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BRIEF REPORTS

Negative Social Evaluation, but Not Mere Social Presence, Elicits Cortisol Responses to a Laboratory Stressor Task

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Background: Recent research has supported the premise that performance conditions characterized by social-evaluative threat, in which an aspect of the self could be judged by others, are associated with cortisol responses. However, it remains unclear whether this effect is due to negative social evaluation per se or simply the presence of another during a performance situation. ***Method:*** In the present study, 89 undergraduates delivered a speech in 1 of 3 conditions: in front of an evaluative audience panel (social-evaluative threat [SET]), in the presence of an inattentive confederate (PRES), or alone in a room (non-SET). ***Results:*** Consistent with hypotheses, participants in the SET condition demonstrated a significant cortisol response, while those in the non-SET and PRES conditions did not show increases in this hormone. Further, participants in the SET condition who reported greater posttask levels of self-conscious cognitions and emotions demonstrated the greatest increases in cortisol. ***Conclusion:*** These findings suggest that the mere social presence of others is not driving the changes in cortisol observed under social-evaluative threat; instead, explicit negative social evaluation may be responsible for increases in this health-relevant physiological parameter.

Keywords: cortisol, stress, social-evaluative threat, self-conscious emotions, mere presence

Social context can profoundly influence emotion, physiology, and health (for review, see Seeman & McEwen, 1996); however, the direction of these effects can hinge on the specific qualities of the social milieu. Negative social contexts—such as those that are evaluative or rejecting—can lead to potentially deleterious physiological responses, whereas the presence of positive, supportive social others can confer protective effects (e.g., Dickerson & Kemeny, 2004; Lepore, 1998). However, it is less clear how ambiguous or minimal social contexts, such as when others are "merely present," may influence physiological responses. The present study tested whether the mere presence of others during an acute stressor is sufficient to elicit cortisol reactivity or whether social presence must be coupled with social evaluation to trigger this response.

The premise that the mere presence of others can provoke physiological changes is central to Zajonc's (1965) theory of social facilitation. A number of studies have found that performing a task in the presence of others can lead to increased autonomic activity (e.g., cardiovascular, electrodermal); however, meta-analyses have found that the effects are stronger under certain conditions, including when the evaluation potential of those present is increased (Bond & Titus, 1983; Mullen, Bryant, & Driskell, 1997). This suggests autonomic reactivity may be greater when challenging tasks are performed under evaluative presence versus mere presence conditions. However, not all physiological systems are elicited in parallel (e.g., Gruenewald, Kemeny, Aziz, & Fahey, 2004). It is unknown whether other parameters, such as the hormone cortisol, may show divergent patterns of activity under mere presence and social-evaluative conditions.

Cortisol may be an important biomarker to examine in this context for several reasons. First, in nonhuman primates and other animals, acute and chronic threats to social status are associated with increases in cortisol (e.g., Sapolsky, 1993; Shively, Laber-Laird, & Anton, 1997); this demonstrates that in animal models, this hormone may be particularly sensitive to social threats. Second, there has been a great deal of confusion in the human cortisol reactivity literature regarding what conditions can elicit increases in this parameter (Dickerson & Kemeny, 2004). Given that repeated or prolonged cortisol elevations can have negative effects on health (e.g., McEwen, 1998), it is important to isolate the specific social contexts capable of triggering cortisol responses; this would delineate the conditions that, if experienced persistently or chronically, could be associated with stress-related disease.

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Social self-preservation theory posits that one set of conditions capable of eliciting cortisol responses in the laboratory are threats to the social self or threats to maintaining one's social acceptance, esteem, and status (Dickerson, Gruenewald, & Kemeny, 2004; Gruenewald, Dickerson, & Kemeny, 2007; Kemeny, Gruenewald, & Dickerson, 2004). Prototypical threats to this central goal include when an important aspect of the self-identity is or could be negatively judged by others (i.e., social-evaluative threat; Dickerson & Kemeny, 2004). These social-evaluative, rejecting situations are theorized to elicit specific emotional and physiological changes; this includes increases in self-conscious emotions, such as shame, as well as activation of the hypothalamic-pituitary-adrenal cortical (HPA) axis, which regulates the release of the hormone cortisol.

