Fall 2021

Examining the Effects of Power Posing on Stress Reactivity and Performance

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DOI: https://doi.org/10.31979/etd.6s48-nvnc

EXAMINING THE EFFECTS OF POWER POSING ON STRESS REACTIVITY AND PERFORMANCE

A Thesis

Presented to

The Faculty of the Department of Psychology

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Mitzi D. Ochoa

December 2021

The Designated Thesis Committee Approves the Thesis Titled

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APPROVED FOR THE DEPARTMENT OF PSYCHOLOGY

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December 2021

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ABSTRACT

EXAMINING THE EFFECTS OF POWER POSING ON STRESS REACTIVITY AND PERFORMANCE

by Mitzi D. Ochoa

Power posing is a concept that has garnered widespread attention due to claims that an expansive powerful posture can improve self-perceptions of power, trigger changes in hormone levels, and improve behavioral outcomes including enhanced performance in social evaluative situations. Recently, these claims have been challenged by studies that failed to replicate the power boosting effects of expansive poses. This study aimed to address inconsistencies in the power posing literature and replicate original findings while controlling for potential effects of experimenter bias and touch. It was predicted that a high-power pose would reduce cortisol, increase perceptions of power, and improve performance. To test this, 60 undergraduate participants were recruited and assigned to a high-power or low-power group. The TSST was utilized to induce psychosocial stress. Cortisol was examined as a physiological marker of stress via salivary samples. Perceived power was measured prior to and following power posing and stress induction. Performance was scored via the SPES, a scale designed to systematically evaluate TSST performance. Findings did not reveal any significant differences between the high-power and low-power group for any dependent measures, and the results are discussed in the context of previous findings. This experiment joins the growing number of studies that have examined the effects of power posing and have been unable to replicate previous findings.

ACKNOWLEDGMENTS

I have received a great deal of support in writing this thesis. I would like to especially thank my mentor and thesis committee chair, Dr. Cheryl Chancellor-Freeland, for her patience and unwavering support. My interest in neuroscience began in her biopsychology lectures when I was an undergraduate. Since that time, she has been the most influential person in my education and research. This thesis would not have been possible without her encouragement.

I would also like to express my gratitude to my thesis committee members for the time and advice dedicated to helping me succeed with this project and in the master's program. Dr. Kimeron Hardin not only inspired my interest in psychology but also became my role model. Dr. Megumi Hosoda provided me with the tools to understand and apply statistical analyses.

Great appreciation is due to the researchers of the International Neuroeconomics Institute (INI) research laboratory who devoted their time to help collect data. It would not have been possible to complete this research without them. I especially commend Brissa Ortega, for her time and continuous guidance. Thank you also to Moema Gondim and Gali Levi-McClure for their support.

Finally, thank you to my wife, Brenda Renteria, who provided me with enormous support throughout this entire process, and always believed that I was capable of achieving this goal.

I dedicate this thesis to my sister, Maritza, and to every brown and black girl who one day chose to listen to the faint whisper promising "yes you can" despite the screams suggesting "no you cannot". We can and we will.

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Introduction

A growing body of neuroscience and psychology research has set out to examine the various processes that influence how powerful humans feel. One particular focus is the physical embodiment of power. This line of research, generally referred to as postural feedback, specifically investigates the effects of *power posing* on decision making, resilience, and well-being. Power posing involves the impact of expansive versus contractive postures on an individual's perception of power, stress levels, and performance in situations where a person is being evaluated (Carney et al., 2010; Cuddy et al. 2015). The premise is that the body position conveys a greater or diminished sense of power to the brain. The central question is whether this power perception has any meaningful, effective outcomes, particularly as it relates to stressful situations.

Postural feedback is a concept that became popularized by Carney et al. (2010). The theoretic basis is that the expansive postures used by animals to both display and engender power would produce similar outcomes in humans. That is that taking on a high-power posture would induce greater feelings of power. Early findings revealed that physical posture had an effect on self-perceptions of stress (Riskind & Gotay, 1982) and physiological stress levels (Abalan et al., 1992; Hennig et al., 2000). Recently, results confirmed the prediction that expansive poses that are similar to those seen in animal models would trigger changes in circulating hormone levels, correspond with perceptions of power (Carney et al., 2010), and improve behavioral performance in humans (Cuddy et al., 2015). Initially, power posing was widely accepted as a short and effective intervention to increase power and mitigate stress. However, subsequent findings have not consistently supported the efficacy of postural feedback. Therefore, the present study aims to replicate previous postural feedback studies and examine the effects of power posing with a behavioral analysis instrument specifically designed to assess performance.

Perceived Power

Power is a concept that is thought to be evolutionary in nature and important in creating hierarchical social environments, both for humans and animals. Power is defined as the ability to control valued resources within social relationships (Anderson & Berdahl, 2002; Huang et al., 2011). The induction of varying levels of perceived power has been largely studied in the context of personal priorities (Guinote, 2007), interpersonal communication (Hogeveen et al., 2014), and even physiological responses and performance (Schmid & Schmid Mast, 2013).

The effects of perceived power on personal priorities have been analyzed by inducing varying levels of power and examining goal seeking behaviors. Guinote (2007) conducted four experiments where power was manipulated in two ways. In the first two experiments, perceived power was primed by having participants write an essay in which they recalled a time when they had power over another individual (powerful condition), or a time when someone had power over them (powerless condition) (see Galinsky et al., 2003 for more details). In the remaining two experiments participants were assigned to either high- or low-power roles (e.g., manager or worker, respectively). Following power induction, participants completed various seemingly unrelated tasks (a puzzle or imagined scenario) to measure goal seeking behaviors. Across all studies, participants in the powerful condition exhibited goal consistent behaviors, regardless of the power manipulation or type of goal. Powerful participants made quicker decisions, took action sooner, and persisted more often than powerless participants, indicating that high-power individuals were able to focus their attention more on the task. Researchers concluded that power contributes to self-regulation, putting powerful individuals at an advantage as it relates to goal-seeking; whereas, the opposite would be true for individuals with little or no power.

The effect of power on social communication has been a topic of interest among social neuroscientists, particularly among those interested in defining mechanisms underlying the interpersonal sensitivity achieved by mimicking the gestures and expressions of others. The brain regions involved in this process are collectively known as the motor resonance system, and it is believed that this system reflects the activity of brain cells (i.e., “mirror neurons”) that become active when a person observes the actions of others while performing the same action (“action observation”) (Maeda et al., 2002; Rajmohan & Mohandas, 2007).

Hogeveen et al. (2014) investigated the role of perceived power on interpersonal sensitivity via the motor resonance system. In their study, participants were primed using the previously described method of recalling a powerful or powerless situation (Galinsky et al., 2003). Participants then completed an action observation task: watching videos in which a right hand squeezed a rubber ball while transcranial magnetic stimulation (TMS) was used to stimulate the area in the primary motor cortex corresponding to the participant’s right hand. The resulting twitching movements in the participant’s hand muscles produced what are known as motor evoked potentials (MEP), which are an index of resonance, as measured via electromyography (EMG). Results indicated that participants induced with high-power showed lower levels of resonance (i.e., reduced EMG activity) compared to the low-power group which had higher levels of resonance (Hogeveen et al., 2014). Researchers interpreted the lower motor resonance in high-power individuals to represent reduced interpersonal sensitivity.

Perceived power also impacts an individual's physiological response and performance in social evaluative situations. Schmid and Schmid Mast (2013) conducted two studies in which power was manipulated by asking participants to recall a high-power event, as described above, or a neutral event, writing a list of their activities from the day before (Galinsky et al., 2003). Physiological arousal was examined via measurements of heart rate following exposure to the Trier Social Stress Test (TSST), an experimental paradigm in which participants deliver a 5 min speech in front of a panel of judges. Results were that the high-power primed group showed significantly lower physiological arousal than the neutral (control) power group following the TSST. The second study was similar and included an increased sample size and evaluation of the speech performance. Researchers found that the high-power condition not only resulted in reduced heart rate and physiological arousal following the TSST, but the speech performance of this group was rated significantly higher than the control group on a five-item general performance scale. Researchers concluded that in this context, power might have a mitigating effect on stress and an enhancing effect on performance. Taken together, these studies reveal that perceived power can provide an advantage in achieving specific goals by reducing sensitivity to other individuals. In addition, induced high-power could have a mitigating effect on a person's physiological response to stress leading to enhanced performance.

