

ABSTRACT

Title: CORTISOL REACTIVITY AND OBSERVED PARENTING AMONG MOTHERS OF CHILDREN WITH AND WITHOUT ADHD

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Parenting is a robust predictor of developmental outcomes among children with ADHD. Early parenting predicts the persistence and course of ADHD and comorbid problems above and beyond risk associated with shared genetic effects. Yet, on average, mothers of children with ADHD are less positive and more negative in their parent-child interactions compared to mothers of non-disordered children. Little is known about psychobiological markers which may be associated with individual variations in maternal parenting in families of children with ADHD. Neurobiological models of parenting suggest that maternal cortisol levels following a stressor may be positively associated with hostile and intrusive parenting; however, to date no studies have examined maternal cortisol reactivity and parenting in school-age, or clinical samples of, children. Mothers' regulation of physiological stress responses may be particularly important for families of children with ADHD, as parenting a child with chronically challenging behaviors

represents a persistent environmental stressor. The current study sought to extend the existing literature by providing an empirical examination of the relationship between maternal cortisol reactivity following two laboratory stressors and parenting among mothers of children with and without ADHD. It was hypothesized that child ADHD group would moderate the relationship between cortisol reactivity and self-reported and observed parenting. Greater total cortisol output and greater increase in cortisol during the TSST were associated with decreased positive parenting and increased negative and directive parenting, with the exception of parental involvement, which was associated with increased cortisol output during the TSST. Conversely, cortisol output during the PCI was associated with increased positive parenting, increased parental involvement, and decreased negative parenting. In contrast to the TSST, a greater decrease in cortisol during the PCI indicated more positive parenting and parental involvement. These associations were specific to mothers of children with ADHD, with the exception of maternal directiveness, which was specific to comparison mothers. Findings add to our understanding of physiological processes associated with maternal parenting and contribute to an integrative biological, psychological, and cognitive process model of parenting in families of children with ADHD.

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CHILDREN WITH AND WITHOUT ADHD

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Introduction

Through research beginning prenatally and continuing across the child's lifespan, we have come to understand that maternal caregiving is a complex and dynamic set of behaviors that are derived from and shaped by internal (i.e., affective, cognitive, and biological) and environmental factors (Barrett & Fleming, 2011; Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). Indeed, better emotion regulation, physiological regulation, and cognitive functioning among mothers of infants and toddlers are linked to more sensitive, responsive, and consistent caregiving (Crandall, Deater-Deckard, & Riley, 2015; Deater-Deckard, 2014), thereby promoting better child developmental outcomes (Collins et al., 2000). Conversely, maternal physiological dysregulation has been associated with hostile, intrusive, insensitive, and detached parenting (Sturge-Apple, Skibo, Rogosch, Ignjatovic, & Heinzelman, 2011). We also know, however, that parenting is part of a dynamic and reciprocal process such that the quality of maternal parenting is shaped not only by parent characteristics, but also by characteristics of the child (Belsky, 1984; Deater-Deckard, 2004). Therefore, the ability to effectively parent in the context of stress may be associated with a mother's ability to consistently regulate internal emotional and physiological responses (Crandall et al,

2015) while acting as an external regulator of her child's behavior through the use of effective behavioral strategies (Calkins et al., 2011).

This may be particularly challenging in the context of difficult child behavior (Deater-Deckard, 2004). Early childhood research suggests that parenting young children with difficult temperaments predicts maternal psychophysiology (Lorber & O'Leary, 2005; Martorell & Bugental, 2006; Merwin, Smith, & Dougherty, 2015). However, it is less clear how that relationship operates within families of children with attention-deficit/hyperactivity disorder (ADHD), a clinical disorder associated with disruptive child behavior and increased parental stress.

Attention-Deficit/Hyperactivity Disorder and Parenting

ADHD is characterized by developmentally-inappropriate levels of inattention, hyperactivity, and impulsivity, evident prior to age 12 (American Psychological Association, 2013). ADHD is also associated with significant academic and social impairments (DuPaul, McGoey, Eckert, & VanBrakle, 2001). Moreover, thirty to sixty percent of children with ADHD have comorbid disruptive behavior disorders (DBDs; Barkley, 2006), symptoms of which include frequent arguing with authority figures, losing temper easily, rule breaking, active defiance, aggression, lying, and stealing. In the presence of comorbid DBDs, outcomes for ADHD can be very serious, including criminality, substance use disorders, depression and suicide (Chronis-Tuscano et al,

2010; Frick & Silverthorn, 2001). Conversely, some children with ADHD are able function with relatively low levels of impairment across development (Biederman, 2011).

A robust predictor of developmental outcomes among children with ADHD is the quality of parenting behavior (Deault, 2010). Among children with ADHD, greater early positive parenting predicts fewer conduct problems over a period of eight years, above and beyond baseline levels of child conduct problems (Chronis et al. 2007; Johnston et al., 2007).

At the same time, longitudinal studies support a transactional model of maternal parenting and difficult child behavior (Harvey & Metcalfe, Herbert, & Fanton, 2011) whereby hyperactive, impulsive, and oppositional child behavior elicits inconsistent or harsh parenting (Johnston & Jassy, 2007). Relative to comparison families, children with ADHD are more noncompliant, aggressive, and destructive during laboratory parent-child interactions (DuPaul, McGoey, Eckert, and VanBrakle, 2001), creating a management problem for mothers. Classic experimental studies conducted by Pelham and colleagues (1998) found that interacting with a confederate child actor behaving as if s/he has ADHD/DBD is associated with increased negative and controlling parenting as well as increased heart rate and blood pressure (Pelham et al., 1997). In turn, parents of children with ADHD feel less competent, experience greater stress in the parenting role, and continually rely on inconsistent or coercive strategies to manage their child's behavior than parents of non-disordered children (Burke et al., 2008; Johnston et al., 2001). Thus, child ADHD symptoms contribute to negative parent-child interactions, and

negative parenting appears to be further exacerbated in the presence of comorbid oppositional and conduct problems (Johnston & Mash, 2001).

Despite the importance of parenting quality in predicting child developmental outcomes and the fact that children with ADHD may elicit negative reactions, there is a great deal of variability in the quality of parenting among mothers of children with ADHD. Some mothers are positive and responsive when interacting with their children with ADHD (Johnston et al., 2002). Thus if child characteristics alone do not fully account for variability in parenting behavior (Burke et al., 2008), it is important to consider biological, cognitive, and psychological factors that may be associated with differences in parenting behavior among mothers of children with ADHD.

Psychosocial Correlates of Parenting in Families of Children with ADHD

The most widely-researched psychosocial factors linked to parenting in families of children with ADHD include maternal depression, maternal ADHD symptoms, and perceived parenting stress (Deault, 2010; Mash & Johnston, 1983b; Johnston & Mash, 2001; Lovejoy et al., 2000). Approximately half of mothers of children with ADHD have a history of major depressive disorder (MDD), a rate 2-3 times higher than the general population (Chronis et al., 2003; Kessler et al., 2006). It is hypothesized that depressive symptoms such as low levels of positive affect, irritability, fatigue, and difficulty concentrating (markers of behavioral and emotional dysregulation) directly impact a mother's ability to parent effectively among unselected (Lovejoy et al., 2000). Among

ADHD samples, mothers with a history of depression may have a lower threshold for challenging child behavior and use more reactive or inconsistent discipline. Indeed, depressed mothers of children with ADHD have been observed to be more negative, controlling, coercive, and rejecting (Johnston & Mash, 2001) and less positive (i.e., responsive, sensitive, warm) toward their children than non-depressed counterparts during parent-child interactions (Johnston et al., 2002; Thomas et al., 2014). These coercive reciprocal processes, over time, place children of depressed mothers at increased risk for the development of conduct problems (Chronis et al., 2007).