Growing empirical evidence supports the links between social-evaluative threat , self-conscious emotions, and cortisol responses. In a meta-analysis of 208 acute stressor studies (Dickerson & Kemeny, 2004), performance tasks characterized by social-evaluative threat (e.g., presence of an evaluative audience) were associated with cortisol responses more than four times larger than tasks without these evaluative elements. A subsequent study manipulated social-evaluative threat by randomly assigning half of the participants to perform a speech and math stressor (Trier Social Stress Test; Kirschbaum, Pirke, & Hellhammer, 1993) in front of an evaluative audience panel, while the other participants completed the task alone in a room (Gruenewald et al., 2004). Only the social-evaluative threat (SET) condition elicited a cortisol response; performance of the identical task in the absence of evaluation (non-SET) did not trigger increases in this hormone. The SET condition also reported greater levels of posttask self-conscious emotions compared to the non-SET group (Gruenewald et al., 2004); however, there were no significant differences between the conditions for other negative emotional states (e.g., fear). Additionally, participants reporting greater increases in self-conscious emotions in response to the stressor also showed greater increases in cortisol. Taken together, these results support the theory that negative, social-evaluative contexts provide conditions capable of eliciting cortisol responses, and these changes may hinge on the experience of self-conscious emotions.

The present study was designed to identify the specific component of this social-evaluative context associated with cortisol reactivity. Previous research has compared situations in which nobody was present to those in which a panel of evaluators observed the performance in a critical and rejecting manner (Gruenewald et al., 2004). Therefore, the SET condition included not only the presence of another person but also negative evaluation. The present study tested whether social presence alone is enough to elicit a cortisol response or whether social presence must be coupled with negative evaluation to provoke these changes. Participants were randomly assigned to deliver a speech in (a) a non–social-evaluative context (non-SET), in which the participant was alone in a room, (b) a social-evaluative context (SET), in which audience members negatively evaluated the performance, or (c) an inattentive presence (PRES) condition, in which someone was present but did not explicitly evaluate the participant. We hypothesized that social evaluation would elicit increases in cortisol, whereas the PRES and non-SET conditions would not show changes in this hormone. Further, we hypothesized that those reporting the highest levels of posttask self-conscious cognitions and emotions would also show the greatest increases in cortisol in response to the social-evaluative task.

Method

Participants

Eighty-nine[1] healthy undergraduate students were recruited through the subject pool or fliers posted on campus. Participants qualified for inclusion if they (a) did not report health conditions that could influence the HPA axis (e.g., flu, diabetes), (b) were not smokers, and (c) were not on hormonal contraceptives. The 33 male and 58 female participants were on average 20.7 years old ($SD = 1.7$, range 18–26) and came from diverse ethnic backgrounds (49% Asian, 11% Caucasian, 12% Chicano/Latino(a), 14% Middle Eastern, and 14% other ethnicities).

Procedure

Participants arrived in the laboratory for individual afternoon sessions (1:00 or 3:30 p.m.), and were randomly assigned to one of three conditions: non-SET ($n = 31$), SET ($n = 28$), or PRES ($n = 30$). After informed consent was obtained, the participant completed baseline questionnaires and rested for 40 minutes. During this time, a research assistant (who was not the experimenter and was unknown to the participant) was working on a computer in the same room. After the 40-minute rest period, the baseline saliva sample was taken. The research assistant then left the room for the non-SET and SET conditions (but remained for the PRES condition).

Participants completed a modified version of the Trier Social Stress Test (Kirschbaum et al., 1993). All participants heard scripted instructions that they would be delivering a speech on why they would be a good job applicant. They were told their speeches would be tape-recorded to ensure that they spoke on the appropriate topic the whole time. For those in the non-SET condition, the instructions were delivered via audiotape and stated that the participant would be alone in the room during the speech. Those in the PRES condition heard identical taped instructions, except it was not specified whether anyone would be present during the task. For the SET condition, the instructions were read by a two-member panel (one male, one female), who told the participants that they would be present during the speech.

