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Research paper

Distraction coping predicts better cortisol recovery after acute psychosocial stress

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ABSTRACT

The aim of this study was to explore whether different manifestations of state coping predict cortisol response and recovery in an acute stress situation. Fifty-nine healthy adults (59.3% female) were exposed to the Trier Social Stress Test (TSST), and salivary cortisol was measured repeatedly before and after stress. Hierarchical linear modeling was used to test for relationships between factor-analytically derived measures of state coping and cortisol response and recovery. Independent of sex, age, BMI, chronic stress and depression, denial coping was related with higher peak levels of cortisol ($\beta = 0.0798$, SE = 0.0381, $p = 0.041$) while distraction coping predicted steeper recovery after TSST (linear effect: $\beta = -0.0430$, SE = 0.0184, $p = 0.023$) and less pronounced curvature (quadratic effect: $\beta = 0.0043$, SE = 0.0017, $p = 0.016$). Our results demonstrate the stress-buffering effect of distraction coping on hypothalamic-pituitary-adrenal (HPA) axis activity in situations without sufficient control.

1. Introduction

Psychosocial stressors such as being exposed to social evaluative threat have repeatedly been shown to activate the hypothalamic-pituitary-adrenal (HPA) axis which plays an important role linking stress and inflammation. Importantly, chronic exposure to stressful life circumstances is often accompanied by systemic low-grade inflammation which constitutes an antecedent of stress-related disease (Rohleder, 2014), thus illustrating the importance of being able to cope effectively with everyday stress in order to anticipate adverse health outcomes. In light of these relationships, research has focused on coping styles or traits to explain inter-individual differences in HPA axis regulation in order to provide an explanatory approach for individual vulnerability to pathophysiological consequences of repeated physiological stress reactions.

HPA axis activity during stress as characterized by a quick rise and decline of glucocorticoid levels is thought to be adaptive in terms of maintaining physiological stability when facing environmental demands. As described by the allostatic load model (McEwen, 1998; Sterling & Eyer, 1988) these allostatic processes have a potential cost to the body, when regulated inefficiently or when repeated or chronic stress requires adaptational reactions to be activated too frequently (McEwen, 2000; McEwen & Stellar, 1993).

On the one hand, associations between physiological stress responses and mental and physical health impairments such as major depression (for a review, see Burke, Davis, Otte, & Mohr, 2005) or chronic fatigue syndrome (for a review, see Tomas, Newton, & Watson, 2013) have been elucidated cross-sectionally, while prospective studies revealing a direct path between heightened stress induced HPA axis responses and disease progression in later life, on the other hand, are lacking. However, a prolonged cortisol secretion as a consequence of repeated or chronic stress experience or to an impaired down-regulation of the HPA axis after stress exposure is thought to prevent the body from recovering from stress appropriately which leads to suppression of immune functions (Sapolsky, Romero, & Munck, 2000) as well as increased susceptibility to diseases (Cohen, Janicki-Deverts, & Miller, 2007).

Promising and indirect evidence arises from longitudinal studies that account for an increased disease risk among individuals exhibiting stronger stress-induced increases of inflammatory proteins such as interleukin-6 and fibrinogen (Brydon & Steptoe, 2005) as well as greater affective reactivity to daily stressors (Charles, Piazza, Mogle, Sliwinski, & Almeida, 2013; Piazza, Charles, Sliwinski, Mogle, & Almeida, 2013) which both are linked to HPA axis activity.

Abbreviations: ADS-L, Allgemeine Depressionsskala; BMI, body mass index; CES-D, Centers for Epidemiological Studies Depression Scale; CFA, confirmatory factor analysis; CLIA, chemiluminescence immunoassay; CV, coefficient of variation; HLM, hierarchical linear model; HPA, hypothalamic-pituitary-adrenal axis; KMO, Kaiser-Meyer-Olkin measure; KS, Kolmogorov-Smirnov test; PCA, principal component analysis; PSS, Perceived Stress Scale; rmANOVA, repeated measures analysis of variance; RSQ, Response Style Questionnaire; SVF, Stressverarbeitungsfragebogen; TSST, Trier Social Stress Test

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Cortisol secretion as an index of HPA axis activation, in turn, indicates how stress activates biological stress-systems and acts as a major regulator of inflammation (Sapolsky, Romero, & Munck, 2000), which itself increases the risk of developing stress-related diseases. In this context, it is of special interest how stress-induced cortisol secretion might be modulated by cognitive responses to stress (i.e. coping).

Coping has originally been defined as cognitive and behavioral efforts to deal with stress (Lazarus & Folkman, 1984). Besides this initial process-oriented approach, which perceives coping as dynamic process depending on appraisals and reappraisals of stress situations, authors frequently define the construct as coping styles or personality traits that are stable across time and situations (Krohne, 1993; Miller, Combs, & Kruus, 1993). Coping has been proposed as a determinant for both mental and physical health (Folkman & Moskowitz, 2000, 2004), and increasing interest in investigating the association between coping and health outcomes has emerged. The results from studies assessing the relationship between coping styles and affect in healthy participants, for example, reveal positive associations between problem/accommodation coping and positive affect as well as between avoidance/disengagement coping and negative affect (e.g. Ben-Zur, 1999, 2002). Furthermore, forms of avoidance and emotion-focused coping have been shown to predict lower well-being (Mayordomo, Viguer, Sales, Satorres, & Meléndez, 2016; Mayordomo-Rodríguez, Meléndez-Moral, Viguer-Segui, & Sales-Galán, 2015; Zeidner, Matthews, & Shemesh, 2015) while task- and problem-oriented coping predict higher well-being (Goodarzi, Shokri, & Sharifi, 2015; Mayordomo-Rodríguez et al., 2015).

