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Genetic analysis of autonomic reactivity to psychologically stressful situations☆

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Abstract

We present the results of a behavioural genetics study on response profiles of autonomic measures (heart rate, blood pressure, and galvanic skin level), under ecologically valid, stressful conditions. Where response profiles of different physiological variables are the object of study, and when daily life stressors are taken into account (Turner and Hewitt, Annals of Behavioral Medicine, 14 (1992) 12–20), autonomic responsiveness to psychological stressors is thought to be an inherited trait. The participants were 100 female twin pairs, 57 monozygotic and 43 dizygotic twin pairs. Participants watched eight films with a stressful social content while autonomic measures were continuously recorded. Results show that the heritability coefficients of response profiles of autonomic measures are almost twice as high as that of single variables. The results further show that genes exert their influence on physiological behaviour not only directly, but also indirectly, by influencing the idiosyncratic relation between a person and his environment.

Keywords: Genetics; Heritability; Person × situation interactions; Physiological response profiles; Cardiac reactivity

☆ The results presented in this paper are part of a more extensive research project on the 'Seven Turtles'—model of Zuckerman (1992, 1993), performed at Tilburg University, The Netherlands, as part of a PhD-research project (Lensvelt-Mulders, 2000).

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1. Introduction

Although it is widely assumed that autonomic responsiveness to psychological stressors should be more than moderately heritable, there is little empirical evidence for this premise to be found (Turner and Hewitt, 1992). Research on the heritability of cardiovascular reactivity to psychological stressors revealed that autonomic responsiveness to stressful events is only moderately heritable (Rose, 1992; Ditto, 1993). However the evidence is not conclusive. For instance most of the work covered by Turner and Hewitt's review article was done on heart rate reactivity and blood pressure changes in relatively small groups, with exclusively male respondents. Turner and Hewitt (1992) therefore suggested that a wider range of physiological variables should be incorporated in future studies, and to search for functional combinations of these variables. The idea that functional combinations are the better object of physiological study than single physiological variables is actually not new within psychology. Several functional covariations between heart rate and blood pressure have already been described (Lacey and Lacey, 1978; Mulder and Mulder, 1981). Secondly, Turner and Hewitt proposed using more ecologically valid psychological stressors to induce stress instead of artificial stressors like the cold pressure test.

In this paper we present a study of the genetic and environmental effects on autonomic responsiveness to psychological stressors for single physiological variables and functional combinations of these variables. In addition autonomic responsiveness will be studied under different stressful situations to illuminate the relation between the effects of the genotype and the effects of the topic situation.

In our laboratory the research program is primarily focussed on the behavioural consequences of stressful events as they appear in daily life situations. As stimuli we use films featuring such situations, while autonomic physiological reactions are monitored continuously in subjects watching these films (Hettema et al., 1989a). Autonomic reactivity, recorded while respondents are watching these films, is affected by the individual's specific response potential and the influence of the situation to elicit these autonomic responses (Vingerhoets, 1985; Hettema et al., 1989b; Geenen, 1991; Hettema, 1994; Manuck, 1994).

A second feature of the research program is the use of multiple physiological indicators of stress to identify meaningful response profiles (Hettema et al., 1989b,c, 2000; Geenen, 1991). Seven physiological measures were selected (Geenen, 1991). Heart rate (IBI, inter beat interval) and systolic and diastolic blood pressure (SBP and DBP) are used to reflect cholinergic and adrenergic activation and baro receptor activity (Larsen et al., 1986). Skin conductance levels (GSL) are used to measure sympathetic and cholinergic activity. To allow discrimination between these different systems the *T*-wave amplitudo (TWA) and pulse transit time (PTT) were added as measures for beta-adrenergic activity. And finally fingertip temperature (FTT) is monitored as a measure for sympathetic autonomic nervous system activity.