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From the Mind to under the Skin: Integrating Endocrine Measures into Organizational and Behavioral Research

DISSERTAÇÃO APRESENTADA À ESCOLA BRASILEIRA DE ADMINISTRAÇÃO PÚBLICA E DE EMPRESAS PARA OBTENÇÃO DO TÍTULO DE MESTRE

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From the Mind to under the Skin: Integrating Endocrine Measures into Organizational and Behavioral Research

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Abstract

Scholars aiming at developing a more comprehensive and integrated understanding of workplace and social phenomena have taken a keen interest in the incorporation of biological processes into organizational and behavioral research. This work seeks to introduce organizational and behavioral scholars to the basic aspects of research involving physiological data collection, with the aim at both describing in detail specific procedural protocols as well as facilitating the application and comprehension of this method. Specifically, in this paper, we focus on two endocrine markers that account for hormonal responses, namely cortisol and testosterone. We first review empirical literature measuring at least one of the endocrine measures of inquiry and then discuss both methodological and conceptual patterns inherent in this kind of research. More importantly, besides elaborating upon the methodological advantages, as the shortcomings associated with the measurement of these endocrine indicators, we offer a practical description of standard research protocols involved in studies that incorporate measures of either cortisol or testosterone. On the pretense of supporting scholars become better acquainted with the method and its procedures, we conclude by presenting an empirical example in which we illustrate how to measure endocrine activity in an actual research setting.

Keywords: Organizational Behavior, Cortisol, Testosterone, Endocrine Measures, Stress, Dominance, Physiological Measures

Contents

Introduction

Organizational research methods are entering a new phase of development conducive to cross-disciplinary collaboration spanning different methodological terrains. Recently, not seldom research has incorporated the study of human biology into explanations of individual and organizational behavior, raising important questions regarding how can the organizational research agenda be reconciled with the study of the biological perspective. Indeed, interest on how bodily responses interact with the different aspects of individuals' attitudes and behaviors has reached the organizational domain, influencing scholars to pursue further scrutiny on the many ways the functioning of the human body influences organizational behavior and decision making in the managerial context (e.g., Coates & Herbert, 2008; Sherman et al., 2012; Schipper, 2015).

Along with the burgeoning body of work concerned with the study of the human body functioning within the organizational sciences (e.g., Heaphy & Dutton, 2008; Akinola, 2010; Nofal et al., 2017; Ganster, Crain, & Brossoit, 2018), a wide array of questions regarding how to better harness the benefits of incorporating such biological processes come to the fore. In fact, with the incorporation of some kind of biological marker into their own research, organizational scholars find themselves urged to obtain a more comprehensive understanding of both administration and interpretation of such indicators, even though prior knowledge in this domain is still scant. In this paper, we introduce organizational and behavioral scholars to the basic aspects of research involving physiological data collection, with the aim at both describing in detail specific procedural protocols as well as facilitating the application and comprehension of this method. Here, we specifically focus on two endocrine markers that account for hormonal responses, namely cortisol and testosterone.

Looking at the current state of organizational research, one can observe that the physiological assessment of either cortisol or testosterone has been widely used in managerial settings as well as in related areas. Apart from organizational behavior (Klumb, Voelkle, & Siegler, 2016), cortisol and testosterone have been considered physiological markers of interest in research on groups and teams (Akinola, Page-Gould, Mehta, & Liu, 2018), consumer behavior (Han, Duhachek, & Agrawal, 2016), leadership (Bendahan, Zehnder, Pralong, & Antonakis, 2015; Li et al., 2018), financial decision making (Kandasamy et al., 2014; Nadler et al., (2017), and in the managerial literature as a whole (Levi, Li, & Zhang, 2010). Accordingly, we purposely concentrate

our efforts on these two endocrine measures mainly because, among the multitude of existing hormones, the use of cortisol and testosterone seem to be more prevalent within the field of management (Nofal et al., 2017), and owing to the fact that data is relatively easy to collect even for those scholars not fully acquainted with the method. More importantly, this methodology has hitherto lacked explicit discussion on how to administer this approach, especially with regards to the specific methodological procedures that should be followed.

In this paper, therefore, our analyses are not meant to dwell on all available methods of physiological measurement, but rather our intent is to focus on two endocrine measures that we consider particularly promising and well suited to advancing organizational and behavioral research. To this end, we assemble and review high-impact literature that used at least one form of assessment of one of the physiological measures of inquiry—cortisol and testosterone, specifically. By limiting our discussion to the measurement of the aforementioned hormones, our study differs from prior research, allowing us to dig deeper into methodological and theoretical issues related to these two objective measures. Our emphasis, moreover, is on the methodological procedures adopted in this type of studies as a means of providing organizational researchers basic principles involved in conducting testosterone and cortisol assessment in their own research. In doing so, we accentuate the conceptual features involving each physiological measure as well as operational characteristics related to the methodological procedures.

Importantly, we consider the incorporation of measures of cortisol and testosterone into organizational and behavioral research a particular promising methodology to obtain data free from problematic characteristics inherent to traditional self-report forms of data collection that are ubiquitous in organizational and behavioral studies (Podsakoff & Organ, 1986; Akinola, 2010; Podsakoff, MacKenzie, & Podsakoff, 2012). We assert that gauging cortisol and testosterone in either laboratory or field research ensures scholars a feasible measurement tool, less sensitive to demand effects and response biases ingrained in self-reporting that might distort true causes of job attitudes and behaviors (Becker & Menges, 2013). Assessing biologically based measures such as cortisol and testosterone, in short, allows unobtrusive measurement that requires no introspective responses from participants and occurs outside of conscious control and awareness (Akinola, 2010; Pastore, Maffezzolli, & Mazzon, 2018). We contend, additionally, that it is crucial to deepen our understanding on the application and operationalization of such measures, inasmuch as we urge scholars to take into consideration this alternative method of data gathering that offers new ways

of understanding organizational behavior while upholding accurate estimates of participants' actual bodily responses as a means of assessing individuals' true feelings and current states of mind (Akinola, 2010; Becker & Menges, 2013).

In what follows, we first situate our research within the literature resorting to some form of endocrine measurement, discussing how empirical research has typically been addressed the usage of this method. The methodological advantages of incorporating such physiological measures into organizational researchers' toolbox, as well as the challenges associated with the use of this method, are then elaborated upon. Thereafter, we offer a practical description of standard research protocols involved in studies that incorporate measures of either cortisol or testosterone. Finally, we further present a brief empirical example in which we illustrate how to measure endocrine activity in an actual research setting.

Physiological Measurement in Recent Research

The pervasiveness of recent research reviewing the adoption of biological indicators within the social sciences, including organizational research, suggest a growing tendency in conducting research that takes into account the biological perspective to enrich understanding of social and organizational phenomena. Heaphy and Dutton (2008), for example, reviewed empirical literature in organizational research to shed light on how positive social interactions at work affect physiological functioning. Focusing on three major physiological systems (i.e., cardiovascular, immune, and neuroendocrine), the authors built on empirical literature committed to measure at least one form of physiological signal to show how everyday interactions at work affect employees' bodily responses, which, in turn, shape micro-organizational behaviors (e.g., engagement and work recovery). Akinola's (2010) work, in turn, focused on the methodological benefits and challenges of integrating physiology to extend organizational theories. In this particular study, the author concentrated her efforts on demonstrating the theoretical implications in incorporating physiological assessment as a tool to enhance the precision of the measurement of individuals' unobservable states and traits as well as organizational phenomena.

More recently, Nofal and colleagues (2017) reviewed a substantial amount of research that considers the role played by human biology in management. The review aimed at presenting management scholars with an organizing framework of the main findings of how the three main

biological strands of research (i.e., genetics, physiology, and neuroscience) influence management behavior. More importantly, they scrutinized not only how each strand affects management individually, but also the interplay between them. Additionally, the study accounted for how the environment and biology jointly interact to influence a plethora of management phenotypes. Thereafter, Ganster, Crain, and Bossuet (2018) organized their review based on the underlying constructs that physiological measures were intended to capture. Concerned with how the use of physiological measures in the organizational sciences would fit the theoretical demands appropriately, the study highlighted the importance of careful selection of indicators for a particular construct, as well as discussed important research design considerations to achieve adequate construct validity.

Unlike prior research, the analyses conducted herein henceforth will be concentrated specifically on the two endocrine indicators of choice. In this sense, we limited our research analysis to the empirical studies that used some form of cortisol or testosterone assessment (or both). In addition to the type of physiological measure used, other criteria determined inclusion in the review. First, we selected only studies published from 2010 onwards—except for one study that was published in 2008[1]. This provides evidence for our argument about the pervasiveness of current interest in these research practices as well as to acknowledge its relevance to the field. Second, the study must have been published in a high-influent scientific journal within either the organizational sciences or the fields of social and applied psychology, as related areas. Limiting our scope to these fields eases thorough comprehension of the methodologies applied, as points to a wide range of research questions and future research avenues that might be particularly compelling to management scholars.

As such, besides presenting the topics related to the main theoretical questions ubiquitous to such research as the main findings elicited from the application of physiological measurement, we discuss methodological and conceptual patterns regarding these types of studies (see Table 1 for a summary of the literature reviewed). Taken together, these studies form the basis for our analysis that aims to provide management scholars a more comprehensive understanding of the application and operationalization of such tools, thereby elucidating the set of benefits in incorporating these practices into explanations of individual and organizational behavior.

[1] Coates & Herbert (2008).

Table 1. Summary of Empirical Research Incorporating Endocrine Measures of either Cortisol or Testosterone (sorted by year)

Study	Work Context and Participants	Research Design	Main Findings
Akinola, Page-Gould, Mehta, & Liu (2018)	370 students participated in a study aiming to investigate the interplay between group diversity and hormonal factors in predicting group performance. It was hypothesized that groups collectively high in testosterone perform optimally when group diversity is low, but poorly when group diversity is high.	Participants were randomly assigned to 74 groups (from three to six people) that engaged in an interdependent weeklong computerized decision-making exercise simulating the supply chain process of blood-testing laboratories. Each group had the responsibility of managing one laboratory outside of class over 7 days. The main goal was to maximize performance relative to the other groups. The primary dependent variable was group performance on Day 7.	Diversity was shown to be beneficial to performance, but only when group-level testosterone was low. In stark contrast, diversity had a negative effect on performance when group-level testosterone was high.
Li, Schaubroeck, Xie, & Keller (2018)	Independent samples from four different cultural contexts (i.e., Switzerland, USA, China, and Japan) were used to expand understanding of the effects of two contrasting perspectives of leadership role occupancy. More specifically, the authors proposed that incumbency in leadership positions is positively related to high levels of both *job demands* and *job control*, whereas job demands and job control have offsetting effects on well-being.	Different designs for the samples were used. The Swiss sample used a longitudinal design to assess leaders' trajectories of job control and job demands. The US sample tested the indirect relationships between leadership role occupancy and psychological well-being through job demands and job control using a cross-sectional design. Moreover, the model was tested using a time-lagged measure of salivary cortisol. The China sample sought to replicate the results of the US sample by using a time-lagged design in a Chinese context. The Japan sample was similar to the US.	Mixed results were found. The authors found consistent support for indirect effects of leadership role occupancy through job demands irrespective of the outcome measure. However, indirect effects through job control were limited to hedonic and eudaimonic well-being (Samples 2 and 4).
Nicolaou et al. (2017)	Of particular interest, Study 1 surveyed 2,146 individuals to provide evidence that testosterone increases the tendency to engage in self-employment.	The authors drew on the Centers for Disease Control and Prevention's (CDC's) National Health and Nutrition Examination Surveys (NHANES) of 2011–2012, where the serum testosterone was measured for a random sample of men and women. In this particular study, three instruments—measured at the time of the reported testosterone measurement in NHANES 2011–2012—were used. A two-stage least-squares model was thus employed.	In Study 1, serum testosterone levels were positively associated with self-employment for males—although only marginally significant.
Nadler et al. (2017)	In order to test how testosterone affects trading decisions, 140 subjects participated in an experiment in which testosterone was exogenously elevated in some traders. It was tested the effects of testosterone on both participants' trading behavior and size and duration of asset price bubbles. The authors hypothesized that testosterone causes male traders to bid and ask at higher prices and neglect an asset's fundamental value. These behaviors, in turn, would lead to larger and longer-lasting bubbles.	Prior to participating in an experimental asset market, participants received a topical gel containing testosterone or a placebo. The first day of a session consisted of a medical screening. Trading took place on the second day. The authors conducted double-auction markets, each consisting of three rounds of 12 trading periods, during which traders bought, sold, bid, and asked for shares of a financial asset.	An exogenous increase in the levels of testosterone—in men—increased bid prices and asset price bubbles.

