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Sex differences in autonomic response and situational appraisal of a competitive situation in young adults

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ABSTRACT

Competition is a social stressor capable of eliciting physiological responses modulated by the outcome. The main objective of this study was to analyze the psychophysiological changes associated with competition and its outcome in men and women, taking into account the role of situational appraisal. To this end, 112 young people (46 men and 66 women) participated in a laboratory task in a competitive or non-competitive condition, while Blood Pressure (BP), Heart Rate Variability (HRV), and Skin Conductance (SC) responses were measured. Our results indicate that competition elicits higher systolic blood pressure (SBP) than a non-competitive task; in addition, winners presented a greater R-R decrease from baseline to task, greater R-R Recovery, and lower frustration and external attribution than losers. Regarding sex, men perceived their opponent's capacity to be lower and their own capacity to be greater than women did, and they also showed higher R-R decreases and lower SC increases. In conclusion, we found a complex pattern of different psychophysiological responses to competition associated with outcome and sex in a laboratory competition. This result could be related to the use of more passive or active coping strategies.

1. Introduction

Competition is a frequent situation in humans and plays an important social role, not only to obtain primary reinforcements such as food, but also to achieve other secondary resources (Salvador & Costa, 2009). Thus, competition has an important impact on daily life because the outcome, winning or losing, affects the achievement of people's significant goals (Salvador, 2005). From an evolutionary perspective, competitive behavior is important for the organization of social species, allowing them to maintain their status or rise to a higher one (Koolhaas, de Boer, Buwalda, & van Reenen, 2007). Therefore, competition is a social stressor that can provoke a wide range of complex physiological and psychological responses (Salvador & Costa, 2009) with individual and sex differences (for a review in humans, see Salvador & Costa, 2009; in animals, Sgoifo, Carnevali, & Grippo, 2014).

In the 1980s and 1990s, research on agonistic behavior was mainly carried out under the biosocial status hypothesis (Mazur, 1985) and the challenge hypothesis (Wingfield, Hegner, Dufty, & Ball, 1990). According to these hypotheses, competitive situations where males or females have to fight for resources (e.g., family, territory, or status) elicit an increase in the androgen levels in several species. However, sex differences in the competitive stress response have been related to different evolutionary functions (Troisi, 2001). In these regard, research in humans concludes that the desire to affiliate with others is more pronounced in women than in men, and this is one of the most robust sexually dimorphic behaviors (Taylor et al., 2000). Even so, according to Geary and Flinn (2002), women compete for social and material resources by showing another type of aggression (e.g., relational). Therefore, even though both men and women compete (Costa, Salvador & Serrano, 2016), the nature of their competition may differ in response to environmental variations (van Anders & Watson, 2006). Nevertheless, some contests are common to both sexes, especially in Western societies, where men and women share academic or intellectual tasks, or even sporting events. Therefore, competition on these tasks could be fairly similar for both (Cashdan, 1998).

The hypotheses mentioned above focus on the role of testosterone (T) in competition or dominance. However, other attempts have also been made to explain competition as a social stress response, including psychological and autonomic responses, as Salvador and Costa propose

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in their coping competition model (CCM) (Costa & Salvador, 2009; Salvador, 2005 Salvador, 2005). According to this model, the appraisal of competition as a challenge would be related to an active coping response pattern characterized by increases in T, sympathetic nervous system (SNS) activation, and positive mood states, increasing the probability of victory. Conversely, an appraisal of the situation as a threat could lead to the opposite pattern, increasing the probability of defeat (Salvador & Costa, 2009). Costa and Salvador (2012) corroborated these psychobiological response patterns in young women, although they also pointed out the need to more closely examine the role of the SNS in the active coping response of men and women. Along the same lines, Blascovich (2008) defended the biopsychosocial model of challenge and threat. According to this model, in goal-relevant situations such as competition, when an individual considers a goal, even a desired goal, to be too difficult or not likely to be attained, the situation will be appraised as a threat, inducing a coping pattern accompanied by less effort and less or insufficient autonomic activation. By contrast, when reaching a goal has a certain difficulty, even though it is perceived as attainable, the situation will be assessed as a challenge and accompanied by a coping pattern related to greater effort and a different cardiovascular (CV) pattern (Blascovich, Vanman, Mendes, & Dickerson, 2011; Levine, 2000; Weiss, 1972).

The autonomic nervous system (ANS) plays an important role in the stress response because the activation or withdrawal of the SNS and parasympathetic nervous system (PNS) regulates individuals' physiology, affect, and cognition (Thayer, Åhs, Fredrikson, Sollers, & Wager, 2012; Thayer & Lane, 2009). Thus, when people face competitive stress, the activation of the ANS may be different depending on their appraisal of the situation, the coping response pattern, and some personality traits, such as competitiveness, that have been related to competitive behavior in laboratory settings (Veldhuijzen van Zanten et al., 2002).

