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How stressful are economic competitions in the lab? An investigation with physiological measures

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ABSTRACT

Competition is ubiquitous in economic life. Yet, negative consequences of competitive environments have been reported and everyday experience suggests that competitive situations can be very stressful. It is, however, an open question whether or not economic competitions in the laboratory indeed elicit physiological stress reactions. Our study examined subjectively perceived stress and physiological changes induced by a well-established economic laboratory competition paradigm (first used in Niederle & Vesterlund, 2007) in a mixed-gender sample of 111 healthy participants. A mental arithmetic task was performed first under a piece rate (i.e., non-competitive) payment scheme and afterwards under a tournament condition. In a third round, participants decided how to be paid (i.e., piece rate or tournament). Our results indicate that compared to a control group, which performed only the non-competitive condition, the competitive game condition elicited subjective and physiological reactions that are indicative of mild stress, i.e., an increase in heart rate and a decrease of calmness and mood. Furthermore, reactions that are thought to reflect an active coping style were related to the self-selection into competition in the third round of the game. We speculate that real-life economic competitions might be even stronger stressors and the way how people cope with this kind of stress might be related to competitiveness in real-life economic contexts.

1. Introduction

Competition is ubiquitous in economic life, be it companies that compete in markets or employees who compete for jobs, careers, or salaries. The most direct form of economic competition at the individual level is evoked by so-called "winner-takes-it-all" payment schemes, a form of tournaments introduced by employers to increase productivity among employees. Principal-agent theory (reviewed in Lazear & Rosen, 1981; Nalebuff & Stiglitz, 1983) generally states that all agents should increase their effort to win the tournament if the difference between winner- and loser-price is set optimally, thereby increasing overall productivity of the company. While there is some experimental evidence for this general prediction

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(e.g., Cabrales, Charness, & Villeval, 2011; Eriksson, Teyssier, & Villeval, 2009), several negative consequences like deteriorated well-being (Brandts, Riedl, & van Winden, 2009) and also decreases in performance (e.g., Baumeister, 1984) have been observed.

Competitive situations are well known as social stressors in the psychological literature. Indeed, competitive situations often contain the core features that characterize psychosocial stressors: uncontrollability and social-evaluative threat (Dickerson & Kemeny, 2004). Uncontrollability results from the uncertainty of the outcome as it depends critically on the performance of others. Social-evaluative threat is inherent in competitions as participants are compared along a common dimension that is often relevant for self-esteem. Indeed, increases in the stress hormone cortisol as well as in markers of sympathetic nervous system activity like blood pressure, heart rate, and alpha-amylase have been observed in reaction to sports competitions (e.g., Cooke, Kavussanu, McIntyre, Boardley, & Ring, 2011; Kivlighan & Granger, 2006; Rohleder, Beulen, Chen, Wolf, & Kirschbaum, 2007), during video game playing (Harrison et al., 2001; Kivikangas, Kätsyri, Järvelä, & Ravaja, 2014; Veldhuijzen van Zanten et al., 2002), and in response to motoric and cognitive tasks which were carried out in a competitive manner (Hatfield et al., 2013; Turner, Jones, Sheffield, & Cross, 2012; Wittchen, Krimmel, Kohler, & Hertel, 2013).

Yet, it might matter how the subject evaluates the competition, i.e., whether it is perceived as threat or as challenge. Blascovich, Seery, Mugridge, Norris, and Weisbuch (2004), for example, found that in athletes different cardiovascular patterns were indicative of the perception of a baseball/softball game as challenging or threatening, and that these patterns were furthermore predictive of future performance. Salvador and Costa (2009) developed a model to predict the outcome of a competition, i.e., winning or losing, by the coping strategy the subject applies. Thereby the authors take into account the relevancy of cognitive variables, i.e., the perception of the situation and the perceived control, which have been emphasized throughout the stress literature (e.g., Biondi & Picardi, 1999; Dickerson & Kemeny, 2004; Kudielka & Kirschbaum, 2007; Lazarus & Folkman, 1987). So, if competition is perceived as a challenge, most likely an active coping strategy is used. This is, according to Salvador and Costa's (2009) model, accompanied by an increase in positive mood as well as increased activity of the sympathetic nervous system and an increase in testosterone levels. On the other hand, if competition is perceived as threat, a passive coping strategy that is characterized by decreased mood, diminished sympathetic activity, and an increase in cortisol is applied. According to the model, an active coping style more likely leads to victory whereas a passive coping style often results in defeat. While animal studies on the rewarding properties of testosterone as well as studies on the differential physiological patterns of coping styles provided the basis for the model's main assumptions (Salvador & Costa, 2009), there is also first direct human empirical evidence supporting this "coping style" model (Costa & Salvador, 2012; Salvador, Suay, Gonzalez-Bono, & Serrano, 2003).

1.1. Aims of the present study

Whereas competition-induced stress reactions are extensively studied in the domain of sports, less is known about the potential of laboratory economic competitions to induce psychophysiological stress responses. Thus, the main aim of our study was to investigate if a well-established laboratory economic tournament game (Niederle & Vesterlund, 2007) which has been shown to be predictive of career choices (Buser, Niederle, & Oosterbeek, 2014) may function as stressor, i.e., elicit a psychophysiological stress response. To this end, we measured changes in mood, heart rate, as well as hormone levels (cortisol and testosterone) in relation to the game. These measures were taken because acute stress mainly activates two systems: the hypothalamus-pituitaryadrenal (HPA) axis as well as the sympathico-adrenal medullary (SAM) system (e.g., Kudielka & Kirschbaum, 2007). Activation of the HPA axis leads to increased levels of circulating cortisol which can be measured in saliva. Activation of the SAM system affects, among others, cardiovascular activity, leading to increased blood pressure and heart rate. Furthermore, testosterone changes have been reported in relation to competitions (for a recent review, see Oliveira & Oliveira, 2014) and some studies also found increased testosterone levels after psychosocial stress induction (Bedgood, Boggiano, & Turan, 2014; Lennartsson, Kushnir, Bergquist, Billig, & Jonsdottir, 2012). To keep unrelated external influences on the hormonal and physiological measures minimal, a laboratory paradigm was chosen.

The tournament game consists of three rounds that differ by the respective payment schemes. Whereas the first round is non-competitive (piece rate payment), the second round is a tournament ("winner-takes-it-all" payment). In the third round, participants are free to choose their preferred payment option. By comparing those who chose piece rate with those who chose the tournament payment scheme, we also explore if the self-selection into the competitive condition is related to the physiological changes during the game.

There are some recent studies which indeed suggest that laboratory economic competitions are able to induce stress reactions. Adam, Krämer, and Müller (2015) reported that the social competitive component of a laboratory auction experiment induced increases in heart rate; however, endocrine measures had not been examined in this study. Most importantly, there are also very recent studies that investigated different physiological stress reactions in response to the same economic tournament game which was used in our study (Buser, Mollerstrom, & Dreber, 2017; Halko & Sääksvuori, 2015; Zhong, Shalev, Koh, Ebstein, & Chew, in press). While cortisol responses to the competitive treatment were observed by Zhong et al. (in press) and Buser et al. (2017), evidence for reactivity of the sympathetic nervous system (as indicated, e.g., by galvanic skin conductance, Buser et al. (2017), heart rate variability, Halko and Sääksvuori (2015), or salivary alpha-amylase, Zhong et al. (in press)) is less clear. Changes in testosterone in response to this paradigm have not yet been investigated. Thus, by pro-