(continued)

Table 1 (continued)

Study	Work Context and Participants	Research Design	Main Findings
Sherman et al. (2016)	74 male executives consented to hormone testing and provided samples for testing its effect on attained status. The authors advocated that testosterone and cortisol jointly predict the number of subordinates—an objective measure of *status attainment*—but do not predict income or education.	Participants' hormone levels were measured physiologically. Thereafter, they were asked about the number of subordinates.	Testosterone was positively associated with attained status, but only for low-cortisol executives. In particular, high-testosterone, low-cortisol executives were especially likely to occupy high-status positions whereas low-testosterone, low-cortisol executives were particularly likely to occupy lower status positions.
Diebig, Bormann & Rowold (2016)	129 participants provided information on their leaders' full-range leadership behaviors together with a hair sample to assess cortisol. The authors proposed that ambiguity-increasing leadership behaviors are positively related to followers' general stress level while clarifying leadership behaviors are negatively related to followers' general stress level.	Data collection took part on two separate occasions with a three-week time gap. In the first instance, participants provided information on the three leadership constructs (i.e., transformational, transactional, and laissez-faire). In the second instance, the hair samples were collected.	Leaders played an important role with regards to the stress levels of their employees. In particular, clarifying leader behaviors were associated with followers' low levels of stress whereas ambiguity-increasing leader behaviors were associated with followers' high levels of stress.
Klumb, Voelkle, & Siegler (2016)	During a 7-day ambulatory assessment with 56 couples, this study assessed daily variations in the severity of negative social interactions at work and at home, along with participants' affect and cortisol levels. The authors expected that both types of work strain (i.e., high- and low-arousal negative affect) to spill over into the home, but to be differentially related to negative couple interactions.	In this field study, parents first completed an online questionnaire containing sociodemographic characteristics. Four months later, both partners participated in a 7-day ambulatory assessment. In the course of each of the seven workdays, both partners completed a questionnaire after waking up and before going to bed. Signal-contingent questionnaires assessed momentary affect, situational variables (e.g., location, activity), and a modified version of the Rochester Interaction Record to evaluate social interactions that occurred between two measurement occasions. In addition, participants provided a saliva sample at each measurement occasion to assess the level of cortisol.	Only men transmitted high-arousal negative affect to the home. There was an intraindividual relationship between the severity of negative work interactions and low- as well as high-arousal affective states at work, for both men and women. Moreover, only women showed a tendency for a slowed decline of cortisol levels on more socially stressful days.
Ketturat et al. (2016)	The authors conducted a short-term longitudinal study in a real-life stress situation with 85 prospective students to investigate the effects of social identification on subjective and endocrine stress reactions. It was suggested a new methodological approach (i.e., longitudinal design) toward investigating this relationship by separating within- and between-person effects of social identification.	The study was embedded in an athletic aptitude test that was part of a university's admission process to the sports sciences program. Students were assigned to one of 10 groups in which they had to pass tests in several athletic disciplines. Examinees were not competing against each other but against admission criteria. From 10:00 a.m. to 7:00 p.m., participants completed six consecutive sporting disciplines.	It was found a significant within-person effect of social identification: the more students identified with their group, the less stress they experienced and the lower their cortisol response was. In contrast, between-person effects were not significant.

(continued)

Table 1 (continued)

Study	Work Context and Participants	Research Design	Main Findings
Han, Duhachek, & Agrawal (2016)	This study shed light on how the matching between different consumers' coping strategies (i.e., problem-focused vs. emotion-focused) and construal levels in ad messages enhances health persuasion. More specifically, the authors argued that individuals primed to employ a problem-focused (vs. emotion-focused) coping will be more likely to be persuaded by health messages at lower (vs. higher) levels of construal. In addition, by conducting an experimental study with 94 participants, they investigated the effects of this matching between coping and construal levels on stress responses, which was measured by participants' cortisol levels. Participants assigned to employ problem-focused (vs. emotion-focused) coping were expected to experience greater stress reduction when receiving health messages presented at low (vs. high) levels of construal.	Of particular interest, Study 2 employed a 2 (coping: problem-focused vs. emotion-focused) x 2 (high vs. low construal level) between-subjects design. Participants were randomly assigned to one of the four conditions. Health stress manipulation involved informing participants that the psychology department was interested in understanding how individuals recall previous stressful events involving a health goal. Thereafter, coping was manipulated by informing that the psychology department was interested in developing a coping strategy to help individuals manage stress (problem- vs. emotion-focused). Next, construal level manipulation was applied by asking participants for feedback on a fitness club ad (high vs. low construal level messages). Participants were then asked to indicate their intention to join the fitness program.	In Study 2, specifically, participants in the problem-focused coping condition experienced a significant decrease in their cortisol levels after seeing a low (vs. high) construal level ad. Participants in the emotion-focused condition, on the other hand, experienced a significant decrease in their cortisol levels after seeing a high (vs. low) construal level ad.
Bendahan, Zehnder, Pralong, & Antonakis (2015)	Of particular interest, Study 2 recruited 240 students to participate in a variant of the dictator game with real power and consequential monetary stakes. The authors advocated that leaders having received high power would be more corrupt than those who have received low power. Additionally, this effect was hypothesized to be moderated by honesty (and testosterone), such that power would predict corruption more strongly at low (vs. high) levels of leader honesty (and testosterone).	Participants played a prisoner's dilemma game, which was used to premeasure their behavioral selfishness. For the dictator game, leaders were randomly assigned to either high or low power condition. In particular, leaders had full discretion on payouts made over three stages—five decision rounds each. Thereafter, the study randomly gave some leaders additional power by assigning these leaders two additional followers and then introducing a new option that increased the leader's pay-off and reduced followers' payoffs.	Both the situation and the person predicted corruption. Power affected individuals in a way that made them behave antisocially. Leaders who received additional power and more discretionary choices were more likely to profit from their power and to violate the very social norms to which they had subscribed. Moreover, it was found more corruption when power and testosterone were both high. Conversely, honesty did not interact with power to predict corruption.
Schipper (2015)	208 subjects participated in an auction experiment in which it was collected salivary hormones such as testosterone and cortisol. It was hypothesized that higher total profits lead to larger positive testosterone responses in males. In addition, higher profits would be associated with larger cortisol responses since larger gains are typically due to lower bids and thus relatively more "risk-taking." Accordingly, more "risk-taking" may be more stressful and thus lead to positive cortisol responses.	Every session of the experiment was divided into eight phases: (1) first saliva sample collection; (2) Holt–Laury lottery task; (3) auction game; (4) questionnaire/filler task; (5) playing out the Holt–Laury lottery task; (6) second saliva sample collection; and (8) payment.	There were null findings for basal testosterone and cortisol for both males and females. No hormone responded to total profits in the auctions except for a small positive response of the stress hormone cortisol in male participants.

(continued)

Table 1 (continued)

Study	Work Context and Participants	Research Design	Main Findings
Peifer et al. (2014)	22 healthy male subjects were exposed to a complex computer task (CAMS) in which the authors investigated the relationship between stress and flow-experience. It was hypothesized that moderate physiological arousal would facilitate flow-experience, whereas excessive physiological arousal would hinder flow-experience—inverted u-shaped relationship.	Before the experiment, the TSST was applied in order to increase physiological and psychological stress. Thereafter, participants completed a computer program task (CAMS) that was told to have predictive value for future job success. Subjects then self-reported their levels of flow experience.	The proposed quadratic relation of cortisol with flow-experience in the first half of the experiment, shortly after the TSST, hold true. However, no support was found for the second half of the experiment given that participants were not sufficiently stressed anymore.
Yang et al. (2014)	68 subjects participated in an experiment in which was examined the effects of interactional unfairness on cortisol activity and whether this activity contributed to deviant behavior. The study proposed that interactional unfairness would trigger the release of cortisol, which in turn would mediate the effects of interactional unfairness on deviant behavior.	Participants were randomly assigned to either a fair or unfair interactional justice condition. In the fair condition, the experimenter showed patience and politeness when explaining the instructions for the task, while in the unfair condition, the experimenter was impatient and impolite.	Cortisol activity mediated the effects of interactional unfairness on deviant behavior. The indirect effect remained significant after controlling for established attitudinal and self-construal mediators of the justice-deviance relationship.
Frisch et al. (2014)	In order to shed light on the stress-buffering effects of social support, this study recruited 90 participants to perform the TSST with either a supportive or an unsupportive committee. The authors hypothesized that social support would be more likely to buffer stress reactions if a shared social identity between the provider and recipient of support is evoked.	Participants were randomly assigned to the conditions of a 2 (identity salience: social vs. personal) × 2 (committee behavior: supportive vs. unsupportive) between-subjects design. The experiment consisted of two parts: the manipulation of identity salience and the TSST.	Participants experiencing a supportive committee had a significantly lower cortisol response at T3 and at T4 than participants confronted with an unsupportive committee. In stark contrast, in the personal identity condition, social support did not make a difference.
Kandasamy et al. (2014)	In order to expand scientific understanding of risk-taking behavior, this study conducted an experiment in which a pharmaceutical form of cortisol (or a placebo) was administered to 36 participants. In this paper, they discriminated between acute (short-lived, i.e., minutes to hours) and chronic (sustained, i.e., days to weeks) stress, and theorized that acute exposure to raised cortisol levels would have either no significant effect or, at most, modest ones on promoting risk-taking, whilst a chronic exposure would promote risk aversion.	Subjects were randomly assigned to one of three different conditions: (i) acute elevated cortisol, (ii) chronic elevated cortisol, or (iii) placebo (control). Then, a series of computer tasks—offering real monetary payoffs—were used to measure participants' risk preferences. In sum, participants visited the study site on the first (Day 0) and last day (Day 7), provided saliva and blood samples and were then dosed with either hydrocortisone or placebo. For the next seven days, participants took hydrocortisone or placebo capsules at home.	It was found no significant difference between risk-preference behavior when participants received an acute dose of cortisol and when receiving a placebo. On the other hand, when participants were exposed to a sustained elevation of cortisol (chronic elevated condition) over eight days, they became more risk-averse.

(continued)

Table 1 (continued)

Study	Work Context and Participants	Research Design	Main Findings
Crum, Salovey & Achor (2013)	This paper explored the role of mindsets in the context of stress by conducting three different studies. Of particular interest, Study 3 demonstrated the effect of stress mindset on physiological and behavioral outcomes. The authors proposed that stress mindset would be a distinct and meaningful variable in determining the stress response.	Early in the semester, participants completed the SMM (Stress Mindset Measure). Next, participants underwent the TSST and were told that they would have the opportunity to receive feedback from their peers and the management professionals on their speeches. Salivary cortisol was collected to measure stress physiologically.	Individuals who endorsed a stress-is-enhancing mindset had a stronger desire to receive feedback than those who endorsed a stress-is-debilitating mindset. Furthermore, for individuals with high cortisol reactivity to stress, having a stress-is-enhancing mindset lowered the cortisol response, whereas for those who had low cortisol reactivity to stress, having a stress-is-enhancing mindset increased the cortisol response.
Beck et al. (2013)	This study shed light on how the interplay between both spouses' attachment styles (i.e., anxious and avoidant) might shape their physiological stress responses. 218 opposite-sex newly married couples participated in a study in which they discussed an area of disagreement with their partner. The authors hypothesized that members of couples with one partner high in anxiety and the other high in avoidance, or two anxious partners, would exhibit greater stress reaction in anticipation of a conflict discussion.	Each partner identified three important and unresolved areas of disagreement in their relationship. Thereafter, the experimenter chose a topic that both partners had listed and provided additional details about the upcoming conflict discussion by reminding that they would discuss an important topic that they had disagreed. Afterward, the experimenter took the couple to a private room in which the experimenter asked couples to try to resolve the conflict topic chosen for them over the next 15 min.	Couples with anxious wives and avoidant husbands showed physiological reactivity in anticipation of conflict: both spouses showed sharp increases in cortisol, followed by rapid declines. Couples including two anxious partners, on the other hand, did not show distinctive stress responses.
Stephens et al. (2012)	82 students participated in a lab study designed to test whether facing a culturally-mismatched environment can lead to a generally aversive psychological state that can alter biological functioning. It was theorized that a cultural mismatch decreases first-generation students' capacity to cope with the demands of university contexts and leads them to experience academic tasks as more aversive. Specifically, first-generation students would experience a more aversive psychological state than continuing-generation students when university culture is framed with independent norms (vs. interdependent).	The study employed a 2 (student-status) x 2 (condition: *independence* vs. *interdependence*) x 4 (Time: cortisol measures) mixed-design experiment. The university culture's focusing on independence (vs. interdependence) was manipulated by assigning two different welcome letters. After participants read one of the messages, they gave a five-minute speech about their college goals—stressor.	As hypothesized, when university culture was represented in terms of independent norms, first-generation students showed greater percentage increases in cortisol than continuing-generation students. However, when the university culture was represented in terms of interdependent norms, this cortisol gap was eliminated.
Häusser et al. (2012)	In this study, a group version of the TSST with 96 participants was employed as a means of testing the idea that the presence of others has a buffering effect on neuroendocrine stress reactions only if a sense of shared social identity is evoked. It was hypothesized that being among others buffers stress reactions to social-evaluative threat only if one develops a shared social identity with those others.	Participants were randomly assigned to the experimental conditions of a 2 × 2 × 5 design with stress induction (TSST-G vs. placebo-TSST-G) and identity salience (social identity vs. personal identity) as between-subjects variables and time of measurement as a within-subjects variable.	Social identity salience attenuated the stress-induced cortisol reaction in the TSST-G condition, while there was no effect of identity salience in the Placebo-TSST-G conditions.