In addition to maternal depression, maternal ADHD symptoms are associated with impaired parenting. Approximately 25-50% of children with ADHD have parents who also have the disorder (Biederman & Faraone, 2005; Chronis et al., 2003). Child and parent ADHD symptoms may exert reciprocal and transactional influences on parenting practices and child functioning (Johnston et al., 2012). Parents of children with ADHD may have difficulty providing external structure and consistency required to effectively manage child ADHD behavior due to their own disorganization, difficulty planning and sustaining attention, impulsive responding, and behavioral dysregulation (Johnston et al., 2012). This results in a poor “fit” between the child’s needs and the parent’s capacity to meet those needs (Johnston et al., 2012). Conversely, the presence of ADHD symptoms in parents has been associated (in some studies) with increased positive parenting, likely due to similar parent-child behavioral patterns that serve to increase dyadic synchrony (Psychogiou, Daley, Thompson, & Sonuga-Barke, 2007; Psychogiou, Daley, Thompson,

& Sonuga-Barke, 2008). Subsequent studies have failed to replicate these findings (Johnston & Lee-Flynn, 2011), which may be attributed to methodological differences in measurement of maternal ADHD, parenting, and emotion regulation (Lui, Johnston, Lee, & Lee-Flynn, 2013; Mazursky-Horowitz et al., 2014; Murray & Johnston, 2006). Additional research is needed, however, to examine individual differences in the association between maternal ADHD symptoms, her physiological response to stress, and parenting using objective measures not subject to self-report bias (Lui et al., 2013; Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007).

Perceived parenting stress is also related to parenting quality among mothers of children with ADHD (Mash & Johnston, 1983). Relative to comparison mothers, mothers of children with ADHD experience greater self-reported parenting stress, and self-blame (Anastopoulos, Guevremont, Shelton, & DuPaul, 1992; Mash & Johnston, 1990; Theule, Wiener, Tannock, & Jenkins, 2013). High levels of parenting stress have been associated with decreased maternal responsiveness and harsh parenting, thus contributing to negative parent-child interactions, family distress, impairment, and child behavior problems (Deault, 2010; Theule et al., 2013). Less is known about how a mother's physiological stress response to different contextual challenges may be associated with her parenting.

Recently, variability in self-reported emotion regulation and coping has been associated with parenting among mothers of children with ADHD (Mazursky-Horowitz, 2014; McKee, Harvey, Danforth, Ulaszek, Friedman, 2004). Less effective self-reported

coping styles such as avoidant or emotion-focused coping (as opposed to active coping or seeking social support) have been related to greater self-reported lax and over-reactive discipline and observed coercive and over-reactive parenting (McKee et al., 2004).

Moreover, problems with emotion regulation mediated the association between maternal ADHD symptoms and harsh responses to child negative emotion (Mazursky-Horowitz, et al., 2014). It is possible that problems with parental emotion regulation predict greater stress and less effective parenting in the context of child ADHD. Indeed, the ability to effectively cope with negative emotions and regulate stress may be a key factor in understanding variability in parenting behavior among mothers of children with ADHD.

Taken together, psychological factors including higher levels of maternal depression, ADHD symptoms, parenting stress, and difficulty with emotion regulation are associated with variations in maternal parenting (Deault, 2010). As parenting relies on the integration of biological, cognitive, and behavioral processes (Barrett & Fleming, 2011), we currently have an incomplete picture of individual difference factors associated with parenting in mothers of children with ADHD. In particular, few studies have examined biological markers which may be associated with parenting quality among mothers of children with and without ADHD.

Hypothalamic-Pituitary-Adrenal (HPA) Axis: An Overview

Hypothalamic-Pituitary-Adrenal functioning is one neurobiological process shown to correlate with parenting (Barrett & Fleming, 2011). Cortisol is a byproduct of

the HPA system, which regulates the body's physiological response to environmental stressors. In response to a stressor, the hypothalamus releases corticotrophin releasing hormone (CRH). CRH stimulates the pituitary to release adrenocorticotropin hormone (ACTH), which then stimulates the adrenal glands to produce cortisol (Lopez et al., 1999). Elevated cortisol levels in the blood signal the hypothalamus to reduce production of CRH in a process described as a negative feedback loop (Munch, Guyre, & Holbrook, 1984). In healthy individuals, this negative feedback loop ensures the body is no longer in the "fight or flight" response and allows the body to appropriately recover once the environmental stressor is no longer present. Thus, adrenocortical functioning following a stressor may represent individual differences in physiological stress reactivity (Gunnar, 1989; Korte, Koolhaas, Wingfield, & McEwen, 2005), emotion regulation (Gunnar, Marvinney, Isensee, & Fisch, 1989), and allostatic dysregulation following prolonged exposure to chronic environmental stressors (Chrousos, 1998; Lupien, King, Meaney, & McEwen, 2001).

A number of hypotheses predict how stress is associated with individual differences in physiological systems. For example, we know that chronic physiological arousal requires greater activation of counter-regulatory systems which work to return the body to homeostatic functioning (McEwen et al., 2005). Individual differences in the magnitude of stress reactivity and the ability to return to baseline following a stressor have been associated with individual differences in allostatic load, which is the adaptive

process of maintaining homeostasis following a stressor through physiological mediators like cortisol and adrenalin (McEwen, 1998).

If an individual experiences chronic physiological arousal, the HPA system may reduce excessive ACTH secretion to lower circulating cortisol (Albeck et al., 1997). Measurements of stress reactivity in these individuals show a *decreased* or “blunted” *rise in cortisol* following an acute stressor (Albeck et al., 2007). Previous research has associated blunted stress reactivity with depression (de Rooji et al., 2010), obesity (Björntorp & Rosmond, 2000), substance dependence (Lovallo et al., 2000), poor health, as well as a history of maltreatment and life adversity (Lovallo, Farag, Sorocco, Cohoon, & Vincent, 2012; Phillips, Ginty, & Hughes, 2013).

Conversely, exposure to chronic stress may be associated with *greater reactivity* by way of a dysfunctional negative feedback system and elevated baseline cortisol, which overproduces cortisol in the body, particularly in those individuals sensitive to environmental stressors (Boyce & Ellis, 2005). As cortisol continues to circulate, arousal systems continue to be activated and the individual remains in a “fight or flight” state. These individuals show a higher or exaggerated increase in cortisol and take longer to return to baseline after an acute stressor (Lupien, King, Meaney, & McEwen, 2001). This pattern of stress reactivity is also detrimental. Prolonged periods of physiological arousal have negative long-term effects on psychological, cognitive, neurological, and cardiovascular functioning (Erickson, Drevets, & Schulkin, 2003; Krantz & Manuck,

1984; Sapolsky, 2000) including clinical depression (Burke, Davis, Otte, & Mohr, 2005) and risk for depression relapse (Zobel et al., 2001).

HPA Axis and Parenting: A Neurobiological Model

Basal Cortisol. HPA functioning has been studied as one regulatory process underlying maternal parenting (Barrett & Fleming, 2011). HPA activation has been shown to increase salience and attention to infant stimuli to facilitate goal-oriented mothering behavior (Barrett & Fleming, 2011). HPA activation, as indicated by increased maternal cortisol levels during the postpartum period, also supports mother-infant attachment, maternal responsiveness, maternal approach behavior, and positive maternal attitudes toward her infant (Fleming, Steiner, & Corter, 1997; Thompson & Trevathan, 2008). Timing of this association is critical, however, as elevated cortisol levels may be negatively associated with adaptive parenting later in the postpartum period (Krpan, Coombs, Zinga, Seiner, & Fleming, 2005; Mills-Koonce et al., 2009). For example, Krpan and colleagues (2005) found that higher baseline levels of salivary cortisol in teen and adult mothers of 6 week-old infants were associated with less responsiveness during mother-infant interactions. Among mothers of 6-month-old infants, Mills-Koonce and colleagues (2009) found that higher resting cortisol levels predicted increased negative parenting (intrusiveness, verbal and physical harshness) during an observed mother-infant interaction. Together, these findings highlight the importance of the offspring's developmental stage when examining the link between maternal stress responses and

adaptive parenting. To date, research on maternal cortisol and parenting has been conducted primarily in mothers of infants (for a review, see Barrett & Fleming, 2011), toddlers (Martorell & Bugental, 2006), and preschoolers (Merwin et al., 2015) with less work conducted in other age groups. In particular, much less is known about HPA functioning and parenting among mothers of school aged-children.

