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Role of shame and body esteem in cortisol stress responses

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Abstract

Studies assessing the role of shame in HPA axis reactivity report mixed findings. Discrepancies may be due to methodological difficulties and inter-individual differences in the propensity to experience shame in a stressful situation. Hence, the current study combined self-report of shame and facial coding of shame expressions and assessed the role of body esteem as a moderator of the shame–stress link. For this, 44 healthy students (24F, age 20.5 ± 2.1 years) were exposed to an acute psychosocial stress paradigm (Trier Social Stress Test: TSST). Salivary cortisol levels were measured throughout the protocol. Trait shame was measured before the stress test, and state shame immediately afterwards. Video recordings of the TSST were coded to determine emotion expressions. State shame was neither associated with cortisol stress responses nor with body esteem (self-report: all $ps > .24$; expression: all $ps > .31$). In contrast, higher trait shame was associated with both negative body esteem ($p = .049$) and stronger cortisol stress responses ($p = .013$). Lastly, having lower body esteem predicted stronger cortisol stress responses ($p = .022$); however, it did not significantly moderate the association between shame indices and cortisol stress responses (all $ps > .94$). These findings suggest that body esteem and trait shame independently contribute to strength of cortisol stress responses. Thus, in addition to trait shame, body esteem emerged as an important predictor of cortisol stress responses and as such, a potential contributor to stress-related negative health outcomes.

Keywords

Shame; Body esteem; Trier Social Stress Test; Cortisol; Facial action coding system

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Compliance with ethical standards

Conflict of interest Sarah B. Lupis, Natalie J. Sabik and Jutta M. Wolf declare that they have no conflict of interest.

Human and animal rights and informed consent All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study.

Introduction

Repeated or chronic activation of stress systems has consistently been linked to negative physical and mental health outcomes (Goldstein & McEwen, 2002; McEwen & Seeman, 1999; Tsigos & Chrousos, 2002). Although research has focused on identifying possible predictors and moderators of acute stress, less is known about the role of emotions. Recent findings suggest that shame, in particular, may predict activation of the hypothalamic–pituitary–adrenal (HPA) axis (Gruenewald et al., 2004). This research, however, typically relies on self-report and thus measures highly processed subjective feelings of shame. Facial coding may provide an alternative, more acute method of assessing shame, particularly in the context of stress. Further, individuals may differ in the propensity to experience shame in a stressful situation. Body esteem, a measure of how one views one's body and appearance, may thus be a moderator of the relationship between shame and acute stress.

Stress responses and shame

Stress exposure can lead to a cascade of physiological changes affecting many bodily systems. The two main processes include the sympathetic nervous system (SNS) and the HPA axis, the latter resulting in the secretion of cortisol (Sapolsky et al., 2000). Although this coordinated response is highly adaptive in the short term, sustained or repeated activation of the stress response can lead to wear and tear (or 'allostatic load'), manifesting itself in changes to the systems' reactivity patterns as well as dysfunctions in the systems' basal activity. Symptoms of allostatic load, in turn, are associated with a host of negative physiological and mental health outcomes (Goldstein & McEwen, 2002; McEwen & Seeman, 1999; Tsigos & Chrousos, 2002).

Given these extensive health implications, recent research has investigated the situational and cognitive factors that predict physiological stress responses (Gruenewald et al., 2006; Lazarus, 1982). Less is known, however, about the role of specific emotions, although some prior evidence suggests that distinct emotions, particularly self-conscious emotions such as shame, can predict unique physiological stress response profiles (Dickerson & Kemeny, 2004). More specifically, the Social Self Preservation Theory suggests that the HPA axis is most likely activated in situations that threaten the 'social self,' potentially lowering self-esteem, social status, and personal worth. These threats to the social self are then proposed to elicit shame, which, in turn, activates the HPA axis (Gruenewald et al., 2004).

Although this theory is currently prevalent in stress research, studies often report mixed and conflicting results, and a recent meta-analysis failed to confirm a relationship between shame experience and cortisol stress responses (Denson et al., 2009). However, the potential lack of associations between shame and cortisol stress responses may be due to (a) measurement issues related to self-report of emotions and/or (b) influence of moderator variables, such as low body esteem, that limit the applicability to specific populations. Additionally, the potential stress-related role of other self-conscious emotions, such as embarrassment, has not yet been identified.

Emotion expression versus self-reported emotions

The majority of studies assessing shame in the context of stress typically do so retrospectively through self-report after stress exposure. As such, this assessment to a large extent reflects how participants have cognitively processed the emotions they experienced during the stressor (Crockett et al., 1987). An alternative mode of emotion assessment is the analysis of emotion expressions through facial coding. This approach has several advantages: emotion expressions can be captured continuously throughout stressor exposure and before participants cognitively process their experiences. Further, a skilled coder can detect emotions which last only fractions of a second, allowing for assessment of emotions that participants may deliberately try to mask. In summary, considering both methods of emotion assessment, self-report and facial coding may together help clarify the role of shame in acute psychophysiological stress responses.

Assessing body esteem as a potential moderator variable

When examining potential shame–stress associations it is important to consider which factors may predict, or contribute to, feelings of shame in the context of stress. Body image may represent one such factor. Body image has been conceptualized as a multidimensional construct that represents individuals' thoughts, feelings, and behaviors with regard to appearance, weight, and other physical attributes (Muth & Cash, 1997). In particular, much research has focused on body esteem, a construct that has been defined as self-evaluations of one's body or appearance (Mendelson et al., 2001; Slade, 1994).