(continued)

Table 1 (continued)

Study	Work Context and Participants	Research Design	Main Findings
Trawalter et al. (2012)	Of particular relevance, Study 1 examined whether individuals' concerns about appearing prejudiced are associated with heightened stress responses during interracial contact. 40 students participated in this study. The authors hypothesized that high-EM (vs. low-EM) individuals will experience more stress during interracial contact but not during same-race contact—EM refers to external motivation. A subsequent study analyzed whether stress responses hold over time.	Participants were informed that they would be videotaped during an experimental interaction. Research assistant's race comprised the experimental manipulation of interracial or same-race contact. Participants interacted with the research assistant for 10 min. More specifically, participants answered questions regarding their daily routine with research assistants that were blind to hypotheses.	Concerns about appearing prejudiced were associated with physiological stress responses during interracial contact. Moreover, high-EM participants' stress, as measured by their behavioral anxiety, increased over the course of interracial interactions.
Sherman et al. (2012)	This study aimed at contradicting the common perception that leaders have higher stress levels than nonleaders. Using a sample of real leaders (148 in study 1; 65 in study 2), it was tested whether leaders and nonleaders differed in their levels of salivary cortisol and/or reports of anxiety. The authors predicted that leaders experience less stress than nonleaders.	Study 1 used a simple comparison of means between leaders and nonleaders, whilst study 2 used a mediation model to test the prediction that the relationship between leadership and stress is mediated by differences in the sense of control.	Leadership was indeed associated with lower levels of stress. This relationship emerged when leaders were compared with nonleaders and when it was looked at variations in status within a group of leaders. Accordingly, the relationship held across two distinct manifestations of stress—i.e., physiological and psychological. Finally, a psychological sense of control played a mediating role, indicating that an increase in one's leadership level might provide stress-buffering benefits.
Townsend et al. (2011)	This study recruited 61 women to participate in an experiment aiming at investigating women's neuroendocrine stress responses associated with sexism. It was predicted that, when being evaluated by a man, women who chronically perceive more sexism would experience more stress, unless the situation contained overt cues that sexism would not occur.	Female participants were instructed to act as job applicants and were interviewed by a male confederate who selected between the participant and a second applicant for a desirable position. In the *merit condition* , the feedback was merit-based and the other applicant was a woman. In the *sexist condition* , the feedback was ambiguously sexist and the other applicant was a man. It was conducted a 2 (Merit vs. Sexist) x 2 (Chronic Perceptions of Sexism: Low vs. High) x 4 (Time: cortisol measures) mixed-design experiment. The stressor was the evaluation by a man—i.e., sexist situation.	Individual differences in chronic perceptions of sexism were associated with cortisol levels among women who were in a situation that contained identity-threatening cues but not in a situation containing identity-safe cues.
Kotsou, Nelis, Grégoire, & Mikolajczak (2011)	This study aimed at testing whether it is possible to improve emotional competence (EC) in adults and what would be the effects of such improvement. In order to test the study's hypotheses, 132 subjects participated in a one-year experiment. It was expected that the intervention would lead to an increase in EC, which would be evidenced not only by an increase in self-reported EC but also by a decrease in cortisol levels, and by an increase in spouse-reported EC.	An experimental design with a between-subjects variable (EC training group vs. no-intervention control) and a within-subject variable (pretest vs. posttest) was employed. Participants were asked to complete the measures just before the intervention (Time 1), 1 month after the intervention (Time 2), and 1 year after the intervention (Time 3). Participants of the intervention group attended to a two-and-a-half-day program (15 hr) on EC.	Results revealed that the level of emotional competencies increased significantly in the intervention group in contrast with the control group. This increase resulted in lower cortisol secretion, enhanced subjective and physical well-being, as well as improved quality of social and marital relationships in the intervention group.

(continued)

Table 1 (continued)

Study	Work Context and Participants	Research Design	Main Findings
Page-Gould, Mendes & Major (2010)	125 Black and White adults completed a stressful evaluative task in the presence of two White or two Black interviewers while hormonal responses were assessed. The authors advocated that, following a stressful intergroup interaction, past intergroup contact would predict greater physiological recovery from the stressor—i.e., intergroup interaction.	A 2 (stressor context: ingroup or intergroup) x 2 (participant race: Black or White) x continuous (past intergroup contact) experiment was conducted. In order to create a psychologically stressful task, the TSST was employed.	A relatively high degree of previous experience with outgroup members was associated with faster recovery following an intergroup stressor.
Taylor et al. (2010)	183 participants going through the TSST experienced either (a) an unsupportive audience, (b) a supportive audience, or (c) no audience. The authors hypothesized that, contrary to the social support literature, individuals with more psychological resources (e.g., optimism, mastery, and self-esteem) might experience support as a threat to self-esteem and thus be less benefited than those with low psychological resources.	Participants first completed individual difference measures online. Next, they reported their experiences of socially supportive or unsupportive interactions each day of a 9-day period. Thereafter, they took the TSST under one of three conditions: unsupportive audience, no audience, and supportive audience.	Both audience conditions produced significantly stronger cortisol, heart rate, and blood pressure responses to the stress tasks relative to the no-audience control, even though the supportive audience was rated as supportive. Peak cortisol responses to the TSST were highest in the supportive audience condition, somewhat lower in the negative audience condition, and lowest in the no audience condition.
Carney, Cuddy, & Yap (2010)	42 subjects participated in a study aiming at addressing the physiological and behavioral consequences of power poses. The authors predicted that posing in high-power nonverbal displays (as opposed to low-power nonverbal displays) would cause neuroendocrine and behavioral changes for both male and female participants.	Participants were randomly assigned to a high-power pose or a low-power pose condition. Each participant held two poses for 1 min each. Participants' risk-taking was measured with a gambling task, feelings of power were measured with self-reports, and levels of cortisol and testosterone with saliva samples.	High-power poses caused an increase in testosterone compared with low-power poses, which caused a decrease in testosterone. Furthermore, high-power poses caused a decrease in cortisol compared with low-power poses, which caused an increase in cortisol. Self-reported feelings of power were also significant.
Levi, Li, & Zhang (2010)	In this study, the role of bidder and target male CEO testosterone levels in bid withdrawals and tender offers were examined. It was hypothesized that the higher the testosterone of the target (vs. bidder) CEO, the more likely it would be for an offer to be withdrawn. Likewise, the higher the testosterone of the target (vs. bidder) CEO, the more likely it would be for a tender offer to be made.	Data from more than 350 acquisition bids for the period 1997–2007 from Thomson's SDC database were used. In this study, testosterone was proxied by the CEO's age.	It was found that the bidder male CEO being young increased the likelihood of bid withdrawal by over 20%. Moreover, the target male CEO being young increased the likelihood of a tender offer by about 2%. Finally, the bidder male CEO being young increased the likelihood of a bid by 4%.

(continued)

Table 1 (continued)

Study	Work Context and Participants	Research Design	Main Findings
Ford & Collins (2010)	In order to test the moderating effect of self-esteem on the relationship between interpersonal rejection and physiological responses, this study recruited 78 participants to experience an ambiguous interpersonal rejection (vs. no rejection) from an opposite-sex partner in the context of an online dating interaction. It was hypothesized that individuals with LSE (vs. with HSE) would show greater increases in cortisol reactivity and would be more likely to engage in defensive social action.	First, participants completed a background questionnaire that contained demographic and personality measures, wrote a personal description of themselves, and had their picture taken. Next, participants were led to believe that they would be participating in a 10-min online chat with an opposite-sex participant. Participants in the *rejection condition* were told that there would be no online chat because the other participant "chose not to continue with the experiment". Participants in the *control condition* were told that the other participant could not continue with the study because he or she was feeling sick.	Individuals with LSE (vs. HSE) responded to rejection by appraising themselves more negatively, making more self-blaming attributions, exhibiting greater cortisol reactivity, and derogating the rejector.
Mehta & Josephs (2010)	In order to shed light on the neuroendocrine influences on dominance, the authors examined whether testosterone works together with other hormones to drive dominant behavior. The authors proposed the dual-hormone hypothesis, suggesting that testosterone interacts with cortisol to regulate dominance. The *dual-hormone hypothesis* was tested in the domains of leadership (Study 1; n = 94) and competition (Study 2; n = 57).	In study 1, participants were randomly assigned to the position of leader or follower and then completed the leadership task (i.e., block design task) while being videotaped. In study 2, participants were told that they would be competing against each other on a test consisted of several puzzles—the competition was rigged. The participant randomly assigned to win was given easier puzzles. Later, participants were asked to choose one of two options: (a) compete again against the same participant or (b) complete a questionnaire on food and entertainment preferences.	Study 1 provided empirical support for the dual-hormone regulation of dominance by showing that testosterone interacts with cortisol to predict dominance in leaders. In Study 2, higher pre-competition testosterone was associated with increased dominance after defeat in individuals low in pre-competition cortisol, but higher pre-competition testosterone was associated with decreased dominance after defeat in individuals high in pre-competition cortisol.
Coates & Herbert (2008)	17 male traders from the City of London were followed for 8 consecutive business days. Under real working conditions, this study investigated the role of the endocrine system in financial risk-taking.	The traders, in the normal course of a working day, sat in front of a bank of computer screens displaying live prices of currency, commodity, bond, and stock index futures. Saliva samples were collected twice per day, at 11:00 a.m. and 4:00 p.m., representing the times that fell before and after the bulk of the day's trading.	Significant relationships between testosterone and financial return and between cortisol and financial uncertainty were found.

As depicted in Table 1, a large amount of the studies on the physiological perspective that we gathered focused on the assessment of cortisol as a variable under examination. Research on cortisol is mainly interested in the many ways individuals respond to physical and psychological stressors (e.g., Ketturat et al., 2016; Li et al., 2018). Accordingly, cortisol is widely accepted as the most reliable biological marker of stress (Akinola, 2010; Becker & Menges, 2013), and its application has been appealing for scholars interested in measuring stress objectively as an alternative methodological tool, as well as for those researchers concerned with how the human body and hormonal responses influence ensuing behavior. Prevalent in laboratory studies, one prominent tool that elicits strong physiological responses is the Trier Social Stress Test (TSST), in which subjects assume the role of a job applicant and perform tasks in the presence of an evaluative audience. The TSST indeed is considered a robust stress task that elicits strong effects on stress activity since it embeds low levels of controllability and a social-evaluative component, which is considered the perfect combination to engender a substantial cortisol response (Dickerson & Kemeny, 2004; Ganster & Rosen, 2013). Laboratory experimental research has incorporated such tasks aiming at understanding physiological stress responses, for instance, to stressful intergroup contact (Page-Gould, Mendes, & Major, 2010), and to the presence of others in threatening situations (Häusser et al., 2012; Frisch et al., 2014).

The common thread across the studies that rely exclusively on the measurement of cortisol is that stress response, denoted by the variation on the levels of cortisol, is regarded as an outcome variable influenced by either a certain factor or a particular context (e.g., Stephens et al., 2012; Beck et al., 2013; Crum, Salovey, & Achor, 2013). With the exception of a particular study in which cortisol was manipulated exogenously via pharmaceutical capsules of hydrocortisone in order to enlighten scientific understanding of risk-taking behavior (Kandasamy et al., 2014), the majority of recent research indicates greater interest devoted to expand knowledge on the determinants of stress, as on the underlying mechanisms that might engender stress-buffering effects.

Scholars have thus been conducting research in both laboratory and field settings aiming at assessing individuals' short-term reactions to stressors, or even those reactions occurring over a longer period, as in the cases of Kotsou et al. (2011) and Klumb, Voelkle, & Siegler (2016), in which the authors conducted a 1-year and a 7-day study, respectively. Studies focused on capturing immediate, or very short-term, stress responses are usually conducted in laboratory settings that

afford experimenters more control over the stressors induced, as well as control over extraneous variables that might compromise the research design. As we shall see further during the discussion of the methodological procedures, over the course of an experimental study, for each participant, cortisol assessments occur at least twice: upon participants' arrival and, given the peak of cortisol response, at 21 to 40 minutes from stressor onset (see Dickerson & Kemeny, 2004); thereby, changes in the levels of cortisol due to the stressor can be evaluated.

Accordingly, researchers have explored different sorts of stress manipulations to investigate how participants react physiologically. As displayed in Table 1, we have summarized the main features of the reviewed studies as the main characteristics of research designs adopted to test the proposed hypotheses. Interestingly, an omnipresent force in stress research is the evaluative threat component accrued from the fear of being negatively judged, reflecting therefore in a considerable number of research publications resorting to some form of social interaction into their designs. Notably, research have examined cortisol responses, for instance, to the effects of a supportive or an unsupportive audience (Taylor et al., 2010), of women's perceptions of sexist cues in a job interview (Townsend et al., 2011), and of concerns about appearing prejudice during interracial interactions (Trawalter et al., 2012). Furthermore, investigations of potential mechanisms that might alleviate stress have also attracted scholars' attention, as in the cases of the stress-buffering effects of self-esteem on the effects of interpersonal rejection on stress responses (Ford & Collins, 2010), and of social identity on the stressful effects of the presence of others in a threatening situation (Häusser et al., 2012).

Unlike other research, it is worth mentioning, Yang et al. (2014) did not consider cortisol activity as either a solely outcome variable or an exclusively antecedent of subsequent behavior. Instead, it was treated as an important mediator underlying the relationship between perceived interactional unfairness and deviant behavior. In this experimental study, participants were randomly assigned to either a fair or unfair interactional justice condition. The release of cortisol triggered by interactional unfairness, in turn, was shown to influence participants to engage in deviant behaviors when they had the opportunity. More importantly in this study, moreover, is that cortisol activity was regarded as an objective measure of stress that overcomes self-reported indicators of psychological stress, contributing therefore to enhance methodological precision—issue that we discuss in more detailed in a later section.

A large body of research on testosterone, on the other hand, has been associated with power and status-seeking behavior in organizations, as with competitive situations (e.g., Levi, Li, & Zhang, 2010; Schipper, 2015). Accordingly, testosterone is commonly regarded as an index of dominance (Schultheiss & Stanton, 2009; Akinola, 2010). Research employing physiological measurement of this hormone usually aims to capture information different from those provided by self-reported measures of dominance or by inferences elicited from manipulations of power positions. Although there is some discussion on to what extent measuring dominance objectively can be determined as a better predictor of status-seeking behavior than scores on self-report measures (Josephs et al., 2006), physiological metrics are rather seen as an integrative tool important to complement and avoid exclusive reliance on subjective measurement. In Carney, Cuddy, and Yap's (2010) study, for example, participants were randomly assigned to a high-power-pose (vs. a low-power-pose) condition to test for the effects of a simple 2-min power-pose manipulation on not only physiological, but also behavioral and psychological measures of power, yielding therefore a more in-depth comprehension of the overall effects that body postures have on individuals.

Other studies assessing testosterone, however, seem more concerned with understanding the effects of individuals' levels of testosterone on organizational phenotypes. Put another way, rather than focusing on the many ways that including physiological measures contributes to improving methodological rigor, current research appears to be also interested in determining the extent to which biological factors affect management behavior per se. Testosterone, for instance, was shown to be associated with leader's level of corruption in a study in which subjects participated in a variant of the dictator game with real power and consequential monetary stakes. Leaders having received high power showed to be more corrupt than those who have received low power and this effect was in fact stronger for those high in testosterone (Bendahan, Zehnder, Pralong, & Antonakis, 2015). In a different study, Nadler and colleagues (2017) manipulated testosterone pharmacologically via a topical gel to subjects about to participate in an experimental asset market. Compared to a control group that received a placebo gel, the testosterone-treated group displayed higher measures of asset overpricing.

