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From “In the Air” to “Under the Skin”: Cortisol Responses to Social Identity Threat

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Abstract

The authors examined women’s neuroendocrine stress responses associated with sexism. They predicted that, when being evaluated by a man, women who chronically perceive more sexism would experience more stress unless the situation contained overt cues that sexism would not occur. The authors measured stress as the end product of the primary stress system linked to social evaluative threat—the hypothalamic–pituitary–adrenal cortical axis. In Study 1, female participants were rejected by a male confederate in favor of another male for sexist reasons or in favor of another *female* for *merit-based* reasons. In Study 2, female participants interacted with a male confederate who they learned held sexist attitudes or whose attitudes were unknown. Participants with higher chronic perceptions of sexism had higher cortisol, unless the situation contained cues that sexism was not possible. These results illustrate the powerful interactive effects of chronic perceptions of sexism and situational cues on women’s stress reactivity.

Keywords

sexism; psychophysiology; stress; discrimination; identity safety

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Imagine a prospective entrepreneur presenting to a group of venture capitalists in an effort to secure investment funding for a new technology company. As is the case with most venture capitalists, the majority of the audience is male. How would a female entrepreneur experience this situation? It is possible that as a member of a group that is negatively stereotyped in leadership and technology domains, she may worry about being the target of sexism and experience social identity threat (SIT). SIT is the psychological state that occurs when people are aware that they have the potential to be viewed negatively or devalued because of their membership in a particular social group (Steele, Spencer, & Aronson, 2002). Features of the situation as well as individual differences influence whether people experience SIT. Thus, if our female entrepreneur experiences SIT, it may likely be the result of both the presence of situational cues to sexism as well as her chronic perceptions of sexism.

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The experience of SIT is commonly assumed to be stressful (Major & O'Brien, 2005; Schmader, Johns, & Forbes, 2008). This stress, in turn, is posited to lead to a variety of deleterious consequences such as depleted working memory (Schmader & Johns, 2003), reduced motivation (Davies, Spencer, & Steele, 2005), poorer task performance (e.g., Spencer, Steele, & Quinn, 1999; see Nguyen & Ryan, 2008, for a review), and poorer health and well-being (Cole, Matheson, & Anisman, 2007; see Steele et al., 2002, for a review). Despite substantial research on the effects of SIT-induced stress, attempts to use self-report measures to directly index this stress have produced mixed results. Only occasionally do authors find increased reports of stress under SIT (e.g., Gonzales, Blanton, & Williams, 2002; Schmader & Johns, 2003). These inconsistent results led Schmader and colleagues (2008) to theorize that indirect measures of stress, such as physiological responses, may be the best indices of SIT-induced stress.

However, there is little direct evidence linking SIT to increases in stress-related physiological, or "under the skin," responses. The current research attempts to fill this void. In two studies we examine the effects of chronic perceptions of sexism and situational cues to sexism on neuroendocrine responses, specifically cortisol levels.

Situational and Individual Antecedents of Social Identity Threat

SIT can occur in a variety of contexts, ranging from performance situations (e.g., Steele et al., 2002) to interactions with prejudiced outgroup members (e.g., Logel et al., 2009). In a given situation, people will experience SIT if they perceive that it is likely that others will devalue them based on their social identity (e.g., Wout, Shih, Jackson, & Sellers, 2009). Although SIT is a situational threat, or one that is "in the air," situational cues and individual differences both contribute to determining when and which people will experience SIT.

First, SIT can be triggered by cues in the environment that signal that discrimination is likely or possible. Examples include being the only woman in a group of men taking a math test (e.g., Inzlicht & Ben-Zeev, 2000) and interacting with a person who one suspects is prejudiced (e.g., Crocker, Voelkl, Testa, & Major, 1991; Logel et al., 2009). Situational cues that highlight the possibility that people will be devalued based on their social identity increase the likelihood that targets will experience SIT and can exacerbate vigilance for potential discrimination or devaluation (e.g., Kaiser, Vick, & Major, 2006; Murphy, Steele, & Gross, 2007). Conversely, situational cues can also signal that others value and respect one's social group or that the context is "identity safe." In these cases, SIT does not occur (e.g., Davies et al., 2005). Importantly, members of negatively stereotyped groups may experience SIT in contexts in which those negative stereotypes are relevant *unless* there are clear situational cues signaling identity safety (e.g., Davies et al., 2005; Spencer et al., 1999). For example, women show stereotype threat performance decrements on math tests unless the test is explicitly described as not showing gender differences (e.g., Davies et al., 2005).

Second, SIT can also be influenced by individual differences in chronic perceptions of the likelihood of being devalued based on one's social identity. In the United States, most, if not all, members of negatively stereotyped groups possess some perception that their group is negatively stereotyped and discriminated against (Crocker & Major, 1989; Major & O'Brien, 2005; Major, Quinton, & McCoy, 2002). Individual differences in the degree to which people chronically perceive this social devaluation affect the way people attend to, interpret, and respond to situations in which their social identities are relevant (Kaiser et al., 2006; Major et al., 2002; Mendoza-Denton, Downey, Purdie, Davis, & Pietrzak, 2002; Pinel, 2002). Constructs such as stigma consciousness (Pinel, 1999), prejudice expectations (Kaiser et al., 2006), and group-based rejection sensitivity (Mendoza-Denton et al., 2002)

have been developed to assess individual differences in chronic perceptions that one's group is devalued and discriminated against in society.

Importantly, individual differences in chronic perceptions of discrimination may interact with situational cues to trigger SIT. In the current article, we argue that chronic perceptions of discrimination are associated with greater SIT-induced stress unless the situation contains very clear cues that signal identity safety. Consistent with this, Brown and Pinel (2003) found that when women were given the identity-threatening information that an upcoming test examined gender differences in math performance, those who were high in gender stigma consciousness experienced higher levels of SIT, compared to those who were low in gender stigma consciousness. However, when women were given identity-safe information that the upcoming test was free of gender bias, both those higher and those lower in gender stigma consciousness showed lower levels of SIT.