One theory in particular, the sociocultural theory of body image, may explain why body esteem may be a factor in stress responses. This theory suggests that exposure to social and cultural expectations with regard to weight and appearance leads to greater body dissatisfaction (Thompson et al., 1999). In particular, media exposure and interactions with family and peers send and reinforce messages about what is considered attractive (Stice, 2002). When individuals internalize these messages and feel that they are unable to meet the cultural ideal, they may experience low body esteem and body shame (Bessenoff & Snow, 2006). Feeling self-conscious about appearance due to low body esteem may make a person more likely to experience shame in stressful and socio-evaluative situations. Indeed, low body esteem has been linked to body shame and rumination (Etu & Gray, 2010; Grabe et al., 2007), both in the context of eating disorders (Andrews, 1997; Frank, 1991; Gutiérrez-Maldonado et al., 2010; Sanftner et al., 1995), as well as in non-clinical populations (Bedford & Johnson, 2006; Fredrickson & Roberts, 1997; Noll & Fredrickson, 1998; Tangney, 1995).

Further emerging evidence suggests a relationship between body esteem and stress experiences, both psychologically (Croghan et al., 2006) and physiologically (Geiger et al., 2014), as well as for both genders and across adulthood (ages 18–65) (Sabik et al., under review). The latter two studies observed body esteem–stress links utilizing the Trier Social Stress Test (TSST), during which the participant stands on full display of a panel of judges; further, the participant is told that his body language will be observed and evaluated (Kirschbaum et al., 1993). This stress paradigm may therefore elicit feelings of shame in those with negative feelings about their weight and appearance.

Thus, since the degree to which one experiences stress as a result of shame may be dependent on body perceptions, the current study proposes that body esteem may moderate the link between shame and biological stress responses. Importantly, these relationships may be gender-dependent in nature. Although body esteem research predominantly focuses on females, some studies suggest that body issues are increasingly of concern for men (McCabe & McGreevy, 2011) and are similarly associated with negative health outcomes (Olivardia et al., 2004).

The current study

In summary, the current study aimed at assessing associations between shame and cortisol responses to acute psychosocial stress using two different approaches. One focused on differentiating the experience of the feeling captured by self-report and the expression of the emotion assessed by facial coding analysis. The second approach focused on assessing the role of body esteem as a potential moderator of the relationship between shame and cortisol stress responses. Based on recent research, we hypothesized that:

1. In a social-evaluative situation, strength of cortisol stress responses will be predicted by shame expression responses, and to a lesser extent, by self-reported trait and state shame responses.
2. Individuals with low body esteem will report and show stronger shame stress responses.
3. Body esteem will itself predict strength of cortisol responses to a psychosocial stressor.
4. Body esteem will moderate the relationship between shame (self-report and facial coding) and cortisol stress responses.

All of the above associations were additionally examined for gender-dependent effects as well as effects of trait shame.

Methods

Participants

Fifty-five participants (30F, age 21.3 ± 3.5 years) were recruited from a pool of undergraduate psychology students and from the general student population using fliers posted on campus. Non-native English speakers as well as individuals who self-reported any cardiovascular or other chronic diseases or were taking medication that could affect measurement of stress hormones (such as beta-blockers, statins, and blood pressure medication) were excluded from study participation. In addition, only females not currently using oral contraceptives were recruited given previous links between oral contraceptive use and cortisol reactivity (Kirschbaum et al., 1999).

For statistical analyses, participants were excluded if they did not provide complete answers to shame or body esteem questionnaires ($N = 7$) or for incomplete biological data ($N = 1$), or if their stress videos were not of high enough quality to allow for facial coding analysis ($N = 1$). Participants were further excluded for state shame scores more than 2 standard deviations

above the mean ($N = 1$) and body esteem scores more than 2 standard deviations below the mean ($N = 1$). This resulted in a final study population of $N = 44$ (24F, age 20.5 ± 2.1 years, BMI 23.3 ± 3.8 kg/m²).¹ Independent t tests showed that the subset of excluded participants did not differ from the overall sample with regards to any of the study variables (e.g., age, gender, BMI, body esteem scores; all $p > .11$). Of the 44 participants, 23 (52 %) self-reported as Caucasian, 15 (34 %) as Asian, 2 (4.5 %) as African–American, 2 (4.5 %) as Latin–American, 1 (2.3 %) as “other” and 1 participant (2.3 %) declined to respond. The University’s Institutional Review Board approved the study protocol. Participants received either one study credit or were paid \$15 for their time.

Procedure

Participants were asked to come to the laboratory on a weekday afternoon between 14:00 and 17:00. After being seated in a comfortable testing room, the experimenter explained the study protocol and asked for informed consent. This was followed by a resting period of 30 min, during which participants were asked to answer questionnaires. This period aimed at mitigating any stress experienced in anticipation of study participation or the upcoming stressful task. Subsequently, a first saliva sample was obtained to assess baseline cortisol levels (1 min pre-TSST). After participants self-reported their current mood, they were led to another room, and a standardized psychosocial stress protocol (Trier Social Stress Test: TSST) was administered (Kirschbaum et al., 1993). After the TSST, a second saliva sample was taken (1 min post-TSST/17 min post-baseline) and post-stress mood as well as state shame was assessed. Participants spent the remainder of the experiment seated comfortably in their testing room. During this time, further saliva samples were taken at +10, +30, and +60 min relative to the end of the TSST to capture the full cortisol stress response and recovery period. At 30 min post-TSST, participants were debriefed by the TSST panel and following the collection of the last saliva sample, were paid and free to leave.