In stark contrast to studies on cortisol, research that rely exclusively on the measurement of testosterone has mostly considered it as a predictor as a means of providing an explanation for a specific phenomenon. Levels of testosterone, therefore, are often regarded as an individual

characteristic intrinsic to the human nature, and its consequences on social and organizational behavior are as important as any other individual trait. Nicolaou et al. (2017), for example, drew on the Centers for Disease Control and Prevention's National Health and Nutrition Examination Surveys (NHANES), where testosterone is measured for a random sample of men and women, to provide evidence that levels of testosterone influence the tendency to engage in self-employment. Common to the studies that consider testosterone or cortisol as explanatory variables is that they treat hormonal levels as a stable characteristic pertaining to individuals, and thus assuring that it is measured at least once is sufficient to associate it to an outcome of interest (e.g., tendency to engage in self-employment). More recently, research on how hormonal factors influence organizational behavior has expanded current knowledge by examining how groups collectively low and high in testosterone affect team performance. In this study, Akinola and colleagues (2018) investigated the interplay between group diversity and group-level testosterone in predicting group performance. By measuring testosterone at the group level, the authors provided theoretical reasoning and empirical evidence for the notion that group diversity is beneficial to performance if group-level testosterone is low, whilst it is detrimental to performance when group-level testosterone is high.

It is noteworthy that even though research considering the interplay between cortisol and testosterone seem to be the exception rather than the rule, there is research interested in measuring both testosterone and cortisol in the same setting (e.g., Coates & Herbert, 2008; Carney, Cuddy, & Yap, 2010; Schipper, 2015). As we have seen, whereas studies preoccupied in assessing cortisol and testosterone separately are associated with different domains of inquiry, research interested in the concurrent analysis of the two hormones seem to share one commonality: the desire to expand understanding on how the interaction between them affects social and organizational behavior. In order to shed light on the antecedents of status attainment among male executives, Sherman et al. (2016), for instance, examined the interactive role played by testosterone and cortisol in predicting leaders' number of subordinates. Unlike one might have suggested, limiting the analysis of status attainment to either cortisol or testosterone would not be sufficient to predict executives' number of subordinates. Instead, it was shown that the two hormones jointly regulate each other in a sense that high-testosterone, low-cortisol executives are more likely to occupy high-status positions. This finding is in accord with the dual-hormone hypothesis that had been developed by Mehta and Josephs (2010), which suggests that the effects of testosterone on dominance are actually contingent on cortisol. By experimentally testing their claims in the domains of leadership and

competition, the dual-hormone hypothesis was one of the first theories to provide empirical support for the moderating role of another hormone (i.e., cortisol) on the relationship between testosterone and dominant behavior.

As has been noted, within the realm of research resorting to endocrine measurement, it is important to discriminate between researchers' primary goals in order to fit research's theoretical demands appropriately. Whereas some studies might be encouraged to incorporate cortisol or testosterone measurement into their own research designs due to the methodological benefits ensued from the objective assessment of a certain construct (e.g., Yang et al., 2014; Diebig, Bormann, & Rowold, 2016), others may be interested in measuring these hormones to examine their direct effects on organizational attitudes and behavior (e.g., Peifer et al., 2014; Nicolaou et al., 2017). We return in the next section to the issues related to the benefits and challenges elicited from applying endocrine measurement in organizational and behavioral research as well as its relation with psychological and behavioral measures where we discuss the advantages of using such biomarkers, as to the issues related to sampling, timing, and storage, when explicitly discuss the methodological procedures.

Methodological Advantages of Using Physiological Measures of Testosterone and Cortisol

Despite the growing interest in investigate how individuals' hormonal levels are related to the myriad behaviors that occur in the workplace and other social contexts (e.g., Kandasamy et al., 2014; Schipper, 2015; Nicolaou et al., 2017), we consider pivotal to present the set of benefits of using methods that incorporate bodily signals such as cortisol and testosterone. Thus, in this section, we turn our attention to the discussion of the advantages of using physiological measures of testosterone and cortisol in organizational and behavioral research from a more methodological point of view. Henceforth, these advantages, as the shortcomings associated with the measurement of these physiological indicators, are elaborated upon.

As we alluded to previously, one prominently characteristic of existing studies in organizational research is the reliance on self-report forms of data collection (Podsakoff, MacKenzie, & Podsakoff, 2012). Indeed, at the same time self-report methodology is pervasive in organizational and behavioral studies, so is the discussion on the problems associated with its use

and the attempts to identify and mitigate them (e.g., Podsakoff & Organ, 1986; Tourangeau & Yan, 2007; Steenkamp, De Jong, & Baumgartner, 2010; Podsakoff, MacKenzie, & Podsakoff, 2012). Accordingly, problems of endogeneity associated with social scientific research have received considerable attention (e.g., Antonakis et al., 2010), which has fostered calls for more rigorous and innovative methods within a handful of laboratory and field studies (e.g., Yang et al., 2014; Diebig, Bormann, & Rowold, 2016; Klumb, Voelkle, & Siegler, 2016).

Chief among these problems associated with the use of self-reported measures are the issues of common method variance, the incidence of which produce spurious relationships that lead to potentially misleading conclusions (see Campbell & Fiske, 1959; Podsakoff & Organ, 1986; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Antonakis et al., 2010; Spector & Brannick, 2010; Spector et al., 2017). Accordingly, many of the sources of common method variance result primarily from the fact that explanatory and outcome variables are obtained from the same source or respondent (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Measuring testosterone and cortisol, in turn, provides an alternative approach to assess intended constructs with an indicator that does not share the common method with self-reported measures. Put differently, when measuring biological markers, individuals do not engage in the same cognitive processes that might influence responses as when responding to questions presented by researchers (Pastore, Maffezzolli, & Mazzon, 2018). Moreover, collecting samples of cortisol and testosterone does not require any introspective response or cognitive effort on the part of participants that would influence their responses.

One widely acknowledged source of common method variance through which method biases influence individuals' responses, for instance, is social desirability (Tourangeau & Yan, 2007; Steenkamp, De Jong, & Baumgartner, 2010, Podsakoff, MacKenzie, & Podsakoff, 2012). Social desirability is generally viewed as the tendency to present oneself in a favorable light, regardless of their true feelings about an issue or topic (Steenkamp, De Jong, & Baumgartner, 2010; Podsakoff, MacKenzie, & Podsakoff, 2012). Questions that trigger social desirability concerns, in fact, are especially common in contexts that involve dominance, power and stress, in which people are likely to engage in responses that make them look good based on sociocultural norms (e.g., Steenkamp, De Jong, & Baumgartner, 2010; Häusser et al., 2012; Frisch et al., 2014). We argue that gauging individuals' levels of testosterone and cortisol can mitigate threats of socially desirable responses since the information provided by this method is participants' actual hormonal

level, which, in turn, occurs beyond any cognitive or affective control. Although we are cognizant that social desirability is not necessarily a conscious process per se, measuring work-related constructs objectively through hormonal assessment avoids the potential influence of social desirability on individuals' responses.

Furthermore, another driver of common method variance assuaged by measuring cortisol and testosterone is consistency bias. Individuals responding to questions posed by researchers oftentimes try to maintain a consistency between their thoughts and attitudes (Podsakoff, MacKenzie, & Podsakoff, 2012). Therefore, in order to avoid the dissonance elicited by differences between cognitions and behaviors, individuals might engage in consistent responding over the course of a questionnaire and thereby cause artificial variance in the relationship between two or more variables. By incorporating the physiological assessment of cortisol or testosterone into the research methodology, scholars benefit from having an additional tool to measure workplace phenomena in which it does not rely exclusively on self-report. Measuring these hormonal markers thus might be especially relevant for the literature on work stress and social dominance in which individuals might behave either consistent with what they might think the researcher wants or coherent with their past behavior.

Besides the aforementioned benefits associated with the issues of common method variance, incorporating the use of hormonal indicators helps to prevent participants from guessing the hypotheses being tested. Indeed, individuals who agree to participate in a research project, especially in an experimental one, might wonder what the real purpose of the study is and thus shape their behavior according to what they guess (Orne, 1962). The collection of participants' saliva convey few, if any, clues about the real purpose of the experiment, which aids to ensure that subjects are not influenced by demand effects that would lead them to provide responses capable of artificially confirm researchers' propositions (Orne, 1962; Cook et al., 1970). Unless participants have previous experience or expertise with research involving physiological assessment, assaying cortisol or testosterone in the research setting contributes to assuring that participants are blind to the hypotheses and experimental conditions. More importantly, even if participants correctly infer the experimenter's intent, it would be extremely difficult to make any difference in influencing individuals' hormonal responses (Akinola, 2010).

From a practical point of view, another advantage of assessing testosterone and cortisol is that the data collection is non-invasive, quick, and easy to operationalize (Becker & Menges, 2013).

The majority of studies we reviewed assessed participants' hormonal responses via salivary samples, which is definitely less invasive than collecting blood. Moreover, saliva collection requires no trained medical personnel, and even participants, when instructed appropriately, can collect saliva samples themselves in actual work environments. We return to the issues related to the operationalization of salivary cortisol and testosterone data collection in a research setting when we explicitly discuss the methodological procedures.

Our foregoing observations, indeed, broach noteworthy methodological concerns that seem to be overlooked by recent empirical research that incorporates physiological measures of cortisol and testosterone. As portrayed in Table 2, few empirical studies embodying measures of either cortisol or testosterone have explored the methodological contributions yielded by the use of these techniques, the advantages of which we deem overly useful for advancements in research's methodological underpinnings. With the exception of a handful of studies that made them salient (e.g., Townsend et al., 2011; Beck et al., 2013; Yang et al., 2014; Diebig, Bormann & Rowold, 2016), the common thread across recent empirical research is to be less attentive to these issues, indicating that in-depth discussion of the methodological advantages ensued by the assessment of these endocrine indicators is more scarce than ideally it would be.

We should note at this point that although the methodological advantages of using physiological measures of cortisol and testosterone have not been regarded as a key priority vis-à-vis the burgeoning interest in simply investigating the many ways that hormonal responses affect, or are affected by, organizational behavior, it does not mean that the empirical literature has relied solely on physiological measurement as a mean of achieving theoretical progress. In fact, a wide array of studies have adopted a holistic approach by incorporating not only psychological but also behavioral measures into research on stress and dominance in order to enrich literature's purview (e.g., Sherman et al., 2012; Beck et al., 2013; Crum, Salovey, & Achor, 2013).

Noteworthy in this respect, however, is that the majority of these studies observed a misfit between self-reported and physiological measures of stress and dominance (e.g., Josephs et al., 2006; Townsend et al., 2011; Häusser et al., 2012; Frisch et al., 2014). In most cases, accordingly, scholars have not found significant results for participants' subjective measures—especially in research on stress (Häusser, Mojzisch, & Schulz-Hardt, 2011). Table 2 offers a description of how the physiological measures of inquiry were addressed conceptually in each study. Furthermore, we present whether the construct of interest was measured psychologically or behaviorally, and, once

Table 2. Main Characteristics of Research Incorporating Endocrine Measures of either Cortisol or Testosterone (sorted by year)

Study	Conceptual Features of the Endocrine Measure	Physiological Assessment	How Measuring Endocrine Activity Contributes to Theory
Akinola, Page-Gould, Mehta, & Liu (2018)	Testosterone was treated as a moderator and the outcome variable was group performance. Testosterone was associated with a greater motivation to attain status and was deemed as an individual characteristic of group members.	One week prior to the study, participants provided a saliva sample for testosterone assessment.	The contribution was focused on bringing an overlooked factor (i.e., group members' hormonal characteristics) in determining whether diversity is detrimental or beneficial to performance. There was no discussion on whether testosterone is a better indicator of a specific social psychological construct.
Li, Schaubroeck, Xie, & Keller (2018)	Cortisol was treated as a dependent variable and regarded as the stress hormone. In particular, cortisol served as an indicator of well-being. The authors also measured stress via self-reports and found mixed results throughout the studies.There was no discussion, however, about the differences between objective and subjective measures of stress, and whether they were supposed to converge.	In the US sample, for four consecutive days, participants provided four saliva samples: at waking, 30 min after getting out of bed, immediately before lunch, and immediately before bed. In the China sample, cortisol was measured from assays of blood one week after participants finished the questionnaire survey.	Although treated as an objective measure of stress, including cortisol in some of their studies was not considered a primary contribution. Additionally, it was not mentioned whether measuring cortisol contributes to methodological advancements. Rather, the contribution was focused on the analysis of the two opposing perspectives on the effects of leadership role incumbency on well-being.
Nicolaou et al. (2017)	Testosterone was treated as an independent variable and the outcome variable was whether the individual was self-employed. The authors were focused on how biology influence behavior. In this case, individuals entrepreneurial activities.	Levels of testosterone tests were serum-based. Testosterone was measured once by the CDC's national survey. In a second study, prenatal testosterone exposure was indicated by the 2D:4D ratio.	The authors were mainly interested in investigating the role of biological factors on self-employment. No mention was made about the methodological contributions yielded by the use of physiological measures.
Nadler et al. (2017)	Testosterone was deemed as an independent variable and the outcome variable was subjects' trading behavior. No discussion on whether testosterone is an indicator of any other construct was offered.	Testosterone was exogenously manipulated via a topical gel.	The study was mainly focused on the role played by neurobiology in affecting investors preferences. No contribution concerning methodology was mentioned.
Sherman et al. (2016)	Testosterone and cortisol were regarded as independent variables, while attained status was the outcome variable. No subjective measure was assessed.	Salivary samples were collected at 3:30 p.m. and at 4:00 p.m. to minimize diurnal variation. For each hormone, the final measure was the average of the two samples.	The two endocrine measures were treated as "personality traits" and the authors were mainly interested in whether these hormones predict attained status.