Cortisol reactivity. While baseline cortisol levels serve as an important physiological marker of parenting, response to discrete stressors may be a more ecologically-valid measure of physiological systems associated with parenting (Martorell & Bugental, 2006). Furthermore, stress reactivity may be more critical than basal cortisol levels when considering the variations in behavioral responses to demands on physiological regulatory systems (Crnic & Acevedo, 1995). To date, few studies have examined the relationship between maternal response to acute stressors and parenting, and fewer have examined this association wherein difficult child behavior is examined as an environmental stressor.

The association between maternal cortisol reactivity and parenting may be more pronounced in the context of a stressful parenting environment. Martorell and Bugental (2006) found that low perceived maternal control predicted greater cortisol reactivity following a stressful mother-child separation among mothers of toddlers with difficult, but not easy, temperaments. For mothers of toddlers with difficult temperaments who

also reported lower perceived power, cortisol increases mediated the relationship between dyadic characteristics (e.g. difficult child temperament, maternal depression) and harsh parenting practices. A proposed explanation linking physiological stress to harsh parenting is that mothers who show greater physiological arousal during a stressor may feel agitated, short tempered, easily frustrated, impatient, and more attentive to negative child behavior (Erickson, Drevets, & Schulkin, 2003) and consequently use harsh, intrusive, or over-reactive parenting to manage child behavior. Conversely, mothers with less exaggerated stress responses may tend to remain calm, attend to positive child behavior, generate behavioral alternatives, respond flexibly, and exhibit more effective and consistent parenting (Barrett & Fleming, 2011; Swain et al., 2011), even in challenging parent-child contexts (Sturge-Apple et al., 2011).

The Proposed Study: Stress Reactivity, Parenting, and Child ADHD Group

To date, we are not aware of any studies that have examined cortisol reactivity and its relation to parenting practices in mothers of school-age children or in mothers of children with ADHD. This represents a significant limitation of the existing literature. Regulating stress responses may be particularly important for mothers of children with ADHD, as parenting a child with persistent challenging behaviors represents a chronic environmental stressor (Johnston & Mash, 2001). Indeed, interacting with a child confederate behaving like s/he has ADHD has been shown in experimental studies to produce greater parental emotional and physiological responses (e.g., increased heart rate,

blood pressure, stress, depression, anxiety, and hostility) than interacting with well-behaved child actors (e.g., Pelham et al., 1999).

The critical nature of this question becomes clearer when we consider that HPA axis dysregulation and being a mother of a child with ADHD are independently associated with elevated stress and depression (Chronis et al., 2003; Gold, Goodwin, & Chrousos, 1988). Thus, in this study we first aim to understand the association between parenting and maternal physiological stress response during an established laboratory stressor task, the Trier Social Stress Task (Kirschbaum, Pirke, & Hellhammer, 1993). We also examined maternal physiological stress response during a challenging parent-child interaction task. The latter task allowed us to capture maternal physiological responses and parenting in real time, providing a more ecologically-valid measure of the link between parenting and stress physiology. Furthermore, this study examined child ADHD group as a moderator of the association between maternal cortisol reactivity and parenting. That is, we examined whether the relationship between maternal physiological stress response and parenting varied as a function of challenging child behavior.

Specific Aims

Aim Ia: This study aimed to examine associations between maternal cortisol reactivity to an established laboratory psychosocial stressor and parenting in a sample of mothers of children with and without ADHD.

Aim Ib: This study aimed to examine cortisol reactivity during a structured parent-child interaction task to determine if a challenging laboratory parent-child interaction elicited elevations in maternal cortisol. We then examined associations between cortisol reactivity during this task and parenting.

Hyp I: It was hypothesized that greater cortisol reactivity following both the laboratory stressor and the parent-child interaction would predict more problematic and directive parenting, as well as less positive and involved parenting.

Aim II: The second aim was to examine child ADHD as a moderator of the association between maternal cortisol reactivity and parenting.

Hyp II: It was hypothesized that the link between maternal stress reactivity and parenting would vary as a function of child ADHD group (i.e., that child ADHD would moderate this relationship). Specifically, we expected that the association between cortisol reactivity and self-reported and observed parenting would be stronger among mothers of children with ADHD relative to mothers of comparison children. This hypothesis was based on research suggesting that the magnitude of a mother's cortisol response is more strongly linked to her harsh/over-reactive parenting in the context of difficult child temperament (Loreber & O'Leary, 2005; Martorell & Bugental, 2006; Merwin et al., 2015).

Aim III: The third aim was to examine the association between maternal cortisol levels during the laboratory stressors and self-reported maternal depressive symptoms, adult ADHD symptoms, parenting stress, and emotion regulation.

Hyp III: We hypothesized that self-reported ADHD symptoms, stress, and emotion dysregulation would be positively related to maternal cortisol reactivity. Based on previous studies, we also hypothesized that maternal depression symptoms would be negatively associated with cortisol reactivity (Burke, Davis, Otte, & Mohr, 2005).

Method

Participants

Participants were recruited from the greater Washington, DC metropolitan area via emails and fliers, community centers, list-servs, ADHD advocacy groups, public bulletin boards, health care providers, contact databases, and >14,000 UMCP Employees. Mailings were distributed to local elementary schools and daycare centers with the expressed approval of school principals and center directors.

Across both the ADHD and non-ADHD groups, mothers were required to be at least 18 years old and the biological parent of a 5-10 year-old child. Mothers were excluded if they were: (1) pregnant or breastfeeding and (2) had been diagnosed with a hypoactive or hyperactive thyroid condition. Finally, mothers taking corticosteroids, oral contraceptives, antidepressants, and stimulant medications were included to increase generalizability, given the nature of this sample.

For inclusion in the ADHD group, children were required to: (1) meet DSM-IV criteria for ADHD according to parent and teacher reports and diagnostic interviews conducted with mothers (Pelham, Fabiano & Massetti, 2005); and (2) have an estimated

IQ above 70 using the vocabulary and block design subtests of the Wechsler Intelligence Scale for Children, 4th Ed. (WISC-IV; Wechsler, 2003) or the Wechsler Preschool and Primary Scale of Intelligence, 3rd Ed. (WPPSI-III; Wechsler, 2003).

Children in the ADHD group taking stimulant medications were included. With the prescribing physician's approval, parent-child interactions (PCI) were conducted while children were unmedicated (i.e., not given medication on the day of the visit). Visits were scheduled on the weekends or school holidays avoiding the need to send the child to school unmedicated. Children of mothers in the comparison condition did not: (1) meet DSM-IV criteria for ADHD according to parent and teacher reports; (2) have a history of disruptive behavior disorders; or (3) have a past diagnosis of- or were ever medicated for ADHD.

Sixty-one mother-child dyads completed the assessment. One family was excluded due to the child's adoption group that was not disclosed until she completed the visit. A final sample of 60 mother-child dyads were included in this analysis. Three mothers (5%) with a history of thyroid dysfunction completed the study prior to our decision to exclude mothers diagnosed with hypoactive and hyperactive thyroid conditions. Analyses conducted with and without these participants showed no significant differences in results and these participants were therefore included in our analyses. Participant demographics are presented in Table 1.

Procedures

Mothers expressing interest in the study completed a 20-25 minute telephone screen assessing basic inclusion/exclusion criteria. Mothers meeting criteria were then invited to attend two 2-hour laboratory visits (Session A and Session B) at the University of Maryland ADHD Program. The order of these visits was counterbalanced. All visits were scheduled between the hours of 12pm and 6pm to ensure that salivary cortisol samples were collected from all participants during the same period of the day.