Measures

Trier Social Stress Test—The current study utilized the TSST, which has a strong social-evaluative component and has been shown to reliably elicit both a cardiovascular and cortisol response (Kirschbaum et al., 1993). In more detail: a panel of observers, consisting of one male and one female study confederate dressed in white laboratory coats, is seated behind a large desk and next to a video camera in an otherwise largely empty room. The participant is asked to imagine that (s)he is applying for his/her “dream job,” and to talk for 5 min about personality characteristics that make him/her particularly attractive to the potential employer. The participant is further told that his/her body language will be evaluated throughout the test and additionally videotaped for later analysis. After a 5-min seated preparation period in the same room, the participant is asked by a panel member to stand up and to step in front of the panel and the camera. In addition to being fully exposed, the participant can further see his/her recording in the video camera display. Throughout, the

¹Of note, based on previous research, this sample size was regarded adequate to address the current aims. In more detail, when assessing anger and fear associations with cortisol stress responses, a former study revealed significant yet small effects (e.g., $R^2 = .15$ for emotion expression; $R^2 = .12$ for self-reported emotion) in a sample of 32 participants when examining gender-by-emotion interactions predicting cortisol stress responses (Lupis et al., 2014). Thus, the sample size of $N = 44$ in the current study would be sufficient to detect similar effects.

TSST panel takes notes and assumes a neutral behavior, i.e. it does not respond to attempts of the participant to establish a relationship or elicit reactions. After 5 min of the verbal task, a member of the panel announces the second task, a mental arithmetic task involving counting backwards from 2043 in increments of 17 as fast and precisely as possible. Every time the participant makes a mistake, (s)he is asked to start over at 2043.

Facial coding—Facial expressions were evaluated using videotapes of the participants recorded during the TSST. Specifically, participants' facial behavior was coded using the EMFACS version of the Facial Action Coding System (Ekman & Friesen, 1978; Ekman et al., 2002), an anatomically based coding system with high reliability and validity (Keltner & Bonanno, 1997). For the current study, the following self-conscious emotions were assessed according to Tracy et al. (2009): shame expression were defined as a combination of the facial Action Units (AU) 54 + 64 (a head tilt down with eyes down, with optional slumped posture). Embarrassment was defined as either an AU combination of 12 + 54 + 55 or 12 + 54 + 56 (a fake smile and a head tilt down and to either side, with optional hand touching the face). Typical recognition rates of shame and embarrassment expression have previously ranged from 47 to 73 % (Tracy et al., 2007, 2009). Coders observed the videos at normal speed, noting at about which part an expression began. From that point, expressions were examined frame-by-frame, with each frame lasting 1/30 s.

Given the scarcity of prior research on facial coding in the context of stress, it is not clear which components of emotion expression, i.e., frequency, length, or intensity, may be most relevant. Therefore, for each emotion, three separate measures were extracted: (1) count: number of distinct times the expression occurred; (2) total duration: number of frames the expression occurred in total over the stress test; and (3) average duration: average number of frames the expression lasted each time it occurred, computed by the total duration divided by the count. Furthermore, each expression was scored for intensity on a 5-point scale with '1' representing minimal intensity and '5' representing extreme intensity, and (4) the maximum intensity shown throughout the stressor across all occurrences of shame and embarrassment as well as (5) the average intensity, indicating the average intensity level across all instances of a particular emotion, were computed. All coding was performed by a coder certified in the FACS system. Passing the certification test demonstrates proficiency in agreeing with criterion codes at a level of .70 or above to pass, suggesting that this coding is reliably consistent with the coding of well-trained people.

Cortisol—Cortisol was measured in saliva samples obtained using the salivette collection system (Sarstedt, Newton, NC), which consists of a small plastic container holding a sterile cotton roll sitting in a lidded larger container for centrifugation. Participants were asked to place the cotton roll into their mouth for about 1 min and then put the roll back into the small container. Saliva samples were stored at -20C until completion of the study. At that point, salivettes were centrifuged and concentrations of salivary free cortisol were measured in nanomoles per liter (nmol/l) using a commercially available chemiluminescence-immunoassay (IBL, Hamburg, Germany). Intra- and inter-assay precisions expressed as percent coefficient of variation were below 8 %.

Questionnaires

Body-Esteem Scale for Adolescents and Adults: The Body-Esteem Scale for Adolescents and Adults (BESAA) combines the constructs “appearance,” or general feelings about appearance satisfaction (for example, “I’m pretty happy about the way I look”), “weight concerns,” assessing specifically weight satisfaction (for example, “I’m satisfied with my weight”), and “attributions,” which assesses evaluations the participant believes others are making about his body and appearance (for example, “Other people consider me good-looking”). The questionnaire contains 23 items and respondents indicate their degree of agreement on a 5-point Likert scale ranging from 0 (“never”) to 4 (“always”). A higher average score across all items indicates higher, or more positive, body esteem ($\alpha = .93$) (Mendelson et al., 2001).