(continued)

Table 2 (continued)

Study	Conceptual Features of the Endocrine Measure	Physiological Assessment	How Measuring Endocrine Activity Contributes to Theory
Diebig, Bormann & Rowold (2016)	Cortisol was treated as a dependent variable and regarded as an objective measure of stress.	In order to measure participants' chronic cortisol level, the study used hair samples that were cut close to the scalp of the head. Three-centimeter-long hair strands were analyzed to represent one mean stress value. According to the authors, hair samples represent cortisol levels of the previous three months.	The authors strongly highlighted that one of the main contributions of this study was the examination of leadership relationships with an objective biological criterion of followers' stress.
Klumb, Voelkle, & Siegler (2016)	Cortisol was treated as a dependent variable. According to the authors, cortisol is an important indicator that complements self-reports of strain, albeit no thorough discussion on the convergence between the two measures were offered.	Levels of cortisol were assessed two times per day, before and after work. The primary interest was in the cortisol recovery (i.e., cortisol slope).	The authors mentioned that the inclusion of cortisol as a stress indicator helps to overcome the sole reliance on self-reports. Additionally, using multiple sources of measurement was considered a strength of this study.
Ketturat et al. (2016)	The study employed both psychological (i.e., self-reported) and neuroendocrinological (i.e., salivary cortisol) indicators of stress. Both measures were treated as dependent variables. It was found a correspondence between physiological and subjective strain. The authors speculated that this was may be due to the time-lagged measurement of strain and cortisol, with strain and social identification being measured concurrently and cortisol being collected approximately 30 min later.	Saliva samples were always taken after the disciplines. More specifically, after registration and after four of the six disciplines, subjective strain, social identification, and saliva cortisol were assessed—i.e., five in total.	Cortisol was treated as an objective measure of stress. The main contribution was on the research design, in which it was employed a longitudinal field study to disentangle between- and within-person effects of social identification on stress. It was also mentioned as a significant strength of the study the fact that it was found the same pattern of results for both subjective and objective levels of stress.
Han, Duhachek, & Agrawal (2016)	In study 2, cortisol was deemed as a dependent variable together with "health persuasion". Cortisol was treated as a physiological indicator of stress.	Participants' cortisol levels were measured at three points in time: at the beginning of the experimental session, after the health stress manipulation, and after participants indicate their intention to join the fitness program, at the end of the session.	Measuring stress via cortisol was considered one of the theoretical contributions given that prior research had already established the effectiveness of coping strategies on self-reported stress reduction.
Bendahan, Zehnder, Pralong, & Antonakis (2015)	Testosterone was regarded as a moderator and the outcome variable was corruption (i.e., contravention to the social norm). Testosterone was treated as a "personality trait" and no subjective measure was obtained.	Before the experiment, three saliva samples were obtained. On the day of the dictator game, three more samples were collected. Importantly, the observed correlation between Time 1 and Time 2 testosterone for all participants was very high.	The authors did not make a case for the benefits of incorporating physiological assessment.

(continued)

Table 2 (continued)

Study	Conceptual Features of the Endocrine Measure	Physiological Assessment	How Measuring Endocrine Activity Contributes to Theory
Schipper (2015)	In this study, both testosterone and cortisol were measured and considered as independent variables. In turn, the authors advocated that testosterone would influence bidding through risk aversion and via aggression/dominance. The outcome variables were bidding and profits. No mention of self-reported measures of stress and dominance was made. Accordingly, the study was more interested in the effects of hormones per se.	Two saliva samples were collected: upon arrival and about 20-30 min after the auction game.	The study was interested in investigating the role sex hormones can play in competitive bidding in auctions rather than pursuing a new methodological tool to assess a specific construct.
Peifer et al. (2014)	In this study, cortisol served as an indicator of stress and it was treated as an independent variable. Flow experience was the outcome variable. No subjective measure of stress was obtained.	Samples were collected every 15 minutes during the experiment: the first two samples after TSST were aggregated to cortisol (t1) and the second three samples to cortisol (t2)—five times in total.	Although cortisol was considered an objective measure of stress, the contribution was mainly focused on the study of physiological arousal rather than on the methodological benefits of using such measure.
Yang et al. (2014)	Cortisol was deemed as a mediator and the outcome variable was deviant behavior. In this paper, the authors mentioned how self-reported indicators of psychological health, such as perceived stress, are a poor proxy for objective assessments. No subjective measure of stress was assessed.	Salivary cortisol was collected at three different times. The first (baseline) sample was collected 20 min after participants arrived at the laboratory, the second (test) sample was collected 25–30 min after the justice manipulation, and the third (recovery) sample was collected after 20 min of relaxation.	In this study, cortisol served as an objective indicator of stress. Additionally, the authors highlighted how incorporating physiological assessment contributes to methodological advancements.
Frisch et al. (2014)	Cortisol was treated as a dependent variable and considered an objective measure of acute social-evaluative stress. Additionally, cortisol was pointed as a more specific indicator of the social-evaluative component of the TSST than cardiovascular parameters. The study also assessed subjective strain via self-reports and no significant correlations between cortisol levels and self-reported strain were found.	Salivary cortisol samples were taken four times: upon arrival (baseline), immediately before the TSST, 10 and 20 min after the task. Subjective strain was measured six times.	Cortisol served as an objective indicator of stress. In this study, the lack of correlation between different measures was discussed and although the contribution is mainly related to theory, the authors did not overlook the methodological advantages of using physiological data.
Kandasamy et al. (2014)	Cortisol was regarded as an independent variable and changes in its levels were associated with stress response. In this study, the outcome variable was risk-preference behavior. No discussion on how physiological measures might overcome self-reported measures were made and there was no subjective assessment of stress.	To mimic the diurnal cortisol pattern of a chronically stressed individual, subjects were asked to take their hydrocortisone in three divided doses: at 7:00 a.m., 1:00 p.m., and 7:00 p.m. Serum cortisol was collected on days 0 and 7, while saliva samples were collected on days 2, 4, and 6.	Although cortisol was deemed as a reliable measure of stress response, the study was mainly interested in understanding how physiology plays a role in financial decision making. One highlighted feature of this study was the discrimination between acute and chronic stress.

(continued)

Table 2 (continued)

Study	Conceptual Features of the Endocrine Measure	Physiological Assessment	How Measuring Endocrine Activity Contributes to Theory
Crum, Salovey & Achor (2013)	In this study, cortisol was treated as a dependent variable. Furthermore, stress was also measured behaviorally and subjectively.	Cortisol reactivity was calculated as the difference between the two days (i.e., AUC Stress day - AUC Baseline day). In each day, three cortisol samples were administered.	Although no contribution to improving methodological rigor was mentioned, cortisol was considered an alternative (vs. behavioral and subjective) measure of stress.
Beck et al. (2013)	In this study, stress was measured physiologically, behaviorally, and psychologically. Cortisol was considered a reliable physiological stress measure and deemed as a dependent variable. Consistent with prior research, there was little correspondence between individuals' physiological stress responses and their self-reported distress.	Participants provided five saliva samples during the lab session: 30 min after arriving at the lab, 15 min after they were reminded about the upcoming discussion, and 10, 30, and 60 min after the conflict discussion ended.	The study strongly highlighted the importance of taking an integrated perspective by examining different types of responses to distress. In addition, it was emphasized recent interest in measuring physiological responses to distress and the benefits of using a less consciously accessible response than self-reported stress.
Stephens et al. (2012)	Cortisol was treated as a dependent variable and was the primary measure of the degree to which participants experience the academic task as aversive. In this study, cortisol was associated with experiences of social evaluative threat, shame, greater mental effort, and general stress. No subjective measure was obtained.	Participants' cortisol levels were measured using standard salivary cortisol collection procedures. Participants provided saliva samples 20 min after their arrival (baseline, Time 1) and 20, 35, and 50 min after participants received the speech instructions.	Although cortisol served as an indicator of health, there was no discussion on whether using it contributes to methodological advancements.
Häusser et al. (2012)	Cortisol was treated as a dependent variable and as an objective measure of stress. A subjective measure of stress via self-reports was also assessed. In this study, the authors briefly discussed the discrepancy between psychological and physiological stress reactions since no stress-buffering effect was found for self-reported stress.	Salivary cortisol and subjective stress responses were measured five times during the experimental session: 1 min prior to the identity salience manipulation, after preparation for the task, after the task, at 10 min and 20 min after the end of the TSST-G or the Placebo-TSST-G.	Even though cortisol served as an objective indicator of stress and despite the fact that the authors have acknowledged the dissonance between psychological and physiological measurement, the contribution was mainly focused on the study of neuroendocrine stress reactions rather than on the methodological benefits of incorporating such measure.
Trawalter et al. (2012)	Behavioral (i.e., nonverbal anxiety) and physiological (i.e., cortisol) stress responses were measured and both were treated as dependent variables. Cortisol change was considered a direct measure of stress. No subjective measure of stress was obtained. In this study, behavioral and physiological responses corresponded.	Cortisol was measured in saliva at four times: upon arrival (baseline), once the interaction was over, 20 min after the interaction, and after 10 min from the third sample.	The study's contribution was not focused on how measuring stress physiologically adds to methodological improvement, but rather on the research findings concerning whether appearing prejudiced moderates physiological stress responses to interracial contact.

(continued)

Table 2 (continued)

Study	Conceptual Features of the Endocrine Measure	Physiological Assessment	How Measuring Endocrine Activity Contributes to Theory
Sherman et al. (2012)	Cortisol was treated as an objective indicator of stress and regarded as a dependent variable. Accordingly, stress was assessed both objectively (i.e., via cortisol) and subjectively (i.e., via self-report). Cortisol and anxiety reports, in turn, were not related to each other.	Each participant provided a 1.5 mL saliva sample at approximately 3:30 p.m.	The contribution was focused on highlighting the association between leadership positions and lower levels of stress. Throughout the paper, cortisol served as an indicator of stress.
Townsend et al. (2011)	Cortisol was treated as a dependent variable and regarded as an objective measure of stress. The problems associated with the use of self-reported measures to directly index stress were pointed out. Accordingly, the authors advocated that physiological responses might be the best indices of SIT-induced stress. Stress was thus assessed subjectively and no significant difference between participants' self-reported stress by condition was found.	Saliva samples were collected at four times. After the participants had been in the lab for 20 minutes, and then 20, 30, and 40 minutes following the stressor—i.e., the moment at which participants heard the rejecting feedback. Participants also reported how stressful the interview was on a scale from 1 to 7.	It was emphasized that the inclusion of physiological reactivity as a direct measure of stress helped to improve methodological rigor.
Kotsou, Nelis, Grégoire, & Mikolajczak (2011)	Cortisol was considered a dependent variable and treated as an objective marker of changes in psychological stress. According to the authors, the use of this biological marker extends the reliability of the results. Stress was also measured subjectively. The two types of measures corresponded over the course of the study.	Participants provided five different saliva samples: in the 30 min following waking up, between 9:00 a.m. and 9:30 a.m., between 11:00 a.m. and 11:30 a.m., between 3:00 p.m. and 4:00 p.m., and between 10:00 p.m. and 11:00 p.m. Overall diurnal profile of cortisol was only measured before the intervention and 1 month after the intervention.	Cortisol served as a reliable objective measure of stress. Although the primary contribution was related to the benefits of the intervention, lower cortisol secretion provided more evidence for the results obtained. In this sense, measuring stress objectively was perceived as an important contribution of this study.
Page-Gould, Mendes & Major (2010)	Physiological recovery from the stressor was measured as an outcome variable. Cortisol was not meant to be an alternative measure to subjective stress. Rather, the study was interested in predict physiological recovery from a social stress. No subjective measure of stress was obtained.	Physiological changes of salivary cortisol prior to (30 min after arrival), during (immediately after the stressor), and following a stressful social interaction (30 min following the stressor) were measured—three times in total.	The study was mainly interested in human physiology per se.
Taylor et al. (2010)	In this study, cortisol was treated as a dependent variable. Moreover, cortisol was implicitly associated with stress, but no thorough discussion on this topic was offered. No subjective measure of stress was obtained.	Stress was measured not only by salivary cortisol but also by heart rate and blood pressure (every 2 min throughout the laboratory session). Five saliva samples were collected: (1) 10 min after arrival, (2) 30 min later, (3) 25 min after the TSST, (4) after a post-task questionnaire, (5) 45 min after the TSST (recovery period).	Cortisol served as an objective measure of stress but the contribution was focused on the study of biological responses rather than on the methodological advantages of incorporating physiological data.

