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Public speaking in front of an unreceptive audience increases implicit power motivation and its endocrine arousal signature[☆]

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ABSTRACT

The present study explored the motivational characteristics of the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993). Seventy-two participants either completed the public-speaking component of the TSST or, as a control condition, the friendly TSST (Wiemers, Schoofs, & Wolf, 2013) and wrote picture stories both before and after treatment. Stories were coded for motivational imagery related to power, achievement, and affiliation as well as for activity inhibition, a marker of functional brain lateralization during stress. The TSST had a specific arousing effect on power motivation, but not on other motivational needs, on activity inhibition, or on story length. TSST-elicited increases in power imagery, but not in achievement or affiliation imagery, were associated with a relatively greater salivary alpha-amylase response and with a relatively lesser salivary cortisol response. These findings suggest that the TSST specifically induces power-related stress.

Introduction

Since its introduction more than 20 years ago (Kirschbaum et al., 1993), the Trier Social Stress Test (TSST) has become the gold standard in human stress research, with hundreds of published studies using this procedure as well as several meta-analyses and in-depth reviews about its properties and effects (e.g., Allen et al., 2014; Campbell and Ehlert, 2012; Foley and Kirschbaum, 2010). During the original version of the TSST, research participants present, after a brief preparation period, a job talk in front of an unreceptive audience of two examiners and are then required to perform a subtraction task. Once they make a mistake, examiners ask them to start over again.

This procedure, as well as a variant of the TSST that omits the subtraction task (Wiemers et al., 2013), elicits robust and reliable activation of the hypothalamic-pituitary-adrenal (HPA) stress axis, as reflected in a transient steep increase of cortisol and the adenocorticotropic hormone (ACTH) during and immediately after the TSST (Kirschbaum et al., 1993). It also elicits robust activation of the sympathetic nervous system (SNS), as indexed by transient increases in heart rate and the sympathetic catecholamines adrenaline and noradrenaline (Schommer et al., 2003) as well as in salivary alpha amylase, a biomarker of the noradrenergic component of SNS activation (Ditzen et al., 2014; Kuebler et al., 2014; Rohleder and Nater, 2009; Wiemers et al., 2013). From a motivation science perspective, it is clear that the TSST induces a strong, aversive motivational state. However, because different types of stressors impact different motivational systems (e.g., food deprivation for energy balance; social isolation for affiliation; see also Kudielka et al., 2009; Stroud et al., 2002), the question is what *type* of motivational need is challenged by the TSST. In the present research, we address this issue by examining motivational changes induced by the TSST and how they relate to endocrine changes.

In so doing, we used measurement methods developed and extensively validated in the context of research on implicit motives. The implicit motive approach to human motivation is based on the assumption that people are characterized by a handful of universal motivational needs (McClelland, 1987; Schultheiss, 2008). The most frequently studied motives are the need for power (frequently abbreviated as n Power), a concern with having impact on others; the need for achievement (n Achievement), a concern with mastering challenging tasks; and the need for affiliation (n Affiliation), a concern with establishing, maintaining, and restoring friendly relationships with others (McClelland, 1987; Schultheiss, 2008).

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Measures for these needs were originally developed by experimentally arousing a given need and then studying how the content of fantasy stories changes that research participants write about pictures with ambiguous social cues (Winter, 1998). For instance, in the case of n Power, researchers examined the stories of individuals who were running for office versus those who were not (Veroff, 1957), of individuals who knew how to cheat on a card game versus those who did not (Uleman, 1972), or of individuals who listened to inspirational speeches versus of those who listened to travel descriptions (Winter, 1973). Across studies, individuals whose need for power had been aroused in these ways, but not control-condition participants, showed a similar tendency to infuse their stories with imagery related to strong, forceful action, control or regulation of others, persuasion and arguing, or impressing others (Winter, 1991). The resulting coding systems for n Power, and those for other motives derived in a similar manner, were thus sensitive to causal manipulations of motivational states (McClelland, 1958, 1987, chapter 6; see also Borsboom et al., 2004 Because they do not correlate substantially with self-report measures purported to assess the same motivational needs (see Köllner and Schultheiss, 2014, for meta-analytic results), picture-story measures of motives have been termed *implicit* by McClelland et al. (1989).

Although the picture-story measurement approach was subsequently used primarily to assess stable individual differences in individuals' implicit motivational needs, its sensitivity to situational changes in motivation makes it an excellent tool for exploring which specific motivational needs are aroused by a given situational cue such as the TSST (see Schultheiss and Pang, 2007, p. 338 f.). This property of the Picture Story Exercise (PSE; McClelland et al., 1989), as the method has become known, has already been used successfully in psychoendocrinological research on the effects of movies on hormonal changes. Here, the PSE was used as a manipulation check to verify that movies intended to arouse power or affiliative concerns did, in fact, also result in the expected motivational changes (Schultheiss et al., 2004; see also Wirth and Schultheiss, 2006).