State Shame and Guilt Scale: The State Shame and Guilt Scale (SSGS) is a 15-item scale that assesses the experience of shame, guilt, and pride (Marschall et al., 1994). The participant answers on a 5-point Likert scale ranging from 1 (“not feeling this way at all”) to 5 (“feeling this way very strongly”). For the current study, only the shame subscale was assessed. Shame is considered a global negative feeling about the self and example items read, “I’ve wanted to sink into the floor and disappear,” or, “I’ve felt like I am a bad person” ($\alpha = .76$). Higher sum scores reflect more shame.

Trait Shame and Guilt Scale: The Trait Shame and Guilt Scale (TSGS) is a modification of the SSGS scale assessing long-term experience of shame, guilt, and pride by referring to feelings during the past few months. The TSGS showed high test–retest reliability for the shame subscale ($r = .49, p < .001$) and satisfactory internal reliability with Cronbach’s alphas ranging from .74 to .76 across the subscales (Rohleder et al., 2008). Similar to the state questionnaire, specifically the shame subscale was used in further analyses. To contrast shame experienced over the last month from shame experience particularly during the TSST, TSGS shame subscale scores will be labeled ‘trait shame’ in the following. As such, rather than being a measure of shame proneness, higher sum scores are indicating more chronic shame experience.

Statistical analysis

Preliminary analyses—A repeated-measures ANOVA was computed to describe cortisol stress responses over time. For all subsequent analyses, cortisol values were first transformed to account for skewness ($\lg_{10}(\text{cortisol value} + 1)$) and each participant’s individual maximum cortisol increase was computed as maximum post-TSST measurement (1, 10, or 30 min post-TSST) minus baseline (1 min pre-TSST). Unless noted otherwise, all analyses further controlled for BMI.

To compare differences between male and female participants with regard to maximum cortisol increases, univariate ANCOVAs were computed. Similar ANCOVAs were run for self-reported state and trait shame, and indices of shame and embarrassment emotions expressed during the TSST. Chi-square tests were computed to test for gender differences in presence/absence of self-conscious emotion expressions. Partial correlations controlling for gender and BMI tested associations between self-reported trait and state shame.

Testing hypotheses—To test Hypothesis 1, i.e. whether self-reported shame would predict cortisol responses and whether potential associations are gender-dependent, regression analyses were computed using maximum cortisol increase as the dependent variable. Predictor variables were gender (0 = female, 1 = male), state shame scores (centered), and a gender-by-state shame interaction term according to procedures outlined in Aiken and West (1991). We further wanted to examine whether presence or absence of self-conscious emotion expression would predict cortisol stress responses. For that, a univariate ANCOVA was computed with maximum cortisol increase as the dependent variable and gender as well as presence/absence of self-conscious emotions as independent variables. To test Hypothesis 2, i.e., whether body esteem would predict self-reported shame, we repeated the above analyses with state shame as outcome/dependent variable and body esteem as predictor/independent variable. Hypothesis 3 assessed whether body esteem is associated with cortisol stress responses. Hence, a regression analysis was computed with maximum cortisol increase as the outcome variable. Gender, body esteem scores, and gender-by-body esteem scores interactions were entered as predictors. Lastly, Hypothesis 4 addressed the question whether body esteem moderates the relationship between shame and stress responses. Due to the small sample size, the subsequent analyses did not include gender as a potential moderator. Specifically, a regression analysis was computed with maximum cortisol increase as the outcome variable and gender, state shame scores, body esteem scores, and state shame-by-body esteem score interactions as predictor variables. A separate regression analysis tested body esteem moderation of the association between presence/absence of self-conscious emotions and cortisol stress responses by including body esteem scores, presence/absence of self-conscious emotions, and body esteem-by-self-conscious emotions interactions as independent variables and max cortisol increases as dependent variable. Lastly, to examine the role of trait shame, regressions similar to those assessing self-reported state shame were computed for self-reported trait shame. SPSS Version 22 software was used and p values of $p < .05$ were considered indicative of a significant effect.

Results

Preliminary analyses

Cortisol stress responses—A summary of descriptive statistics for all study variables can be found in Table 1. Repeated-measures ANOVA of participants with full cortisol data ($N = 41^2$) revealed a significant change in cortisol levels from time 1 through time 5 [$F(4, 160) = 7.12, p < .001, \eta_p^2 = .15$] suggesting that the TSST was successful in eliciting a cortisol stress response. Maximum cortisol levels thereby increased on average 32.93 % over baseline, with a mean maximum cortisol increase of 2.92 nmol/l ($SD = 6.42$; see Fig. 1).

Emotion assessments—Across participants, very similar scores were found for self-reported trait shame (range 5–18, mean = 9.68, $SD = 3.59$) as well as stress-related state

²Two of the three excluded participants were missing the last value (sample 5), while one participant was missing samples 4 and 5. As such, subsequent computation of maximum cortisol increases was not affected for the former two. To assess the effect of only including samples 2 and 3 in the maximum cortisol increase computation for the latter participant, we re-ran all analyses without that participant. As none of the findings changed, we retained the participant's data in the current dataset.

shame (range 5–18, mean = 9.86, SD = 3.99). Consequently, even when controlling for gender and BMI, the two measures were highly correlated [$r(40) = .49, p = .001$].