(continued)

Table 2 (continued)

Study	Conceptual Features of the Endocrine Measure	Physiological Assessment	How Measuring Endocrine Activity Contributes to Theory
Carney, Cuddy, & Yap (2010)	Both testosterone and cortisol were treated as dependent variables. The study also included psychological and behavioral outcome variables. There was no explicit discussion on how physiological measures might overcome psychological ones. In this study, the three types of measures converged.	Saliva samples were taken before and approximately 17 min after the power-pose manipulation.	Although testosterone was treated as a measure of dominance and cortisol as a measure of stress, the contribution was focused on the psychological, behavioral, and physiological changes caused by posing in displays of power.
Levi, Li, & Zhang (2010)	Testosterone was treated as an independent variable and the dependent variable was the bid outcome. Testosterone, in this study, was deemed as a reliable indicator of male dominance.	Testosterone was proxied by age.	No contribution regarding methodological advancements was discussed.
Ford & Collins (2010)	In this study, cortisol was treated as a dependent variable. Behavioral (e.g., derogation of their interaction partner) and psychological (e.g., social self-evaluation) outcomes were also measured, albeit none of them as an indicator of stress. According to the authors, cortisol may be conceptualized as an implicit, biological marker of psychological threat.	Salivary cortisol was assessed at five times: 20 min after arrival, 15–20 min prior to the manipulation, and three post manipulation saliva samples were taken at 20 min intervals.	The study was primarily interested in taking a physiological perspective on the consequences of social rejection. Cortisol was associated with rejection and other forms of social evaluative threat. However, there was no in-depth discussion about whether measuring stress physiologically overcomes reliance on self-reported forms of data collection.
Mehta & Josephs (2010)	Both testosterone and cortisol were treated as independent variables, while the outcome variable was dominance. Psychological (via self-report) and behavioral (via videotaped observation) dominance were therefore measured. These latter two were found to correlate moderately.	A saliva sample for testosterone and cortisol was collected at the beginning of the session in both studies. In study 2, participants provided a second saliva sample 15 min after the end of the competition task.	This paper was mainly interested in understanding how neuroendocrinology is related to dominance. Thus, it was provided new evidence for the neuroendocrine regulation of dominant behavior through the interaction between testosterone and cortisol. Accordingly, the central thesis of this paper was that testosterone and cortisol jointly regulate dominance.
Coates & Herbert (2008)	In this study, both testosterone and cortisol were treated as independent variables, whilst financial returns and financial risk-taking were considered outcome variables. No subjective measures were obtained and no discussion on whether measuring testosterone and cortisol helps to overcome sole reliance on self-reports forms of data gathering was offered.	Saliva samples of both testosterone and cortisol were collected twice a day—at 11:00 a.m. and 4:00 p.m.	The study was mainly interested in human physiology per se.

the comparison between measures is established, we highlight whether they converge or not with the endocrine response. It seems that the discrepancy between perceived emotional stress and cortisol responses to stressors is rather a rule than an exception, which is somewhat surprising given that, even though attained from distinct assessment approaches, one would expect the same pattern of results or at least some degree of association between them (Townsend et al., 2011; Häusser et al., 2012; Frisch et al., 2014).

Explanations for this dissonance are manifold and have been extensively discussed in prior research (see Häusser, Mojzisch, & Schulz-Hardt, 2011; Campbell & Ehlert, 2012). In particular, the lack of correlation between those two measures of stress has been commonly found and attributed to problems related to the susceptibility of psychometric measures to self-reported biases (e.g., social desirability), the prevalence of which provides compelling support for our aforementioned claims regarding the methodological benefits of using hormonal markers in organizational research (Häusser, Mojzisch, & Schulz-Hardt, 2011). Moreover, it has been shown that there is a lack of specificity of the time when self-reported strain is assessed in the empirical studies. Ratings of psychological stress are oftentimes either limited to a single measure following the stressor, which does not capture changes in subjective stress experienced; or are gauged prior and after exposure to a stressful situation, but without precise specification, ranging from participants' arrival to minutes before departure from the experimental setting. As such, the current analysis might be blurred by the lack of feasibility in detecting variations in emotional states in response to stressors whether by measuring it only once or by failing to capture substantial effects in self-reported stress during the actual stressful episode. Pre-assessment of subjective strain, for instance, might not reflect a reliable baseline measure for a neutral state due to possible anticipatory responses to stressful events (Campbell & Ehlert, 2012). In Table 3, we summarize the main problems and limitations with self-reported methodologies as well as the benefits of incorporating endocrine-based approaches into organizational and behavioral studies.

Table 3. The Added Value of Incorporating Endocrine Methodologies into Organizational and Behavioral Research

Problems and Limitations with Traditional Methodologies	Benefits of Endocrine Methodologies
• Subject to biases, such as social desirability and consistency bias	• Require no introspective responses or cognitive effort on the part of participants and occurs outside of conscious control and awareness
• Require introspective responses from participants	• Allow for a more complete and integrated understanding of workplace phenomena
• Difficult to measure within-person variation psychometrically	• Might contribute to validate subjective measures, complementing self-report results with a methodology that is not subject to the same biases
• Lack of convergence between psychometric measures of stress and dominance and endocrine indicators	• Provide an alternative tool to obtain information beyond that provided by self-reports
	• Contribute to advance knowledge about the way that the human body functioning can be related to workplace and social phenomena
	• Data collection is easy, noninvasive, and researchers require little specialized training
	• Cost of endocrine data collection is not an impediment if compared to other biological methodologies

Although sorely lacking from the literature we assembled, in the few cases where behavioral stress was measured (Carney, Cuddy, & Yap, 2010; Trawalter et al., 2012; Crum, Salovey, & Achor, 2013; Beck et al., 2013), it was found a similar pattern with respect to the physiological arousal. Examples of behaviors that have been linked to stress include nonverbal anxiety such as closed body posture, facial rigidity, and averted eye gaze (Trawalter et al., 2012). Notwithstanding, the effects of stress were shown to be closely related to behavioral change with regard to tolerance for risk (Carney, Cuddy, & Yap, 2010), desire for feedback (Crum, Salovey, & Achor, 2013), and observed care-seeking and caregiving behaviors during conflict discussions among dating couples (Beck et al., 2013). In short, in spite of the difficulties in assign what exhibited behavior correspond to stress experienced, behavioral measures emerge as a promising avenue for further investigation that seem to convey interesting information about individuals' responses to stressors.

Nevertheless, there are, of course, some shortcomings associated with the use of research methodologies that incorporate measures of cortisol and testosterone. One drawback is related to

the interpretation of physiological data and the establishment of inference between physiological signal and psychological states (Akinola, 2010). Specifically, organizational scholars should be sensitive to the conclusions drawn from hormonal indicators and interpret their meaning with caution. In particular, an observed endocrine response indicates that certain psychological state is either present, absent, or augmented; however, the physiological manifestation by itself does not assure perfect correspondence with a social psychological construct (Schultheiss & Stanton, 2009; Akinola, 2010). Another challenge presented by the use of salivary cortisol and testosterone in experimental studies refers to the replicability of real-life situations necessary to elicit biological reactions. In terms of cortisol, for instance, it takes approximately 21 to 40 minutes for concentrations to accumulate in sufficient quantities in saliva, implying that researchers should choose a suitable stressor that allows enough time in the lab to obtain participants' baseline and peak response measures (Ganster, Crain, & Brossoit, 2018).

In addition, although the process of measuring individuals' hormonal levels does not rely on human judgment, it is still not entirely immune from the influence of extraneous factors as one would imagine (Spector et al., 2017). Accordingly, salivary measures of cortisol and testosterone do not rule out all sources of errors that can result in a confounding physiological analysis. For example, caffeine and food intake prior to hormonal assessment were shown to have a strong influence on physiological responsiveness in the same way as mood and all sorts of cognitive biases might affect self-reports (Spector et al., 2017). Therefore, researchers should be attentive to these issues and ensure a clean assessment by instructing participants to refrain from activities that might affect hormonal responses.

Overall, we took the stock of the advantages and shortcomings associated with the use of physiological responses as indicators of stress and dominance. To this end, examples of methodological concerns that are pervasive in our field of inquiry have been provided, and in so doing we demonstrate how hormonal measures might address them in the organizational literature. Moreover, there have been noteworthy considerations that were important to emphasize and enlighten for scholars who want to apply this type of methodology in their own research. In the next section, we shed light on the methodological procedures involved in research that incorporate measures of cortisol and testosterone, inasmuch as we provide guidance on how to carry out this type of methodology in organizational and behavioral studies.

Methodological Procedures

The analyses presented thus far have revolved around the way that the empirical literature has addressed the usage of endocrine responses as a mean of achieving theoretical advancements. Notwithstanding, we demonstrated how the incorporation of such measures contributes to enriching researchers' current methodological apparatus. Yet, organizational and behavioral scholars also need guidance on how to administer this approach in their own research. Our aim in this section thus is to provide explicit blueprints for conducting research expecting to capture individuals' change in hormonal markers in response to experimental stimuli. In so doing, we seek to provide a comprehensive review, from start to finish, of the procedures involved in studies that incorporate measures of either cortisol or testosterone. Throughout our discussion, we have sought to explain the various protocols in a language suitable to organizational and behavioral scholars while upholding academic rigor.

Standard salivary-hormone collection procedures and recommendations for the best laboratory practices to carry out were based on the analysis of the selected studies, which, although may not be representative of the literature as a whole, were observed to follow a similar pattern with respect to the methodological procedures utilized and also adhered strictly to established research protocols. In addition, we have selected a handful of reviews that we perceived as influential to substantiate our recommendations (e.g., Dickerson & Kemeny, 2004; Nicolson, 2008; Schultheiss & Stanton, 2009; Becker & Menges, 2013). Our approach, in turn, differs from prior research in that we focus on two particular hormones, specifically, cortisol and testosterone, which allows us to dig deeper into the specific aspects related to these two physiological measures and provide scholars detailed steps to follow when administering either of them.

The measurement of cortisol and testosterone is relatively inexpensive compared to other biological methods—although the necessity to obtain several samples adds to the overall cost—and quite simple, which makes the assessment of such indicators fairly feasible (Becker & Menges, 2013; Ganster, Crain, & Brossoit, 2018). Assessing individuals' hormonal levels via salivary assays has become the method of choice among scholars working with human populations (Schultheiss & Stanton, 2009). Indeed, compared to blood or urine sampling, the collection of saliva samples is easier and less intrusive for participants, not to mention less stressful. The procedure through which data collection is obtained involves participants providing saliva either

by chewing a cotton swab and then placing it in a vial known as *salivette* (e.g., Kotsou et al., 2011; Townsend et al., 2011) or by spitting directly into tubes (e.g., Carney, Cuddy, & Yap, 2010; Trawalter et al., 2012). In particular, participants instructed to spit into tubes are usually offered a sugar-free gum in order to stimulate saliva flow and accumulation (e.g., Schultheiss & Stanton, 2009; Carney, Cuddy, & Yap, 2010; Schipper, 2015).

In the course of an experimental study involving cortisol measurement, researchers may wonder how many samples should be collected, and, more importantly, at what time the assessment should occur. First, a baseline measure should be obtained at the very start of the session, upon participants' arrival (Schultheiss & Stanton, 2009). This first saliva sample reflects participants' basic state and cortisol level before entering the laboratory. Thereafter, given the peak of cortisol response, subsequent saliva sample reflecting the cortisol change due to the manipulation stimulus (i.e., stressor) should be collected at 21 to 40 minutes from stressor onset (Dickerson & Kemeny, 2004). Accordingly, it takes approximately 20 minutes for the release of cortisol to be transferred from blood into saliva (Schultheiss & Stanton, 2009; Ford & Collins, 2010), and cortisol assessments at 21 to 40 minutes after the stress exposure are associated with the largest effect sizes (see Dickerson & Kemeny, 2004, for a review). Moreover, researchers intending to capture the trajectory for recovery are recommended to obtain an additional saliva sample 60 minutes or longer after the stressor completion, which in turn is associated with the time that cortisol takes to return to pre-stressor levels (Dickerson & Kemeny, 2004).

Another issue of concern to an organizational or a behavioral scholar who wants to incorporate endocrine measures into his or her own research refers to the time of the day that experimental sessions should be carried out. Indeed, hormones such as cortisol and testosterone have a circadian rhythm in which they naturally start out at high levels upon awakening and dramatically decrease through the course of the morning and relatively stabilize in the afternoon (Dickerson & Kemeny, 2004; Schultheiss & Stanton, 2009). Thus, experimental sessions conducted later in the day seem to be more appropriate to detect cortisol responses to stressors. In cases where the researcher has to conduct the experiment in the morning, appropriate research designs should be taken into account. For these cases, for instance, including a control group not exposed to stressors or conducting a within-subjects design might be critical to assure reliable inferences about participants' cortisol activity (Dickerson & Kemeny, 2004; Schultheiss & Stanton, 2009).

Besides the issues related to the diurnal pattern of cortisol secretion, interpretation of cortisol results should also consider individual factors that can influence cortisol activity (Nicolson, 2008). These include the drug status of research participants (Schultheiss & Stanton, 2009), especially in cases where medications affect cardiovascular or endocrine function (Taylor et al., 2010). In addition, the hormonal activity can also be significantly affected by daily activities such as food and caffeine intake. Accordingly, research involving cortisol measurement usually instruct participants to refrain from dental work (3 days), smoking (1 hour), caffeine intake (1 to 2 hours), eating (1 hour), consuming alcoholic beverages (12 hours), physical activity (2 hours), and flossing or brushing their teeth (1 hour) prior to the laboratory session (e.g., Nicolson, 2008; Page-Gould, Mendes, & Major, 2010; Yang et al., 2014; Sherman et al., 2016). In the case of female participants, another confounder that might taint the relationship between experimental stimulus and cortisol response refers to the menstrual cycle stage (Nicolson, 2008; Schultheiss & Stanton, 2009). In particular, both the use of oral contraceptives and the menstrual phase presumably influence cortisol reactivity due to the strong hormonal variation as a function of the menstrual cycle phase (Schultheiss & Stanton, 2009). Likewise, close attention has to be placed on other potentially relevant confounding factors related to individual characteristics and health conditions of participants, such as body mass index or obesity, cholesterol level, and the prevalence of acute (e.g., fever) or chronic (e.g. cardiovascular disease, diabetes) disorders, that can be associated with interindividual variability in endocrine activity (Nicolson, 2008; Kudielka et al., 2012). In Figure 1, we list some of the most common methodological issues surrounding salivary hormone measurement and suggestions as to how we may address these concerns.

After the samples have been collected, the experimenter must assure whether all tubes are properly identified and sealed. Thereafter, vials are usually frozen storage until the samples are shipped on dry ice to an offsite commercial assay laboratory specialized in salivary hormone measurement where the samples will be processed and analyzed. Whereas there are some studies in which samples were frozen in a –80°C freezer until they were shipped (e.g., Page-Gould, Mendes, & Major, 2010; Kandasamy et al., 2014), other research frozen at –20°C (Townsend et al., 2011; Trawalter et al., 2012). Schultheiss & Stanton (2009), on the other hand, argue that a regular home freezer is sufficient for proper storage, albeit freezing at either –20°C or –80°C extends salivary cortisol stability for months (Nicolson, 2008).