Stress

Physiological stress is a necessary function of the human body; therefore, stress is experienced by people of all ages and walks of life, at times producing serious deleterious effects (Lupien et al., 2007; McEwen, 2008). Extensive research has examined both the underlying central mechanisms and the physical and mental health outcomes of various forms of stress. When a person encounters a stressful situation, the hypothalamic-pituitary-adrenal (HPA) axis is activated. This triggers a cascade of hormones, ultimately resulting in the release of cortisol, the stress biomarker (Lupien et al., 2007). This response is considered adaptive and helpful in specific situations. It mobilizes the body's resources to accomplish existing demands, but it also suppresses other functions associated with the repair and maintenance of the body. Both the physical health and cognitive benefits of stress depend on its intensity and duration. In terms of behavior, performance can be enhanced when optimal levels of stress are reached (Chaby et al., 2015; Yerkes & Dodson, 1908), but prolonged activation of the cortisol system can impair performance and even harm mental and physical health. Taken together, research shows that acute stress can be beneficial; whereas, too much stress can lead to long lasting negative effects in the brain and body (Lupien et al., 2007; McEwen, 2008).

Continuous stress is a part of the average student's college experience, and it can negatively affect academic performance as well as physical and mental health. College-related stressors come in various forms, ranging from paying for school to performance deliverables. In reference to the latter, oral presentations sit at the top of the list of academic-related stressors. For example, as many as 75% of students have reported experiencing stress and fear when speaking in front of an audience (Raja, 2017). In a National College Health Assessment by the American College Health Association (2014) with 79,266 respondents, 30% of students reported that stress was the primary factor affecting academic performance. Another study reported as many as 10% to 12% of college students as being severely stressed, and up to 80% as experiencing moderate levels of stress (Brougham et al., 2009). In addition to its impact on academic performance, stress affects areas in the brain: the hippocampus, prefrontal cortex, and amygdala. Stress can even produce neurodegeneration if unremitting (McEwen, 2008). Chronic stress can also lead to comorbid behaviors, such as smoking, drinking, and poor sleep quality, all of which can lead to negative effects on academic performance and on a person's health (McEwen, 2008). For these reasons, it is important to investigate what students can do to manage stress on a day-to-day basis. Due to college students' inherently busy lifestyles, any intervention would need to be quick and easy if it is to mitigate the effects of stress.

Postural Feedback: Power Posing

Theorists have long postulated the existence of a bidirectional communication between external bodily expressions and internal psychological processes. Early work examining posture looked at the impact of a slumped versus relaxed posture on subjective emotional experiences (Riskind & Gotay, 1982). Participants who were placed in a hunched position reported higher self-perceptions of stress compared to participants who had been in a relaxed position. The effects of postural feedback on physiological cortisol have also been previously investigated. Early findings from Abalan et al. (1992) showed an increase of 32% in cortisol plasma concentrations after participants remained standing for 40 minutes. Hennig et al.

(2000) compared the effects of sitting, lying down, and standing on salivary cortisol. Again, researchers observed an increase in cortisol concentrations after participants had been in a standing posture, only this time cortisol samples were collected after 20 minutes. Findings from Abalan et al. (1992) and Hennig et al. (2000) could have significant implications for studies that examine cortisol where tasks require participants to stand; however, their findings are at odds with a more recent study that found no effect of a standing posture on cortisol compared to sitting. Hucklebridge et al. (2002) did not observe any effect of postural condition on cortisol levels when they examined levels of salivary cortisol after participants shifted from a laying down to a standing posture and remained standing for 15 minutes. Cortisol response was measured in two different conditions: following awakening at home and in the afternoon in the laboratory. Hucklebridge et al. (2002) point to the data of Hennig et al. (2000) as the most likely cause for conflicting findings, as two participants in their study showed unusually high increases in cortisol.

More recent research has gone beyond simple sitting, standing, or laying down positions. The theoretical concept of postural feedback has been refined to include two dimensions of posture derived from the nonverbal literature related to power: expansiveness and openness (Carney et al. 2010, Cuddy et al., 2015). Expansiveness refers to how much space an individual takes up and openness involves whether limbs are kept open or closed. Early work by Cashdan (1998) suggested that open-body postures, especially open arms in women, were associated with displays of power, and this research was underscored by Carney et al. (2005), who found that participants viewed high-power individuals as being more open and expressive.

Carney et al. (2010) introduced power posing as a postural feedback technique, whereby manipulating physical posture triggered changes in emotion, behavior, and physiology. They hypothesized that holding a high-power pose compared to a low-power pose would result in increased feelings of power and a hormone profile mimicking that of high-power individuals (high testosterone and low cortisol) and as a result, participants would be more likely to take on gambling risk. Participants held two high-power or two low-power poses, one standing and one sitting, for 1 min each. Salivary samples were collected throughout the study to measure neuroendocrine changes of testosterone, a hormone involved in dominance, and cortisol, as a stress biomarker. Following the pose, participants completed a gambling task which indicated their willingness to take on gambling risk, and they reported how “powerful” and “in charge” they felt. Results indicated that participants who held the high-power pose had significantly elevated testosterone levels and a significant reduction in cortisol; whereas, the low-power posers exhibited the opposite response, a decrease in testosterone and an increase in cortisol (Carney et al., 2010). Researchers explained that high testosterone and low cortisol levels comprised the hormone profiles of high-power individuals (Carney et al., 2010). High-power posers were also found to feel significantly more “powerful” and “in-charge,” compared to low-power posers. In the gambling task, participants in the high-power pose group were more likely to gamble, with 86.36% of them taking on the gambling risk compared to 60% of the low-power participants who took the risk. These findings demonstrate that specific high- or low-power poses could produce physiological and behavioral changes. The relationship between posture and cortisol appears to be key to an understanding of potential mitigators of stress. The finding that postural feedback lowers cortisol reactivity could be particularly important in reference to students' stressful lifestyles, as cortisol can produce damaging effects on health and academic performance.

Postural feedback was posited as a promising new method for inducing feelings of power in participants. The existing power literature had previously relied on priming a person's sense of power by asking participants to recall a time when they felt powerful or powerless. This depended mainly on each individual's experience and memory; whereas, postural feedback induces power through the manipulation of body posture in real time and provides the same experience for participants in a controlled setting. Huang et al. (2011) compared the effectiveness of inducing high- and low-power via recall versus power posing on taking action, as individuals who possess power have been found more likely to take action (Galinsky et al., 2003). They measured the number of times a participant decided to act in three different scenarios: speaking first in a debate, searching for help after a plane crash, and becoming part of an attempt to free a wrongly imprisoned person. Results indicated that the expansive posture caused participants to take action more often than recalling a time when they had power over another.

Power Posing: Inconsistent Findings

More recently, inconsistent findings have challenged the efficacy of power posing. Most notably, Ranehill et al. (2015) conceptually replicated the original posing study by Carney et al. (2010) but failed to reproduce some key power-boosting effects. This replication included a few modifications that were intended to strengthen and extend original findings: a larger sample (n = 200); experimenters were blind to participant conditions, and poses were held for a longer duration. Although Ranehill et al. (2015) supported the original findings with a significant power posing effect on participants' self-reported feelings of power, they did not confirm the original findings for behavioral and hormonal effects as a function of power posing. Ranehill et al. (2015) suggested that the subtle differences in experimental protocols could have been responsible for the discrepant results.