With regard to emotion expressions shown during stress exposure, shame did not appear to be a predominant response to the TSST; of the 44 participants, only 8 showed any incidence of shame expression (four females, four males). Of those who did express shame, the counts ranged from 1 to 11, with an average duration across participants between 28 and 1061 frames, i.e., 1–35 s. The average intensity of shame expression ranged from 3.25 to a maximum of 5. Twenty-one of 44 participants showed embarrassment expressions (11 females, 10 males). Among those participants, the embarrassment counts ranged from 1 to 11, with an average duration range of 51 and 621 frames (2–21 s), and an average intensity between 2.5 and 5. Due to the low occurrence of shame responses, and the theoretical similarities between shame and embarrassment as well as their similarity in coding criteria, the two measures were combined into ‘self-conscious emotions.’ As a result, 23 of the 44 participants showed any incidence of self-conscious emotions. Since the number of incidences of self-conscious emotions within a person was still low, self-conscious emotion expression was treated as a dichotomous variable (absence or presence). Importantly, combining shame and embarrassment did not result in an unbalanced gender distribution (presence: 12 female and 11 male participants; absence: 12 female and 9 male; $\chi^2 = .11, p = .74$).

When comparing self-reports and emotion expressions, ANCOVA revealed that neither self-reported state shame nor self-reported trait shame were associated with the presence or absence of self-conscious emotions [state shame: $F(1, 41) = .01, p = .94$; trait shame: $F(1, 41) = .58, p = .45$]. Additionally, BMI was negatively correlated with body esteem [$r(44) = -.33, p = .028$] but was not associated with self-reported state or trait shame (all $p > .61$) or strength of cortisol stress responses [$r(44) = -.18, p = .24$].

Gender differences—Next, we tested whether gender differences existed in any variable of interest. While maximum cortisol increases were comparable between male and female participants, [$F(1, 41) = .41, p = .53$], females reported higher levels of state shame stress responses [$F(1, 41) = 5.09, p = .03, \eta_p^2 = .11$], higher trait shame [$F(1, 41) = 5.21, p = .028, \eta_p^2 = .11$], and lower overall body esteem [$F(1, 41) = 4.71, p = .036, \eta_p^2 = .10$] compared to men.

Testing hypotheses

Does shame predict cortisol stress responses?—To determine whether self-reported shame stress responses predicted strength of cortisol increases to stress, regression analysis was performed controlling for BMI and revealed that self-reported state shame was not significantly associated with cortisol stress responses in either gender (main effect shame: $p = .28$ gender-by-shame: $p = .67, R^2 = .077$; Table 2). Likewise, shame/embarrassment emotion expressions did not predict maximum cortisol response to the stressor ($p = .85, \eta_p^2 = .001$). When repeating the regression analysis for trait shame, a significant main effect indicated that individuals with higher trait shame showed stronger cortisol stress responses ($p = .013, R^2 = .19$; Fig. 2a).

Are body esteem and shame associated?—Contrary to our hypothesis, individuals' body esteem scores did not predict their shame responses to the TSST (self-reported shame: $p = .24$, $R^2 = .24$; likewise, nor did self-conscious emotion expression: $p = .44$, $\eta_p^2 = .02$; Table 2). However, lower body esteem was for both genders associated with higher trait shame ($p = .049$, $R^2 = .23$; Fig. 2b).

A regression analysis controlling for BMI revealed a trend-level main effect of body esteem on maximum cortisol increases ($\beta = -.36$, $p = .091$, $R^2 = .12$; gender: $\beta = .11$, $p = .49$; gender-by-body esteem: $\beta = .30$, $p = .14$; Fig. 3), such that lower body esteem was linked to stronger cortisol stress responses.

Does body esteem moderate the association between shame and cortisol stress responses?—Body esteem did neither moderate the association between cortisol stress responses and self-reported shame (self-reported shame: $p = .41$, body esteem-by-state shame: $p = .58$, $R^2 = .09$) nor between cortisol stress responses and trait shame (trait shame: $p = .036$, body esteem-by-trait shame: $p = .74$, $R^2 = .18$), thus confirmed the strong role of trait shame in predicting the strength of cortisol stress responses. However, assessing self-conscious emotion expression revealed a trend-level interaction effect (self-conscious emotion: $p = .65$, body esteem-by-self-conscious emotion expression: $p = .094$, $R^2 = .14$; Table 3). Simple slopes analyses according to Holmbeck (2002) showed that for participants not expressing self-conscious emotions, lower body esteem was linked to stronger cortisol stress responses ($B = -.14$, $SEB = .06$, $\beta = -.43$, $p = .068$). In contrast, for participants expressing self-conscious emotion, body esteem was unrelated to cortisol responses to the TSST ($B = .04$, $SEB = .07$, $\beta = .12$, $p = .58$; see Fig. 3).

Secondary/exploratory analyses—To provide support for the approach to combine shame and embarrassment expression into a dichotomous variable indicating presence or absence of self-conscious emotion shown during the TSST, a secondary set of regression analyses was performed to determine if shame expression, independent from embarrassment expression, predicted strength of cortisol stress responses. Controlling for BMI and gender, shame expression alone did not predict strength of cortisol stress responses (shame count, total duration, average duration, average intensity, and maximum intensity: all $ps > .12$). Repeating these analyses just among those who did show shame expression ($N = 8$, 4F) yielded similar results (all $ps > .52$), as did a second set of regression analyses assessing whether embarrassment expression, independent from shame expressions, would predict cortisol stress responses across all participants (all $ps > .54$) or only among participants who did express embarrassment during the TSST ($N = 21$, 11F; all $p > .41$). Lastly, regression analyses confirmed that shame expression apart from embarrassment expression was also not associated with self-reported state shame (all $ps > .16$) or self-reported trait shame (all $ps > .23$).