A limited number of studies also reveal associations between (avoidance) coping and indicators of physical health (for a review, see Penley, Tomaka, & Wiebe, 2002). Kohlmann, Weidner, and Messina (1996), for example, showed that avoidance coping was associated with greater systolic blood pressure reactivity during a laboratory speech session. In addition, the results from Vitaliano, Russo, Paulsen, and Bailey (1995) indicate a relationship between avoidance coping and slower cardiovascular recovery (diastolic blood pressure and heart rate) to emotional and cognitive tasks among older adults. As demonstrated by Birditt, Nevitt, and Almeida (2015), avoidance coping further entails delayed effects with lower well-being and higher cortisol when having an interpersonal tension the previous day. Stowell, Kiecolt-Glaser, and Glaser (2001) found a significant interaction between perceived stress and active/avoidance coping on proliferative immune responses. Taken together, studies show that indicators of both mental and physical health are positively associated with forms of task- and problem-oriented coping while avoidance- and emotion-focused coping styles are proposed as negative correlates of health-related parameters.

Few studies have investigated coping styles in relationship with HPA axis reactivity to natural and laboratory stressors. As described below and summarized by Biondi and Picardi (1999), it has been consistently demonstrated that HPA axis reactivity in response to both types of stressors is modulated by coping style. For instance, Bohnen, Nicolson, Sulon, and Jolles (1991) examined the association between coping styles and cortisol responses of healthy female participants during a 4-h continuous mental stress task. Cortisol response was found to be negatively correlated with the emotion-focused coping style described as “comforting cognitions”. Moreover, Nicolson (1992) explored the association between coping styles and HPA axis activity over the course of three different examination situations. While no association between coping styles and cortisol reactivity was found, the results reveal a stronger cortisol decline among participants with a high affinity to “problem-oriented” coping style as well as a weaker decline among participants scoring high on the dimensions “distraction” and “comforting cognitions”. In a more recent study, Höhne et al. (2014) examined the modulating effect of coping styles on HPA axis activity in response to two consecutive Trier Social Stress Tests (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) which constitutes a standard protocol for the experimental induction of psychosocial stress. In a combined group consisting of both individuals with a remitted major depression and healthy controls, the extent of negative coping (e.g. rumination, self-blame) positively predicted cortisol response both during reactivity and recovery. Other studies, in turn, did not find relationships between coping styles and HPA axis stress responses (Bossert et al., 1988; van Eck et al., 1996). To sum up, active, direct, and problem-focused coping strategies are correlated with reduced psychoendocrine reactivity, while avoidant- and denial-oriented coping strategies are associated with elevated HPA axis reactivity (Biondi & Picardi, 1999).

Since variation in HPA axis activity in acute stress-situations arises from various situation-specific appraisals such as threat and challenge (Gaab, Rohleder, Nater, & Ehlert, 2005), actual coping behavior may vary according to subjective appraisals of own competence and control expectancies and, in turn, deviate from habitual and established coping styles. As illustrated by Erdmann and Janke (2008) coping can be considered as states, as well, whereby the way of coping strongly depends on specific characteristics of stress situations which has been shown to result in instable factor-analytic integrations of coping responses. Despite the importance of coping skills for healthy psychological and physiological functioning, no study to date has investigated the role of situational coping efforts when predicting endocrine stress reactivity and recovery. To better understand the role of coping as determinant of stress responses and to evaluate the efficiency of actual coping responses with regard to physiological functioning, individual coping approaches during acute stress situations have to be taken into account when exploring the etiology of disease. Identifying potential stress-buffering coping responses, in turn, might enable to systematically promote adequate coping behavior.

In summary, studies reveal that variation in HPA axis activity in response to psychosocial stress is modulated by coping style. Since coping styles do not shed light on the efficiency of coping efforts, state coping responses must be taken into consideration when exploring stress-buffering coping responses. Since the factor structure of state coping dimensions is instable and varies across study settings and samples (Erdmann & Janke, 2008), the first aim of the present study was to identify state coping dimensions that indicate representative responses to acute psychosocial stress. As increased stress reactions as well as insufficient recovery from acute stress have been proposed as antecedents of stress-related disease such as cardiovascular disease, and cancer (Cohen et al., 2007), it is of particular interest whether variation in HPA axis activity can be explained by different types of situational coping behavior. A further aim of the present study was therefore to test the hypothesis whether different manifestations of state coping predict differences in cortisol response and recovery (i.e. baseline cortisol level, slope, decrease) in an acute psychosocial stress situation.

2. Methods

2.1. Participants

Participants (N = 61, mean age = 22.92, SD = 4.34, 60.7% female) were recruited from the Friedrich-Alexander-University Erlangen-Nürnberg campus via print and multi-media advertising and received monetary compensation. Before testing, eligibility was assessed by an online screening-questionnaire. Participants were invited to a laboratory session if they met the following inclusion criteria: 1) minimum age of 18 years, 2) non-smoker, 3) Body Mass Index (BMI) between 18 and 30 kg/m^2, 4) no drug intake (e.g. beta blocker, glucocorticoids, anti-depressants), with the exception of hormonal contraceptives in women, 5) absence of physical or mental disorders, 6) no previous experience with the stress protocol, and 6) self-reported depression. To exclude effects of depression on stress responses (Burke et al., 2005), we used the German version of the Centers for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977) termed “Allgemeine Depressionsskala” (ADS-L; Hautzinger, Bailer,