In response to the findings by Ranehill et al. (2015), Carney et al. (2015) provided a review of published research on expansive versus contractive postures. Of the thirty-three experiments examining expansive posture on psychological outcomes, Carney et al. (2015) identified two common factors distinguishing the reports of significant differences between expansive and contractive displays: a cover story prevented participants from knowing the hypothesis of the experiment, and a social context, defined as either interacting with another person or engaging in a social task alone. However, not all significant results included a social context. Carney et al. (2015) also specifically defined three methodological differences between the one published by Ranehill et al. (2015) and Carney et al. (2010): (a) Ranehill et al. (2015) explicitly stated the purpose of the study was to investigate the effects of posture on hormones; (b) Ranehill et al. (2015) did not include a social task during the postural manipulation, and (c) Ranehill et al. (2015) used postures that were held three times longer than the original experiment; whereas, Carney et al. (2010) employed postural manipulations that they defined as comfortable and short in duration. In addition, Ranehill et al. (2015) delivered instructions to participants via a computer instead of in person, and participants were not configured manually. Carney et al. (2015) critiqued the use of a computer versus an experimenter to deliver power posing instructions, as they believed eliminating the social interaction during the posture manipulation could be a moderator. In the experiment by

Carney et al. (2010) experimenters were not blind to experimental conditions, which could lead to them inadvertently cueing participants to respond in the way they predicted. Therefore, they also identified potential experimenter bias as a confounding variable that required further examination. Carney et al. (2010) stated that a direct replication of their 2010 experiment would be needed to test the validation of their original work.

Subsequent studies attempted to replicate and extend the effects of power posing, but they also failed to reproduce original findings by Carney et al. (2010). Deuter et al. (2016) combined power posing with "cognitive role taking" in a 2 x 2 design and analyzed salivary cortisol and testosterone levels. With the recall method previously described (Galinsky et al., 2003), participants were asked to write down a time when they were powerful (dominant) or powerless (submissive). Following this instruction, they adopted a high- or low-power pose while performing the TSST. Researchers observed an effect of the role taking manipulation on testosterone, participants in the dominant condition had an increase in testosterone, regardless of the power pose condition. However, there was no effect of power posing on cortisol, testosterone, or subjective ratings of stress and power.

In another study, Garrison et al. (2016) examined the effects of power posing and eye gaze on risk taking and feelings of power with a relatively large sample ($n = 305$). Participants held two high- or low-power poses taken from Carney et al. (2010) while adopting a dominant (looking ahead) or submissive eye gaze (looking down). Results from this study showed no effect of power posing or gaze on risk-taking. However, there was an effect of power posing on subjective feelings of power with high-power posers feeling less powerful than those in the low-power group. These results are in direct contrast to results from Carney et al. (2010) where the high-power group reported higher feelings of power.

A study by Ronay et al. (2017) also failed to replicate the results of Carney et al. (2010). The researchers conducted what they referred to as an *exact replication* of Carney et al. (2010); they found no impact of power posing on feelings of power, risk-taking, testosterone, or cortisol levels. Ronay et al. (2017) noted that their findings could be due to differences in sample characteristics. Ronay et al. (2017) conducted their research with Dutch psychology undergraduates, while Carney et al. (2010) utilized MBA students in the United States.

Smith and Apicella (2017) conducted a replication of Carney et al. (2010) with a larger sample (*n* = 247) and added a competitive task. Again, power posing failed to affect testosterone, cortisol, and reported feelings of power. Smith and Apicella (2017) pointed out that their study employed similar methods as Carney et al. (2010) and did not include the same methodological differences associated with the Ranehill et al. (2015) research. Participants held the poses used by Carney et al. (2010) for the same duration, and the same filler task was utilized while they held the pose. Smith and Apicella (2017) did not use an elaborate cover story; however, they did not reveal the purpose of the study to participants. Even with the exclusion of participants who correctly identified the purpose of the study, Smith and Apicella (2017) could not reproduce the original findings from Carney et al. (2010) for pose-induced changes in neuroendocrine and perceived power responses.

Power Posing and Performance

In other research, power has been observed to improve behavioral outcomes (Guinote, 2007), which may be more relevant to the student population. To examine the effects of power posing on behavior and performance, Cuddy et al. (2015) introduced a public speaking task, the TSST. In this study, participants held either a low- or high-standing power pose for 5 to 6 min and subsequently gave a mock job interview for their dream job in an adaptation of the TSST. To measure the effects of postural feedback, the job interview was scored via overall performance (7-point Likert scale) and *hireability* (should the participant be hired for the job). They also coded the speeches for verbal content (how structured, straightforward, and intelligent was the speech and how impressive were the speaker's qualifications) and nonverbal presence (how enthusiastic and confident was the speaker and how well did they capture the coder's attention). Results indicated that participants who held a high-power pose were rated higher in performance and were more likely to be hired than participants in the low-power condition. Researchers further examined mediators of the relationship between power pose and performance and hireability. They found that nonverbal presence, and how "confident, enthusiastic, captivating, and awkward" participants were, predicted speech performance and hireability. Klaschinski et al. (2017) replicated the study conducted by Carney et al. (2015) with a larger sample size (n = 200); however, they did not observe any difference in performance between high- and low-power groups.

Research Limitations

As presented, subsequent power posing research studies have failed to replicate findings from Carney et al. (2010) and Cuddy et al. (2015) that participants who held a high-power pose exhibited lower cortisol levels compared to participants who hold a low-power pose. Consistent with Carney et al. (2010), Ranehill et al. (2015) did find a significant effect of power pose on self-reported feelings of power such that high-power posers reported increased feelings of power. However, Cuddy et al. (2015) were unable to replicate these results and reported differences in feelings of power between high-power posers and low-power posers as only "marginally significant" (p = .076).

In studies by Carney et al. (2010) and Cuddy et al. (2015), these researchers physically manipulated participants' bodies in order to ensure they adopted high-power and low-power poses correctly. This could have been a confounding factor as the experimenters may have unknowingly provided support to participants through touch. Touch has been observed to increase compliance in participants (Patterson et al., 1986). Indeed, our laboratory has also reported reductions in circulating cortisol following even a brief handshake (Ortega Jaimes, 2019). Ranehill et al. (2015) attempted to control for this potential confound by using a computer to deliver posing instructions to participants. However, Carney et al. (2015) argued this method of delivering instructions eliminated the social context during the pose manipulation, which they believed to be a moderator of the effects of power posing on a variety of outcome measures, such as perceived power and cortisol.

A particularly compelling finding involves the role of power posing on performance. This underscores the real world relevance, particularly as an intervention strategy for students. As stated previously, Cuddy et al. (2015) found that high-power posers were more likely to be judged as hireable, and they scored higher on overall job interview performance. However, speech performance following a power pose remains largely unexplored as performance and hireability findings have not been replicated. The scale utilized by Cuddy et al. (2015) was created to score performance for their specific experimental paradigm. The measures were tailored to capture a range of hiring and admissions decisions, with a metric that provided a general assessment of performance and hireability. Raters scored variables related to hiring on a 7-point Likert scale (1 = *awful*, 7 = *amazing*). Nonverbal presence and verbal content, which were identified as potential mediators, were also scored on a 7-point scale (1 = *not at all*, 7 = *extremely*). Cuddy et al. (2015) mention that hiring decisions are complex and may involve other dimensions, and an established method for evaluating performance and the quality of the speech had not been developed. Therefore, in order to allow for accurate replications and real-world applications (e.g., student population), a standardized, detailed measure was needed to precisely define speech performance following the power pose manipulation.

Purpose and Hypotheses of the Present Study

The primary purpose of the present study was to resolve inconsistencies in previous power posing findings. Specifically, this study aimed to replicate postural feedback studies by Carney et al. (2010) and Cuddy et al. (2015) while controlling for earlier research limitations. I intended to eliminate potential confounds of experimenter bias and touch. I anticipated that the results of the present study would support previous research and show an effect of power posing on self-reported feelings of power and cortisol. I expected that participants in the high-power condition would exhibit lower cortisol reactivity and report higher feelings of power than participants in the low-power condition.

To examine the effects of power posing on increased performance, the speech delivered by participants was rigorously assessed. Performance was evaluated via a scale developed by our laboratory specifically for the speech task utilized that resolutely defines behavior. I anticipated to further confirm the relationship between power posing and performance and I expected participants in the high-power condition to score higher on speech performance and to be rated as more hireable compared to participants in the low-power condition.

In sum, the four hypotheses in this study are as follows:

1. Participants in the high-power condition will exhibit lower cortisol reactivity than participants in the low-power condition.
2. Participants in the high-power condition will report higher feelings of power than participants in the low-power condition.
3. Participants in the high-power condition will score higher on speech performance.
4. Participants in the high-power condition will be more likely to be rated as hireable compared to participants in the low-power condition.