After a 10-minute preparation period, the participants delivered the 5-minute speech in the social context consistent with their experimental condition; alone in a room (non-SET), in front of an evaluative audience (SET), or in the presence of a research assistant who worked on a computer in the participants' line of vision but who did not look at or acknowledge the participant[2] (PRES). After the conclusion of the speech, the research assistants left the room (for the PRES and SET conditions), and the posttask saliva sample was collected. Participants completed additional questionnaires and rested during a 40-minute recovery period, and saliva samples were taken 10 minutes, 25 minutes, and 40 minutes after the task. Participants were then debriefed and awarded extra credit or paid $20.

[1] Ninety-two participants were originally recruited for the study; however, two were not included in analyses because of outlying values on one or more baseline variables (i.e., more than 4 *SD*s above the mean), and one was not included because of equipment failure during the lab session.

[2] The research assistant and participant sat with their backs to each other (their desks faced opposite sides of the room) during the baseline and preparation period; therefore, the research assistant was not in the participant's line of vision. Just before the speech, all participants were repositioned to face away from the desk. This enabled the participant to see the research assistant (in the PRES condition) or the audience members (in the SET condition).

Measures

Affect. A version of the 20-item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) was used to assess state affect. Participants reported the degree to which they were currently feeling positive and negative mood adjectives along a 5-point scale. The 20-item PANAS scale was supplemented with the sadness and fear subscales from the longer 60-item version (Zevon & Tellegen, 1982) to assess these specific emotions. Self-conscious emotions were assessed with the "ashamed" item (included in the PANAS), plus three additional descriptors (embarrassed, humiliated, and self-conscious). Six items were also added to assess self-conscious cognitions or cognitive terms used to describe the shame experience (foolish, stupid, defective, awkward, exposed, defeated; Lewis, 1971). Because the posttask self-conscious cognitions and emotions were highly correlated [$r(87) = .83$, $p < .001$], the scales were combined into one composite measure of self-conscious states.

Manipulation check. Following the speech, participants were asked to rate how much their performance had been evaluated during the task (1 = *not at all*, 7 = *very much*).

Demographics. A short questionnaire assessed demographic characteristics, including participants' age, ethnicity, and academic/educational background.

Health Behavior Questionnaire. This assessed health behaviors during the previous week, day, and hour, including participants' exercise, eating, and smoking behavior; alcohol, drug, and prescription and nonprescription medication use; sleep behavior; and menstrual cycle.

Cortisol Assessment

Salivary cortisol was collected at five time points to capture peak reactivity and recovery (Dickerson & Kemeny, 2004). Saliva samples were collected with the Salivette sampling device (Sarstedt, Nümbrecht, Germany), stored at room temperature until completion of the session, and then kept at –20 °C. After thawing for biochemical analysis, samples were centrifuged for 10 minutes at 2,000 × g and 10 °C. Salivary cortisol was determined using the Active-Cortisol ELISA (DSL-10-67100; Diagnostic Systems Laboratories, Webster, TX). Interassay coefficient of variation (CV) was 2.8% – 7.2%, intraassay CV was 1.9% – 4.8%, and the sensitivity was <0.011 μg/dL. Cortisol values were log-transformed because of nonnormality, and the transformed values were used in all analyses.

Statistical Analyses

All analyses predicting cortisol responses were conducted with multilevel modeling methods using the SAS 9.1 PROC MIXED procedure (see Singer & Willet, 2003). Multilevel modeling techniques allow one to model both within-subject and between-subject differences in cortisol response patterns. A Level 1 submodel represents individual change in cortisol as a function of time. A Level 2 submodel represents interindividual differences in the cortisol response patterns (e.g., experimental condition). First, a Level 1 submodel was fit, and, across all subjects, the cortisol response pattern demonstrated a significant curvilinear shape (peaking after the speech task). As such, time was entered as a quadratic term ($TIME^2$). To test the effect of social context and cognitive and emotional responses on cortisol response patterns, the experimental condition and/or posttask cognitive and emotional responses were entered as Level 2 predictors. Initial analyses tested whether gender, time of laboratory session (1:00 or 3:30 p.m.), and menstrual cycle phase were associated with cortisol levels. However, none were significant predictors of either initial cortisol levels or cortisol responses across the three conditions (all ps $> .20$) and, therefore, were not included in the final models.