Mothers were asked to refrain from the following prior to their visit: smoking and consuming alcohol for 24 hours; exercise and caffeine consumption for 4 hours prior; and eating 1 hour prior to each visit to control for external effects of alcohol, caffeine, smoking, eating, and exercise on HPA axis functioning, integrity of saliva samples, and free cortisol levels (Kirschbaum & Hellhammer, 1994). Mothers who were regular smokers but agreed to refrain from smoking 24 hours prior to each visit were included. Adherence was assessed using a protocol adherence questionnaire. Childcare was provided for the participating child and siblings.

During the first visit to the laboratory, a standard protocol was administered to the mothers which included the following: informed consent, a semi-structured diagnostic interview (KSADS), a demographic questionnaire as well as a protocol adherence questionnaire. This protocol adherence questionnaire described the day's medication usage, sleep, eating, and exercise habits to assess factors that may have impacted

mothers' free cortisol levels at the time of the visit. Next, mothers either completed the Session A stressor (Trier Social Stress Test; TSST) or the Session B stressor (Parent Child Interaction; PCI). Mothers then returned for the second visit to complete the remaining stressor, finish questionnaires, and receive payment.

At the beginning of Session A, mothers were asked to rest for 10 minutes during which they were instructed to relax, read magazines or a book, listen to classical music, and avoid engaging in stressful activities (e.g., checking work emails). The first (baseline) saliva sample was taken, then mothers completed the Trier Social Stress Test (TSST; described below). This was followed by a 60 minute rest period during which mothers completed questionnaires and listened to classical music. Two additional saliva samples were collected 20 and 41 minutes after the onset of the TSST. Mothers completed the Positive and Negative Affect Scale (PANAS) before and after the laboratory tasks to assess self-reported change in affect. Mothers were debriefed and the session concluded when mothers reported no more than mild levels of residual distress.

During Session B (mothers and children), mothers completed the baseline relaxation period. Mothers and their children completed the 20-minute parent-child interaction (described below). Following the interaction, mothers completed a 60-minute rest period while completing questionnaires. Concurrently, research assistants completed IQ screening tests with the child. The session concluded when mothers reported no more than mild levels of residual distress. Saliva samples were collected from the mother at baseline, 30 and 50 minutes following the onset of the stressor (see Figure 1).

All mothers were financially compensated for their participation at the end of the second visit in the amount of \$50. Additionally, all mothers were offered a 2-hour Parenting Tips workshop which provided an overview of general evidence-based parenting strategies, including positive parenting and effective behavior management. Free childcare for the participating child and siblings was provided during the workshop.

After release forms were obtained from mothers during the first session, teachers were contacted and asked to complete a confidential online survey regarding the child's classroom behavior. Teachers agreeing to participate were provided a secure web-based link and a participant-specific code to complete teacher questionnaires online to determine eligibility. These forms took approximately 15-20 minutes to complete and teachers were compensated \$10. Teacher ratings were available for 20 (33%) children participating in the study. Teacher ratings were utilized for the purpose of diagnosing ADHD in the child for inclusion but were not included in analyses.

Trier Social Stress Test

A meta-analytic review of psychological stressors found that laboratory paradigms likely to produce the strongest changes in cortisol contain elements of uncontrollability and social-evaluative threat wherein the participants' task performance is judged negatively by others (Dickerson & Kemeny, 2004). A paradigm that includes both of these elements is the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993), a widely-used laboratory stress paradigm shown to most reliably

produce at least moderate elevations in physiological stress in healthy and clinical populations (Dickerson & Kemeny, 2004; Kirschbaum et al., 1993). The TSST protocol (see Appendix A for protocol) consists of an anticipatory period followed by a social evaluative task. The task was introduced by asking the participant to prepare a job interview speech for company managers that would be videotaped for voice frequency analysis. Mothers were given approximately 8 minutes to prepare using notes, however they were told they could not use these notes during the speech. Following the 8-minute preparation time, the mothers were brought into the observation room with an audience of 2 or 3 trained undergraduate research confederates wearing white lab coats. A camera, microphone, and cassette recorder were prominently started. Mothers were told to give a free speech using the full 5 minutes. A stopwatch lying prominently on the table was set to keep time. If mothers stopped talking before the 5 minutes ended, confederates prompted her to continue using standardized responses such as “You still have some time. Please continue.”

Immediately following the speech, the confederates asked mothers to complete a mental arithmetic task by subtracting 17 from 13,278 as quickly and accurately as possible. If a mistake was made, confederates directed mothers to start again with a standardized prompt: “That’s incorrect. Start from the beginning. Subtract 17 from 13,278.” The task was ended after 5 minutes and the mother returned to the waiting room with the experimenter. When mothers showed moderate levels of distress during the task, confederates asked mothers if they would like to stop the task. At the end of the visit

(approximately 1 hour later), mothers were debriefed extensively as to the purpose of the study, the deceptive nature of the task, and the confederates role. Mothers electing to stop the task were immediately debriefed and given the option to continue participation in the overall study without penalty. Sixteen mothers (29.6%) elected to discontinue participation in the stress task and all elected to continue participation in the overall study including providing cortisol samples and completing questionnaires.

Observed Parenting

The present study utilized observational tasks widely employed in research on parent-child interactions in families of children with ADHD (Danforth et al., 1991; Johnston et al., 2002): (1) 5-minute free play, (2) 5-minute clean-up/organization task in which clothing, toys, papers, and trash were scattered around the room and a (3) 10-minute “homework” task that involved the child completing an grade-appropriate math worksheet while the parent was instructed to provide assistance as they saw fit (see Appendix B for protocol). We have used this protocol in many NIH-funded studies conducted with the same age group (Chronis-Tuscano et al., 2008a; 2008b; 2013). Discrete parent and child behaviors were coded using the Dyadic Parent-Child Interaction Coding System (DPICS; Eyberg, Nelson, Duke, & Boggs, 2005). Maternal discrete parenting behaviors were grouped into composite categories (Eyberg et al., 2005). The positive parenting composite was comprised of maternal behavioral descriptions, labeled and unlabeled praise, positive touch, and reflecting behaviors. The negative parenting

composite included maternal negative talk and negative touch. The commands composite included direct and indirect commands. Rapid fire commands, or “no opportunity to comply” commands, were commands given without sufficient time for the child to comply and have been associated with behavior problems among children. The child deviance composite included noncompliant behavior and negative talk. In addition, to account for the effects of hyperactive and impulsive behavior on maternal cortisol during the parent-child interaction, child activity level during the parent-child interaction was coded using a one-item Likert rating with higher scores indicating greater frequency of a behavior. Observers blind to participant group were trained to 80% agreement on the DPICS and the Likert scale. Inter-coder reliability was calculated for approximately 20% of observed videos. The intraclass correlation coefficient (ICC) for the DPICS and Likert rating were good (DPICS ICC = .77 to .98 and Likert ICC = .86 respectively).

Child Assessment Measures

Diagnosis of child ADHD was assessed using well-validated parent and teacher rating scales assessing symptoms and impairment associated with ADHD (Pelham, Fabiano, & Massetti, 2005). Mothers and teachers completed the Disruptive Behavior Disorders checklist (DBD; Pelham, Gnagy, Greenslade, & Milch, 1992). On the DBD, the parents and teachers rated the degree to which each DSM-IV symptom of ADHD, ODD, and CD is displayed by the child, with symptoms rated “pretty much” or “very much” considered clinically significant (Pelham et al., 1992). Internal consistency for

total DBD symptoms in this sample was strong ($\alpha = .96$). Additionally, the ADHD section of the Schedule for Affective Disorders for School-Aged Children, Fifth Version (K-SADS; Orvaschel & Puig-Antich, 1995), a semi-structured, DSM-IV clinical interview assessing child symptomatology, was administered to mothers. ADHD symptoms were considered present if they were endorsed by either the parent or the teacher as occurring to a clinically significant degree on any of these measures (Shemmassian & Lee, 2015). Next, to examine whether the child displays impairment in at least two settings, necessary for a DSM-IV ADHD diagnosis (American Psychiatric Association, 2013), mothers and teachers completed the Children's Impairment Rating Scale (CIRS; Fabiano et al., 2006). On the CIRS, parents and teachers assessed impairment and need for treatment across multiple domains. Ratings were made on a 6-point scale, with scores above the midpoint indicating significant impairment. Teacher ratings were available for 20 (33%) of children participating in the study. Teacher ratings were utilized for diagnostic purposes and therefore not included in our analyses.