Method

Participants

A total of 60 San José State University (SJSU) undergraduates were recruited from the general psychology research pool and received course credit for participation. A screening questionnaire was administered prior to beginning the experiment to confirm eligibility. Exclusion criteria included: pregnancy, neuroendocrine disease, chronic inflammatory disease, and active mood or anxiety disorders. Individuals were also excluded if they were under 18 years of age, or failed to refrain from smoking, eating, drinking, or exercising for at least one hour prior to the experiment (12 participants were excluded). An additional eight participants were excluded due to contaminated salivary samples: 5 participants (3 females, 2 males) from the high-power condition and 3 from the low-power condition (2 female, 1 male).

The final sample consisted of 40 participants. Their ages ranged from 18 to 25 years old, with a mean age of 19.60 years (*SD* = 1.84). With regards to gender, 23 participants identified as female, 16 as male, and one as "other." Participants were randomly assigned to a high-power (*n* = 21) or low-power (*n* = 19) condition.

Tests and Measures

Screening Questionnaire

A 9-item, "Yes" or "No" screening questionnaire was administered prior to beginning the study to establish eligibility (see Appendix A for the complete screening questionnaire). The first question confirmed the age of participants of at least 18 years. Six of the screening questions were used to ensure accurate salivary cortisol samples and confirmed abstinence from smoking, exercising, eating, or drinking one hour prior to the experiment. Other survey items ensured that participants did not have any chronic inflammatory, neuroendocrine, mood, or anxiety disorders. One question confirmed that females were not pregnant. The last question asked if participants had served in the military to avoid putting them through undue stress. Those who answered "yes" to any of the exclusionary prompts were not eligible to participate in the study.

The Trier Social Stress Test

The Trier Social Stress Test (TSST) is an experimental method of inducing social-evaluative stress, which can be observed as increased circulating levels of cortisol (Kirschbaum et al., 1993). The TSST is composed of a 5 min speech and a 5 min mental arithmetic task in front of a panel of judges. A slightly modified version of the protocol by Kirschbaum et al. (1993) has been used by our laboratory and has previously proven to be a particularly reliable stress-inducing protocol. Kirschbaum et al. (1993) gave participants 10 min to prepare for the speech portion of the task, consistent with the practice in our laboratory and in order to closely follow the protocol by Cuddy et al. (2015), for this experiment, participants were given 5 min to prepare. The judges and experimenters wore white lab coats, professional attire, and remained neutral throughout the duration of the TSST.

To avoid inadvertent bias, the main experimenter was blind to condition, but the instructions were still delivered live. Therefore, two experimenters were employed for each session: experimenter 1 and experimenter 2. Experimenter 1 ran the entire session with the exception of the power pose, experimenter 2 only had contact with the participant during the power pose portion of the experiment and was the only researcher who had knowledge of the condition. Both remained neutral in their demeanor when interacting with participants. Throughout the session, the experimenters gave participants instructions about each task and left the study room while participants completed the assigned task.

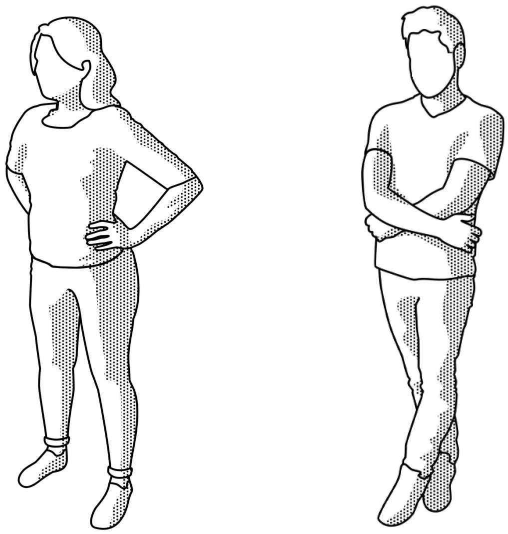
Two rooms were required to execute the TSST: a study room and an interview room. To begin the onset of the stress, experimenter 1 introduced participants to the interview room, where two judges were already seated, and gave instructions about the speech task. Experimenter 1 advised that the judges were especially trained in behavioral observation and that their speech would be videotaped to further evaluate their performance. Following the preparation period in the study room, experimenter 1 guided participants back to the interview room. The main judge instructed participants to deliver a 5 min speech on their ideal job and why they were the ideal candidate for the job. The assistant judge took notes during the speech and held up a sign to warn the participant when they had 30 seconds remaining.

Postural Manipulation

Participants were randomly assigned to a high- or low-postural feedback group. Participants in each group adopted a power pose as used in Cuddy et al. (2015) for 1 min to become familiar with the pose and for 5 min thereafter, while preparing for the TSST (see Figure 1). The script from Cuddy et al. (2015) was used by experimenter 2 to instruct participants how to adopt each pose (see Appendix B for the complete script).

Figure 1

Power Poses



a). High-Power b). Low-Power

Note. Figures depicting high- and low-power poses adopted by participants in this experiment. From "Preparatory Power Posing Affects Nonverbal Presence and Job Interview Performance" by Cuddy, A. J. C., Wilmuth, C. A., Yap, A. J., & Carney, D. R, 2015, *Journal of Applied Psychology*, *100*(4), 1286-1295. Copyright 2015 by American Psychological Association.

Self-Reported Power

To examine perceived power, participants completed the same questions used by Cuddy et al. (2015). Self-reported power was measured with five items. More specifically, participants rated how dominant, in control, in charge, powerful and how much like a leader they felt on a 5-point Likert scale (1 = *not at all* and 5 = *a lot*). The items had high reliability ($\alpha = .89$) when assessed by Cuddy et al. (2015) (see Appendix C for full questionnaire). As reported by Cuddy et al. (2015), participants were given the questionnaire following the TSST; however, in the present study, participants completed the survey twice to detect changes due to the power pose: once at the beginning of the experiment (power rating 1) and again following the TSST (power rating 2).

Physiological Stress: Saliva Sampling for Cortisol Analysis

Participants' physiological stress was examined via salivary cortisol levels. A total of three saliva samples were collected throughout the experiment in the following sequence: S1 was collected prior to introducing participants to the power pose and TSST, S2 was collected 24 min after the stress onset (introduction to the TSST), and S3 was collected 41 min after stress onset. The first sample, S1, served as the baseline cortisol measure. Because cortisol levels have been reported to be highest 10 min after the cessation of the stressor (Kirschbaum et al. 1993) and between 21 and 40 min from stress onset (Dickerson & Kemeny, 2004), salivary samples at two time points, S2 and S3, allowed for the determination of peak cortisol across participants. Saliva samples were collected using Salivetters® (Sarstedt AG & Co., Nümbrecht, Germany). Participants were asked to take the cotton pad from a test tube and chew on it for 2 min, then put it back into the tube without touching it with their hands. Saliva samples were held on ice, then stored at 0° F (-18° C) until cortisol assays were conducted. Cortisol concentrations were analyzed using the Salimetrics® salivary cortisol enzyme immunoassay kit. Peak cortisol was defined as the highest level of cortisol following stress induction (either S2 or S3). Delta cortisol (ΔCortisol) was calculated by subtracting baseline from peak cortisol. Cortisol levels are reported in nmol/L (Kirschbaum et al., 1993).

Perceived Stress

Participants completed the Perceived Stress Questionnaire (PSQ) prior to stress induction. The purpose of this questionnaire was to examine perceived chronic stress as previous studies have shown that chronic stress can affect cortisol reactivity to an acute stressor (Miller et al., 2007). The PSQ is a 30-item questionnaire that assesses self-rated stress in the past year or 2 on a 4-point Likert scale (1 = almost never, 4 = usually), the value for Cronbach's alpha has been reported to be $\alpha = 0.90$ (Levenstein et al., 1993). See Appendix D for the complete questionnaire.