The Stress of Social Identity Threat

As noted above, although SIT is assumed to cause stress, this stress is often not reflected in individuals' self-reported experiences (e.g., Major & O'Brien, 2005; Schmader et al., 2008). For this reason, researchers have commonly relied on indirect measures to index the stress associated with SIT, such as increased anxious arousal (e.g., Ben-Zeev, Fein, & Inzlicht, 2005; O'Brien & Crandall, 2003). For example, women under SIT show performance effects consistent with high arousal (i.e., better performance on an easy task and worse performance on a hard task), and these performance differences are erased when women are able to misattribute their arousal to an irrelevant source (Ben-Zeev et al., 2005, Study 2).

Physiological measures provide another way to assess stress. The experience of stress elicits a cascade of biological responses across the autonomic nervous system, the hypothalamic-pituitary-adrenal cortical (HPA) axis, and the immune system (McEwen, 1998). Activation of these systems is an adaptive reaction to acute stressors, orienting an individual to the demands of a taxing situation (McEwen, 1998). A growing body of research has begun to examine the association between SIT and these physical responses.

Some correlational studies have found an association between African Americans' perceived experiences of discrimination and various physiological stress responses (e.g., Clark, Benkert, & Flack, 2006; Steffen, McNeilly, Anderson, & Sherwood, 2003). In addition, several experimental studies have found that situations containing cues to SIT can lead to increased physiological stress responses—most commonly blood pressure (e.g., Armstead, Lawler, Gordon, Cross, & Gibbons, 1989; Blascovich, Spencer, Quinn, & Steele, 2001; Fang & Myers, 2001; Lepore et al., 2006). Beyond blood pressure reactivity, in a recent study (Mendes, Major, McCoy, & Blascovich, 2008), Black participants who were rejected by White partners, an identity-threatening situation, showed greater sympathetic activation compared to Black participants rejected by Black partners, an identity-safe situation. Although studies assessing the impact of SIT on physiological stress responses among women are less common, several studies report a positive correlation between perceived experiences of sexism and self-reported physical stress-related symptoms such as nausea, headaches, depression, and gastrointestinal distress (e.g., Berg, 2006; Goldenhar, Swanson, Hurrell, Ruder, & Deddens, 1998; Landrine & Klonoff, 2001; Landrine, Klonoff, Gibbs, Manning, & Lund, 1995). A recent review of research examining the relationship between perceived discrimination and physiological stress responses, however, concluded that the majority of studies show “conditional associations,” such that a relationship is present for some subgroups but not others (Williams & Mohammed, 2009).

The interaction between situational cues and individual differences, discussed above, may explain these conditional associations. For example, Guyll, Matthews, and Bromberger

(2001) assessed cardiovascular reactivity among African American women while they performed a stressful task that primed discrimination—giving a speech about the experience of being accused of shoplifting—and while they performed a nonsocial stress task unrelated to discrimination—a mirror-tracing task. Women who attributed past mistreatment to racial or ethnic discrimination showed greater diastolic blood pressure reactivity during a discrimination speech task but not during a nonsocial task. Women who avoided making discrimination attributions for past mistreatment, in contrast, did not show increased reactivity to the discrimination speech. Therefore, exacerbated threat or stress seems to require a coupling of person effects and specific contexts.

SIT and Activation of the Hypothalamic-Pituitary-Adrenal Cortical (HPA) Axis

Most research examining the link between SIT or discrimination and physiological stress has focused on cardiovascular responses (for reviews, see Harrell, Hall, & Taliaferro, 2003; Paradies, 2006; Williams & Mohammed, 2009). The present research examines the interaction of individual differences and situational cues to induce SIT and trigger another important system, the HPA axis. When the HPA axis is activated, it stimulates a cascade of neuroendocrine responses of which the end product is cortisol (Lovallo & Thomas, 2000). Stress-induced increases in cortisol can have a negative effect on cognitive processes (e.g., Bernstein-Bercovitz, 2003), and repeated elevations of cortisol have been linked to physical and mental health problems such as major depression, cardiovascular disease, insulin resistance, and obesity (McEwen, 1998).

The types of situations most likely to lead to increases in cortisol are those characterized by *social evaluative threat*—situations in which people fear being negatively evaluated by others (Dickerson & Kemeny, 2004). SIT can be conceptualized as a specific type of social evaluative threat, in which individuals fear a negative evaluation because of their social identity. Matheson and Cole (2004) examined individuals' cortisol reactivity during an experience of SIT. They induced SIT by telling students, who typically relied on either emotion-focused or problem-focused coping styles, that students at their university were less competent than other university students. When exposed to SIT, students who had emotion-focused coping styles had higher levels of cortisol than students who relied on problem-focused coping styles. This study is important because it shows that cortisol responses can be increased by an acute experience of SIT within an experimental setting and that both situational cues and individual differences can interact to affect cortisol levels. Our work extends this in important ways by examining a directly relevant individual difference construct and measuring stress responses of members of a group that is chronically devalued in society during face-to-face interactions with an outgroup member.

The Current Research

Our primary goal in the current research was to examine women's cortisol reactivity when they are being evaluated by a man as a function of their chronic perceptions of sexism and of the presence of situational cues to sexism or identity safety. We hypothesized that women would experience SIT-related stress, indexed by higher cortisol levels, when they believed that it was likely that they would be the targets of sexism. Women who chronically perceive high levels of sexism believe that discrimination is more likely to occur (e.g., Pintel, 1999; Tropp, 2003). Therefore, we predicted that chronically perceiving high levels of sexism would be associated with increased stress reactivity during any intergroup interaction in which sexism was possible—interactions that contain identity-threatening cues and those that do not contain such cues but also do not contain clear cues to identity safety. However, in interactions that contain clear situational cues to identity safety, indicating that sexism is not a possible factor, we expected women's chronic perceptions of sexism to have no impact on stress responses.

We also assessed women's conscious experience of SIT using a self-report measure following the interaction. As mentioned above, previous SIT and stereotype threat research has only occasionally found effects on self-reported stress (e.g., Gonzales et al., 2002; Schmader & Johns, 2003). These null results may stem from self-presentational concerns associated with admitting that one feels stress in response to SIT situations (see Johns, Inzlicht, & Schmader, 2008) or from cues to SIT being attended to outside of conscious awareness such that individuals are unaware that they are experiencing stress (Schmader & Johns, 2003). Given this, we were agnostic as to whether we would find significant effects on self-reported stress.