The reliability coefficient for ADHD diagnoses made by our research team was 1.00. Fifteen children (24.6%) met criteria for ADHD Combined Type, 7 children (11.5%) met criteria for the Predominately Inattentive type, and 2 children (3.3%) met criteria for the Hyperactive/Impulsive subtype. Clinical characteristics of the children are presented in Table 1.

Maternal Self-Report Measures

Mothers completed questionnaires about their own feelings and behaviors. At the start of each laboratory visit, the Health Screening Questionnaire assessed additional variables that may influence HPA axis functioning and study protocol compliance including duration and quality of sleep, height, weight, medication use, as well as recent caffeine, or alcohol use, smoking, meals prior to the visit (see Appendix C for copies of all non-copyrighted measures).

The Alabama Parenting Questionnaire (APQ; Shelton, Frick, & Wooton, 1996), a 42-item measure, was used to assess self-reported parenting. Parents rated use of different parenting strategies on a 5-point scale (1 = “Almost Never”, 5 = “Always”). Total scores were then derived for dimensions of parenting, including involvement, positive parenting, poor monitoring and supervision, inconsistent discipline, use of corporal punishment, and other discipline practices. Internal consistency across subscales was acceptable (Cronbach’s alpha = 0.82 - 0.84).

The Positive and Negative Affect Scale (PANAS; Watson, Clark Tellegen, 1988), a 20-item measure used to assess positive and negative affect, was administered immediately before and after each laboratory stressor to assess change in subjective distress. Mean scores for positive and negative affect subscales were included in these analyses. Internal consistency for the positive and negative subscales was acceptable (Cronbach’s alpha = .89 and .85 respectively).

The Difficulties with Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a 36-item self-report questionnaire administered to assess 6 aspects of emotion

dysregulation in mothers; non-acceptance, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. Total scores were included in these analyses. This measure had strong internal consistency overall (Cronbach's alpha = .89) and for each subscale (Cronbach's alpha = .80 - .94).

To assess for depressive symptoms, the 21-item Beck Depression Inventory – II (BDI-II; Beck, Steer, & Ball, 1996), was administered to mothers. Overall, the sample reported current depressive symptoms in the mild range ($M = 9.62$, $SD = 7.15$; Beck et al., 1996). Internal consistency of the BDI-II within this sample was strong (Cronbach's alpha = .89).

The Parenting Stress Index–Short Form (PSI-SF; Abidin, 1995) was used to gather information concerning the degree of and types of stress attributed to parenting. This measure also demonstrated strong internal consistency across subscales (Cronbach's alpha = .88 to .95).

Maternal ADHD symptoms were assessed using the Conners' Adult ADHD Rating Scales: Short Version Self Report (CAARS; Conners et al. 1999), a 64-item dimensional measure of ADHD symptoms that yields scores on DSM-IV Inattentive, Hyperactive/Impulsive, and Total Symptoms subscales. Internal consistency was acceptable (Cronbach's alpha = .80, .78, and .86 respectively).

Salivary Sampling and Analysis

Mothers were asked to provide three saliva samples during each visit for a total of 6 samples. Samples were timed to capture baseline as well as peak cortisol levels. Baseline samples were collected immediately prior to the start of the task. Follow up samples were taken at +20 and +40 minutes post TSST onset and +30 and +50 minutes post PCI onset. These sampling intervals have been shown to capture peak elevations in cortisol following a laboratory stressor (Dickerson & Kemeny, 2004). Samples were collected using Cortisol Salivettes™. Mothers were asked to place the Salivette synthetic swab under their tongue for 2-3 minutes or until saturated. The swab was then removed and placed into the plastic collection tube. The tube was then sealed and labeled with the participant 3-digit ID number, date, time, session, and sample number. Samples were stored at -20°C in a secure refrigerator located in Dr. Erica Glasper's laboratory in the UMCP Psychology Department until thawed for analysis. Samples were assayed in duplicate by the University of Trier, Germany Research Institute for Psychobiology.

Samples were assayed with a time-resolved immunoassay with fluorometric end-point detection (DELFI). Samples with higher values than the highest standard (100nmol/l) were diluted and re-analysed. Additional details regarding the assay process are described in Dressendörfer, Kirschbaum, Rohde, Stahl, and Strasburger (1992). The mean and coefficient of variance (CV) are computed for each duplicate assay. Samples that showed a CV that is higher than 15%, or cortisol values that are outside of a defined

range (+/- 2SD), were reanalyzed. Samples with cortisol values lower 2nmol/l often show higher CVs and thus were included in the analysis (Dressendörfer et al., 1992). The intra-assay coefficient of variation was 6.5% and the corresponding inter-assay coefficient of variation was 6.4%. All samples were destroyed immediately following cortisol analyses. Three hundred and sixty samples were collected across the two tasks. Thirteen (3.61%) were excluded due to extreme cortisol values (i.e., >3 standard deviations above the mean; Gunnar & White, 2001), therefore 347 cortisol samples from 60 participants were included in the final analysis.

Analytic Plan

Computation of Area Under the Curve (AUC) is commonly used in endocrinological research involving repeated measurements over time because it increases the power of testing compared to other methods (e.g., repeated measures ANOVA using individual cortisol samples) without sacrificing information contained in multiple measurements (Pruessner et al., 2003). The current analysis utilized Pruessner and colleagues' approach for computing "area under the curve with respect to ground" (AUC_g) and "area under the curve with respect to increase" (AUC_i). AUC_g is a measure of total cortisol output across the entire sampling period. AUC_i is calculated based on the distance of each measurement from baseline (i.e., pre-stress), and is most closely related to the overall magnitude of change over time, with positive values representing an increase and negative values representing a decrease over time. Aim I was tested by

computing AUC_g (total cortisol output) and AUC_i (magnitude of change) across the three different sampling time points for the Trier Social Stress Test (TSST) and the parent-child interaction (PCI) in separate regression models. AUC and baseline cortisol values were log-transformed to correct for skewed distribution prior to inclusion in the analysis. Transformed values were then used in all analyses.

In *preliminary analyses*, Pearson product-moment correlations and one-way ANOVAs were conducted to examine associations between demographic variables, medication use (antidepressants, oral contraceptives, corticosteroids, and stimulants), and child stimulant use at the time of the parent-child interaction as well as self-reported sleep, protocol adherence, cortisol, and parenting across groups. Self-reported parenting as well as observed positive parenting, negative parenting, and total commands were included as dependent variables in separate models. Observed difficult child behavior and a Likert rating of child activity level during the PCI were included as covariates to assess child effects on parenting during the PCI (Chronis et al., 2007; 2008, Chronis-Tuscano et al., 2013). Significant covariates were centered and included in the statistical models to account for the effects of these variables on observed and self-reported parenting. In the next step, TSST AUC and PCI AUC values were included as predictors to test the main effects of each task's AUC on parenting.

For the Aim II analyses, we used Generalized Estimating Equations (GEE) to estimate cross level moderation effects of child ADHD group on the association between cortisol reactivity, observed and self-reported parenting. GEEs are used to estimate

associations among correlated data over time. It also allows users to specify the distribution of dependent variables. Group group was entered as a dummy coded predictor variable and the comparison group was coded as “0.” Regarding parenting, covariates, AUC, group group, and PCI AUC x Group and TSST AUC x Group interaction terms were included in each model. Significant interaction terms were then decomposed by testing simple slopes (Aiken & West, 1991) to determine if estimates of association between PCI AUC and TSST AUC values and parenting slopes were significantly different from zero for the ADHD and comparison group.

Aim III examined bivariate correlations between cortisol levels during the TSST and PCI and maternal self-reported depression symptoms, ADHD symptoms, parenting stress, and emotion regulation.