To provide more background for findings concerning maximum cortisol responses, shame and body esteem associations with cortisol area-under-curve with respect to ground (AUC_g) and with respect to increase (AUC_i) were assessed (Pruessner et al., 2003). While overall cortisol output captured by AUC_g was unrelated to shame measures (all $ps > .29$) and body

esteem (all $p > .78$), AUC_i-related findings reflected the pattern observed for maximum cortisol increase (trait shame: $p = .026$; state shame and body esteem: all $ps > .13$). Lastly, given the variability in cortisol increases to the TSST, we explored the above findings separately for ‘responders’ (defined as positive maximum cortisol increase; $N = 28$) and ‘non-responders’ ($N = 16$; gender, age, BMI differences: all $ps > .25$). In line with the above findings, maximum cortisol increases were not predicted in either group by state shame (responders: $p = .77$; non-responders: $p = .13$) or presence/absence of self-conscious emotions (responders: $p = .53$; non-responders: $p = .82$). Furthermore, cortisol stress responses were positively linked to trait shame in responders ($\beta = .64$, $p = .011$, $R^2 = .37$; non-responders: $p = .68$), while higher body esteem predicted lower cortisol increases particularly in non-responders ($\beta = -.83$, $p = .048$, $R^2 = .40$; responders: $\beta = -.45$, $p = .099$, $R^2 = .13$).

Discussion

The current study aimed at elucidating the role of shame in cortisol stress responses by supplementing post-stressor emotion self-report with assessment of emotion expression shown during stress exposure as well as by exploring body esteem as a moderator. Contrary to our hypotheses, we did not find evidence for perceived or expressed shame responses to stress to be linked to cortisol stress responses. Higher trait shame, on the other hand, did predict stronger cortisol stress responses and was furthermore closely linked to lower body esteem. Body esteem itself predicted cortisol stress responses at a trend-level as well, with lower body esteem being associated with stronger cortisol stress responses. As such, our findings suggest that body esteem and chronic shame experience for both genders independently contribute to strength of cortisol stress responses, while state-dependent perceived and expressed shame appear to be unrelated to cortisol stress responses.

Shame and cortisol stress responses

Self-reported shame and cortisol stress responses—Overall, the present findings exploring the link between shame and HPA reactivity mirror the majority of studies that fail to find this link (Denson et al., 2009). The discrepancies seen in the literature could thereby be due to differences in study design. Contrary to studies explicitly inducing shame, the TSST is not designed to induce or evoke a specific emotion, so reactions vary both within and across individuals (Kirschbaum et al., 1993). Thus, although several of the participants in the current study did report feeling shame throughout the social-evaluative task, they often also reported feeling a wide range of emotions including anger and fear. Perhaps it is not shame in particular, but rather a combination or pattern of several emotions that plays a role in the physiological stress response.

Furthermore, while stress-related (i.e., state) shame was not linked to cortisol stress responses, individuals with more chronic shame experiences (i.e., higher trait shame) did show stronger cortisol stress responses than individuals reporting lower trait shame. As such, a trait-like propensity to feel shame appears to be more pervasive than shame elicited context-specifically, questioning the assumption that a person who feels shame on a regular basis will be more likely to feel or express shame in an acute stressful situation (Rohleder et

al., 2008). This observation is supported by previous research that not only links shame with both disengagement and dissociation coping strategies (Irwin, 1998; Talbot et al., 2004; Thomson & Jaque, 2013), but further suggests that shame-prone individuals are more likely to use these strategies to avoid shame-related arousal in stressful situations (Mason et al., 2001) or even in anticipation of a stressful task (Tops et al., 2006). This protective disengagement mechanism has recently been formalized into a model of “protective inhibition” (Tops et al., 2008). Although these strategies may be successful psychologically, the current observation suggest that individuals with more chronic shame experiences may nevertheless respond physiologically, as indicated by stronger acute cortisol stress responses.

Shame expression and cortisol stress responses—In addition to self-report, the current study also observed incidences of self-conscious emotion expression. Unexpectedly, fewer than 20 % of participants actually showed any incidence of shame expression during the TSST. In other words, shame does not appear to be a predominant emotion expressed in the context of acute psychosocial stress. This observation may not only underlie some of the inconsistency in the literature, but also helps to explain why studies using shame induction paradigms were more successful in uncovering links between state shame and cortisol responses (Denson et al., 2009).

Given the low incidence of shame expression responses to stress, the current analyses combined shame and embarrassment expressions into presence/absence of self-conscious emotions. Still, self-conscious expressions in the moment of stress did not predict the strength of cortisol responses in either female or male participants, and this lack of association held when shame expressions were examined separately. This lack of a shame expression–cortisol link may partly be due to time dynamics of cortisol responses. While SNS measures may be more sensitive in picking up the effects of short and/or early expression changes, the cortisol response is slower and more sustained (Sapolsky, 2000). Maximum cortisol stress responses thus may represent a more integrated measure in terms of emotion expression responses reflecting the sum of emotions that occurred over a longer period of time.