Speech Performance Evaluation Scale (SPES)

Participants' speech during the TSST was coded and evaluated by two raters blind to condition using the SPES (Ochoa et al., 2016). The SPES is an instrument developed by our laboratory to systematically evaluate TSST speech performance through a single score. The metric consists of four domains: ideas, syntax, oral quality, and body language (See Appendix E for the complete scale). Each domain was intended to be rated and scored independently as well as to contribute to an overall score. Scores from each domain have an equal impact on the overall score of the speech. The strength of the SPES has been previously supported (Cronbach's alpha: $\alpha = .91$; Ochoa et al., 2016). Two independent raters coded a subset of videotaped TSST performances. A strong inter-rater reliability for this experiment was established between the two raters, $r(15) = .67$, $p < .01$. Both raters' scores were averaged to form a single composite score for each participant. In addition, coders were asked if they would hire the participant, as was done previously by Cuddy et al. (2015).

Demographic Questionnaire

A 9-item questionnaire was administered at the end of the study to obtain demographic information such as age, gender, and year in college (See Appendix F for full questionnaire).

Procedure

Every participant completed the experiment individually. Experimental sessions were scheduled between 12:00 p.m. and 6:00 p.m. to avoid normal diurnal fluctuations in cortisol. Participants were randomly assigned to either a high- or low-postural feedback condition, both groups followed the same procedure with the exception of the pose they adopted.

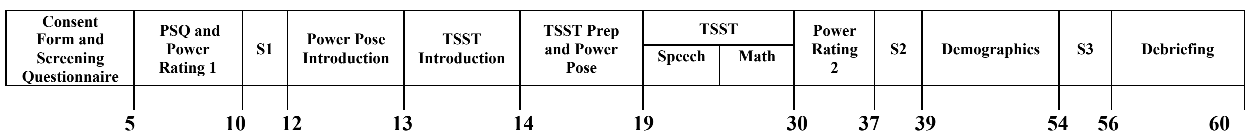
When participants arrived, experimenter 1 led them to the study room where they completed all portions of the study except the TSST. A screening questionnaire was administered to ensure that participants met the requirements for the study. After screening, eligible participants were given a consent form for review and signature. In order to avoid interruptions during the experiment, participants were asked to turn off their cell phone for the duration of the study.

To begin the study, participants completed the PSQ and the first power rating. Following the questionnaires, the first saliva sample was collected. Experimenter 1 then exited the study room, and experimenter 2 gave participants verbal instructions to adopt the power pose followed by instructions for participants to get comfortable with the pose for 1 min. After 1 min, experimenter 2 asked participants to relax and follow experimenter 1 to the interview room, at which time the TSST was introduced. Participants were guided back to the study room, where experimenter 1 delivered instructions for the preparation of the TSST and exited. Immediately following, experimenter 2 entered the study room and instructed participants to hold the pose throughout the preparation period. The experimenter asked participants to demonstrate the pose to confirm their posture was adopted and held properly. Participants were video recorded to ensure the pose was held throughout the preparation period. After the 5 min preparation with the assigned power position, participants were guided back to the interview room to complete the TSST.

Following the TSST, participants returned to the study room to complete power rating 2 and a second saliva sample (S2) was collected. Finally, participants completed the demographics questionnaire, and a final saliva sample (S3) was collected. At the end of the experiment, participants were debriefed (see Appendix G). The experimenter thanked them for their participation and explained the nature of the study. Participants were also notified about the counseling service center at SJSU. A timeline of the experiment is shown in Figure 2.

Figure 2

Procedural Timeline



Note. The numbers at the bottom reflect the duration of the experiment in minutes. The total duration was approximately 60 min. PSQ = Perceived Stress Questionnaire, S = Saliva sample for cortisol analysis, TSST = Trier Social Stress Test.

After data collection was complete, the Statistical Package for Social Sciences (SPSS Version 27) was used for statistical analyses.

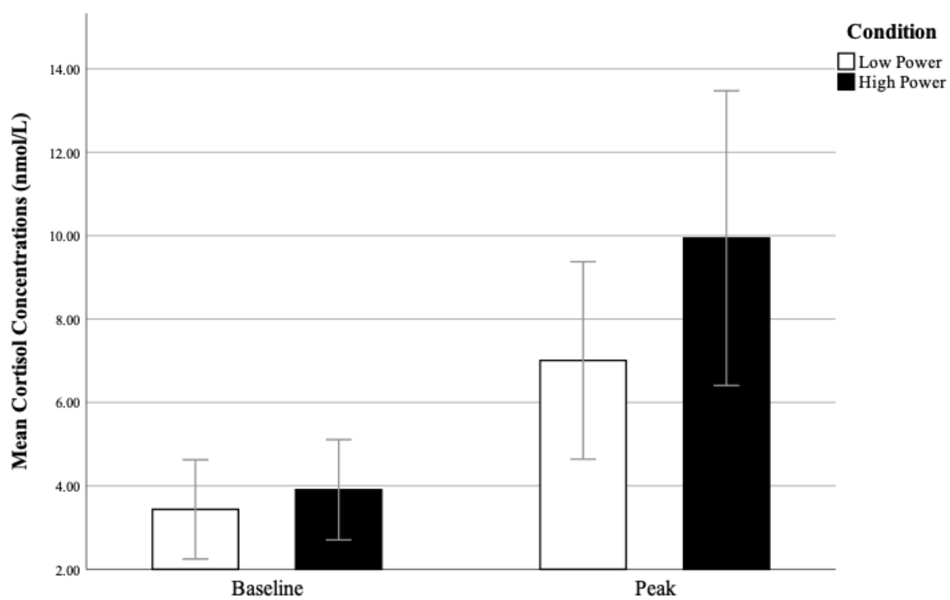
Results

Manipulation Checks

Cortisol levels served as a manipulation check to ensure the efficacy of the stress protocol. A repeated-measures *t*-test was conducted with a Type I error rate of .05 to confirm that the TSST resulted in an increase in cortisol (peak vs. baseline cortisol levels). As shown in Figure 3, results showed that the TSST successfully induced stress, with cortisol concentrations significantly higher following TSST exposure (M = 8.55 nmol/L, SD = 6.65) than seen with baseline levels (M = 3.68 nmol/L, SD = 2.54), t (39) = 5.62, p < .001, d = 0.89.

Figure 3

Mean Cortisol Concentrations



Note. Peak levels of cortisol compared to baseline levels in nmol/L. Cortisol concentrations were significantly higher in all participants post TSST, indicating that TSST successfully induced stress. Error bars indicate standard error of the mean.

Possible pre-existing differences in stress reactivity due to chronic stress for the high- and low-pose groups were examined. The PSQ served as a measure of self-reported chronic stress, baseline cortisol levels were the physiological measure of ongoing stress. To examine both variables, independent samples *t*-tests with a Type I error rate of .05 were conducted. There were no significant differences in baseline cortisol between the low-power (M = 3.44 nmol/L, SD = 2.47) and high-power group (M = 3.91 nmol/L, SD = 2.64), t (38) = 0.58, p = .57. There was also no significant difference in perceived chronic stress between the low-power (M = 0.38, SD = 0.16) and high-power group (M = 0.46, SD = 0.13), t (38) = 1.91, p = 0.06.

To control for potential differences in inherent sense of power between groups, baseline power was examined. An independent samples *t*-test was conducted with a Type I error rate of .05. Results indicated no significant differences in perceived power between the high- (M = 2.90, SD = 0.87) and low-power (M = 3.11, SD = 0.72) groups, t (37) = -0.80, p = 0.43.

Participants were videorecorded to ensure they held the power pose for the duration requested. Videos were reviewed and subsequently destroyed. All participants were found to have held the power pose for the instructed length of time.