Results

Preliminary Analysis

Descriptive data and comparisons between the ADHD and control groups are presented in Table 1. As expected, children in the ADHD group demonstrated significantly more parent-reported ADHD symptoms, ODD/CD symptoms, and functional impairment, and were more likely to be prescribed ADHD medication. Mothers in the ADHD group reported greater parenting stress and self-reported poor parental monitoring and supervision. Mothers in the ADHD group were also observed to

be more negative than comparison mothers during the parent-child interaction. Groups were equivalent on all other demographic and clinical characteristics. There were no group differences in baseline cortisol, AUC_g and AUC_i during the TSST or PCI.

Next, patterns of cortisol reactivity for the sample as a whole were observed during the TSST and PCI. Figure 1 depicts mean changes in maternal cortisol during the TSST across the entire sample. There was a significant increase in cortisol from Baseline to +40 minutes post TSST onset (Mean Difference $t(59) = 1.83$, $SE = .81$, $p < .001$) and from +20 to +40 minutes post TSST onset (Mean difference $t(59) = 1.59$, $SE = .49$, $p = .001$). TSST Baseline, +20 minute, and +40minute cortisol levels did not differ significantly by group (see Table 1). Thirty nine mothers (65%) demonstrated an increase in cortisol during the TSST and 21 mothers (35%) showed a decrease in cortisol. Of those mothers, 15 (71.4%) were in the comparison group. There were no significant differences in parenting stress, self-reported emotion regulation, child diagnostic group, or child deviance between those whose cortisol decreased and those who did not. Finally, changes in subjective positive and negative affect following the TSST were elicited using the PANAS. Overall, mothers reported a significant increase in negative affect ($t(59) = 6.78$, $p < .001$) but no differences in positive affect following the TSST ($t(59) = .26$, $p = .82$). These results did not differ based on change in cortisol during the TSST ($\chi^2(1, N = 60) = .001$, $p = .97$ and $\chi^2(1, N = 60) = 3.10$, $p = .08$ respectively) or by group ($\chi^2(1, N = 60) = 0$, $p = .99$ and $\chi^2(1, N = 60) = .004$, $p = .95$ respectively).

According to Aim Ia, we examined change in maternal cortisol levels during the PCI presented in Figure 2. Contrary to our hypothesis, there was a significant decrease in maternal cortisol levels from Baseline to + 30 minutes post PCI onset (Mean difference $t(59) = -.412, SE = .07, p < .001$), and Baseline to + 50 minutes post PCI onset (Mean difference $t(59) = -.631, SE = .09, p < .001$) for the sample as a whole. PCI AUC_i thus represents a change in cortisol during the parent-child interaction. In this context, higher PCI AUC_i values should be interpreted as “less of a decrease” over time rather than an index of more or less cortisol (Pruessner et al., 2003). PCI AUC_g should continue to be interpreted as a measure of total cortisol output, with greater values indicating more total cortisol output. Of note, 8 mothers (13% of sample; 4 in ADHD group and 4 in comparison group) showed an increase in cortisol over the course of the parenting-child interaction. Four of these participants were mothers of children with ADHD and had children who demonstrated significantly more deviance during the parenting-child interaction than mothers whose cortisol decreased during the parent child interaction ($F(1, 4) = 4.73, p = .03$). Finally, changes in subjective positive and negative affect following the PCI were also elicited using the PANAS. Mothers reported a significant decrease in negative affect ($t(590) = -.91, p = .01$) and a significant increase in positive affect following the PCI ($t(59) = 1.87, p = .005$). Mothers whose cortisol decreased during the PCI also reported decreased negative affect ($t(51) = -1.06, p = .004$) and increased positive affect ($t(51) = 1.88, p = .01$) after the PCI. Conversely, mothers whose cortisol levels increased during the PCI did not show significant change in negative ($t(7)$

= .71, $p = .34$) or positive ($t(7) = 1.86, p = .09$) affect after the PCI. Positive and negative affect ratings did not differ by group ($\chi^2(1, N = 60) = .73, p = .39$ and $\chi^2(1, N = 60) = .24, p = .63$ respectively). Increase and decrease in cortisol during the PCI did not differ by group ($\chi^2(1, N = 60) = .36, p = .55$).

Correlates of maternal cortisol were next examined. Maternal antidepressant, corticosteroid, stimulant, and oral contraceptive use, captured using a binary variable was positively associated with baseline cortisol during the TSST ($F(1,59) = 5.06, p = .03$). Quitting the stress task was positively associated with cortisol reactivity such that mothers who ended the task early (prior to completing the 10 minutes) showed significantly greater baseline cortisol ($F(1, 59) = 4.45, p = .04$), AUCg ($F(1, 59) = 4.49, p = .04$), and AUCi ($F(1, 59) = 6.89, p = .01$) levels during the TSST. Duration of menstrual cycle ($r(58) = .43, p = .007$) and protocol adherence ($F(1, 59) = 6.373, p = .014$) were positively associated with AUCi during the PCI. Finally, parent-reported child hyperactivity/impulsivity and disruptive behavior disorder symptoms were positively associated with PCI AUCi ($r(58) = .30, p = .03$ and $r(58) = .34, p = .01$ respectively). Maternal age, BMI, sleep quality, abnormal thyroid function as well as child medication status were not associated with cortisol variables. Associations between remaining mother-child demographics, clinical characteristics and parenting were not significant (see Table 2).

Correlates of self-reported and observed parenting were next assessed. Maternal medication status (i.e., stimulants, antidepressants, corticosteroids, and oral

contraceptives) was significantly associated with self-reported involvement ($F(1, 59) = 8.66, p=.005$) and inconsistent discipline ($F(1,59) = 5.70, p=.02$), such that mothers taking medications reported less parental involvement ($M=27.56, SD = 6.25$) and greater inconsistent discipline ($M = 9.89, SD = 3.44$) than mothers not taking medication ($M = 32.21, SD = 3.94$ and $M = 7.00, SD = 3.31$ respectively). Child medication status at the time of the visit was significantly associated with poor monitoring/supervision ($F(1,59) = 6.34, p=.02$) and corporal punishment ($F(1,59) = 4.69, p=.04$), such that mothers of children taking medication reported poorer supervision/monitoring ($M = 5.27, SD = 4.86$) and more corporal punishment ($M = 8.27, SD = 3.50$) than mothers of children not taking medication ($M = 2.65, SD = 2.55$ and $M = 7.26, SD = 3.47$, respectively). Observed child deviance was positively associated with observed negative parenting ($r (58)= .49, p<.001$) and commands ($r (58)= .29, p=.03$) during the PCI. Thus, mother and child medication status were included as covariates in analyses of self-reported parenting. Observed child deviance was included as a covariate in all statistical models predicting observed parenting to control for “child effects.”

Aim I: To examine associations between maternal cortisol reactivity following the TSST and PCI and parenting among mothers of children with and without ADHD.

Main effects of TSST and PCI cortisol output and change in cortisol on self-reported and observed parenting are presented in Tables 3 and 4, respectively.

TSST. Contrary to our hypotheses, higher maternal TSST AUCg levels were associated with greater self-reported parental involvement ($\beta = 2.11, SE = 1.05, p = .05$). However, as hypothesized, higher maternal TSST AUCg levels were significantly associated with more observed negative parenting ($\beta = 1.03, SE = .23, p < .001$). Higher TSST AUCg levels were also associated with less observed positive parenting ($\beta = -.20, SE = .05, p < .001$).

Contrary to our predictions, there were no significant main effects of TSST AUCi on self-reported parenting. There were, however, significant main effects of maternal TSST AUCi on observed parenting in line with our predictions. Higher maternal TSST AUCi levels were significantly associated with less positive parenting ($\beta = -.10, SE = .03, p < .001$) and more negative parenting ($\beta = .41, SE = .14, p < .01$), commands ($\beta = .05, SE = .02, p = .03$), and “no opportunity to comply” commands ($\beta = .07, SE = .03, p = .02$) during the PCI.