Results

There were no significant differences between SET, non-SET, and PRES conditions on demographic variables (ethnicity, gender, age), baseline cognitive and emotional states, health behaviors (e.g., caffeine consumption, exercise, sleep), or cortisol (all ps $> .19$), indicating random assignment was successful. Posttask ratings demonstrated that the manipulation was effective in differentially inducing social-evaluative threat across the three conditions. There were significant differences in the perceptions of how negatively evaluated the participants felt during the task, $F(2, 86) = 14.8$, $p < .001$. Those in the SET condition felt most evaluated ($M = 5.2$, $SD = 1.9$), followed by those in the PRES condition ($M = 4.1$, $SD = 1.7$) and the non-SET condition ($M = 2.7$, $SD = 1.7$); each was significantly different from the others (all ps $< .05$).

Across all participants, the speech task elicited increases in fear, $F(1, 84) = 38.82$, $p < .001$, and self-conscious cognitions and emotions, $F(1, 84) = 104.64$, $p < .001$, but no changes in sadness, $F(1, 84) = 0.16$, $p > .20$. However, consistent with hypotheses, the increases in self-conscious cognitions and emotions differed by the social context of the stressor (Time × Condition interaction), $F(2, 84) = 3.35$, $p < .05$. There were significant differences between the conditions for posttask self-conscious cognitions and emotions, $F(2, 84) = 4.24$, $p < .05$; post hoc analyses revealed that the SET condition reported significantly higher levels of posttask self-conscious states ($M = 2.6$, $SE = 0.16$) than the non-SET condition ($M = 1.9$, $SE = 0.15$), $F(1, 55) = 8.07$, $p < .01$, with the PRES condition falling in between ($M = 2.3$, $SE = 0.15$). As predicted, this effect was specific to self-conscious states; the Time x Condition interactions were not significant for fear, $F(2, 84) = 0.37$, $p > .20$, or sadness, $F(2, 84) = 0.43$, $p > .20$. This suggests that the *self-conscious* cognitions and emotions were the most sensitive to the social-evaluative context of the stressor.

Consistent with hypotheses, there was a significant interaction between condition and cortisol changes, $F(2, 264) = 11.02$, $p < .0001$, meaning there was a difference in the cortisol response patterns over time across the three conditions (as illustrated in Figure 1). While those in the SET condition showed marked increases in cortisol reactivity [$TIME^2$; $\beta = –.00025$, $SE = .000065$, $t(264) = –3.93$, $p < .0001$, indicating a significant peak increase], those in the other two conditions showed no significant changes [PRES: $TIME^2$, $\beta = .0000045$, $SE = .000061$, $t(264) = .73$, $p > .20$] or slight cortisol declines [non-SET: $TIME^2$, $\beta = .000150$, $SE = .000060$, $t(264) = 2.48$, $p < .05$]. Contrasts comparing cortisol responses by condition revealed that the patterns of cortisol reactivity in the SET condition were different than those in the PRES, $F(1, 98.7) = 6.76$, $p = .05$, and non-SET conditions, $F(1, 98.7) = 13.98$, $p < .001$. However, there were no

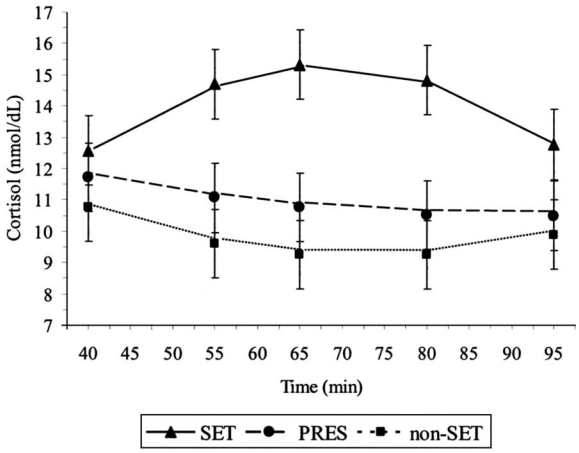

Figure 1. Predicted cortisol responses across the laboratory session by experimental condition. Minutes 0–40 represent the resting baseline period; minutes 41–55 represent speech preparation and delivery; minutes 56–95 represent recovery. SET = social-evaluative threat condition; non-SET = non–social-evaluative threat condition; PRES = inattentive presence condition.

significant differences between the non-SET and PRES conditions ($p > .25$).

