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An experimental examination of the effort-reward imbalance model of occupational stress: Increased financial reward is related to reduced stress physiology

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ABSTRACT

Effort-reward imbalance in the workplace is linked to a variety of negative health and organisational outcomes, but it has rarely been assessed experimentally. We manipulated reward (while keeping effort constant) in a within-subjects design with female participants ($N = 60$) who were randomly assigned to high and standard reward conditions within a simulated office environment. Self-report, behavioural (task performance), and physiological (heart rate variability, salivary alpha amylase) measures assessed the impact of increased financial reward. Participants reported increased perceptions of reward, performed moderately better on the task, and were less physiologically reactive in the high reward versus the standard condition. These findings highlight the importance of assessing both subjective self-reports of stress together with objective physiological measures of stress, and suggest that increasing monetary rewards has the potential to decrease stress physiological reactivity, and in turn, reduce the risk of ill-health in employees, and may also positively influence task efficacy.

1. Introduction

The effort-reward imbalance model (ERI) proposed by Siegrist (1996) is one of the most examined models in occupational health research and practice. The central tenet of the ERI model is that occupational stress occurs when there is an imbalance between high efforts expended in the workplace compared with low rewards received (Siegrist, 1996). It is this imbalance, or the lack of reciprocity between efforts and rewards, that is thought to subsequently place individuals at risk of ill-health (Siegrist, 2001). Although different conceptualisations of the health effects of ERI exist, three hypotheses can be highlighted (van Vegchel, de Jonge, Bosma, & Schaufeli, 2005) (1) that efforts, rewards, and overcommitment (an inability to 'turn off' from work) are all individually related to employee health states; (2), that an imbalance of efforts and reward, or an interaction of these variables increases the risk of ill-health; and (3), that overcommitment moderates the experience of the imbalance on health outcomes (Siegrist, 2008). Whilst the first two hypotheses of the model have received considerable empirical support, this has mainly been through cross-sectional and large-scale prospective epidemiological studies (for reviews, see Tsutsumi & Kawakami, 2004; van Vegchel et al., 2005). The present investigation sought to assess the ERI hypotheses using an experimental design which is scarcely used in studies of the ERI model and focussed on the lesser studied physiological indices of heart rate variability (HRV) and salivary alpha amylase (sAA).

Studies have found overwhelming support for the interaction hypothesis of high efforts and low rewards leading to impaired health and well-being in employees (van Vegchel et al., 2005). In their review, van Vegchel et al. (2005) found that studies examining the ERI model used one of three measures including physical health outcomes (predominantly cardiovascular disease), behavioural outcomes (e.g., sickness absence, smoking), and psychological well-being (e.g., depression, job related well-being, burnout). Only one study reported using a physiological outcome measure (salivary cortisol secretion) as their health outcome; this is despite physiological indices being able to potentially provide continuous and covert measures of job stress (Chandola, Heraclides, & Kumari, 2010). More recently, an increasing number of studies have begun assessing ERI using physiological outcomes. Salivary

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immunoglobulin A (sIgA) and cortisol secretion, both pre-clinical biological indices of ill-health, were found to be related to ERI in disability workers (Wright, 2011). Similarly, a higher ERI was found to predict higher sIgA scores in a group of dairy farmers (Bathman, Almond, Hazi, & Wright, 2013). Although HRV has been used in investigations assessing ERI (e.g., Hanson, Godaert, Maas, & Meijman, 2001; Loerbroks et al., 2010; Uusitalo et al., 2011), this has been infrequent. Similarly, while sAA has been used in a number of studies examining the acute stress response (e.g., Iizuka, Awano, & Ansai, 2012; Nater et al., 2005; Skosnik, Chatterton, Swisher, & Park, 2010), it has not been used in studies directly investigating ERI.

Elevated levels of sAA concentrations are indicative of autonomic activity, involving activation of both the parasympathetic and sympathetic nerves in response to acute stressors (Nater et al., 2005), as well as being an indirect biomarker of sympathetic-adrenal-medullary responses (Filaire, Portier, Massart, Ramat, & Teixeira, 2010; Nater, La Marca, et al., 2006). Salivary alpha amylase has consistently been found to be a reliable indicator of human stress reaction, and in acute stress testing, it has a shorter time-lag between stress exposure and salivary secretion than cortisol, and quickly returns to basal states post-exposure (Takai et al., 2004).

Heart rate variability is a sensitive, yet non-invasive marker of the autonomic nervous system (ANS), with the heart receiving impulses from the sympathetic and parasympathetic nerves (Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012). Generally, the two divisions are complementary, with increases in sympathetic activity associated with increases in heart rate, whereas increased parasympathetic nervous activity decreases heart rate (Aubert, Seps, & Beckers, 2003). Increased HRV is a result of increased parasympathetic activity – in times of perceived stress the sympathetic nerves produce a ‘stress response’ by increasing adrenaline and reducing vagal tone, whereas the parasympathetic nerves attempt to ‘regulate’ arousal (Sharpley, 2002). Low HRV has been observed in response to workplace stress (for a review, see Chandola et al., 2010), as well as being a pre-clinical marker for disease (Thayer, Yamamoto, & Brosschot, 2010).