Finally, we attempted to rule out alternative explanations for our results, namely, that they stem from variation in other individual difference constructs rather than chronic perceptions of sexism. In particular, we examined whether we would obtain our hypothesized results when statistically controlling for participants' levels of personal control, general anxiety, and depression. We did so because chronic perceptions of sexism are associated with individual differences on these constructs (e.g., Fischer & Holz, 2007; Klonoff, Landrine, & Campbell, 2000; Lambert, Herman, Bynum, & Jalongo, 2009). This suggests the possibility that women who experience greater stress during intergroup interactions containing identity-threatening cues might do so because of lower perceptions of personal control, higher anxiety, or greater depression symptomatology and that these individual differences account for the effects attributed to chronic perceptions of sexism. To control for this possibility, all participants completed measures of personal control, general anxiety, and depression prior to each experiment.

Study 1

In our first experiment, European American female participants were instructed to act as job applicants and were interviewed by a European American male confederate who was to select between the participant and a second applicant for a desirable position. The second applicant was a male or female confederate, also European American. Prior to the interview, all participants heard the interviewer give them an initial negative evaluation. In the merit condition, the feedback was merit based and the other applicant was female. In the sexist condition, the feedback was ambiguously sexist and the other applicant was male. Subsequently, women completed an in-person interview with the interviewer and provided saliva samples at four time points, which were assayed for cortisol—our primary index of SIT-induced stress.

We also assessed participants' self-reported experience of stress following the interaction. We deliberately confounded the gender of the confederate and the type of feedback to provide clear situational cues in the merit condition that sexism was not a possible explanation for the negative evaluation. This enabled us to test our hypothesis that women's chronic perceptions of sexism would lead to greater stress when there were identity-threatening situational cues but not when there were clear situational cues signaling that the context was identity safe. Specifically, we predicted that chronically perceiving sexism would be associated with higher cortisol levels among participants who were rejected because of ambiguously sexist reasons in favor of a male—those in the sexist condition. However, we predicted that chronically perceiving sexism would be unrelated to cortisol changes among participants who were rejected for merit-based reasons in favor of a female—those in the merit condition.

Method

Setting and participants—The experiment took place in a social psychophysiology laboratory that consisted of separate control and participant preparation and recording

rooms. We recruited European American female undergraduate participants ($N = 61$) who received either course credit or \$20.00.

Confederates—We trained five European American male confederates to act neutrally throughout the experiment. They were unaware of the gender of the applicant confederate, the sexism manipulation, and the study hypotheses.

Preliminary measures—Before the experiment, participants completed online measures of chronic perceptions of sexism, anxiety, depression, and personal control as part of a larger set of questionnaires.

We modeled the measure of chronic perceptions of sexism after that used by Kaiser et al. (2006). Women indicated their agreement—on a scale from 0 (*strongly disagree*) to 6 (*strongly agree*)—with five statements: “In general, others respect the gender group I am a member of” (reverse scored), “I experience discrimination because of my gender,” “My gender group is discriminated against,” “I have been unfairly treated because of my gender,” and “Members of my gender group face a good deal of gender discrimination.” The items were averaged to form a highly reliable scale $\alpha = .89$ ($M = 3.23$, $SD = 1.25$).

To control for individual differences that may covary with chronic perceptions of sexism, we also assessed participants’ anxiety, depression, and perceptions of personal control. We measured anxiety and depression using items from the Brief Symptoms Inventory (Derogatis & Spencer, 1982). Participants reported how often they felt five anxiety symptoms (e.g., nervousness or shakiness inside, tense or keyed up; $\alpha = .82$) and six depression symptoms (e.g., lonely, hopeless about the future; $\alpha = .86$) on a scale from 0 (*never*) to 6 (*all of the time*). We measured personal control with a five-item version of Pearlin and Schooler’s (1978) Mastery Scale. This measure contains items such as “What happens to me in the future mostly depends on me” ($\alpha = .63$). Participants reported how true each statement was of them on a scale of (*not at all true*) to 6 (*very much true*).

Procedure—We modeled our procedure on published studies examining dyadic interactions using the “workgroup paradigm” (e.g., Major et al., 2002) and followed standard procedures for collecting salivary cortisol (Kirschbaum & Hellhammer, 1989). Participants were run between 2:00 p.m. and 7:00 p.m. when cortisol levels are at their waking nadir. One day in advance of their scheduled lab visit, participants were sent email guidelines asking them to refrain from activities that could influence their cortisol levels. The list included, for example, brushing their teeth or drinking caffeinated beverages within 4 hours of their scheduled time and exercising at any point on the day of their scheduled time.

Women arrived individually but waited outside of the laboratory with a male confederate. The experimenter greeted them and said that even though they were waiting for a third “participant”—Andy (sexist condition) or Amy (merit condition)—they would get started with the study. The experimenter then escorted the participant into the experimental room while a second experimenter led the confederate into another room. Participants read that the study involved measuring the body’s stress response during interview situations. They then completed the hormone screening form followed by a 14-item bogus leadership questionnaire designed to bolster our cover story and provide a merit-based reason for feedback in the merit condition. After participants had been in the lab 20 minutes, they provided a baseline saliva sample.

Next, the participant and both of the confederates introduced themselves via video. Over an intercom, the experimenter told them to give their first name, year in school, major, and

hobbies. Participants saw the confederate whom they had seen in the hallway introduce himself first, followed by the “late” bogus participant, Amy or Andy. Both introductions were pretaped and showed the confederates in an experimental room similar to the participants’. Participants introduced themselves last.

The experimenter then explained that based on a random drawing, the participant and Amy or Andy were assigned roles as applicants and the other, male, confederate was assigned the role of interviewer. His job was to interview the applicants and choose one to be his partner on a task with a chance to win \$50. He was then given time to review both applicants’ performances on the leadership questionnaire, which were ostensibly scored using “a system developed by the Stanford Graduate School of Business.” The experimenter then asked him to state his initial impression of the two applicants over the intercom.

This audio feedback was pretaped and was negative in both conditions. Participants in the merit condition heard, “Uh . . . well, it says here that Participant B got a lower score on the leadership questionnaire . . . so, just based on that, I’d have to say that at this point I would pick Participant A over B. I think I will have a better chance of winning the prize if I work with her.” Participants in the sexist condition heard, “Uh . . . well, Participant B is probably too emotional and won’t be a strong partner . . . so, I’d have to say at this point that I would pick Participant A over B. I think I will have a better chance of winning the prize if I work with him.” Thus, the only difference between conditions was the reason given for potential rejection.