PCI. There were significant main effects of maternal PCI AUCg and AUCi on self-reported and observed parenting during the PCI. Contrary to our hypotheses, higher maternal PCI AUCg levels were significantly associated with more self-reported parenting involvement ($\beta = 2.95, SE = 1.28, p = .03$), self-reported positive parenting ($\beta = 2.03, SE = .85, p = .02$) and observed positive parenting ($\beta = .06, SE = .07, p < .001$). Higher levels of maternal PCI AUCg were associated with less observed negative parenting ($\beta = -1.01, SE = .27, p < .001$).

Higher maternal PCI AUC_i levels was significantly associated with less self-reported involvement ($\beta = -1.28, SE = .63, p < .001$), observed positive parenting ($\beta = -.19, SE = .02, p < .001$) and “no opportunity to comply” commands ($\beta = -.05, SE = .03, p = .049$).

Aim II: To examine child ADHD group as a moderator of the association between maternal cortisol reactivity and parenting.

Next, we examined child ADHD group as a moderator of the association between maternal cortisol reactivity during the TSST and PCI and parenting. Results are presented in Tables 5 and 6, respectively.

TSST. Consistent with our hypothesis and as shown in Figure 3, there were significant interactions between maternal TSST AUC_g and child ADHD group on observed commands ($\beta = -.34, SE = .13, p = .01$) and “no opportunity to comply” commands ($\beta = -.37, SE = .14, p = .008$). For comparison mothers, higher levels of TSST AUC_g were significantly associated with fewer observed commands ($\beta = -.16, SE = .08, p = .04$). In contrast, for mothers of children with ADHD, TSST AUC_g was not significantly associated with observed commands ($\beta = -.17, SE = .10, p = .11$). In addition, as shown in Figure 4, for comparison mothers, higher levels of TSST AUC_g was associated with fewer observed “no opportunity to comply” commands ($\beta = -.20, SE = .08, p = .01$) whereas for mothers of children with ADHD, TSST AUC_g was not

significantly associated with observed “no opportunity to comply” commands ($\beta = .17$, $SE = .11$, $p = .14$).

Contrary to our hypotheses, there were no significant interactions between TSST AUC_i and child ADHD group on self-reported or observed parenting, as presented in Table 6.

PCI. Consistent with our hypothesis, and shown in Figure 5, there was a significant interaction between maternal PCI AUC_g and child ADHD group on self-reported inconsistent discipline ($\beta = 2.47$, $SE = .78$, $p = .002$) and observed negative parenting ($\beta = .36$, $SE = .14$, $p = .01$). For mothers of children with ADHD, higher levels of PCI AUC_g were significantly associated with less self-reported inconsistent discipline ($\beta = -1.55$, $SE = .50$, $p = .002$). In contrast, for comparison mothers, higher levels of PCI AUC_g was not significantly associated with self-reported inconsistent discipline ($\beta = .92$, $SE = .58$, $p = .11$). Additionally, as shown in Figure 6, for mothers of children with ADHD, lower levels of PCI AUC_g were significantly associated with more observed negative parenting ($\beta = -.23$, $SE = .09$, $p = .02$), whereas for comparison mothers, PCI AUC_g was not significantly associated with observed negative parenting ($\beta = .13$, $SE = .11$, $p = .22$).

There were also significant interactions between maternal PCI AUC_i and child ADHD group on self-reported inconsistent discipline ($\beta = -2.01$, $SE = .86$, $p = .02$) and corporal punishment ($\beta = -.73$, $SE = .33$, $p = .03$) as shown in Figure 7. For mothers of children with ADHD, lower PCI AUC_i levels were associated with more self-reported

inconsistent discipline ($\beta = 1.41, SE = .50, p = .005$). In contrast, for comparison mothers, PCI AUCi was not significantly associated with self-reported inconsistent discipline ($\beta = -.67, SE = .73, p = .36$). Similarly, as shown in Figure 8, for mothers of children with ADHD, lower PCI AUCi levels were significantly associated with more self-reported corporal punishment ($\beta = .55, SE = .20, p = .006$), whereas for comparison mothers, there was no significant association between PCI AUCi and self-reported corporal punishment ($\beta = -.30, SE = .29, p = .30$). Contrary to our hypothesis, there were no significant interactive effects of maternal PCI AUCi levels and child ADHD group on observed positive parenting ($\beta = -.55, SE = .84, p = .51$), negative parenting ($\beta = -.52, SE = .53, p = .33$), commands ($\beta = -.41, SE = .54, p = .44$), and “no opportunity to comply” commands ($\beta = -.55, SE = .56, p = .33$).

Aim III: To examine the association between maternal cortisol reactivity following the laboratory stressors and self-reported maternal depression symptoms, ADHD symptoms, parenting stress, and emotion regulation.

Finally, we examined the association between indices of maternal cortisol reactivity during the TSST and PCI with self-reported maternal depression symptoms, ADHD symptoms, parenting stress and emotion regulation. Table 7 shows that there were no significant associations between cortisol levels during the TSST and self-reported maternal depression symptoms, ADHD symptoms, parenting stress and emotion regulation. Also contrary to our hypothesis, maternal depression symptoms were not

significantly associated with AUCg or AUCi cortisol levels across the laboratory stressors. Also contrary to our hypothesis, greater self-reported maternal inattentive symptoms on the CAARS were significantly associated with lower baseline cortisol levels during the PCI ($r(58) = -.28, p < .05$). Greater lack of emotional awareness on the DERS was significantly associated with lower levels of PCI AUCg ($r(58) = -.27, p < .05$). Higher PCI AUCi levels were significantly associated with more difficult parent-child interactions ($r(58) = .28, p < .05$), stress related to parenting a difficult child ($r(58) = .36, p < .01$), and total parenting stress ($r(58) = .29, p < .05$). Finally, contrary to our hypothesis, higher PCI baseline cortisol levels were also associated with less stress related to parenting a difficult child on the PSI ($r(58) = -.29, p < .05$).

Discussion

This study examined associations between parenting and maternal cortisol reactivity elicited using a well-established laboratory stressor paradigm and a parent-child interaction in mothers of children with and without ADHD. This study also examined child ADHD group as a moderator of these associations, with the hypothesis that associations between cortisol reactivity and parenting would be stronger in families of children with ADHD. Results indicated significant main effects of maternal cortisol levels on maternal positive parenting, negative parenting, involvement and directiveness. Moreover, child ADHD group moderated the association between maternal cortisol

reactivity and inconsistent discipline, directiveness, negative parenting, and use of corporal punishment. This was the first study, to our knowledge, to examine child ADHD as moderator of the association between maternal cortisol reactivity and parenting.

Unlike prior studies of cortisol reactivity and parenting, we measured maternal stress response using both an established laboratory paradigm as well as an ecologically valid parent-child interaction. The majority of the mothers participating in our study demonstrated a significant increase in cortisol levels during the TSST. This is consistent with previous studies that found reliable increases in cortisol using this laboratory stress paradigm (Dickerson & Kemeny, 2004). Additionally, mothers overall demonstrated a significant increase in subjective negative affect following the TSST, even those mothers whose cortisol levels decreased during the TSST. This difference between indices of objective and subjective stress is consistent with literature showing that change in subjective distress does not necessarily predict changes in cortisol levels (Hellhammer & Schubert, 2012). Different methods (i.e., physiological and self-report) may capture different aspects of maternal stress (Campbell & Ehlert, 2011). Therefore, it is important to utilize both self-report and objective measures when examining maternal stress in the parenting context.