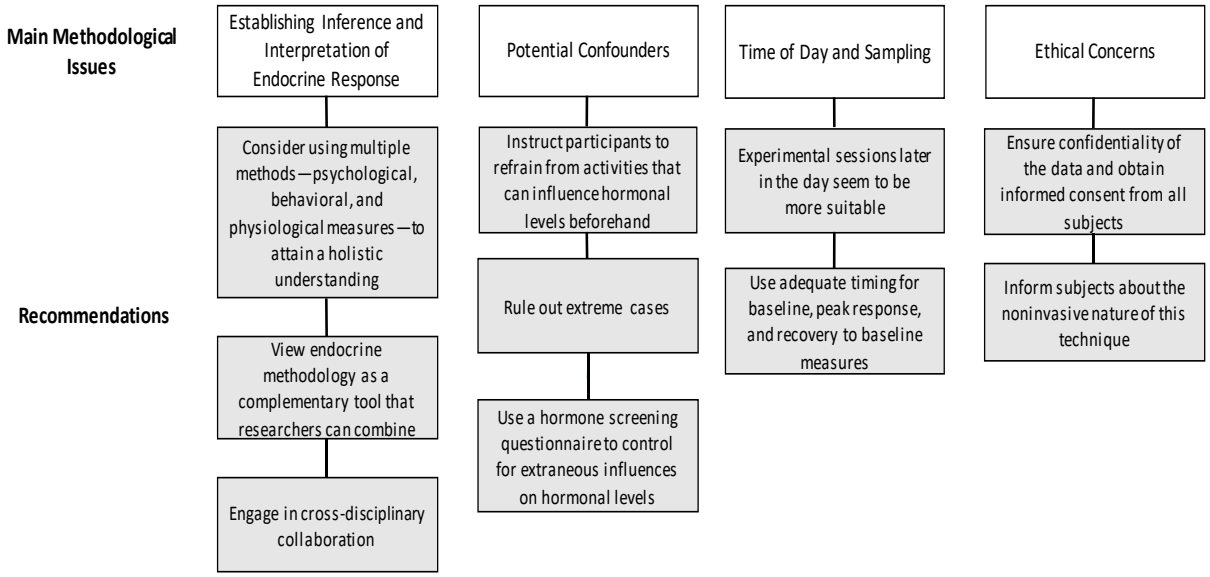

Figure 1. Common Methodological Concerns and Recommendations for Research with Endocrine Markers

The methodological procedures involved in research that measures testosterone, in turn, do not differ from those outlined above. In fact, cortisol and testosterone share similar biochemical properties that make them belong to the same major class of hormones called *steroid hormones* (Schultheiss & Stanton, 2009). Like cortisol, testosterone has a circadian rhythm that should be taken into consideration when running an experiment and it is also susceptible to the influence of daily activities such as smoking and drug use. Therefore, experimental studies examining testosterone activity are commonly conducted in the afternoon to minimize the effects of circadian fluctuation in testosterone levels, and experimenters usually instruct participants to refrain from activities that might affect hormonal responses (e.g., Carney, Cuddy, & Yap, 2010; Sherman et al., 2016).

Of course, unlike research measuring cortisol, experimental studies intending to capture testosterone change should manipulate dominance instead of stress. Manipulation stimuli thus have to induce feelings of power and dominance. Mehta and Josephs (2010), for instance, experimentally manipulated dominance by randomly assigning individuals participating in a competitive task to one of two conditions (defeat vs. victory) in which participants were told they would be competing against each other in an intelligence competition that was, in fact, rigged. Correspondingly, Schipper's (2015) experimental study used a first-price, sealed-bid auction game, in order to observe participants' hormone responses with respect to the outcomes (i.e., monetary rewards) in the auction.

Researchers willing to become more acquainted with these endocrine measures should also take into consideration hormonal differences between groups. In the case of testosterone, for example, women and men differ substantially (see Stanton, 2011). Observed levels of testosterone in women are typically much lower, on average, than the levels measured in men at the same time of day (Schultheiss & Stanton, 2009). Accordingly, normal ranges of salivary testosterone accuracy for men ranges from 59 to 250 pg/ml—which correspond to low and high salivary levels, respectively—whilst for women these values can decrease by one-fourth to one-sixth (Schultheiss & Stanton, 2009). Normal ranges for salivary cortisol, in turn, are typically about 1.5–3.5 ng/ml for both men and women (Schultheiss & Stanton, 2009).

In summary, we explained the methodology of measuring testosterone and cortisol activity and put forward a practical starting point with a straightforward guidance for scholars interested in applying these methods, along with relevant experimental and methodological design considerations. Here it is essential to emphasize that inasmuch as we encourage researchers to incorporate endocrine analysis into their own studies, we must reinforce that research should be accompanied by methodological accuracy to ensure trustworthy inferences. In this respect, compliance with procedural protocols such as the appropriate time of endocrine recording is of paramount importance. In the next section, to help illustrate how to measure endocrine activity in a research setting, we present a brief empirical example that incorporates cortisol measurement.

An Empirical Demonstration of Endocrine Assessment

To help illuminate the method of measuring endocrine responses in organizational and behavioral research, we introduce a simple empirical example on the pretense of supporting scholars become better acquainted with the method and research protocols. To this end, we conducted a laboratory experiment focusing on the assessment of individuals' cortisol response in the context of a negotiation simulation. In doing so, we not only present the methodological procedures previously discussed through a practical empirical demonstration but also experimentally explore how stress may influence negotiation behavior.

Before presenting the illustrative case and its analysis, we first must succinctly set the stage for the pathway by which stress might affect bargaining behavior and delineate the theoretical bases on which we shall proceed. Negotiations are pervasive in organizations, as in social settings, as a

means of resolving disputes (for a review, see Bazerman et al., 2000). Such negotiating interactions exert a strong influence on individuals' ordinary interests such as the process of negotiating salaries, job promotions, and decisions over purchasing a new car. In this sense, some people might appraise negotiations as stressful events, given that there is too much at stake at the bargaining table to be settled with the counterpart. Herein, we expand understanding of whether there are gender differences in negotiation tactics and behaviors and how such differences can be linked to the way men and women view competitive social interactions through different lenses.

Behavioral incongruities across genders have been extensively studied in the realm of negotiations (Walters, Stuhlmacher, & Meyer, 1998; Stuhlmacher & Walters, 1999; Kray & Thompson, 2005; Kugler et al., 2018) as in other fields. Prior research suggests that men and women differ in terms of risk preferences, social preferences, and in attitudes toward competition (Croson & Gneezy, 2009). Likewise, research on negotiation has indicated that women as compared with men exhibit a greater tendency to feel less entitled to negotiate and are more unlikely to initiate negotiations (Babcock et al., 2006). Yet, even though such differences are deemed as one of the most enduring issues in the negotiation literature, there is still a lot of concern about the boundary conditions under which gender effects in negotiation would be alleviated, exacerbated, or even absent (Bowles, Babcock, & Lai, 2007; Small et al., 2007; Mazei et al., 2015).

In light of this viewpoint, a substantial body of work on gender differences in negotiations have made clear that gender effects are not as stationary as one would have thought, indicating that the gender gap in negotiation outcomes and behaviors are to some extent influenced by the situational context (Kray, Galinsky, & Thompson, 2002; Bowles, Babcock, & McGinn, 2005; Stuhlmacher & Linnabery, 2013). A central theme throughout this reasoning is the importance of social role theories in illuminating why gender differences at the bargaining table are expected to occur (e.g., Kray, Thompson, & Galinsky, 2001; Stuhlmacher & Linnabery, 2013; Mazei et al., 2015; Kugler et al., 2018). Indeed, one explanation for the prevalence of such gender discrepancies stems from the fact that gender roles and societal stereotypes are highly influential in shaping negotiators' behavior and expectations, leading individuals to adjust their bargaining behavior according to the gender role he or she is expected to adhere in order to manage social impression and avoid incurring in social backlash (Amanatullah & Morris, 2010; Stuhlmacher & Linnabery, 2013; Mazei et al., 2015).

Despite these widely held stereotypes, the bulk of evidence is consistent with the idea that gender effects in bargaining situations are malleable and thus subject to change (Mazei et al., 2015). Whereas existing research have proposed a plethora of conditions under which gender differences can be mitigated, or even reversed (see, for example, Bowles, Babcock, & McGinn, 2005; Small et al., 2007; Amanatullah & Morris, 2010), in the present study we devote our attention to the underlying process through which gender differences impact negotiation behavior. Of importance, we focus specifically on negotiators' first offers and analyze the underlying role played by the stress individuals experience in guiding behavioral differences at the bargaining table.

Notably, initial demands that negotiators make in bargaining situations are crucial in dictating how agreements unfold. In particular, making the first offer provides, for whichever party who made it, important advantages in negotiation outcomes because the first offer can serve as an anchor that sets the focal point at which subsequent settlements will take place (Galinsky & Mussweiler, 2001; Galinsky et al., 2002). Thus, in view of the importance of the initial offer on subsequent patterns of concessions and negotiated outcomes, in the current study, we shed light on how different in terms of value male and female negotiators make first offers relative to one another. In other words, we specifically examine the extent to which men and women differ in terms of the initial amount of money demanded in bargaining interactions.

As alluded to earlier and in line with role congruity theory (see Eagly & Karau, 2002), implicit beliefs about what it takes to achieve successful negotiation outcomes are typically compatible with stereotypically male characteristics such as competitiveness, assertiveness, and high concern for self-interests (Walters, Stuhlmacher, & Meyer, 1998; Kray & Thompson, 2005). When men fail to comply with standards of behavior that ensure the reinforcement of gender role scripts, increased anxiety-related thoughts are expected to arise due to the imminent fear of having their own gender status questioned by others (Vandello et al., 2008). In order to accomplish the requirements to maintain their status and overcome the threat to their masculinity, we expect that men, when placed in a negotiation situation, will engage in more agentic behavior as compared with women thus making, on average, higher first offers, which are aligned with the male gender role.

Of course, one might make the case that women, instead of men, are more likely to react with discomfort and anxiety in the face of a bargaining situation. According to this view, stereotype threat can elicit negative feelings toward negotiation opportunities among women, who in turn can

appraise them as intimidating (Babcock et al., 2006). Although we do not deny this possibility, we argue that in the case of stereotypically masculine tasks involving competitive elements, the positive male stereotype becomes a burden that increases anxiety and the pressure to prove oneself (Kray & Haselhuhn, 2012). As such, in response to the social environment, we believe that men and women experience competitive bargaining situations differently, with the former being more likely than the latter to feel under pressure and eager to demonstrate negotiation mastery. Consequently, attempts to meet gender role congruence and the struggle to leave the table with the best deal by demanding higher values are expected to be more prevalent among men compared to women. Moreover, we expect that part of this behavior can be explained by the greater levels of stress that men experience.

In what follows, we tested our propositions using an experimental design in which participants were exposed to a dyadic negotiation simulation involving an acquisition of a car. Participants were informed to play the role of either seller or buyer negotiating via computers with a randomly assigned negotiation counterpart. In reality, and unbeknownst to participants, all of them were assigned to the role of a seller and the counterpart was a computer program. By assigning all participants to the role of a seller, our experiment allows for clear assessment of gender differences in negotiators' first offers. In addition, besides presenting an empirical illustration of standard research protocols involving endocrine measurement, we verify whether men and women experience bargaining situations differently and how it reflects on acute physiological stress. We hypothesize that men as compared with women will demand, at first blush, higher values and that cortisol levels will mediate the effect of gender on first offers. Below we describe the method.

Method

Participants

We recruited participants enrolled in undergraduate courses and university staff from a large university in Brazil, and as a token of appreciation for their participation, they were rewarded with a free meal after experiment termination. A total of 50 participants (28 females, 22 male) participated in the experiment. Most respondents were students (30 students, 20 employees), and on average, participants were 23.68 years old (SD_{age} = 6.65). All procedures were approved by the

Committee for Ethical Compliance in Research Involving Human Beings of Fundação Getulio Vargas (CEPH/FGV) and informed consent was obtained from all participants.

Procedure

People who were interested in participating were informed that they would participate in a study concerning the influence of basic human needs, including hungry, on decision-making. Consistent with this cover story, we asked participants to refrain from eating before the experimental session in order to warrant that food intake would not wreak havoc on cortisol results. The experiment was purposely conducted during lunchtime for two main reasons. First, undergraduate class hours was identified as a factor impinging on people's participation. Therefore, in order to encourage students to participate, we scheduled the session at the time that the majority of participants would be available. Second, the session was scheduled for 1 p.m. to control for the circadian variation in cortisol levels (Dickerson & Kemeny, 2004; Schultheiss & Stanton, 2009). After students' morning classes, participants were escorted to the laboratory where the experiment took place. The session lasted approximately one hour.

Upon arriving at the laboratory, we seated participants in front of separate computers and then the experimenter collected the baseline saliva sample of cortisol by having participants insert a cotton roll into their mouths for approximately two minutes and then place it in a plastic tube (i.e., *salivette*). Each vial had been labeled prior to the experiment with the subject number. Once the first saliva sample was collected, participants performed on a "Negotiation Aptitude Test" using a procedure similar to that employed in prior research (Brooks & Schweitzer, 2011). The Negotiation Aptitude Test (NAT) is composed of ten questions and was created to purportedly assess individuals' negotiation ability. In this study, the primary purpose of employing this task was to induce thoughts about negotiation and expose participants to simultaneous stress before undergoing the bargaining simulation.

Afterward, participants were instructed to watch a video clip that discusses the role schools can play in nourishing students' bodies in addition to their minds, and then they were given one questionnaire related to the video to complete. After participants completed this ostensibly unrelated task (approximately 20–25 minutes after the stressful stimulus), the experimenter collected the second saliva sample. Participants completed this unrelated task to allow enough time in the laboratory to obtain subjects' peak cortisol response measures (Dickerson & Kemeny, 2004).