Participants were then given 2 minutes to prepare for the interview. They were told that during the interview they should try to convince the interviewer to select them by explaining why their talents, skills, and experiences make them the best teammate.

The experimenter then brought the confederate into the participant’s experimental room and seated him at a table facing her. To maintain the cover story, the experimenter explained that the participant would be interviewed prior to the second applicant. The experimenter left the room and then, over the intercom, instructed the participant to begin speaking. If she stopped speaking before the required 5 minutes had elapsed, the experimenter prompted her to continue.

Next, the participant completed a 5-minute backward digit span task while the interviewer kept track of her performance. Over the intercom, participants heard a prerecorded adult female voice recite a list of 19 sets of two-digit numbers (4 to 6 numbers per set). Their task was to repeat the numbers in reverse order immediately following each set. Following this, the experimenter escorted the confederate out of the room.

Subsequently, the participants reported how stressful they thought the interview was and then completed the manipulation check. We collected saliva samples at three additional times, 20, 30, and 40 minutes following the stressor, which was operationalized as when participants heard the rejecting feedback. These times were selected based on the consistent finding that peak concentrations of salivary cortisol occur about 20 minutes following a stressor (Dickerson & Kemeny, 2004). Finally, participants were probed for suspicion concerning the feedback and confederates and were then fully debriefed and, when applicable, paid.

Hormone screening questionnaire—We asked participants to report (0 = *no*, 1 = *yes*) whether they had exercised, drank caffeine or alcohol, or smoked on the day of the experiment as well as whether they were feeling depressed that day. Participants received a score of 1 for every affirmative answer. As all of these factors increase cortisol levels (e.g.,

Gotthardt et al., 1995; Lovallo, Farag, Vincent, Thomas, & Wilson, 2006; Petrides et al., 1994), we added across these scores and used the sum as a covariate in the cortisol analysis. We also asked participants to report their age, the time they woke that morning, and the first day of their last menstruation.

Self-reported stress—Participants reported how stressful the interview was on a scale from 1 (*not at all stressful*) to 7 (*extremely stressful*).

Cortisol reactivity—We collected saliva samples by having participants expectorate 1 ml of saliva into IBL (Hamburg, Germany) SaliCap sampling devices using a plastic straw. SaliCaps were stored in a -20°C freezer until shipped on dry ice to be assayed. Saliva samples were assayed at the California National Primate Research Center at the University of California, Davis. Prior to assay, samples were centrifuged at 3,000 rpm for 20 minutes to separate the aqueous component from mucins and other suspended particles. Salivary concentrations of cortisol were estimated in duplicate using commercial radioimmunoassay kits (Diagnostics Products Corporation, Los Angeles, CA). Intra- and interassay coefficients of variation were 2.44 and 3.97, respectively.

We created three measures of cortisol reactivity by subtracting baseline cortisol values from the cortisol values at Time 2 (20 minutes poststressor), Time 3 (30 minutes post-stressor), and Time 4 (40 minutes poststressor). Higher values indicate greater cortisol. Since cortisol levels naturally decline from awakening to afternoon (Schmidt-Reinwald et al., 1999) and our procedure was less stressful than those that typically show increases in cortisol (e.g., Dickerson & Kemeny, 2004), we expected a drop in cortisol levels over the course of the experimental session for all participants. Consequently, we focus on differences in *levels* of cortisol, not on increases per se (e.g., Miller & Maner, 2009; Page-Gould, Mendoza-Denton, & Tropp, 2008). To maintain consistency with the literature, we use the term *cortisol reactivity* to refer to our measure of change in cortisol from baseline (e.g., Dickerson & Kemeny, 2004; Page-Gould et al., 2008).

Manipulation check—Participants reported how sexist they thought the interviewer was on a 1 (*not at all sexist*) to 7 (*sexist*) scale.

Results

Participant attrition—Five participants, one in the merit condition and four in the sexist condition, demonstrated significant levels of suspicion and were excluded from our analysis. Given that all participants received rejecting feedback from the confederate despite strong social norms discouraging people from giving negative feedback, we were not surprised by this result. In addition, six participants were not included because they did not have complete data—two provided saliva samples that were insufficient to assay, one was unable to hear the confederate's feedback because of a technical malfunction, one did not provide necessary information to allow us to control for menstrual cycle phase, and two did not complete the measures of anxiety, depression, and personal control. Our final data set included 50 participants, 22 in the sexist condition and 28 in the merit condition.

Preliminary analyses—We conducted an independent samples *t* test to check that our manipulation was successful. As expected, participants in the sexist condition perceived the interviewer to be significantly more sexist ($M = 3.32$, $SD = 1.09$) than those in the merit condition, ($M = 2.32$, $SD = 1.25$), $t(48) = 2.96$, $p = .005$.

Analytic strategy—To test our hypotheses we conducted a series of moderated regression analyses (Aiken & West, 1991). To control for the effect of participants' anxiety and

depression scores and their perceptions of personal control, we mean centered these variables and entered them on Step 1. On Step 2, we tested the independent effects of condition (0 = *sexist*, 1 = *unknown attitudes*) and chronic perceptions of sexism (mean centered). Finally, to test the interaction between condition and chronic perceptions of sexism, we created an interaction term and entered this on Step 3. We tested the ability of this model to predict self-reported stress and cortisol reactivity. In addition, for the analyses of cortisol responses, we also included the following covariates on Step 1: baseline cortisol level, time since awakening, days since last menstrual cycle, age, and number of cortisol-influencing factors. See Table 1 for a summary of these analyses.¹

Prior to running these analyses, we also conducted the above moderated regression, using the cortisol covariates, predicting baseline cortisol levels. These regressions yielded no significant effects, $F_{Step2}(2, 42) = 0.82, p = .45, R^2 = .03$ and $F_{Interaction}(1, 41) = 1.35, p = .25, R^2 = .03$.