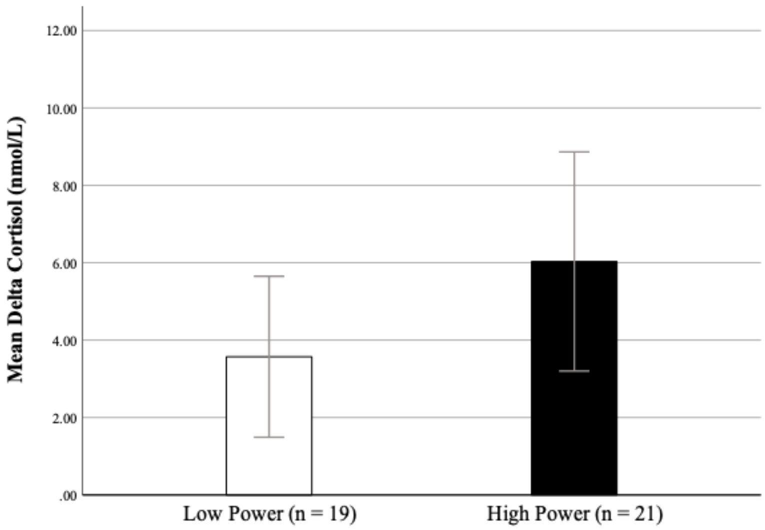
Cortisol Reactivity

One of the goals of the present study was to replicate findings that high-power poses would result in lower cortisol reactivity following the TSST. In order to assess whether power pose condition reduced stress reactivity, ΔCortisol (peak-baseline) was examined (see Figure 4). An independent samples *t*-test was conducted with a Type I error rate of .05. Results indicated that ΔCortisol did not significantly differ between the high-power group ΔCortisol (M = 6.03 nmol/L, SD = 6.21) and low-power ΔCortisol (M = 3.57 nmol/L, SD =

4.31), *t* (38) = 1.44, *p* = .16. These results showed that the first hypothesis was not supported.

Figure 4

Mean Salivary ΔCortisol Concentrations



Note. ΔCortisol (peak-baseline) represents cortisol reactivity to stress in nmol/L. Error bars represent standard error of the mean. No significant difference was found in ΔCortisol between high-power and low-power groups.

Perceived Power

To assess perceived power, power ratings following the power pose and TSST were examined and compared to baseline. One participant in the low-power group did not respond to the first set of power rating questions, therefore, perceived power ratings from this participant were excluded from these analyses.

To be consistent with the methods employed by Cuddy et al. (2010) and Carney et al. (2015), the hypothesis that the high-power group would report higher feelings of power than the low-power group following the power pose and TSST was tested. An independent samples *t*-test was conducted and there was no significant difference between the high-power (*M* = 1.92, *SD* = 1.12) and low-power (*M* = 2.38, *SD* = 0.93) groups in perceived power, *t*

(37) = -1.36, $p = 0.18$. These results showed that the second hypothesis was not supported.

To examine if there was a difference between participant's power perception after the power pose and TSST compared to baseline, paired samples *t*-tests were conducted for both groups comparing power rating 1 and power rating 2 (see Table 1). In both the high-power, $t\ (20) = 4.66$, $p < .001$, and low-power, $t\ (17) = 4.16$, $p = .001$, groups there was a significant difference between ratings, with feelings of power being lower following the power pose and TSST compared to baseline.

Table 1

Reported Means for Feelings of Power by Group

Condition	n	Power Rating 1 *M* (*SD*)	Power Rating 2 *M* (*SD*)
High-power	21	2.90 (0.87)	1.92 (1.12)
Low-power	18	3.11 (0.72)	2.38 (0.93)

Performance

A subset of speeches was rated for performance using the SPES by two independent coders. As mentioned earlier, inter-rater reliability was $r(15) = .67$, $p < .01$. A total of 17 speeches were scored. To examine differences in overall speech performance between groups, an independent samples *t*-test was conducted. Results revealed no significant difference in overall speech performance between participants who held a high-power pose ($M = 12.48$, $SD = 2.53$) and participants who held a low-power pose ($M = 11.37$, $SD = 2.46$), $t\ (15) = 0.87$, $p = .40$.

To obtain a more resolute picture of speech performance, a one-way multivariate analysis of variance (MANOVA) examined the effects of power posing on each domain of the SPES: ideas, syntax, oral quality, and body language (see Table 2). Results indicate that scores were not significantly different between the two groups F (4, 12) = 1.63, p = .23; Wilk's Λ = 0.648, partial η^2 = .35. These results show that the third hypothesis was not supported.

Table 2

SPES Average Scores by Domain as a Function of Power Pose

Domain	High-Power *M* (*SD*)	Low-Power *M* (*SD*)
Ideas	3.22 (0.80)	3.38 (0.94)
Syntax	3.03 (0.84)	3.11 (0.67)
Oral Quality	3.50 (0.72)	3.08 (0.65)
Body Language	2.64 (0.77)	1.79 (0.70)

Consistent with Cuddy et al. (2015), a single item assessing hireability was included, coders were asked if they would hire the participant after rating their speech (see Table 3). Coders rated either "yes" or "no." Participants in the high-power condition were predicted to be more likely to be hired. To test this hypothesis a 2 (condition) by 2 (hireability) chi square test was conducted for each coder. Results showed that hireability did not differ by power pose group, for rater 1, x^2 = (1, n = 17) = 0.726, p = .39, or rater 2, x^2 = (1, n = 17) = 0.298, p = .59. Therefore, the fourth hypothesis was not supported.

Table 3

Hireability Percentages by Rater

Rater	*n*	High-power		Low-power	
		Yes	No	Yes	No
Rater 1	17	63.6%	36.4%	83.3%	16.7%
Rater 2	17	63.6%	36.4%	50.0%	50.0%

Discussion

Power posing was introduced by Carney et al. (2010) as a revolutionary, fast, and easy intervention for inducing power with wide reaching effects. Previous findings showed that high-power poses reportedly decreased cortisol, elevated testosterone, increased feelings of power, and improved performance in social evaluative situations. The topic received wide attention from researchers and the public after Amy Cuddy's Ted Talk *Your Body Language May Shape Who You Are* (2012). According to Cuddy, power posing was a useful "life hack" that could improve lives. The questions that the researchers originally posed were whether postural feedback induced a sense of enhanced power and whether this would create meaningful results in terms of stress reactivity and performance. Early on, the answer to both questions appeared to be a resounding "yes." The implications were important in the postural feedback literature as well as actionable in real world situations. However, inconsistent findings and failed replications cast doubt on the effects of power posing.

The primary aim of the present study was to implement rigorous controls and replicate original postural feedback findings on stress reactivity, sense of power, and performance. An additional aim was to clarify inconsistencies in the literature surrounding power posing while controlling for possible effects of experimenter bias and touch. It was also expected that by employing a more precise measure of performance, the SPES, findings would confirm that a high-power pose improved performance in a public speaking task. However, the present research failed to replicate findings from Carney et al. (2010) and Cuddy et al. (2015) and was inconsistent with the predicted outcomes.

The present findings for the effects of postural feedback did not show significant differences for cortisol reactivity between the high- and low-power groups. In contrast to the first hypothesis, a higher ΔCortisol was observed in the high-power group than in the low-power group, although the difference in ΔCortisol between the two groups did not reach statistical significance. It is possible that a larger sample size would have yielded significant differences. The seminal work by Carney et al. (2010) indicated that high-power posing reduced stress reactivity and cortisol; however, work by Ranehill et al. (2015), Ronay et al. (2017), and Davis et al. (2017) failed to reproduce these results and was consistent with the present study's findings by reporting no differences between the two power pose groups. These various research groups attempted to explain the inconsistent findings through differences in their sample or protocols.

As with the present study, Turan (2015) examined the effects of posture on cortisol levels following the TSST and also observed significantly higher peak cortisol levels in the expansive pose group compared to the constrictive pose group. The explanation for these findings was that Turan's larger sample size ($n = 85$ versus $n = 42$) and an only male participant sample accounted for differences in findings relative to those of Carney et al. (2010). However, Turan (2015) further proposed that the differences in cortisol results could be due to the presence of a stressor in their study. In the research by Carney et al. (2010), where a decrease in cortisol was observed following an expansive posture, stress was not induced. Turan (2015) suggested that the evaluative TSST situation may have caused the high-power group to experience greater social threat. In other words, high-power individuals may have felt they had more to lose than low-power individuals, causing them to interpret the situation as more stressful.

The seminal work by Carney et al. (2010) also reported that high-power posers had more powerful feelings than low-power posers. Again, this finding was not supported by the present study's results and did not support the second hypothesis. The induction of perceived power by the high-power pose was also not replicated by Cuddy et al. (2015) after administering the power perception questionnaire to participants following the power pose and TSST. The present study aimed to capture any difference the power pose might cause and evaluated perceived power before and after the pose and TSST. A diminished sense of power following the TSST was observed for both low- and high-power conditions. Both the present study's findings and those from Carney at al. (2015) align with previous studies. However, in a systematic review of the literature, Cuddy et al. (2018) identified feelings of power as a "theoretically important single outcome" through support from previous studies.