As the ERI model is an environmental model describing the occurrence of stress within a work context, it should not be surprising that the vast majority of research has been conducted using cross-sectional and longitudinal studies. Despite their strengths, epidemiological studies provide limited insight into the systems underlying the observed statistical association (Siegrist, 2010). Further, although longitudinal studies address some of the shortcomings of cross-sectional studies and generally have sound ecological validity, there are still some methodological problems, making it difficult to draw concrete conclusions regarding causality. These include selective attrition, inappropriate time-lags, and the issue of third variables (Hausser, Mojzisch, & Schulz-Hardt, 2011; Zaph, Dormann, & Frese, 1996). Although there are some limitations with experimental designs (e.g., observing short-term stress responses only), the advantages include being able to manipulate the stimuli in the environment, and monitor or account for confounding factors (Chida & Hamer, 2008). A deeper understanding of the cause-effect relationships of the ERI model may be best obtained through the convergence of experimental research coupled with epidemiological evidence (Hausser et al., 2011).

There is some evidence that occupational stress models are amenable to being experimentally tested. However, apart from a handful of studies investigating heart rate and blood pressure (e.g., Flynn & James, 2009; Rau, 1996), most designs have generally ignored physiological variables, and have incorporated between-group manipulations (Boksem, Meijman, & Lorist, 2006; Hausser et al., 2011). To our knowledge, the ERI model has not been assessed in an experimental setting using a within-groups design, which controls for individual differences in diurnal rhythms and physiology. A recent and comprehensive experimental design using a between-groups design incorporating physiological indices of stress in assessing the job demand-control model (Karasek, 1979) found a stronger association of task manipulation with objective physiological evidence versus subjective measures (Hausser et al., 2011). Some studies have assessed the effect of increased reward (though not specific to the ERI model) upon physiological reactivity by offering a financial reward (Boksem et al., 2006), whereas a more recent study manipulated rewards in an unusual way by offering reduced time-on-task for positive performance (Hopstaken, Linden, Bakker, & Kompier, 2015). Both studies reported an improvement in mental fatigue and performance on a working memory task respectively for those assigned to the reward condition. While all three investigations are useful, they employed between-groups designs. A more recent study using a within-groups design to experimentally assess the JDC model in relation to physiology (i.e., sAA, HRV) and self-report measures unexpectedly found that increased break autonomy was related with dysregulated physiological reactivity (O'Donnell, Landolt, Hazi, Dragano, & Wright, 2015).

The present study employed a within-groups experimental design to investigate the ERI model. Consistent with Siegrist's (1996) hypotheses, it was anticipated that; (i) increased financial reward would lead to decreased physiological responses (i.e., increased HRV and decreased sAA) and (ii), that efforts and rewards in combination (ERI ratio) would be more related to physiology than either efforts or rewards considered separately. To assess the third hypothesis of the ERI model, we used neuroticism, as a proxy measure of overcommitment, to determine if this intrinsic variable moderated the acute stress response. Finally, in line with Hausser et al. (2011) findings, we also assessed if objective measures (e.g., physiological assessments, task performance) would be more sensitive to reward manipulation than subjective measures (e.g., neuroticism, perceptions of task efforts and rewards). Our outcome variables included sAA and HRV, and in addition to these physiological indices, we assessed and controlled for self-reported neuroticism and chronic stress. In the interests of brevity, these variables and their relationships with physiology and the ERI model are detailed in Section 2.

2. Method

2.1. Participants

To be included in the study, participants needed to be female, aged 18–60, and proficient in English. Healthy females were recruited via responses to flyers posted on university noticeboards as there may be sex differences in relation to sAA reactivity (Nater, Abbruzzese, Krebs, & Ehlert, 2006). Those that reported taking medication (other than the contraceptive pill), presently experiencing ill-health, considered to be physically frail, or had a chronic health, thyroidal, heart or mental health problem were excluded from the study as these factors can all potentially confound the physiological measures used (Nater et al., 2005). Sixty females aged between 18 and 56 ($M = 25.82$, $SD = 9.99$) participated in the study. Participants were asked to refrain from alcoholic beverages, meals, soft drinks, smoking, and engaging in physical exercise in the 1 h prior to the experiment, as these activities may impact on sAA activity (Klein, Bennett, Whetzel, Granger, & Ritter, 2010; Mackie & Pangborn, 1990; Nater, Rohleder, Schlotz, Ehlert, & Kirschbaum, 2007; Weiner, Levy, Khankin, & Reznick, 2008). Participants were advised that they would be compensated $A20 for their time if they successfully completed 80% of the assigned tasks. Written informed consent was obtained prior to the study. Institutional ethics approval was granted for this study (FSTE13/R16).

2.2. Procedure

Upon arriving for their testing, participants were given access to a private room with instructions on how to fit the heart rate variability equipment. Experimenters then checked it was fitted correctly and operational. Although the design included a within-subject comparison of tasks, testing was conducted between 12 pm and 6 pm to control for the diurnal pattern of sAA (Nater et al., 2007). Testing took place in one of three identically matched rooms which were arranged to simulate a typical office environment with a desk, laptop computer, and filing cabinet in every room. Twenty participants were tested in each room. Instructions for the tasks were provided at