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Inhibited and disinhibited temperament and autonomic stress reactivity

Liisa Keltikangas-Järvinen*, Joni Kettunen, Niklas Ravaja, Petri Näätänen

Department of Psychology, P.O. Box 4, FIN-00014 University of Helsinki, Finland

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Abstract

We examined the relationship of temperament dimensions serving as markers for Gray's behavioral activation system (BAS) and behavioral inhibition system (BIS) with autonomic stress reactivity in 35 middle-aged men. Temperament was measured using the Strelau Temperament Inventory — Revised. Skin conductance responses and inter-beat interval were measured during administration of the Rorschach test. The results showed that temperamental activation was positively related to the task-level of and task-induced change in respiratory sinus arrhythmia (RSA) amplitude, but unrelated to heart rate (HR) reactivity. Temperamental inhibition was negatively associated with the task-level of electrodermal activity and task-induced change in RSA amplitude, and positively associated with HR reactivity. The findings are in part contrary to the hypotheses presented in the literature. They also suggest that the temperamental inhibition–HR reactivity relationship is mediated by the parasympathetic nervous system.

Keywords: Autonomic reactivity; Electrodermal activity; Heart rate; Parasympathetic; Sympathetic; Temperament

1. Introduction

Exposure to acute stressors is an ubiquitous part of everyday life. Consequently, all research providing information on factors underlying stress vulnerability is of importance. Especially important are the factors which explain inter-individual differences in stress reactivity because they may increase our understanding of why coping with daily stressors has greater health consequences for some individuals than for others. Individual variation in autonomic nervous system (ANS) reactivity to brief psychological stressors might explain why daily annoyances are more likely to call

* Corresponding author. Tel.: +358-9-191-23246; fax: +358-9-191-23379.
E-mail address: liisa.keltikangas-jarvinen@helsinki.fi (L. Keltikangas-Järvinen)

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forth somatic endpoints in some individuals than in others (e.g. Pollak, 1991; Matthews et al., 1992; Cacioppo, 1994).

To increase our understanding of stress-related individual differences in cardiovascular and neuroendocrine reactivity, recent research has discussed the concept of temperament (e.g. Calkims and Fox, 1995; Gunnar, 1995; Rothbart et al., 1995). Temperament consists of biologically rooted individual differences in behavior tendencies that are present early in life and are relatively stable across time and situations (Bates, 1989); temperament highlights a person's behavioral style, the *how* of behavior. Given that individual differences in temperament are attributable to differences in neural and physiological functions (e.g. Rothbart, 1989; Steinmetz, 1995; Strelau, 1995), it has been suggested that biologically rooted temperament may operate as a stress-buffer or increase stress-vulnerability via temperament-related cardiovascular and neuroendocrine functions (e.g. Gunnar, 1995).

Researchers sharing the suggestion that reactivity to stressors is an important aspect of temperament frequently refer to Gray's neurophysiological model of temperament (Gray, 1979, 1982), which organizes a large number of findings that would otherwise appear unrelated. According to Gray (1991) temperament reflects individual differences in predispositions towards particular kinds of emotion. His model posits that behavioral reinforcement is mediated by three fundamental motivational systems, which involve separate sets of interacting brain structures. The systems are the behavioral inhibition system (BIS), the behavioral activation system (BAS), and the fight–flight system (FFS). It has been suggested that the dispositional balance of these systems to respond to external cues underlies individual differences in temperament (e.g. Rothbart, 1989).

The BIS is responsible for the inhibition of behavior (i.e. passive avoidance and extinction) and it responds to negatively conditioned stimuli (i.e. punishment and non-reward) or novel stimuli. It is a substrate for anxiety, and is linked to an increase in arousal and attention. The BAS mediates responses for positively conditioned stimuli (i.e. reward and non-punishment). It is associated with pleasurable emotions and non-specific arousal, and it mediates the cardiac–somatic coupling. The FFS responds to unconditioned aversive stimuli, and its activity leads to defensive aggression or escape behavior. The FFS is not discussed any further in this study, however.

Gray did not extend his theory to the traditional psychophysiological measures but stated that the significance of autonomic activity for emotional behavior '... is opaque' (Gray, 1973, p. 434; cf. Fowles, 1980). Later, Fowles (1980, 1982, 1983, 1988) and Fowles et al. (1982) proposed a model of cardiovascular and electrodermal activity to be applied to Gray's theory. According to Fowles, tonic increases in heart rate (HR) reflect central activity of the BAS, or more specifically, the incentive-related activation of the BAS, while activation of the BIS was presumed to lead to an increase in tonic electrodermal activity (EDA), particularly in the frequency of non-specific skin conductance responses (NSCRs).

There are many convincing studies suggesting that tonic heart rate changes can be used as an index of the BAS in conditions that demand active coping with acute stress in order to avoid punishment or to gain reward (e.g. Scher et al., 1984; Wright et al., 1992; Wright and Dismukes, 1995; see also Sosnowski et al., 1991), although studies that have failed to reveal the predicted physiological outcome also exist (Sosnowski et al., 1991; Clements and Turpin, 1995).

The relationship between EDA and the BIS is more equivocal, however. Despite some positive evidence (see Fowles, 1980; Clements and Turpin, 1995), other studies have failed to link EDA to the activity of the BIS (e.g. Sosnowski et al., 1991). This might be attributable, in part, to the fact that EDA responds unspecifically to a wide range of stimuli (e.g. Fowles, 1980; see also Boucsein, 1992). Although empirical findings provide only limited support for the predictions made by Fowles' 'three-arousal model' (Fowles, 1980), it provides an alternative to a simple arousal-based interpretation of autonomic activity and offers a solid theoretical base for research on stress psychology.

The work of Kagan and co-workers is also of interest here (Kagan, 1989; Kagan et al., 1989). In