Self-reported stress—First, we examined levels of stress reported by participants after the interaction. We found no significant effects, $F_{Step2}(2, 44) = 0.27, p = .76, R^2 = .01$, $F_{Interaction}(1, 43) = 2.04, p = .16, R^2 = .04$. There were no significant differences in participants' self-reported stress by condition (*sexist* $M = 4.64, SD = 1.18$, merit based, $M = 4.46, SD = 1.35$).

Cortisol reactivity—We then repeated the analyses testing cortisol reactivity at Times 2, 3, and 4, which were taken 20, 30, and 40 minutes postrejection, respectively. Results were consistent across these three samples. The regression models yielded significant interactions at Time 2, $F_{Interaction}(1, 38) = 4.56, p = .04, \Delta R^2 = .09$, Time 3, $F_{Interaction}(1, 38) = 6.87, p = .01, \Delta R^2 = .11$, and Time 4, $F_{Interaction}(1, 30) = 7.52, p = .009, \Delta R^2 = .11$.

As predicted, in the sexist condition women who were higher in chronic perceptions of sexism showed significantly higher cortisol at Time 2, $\beta = .667, p = .009$, Time 3, $\beta = .584, p = .01$, and Time 4, $\beta = .603, p = .007$. However, in the merit condition, where the possibility of sexism was removed or greatly reduced, women's chronic perceptions of sexism were unrelated to their cortisol changes at Time 2, $\beta = -.034, p = .87$, Time 3, $\beta = -.215, p = .33$, or Time 4, $\beta = -.190, p = .36$ (Figure 1).

Discussion

Results of Study 1 confirmed our predictions for women's experience of SIT-induced stress, as measured by cortisol reactivity. Individual differences in chronic perceptions of sexism were associated with cortisol levels among women who were in a situation that contained identity-threatening cues but not one that contained identity-safe cues. Specifically, when women interacted with a man who previously gave them rejecting, ambiguously sexist feedback and indicated a preference for a male, their chronic perceptions of sexism were associated with higher cortisol. However, when women interacted with a man who previously gave them rejecting but merit-based feedback and indicated a preference for another female, their chronic perceptions of sexism were unassociated with cortisol changes.

We did not observe significant effects of condition, chronic perceptions of sexism, or their interaction on self-reported stress. The lack of correspondence between cortisol levels and self-reported stress may not be surprising given that physiological and self-report measures can show different patterns of results, especially in studies that examine more sensitive

¹In the cortisol analysis, the additional variance predicted by personal control, anxiety, and depression was $\Delta R^2 = .021$ at Time 2, $\Delta R^2 = .048$ at Time 3, and $\Delta R^2 = .051$ at Time 4. See Table 1 for self-reported stress.

contexts like discrimination or racial bias (e.g., Blascovich, Mendes, & Seery, 2002; Kirschbaum, Klauer, Filipp, & Hellhammer, 1995; Maina, Palmas, & Filon, 2008). Study 2 gave us a second opportunity to examine whether self-reported stress would be discrepant from cortisol reactivity.

These results show that chronically perceiving one's group to be discriminated against is associated with greater SIT during an evaluative interpersonal interaction with an out-group member when there are identity-threatening situational cues but not when there are identity-safe situational cues. However, it is unclear whether chronic perceptions of discrimination are associated with greater SIT in situations that do not contain strong cues signaling either identity threat or identity safety. We examine this in Study 2 and hypothesize that chronic perceptions of sexism will indeed be related to greater SIT in these situations.

Study 2

In our second study, women who varied in their chronic perceptions of sexism performed a cognitive task with a male who they believed would evaluate their desirability as a coworker and supervisor on the basis of their performance. Half of the women were told nothing about his attitudes toward women; the remaining women were led to believe that the male endorsed sexist attitudes. The confederate behaved neutrally in both conditions.

Given that women experience stereotype threat unless there are clear situational cues signaling identity safety (e.g., Davies et al., 2005; Spencer et al., 1999), we predicted that women's chronic perceptions of sexism would be associated with greater SIT-related stress in both conditions in Study 2 since neither contained clear cues indicating identity safety. However, we also predicted that this association would be stronger when the situation contained the identity-threatening cue of a sexist partner than when the situation did not contain this identity-threatening cue. As in Study 1, our primary index of stress was cortisol reactivity; we also measured self-reported feelings of stress.

Method

Setting and participants—The experimental setting was a social psychophysiology laboratory similar to Study 1. We recruited European American female undergraduate participants ($N = 52$) who received either course credit or \$15.00.

Confederates—Two European American male research assistants served as confederates. They were trained to act neutrally throughout the experiment and were unaware of participants' conditions and the study hypotheses.

Preliminary measures—As in Study 1, prior to the laboratory portion of the study, participants completed online measures of chronic perceptions of sexism, anxiety, depression, and personal control as part of a larger set of questionnaires.

We assessed chronic perceptions of sexism with a five-item scale; three items were identical to those used in Study 1 (i.e., "In general, others respect the gender group I am a member of" [reverse scored], "I experience discrimination because of my gender," and "My gender group is discriminated against"). The remaining two items were slight variations of those in Study 1 (i.e., "I consider myself a person who is deprived of opportunities that are available to others because of my gender" and "Other members of my gender group experience discrimination"). Participants rated each statement on a scale from 0 (*strongly disagree*) to 6 (*strongly agree*). The interitem reliability was very good ($\alpha = .83$, $M = 3.44$, $SD = 1.02$).

Participants completed the same measures of anxiety ($\alpha = .79$), depression ($\alpha = .80$), and personal control ($\alpha = .88$) as in Study 1.

Procedure—We modeled our procedure on published studies examining dyadic interactions (e.g., Blascovich, Mendes, Hunter, Lickel, & Kowai-Bell, 2001) and followed standard procedures for collecting salivary cortisol (Kirschbaum & Hellhammer, 1989). Participants were run between 2:30 p.m. and 7:00 p.m. and were sent the same guidelines as in Study 1.

Women were scheduled individually but waited outside of the laboratory with a male confederate. The experimenter escorted them both into the laboratory and informed them that the study concerned behavior in the workplace and that they would be interacting and cooperating on a task with each other. They were also informed that we were interested in measuring the body's stress response, which warranted the collection of saliva samples.