So which motivational need should the TSST impact the most? We hypothesize that it is a specific stressor for n Power, because the mock job interview around which most of the TSST revolves requires a person to be persuasive and convincing, to impress others—in short: to have an impact on other people. This is the core incentive for n Power, but not for other motivational needs. If our reasoning is correct, then the TSST should lead to a specific increase in power-related imagery on the PSE, but not in other types of motivational imagery (Hypothesis 1). Some supportive evidence comes from a study by Fodor and Wick (2009), who had research participants give an impromptu speech in front of two judges acting in a negative manner. Participants with a strong dispositional n Power, measured before the task, showed greater activation of the corrugator muscle and also reported higher levels of anxiety than participants low in n Power. This difference did not emerge in a control condition in which the audience was supportive and friendly. Other supporting evidence was reported by McClelland et al. (1985), who observed that highly power-motivated individuals, but not other participants, responded with an increase in salivary noradrenaline to an exam, that is, to a situation in which an individual is subject to others' critical evaluation. Although these studies did not address whether a public-evaluation challenge actually increases power motivation in a transient manner, it is consistent with our reasoning that a situation akin to the TSST should be a relevant stressor specifically for n Power.

If our hypothesis is correct, then TSST-induced changes in n Power should be associated with a specific hormonal signature of power arousal. Arousal of n Power has been linked to the release of noradrenaline (and sometimes also adrenaline) in early psychonedocrinological research by McClelland and colleagues (e.g., McClelland et al., 1985; for reviews, see McClelland, 1987, 1989). More recent research shows that dominance success is related to quick, transient increases in testosterone among men high in n Power, an effect that Schultheiss (2007) explained as follows, based on Sapolsky's (1985, 1986) earlier work on the interaction between stress hormones and gonadal steroid release: to the extent that a challenge activates a concern for power, it will elicit a stronger response from the SNS than from the HPA axis. In men, this results in a net increase of stimulatory action of catecholamines (relative to cortisol's inhibitory action) on the testes' Leydig cells and thus to the rapid testosterone increases observed in research on male power motivation. According to this account, power motivation arousal should lead to greater SNS activation and comparatively weaker HPA activation (although both can be activated to some extent). We thus expected variations in power motivation increases in response to the TSST to be associated with greater SNS activation and lesser HPA activation (*Hypothesis 2*).

We tested these hypotheses in a study in which participants were either exposed to a variant of the TSST that featured the job interview task, but not the mental-arithmetic task (Wiemers et al., 2013), and thus represented a power-related incentive or to a control version of this task that explicitly lacked all power-related stressors, the friendly TSST (f-TSST; Wiemers et al, 2013). To assess changes in motivational states, we administered parallel forms of the PSE in a counterbalanced order before and after the treatment and later analyzed them for changes in motivational imagery related to power, achievement, and affiliation as well as for changes in activity inhibition, a linguistic marker of functional brain asymmetry (Schultheiss et al., 2009) that has been related to n Power and endocrine or physiological stress responses in past research (Fontana et al., 1987; McClelland, 1979; Schultheiss and Rohde, 2002). Analyses for activity inhibition were exploratory. To measure activation of stress axes, we repeatedly sampled saliva before and after treatment and later determined levels of cortisol (HPA axis) and alpha amylase (SNS axis).

Methods

Participants

A total of 95 (48 males) participants between 18 and 32 years initially took part in the experiment. Participants were excluded from participation if they previously participated in the TSST, smoked, had a body mass index (BMI, weight in kg/(height in m)^2) under 19 or over 30, were in medical treatment, or took medication influencing the HPA axis. Additionally, pregnant or menstruating women or those taking hormonal contraception were excluded from participation as well. Participants received a compensatory payment of 25€. The study was approved by the local ethics committee of the Faculty of Medicine of the Ruhr–University Bochum, and the Declaration of Helsinki was followed. Results from this study that were unrelated to the research questions addressed here were published by Wiemers et al. (2014).

Due to technical problems, we had to exclude 19 participants. Three further participants from the control group had to be excluded from analyses because they exhibited outlier cortisol values reflecting a stress response to the control condition. One participant of the stress group had to be excluded since he previously took part in the TSST. This left 72 participants (38 males) in the analyses, 37 in the stress, and 35 in the control group. Mean age was 24.03 years, and mean BMI was 22.63. There were no differences between the stress and control group in age or BMI ($p > .40$).

Procedure

Participants first provided informed consent and afterwards completed the first PSE (T1). Then they provided a baseline saliva sample. Afterwards, they were randomly exposed to either the stress (TSST) or control procedure (f-TSST). Both procedures took 15 min. Back in the experimental room, after the respective procedure, participants provided a further saliva sample (+1 min) and completed the second PSE (T2) before providing the third saliva sample (+15 min). A fourth saliva