Very much
10. I felt judged by the evaluators.

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<th>6</th>
<th>7</th>
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<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Very much</td>
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11. My performance on the speech was being evaluated by others during the task.

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<tr>
<td></td>
<td>Not at all</td>
<td>Very much</td>
<td></td>
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12. How do you think the evaluators rated your performance overall?

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<th>7</th>
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<tbody>
<tr>
<td></td>
<td>Very poor</td>
<td>Average</td>
<td>Very excellent</td>
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13. How effective do you think you were in convincing those around you that you should get the job you were applying for in your speech?

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<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Very effective</td>
<td></td>
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14. Overall, I thought I performed well:

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<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Very much</td>
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15. Overall, I thought I performed poorly:

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</thead>
<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Very much</td>
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Appendix D: Post-Feedback Appraisals

Post-Feedback Task Appraisals
Please indicate your impressions of the feedback you just received.

1. Overall, the feedback I received was:

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<tr>
<th>1</th>
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<th>5</th>
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<tbody>
<tr>
<td>Very Negative</td>
<td>Very Positive</td>
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</table>

2. The panelists praised my performance.

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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
<td></td>
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</table>

3. The panelists criticized my performance.

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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
<td></td>
<td></td>
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</table>

4. Overall, I thought the feedback was STRESSFUL.

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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
<td></td>
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</table>

5. Overall, I thought the feedback was THREATENING.

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<th>4</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
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</table>

6. I felt relaxed during feedback.

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<th>3</th>
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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
<td></td>
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</table>

7. Overall, I thought the feedback was USEFUL.

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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
<td></td>
<td></td>
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</table>

8. I was able to learn from the feedback.

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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. The feedback will be helpful for me in the future.
   1 2 3 4 5
   Strongly Strongly
   Disagree Agree

10. Overall, I thought the feedback was ACCURATE.
    1 2 3 4 5
    Strongly Strongly
    Disagree Agree

11. Overall, I agree with my feedback.
    1 2 3 4 5
    Not at all Very True

12. Overall, I thought the feedback MATCHED MY VIEW OF MY PERFORMANCE.
    1 2 3 4 5
    Strongly Strongly
    Disagree Agree

13. During the feedback, how much of the time were you able to focus on the feedback?
    1 2 3 4 5
    Not at all a little moderately quite a bit all the time

14. During the feedback, how much did you focus on things UNRELATED to the feedback?
    1 2 3 4 5
    Not at all a little moderately quite a bit all the time

15. How closely did you pay attention to the feedback?
    1 2 3 4 5
    Not at all a little moderately quite a bit all the time
Appendix E: Video Rating Form

File Name: _____________     Video ID: ___________     Date of Speech _____
Evaluator Name: ___________     Time of Speech: _______

1. How **anxious** would you say the participant was?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all anxious</td>
<td>anxious</td>
<td>very anxious</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

2. How **embarrassed** would you say the participant was?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all embarrassed</td>
<td>embarrassed</td>
<td>very embarrassed</td>
<td></td>
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</table>

3. How **confident** would you say the participant was?

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<tr>
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<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all confident</td>
<td>confident</td>
<td>very confident</td>
<td></td>
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4. Was the subject ‘fidget’ or did they perform odd body movements (e.g., wringing hands)?

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<th>4</th>
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<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>never/not at all</td>
<td>definitely/ all the time</td>
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</table>

5. How frequently did the participant use **transitional phrases** to stall or pause (e.g., “like” or “um”)?

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<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>never</td>
<td>all of the time</td>
<td></td>
<td></td>
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</tbody>
</table>

6. **Overall,** please rate the subject’s performance on the speech task:

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<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>very poor</td>
<td>excellent</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

7. When did the participant **ran out of speech material** (min, sec since start)? _______

8. How many times was the participant **prompted to continue speaking**? _______
Appendix F: Speech Task Instructions

Speech Task Instructions

- In several minutes, you will be asked to deliver a speech in which you will talk freely for 5 minutes.

