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Harsh discipline and behavior problems: The moderating effects of cortisol and alpha-amylase

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ABSTRACT

Numerous studies link harsh discipline to adjustment problems in youth, yet not all individuals exposed to harsh discipline develop behavior problems. Contemporary theory suggests that this relationship could be moderated by individual differences in environmentally sensitive biological systems. This study investigated whether the interaction between hypothalamic-pituitary-adrenal (HPA) activity and autonomic nervous system (ANS) arousal moderated the link between harsh discipline and behavior problems. Three saliva samples were collected on a single day from 425 inner city youth (50% male, age 11–12 years, 80% African American) and were later assayed for cortisol (HPA) and alpha-amylase (ANS). Problem behavior was assessed by self- and parent-report using the Child Behavior Checklist. Youth also reported the level of harsh discipline that they experienced. Harsh discipline was positively associated with externalizing and internalizing problems only when there were asymmetrical profiles of HPA activity and ANS arousal. This pattern was evident for boys but not girls. Findings are discussed in relation to prevailing theories suggesting that biological susceptibility translates adversity into risk for behavior problems.

1. Introduction

Harsh parenting behavior encompasses a wide spectrum of physical and verbal behavior toward offspring including corporal punishment, shouting, and threats (Reid, Patterson, & Snyder, 2002). Studies report that children's exposure to these negative parenting behaviors early in life is associated with later adjustment problems including higher rates of aggressive behavior (Gershoff, 2002; Gershoff, Lansford, Sexton, Davis-Kean, & Sameroff, 2012) and anxiety and depression (McLoyd, Kaplan, Hardaway, & Wood, 2007; Rodriguez, 2003; Wang & Kenny, 2014). It is noteworthy that these findings have been corroborated in many countries and cultures (e.g., Csorba et al., 2001; Steely & Rohner, 2006). Nevertheless, these effects are not universal in the sense that not all individuals raised in such adverse family circumstances express behavior problems later in life—adversity places some at risk, but others are resilient (e.g., Toth & Cicchetti, 2013).

Developmental science has drawn upon notions of *diathesis-stress* and *differential susceptibility* to explain these individual differences (Belsky & Pluess, 2009; Monroe & Simons, 1991). The diathesis-stress model (or dual hazard model) postulates that biological vulnerability is exacerbated by environmental adversity (Monroe & Simons, 1991; Raine, 2005). In contrast, differential susceptibility emphasizes the role of individual differences in developmental plasticity. That is, individuals with high plasticity are assumed to be more affected by either supportive or adverse features of their social environments, whereas individuals with low plasticity show less biobehavioral reactivity to their circumstances regardless of the valence (Belsky & Pluess, 2009). Central to both models is the notion that environmentally sensitive biological systems moderate the effects of adversity on the development of behavior problems. Most recently, researchers have operationalized individual differences in environmentally responsive biological processes as related to problem behavior with a multi-system approach and tested main and interactive effects

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of, hypothalamic-pituitary-adrenal (HPA) axis activity and autonomic nervous system (ANS) arousal (Chen et al., 2014; El-Sheikh, Erath, Buckhalt, Granger, & Mize, 2008; Gordis, Granger, Susman, & Trickett, 2006). In the present study we attempt to extend our understanding about these complex relationships to new limits by investigating whether the interaction between HPA activity and ANS arousal moderates the link between harsh discipline and behavior problems in a large sample ($N = 425$) of predominantly low socioeconomic status, urban dwelling African American children (50% male, 11–12 years of age).

The psychobiology of the stress response has two major components, the HPA axis and the ANS. Activation of the HPA axis culminates in the secretion of cortisol into circulation. This response is relatively slow (in minutes) as the primary signaling molecules with this system, must be synthesized de novo. Studies have shown that HPA axis activation is more likely to occur when the situation is novel or unfamiliar, uncontrollable, involves social evaluative threat, and generates emotional distress (Gerra et al., 2001; Kirschbaum & Hellhammer, 1994; Peters et al., 1998; Schommer, Hellhammer, & Kirschbaum, 2003). HPA axis reactivity and regulation is considered a "defeat reaction" (Henry, 1993). By contrast, activation of the ANS occurs very rapidly (in seconds) and involves the release of catecholamines into the blood stream (e.g., Chrousos & Gold, 1992; Lundberg & Frankenhaeuser, 1980). ANS arousal facilitates fast and diffuse reactions which are collectively known as "fight or flight" responses and include changes in physiology such as elevated heart rate and blood pressure (Cannon, 1914). ANS activation is considered a "defense reaction" (Folkow, 1985; Henry, 1993) – an active, effortful response to environmental demands that are manageable and controllable (Lovallo & Thomas, 2000; Schommer et al., 2003). Individual differences in the levels of HPA axis activity and ANS arousal can be estimated non-invasively by assessing salivary cortisol and alpha-amylase (sAA) (Granger, Kivlighan, El-Sheikh, Gordis, & Stroud, 2007; Hellhammer, Kirschbaum, & Belkien, 1987; Kirschbaum & Hellhammer, 1994; Nater & Rohleder, 2009).