Interestingly, while neither self-reported state shame nor shame expressions were linked to cortisol stress responses, they were also not linked to each other. This is perhaps not surprising considering that previous studies have found that although participants may believe they are reporting their emotions accurately, they may not be very good judges of their own emotional experience (Derakshan & Eysenck, 1999). Since the state shame questionnaire was given after the stressor had already passed, participants may not have fully remembered how shameful they felt in the moment of stress, leading to over- or under-reporting (Myers & Brewin, 1995). Additionally, facial coding and self-report capture different components of emotion: facial coding allows for assessment of visceral, less-processed emotion experience in the moment of stress, while self-report reflects the perception of emotion after cognitive processing and self-reflection have occurred (Crockett et al., 1987). In line with this differentiation, prior research using FACS in the context of the TSST did reveal associations between anger expression and cortisol responses among men in the absence of such links for self-reported emotions (Lupis et al., 2014). Hence, although no emotion expression–cortisol relationships were discovered in the current study, future

studies assessing the role of other emotions besides self-conscious emotions for cortisol stress responses may still benefit from using both methods, self-report and facial coding in conjunction.

Body esteem, shame, and cortisol stress responses

Shame and body esteem—Besides the factors suggested above potentially contributing to the inconsistent link between shame responses and cortisol responses to acute psychosocial stress, the current study proposed that the propensity to respond with shame in such a situation may vary systematically between individuals depending on their body esteem. Indeed, we found that participants who reported dissatisfaction with their bodies also reported higher levels of trait shame. However, it appears that those who felt negatively about their body did not show higher stress-related state shame (self-reported shame or shame expressions) in response to the TSST. As discussed above, the TSST is not specifically designed to elicit feelings of shame. Thus it may be that in stressful situations such as created by the TSST, self-conscious emotions are put on hold to focus on the novel task at hand. Furthermore, being prone to experiencing shame may increase the likelihood of developing strategies helping to cope with possibly shame-inducing situations, such as disengagement and dissociation coping strategies mentioned above, or displaying a ‘safer’ emotion like anger or contempt (Gao et al., 2011). Similarly, some research suggests that those with greater body shame are more likely to utilize an avoidant coping style, which may manifest in stressful situations such as the TSST and as well contribute to lower incidences of shame expressed during or reported after the event (Choma et al., 2009).

Body esteem and cortisol stress responses—In terms of biological stress responses, participants who had less positive feelings about their bodies showed stronger cortisol stress responses than participants with higher body esteem. While we observed this trend for both genders, previous research suggests that the underlying processes, specifically socio-cultural expectations, may differ for men and women. That is, it has been proposed that while a woman’s self-concept is driven by attractiveness, males’ self-concept is driven by effectiveness (Franzoi, 1995). Thus, for men, body esteem may be more closely linked to performance than it is for women, driving the negative association between body esteem and stress in a performance situation (i.e., the TSST). Women with high body esteem, on the other hand, would be expected to be buffered against certain kinds of stress. For example, Etcoff (2000) suggested that for women, physical beauty may translate into feelings of power. Indeed, the advantages of attractiveness for women have been well-documented, and range from preferential treatment in the workplace (Moffitt & Szymanski, 2011) to higher salaries than their less attractive women (Andreoni & Petrie, 2008).

Interestingly, subsequent moderation analyses revealed that body esteem was negatively associated with cortisol stress responses specifically in those participants not showing self-conscious emotions during stress exposure. This effect is surprising, as one would expect additive effects in terms of strength of cortisol stress responses. However, together with the responder/non-responder findings, this might suggest that individuals with more positive body-related feelings may be less likely to experience shame or embarrassment during a social evaluative situation and thus a cortisol stress response. Given the scarcity of research

in this area, these latter findings have to be considered exploratory and will have to be confirmed in future research.

Limitations

It should be noted that the present study does have some limitations. The study utilized a relatively small sample size, limiting the power to detect smaller effects. This may be especially relevant with regards to being able to test for moderation effects. However, a post hoc power analysis revealed that with five predictors in the regression models, an alpha of .05, a sample size of 44, and observed R^2 values of, e.g., .24 for the regression examining body esteem and shame in response to the TSST, the observed statistical power was .77. Cohen (1988, 1992) recommended .80 as an acceptable convention for desired power. Thus, while a larger sample size would have marginally increased statistical power in the current study, the estimate of the observed power indicates that the failure to find the hypothesized effects may be due to the size of the effect rather than the power of the study. Further, all participants were healthy undergraduates who constituted a rather lean BMI at about 23.3 kg/m². As such, the current findings may not generalize to an older, more diverse, more overweight, or less healthy population. Thirdly, although women taking oral contraceptives were excluded, analyses did not control for menstrual cycle phase, which has been shown to moderate cortisol stress responses in women (Kirschbaum et al., 1999).

Due to the low number of participants showing shame expression responses to the TSST, the current analyses combined shame and embarrassment expressions into presence/absence of self-conscious emotions. While this approach increased statistical power, it may have obscured differential links between shame expressions and cortisol stress responses. The current study further focused on expressions of self-conscious emotions; however, prior studies have shown that other emotions (most notably, fear and anger) could determine strength of both SNS and HPA axis reactivity to stress, thus emphasizing the value of exploring emotion–stress links using facial coding analysis (Ekman et al., 1983; Levenson, 1992; Lupis et al., 2014; Moons et al., 2010). Together these findings suggest that future studies may benefit from assessing potential stress-relevant effects of specific emotion response patterns. Lastly, including repeated cortisol sampling during the acclimation period prior to stress exposure in future studies will allow examination of the role of anticipatory stress.