- During your 5-minute speech, please pretend that you are interviewing for a job in your field – you will introduce yourself and explain why you would believe you would be qualified for the job.

- Please assume that you are actually applying for this job. You could discuss your strengths and weaknesses—such as whether you possess relevant skills, abilities, and attributes. Hiring decisions would be made on the basis of these characteristics.

- You will deliver the speech in front of us, the evaluative panel. We will remain neutral throughout the task and will deliver our feedback afterwards.

- After you complete your speech we will leave for a few minutes to confer, and then return to give you feedback on your performance.

- You now have a few minutes to mentally prepare your speech. During this time, please think about what you will say during your speech, as you will not be able to use notes during it.
Appendix G: Sample Feedback for the Criticism Condition

Sample feedback for the Criticism condition.

Overall Score:
On a scale of 1-10, in which a score of 10 is excellent performance; you received a score of 6. Most participants had a higher overall score than you. Your score was significantly lower than the average score of your peers.

Eye Contact:
During a speech, it is important to maintain regular eye contact with your audience. You did not maintain appropriate eye contact with us, the evaluation panel.

Clarity of Speech:
It is also important to present your points using clear language. Your voice was shaky and your sentences were difficult to follow at times.

Body Language:
It is important to carry yourself confidently during a speech. Your body language was fidgety and insecure.

Facial Expression:
Maintaining an engaging facial expression is a critical part of delivering a speech. Your facial expression was distant and disengaged. It was difficult to connect with you.

Clarity of Argument:
In order to communicate your points effectively, it is important to structure your argument clearly. The points of your speech were difficult to follow.

Appendix H: Sample Feedback for the Praise Condition

Sample feedback for the Praise condition.

<table>
<thead>
<tr>
<th>Overall Score:</th>
<th>On a scale of 1-10, in which a score of 10 is excellent performance; you received a score of 6. Most participants had a lower overall score than you. Your score was significantly higher than the average score of your peers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye Contact:</td>
<td>During a speech, it is important to maintain regular eye contact with your audience. You successfully maintained appropriate eye contact with us, the evaluation panel.</td>
</tr>
<tr>
<td>Clarity of Speech:</td>
<td>It is also important to present your points using clear language. Your voice was clear and your sentences were easy to follow.</td>
</tr>
<tr>
<td>Body Language:</td>
<td>It is important to carry yourself confidently during a speech. Your body language was professional and secure.</td>
</tr>
<tr>
<td>Facial Expression:</td>
<td>Maintaining an engaging facial expression is a critical part of delivering a speech. Your facial expression was open and engaged. It was easy to connect with you.</td>
</tr>
<tr>
<td>Clarity of Argument:</td>
<td>In order to communicate your points effectively, it is important to structure your argument clearly. The points of your speech were easy to follow.</td>
</tr>
</tbody>
</table>

Appendix I: Sample Feedback for the Neutral Condition

Sample Feedback for the Neutral Condition.

Overall Score:
On a scale of 1-10, in which a score of 10 is excellent performance; you received a score of 6. Your score was the same as the average score of your peers.

Eye Contact:
During a speech, it is important to maintain regular eye contact with your audience. This helps the audience stay engaged.

Clarity of Speech:
It is also important to present one’s points using clear language. This way, the audience is able to immediately understand the speaker’s statements.

Body Language:
It is important to carry oneself confidently during a speech. This helps the audience to believe that the speaker understands the topic well.

Facial Expression:
Maintaining an engaging facial expression is a critical part of delivering a speech. This helps the audience to understand the speaker’s point.

Clarity of Argument:
In order to communicate the points effectively, one must structure the argument clearly using summary and evidence-bearing statements.