As previously mentioned, in response to the failed replication by Ranehill et al. (2015), Carney et al. (2015) identified 33 experiments that examined the effects of posture on various outcomes. Simmons and Simonsohn (2017) conducted a *p*-curve analysis of those 33 studies with the aim of identifying whether there was an overall effect on power perception. A *p*-curve analysis examines the distribution of p-values in significant results to assess if the effect is real or most likely due to selective reporting. Based on their analysis, Simmons and Simonsohn (2017) concluded that expansive versus contractive poses lacked empirical support. In response to Simmons and Simonsohn, Cuddy et al. (2018) expanded the systematic review of literature to include 55 studies examining expansive versus contractive postures. These researchers also conducted a *p*-curve analysis and expanded analyses to include the impact on emotional and affective states (EASE) variables as well as the non-EASE variables that included hormones. Cuddy et al. (2018) found empirical support in the literature for aggregated variables, feelings of power, and EASE variables. The conclusion from these analyses was that although neuroendocrine and behavioral responses were not supported, power posing seemed capable of affecting feelings of power. However, the studies that observed an impact of power posing on perceived power reported the expansive position to both increase (Carney et al., 2010; Ranehill et al., 2015) and reduce (Garrison et al., 2016) perceived power.

The present study implemented the SPES, a scale designed to precisely measure TSST speech performance, to obtain a more detailed picture of the impact of posing on behavior. Cuddy et al. (2015) found that high-power posers performed better in delivering a job interview speech than low-power posers and that this was mediated through nonverbal presence ("confident, enthusiastic, captivating, and awkward"). However, the measures created by Cuddy et al. (2015) were based on hiring decisions research from 1997. Although the TSST is a job interview task, it is conducted as an oral presentation, rather than an interview for a job. The TSST mimics the same pressures students face when making a big presentation in the classroom and in a job setting after graduating.

The SPES was designed to capture each dimension of speech performance by tailoring items to the TSST speech task. Since the SPES was created specifically to measure TSST performance, I expected to reveal evidence supporting improved performance following a high-power pose, a finding that would be useful to a student population. Results from the present study did not support the third and fourth hypotheses and failed to support the beneficial effects of power posing on overall performance or on the likelihood that the participant would be hired. It is important to note that for the most part Cuddy et al. relied on a single rater. In the present study, two coders rated the videos of participants' TSST performance, and an average score was used. Nonverbal presence has been reported to predict performance and hireability (Cuddy et al. 2015), however, this was also not supported by the present study's findings.

Recently, the lack of a control group or neutral pose in original power posing literature as well as in replications has been identified as a design flaw with major implications. Credé (2019) argues that without a comparison group, it is impossible to determine whether feelings of power are a result of the positive effects of the expansive pose, the negative effects of a contractive pose or a combination of both. In addition, Credé (2019) revealed that out of eleven studies where power posing resulted in a significant change on feelings of power, only one study included a control group. This appears to be supported by Brown et al. (2020) where participants adopted two neutral or powerful poses. Researchers used a neutral pose to be able to observe the positive effects of the expansive pose. However, there were no significant differences in self-reported feelings of power between the control or power groups. This point was further underscored by Elkjær et al. (2020) in a meta-analysis.

Researchers identified a main effect for contractive versus neutral displays and expansive versus contractive displays but not for expansive versus neutral displays. Elkjær et al. (2020) point out that the experimental effects appear to be due to the absence of the contractive displays rather than the presence of expansive displays.

Another variable that should be further examined is the effect of the duration of power poses. In the original experiment by Carney et al. (2010), participants held two poses for 1 min each. A critique of Ranehill et al. (2015) was that the experiment tripled time of posing from 1 min per pose to 3 min, for a total of 6 min. However, in the experiment by Cuddy et al. (2015), participants held poses for 5 to 6 min and this is consistent with the methods described in the present experiment.

One limitation of the current study may have been is that the power rating questionnaire was administered following the TSST, therefore, the decrease in perceived power could likely be attributed to the stressful task. Although it is difficult in this procedure to isolate the effects of power posing due to participants adopting the pose after the onset of anticipatory stress, it would be beneficial to consider administering the questionnaire following the power pose but before the speech task to capture whether the pose causes an increase in feelings of power.

Conclusion

Although the general public has embraced the beneficial effects of power posing, academic questions have emerged concerning methodological confounds and inconsistencies. The current research intended to replicate findings from original postural feedback studies by addressing noted limitations (Carney et al, 2010; Cuddy et al., 2015). Taking into account the suggestions from Carney et al. (2015) about potential moderators of power posing, the present experiment employed the same cover story and social context as the original studies, while attempting to control for experimenter bias. Still, these results did not support an effect of power posing on cortisol, feelings of power, or performance. This study joins several other rigorous studies that have examined the effects of postural feedback but have been unable to reproduce the original findings.

Overwhelming evidence suggests that postural feedback is not living up to its original claims, particularly in its mitigatory role in stress and cortisol elevations. Most of the supported findings in the literature have involved the effects of power posing on feelings of power, but even these results have not been consistently replicated. Indeed, researchers suggest the more meaningful effect may involve the presence or absence of the constrictive rather than the expansive high-power posture. It might also be true that the effects of posture are culturally specific. For example, certain expansive postures produce different outcomes on individuals from Western versus East Asian cultural backgrounds (Park et al., 2013).

Finally, a significant strength of the present study is the adoption of the SPES to assess TSST speech performance. The scale provides a standardized method to examine performance. Future studies that employ the TSST may find it useful to implement the SPES to more resolutely assess factors that improve behavioral performance.

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Appendix A

Screening Questionnaire

The following questions ask about activities that you may or may not have done ***within the last hour***. The rest of the questions are related to the study. Mark either the “Yes” or “No” box to the right of each question. If a question does not apply to you, mark “N/A”. Please answer the following questions as best as you can.

1.	Are you under the age of 18?		□ Yes	□ No
2.	Did you smoke any cigarettes in the last hour?		□ Yes	□ No
3.	Did you exercise in the last hour?		□ Yes	□ No
4.	Did you eat any food in the last hour, including gum and mints?		□ Yes	□ No
5.	Did you drink anything in the last hour? (Except water)		□ Yes	□ No
6.	Do you have any chronic inflammatory or neuroendocrine disorders?		□ Yes	□ No
7.	Are you currently being treated for any Mood or Anxiety disorders or have been diagnosed with a Mood or Anxiety disorder within the past 3 months?		□ Yes	□ No
8.	Are you pregnant?	□ n/a	□ Yes	□ No
9.	Have you served in the military?		□ Yes	□ No

Appendix B

Power Posing Script
Experimenter 2 Protocol

Power Pose Introduction

- **High-power Pose**

This study is about physical motion and performance. There is a physical position we'd like you to try out. If you could stand up <*pause*> stand here and face me <*point to correct place*> and stand with your two feet apart and hands on your hips like this <*demonstrate for participant*>. Get comfortable in this pose for a minute while I go set something up. Just get comfortable in this physical position and I will be back in 1 minute.

- **Low-power Pose**

This study is about physical motion and performance. There is a physical position we'd like you to try out. If you could stand up <*pause*> stand here and face me <*point to correct place*> and stand with your feet together and crossed over and your arms and hands wrapped around your torso like this <*demonstrate for participant*>. Get comfortable in this pose for a minute while I go set something up. Just get comfortable in this physical position and I will be back in 1 minute.

TSST Introduction

After 1 minute has passed: You can relax now. For the next exercise, follow <experimenter 1> to another room. You may leave your belongings here, you will be back shortly.

After TSST Introduction and Preparation Instructions

Experimenter 2: Stand up. <pause> Throughout your preparation we'd like you to stay in the position I had you try out earlier. Could you demonstrate the position for me?

<*make sure participant is standing in correct spot and demonstrates pose*, *correct if necessary*>

To prepare, just think through what you want to say. I am going to turn on this video camera while you prepare. The camera is there so that we can later verify that you maintained this physical position. Remember you are preparing for 5 minutes.