The nature of the coordination between the ANS and HPA axis reactivity and regulation in response to environmental demands is complex. At the molecular and cellular level, it is assumed that activity of the HPA axis has potential *permissive*, *stimulating*, *suppressive* and *preparative* actions on the ANS (Sapolsky, Romero, & Munck, 2000). Permissive actions are typically associated with levels of cortisol whereas the other three actions are linked to acute stress-induced change in cortisol production. At the behavioral level, Bauer and colleagues (2002) proposed two working models which have been used extensively to explore the coordinated effects of the ANS and HPA on problem behavior. They hypothesized that an optimal level, the medium level, of arousal is associated with the least risk of behavior problems based on the classic theories and empirical research concerning arousal and performance. In the *additive model* it is assume that the HPA and ANS augment each other's effect. Thus, asymmetrical profiles of HPA axis and ANS (i.e., low HPA axis activity and high ANS arousal, or high HPA axis activity and low ANS arousal) would achieve the optimal arousal level and be associated with the lowest levels of behavior problems. In contrast, in the *interactive model* the two systems are assumed to work in a suppressive fashion, that is, one suppresses the other's effect. Thus, symmetrical profiles of HPA axis and ANS (i.e., concurrently high or concurrently low levels of HPA axis activity and ANS arousal) would achieve the optimal arousal level and be associated with the least levels of behavior problems.

Multiple studies test these theoretical models but to date findings are incomplete. Stress-related cortisol reactivity was found to be negatively associated with aggression but only among those with corresponding low sAA reactivity (Gordis et al., 2006). By contrast, cortisol levels were positively associated with both externalizing and internalizing problems but only among those with high sAA levels, and no relation was detected between cortisol and behavior problems among those with low sAA levels (El-Sheikh et al., 2008). In the largest study ($N = 429$), Chen et al. (2014) reported that cortisol levels were negatively associated with both externalizing and internalizing problems but only among those with low sAA levels.

2. Present study

This study aimed to test the individual and interactive effects of harsh discipline, cortisol and sAA on externalizing and internalizing problems. We employed a multiple time point assessment strategy for salivary sAA and cortisol and used a latent variable approach as a tactic to isolate the variance in each salivary analyte attributable to stable individual differences (Booth, Granger, & Shirtcliff, 2008; Out, Bakermans-Kranenburg, Granger, Cobbaert, & van IJzendoorn, 2011; Out, Granger, Sephton, & Segerstrom, 2013; Taylor et al., 2012). Variability in HPA axis activity or ANS arousal at any given moment can derive from trait-like intrinsic differences, activity attributable to momentary situational influence (e.g., Adam, 2006), and measurement error (Kenny & Zautra, 2001). By minimizing the influence of variation in salivary analytes attributable to momentary situational influence (and measurement error) we expected to increase the probability of revealing the relationship between harsh discipline, stress psychobiology, and problem behavior in our models.

Given the HPA axis has the potential to exert a permissive/augmenting action on the ANS (e.g., Sapolsky et al., 2000), we anticipated an *additive* rather than *interactive* model would reflect the nature of the combined effects of HPA axis and ANS (Bauer, Quas, & Boyce, 2002). Thus, asymmetrical instead of symmetrical profiles would be associated with the optimal arousal levels. Built on this prediction, we widened the frame of reference provided by Bauer et al.'s models by incorporating a biosocial component. That is, following the logic of *differential susceptibility*, we viewed asymmetrical profiles as an index of plasticity. Correspondingly, individuals expressing asymmetrical profiles would display the highest levels of behavior problems when experiencing high levels of harsh discipline but would display the lowest levels of behavior problems when experiencing low levels of harsh discipline. In contrast, following the logic of *diathesis-stress*, symmetrical profiles was viewed as biological vulnerability with a resulting arousal level being too high or too low. Symmetrical profiles would be associated with the highest levels of behavior problems when individuals experienced high levels of harsh discipline because they would possess both biological and environmental vulnerability. We hypothesized that our test of the relationship between harsh discipline, stress psychobiology, and behavior problems would reveal support for the *differential susceptibility* rather than *diathesis-stress* model.

3. Methods

3.1. Overview

Boys and girls aged 11 and 12 years were enrolled from 2008 to 2012 in the Philadelphia Healthy Brains and Behavior (HBB) project. HHB aimed to identify risk and protective factors for aggression and to test the effectiveness of the treatments (i.e., cognitive behavior therapy and nutrition supplements) for children with high levels of aggressive behaviors. Participants were recruited by advertisements within the city of Philadelphia and contiguous suburbs. Participants completed an initial assessment at time 1 and were followed up one year later. The initial assessment included the collection of biological, psychological, physical, demographic and social data. Exclusion criteria were diagnosis of a psychotic disorder, mental retardation, pregnancy, a pervasive developmental disorder or current medication use with the potential to interfere with the measurement of salivary analytes such as steroid based anti-inflammatory (more details see Granger, Hibel, Fortunato, & Kapelewski, 2009). There were 446 children in the HBB project. For