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SHORT COMMUNICATION

Is a submissive posture adaptive when being evaluated negatively? Effects on cortisol reactivity

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Abstract

OBJECTIVES: Subordinate status and submissiveness are stressful and are often associated with ill-health. However, when there is a physical or social threat posed by more powerful others, showing submissiveness may be a good strategy to avoid or terminate conflict. One way to show submissiveness is to assume a subordinate body posture, which may also help regulate one's own stress responses by making one feel safer, and by diverting attention away from one's negative emotions and positive expectations.
METHODS: 85 male participants were randomly assigned to assume either a dominant posture (expansive, taking up more space with open limbs) or a subordinate posture (constrictive, taking up less space with closed limbs) while delivering a speech and performing difficult arithmetic tasks in front of two critical evaluators. Cortisol levels were assessed from saliva samples obtained before and after these stressful tasks.
RESULTS: Dominant posture resulted in a larger cortisol response compared to the subordinate posture. Participants in the subordinate posture did not show the normative increase in cortisol observed in other studies using this standardized social-evaluative stress protocol.
CONCLUSION: The finding that a subordinate posture decreases acute stress responses during negative social evaluation suggests that submissive strategies may be appropriate and adaptive in uncontrollable situations involving negative social evaluation. Submissiveness may diminish endocrine stress responses, which are hypothesized to have adverse effects on health in the long term. These findings have implications for developing strategies to help individuals deal with stressful social-evaluative situations while protecting their physical and mental health.

INTRODUCTION

In many species, those with a dominant status enjoy benefits such as increased predictability, control, and access to resources. Large body size communicates dominant status to others. Making one's body temporarily larger by taking up more space (assuming an expansive body posture) also increases one's perceived dominance in the eyes of others (Darwin 1872; Lorenz 1966). Furthermore, extensive research suggests that people assuming expansive postures themselves experience increased confidence and self-esteem, and act in more dominant ways than those assuming constrictive postures (Tiedens & Fragale 2003; Huang *et al.* 2011; Riskind 1984). The reason for these powerful effects may be that the association between expansive postures and dominance is deeply rooted in our evolutionary background.

However, the effects of assuming dominant postures on stress responses when one's performance is being evaluated by others are unexplored. It is possible that dominant postures decrease stress responses during social evaluation by increasing perceived social status, self-efficacy, and confidence. However, a recent study found that individuals assigned to dominant postures experience stronger negative effects of social exclusion (Welker *et al.* 2013). Similarly, higher negative subjective reactions to failure and helplessness were reported for participants in a dominant posture compared to participants in a submissive posture (Riskind 1984). These findings suggest the possibility that in certain contexts subordinate postures are more beneficial than dominant postures.

The aim of the present study was to test the effect of assuming a dominant posture during social evaluation on the cortisol response – the prototypic endocrine response to stress (Dawe *et al.* 2014). Participants underwent a standardized laboratory stressor: The Trier Social Stress Test (TSST; (Kirschbaum *et al.* 1993)). In the TSST, participants prepare and deliver a speech, and perform difficult arithmetic tasks in front of evaluators, who appear to be very critical. The TSST is a validated stress protocol, resulting in intense feelings of negative evaluation and a reliable cortisol response (Dickerson & Kemeny 2004). In this study, participants were randomly assigned to assume either a dominant posture (i.e., expansive with open limbs) or a subordinate posture (i.e., constrictive with closed limbs) throughout the TSST. We have examined a marker of endocrine stress response (increase in cortisol), which has not shown reliable associations with self-reported emotions in previous research (e.g., (Campbell & Ehlert 2012; Dawe *et al.* 2014)). Given the link between cortisol responses and physical and emotional health (McEwen 2004; Miller *et al.* 2007; Taylor & Stanton 2007) learning about the effects of posture on cortisol response is important for health research.