Although little information is available about the role of the SNS in competition and its outcome, studies have shown that competitive tasks elicit greater SNS reactivity than non-competitive ones (García-León, Reyes del Paso, Robles, & Vila, 2003). Findings show higher heart rate (HR), blood pressure (BP) (Beh, 1998), and heart rate variability (HRV) responses (Veldhuijzen van Zanten et al., 2002), as well as higher levels of CV activity, in pre-competitive and competitive periods compared to baseline in women in competitive situations (Costa & Salvador, 2012; D'Ascenzi et al., 2013). Overall, these data support the active coping response described by Obrist (1981), who predicted that stress would elicit the stimulation of beta-adrenergic receptors, with a sympathetic impact on the heart proportional to the level of the task demands. Moreover, reductions in power in the high frequency (HF) range of HRV reflect lower parasympathetic cardiac control in situations where stress increases (Berntson et al., 1997; Morales et al., 2013; Reyes del Paso, Langewitz, Mulder, van Roon, & Duschek, 2013). In addition, greater HR and BP responses associated with the outcome of a negotiation have been found (Ricarte, Salvador, Costa, Torres, & Subirats, 2001). However, in other studies no effects of outcome on HR response were found in men facing a laboratory competition, although differences in the perceived capacity of the opponent were detected (van der Meij, Buunk, Almela, & Salvador, 2010). On this point, it is important to take into account that men and women differ in their basal ANS activity and their response to stressors; some studies suggest that women could react to laboratory stressors with higher HR responses, whereas men would show greater BP (Carrillo et al., 2001; Fichera & Andreassi, 2000; Kivlighan, Granger, & Booth, 2005), although these differences can be mediated by the value of the incentive and the difficulty of the task (Barreto, Wong, Estes, & Wright, 2012). In addition, in their meta-analysis, Chida and Steptoe (2010) concluded that CV responses to laboratory stress were related to the probability of developing CV disease. In this context, it is important to consider the recovery pace as the time required to return to physiological baseline levels after stress. Thus, a slow CV recovery after mental stress could predict a poor future CV status or the progression of CV disease risk (Chida & Steptoe, 2010; Stewart, Janicki, & Kamarck, 2006).

Stress elicits SNS activation, increases arousal, elevates HR, and proves energy to deal with the stressor (fight-or-flight) (Reeder & Kramer, 2005). In addition, SNS activity leads to excitation of the eccrine sweat glands and, thus, increased conductivity on the surface of the skin (Fowles, 1986). In other words, stress elicits SNS activation and increases skin conductance (SC) (Carrillo et al., 2001; Köhler, Scherbaum, & Ritz, 1995). To the best of our knowledge, few studies have examined the SC response to competition and its outcome, but they have generally indicated that competition situations elicit a larger SC response than non-competitive situations (Adolph, Schlösser, Hawinghorst, & Pause, 2010). Higher levels of SC during anticipation (pre-task) and stress (task) periods, compared to baseline, with a reduction after the stressor, have been reported (Guirado et al., 1995; Romero-Martínez, Lila, Williams, González-Bono, & Moya-Albiol, 2013). Furthermore, situational appraisal can modulate the SC response, and so a decrease in SC will occur in conditions where individuals consider that their resources to cope with the situation are especially low (Pecchinenda, 1996). Other studies have indicated that in threat conditions, men exhibited higher basal SC levels, whereas women displayed greater reactivity (Kopacz & Smith, 1971).

Taking into account that studies have often focused on the physiological response to competition in men and divergences in the results (especially concerning sex), we aimed to provide an integrative vision by including physiological and cognitive variables in both men and women. Therefore, our main objective was to analyze the autonomic response to competition and its relationship with the cognitive appraisal, outcome, and sex. To do so, we first compared the psychophysiological responses of young men and women in three different conditions: 2 groups that participated in a face-to-face laboratory competition with a real outcome (Winners and Losers) and one group that performed the same face-to-face task, but in a non-competitive condition (CG, control group). Second, we analyzed the relationship between the psychological and autonomic responses. Different indexes of sympathetic and parasympathetic activity were used, including cardiovascular (BP, R-R and HF) and electrodermal (SC) measures, along with self-reports. We expected a greater increase in sympathetic activity from baseline to the task in the competitive groups (Winners and Losers) compared to the CG. More specifically, we hypothesized that winners would show greater decreases in R-R and HF and greater increases in SBP and SC than losers and CG in response to the task. Moreover, we hypothesized that winners would show higher perceived self-capacity, lower perceived opponent's capacity (van der Meij et al., 2010), better performance, and lower frustration than losers (Costa & Salvador, 2012). Furthermore, we expected to confirm the relationship between appraisal and the autonomous response to competition as the background to the CCM. Thus, individuals with high perceived self-capacity and low perceived opponent's capacity would show higher parasympathetic withdrawal in a competitive situation, which would be related to an active coping pattern, as described in Salvador and Costa (2009).

2. Methods

2.1. Participants

Participants in this study were 120 university students (50 males and 70 females) from different faculties at the University of Valencia, Spain. All the volunteer students completed a screening questionnaire; participants were selected by excluding smokers (more than five cigarettes per day), regular drug consumers, people who did more than 10 h of physical activity per week, those who suffered from cardiovascular, neurological, or psychiatric disease, and those taking medications that could affect the responses studied. In order to control any potential influence of oral contraceptive use on the psychophysiological response, only regular free-cycling women were selected (cycles of