Hypotheses also predicted that cortisol responses would be associated with self-conscious cognitions and emotions. To test this, we examined the interactive effects of condition and posttask self-conscious cognitions and emotions over time (Condition × Self-Concious Cognitions and Emotions x TIME^2). This three-way interaction was marginally significant, $F(2, 258) = 2.71$, $p < .07$. As shown in Figure 2, participants in the SET condition reporting greater posttask self-conscious states had significantly larger increases in cortisol, $F(1, 78) = 8.23$, $p < .01$. However, this was not the case in the PRES or non-SET conditions ($ps > .70$). Additionally, there were no significant interactions between cortisol reactivity and posttask ratings of fear, $F(1, 258) = 1.12$, $p > .29$, or sadness, $F(1, 258) = 1.27$, $p > .26$. Therefore, increases in self-conscious cognitions and emotions occurred in concert with the cortisol changes under SET and not with other negative emotions.

Discussion

Prior research has demonstrated that laboratory stressors with social-evaluative threat, in which the self could be negatively judged by others, trigger larger cortisol responses compared to stressors without this element (Dickerson & Kemeny, 2004; Gruenewald et al., 2004). The present study was designed to test which component of the social-evaluative context—social presence or negative social evaluation—is responsible for the increases in cortisol observed in previous investigations. The social context of the stressor was manipulated by having participants deliver a speech in front of an evaluative audience (SET), alone in a room (non-SET), or in the presence of an inattentive confederate (PRES). Consistent with hypotheses, only the SET condition elicited a robust cortisol response. Participants performing a speech in the absence of explicit negative social evaluation (non-SET and PRES conditions) did not show increases in cortisol from pre- to posttask. Furthermore, those in the SET condition reported higher levels of posttask self-conscious cognitions and emotions, and these self-conscious states were correlated with the increases in cortisol. However, there was no association between cortisol responses and other negative emotional states, such as sadness or fear.

These findings support social self-preservation theory (Dickerson et al., 2004; Gruenewald, Dickerson, & Kemeny, 2007; Kemeny et al. 2004), which posits that threats to the social self trigger specific psychobiological changes, including increases in self-conscious emotions and cortisol. The results from the present study corroborate and extend previous research by delineating the component of the social-evaluative context that is driving cortisol reactivity. We found that mere social presence is not the "active ingredient" that elicits these changes under social-evaluative threat. Instead, the negative social evaluation component in the SET condition appears to be triggering increases in cortisol. Our findings bring us closer to isolating the specific elements imbedded in the social-evaluative context capable of eliciting cortisol responses.

Our results are aligned with a small but growing body of evidence that self-conscious emotions may be a key affective correlate of the cortisol changes observed under social-evaluative conditions (Gruenewald et al., 2004; Lewis & Ramsay, 2002). Although other emotions, such as fear, were experienced during the speech task, only the self-conscious cognitions and emotions were sensitive to the social context of the stressor; these self-conscious states were correlated with the cortisol changes under social-evaluative threat. These findings are consistent with an integrated specificity approach (Kemeny, 2003), in which the presence of specific goal threats, such as threats to maintaining the social self, elicits coordinated emotional and physiological responses. Future research should further examine the specificity of this effect by including additional comparison emotions (e.g., anger), as well as delineating the components of the "self-conscious" composite that are specifically tied to the cortisol changes (e.g., ashamed vs. embarrassed). Designing experimental manipulations that induce different discrete emotions would also

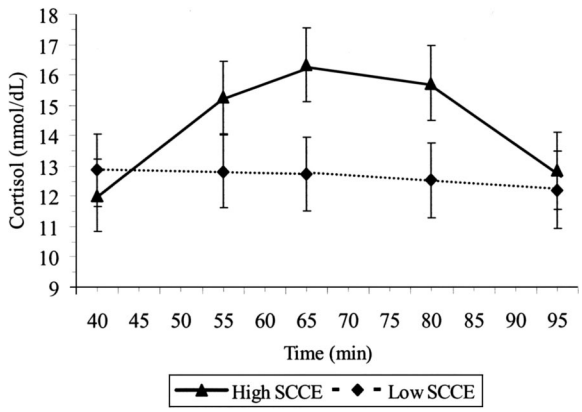

Figure 2. Predicted cortisol responses across the laboratory session for those in the social-evaluative threat condition falling 1 *SD* above and below the mean on posttask self-conscious cognitions and emotions (SCCE). Minutes 0–40 represent the resting baseline period; minutes 41–55 represent speech preparation and delivery; and minutes 56–95 represent recovery.

be useful for clarifying the specificity of the self-conscious emotion–cortisol linkage.