MATERIAL AND METHODS

Participants

Participants were young undergraduate students (N=85; 53 white, 32 black) who were part of a study on endocrine responses to social stressors (Bedgood *et al.* 2014; Turan *et al.* 2015). Only male participants were recruited, since men and women differ in both dominance and cortisol response (Kudielka *et al.* 2009). Participants were pre-screened to exclude those with conditions that might affect hormone levels: having an endocrine or hormone disease (e.g., Addison's disease), using corticosteroid-based medications or recreational drugs, smoking more than 15 cigarettes a week, getting treatment for depression or anxiety, or having an active cancer. Participants who had general anesthesia in the past four weeks or had fractures in the past eight weeks were rescheduled for a later time. Participants with the following conditions were rescheduled for when they were at least two weeks symptom free: being sick, having gum disease, or having an inflammation in the mouth.

Procedures

This study was approved by the Institutional Review Board at the University of Alabama at Birmingham. All procedures were carried out with the written consent of participants. Participants were instructed to avoid strenuous exercise and alcoholic beverages on the day of their visits since these may affect hormone levels. Participants were also instructed to avoid caffeinated drinks, smoking, and tooth-brushing within two hours of the experiment, and eating within one hour of the experiment. Compliance with these requests was confirmed upon arrival at the laboratory (see Bedgood *et al.* 2014; Turan *et al.* 2015) for more details on the procedures).

Experimental sessions were scheduled between 1 pm and 4 pm to minimize the effects of circadian rhythms on cortisol levels. Participants first completed questionnaires for 25–30 minutes before providing their first (baseline) saliva sample. Then, sham electrodes were placed on the participant's left ankle and right wrist to provide a rationale for asking them to maintain a posture. Participants were told that the electrodes would be used to monitor their cardiac activity and were asked to assume either the dominant or the subordinate posture depending on their randomly assigned condition. These postures were based on theory and extensive research on the effects of expansive and open (dominant) versus constricting and closed (subordinate) postures (Huang *et al.* 2011; Riskind 1984; Tiedens & Fragale 2003).

For participants in the dominant posture condition, a chair was placed on each side of the participant. Participants were instructed to put each arm on the back of each chair, to spread their legs, and to move their feet forward. Participants in the subordinate posture condition were instructed to put their hands on their knees,

to keep their legs close to each other, and to pull their feet toward themselves. Participants in the dominant posture condition were told that the reason for sitting in this position is to maximize the distance between their left ankle and right wrist in order to obtain accurate readings of their cardiac activity. Participants in the subordinate posture condition were told that the reason for sitting in this position is to minimize the distance between their left ankle and right wrist in order to obtain accurate readings of their cardiac activity. In reality, however, no cardiac readings were obtained. Participants' posture was monitored throughout the experiment, and participants were reminded to reassume their assigned posture if they deviated from it.

A separate sample of 142 participants was shown photographs of actors in the two postures used in this study. Similar to findings from previous studies, the dominant posture was perceived as being more dominant than the subordinate posture; F=232.10, p<0.001.

After assuming their assigned posture, participants were told about the speech and arithmetic tasks. Before participants started preparing their speech, the electrodes were temporarily removed so that participants could provide the pre-stress saliva sample (approximately 28 minutes after they were put in their assigned posture). Electrodes were then re-attached, posture re-established, and participants completed the TSST: Participants developed a speech on why they were the best candidate for a job that they desired (3 minutes), performed the speech (5 minutes), and completed a mental arithmetic task (5 minutes). Each participant performed these tasks in front of two trained female evaluators and a video camera. The evaluators appeared to be very critical throughout the protocol and increased the difficulty of tasks if a participant seemed to be performing well, with the goal of making every participant feel negatively evaluated.

The electrodes were then removed and participants provided the post-stress saliva sample (approximately 22 minutes after the start of the TSST). Participants then completed questionnaires and other tasks not relevant to this manuscript. Two additional saliva samples were obtained approximately 47 minutes and 77 minutes after the start of the TSST. (Effort was also manipulated in the TSST tasks. The effort manipulation did not have a significant effect on cortisol responses and therefore is not discussed further.)

Saliva samples and cortisol assays

Saliva samples (approximately 1 ml each time) were obtained by having participants drool passively into a test tube using a straw. Samples were immediately placed in a freezer to be stored at −20 °C until transferred to a −80 °C freezer. Saliva samples were shipped on dry ice to the Center for Interdisciplinary Salivary Bioscience Research to be assayed. The mean cortisol intra-assay and inter-assay coefficients of variability were 5.97% and 5.09%, respectively.