The experimenter then escorted the participant into a private experimental room where she completed a hormone screening questionnaire, a brief demographic information sheet, and four attitude questionnaires. The first three attitude questionnaires assessed opinions on neutral topics (e.g., the Electoral College). The fourth and critical questionnaire served as the basis of our sexism manipulation. This questionnaire assessed opinions on gender issues in the workplace. Participants were asked their extent of agreement with four statements: "Women should not earn the same amount of money in certain fields because they do not have the same abilities as men," "I think a man should be hired over a woman because men often have families to support," "I could not work for a female boss because women can be overly emotional," and "In my opinion, it is a good thing the equal rights amendment never passed." A baseline saliva sample was collected 20 minutes postarrival, typically following completion of these questionnaires.

Next the experimenter ostensibly exchanged the participants' and confederates' attitude questionnaires, on the pretense of helping them become better acquainted with one another "just as coworkers do in the workplace." The confederate's responses on the three neutral questionnaires were matched to the campus mean. However, his responses on the gender issues questionnaire differed by condition. In the sexist condition, his responses indicated strong agreement with all four of the statements above. In the unknown attitudes condition, the partner's gender attitudes questionnaire was missing.

The experimenter then brought the confederate into the participant's room and seated him at an adjacent computer monitor. The interaction consisted of the dyads performing a word-finding game similar to Boggle in which they took turns finding and saying aloud words from an 8×8 letter matrix. Participants were informed that their partners would be evaluating them as a coworker and potential supervisor based on their performance and that the team with the most correct responses would win \$50. The confederate responded with valid words in timed increments dictated by an algorithm representing typical performance (Blascovich, Mendes, et al., 2001). On completion of the task, the confederate was escorted from the room and participants reported how stressful they found the interaction to be.

We collected saliva samples at two additional times, approximately 15 and 35 minutes poststressor, which we operationalized as the time from the beginning of the interaction. These times were exactly 20 and 40 minutes after the exchange of the attitude questionnaires. The slight variation in the amount of time is the result of differences in participants' speed at completing the questionnaires. Finally, participants completed a manipulation check and were probed for suspicion, debriefed, and, when applicable, paid.

Hormone screening questionnaire—Participants completed the same hormone screening questionnaire used in Study 1 as a measure of the covariates for the cortisol analysis.

Cortisol responses—We collected saliva samples by having participants insert a cotton swab into their mouths for 2 minutes and then place it in a plastic tube (Salimetrics, State College, PA). As in Study 1, saliva samples were stored in a -20°C freezer until they were shipped on dry ice to be assayed. Cortisol concentrations were determined by radio-immune assay at the California National Primate Research Center at the University of California, Davis. Samples were assayed for free cortisol, and the inter- and intra-assay coefficients of variance were 7.11 and 7.61, respectively. We created measures of cortisol reactivity in the same way as Study 1.

Self-reported stress—Participants' indicated how stressful they experienced the interaction to be on a scale from 1 (*not at all stressful*) to 7 (*extremely stressful*).

Manipulation check—Participants responded to three items: "My partner's attitude questionnaire suggested that he or she had sexist attitudes," "My partner's attitude questionnaire suggested he or she had positive attitudes towards women" (reverse scored), and "My partner's attitude questionnaire suggested he or she was chauvinistic" ($\alpha = .85$). They reported their agreement on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale.

Results

Participant attrition—When reading their partner's questionnaires, five participants in the unknown attitudes condition mentioned that the gender issues questionnaire was missing. In these cases the experimenter told them that there must have been an error and to continue anyway. Importantly, none of these participants expressed suspicion regarding the procedures during debriefing and are, therefore, retained in our analyses. However, four participants provided saliva samples that were insufficient to assay (one in the sexist condition, three in the unknown condition), four participants did not complete the anxiety and depression measures (two in each condition), and one participant did not complete the manipulation check (unknown condition). To maintain a consistent sample throughout our analyses, only those participants with complete data are included in our final sample of $N = 43$ (26 in the sexist condition, 17 in the unknown condition).

Preliminary analyses—To check that our manipulation was successful, we conducted an independent samples t test. As expected, participants in the sexist condition rated their partner's attitudes as more sexist ($M = 5.91$, $SD = 1.00$) than participants in the unknown condition ($M = 2.80$, $SD = 0.79$), $t(41) = 10.81$, $p < .001$.

Analysis strategy—We tested our hypotheses using the same series of moderated regression analyses as in Study 1. See Table 2 for a summary of these results.² As before, we conducted this moderated regression on baseline cortisol and found no significant effects of condition, chronic perceptions of sexism, or their interaction, $F_{Step2}(2, 36) = 0.72$, $p = .50$, $R^2 = .03$, and $F_{Interaction}(1, 35) = 0.95$, $p = .34$, $R^2 = .02$.

Self-reported stress—We first examined self-reported stress and found that neither the main effects nor the interaction were significant, $F_{Step2}(2, 37) = 0.12$, $p = .89$, $\Delta R^2 = .005$, and $F_{Interaction}(1, 36) = 0.39$, $p = .53$, $\Delta R^2 = .009$, respectively. Participants reported the

²In the cortisol analysis, the additional variance predicted by personal control, anxiety, and depression covariate was $\Delta R^2 = .030$ at Time 2 and $\Delta R^2 = .039$ at Time 3. See Table 2 for self-reported stress.

experience to be equivalently stressful regardless of whether their partner's attitudes were sexist ($M = 3.50$, $SD = 1.33$) or unknown ($M = 3.59$, $SD = 1.06$).

Cortisol reactivity—We then conducted analyses testing cortisol reactivity at Time 2 and Time 3. The regression model predicting cortisol reactivity at Time 2 yielded a significant main effect for chronic perceptions of sexism, $t(32) = 2.94$, $p = .006$, $\beta = .495$. The main effect of condition, $t(32) = -0.66$, $p = .52$, $\beta = -.096$, and the interaction, $F_{Interaction}(1, 31) = 0.34$, $p = .57$, $\Delta R^2 = .006$, were not significant. In partial support of our hypothesis, the more women chronically perceived sexism, the more cortisol they had, although this association was not significantly stronger in the sexist relative to the unknown condition. The regression model predicting cortisol at Time 3 also revealed a significant main effect of chronic perceptions of sexism, $t(32) = 2.82$, $p = .008$, $\beta = .359$. Again, the main effect of condition, $t(31) = 0.08$, $p = .94$, $\beta = .009$, and the interaction, $F_{Interaction}(1, 31) = 0.003$, $p = .60$, $\Delta R^2 = .003$, were not significant. The more women chronically perceived sexism, the greater cortisol levels they had in both the sexist and unknown conditions.

