



Evolution and ontogeny of stress response to social challenges in the human child

Mark V. Flinn

Department of Anthropology, University of Missouri, Columbia, MO 65211, USA
Department of Psychological Sciences, University of Missouri, Columbia, MO 65211, USA

Received 24 November 2005; revised 20 February 2006
Available online 3 May 2006

Abstract

The stress response systems of the human child are highly sensitive to social challenges. Because stress hormones can have negative developmental and health consequences, this presents an evolutionary paradox: Why would natural selection have favored mechanisms that elevate stress hormone levels in response to psychosocial stimuli? Two complementary hypotheses are considered: (a) maladaptation to the novelty of chronic stress in social environments, and (b) adaptive neural reorganization that facilitates the ontogeny of social competencies. Data on salivary cortisol, morbidity, and social environment from an 18 year study of child health in a rural community on the island of Dominica are examined from the perspective of these alternative hypotheses. Results indicate that difficult family environments and traumatic events are associated with elevated cortisol levels and higher morbidity. The long-term effects of traumatic early experiences on cortisol profiles are complex and indicate domain-specific effects, with normal recovery from physical stressors, but heightened response to negative-affect social challenges.

© 2006 Elsevier Inc. All rights reserved.

Keywords: Cortisol; Family environment; Child development; Brain evolution

Introduction

Social challenges reliably stimulate release of the stress hormone cortisol (Dickerson & Kemeny, 2004; Flinn & England, 1997; Gunnar, Bruce, & Donzella, 2000; Kirschbaum & Hellhammer, 1994). Given the evident short- and long-term costs to physical health

E-mail address: FlinnM@Missouri.edu.

(Ader, Felten, & Cohen, 2001; McEwen, 1998; Sapolsky, 2005), this presents an evolutionary paradox: *Why do social interactions have such potent effects on physiological stress response in the human child?* We do not have good explanations for why natural selection favored links between the neuropsychological mechanisms involved with assessment of the social environment and the neuroendocrine mechanisms that regulate stress hormones, such as cortisol and norepinephrine. Furthermore, we do not understand why these links are modifiable during ontogeny, such that early experiences may permanently alter neuroendocrine response to social challenges (Bartolomucci et al., 2005; Buwalda et al., 2005; Francis, Diorio, Plotsky, & Meaney, 2002; Maestripieri, Lindell, Ayala, Gold, & Higley, 2005; Mirescu, Peters, & Gould, 2004; Weaver et al., 2004).

I approach this paradox from the integrative evolutionary paradigm of Nobel laureate Niko Tinbergen (1963), who emphasized the importance of linking proximate physiological explanations with ontogeny, phylogeny, and adaptive function. Here I first briefly review the idea that humans evolved large brains and an extended childhood as adaptations for coping with an increasingly complex and dynamic social and cultural environment. I then explore relations between physiological stress response and the ontogeny of social competencies. Two complementary theoretical models of hormonal stress response are considered: (a) maladaptation to the novelty of chronic stress in social environments (Hamburg, 1952; McEwen, 1995; Sapolsky, 1994), and (b) adaptive neural reorganization (Ademec, Blundell, & Burton, 2005; Flinn, Ward, & Noone, 2005, chap. 19; Huether, 1998; Kaiser & Sachser, 2005; Rodriguez Manzanares, Isoari, Carrer, & Molina, 2001; Rodriguez Manzanares et al., 2005). I posit that one of the important functions of the stress response system, in connection with emotional states, such as fear or anxiety, is to manage the direction of mental processes to solving specific problems. In the relatively simple case of a rabbit seeing a fox, a “freeze” response may be enabled. The human child may face more cognitively challenging problems, including especially social interactions. For example, when dealing with the threat of an approaching bully, a child needs to reallocate her cognitive efforts to the task at hand: prepare for immediate contingencies by recalling salient information, enhancing relevant sensory input, and activating circuits for appropriate actions. Stress hormones may enable not only the acute responses to such challenges, but facilitate their modification during development as well.

Hypotheses are evaluated with analyses of data from an 18-year study of child stress in a rural community on the island of Dominica. The longitudinal depth, large sample size (30,122 salivary cortisol measures from 282 children and their families), and naturalistic paradigm provide a unique research design for investigating relations between social environment and ontogeny of stress response. Empirical analysis is complicated by the pleiotropic (i.e., multiple effects) nature of the key stress hormone cortisol. Moreover, the Dominica study does not have neurological data, hence direct or strong tests of hypotheses relating stress response, neural plasticity, and ontogeny of social competencies are not possible.

My objective here is to provide a plausible model and some new data pieces for the puzzle linking stress response to the neural plasticity that enables adaptation to the dynamic human social environment. Resolution of this paradox may have significant consequences for public health (Dressler & Bindon, 2000; Dressler, Oths, & Gravely, 2005; Flinn & England, 2003; Marmot, 2004), because it could provide new insights into associations among stress response, social disparities, and perinatal programming, among other outcomes (Barker, 1998; Heim & Nemeroff, 2001; Maccari et al., 2003; Worthman, 1999).

Download English Version:

<https://daneshyari.com/en/article/353593>

Download Persian Version:

<https://daneshyari.com/article/353593>

[Daneshyari.com](https://daneshyari.com)