It is interesting that perceptions of evaluation and the self-conscious cognitions and emotions exhibited an incremental effect by condition; those in the SET condition reported the highest levels, the non-SET the lowest and the PRES condition fell between. However, the cortisol patterns did not show this same gradient, with only the SET condition eliciting a significant cortisol response. This suggests that a certain threshold of evaluation and/or self-conscious states may be necessary to trigger cortisol reactivity, rather than a sensitivity to incremental intensity of the appraisals. Future research should specifically address this threshold hypothesis.

Zajonc (1965) theorized that the mere presence of social others can increase physiological activity, and this, in turn, could facilitate dominant responses (e.g., enhanced performance on easy tasks, impaired performance on difficult ones). Cottrell and colleagues (Cottrell, Wack, Sekerak, & Rittle, 1968) proposed that *evaluation apprehension* drives the association between the presence of social others and physiological and behavioral consequences. Indeed, studies have demonstrate that social facilitation effects (on performance and autonomic activity) are strongest when participants believe others are evaluating them, compared to conditions where others are merely present in a nonevaluative mode (e.g., Bond & Titus, 1983; Cottrell et al., 1968). The present study extends this research to cortisol and supports an evaluation apprehension theory of social facilitation in which others must be explicitly evaluative to elicit cortisol responses.

Although the current study focused on the presence of evaluative others to delineate the specific conditions capable of eliciting cortisol responses in the laboratory, a large research enterprise has examined how the presence of supportive others can attenuate acute stress responses (for review, see Lepore, 1998; Uchino, 2006). In general, the presence of a nonevaluative, unequivocally supportive friend or stranger (i.e., active support) reduces heart rate and/or blood pressure responses to acute stressors. However, the findings have been mixed when social support is passive and simply implied by the mere presence of a friend or stranger (Lepore, 1998). The stress-buffering potential of passive support appears to be predicated on whether the presence of others is viewed as supportive or as evaluative. Unless the potential for evaluation is completely prevented (e.g., friends wearing headphones so they cannot monitor speech performance), passive support does not necessarily reduce cardiovascular responses (e.g., Kors, Linden, & Gerin, 1997). The current study supports this notion in the context of cortisol reactivity, as there was not an overall stress-buffering (or stress-enhancing) effect in the PRES condition. A key focus for future research will be to identify the contexts and individual differences that foster appraisals of support versus evaluation and to examine when the presence of others may attenuate cortisol responses.

Additional studies should also examine multiple physiological systems to delineate the patterned set of emotional and physiological responses that may be activated under specific social conditions. Much of the research on the mere presence of others (in the social facilitation and active/passive social support literature) has examined cardiovascular or autonomic reactivity; however, physiological systems (e.g., cardiovascular, HPA) are not always elicited in concert. For example, cardiovascular parameters generally increase as a result of performing difficult tasks regardless of social condition (e.g., Gruenewald et al., 2004), although these responses can be potentiated in the presence of a negative social context (e.g., harassment, criticism) or attenuated in the presence of a positive social context (e.g., active social support; Lepore, Allen, & Evans, 1993). Cortisol reactivity appears to operate somewhat differently; the social milieu can determine whether this parameter is elicited at all. Research should continue to isolate the elements of the social-evaluative context that trigger cortisol responses, as consistent, prolonged, or exaggerated exposure to this hormone can lead to detrimental effects on health (McEwen, 1998). Therefore, further characterizing the conditions capable of eliciting cortisol may help us identify the specific social threats (e.g., ostracism, rejection) that, if experienced persistently or chronically, could lead to negative health effects.

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