Discussion

As predicted, during and following an evaluative interaction with either a male who held sexist attitudes or one whose attitudes were unknown, women who chronically perceived more sexism showed higher cortisol. This suggests that the unknown condition may not have provided situational cues sufficient to indicate an identity-safe environment. Although participants in this condition did not learn that the confederate held prejudiced attitudes, they also did not learn that he held *un*prejudiced attitudes. Therefore, it was still possible that the confederate held prejudiced attitudes toward women and would behave in a sexist manner. As mentioned above, this is consistent with work demonstrating that SIT-induced performance decrements persist unless there are very clear situational cues signaling identity safety (e.g., Davies et al., 2005; Spencer et al., 1999). In addition, although we predicted that the association between chronic perceptions of sexism and cortisol would be stronger for participants paired with a sexist partner, we found no differences by condition. Thus, it appears that our participants experienced situations containing identity-threatening cues and those containing no clear cues in similar ways.

We also found no significant effects of chronic perceptions of sexism, condition, or their interaction on self-reported stress. As in Study 1, participants' perceptions of stress did not correspond to their physiological reactions.

General Discussion

In the present research, we examined women's "under the skin" hormonal stress responses associated with SIT, a "threat in the air." Across two studies, we assessed women's chronic perceptions of sexism and manipulated situational cues to identity safety versus identity threat. During an evaluative interaction with a man, women who chronically perceive more sexism had higher cortisol when there were identity-threatening situational cues (i.e., the sexist conditions in both studies) or no clear situational cues (i.e., the unknown condition in Study 2). However, women's chronic perceptions of sexism were unrelated to their cortisol changes when there were clear identity-safe cues (i.e., the merit condition in Study 1).

These results reveal that the experience of SIT-induced stress requires both an individual's belief or perception that his or her group is vulnerable to being the target of discrimination and the absence of situational cues signaling identity safety. Thus, even in situations with cues to discrimination, some individuals may not experience SIT-induced stress, and even among people who chronically perceive their group to be the target of discrimination, some evaluative intergroup situations may still be experienced as identity safe.

Social Identity Threat and Health

The present research has important implications for mental and physical health. There is a growing consensus that stress linked to perceived and actual discrimination may be a contributing factor to health disparities between members of stigmatized and nonstigmatized groups. Although stress responses are part of normal and adaptive physiological functioning, prolonged activation can result in accumulated wear and tear on the body and is associated with a variety of negative health outcomes (e.g., Epel et al., 2006; McEwen, 1998; Segerstrom & Miller, 2004).

One cause of such prolonged activation is the frequent experience of SIT-induced stress. Indeed, perceived experiences of discrimination are associated with negative mental and physical health outcomes (e.g., Borrell, Kiefe, Williams, Pletcher, & Houston, 2006; Krieger, 2000). Given that discrimination is possible in many intergroup interactions, stress may be quite frequent for members of devalued groups, especially those who chronically perceive this devaluation and discrimination as likely. Our results, by revealing which individuals in which situations will experience SIT-induced stress, take an important step toward delineating some of the conditions that might contribute to negative health outcomes.

Future Directions

One interesting result was the lack of convergence between self-reported experience of stress and biological stress responses, a finding that has been observed in other studies (e.g., Kirschbaum et al., 1995). It may be that individuals' self-reported reactions and their physiological responses index different aspects of their experiences. This is consistent with current theorizing that these classes of responses may serve different functions (e.g., Blascovich et al., 2002; Lang, Bradley, & Cuthbert, 1998; Mendes, Blascovich, Lickel, & Hunter, 2002). For example, self-reported responses might predict deliberate social behavior, whereas physiological responses may be associated with more automatic reactions (Mendes et al., 2002). Future research should examine the specific situational and individual difference variables that influence these responses.

Another area for future research concerns examining the experience of SIT-induced stress in response to blatant discrimination. In both studies, the situational cues to sexism were relatively ambiguous as to whether the women would indeed receive a sexist evaluation. Even in the sexism condition in Study 1, the rejecting feedback was an initial impression that participants had the opportunity to change during the interview. It is possible that when situations contain strong cues to blatant discrimination, all individuals will experience SIT-induced stress. However, it is also possible that individuals who *expect* discrimination during interpersonal interactions may be buffered from some of the negative effects of SIT-induced stress. For example, the belief that the status system is unfair and the implicit expectation of prejudice are linked to higher self-esteem and less threat when people encounter clear prejudice or discrimination (Major, Kaiser, O'Brien, & McCoy, 2007; Townsend, Major, Sawyer, & Mendes, 2010).

Given the frequency of contact between members of groups that are and are not negatively stereotyped or devalued, it is important to understand individuals' psychological and physiological experiences during these interactions. For instance, when women work in male-dominated fields, such as the female entrepreneur we described at the beginning of this article, their experiences interacting with their coworkers and superiors may be quite different from those of their male counterparts. In particular, women may often experience SIT during these interactions, especially if they chronically perceive high levels of sexism. Our research demonstrates not only that intergroup interactions carry with them this

potential “threat in the air” but also that as situational cues and individual differences interact, this threat can go “under the skin” to affect individuals’ physiology.