Measures

Perceived state dominance. Participants completed the dominance scale (eight items) of the Revised Interpersonal Adjective Scales (IAS-R; (Wiggins *et al.* 1988)) before and after the TSST. Participants rated the degree to which each of the eight interpersonal adjectives (e.g., dominant, assertive) describe them "right now". Cronbach's alpha values were 0.77 and 0.86, respectively before and after the TSST.

RESULTS

As in previous studies, participants assigned to the dominant posture during the TSST reported higher levels of interpersonal dominance on the IAS-R compared to participants assigned to the subordinate posture, albeit with a smaller effect size (post-TSST, controlling for pre-TSST levels; F=3.84, p=0.05, n=84) (Bedgood *et al.* 2014; Turan *et al.* 2015). Our participants were clearly placed in a subordinate role – they were being evaluated while performing very difficult tasks. It was likely difficult to change their self-perceived dominance substantially with a posture in this situation. As mentioned earlier, a separate sample of 142 participants, who were shown photographs of actors in the two postures used in this study judged the dominant posture as being more dominant than the subordinate posture. Thus, the dominant posture resulted in slightly higher self-perceived dominance compared to the subordinate posture, and in substantially higher dominance perceived by others (and the participants were probably aware of this (Ginsburg *et al.* 1977)).

As in previous studies, cortisol values were skewed, and were therefore log-transformed prior to analyses. The two posture groups were not significantly different in baseline cortisol (t=1.36, p=0.18). Seventy-three participants reached peak cortisol levels at the time of the first post-stress saliva sample (22 minutes after stress onset). Four participants reached peak cortisol levels 47 minutes after stress onset and eight participants 77 minutes after stress onset and these peak values were used in analyses. In order to test the effects of the posture manipulation on cortisol reactivity, t-tests were conducted to examine the effect of posture on the change in cortisol values (pre-stress cortisol minus baseline cortisol, as well as peak cortisol minus pre-stress cortisol) (Bedgood *et al.* 2014). The effect of posture (dominant vs. subordinate) on the change in cortisol from baseline to pre-stress was not significant (t=0.08, p=0.94). However, the effect of posture on the change in cortisol from pre-stress to peak was significant (t=2.22, p<0.05). Participants in the dominant posture showed a larger increase in cortisol from pre-stress to peak (M=0.28, SD=0.54) compared to participants in the subordinate posture (M=0.02, SD=0.50; see Figure 1). When analyzed separately, cortisol increase for the dominant posture condition was significantly higher than zero (t=3.26, p<0.01), while the cortisol change was not

significantly different than zero for the subordinate posture condition (t=0.31, n.s.). Thus, posture did not affect the change in cortisol from baseline to pre-stress, but the dominant posture did result in a larger cortisol increase during the interpersonal stress task.

DISCUSSION

When facing a threat of negative social evaluation, male participants randomly assigned to a dominant posture showed larger cortisol reactivity compared to participants assigned to a subordinate posture. One explanation for this result may be based on evolutionary theory. Darwin (1872) suggested that when there is a threat from more powerful others, making one's body look smaller is a good strategy in order to avoid or reduce conflict. Animals as well as humans use these "appeasement displays", which seem to successfully accomplish the intended goal of ending conflict (Lorenz 1966; Tiedens & Fragale 2003). For example, Ginsburg, *et al.* (1977) found that compared to other behaviors, behaviors that involve making one's body smaller were more likely to precede the termination of hostile activity by other boys. In addition to signaling submissiveness, thus preventing further threats from powerful others, it has been suggested that subordinate postures may help regulate one's own stress responses by making one feel safer due to the reduced likelihood of further threats, and by diverting attention away from one's negative emotions and positive expectations (Riskind 1984).