Do you have any questions regarding the position? (Answer any questions) I'll return in 5 minutes.

<Leave the room and start timer for 5m>

When 5m have passed:

Experimenter 2: You can relax now. Follow <experimenter 1> back to the interview room.

Appendix C

Power Rating

Read each statement and indicate how you feel at this very moment.

1. How dominant do you feel?

1	2	3	4	5
Not at all				A lot

2. How in control do you feel?

1	2	3	4	5
Not at all				A lot

3. How in charge do you feel?

1	2	3	4	5
Not at all				A lot

4. How powerful do you feel?

1	2	3	4	5
Not at all				A lot

5. How much like a leader do you feel?

1	2	3	4	5
Not at all				A lot

Appendix D

Perceived Stress Questionnaire

For each sentence, circle the number that describes how often it applies to you in general, *during the last year or two.* Work quickly, without bothering to check your answers, and be careful to describe your like *in the long run.*

		Almost never	Sometimes	Often	Usually
1.	You feel rested	1	2	3	4
2.	You feel that too many demands are being made on you	1	2	3	4
3.	You are irritable or grouchy	1	2	3	4
4.	You have too many things to do	1	2	3	4
5.	You feel lonely or isolated	1	2	3	4
6.	You find yourself in situations of conflict	1	2	3	4
7.	You feel you're doing things you really like	1	2	3	4
8.	You feel tired	1	2	3	4
9.	You fear you may not manage to attain your goals	1	2	3	4
10.	You feel calm	1	2	3	4
11.	You have too many decisions to make	1	2	3	4
12.	You feel frustrated	1	2	3	4
13.	You are full of energy	1	2	3	4
14.	You feel tense	1	2	3	4
15.	Your problems seem to be piling up	1	2	3	4
16.	You feel you're in a hurry	1	2	3	4
17.	You feel safe and protected	1	2	3	4

18.	You have many worries	1	2	3	4
19.	You are under pressure from other people	1	2	3	4
20.	You feel discouraged	1	2	3	4
21.	You enjoy yourself	1	2	3	4
22.	You are afraid for the future	1	2	3	4
23.	You feel you're doing things because you have to not because you want to	1	2	3	4
24.	You feel criticized or judged	1	2	3	4
25.	You are lighthearted	1	2	3	4
26.	You feel mentally exhausted	1	2	3	4
27.	You have trouble relaxing	1	2	3	4
28.	You feel loaded down with responsibility	1	2	3	4
29.	You have enough time for yourself	1	2	3	4
30.	You feel under pressure from deadlines	1	2	3	4

Appendix E

Speech Performance Evaluation Scale

Raters:

Watch full video at 100% volume (for the player and the computer) before rating any categories. Once you have watched the entire video you are able to re-watch the video or rewind as many times as necessary. Circle the category that best describes the speech for every row. If you're unsure where a speech falls, use your best judgment. Make sure you rate every section, do not leave any row blank.

A space for notes is included next to each section, it is encouraged that you use these when making notes that pertain to that category, but not mandatory.

Please rate each video individually, without the influence of other individuals. Remember this is confidential information, it should not be shared or discussed with anyone.

Ideas

	1	2	3	4	5
Organization	Speech has no apparent direction	Speech has a scattered direction	Speech appears to have some direction	Speech has mostly good direction	Speech has clear structure: beginning, middle, end
	Hard to follow	Mostly hard to follow	At times hard to follow	Mostly easy to follow	Speech flows well
	No clear ending	Ends abruptly	Has a clear ending	Good ending	Strong ending
Persuasiveness/Content	No clearly defined support	Little to no support	Some stated support	Good amount of support	Presentation full of support
	Details unrelated to desired occupation	Support vaguely relevant to desired occupation	Some relevance concerning desired occupation	Support mostly relevant or applicable to desired occupation	All support pertinent to desired occupation

Syntax

	1	2	3	4	5
Articulation	Frequently stutters or mumbles, speech may be unclear	Stutters or mumbles, but has clear enunciation some of the time	Clear enunciation, some mumbling or stuttering	Clear enunciation, may have minor mumbling or stuttering	Clear enunciation, no mumbling or stuttering
	Consistent use of informal language, slang terms or words such as "like", "um", "uh"	Frequent use of informal language, some use of slang terms	Some use of use of informal language, slang terms or words such as "like", "um", "uh"	Very little to no use of informal language, slang terms or words such as "like", "um", "uh"	Does not use informal language, slang terms or words such as "like", "um", "uh"
	Speaks very little with frequent and awkward pauses	Speaks less than half the time or has frequent awkward pauses	Speaks more than half of time, some awkward pauses	Speaks nearly all of the time, very few awkward pauses	Speaks throughout with appropriate pauses

Oral Quality					
	1	2	3	4	5
Volume	Consistently too soft or too loud, may vary between extremes	Volume varies between appropriate and extreme levels	Consistent volume, but slightly too soft or too loud, may fluctuate slightly	Mostly consistent volume, at times too soft or too loud	Holds consistent volume throughout, not too soft or too loud. Projects well.
Speed	Pace too fast or too slow throughout, may vary between extremes	Pace frequently too fast or too slow, may vary between appropriate and extreme levels	Consistent pace, but slightly too fast or too slow, may fluctuate slightly	Almost entirely consistent pace, very few fluctuations between too fast and too slow	Holds consistent pace throughout, never too fast or too slow

Body language					
	1	2	3	4	5
Posture	Constant rocking, slouching, and/or crossed arms	Some rocking, slouching, and/or crossed arms	Straight posture, rarely rocks and/or slouches	Mostly straight and/or relaxed posture	Straight/relaxed posture throughout, no rocking or slouching
Hands	Constant awkward hand gestures such as fidgeting or hugging themselves, or hands in pockets/ behind throughout	Uses some awkward hand gestures, or keeps hand in pocket/ behind most of the time	Little to no hand gestures, hands visible most of the time, may occasionally put hands in pockets or behind	Uses some hand gestures that complement speech, hands visible throughout	Uses hand gestures that complement speech, hands visible throughout, no fidgeting

Would you hire this person for the job they're applying for? ☐ Yes ☐ No

Appendix F

Demographics Questionnaire

Below are a series of questions related to the study. Your responses to the last question will provide us with information that may affect the composition of hormones in your saliva. Please answer them as accurately as you can. Please make sure all questions are completed. Be assured that information provided is anonymous. Should you have any questions, please notify the experimenter.

1. Age:
2. Gender:

   ☐ Male ☐ Female ☐ Other

3. Ethnicity:

   ☐ African American ☐ Asian ☐ Caucasian
   ☐ Native American ☐ Latino/a ☐ Other

4. Is English your primary language?

   ☐ Yes ☐ No

5. How well do you understand English?

1	2	3	4	5	6	7
Not at all			Moderately			Very Well
☐	☐	☐	☐	☐	☐	☐

6. GPA:
7. Year in College:
8. Major:
9. If you are female:

   a. When was the first day of your last period?

   b. Are you currently using birth control? ☐ Yes ☐ No

   If yes, name the type you are using:

   d. If you are no longer using birth control, please provide the <u>method you last used</u> and the <u>month and year you stopped</u> using this method

Appendix G

Debriefing Script

This is the end of the study. I'd like to thank you for your participation and tell you a little more about our study.

This study examined posture, information processing, and hormone levels during stressful cognitive exercises. We are interested in student's hormone responses to the tasks you experienced as well as and the questionnaires you completed.

Although, you might not have felt like it, you did great. During the speech task, the judges were instructed not to respond or offer any encouragement, so please do not feel that you did poorly.

We want to thank you for your participation and ask that you don't communicate details of this study with current classmates as they may need to participate in this study. This would help us in collecting quality data to yield accurate results.

If you'd like more information regarding this study, or its results, you can contact us via the phone number listed in the consent form.

Furthermore, we are required to notify you about the counseling services available at SJSU.

The SJSU Counseling Services is located in the Administration Building second floor room 201. You may visit them for any academic or personal reasons. It is a free service for SJSU students.

Do you have any questions? (Answer any questions the participant may have).
Please feel free to take a complimentary chocolate on your way out. Thank you again for your time and participation