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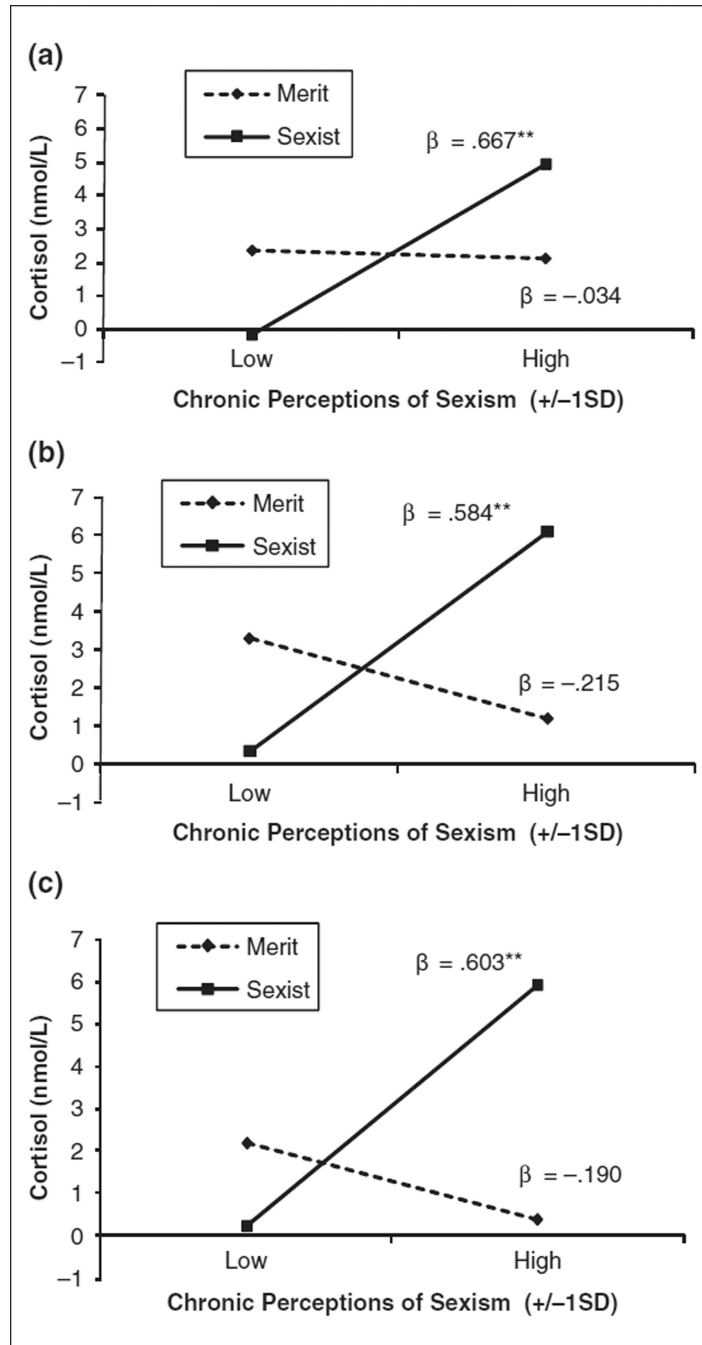


Figure 1.

Cortisol reactivity as a function of condition (*sexist* = 0, *merit* = 1) and chronic perceptions of sexism (mean centered) at (a) Time 2, (b) Time 3, and (c) Time 4 (i.e., stressor onset +20, 30, and 40 minutes, respectively). Graphed at ± 1 SD from chronic perceptions of sexism mean, controlling for perceptions of anxiety, depression, perceptions of personal control, day of menstrual cycle, number of minutes since waking, age, number of hormone reactivity influencing factors, and baseline cortisol (mean centered).

* p .05. ** p .01. *** p .001.

Table 1

Summary of Moderated Regressions Analyses: Study 1

	Cortisol reactivity			Self-reported stress
	Time 2 (+20 min)	Time 3 (+30 min)	Time 4 (+40 min)	
Step 1 (covariates)				
Step R^2	.11	.24	.28	.07
Step F	0.64	1.57	2.02 [†]	1.17
Anxiety β	.042	.176	.141	-.106
Depression β	.106	.118	.136	.299 [†]
Control β	-.042	.030	-.023	.002
Baseline cortisol β	-.123	-.340 [*]	-.401 ^{**}	—
Minutes awake β	.215	.233	.186	—
Menstrual cycle β	-.148	-.006	-.041	—
Age β	.089	-.018	.049	—
Cortisol factors β	-.117	-.180	-.160	—
Step 2 (main effects)				
Step ΔR^2	.07	.02	.04	.01
Step F	1.64	0.53	1.05	0.27
Condition β	.001	-.076	-.169	-.112
CPS β	.306 [†]	.173	.195	.039
Step 3 (condition \times CPS)				
Step ΔR^2	.09	.11	.11	.04
Step F	4.56 [*]	6.87 [*]	7.52 ^{**}	2.04

CPS = chronic perceptions of sexism. Results of moderated regression analyses, entering covariates on Step 1, condition (*sexist* = 0, *merit* = 1) and CPS (mean centered) on Step 2, and their interaction on Step 3. All regressions were conducted controlling for anxiety, depression, and perceptions of personal control. Cortisol analyses also included day of menstrual cycle, number of minutes since waking, age, number of hormone reactivity influencing factors, and baseline cortisol as covariates.

[†] p .10.

^{*} p .05.

^{**} p .01.

Table 2

Summary of Moderated Regressions Analyses: Study 2

	Cortisol reactivity		
	Time 2 (+15 min)	Time 3 (+35 min)	Self-reported stress
Step 1 (Covariates)			
Step R^2	.30	.60	.16
Step F	1.85 [†]	6.42 ^{***}	2.53 [†]
Anxiety β	.087	-.005	.433 [*]
Depression β	-.170	-.179	-.160
Control β	.155	.164	.107
Baseline cortisol β	-.485 ^{**}	-.690 ^{***}	-
Minutes awake β	-.125	-.188	-
Menstrual cycle β	-.043	.009	-
Age β	.115	.074	-
Cortisol factors β	.014	.101	-
Step 2 (main effects)			
Step ΔR^2	.15	.09	.005
Step F	4.34 [*]	4.43 [*]	0.12
Condition β	-.096	.009	.049
CPS β	.495 ^{**}	.359 ^{**}	.047
Step 3 (condition \times CPS)			
Step ΔR^2	.006	.003	.009
Step F	0.34	0.29	0.39

CPS = chronic perceptions of sexism. Results of moderated regression analyses, entering covariates on Step 1, condition (*sexist* = 0, *unknown* = 1) and CPS (mean centered) on Step 2, and their interaction on Step 3. All regressions were conducted controlling for anxiety, depression, and perceptions of personal control. Cortisol analyses also included day of menstrual cycle, number of minutes since waking, age, number of hormone reactivity influencing factors, and baseline cortisol as covariates.

[†] p .10

^{*} p .05.

^{**} p .01.

^{***} p .001.