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Trait anxiety moderates the impact of performance pressure on salivary cortisol in everyday life

Wolff Schlotz[a,*], Peter Schulz[a], Juliane Hellhammer[a], Arthur A. Stone[b], Dirk H. Hellhammer[a]

[a]*Department of Psychobiology, University of Trier, Johanniterufer 15, 54290 Trier, Germany*
[b]*Department of Psychiatry and Behavioral Science, Stony Brook University, NY, USA*

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Summary Stress and negative affective states are associated with cortisol in everyday life. However, it remains unclear what types of stressors and which affective states yield these associations, and the effect of trait anxiety is unknown. This study investigates the associations of specific task-related stressors and negative affective states in everyday life with salivary cortisol, and explores the mediating and moderating role of state negative affect and trait anxiety, respectively.

Salivary cortisol, subjective stress, and state negative affect were measured three times a day on 2 days in 71 participants in everyday life, using a handheld computer to collect self-reports and time stamps and an electronic device to monitor saliva sampling compliance. Stress measures comprised the experience of performance pressure and failure during daily tasks; measures of negative affect comprised worn-out, tense, unhappy, and angry. Effects were tested using multilevel fixed-occasion models.

Momentary performance under pressure was related to higher momentary cortisol measures, while mean task failure was related to lower daily cortisol concentrations. The association of performance pressure with cortisol varied between subjects, and this variation was explained by trait anxiety, yielding stronger associations in participants scoring high on trait anxiety. No evidence was found for a mediating role of state negative affect.

These results describe the well-documented associations of everyday stressors and affect with salivary cortisol more precisely, suggesting that performance pressure is a significant condition related to short-term changes in cortisol. Subjects scoring high on trait anxiety seem to process stress-relevant information in a way that amplifies the association of performance pressure with reactions of the hypothalamus-pituitary-adrenal axis.

* Corresponding author. Address: MRC Epidemiology Resource Centre, Southampton General Hospital, University of Southampton, Southampton SO16 6YD, UK. Tel.: +44 23 8077 7624; fax: +44 23 8070 4021.
E-mail address: ws@mrc.soton.ac.uk (W. Schlotz).

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Nomenclature

B-S	between-subject	STAI-T	state-trait anxiety inventory, trait version
HPA	hypothalamus–pituitary–adrenal axis	W-S	within-subject

1. Introduction

In humans, stress results from uncontrollable demands, which may trigger changes in physiological, emotional, cognitive, and behavioural states. Two prominent elements of the stress response are the activation of the hypothalamus–pituitary–adrenal (HPA) axis, with an increase in its end product cortisol, and negative emotional reactions, experienced as negative affective states like tension or anger. In the absence of specific physiological challenges, relevant stimulus information is processed in cortical and limbic central nervous system areas before endocrine changes are triggered (Feldman et al., 1995; López et al., 1999; Buijs & Van Eden, 2000; Herman et al., 2003). Thus, psychosocial stressors from everyday life, e.g. momentary work-related or social stressors, are expected to trigger both emotional and endocrine stress responses, and the strength of the response associations may depend on individual differences in the processing of emotional information. However, in studies that reported results of a correlation analysis the covariation of endocrine and psychological stress indicators was found to be small (e.g. al'Absi et al., 1997; Buchanan et al., 1999; Cohen et al., 2000).

The investigation of the relative importance of specific stressors and the role of particular affective states and traits may help us to understand psychoendocrine responses to stressors. Given the links between HPA activity and various bodily and mental disorders (e.g. Chrousos & Gold, 1992), specific psychoendocrine associations may also help to understand the role of subjective stress in health and disease processes. This study investigates the effects of specific task-related demands and negative affective states on salivary cortisol secretion in everyday life. In addition, the impact of trait anxiety on the relationship between task-related demands and salivary cortisol will be studied.

1.1. Everyday stressors and cortisol

A relatively new field of research is the investigation of associations between stressful events and cortisol responses using synchronous measures in a naturalistic design, and making use of suitable methods to measure cortisol and self-reports synchronously, as well as suitable statistical methods to test the effects of interest. Three studies (Van Eck et al., 1996; Smyth et al., 1998; Peeters et al., 2003) used paper–pencil diaries and instructed the participants to report every stress-relevant events that took place since the last measure. These reports were aggregated, yielding an event score, but the influence of specific events or stressors was not tested. All three studies found positive effects of stress-relevant events on synchronous (Van Eck et al., 1996; Peeters et al., 2003) or 20 min lagged (Smyth et al., 1998) salivary cortisol measures. The fourth study (Hanson et al., 2000) used a handheld computer and asked the participants about specific momentary demands (being interrupted and experiencing time pressure, respectively), as well as satisfaction and acknowledgement resulting from their work, but found no effect of these stressors on synchronous salivary cortisol measures. Thus, while stressful events in everyday life seem to have an impact on salivary cortisol, the type of event that is most relevant is unknown. Because a meta-analysis demonstrated the effect of motivated performance situations on cortisol in laboratory situations convincingly (Dickerson & Kemeny, 2004), cortisol responses in everyday life may be expected to be most reliably elicited in motivated performance situations, i.e. tasks where an important goal is threatened.

1.2. State negative affect and cortisol

On average emotion induction procedures in the laboratory produce equivocal results. On the basis of 16 studies included in a meta-analysis, positive as well as negative effects were observed, which balanced to a zero net effect (Dickerson & Kemeny, 2004). In contrast, all four field studies that tested the association of stressor occurrence and state negative affect in everyday life (Van Eck et al., 1996; Smyth et al., 1998; Hanson et al., 2000; Peeters et al., 2003) reported positive associations of state negative affect with salivary cortisol. All of the studies used scales to assess negative affect, thus