Subsequently, participants proceeded to the final part of the study, which consisted of a negotiation task, via computer. Participants were asked to imagine themselves negotiating for a car, and that they would be randomly assigned to the role of either buyer or seller. They were led to believe that they would be negotiating with other participants. First, participants read background information and prepared themselves for the negotiation task. All participants were assigned to the role of a seller, and their goal was to sell the car according to the interests presented in the scenario. Following the scenario presentation, participants answered a couple of questions in which they had the opportunity to interact with the buyer. Of importance, we consider decisions about the value of initial offers made by sellers as our main dependent measure.

Lastly, participants answered demographic questions and completed a comprehension check to test their understanding of the negotiation. Participants were then debriefed with an explanation of the study's purpose and its deceptive elements and thereafter thanked for participating. After the participants had left the laboratory, the experimenter assured that all tubes were properly identified and sealed. Saliva samples were then immediately shipped on dry ice to an offsite laboratory for analysis of cortisol levels.

Results

Table 5 presents descriptive statistics and correlations associated with key variables. In order to test our propositions, we estimated the models using ordinary least squares and then performed a bootstrapping procedure. All tests used a less conservative alpha level of .10 due to low power and the small size of the sample. We first tested the relationship between gender and first offers. The dependent variable *first offer* was created in which participants were asked to indicate how much money they would demand to sell the car being negotiated. Responses were recorded on a 5-point scale, with higher values indicating higher first offers. In accordance with prior research, gender effects were in the expected direction, although marginally significant at the 10% level. Accordingly, compared to female negotiators, male negotiators made higher initial offers ($\beta = -.39$, $F(1, 48) = 2.63$, $p = .11$, $d = .46$; see Figure 2).

Table 5

Descriptive Statistics and Correlations Among Variables

Variable	Mean	SD	1	2	3	4
Independent Variable						
1. Gender	.55	.50	—			
Dependent Variables						
2. First Offer	3.60	.86	- .22	—		
3. Cortisol	2.48	1.45	- .27*	- .04	—	
Control Variable						
4. Baseline Cortisol	2.92	1.48	- .14	.08	.61**	—

Note. N = 49. Gender was coded as 1 = female (*n* = 27) and 0 = male (*n* = 22). Unit of cortisol levels was ng/ml. We excluded one female participant who had an abnormally high level of cortisol (19.24 ng/ml).

*p < .10 **p < .05

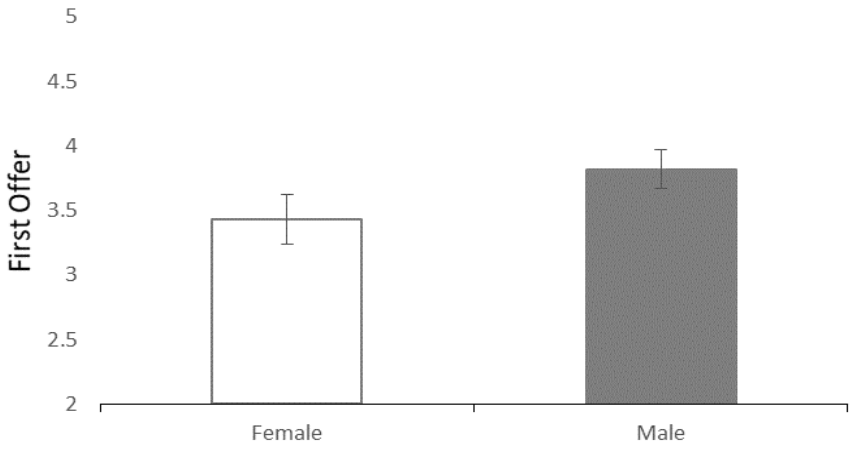

Figure 2. Negotiators' First Offer by Gender. Error bars represent standard errors of the mean.

In the next set of analyses, we tested whether male negotiators experienced higher levels of stress during the negotiation simulation. As expected, we first observed that there was no difference in cortisol across gender groups at baseline, $t(45) = .96$, $p = .34$. In support of our prediction, we found a marginally significant gender effect on cortisol at the 10% level, such that men had higher levels of cortisol as compared with women at task time ($\beta = -.56$, $F(3, 43) = 10.09$, $p = .109$; see Table 6). The results of the cortisol analyses are depicted graphically in Figure 3, which shows the cortisol difference across genders before and after the stressor. As we can see, upon arrival at the laboratory, levels of cortisol were practically the same across groups, while after stressor exposure, a clear difference was observed, indicating that the negotiation simulation was perceived as less stressful by female rather than by male negotiators.

It is noteworthy that, compared to baseline samples collected at the beginning of the experiment, levels of cortisol slightly decreased at task time. However, this may not come as a surprise since cortisol follows a circadian rhythm and naturally decline through the course of the day. Additionally, our procedure was less stressful than those that usually elicit effective cortisol changes (Dickerson & Kemeny, 2004). As a matter of fact, previous research has also observed, and expected, a drop in the levels of cortisol over the course of the experimental study (e.g., Townsend et al., 2011; Stephens et al., 2012; Schipper, 2015). As Figure 3 suggests, the observed difference in cortisol reactions across genders was primarily driven by a steeper decrease in cortisol levels among women rather than a change in men's hormonal levels, which remained stable over the course of the experiment.

Table 6
The Effect of Gender on Cortisol Activity

	Dependent Variable: *Cortisol*		
Predictors	Model 1	Model 2	Model 3
Gender (1=female; 0=male)	-0.7764*	-0.7955*	-0.5597
	(0.067)	(0.065)	(0.109)
Age		0.0130	0.0152
		(0.680)	(0.548)
Baseline cortisol			0.5738***
			(0.000)
Constant	2.9053***	2.6054***	0.7436
	(0.000)	(0.002)	(0.318)
Observations	47	47	47
R-squared	0.0726	0.0762	0.4131

Note. P-values in parentheses. We excluded one participant who had an abnormally high level of cortisol (19.24 ng/ml) and two other participants were excluded due to a failure to properly follow the procedures necessary to ensure a clean saliva sample.

* p<0.10, ** p<0.05, *** p<0.01

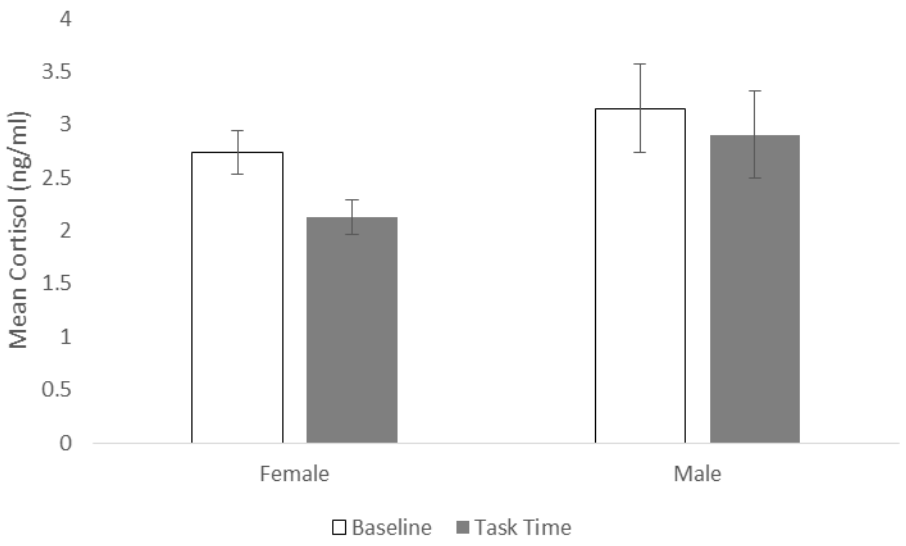

Figure 3. Cortisol levels as a function of gender and time. Error bars represent standard errors of the mean.

For the mediation hypothesis, which predicted that cortisol mediates the effects of gender on first offers, we first regressed initial offers made by negotiators on gender in Step 1, followed by cortisol level at task time and baseline cortisol (as a control variable) in Step 2. Thereafter, we performed a bootstrapping procedure with 1,000 replications to estimate the indirect gender effect on the first offer via cortisol. As portrayed in Table 7, the estimated effect of gender in Step 1 (β = - .39, $F(1 , 48) = 2.63$, p = .111), became nonsignificant at the 10% level (β = - .39, $F(3 , 43) = 1.03$, p = .139) after we added cortisol to the model. In addition, results from a Sobel test suggested that the hypothesized meditation was not supported by our data (z = .88; p = .37). Lastly, the hypothesized indirect effect of gender on first offers via physiological stress was not supported by a bootstrapping analysis as the 95% confidence interval included zero (lower limit = -.016; upper limit = .332).

Table 7

Effects of Gender on First Offers made by Negotiators

	First Offer	
Predictor	Step 1	Step 2
Independent Variable		
Gender (1=female; 0=male)	-0.39	-0.39
	(0.111)	(0.139)
Mediator		
Cortisol		-0.12
		(0.293)
Covariate		
Baseline Cortisol		0.10
		(0.368)
Observations	50	47
R-squared	0.05	0.07

Note. P-values in parentheses. In Step 2, we excluded one participant who had an abnormally high level of cortisol (19.24 ng/ml) and two other participants were excluded due to a failure to properly follow the procedures necassary to ensure a clean saliva sample.

* p<0.10, ** p<0.05, *** p<0.01

Discussion and Limitations

Through this study, we experimentally tested the effects of gender on negotiators' first offers and examined whether cortisol reactivity contributes to this effect. Results of the current experiment confirmed our prediction that men experience a higher degree of stress, as measured by cortisol, under a competitive negotiation interaction. Although our laboratory-induced stress is far from intense when compared to those in which participants are exposed to low levels of controllability and that involves a strong social-evaluative component (Dickerson & Kemeny, 2004), the observed difference in cortisol reactions across genders—albeit only marginal—revealed a clear pattern of association between male negotiators and heightened stress response. As such, besides describing in detail pivotal research protocols involving salivary-hormone collection, we found support for our argument that men and women perceive negotiating opportunities quite differently, as reflected by participants' physiological signals at the bargaining table.

In addition, we have asserted that the prevalence of agentic bargaining behavior among men could at least in part be explained by the stress-related thoughts associated with the competitive

nature of negotiations and by male attempts to warrant their status as men. By measuring negotiators' levels of stress via cortisol, we took an endocrinological approach that enabled us to address the hypothesized underlying process without invoking cognitive and affective efforts from participants. Unfortunately, our analyses failed to present robust evidence for the mediation hypothesis, thus not confirming our expectations. We argue that one plausible explanation for the lack of significant result is that the experiment's sample size was not predetermined based on a power analysis, but rather on the number of prospective undergraduates who would be willing to participate. Accordingly, a factor impinging on the attainment of a larger pool of participants was the relatively limited financial resources to recruit an adequate sample and the inherent difficulties in conducting this type of research in which the number of saliva samples that can be assayed per participant is strongly limited by cost considerations.

Because the low power of the research design might have contributed to these unclear research findings, we believe that ensuring a sample that is adequately sized to have enough power to detect an effect would address this issue, especially in regard to the indirect gender effect on first offers via cortisol. Aside from the limitations associated with the low power of the design, we strove to ensure that all conditions and behaviors that might affect cortisol activity were actually ruled out. We attempted to mitigate confounding influences of some daily activities, such as smoking, caffeine consumption, or food intake, on cortisol results by scheduling the experimental session right after students' morning classes, just before lunch. Moreover, one female participant who, for some unknown reason, had an abnormally high level of cortisol, had to be excluded from all of the cortisol analyses. We speculate that this unusual cortisol level was probably due to pregnancy or some use of prescribed medicaments.

In closing, our experiment was successful in accomplishing our primary purpose, which was to introduce to organizational scholars the basic aspects of the methodology of measuring endocrine responses in a research setting. Although we failed to reach statistical significance in some of our main results, our experimental study contributed to the debate on gender differences in negotiations and shed some light on the physiological responses occurring in the aftermath of exposure to a negotiation opportunity. Caution should be exercised, however, when extrapolating the research findings since our experiment was an artificial representation of a bargaining situation, the limitations of which impose some restrictions in generalizing such findings to every negotiation context.

Conclusions

In the preceding sections, we sought to contribute to strengthening comprehension of physiologically based assessment in organizational and behavioral studies. By focusing on those two hormones that researchers most often mean to represent—cortisol and testosterone—, whether they are interested in understanding stress and/or dominance, the current work has been selective in an attempt to further fill the void in the literature concerning the basic procedural aspects of research involving endocrine measurement and the inferences they can yield. Importantly, in parallel with advocating that the incorporation of such physiological indicators into organizational and behavioral research is a methodology worth pursuing, we have also aimed at being critical by underlining specific weaknesses and challenges associated with the use of research methodologies that embody those endocrine measures.

Altogether, apart from presenting putative benefits of gauging physiological activity, we have articulated how endocrine measures could be administered to advance both research practices and theory. The contribution of this paper, however, goes beyond pinpointing the methodological advantages of using physiological indicators such as cortisol and testosterone as a complementary method that researchers can combine to enhance current knowledge. By empirically demonstrating how to measure cortisol reactions in an actual research setting, we provided detailed steps to follow when administering salivary hormone collection, lest there be any doubt about how to employ them.

In closing, endocrine measurement of individuals' responses to organizational and social phenomena holds great promise. While it aids to expand our understanding about human behavior in ways that cannot be captured by traditional self-reported methods of data collection, the interdisciplinary nature of organizational research that includes this methodology also points to a broad array of research questions and future research avenues that can be explored by researchers and practitioners alike. Despite the potential limitations we described earlier, including the overall costs of collecting several saliva samples and the issues related to sampling, timing, and storage, this work adds to the growing body of literature concerned to further the dialogue between physiology and other fields studying behavior at an organizational and individual level. We hope that a better understanding of how to measure endocrine responses will not only encourage organizational and behavioral scholars to pay more attention to this method but also assist

researchers in acquiring knowledge of this methodology, which offers novel possibilities to enrich theorizing in organizational and behavioral research.

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