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Biological Psychology 65 (2004) 121–135
BIOLOGICAL PSYCHOLOGY
www.elsevier.com/locate/biopsycho

Vital exhaustion, temperament, and cardiac reactivity in task-induced stress

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Received 30 September 2002; accepted 13 June 2003

Abstract

The associations between vital exhaustion (long-term stress), temperament, and cardiac reactivity were studied during an experimentally induced stress in a sample of 76 healthy subjects. Vital exhaustion was assessed with the Maastricht Questionnaire(MQ), and temperament with Cloninger's Temperament and Character Inventory (TCI). Cardiac reactivity was measured in terms of heart rate, respiratory sinus arrhythmia, and pre-ejection period. They were continuously measured during three stressors, i.e. mental arithmetic, reaction time, and giving speech. Results showed that vital exhaustion (long-term stress) was first of all associated with parasympathetic withdrawal. In addition, among exhausted persons the initial parasympathetic tone had no effect on task-induced parasympathetic reactivity, whereas in non-exhausted subjects parasympathetic reactivity was greatest when initial parasympathetic tone was high. Vital exhaustion interacted with temperament and gender: exhausted, persistent women expressed the highest level of physiological stress reactivity. Findings suggest that background stress may diminish one's capacity to cope with acute stress.

Keywords: Vital exhaustion; Temperament; Persistence; Stress; Cardiac reactivity

1. Introduction

Vital exhaustion, a state of an unusual fatigue, a loss of mental and physical energy, and an increased irritability, is labeled a risk indicator of coronary heart disease. Epidemiological studies have demonstrated its presence both before (Appels and Mulder, 1988) and after (Mendes de Leon et al., 1996) the occurrence of myocardial infarction. In addition,

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doi:10.1016/S0301-0511(03)00112-1

exhaustion is a common condition after stroke (Ingles et al., 1999). Finally, exhaustion is seen to be of importance for rehabilitation, exhaustion-related implications for rehabilitation expressed in the form: "I want to, but I can't" (Appels, 2001).

Pathophysiological aspects of the relationship between infarction or stroke and vital exhaustion can only be speculated about. Stress might be among key concepts. Vital exhaustion is seen as an indicator of long-term mental stress (Ingles et al., 1999), and it has also been shown to be related to insulin resistance syndrome (IRS) through the pituitary hypothalamic adrenocortical (HPA) axis (Keltikangas-Järvinen et al., 1996) which is a physiological indicator of long-lasting stress (Palkovits, 1987). IRS (i.e. hyperinsulinemia, hypertension, hypertriglyceridemia, a decreased plasma concentration of high-density lipoprotein (HDL), and abdominal obesity) in turn, is a risk factor both for stroke and coronary heart disease (Pyorala et al., 2000).

As far as we know, there is no study investigating the association between vital exhaustion and physiological reactivity under short-term stress. This study was undertaken with this purpose. The first aim was to determine whether there is an association between vital exhaustion (i.e. chronic stress) and cardiac autonomic reactivity in task-induced stress (in acute stress). It was hypothesized that long-term mental stress impaires one's physiological coping with acute stress.

Previously we have found that vital exhaustion is associated with a certain temperament, that is, with a tendency to be fearful and worried even in supportive circumstances, and to be inhibited even by minor risks (Keltikangas-Järvinen, 2000). Subsequently, the second question was whether temperament plays a role in stress-related cardiac reactivity among exhausted people. Temperament refers to individual differences in mental and physiological reactivity that are attributable to individual differences in neural function (for a review, see Bates and Wachs, 1994). It is inherited, at least to some extent, and very stable over time and situations. Temperament may play an important role in moderating stress, i.e. in environmental interpretations, in coping with stress, and in consequences of stress. In other words, an inherited temperament might help to explain why the same daily troubles constitute a positive challenge to one person, but distress to another, and especially why the same daily distress has such widely varying somatic endpoints in different persons.

Cloninger's (1987) theory on temperament has recently received attention in epidemiological studies (Keltikangas-Järvinen et al., 1999). Cloninger's formulation of temperament was inferred from genetic studies of personality and neurobiological studies of the functional organization of brain networks. According to this model, temperament consists of four dimensions, which are moderately heritable and related to the brain systems, that is, the amygdala, hypothalamus, striatum, and other parts of the limbic system. Temperament is involved in individual differences in response to environmental stimuli such as novelty, danger or punishment, and reward. The four neurobiologically-based temperament dimensions are Reward dependence (RD), Harm avoidance (HA), novelty seeking (NS), and persistence (P). RD is associated with individual variation in norepinephrine levels, and refers to a tendency to respond intensely to signals of reward, in particular to social approval and succor. People with high RD tend to maintain behaviors that have previously been socially rewarded. They seek social support, attachments, and praise from others. HA is associated with individual variation in serotonin levels. It refers to a tendency to intensely respond to aversive stimuli, novelty, and nonreward, leading to inhibition of behaviors and social