Conclusion

In summary, the current findings expand the literature on the role of shame in cortisol stress responses. Though the Social Self-Preservation Theory suggests shame being a driving emotion of cortisol stress responses, emotion expression analysis revealed that few participants actually express this emotion in the context of an acute psychosocial stress test. Additionally, self-conscious emotion expressions did not predict cortisol stress responses, nor did self-report of state shame. Instead, body dissatisfaction predicted cortisol stress responses. Satisfaction with appearance may thus be itself a contributor to activation of the HPA axis during stress, beyond its role as a determinant of trait shame. Importantly, although acutely functional, stronger stress responses may over time contribute to negative

health outcomes (Goldstein & McEwen, 2002; McEwen & Seeman, 1999; Tsigos & Chrousos, 2002).

Collectively, the current results suggest that, apart from trait shame, body esteem may be an important predictor of cortisol stress responses and as such, a contributor to stress-related negative health outcomes. Future studies assessing the potential of body esteem manipulation to change stress experience may help emphasizing the role of body esteem as a promising target for health interventions.

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Fig. 1. Cortisol stress responses to a psychosocial stressor (Trier Social Stress Test; insert: mean and standard errors for maximum cortisol increases in nmol/l)

Fig. 2. Self-reported trait shame was positively related to maximum cortisol increases to stress (**a**) and negatively to body esteem (**b**)

Fig. 3.

Body esteem is only negatively linked to cortisol stress responses in participants not expressing self-conscious emotions (SCE) during the TSST

Table 1

Means and standard deviations (SD) of all study variables separated by gender

	Males (N = 20)		Females (N = 24)		T-Value	p Value
	Mean	SD	Mean	SD		
Max Cortisol increase (nmol/l)	4.56	8.22	1.54	4.11	-1.49	.15
State shame	8.40	4.06	11.08	3.57	2.33	.025
Trait shame	8.35	2.87	10.79	3.81	2.36	.023
Body esteem	2.36	.52	2.20	.67	-2.38	.022

	Males (N = 4)		Females (N = 4)		T-Value	p Value
	Mean	SD	Mean	SD		
<i>Shame expression</i>						
Count	2.5	1.73	4.25	4.57	.72	.50
Total duration	659.75	1002.2	1191.0	1247.4	.67	.53
Average duration	215.19	235.81	411.64	440.04	.79	.46
Average intensity	4.19	.75	4.18	.36	-.01	.99
Maximum intensity	4.50	.58	4.50	.58	-.00	1.00

	Males (N = 10)		Females (N = 11)		T-Value	p Value
	Mean	SD	Mean	SD		
<i>Embarrassment expression</i>						
Count	3.40	2.46	3.18	3.16	-.18	.86
Total duration	573.50	770.78	674.27	801.07	.29	.77
Average duration	158.26	101.09	194.44	197.50	.76	.46
Average intensity	1.18	1.92	1.16	1.99	-.02	.98
Maximum intensity	3.90	.99	3.73	.79	-.44	.66

Table 2

Analyses examining associations between self-reported state shame (left), self-reported trait shame (middle) and self-conscious emotion expressions (right) and maximum cortisol increases (top) body esteem (bottom)

IV	Self-reported state shame				Self-reported trait shame				Emotion expression			
	Maximum cortisol increase				Maximum cortisol increase				Maximum cortisol increase			
	β	SE	B	p	β	SE	B	p	η	df	F	p
BMI	-.16	.01	-.01	.34	-.17	.01	-.01	.25	.03	1/39	1.12	.30
Gender	.16	.07	.07	.33	.21	.06	.09	.18	.01	1/39	.35	.56
IV	.26	.01	.01	.28	.48	.01	.03	.013	.001	1/39	.03	.85
Gender $\times$ IV	-.10	.02	-.01	.67	-.15	.02	-.02	.42	.03	1/39	1.06	.31
R ²	.077				.193				–			

IV	Body esteem				Body esteem				Emotion expression			
	Self-reported state shame				Self-reported trait shame				Body esteem			
	β	SE	B	p	β	SE	B	p	η	df	F	p
BMI	-.05	.16	-.05	.75	-.08	.14	-.07	.60	.05	1/39	4.05	.094
Gender	-.20	1.19	-1.57	.20	-.23	1.08	-1.63	.14	.11	1/39	4.63	.04
IV	-.23	1.21	-1.46	.24	-.39	1.10	-2.23	.049	.02	1/39	.61	.44
Gender $\times$ IV	-.20	2.00	-2.23	.27	.04	1.82	.34	.85	.02	1/39	.66	.42
R ²	.241				.230				–			

Table 3

Analyses examining body esteem (BE) as a moderator of the associations between maximum cortisol increases and self-reported state shame (left), self-reported trait shame (middle) and self-conscious emotion expressions (right)

IV	Self-reported state shame			Self-reported trait shame			Emotion expression		
	Maximum cortisol increases			Maximum cortisol increases			Maximum cortisol increases		
	β	SE	p	β	SE	p	β	SE	p
BMI	-.20	.01	.23	.20	.01	.22	-.20	.01	.23
Gender	.20	.07	.25	.24	.07	.15	.13	.07	.42
BE	-.15	.06	.43	-.04	.06	.82	-.47	.08	.055
IV	.15	.01	.41	.37	.01	.02	-.07	.06	.65
BE $\times$ IV	.09	.01	.01	-.05	.01	-.004	.40	.10	.17
R ²	.091			.183			.138		