A similar mechanism may play a role in situations of negative social evaluation. The threat of social evaluation has implications for social status and constitutes one of the most important stressors in modern life. Similar to physical threats, threats to the social self have powerful negative effects on affect, behavior, and physiology (Dickerson & Kemeny 2004). In a situation involving a social threat, assuming a dominant posture may lead participants to feel vulnerable to more severe criticism. Assuming a subordinate posture, on the other hand, may be a more adaptive strategy, by signaling appeasement and leading to feeling safer, and resulting in a smaller stress response. It is possible that a subordinate posture leads to disengagement with the task, resulting in a low cortisol reaction. (As a side note, participants perceived the dominant posture as more relaxed and easier to maintain than the subordinate posture (data not shown), and these "relaxation" and "difficulty" variables did not predict the cortisol response. Therefore, the effect of posture on how relaxed participants felt cannot account for the findings).

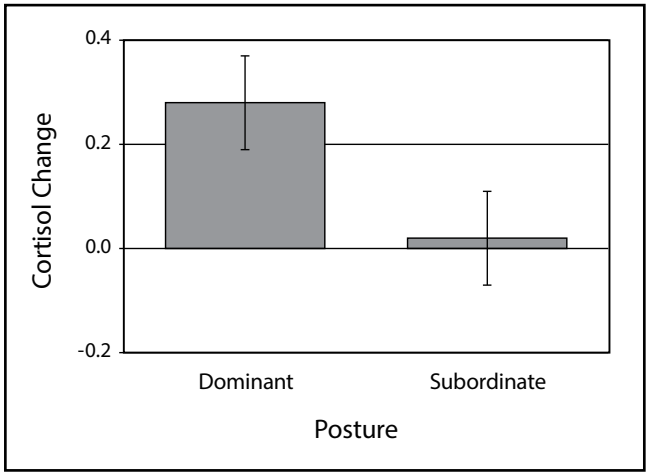

Fig. 1. Cortisol change from pre-stressor to peak values.

The finding that dominant posture resulted in larger cortisol reactivity compared to the subordinate posture is in line with psychological theories and research on the importance of the match between the situation/context and behavioral response tendencies. For example, more positive outcomes are observed when (a) the strategy chosen to pursue a goal matches the individual's motivational orientation (regulatory fit theory; (Higgins 2000)), (b) when a subordinate posture is assumed after experiencing a failure (appropriateness hypothesis; (Riskind 1984)), or (c) when a person's basal testosterone level (which is associated with trait dominance; (Turan *et al.* 2014)) matches that person's current level of social status (Josephs *et al.* 2006).

Another, related possible explanation for the present results is based on the assumption that dominant individuals perceive a negative social evaluation as a bigger threat to their social status: Dominant individuals may feel that they have more to lose and therefore may perceive an evaluative situation as more stressful (Scheepers 2009). Animal and human research suggests that individuals with a dominant status indeed show larger cortisol reactivity than subordinate individuals during dominance struggles and social status threats (Sapolsky 1995; Gruenewald *et al.* 2006; Hellhammer *et al.* 1997).

It should be noted that another study (Carney *et al.* 2010) found that participants in a dominant posture showed larger cortisol decreases compared to participants in a subordinate posture. However, that study differed from the present one in two important ways: (a) It had a smaller sample consisting of mainly women (26 women and only 16 men; and men and women differ substantially in their dominance as well as their hormonal responses (Kudielka *et al.* 2009); also see (Stanton 2011) for comments on this study), and (b) it did not involve a laboratory stressor or an interpersonal situation. Future studies examining the association between dominance strategies and stress responses in women would add to our understanding in this area. Future studies should also examine the precise mechanism involved in the effect of dominant and subordinate postures on the cortisol response. Given that previous laboratory stress studies have not revealed reliable associations between self-reported emotions and cortisol (e.g., (Campbell & Ehlert 2012; Dawe *et al.* 2014)), the best way to accomplish this may be by experimentally manipulating relevant variables.

Extensive research suggests that submissiveness is stressful and is associated with ill-health (e.g., cardiovascular, immunological, and mental-health problems). However, our finding that a dominant posture increases acute stress responses during negative social evaluation suggests that individuals who frequently find themselves in such situations and do not use submissiveness or appeasement displays may suffer negative effects on their health in the long run (Rivers & Josephs 2010). These findings have implications for the development of strategies to help individuals deal with stressful social evaluative situations while protecting their physical and mental health.

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