Appendix J: Pilot Study Description, Results, and Sample Size Determination

**Pilot Study.** A pilot study was used to examine whether participants would rate the praise, criticism, and neutral feedback scripts as qualitatively different and to estimate effect size of the feedback manipulation on valence ratings to determine sample size for the larger study. The pilot study was presented online via Qualtrics Survey Research Suite (2012) to undergraduate participants, who were compensated with course credit for their participation in the task. A total of 96 participants were recruited through undergraduate psychology classes at a Midwestern university. After the consenting process, participants were presented a vignette of a participant who was presented with the feedback scripts in response to a speech stressor. The participants were asked to rate the scripts on a 9-point rating scale, a score of 1 indicating the feedback was the most negative and 9 indicating the feedback was the most positive. Participants rated all 3 scripts, and the scripts were presented in random order to avoid presentation effects.

**Pilot Results.** Analysis of the feedback data indicated that the valence of the Criticism ($M = 1.66, SE = 0.09$), Praise ($M = 5.57, SE = 0.61$), and Neutral scripts ($M = 3.55, SE = 0.13$) were significantly different from one another, as assessed by a repeated measures ANOVA ($F(2, 94) = 195.43, p < .001$) and Bonferonni-adjusted pairwise comparisons (all $p$’s < .001). The omnibus effect of feedback condition on valence was large ($\eta^2_{\text{partial}} = .81$). Effect sizes for difference in feedback valence for each comparison were all large (Praise/Criticism, $d = 3.27$; Praise/Neutral, $d = 1.61$; Criticism/Neutral, $d = -1.06$).
Sample Size Determination. The sample size estimates for the current study were determined *a priori* through a power analysis conducted with the results of the pilot study and consideration of relevant past research (Earle et al., 1999). The *a priori* power analysis with the large effect sizes from the pilot study suggested the current study would achieve 96% power to detect differences in feedback valence between groups with a sample size of 13 participants per condition. Although the pilot study provided effect sizes for the feedback valence manipulation, it did not provide information about the expected magnitude of cortisol outcomes. Earle and colleagues (1999) examined the effect of criticism verbal feedback compared to no feedback on cortisol reactivity in response to a laboratory stressor, similar to the present study. Using the large effect sizes found in the study by Earle and colleagues, power analyses suggest that a total sample size of 75 participants, with 25 participants per condition, would provide 80% power to detect differences in cortisol reactivity in the current study. The goal of the current study was to conservatively sample at least 40 participants per condition for a total sample of 120 participants.
Appendix K: Total Sample Bi-variate Correlations

**Bivariate Correlations.** Bivariate correlation analyses were conducted in order to identify covariates among the main predictor and outcome variables. Speech performance was not significantly related to participant gender ($r = .05, p > 0.05; r = .17, p > 0.05$; please see Table 5 and for all calculated bivariate correlations). This suggests that any gender differences in the main outcome variables are not based on a gender differences in performance. Individuals who reported higher BMIs were also more likely to report depressive symptoms ($r = 0.37, p < .001$). Individuals who reported higher trait rumination also tended to report higher levels of depressive symptoms ($r = 0.39, p < .01$) and symptoms of social phobia ($r = 0.45, p < .001$). Similarly, individuals with higher state rumination following the speech stressor were also more likely to report higher levels of social phobia symptoms ($r = 0.33, p < .001$), which falls in line with previous findings indicating individuals with social phobia exhibit higher levels of negative rumination following an impromptu speech (Abbott, & Rapee, 2004). These results might be expected based on previous work finding concurrent elevations of rumination and depressive and anxiety symptoms (e.g., McLaughlin, Borkovec, & Sibrava, 2007). Taken together, the results of these analyses suggest that depressive and social phobia symptoms may be important to examine as potential covariates.
# Appendix L: Total Sample Bi-variate Correlation Table

Table 6.

*Pearson correlations for the total sample.*

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<tbody>
<tr>
<td></td>
<td>-.05</td>
<td>.14</td>
<td>.20*</td>
<td>.15</td>
<td>-.03</td>
<td>.16†</td>
<td>.01</td>
<td>-.06</td>
<td>-.18†</td>
<td>-.26**</td>
</tr>
<tr>
<td></td>
<td>1</td>
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<td>3</td>
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<td>8</td>
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<td>10</td>
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</table>

*Note.* ** p < .01; * p < .05; † < .10; *** p < .001; .98***