Contrary to our expectations, maternal cortisol levels significantly *decreased* over the course of the laboratory parent-child interaction task for a majority of mothers. Ratings of subjective distress were consistent with changes in cortisol during the PCI. Specifically, mothers self-reported positive affect increased during the PCI while

negative affect significantly decreased. It is possible that the PCI, although ecologically valid and more relevant to parenting, was not sufficiently challenging to elicit an increase in cortisol. Results of a seminal meta-analysis determined that paradigms that had elements of perceived failure, uncontrollability, and social evaluated threat produced the most reliable physiological responses (Dickerson and Kemeny, 2004). It is possible that, on average, mothers did not perceive the PCI as socially threatening or child behavior as uncontrollable during the interaction. Interestingly, children of mothers whose cortisol increased during the parent-child interaction demonstrated significantly greater noncompliance and negative talk than mothers whose cortisol decreased during the PCI. Mothers who did not demonstrate a decrease in cortisol output also did not report changes in negative or positive affect during the PCI, which contrasts the decrease of negative affect shown by the majority of mothers. It is possible that high levels of child negative behavior during the PCI represents an uncontrollable stressor or a failure to effectively manage child behavior, which sufficiently increased cortisol levels in line with the Dickerson and Kemeny (2004) meta-analysis. However, because child negative behavior was not standardized (i.e., children varied in how much negative behavior they displayed), we were unable to ensure that the interaction was challenging enough to elicit a cortisol increase among all mothers. These findings underscore the importance of assessing maternal stress using both methodologically- and ecologically-valid methods.

Associations between maternal cortisol reactivity and parenting were quite different in the context of the TSST and PCI. During the TSST, there were significant

main effects of AUC_g on observed positive and negative parenting, as well as self-reported involvement. Indeed, greater total cortisol output during the TSST predicted less observed positive parenting and more negative parenting, in line with our predictions. Similarly, there were main effects of TSST AUC_i on parenting such that higher levels of AUC_i were associated with less positive and more negative and directive observed parenting. These findings are consistent with previous studies linking greater stress reactivity to more maladaptive parenting. Martorell and Bugental (2006) found associations between stress and parenting among mothers of toddlers such that harsh parenting was associated with greater cortisol reactivity during a mother-child laboratory separation. Indeed, greater total cortisol output during an established laboratory stressor (like the TSST) may be a biological marker for more negative and less positive parenting.

At the same time, higher TSST AUC_g was associated with more self-reported parental involvement, contrary to our prediction. One potential explanation for this finding is that higher cortisol may represent the physiological activation required to be engaged and consistent. Indeed, infant studies have demonstrated that cortisol levels were positively associated with engaged and responsive caregiving (Thompson & Trevathan, 2008). Moreover, physiological activation and parental involvement in the context of stress, may reflect the “tend and befriend” stress response that has been demonstrated in animal and human studies (Taylor, Klein, Lewis, Gruenwal, Gurung, & Updegraff, 2000). In other words, females have a greater tendency to nurture offspring (grooming in the case of animal models) to promote safety and reduce distress, which also serves to

activate and strengthen attachment systems in the context of a stressful separation (Taylor, et al., 2000). In this context, greater stress reactivity may prompt mothers to become more involved in their children's daily activities in order to strengthen attachment and reduce parenting stress.

Child ADHD group moderated the relationship between total cortisol output (AUCg) during the TSST and parenting directiveness, such that higher levels of cortisol output were associated with decreased use of total commands overall and rapid fire commands among comparison mothers only. Contrary to our prediction, there was no significant association between directiveness and AUCg levels among mothers of children with ADHD. Among comparison mothers, the relationship between reduced directiveness and physiological stress may represent an emotion regulation strategy such that stressed mothers may avoid giving commands to their children due to the taxing demands required to follow through with them (Stuge-Apple, Davies, Cicchetti, & Cummings, 2009). Among mothers of children with ADHD, maternal directiveness may be more strongly related to negative child behavior than to maternal cortisol levels, as evidenced by significant correlations between the frequency of commands and child deviance observed during the parent-child interaction.

A different pattern of results was found with respect to cortisol reactivity during the PCI. There were significant main effects of total cortisol output (AUCg) during the PCI and self-reported and observed parenting. Specifically, higher cortisol AUCg levels predicted less negative parenting, more parental involvement, and more positive

parenting (both self-reported and observed). In the context of the parent-child interaction (but in contrast to what was found during the TSST), higher levels of AUCg may be a marker for more positive and responsive parenting, consistent with the findings of Thompson and colleagues (2008). Similarly, mothers likely found the parent-child interaction enjoyable, as indicated by the significant increase in positive affect following the PCI. Thus higher AUCg levels may indicate significant magnitude of change in the direction of reduced cortisol output in response to an enjoyable event.

Additional evidence for this was found in our moderator analyses. Lower total cortisol output (AUCg) during the PCI was associated with higher self-reported inconsistent discipline and observed negative parenting among mothers of children with ADHD but not comparison mothers. One possible explanation is that lower AUCg levels over the course of a parent-child interaction may reflect hypocortisolism, which has been associated with prolonged exposure to chronic environmental stress (Lupien, King, Meaney, & McEwen, 2001). Indeed, as we theorized, parenting a child with ADHD may represent a chronic stressor (Johnston & Mash, 2001). Merwin and colleagues (2015) observed a similar moderating role of child temperament on the association between hostile parenting and maternal cortisol awakening response (CAR) such that mothers who showed lower mean cortisol output (AUCg) at waking demonstrated greater hostile parenting during an observational parent-child interaction task. Additionally, other studies have found a stronger association between parenting stress and lower cortisol levels throughout the day among mothers of children with cerebral palsy (Bella et al.,

2011). The current study contributes to the literature by demonstrating the moderating role of child ADHD group on the relationship between parenting and AUCg captured in real time. Our findings suggest that mothers with physiological profiles that reflect chronic allostatic load (Heim et al., 2000) and who parent a difficult child, may rely on less effective parenting strategies, such as inconsistent discipline or negative parenting, to manage child behavior. Conversely, greater activation (i.e., more change in cortisol) may be needed during parent-child interactions to effectively parent a child with ADHD.

Results also indicated significant main effects of change in cortisol levels (AUCi) on parental involvement and positive parenting such that higher AUCi levels during the PCI were associated with less self-reported parental involvement and less observed positive parenting. Similarly, child ADHD moderated the association between changes in cortisol (AUCi) during the PCI and self-reported inconsistent discipline and corporal punishment. Higher AUCi levels during the PCI were associated with greater self-reported inconsistent parenting and use of corporal punishment among mothers of children with ADHD. Indeed, less of a change in cortisol levels during the parent-child interaction may indicate that mothers who are less involved, less positive, more inconsistent, and more likely to use corporal punishment also show higher circulating levels of cortisol which has been associated with elevated life stress (Boyce & Ellis, 2005). These findings are consistent with existing literature demonstrating a link between less of a change in cortisol levels and problematic parenting among other of children with difficulty temperaments (Lovell et al., 2013; Merwin et al., 2015). More specifically,

flatter cortisol slopes may be one physiological indicator of elevated daily environmental stress among mother such that mothers whose curves remain flat show a less effective ability to regulate cortisol output over the course of day. Using bivariate correlations, Lovell and colleagues (2013) demonstrated that a flatter diurnal cortisol slope was related to parent-reported child hyperactivity and conduct problems among a small sample of caregivers ($n = 18$) of children with autism and ADHD (Lovell, Moss, & Wetherell, 2013). Merwin and colleagues (2015) also found that child effortful control moderated the association between parental hostility and total increase in parental cortisol across wakening. More specifically, parental hostility predicted lower AUC_i levels across waking among mothers of preschool-age children with lower levels of effortful control.

When comparing our results to previous studies, there seem to be different findings with respect to total cortisol output and parenting. Studies have found associations between greater maternal cortisol reactivity and greater hostile/intrusive parenting among mothers of toddlers with inhibited or difficult temperaments (Kiel & Buss, 2013; Martorell & Bugental 2006) while we observed in our moderator analysis that greater maternal cortisol reactivity, as indicated by a significant change in cortisol, during the parent-child interaction predicted more involved and positive parenting. There are several possible explanations for the discrepancy, however. First, the Martorell and colleagues (2006) and Kiel and Buss (2013) studies utilized a mother-infant separation task and the Strange Situation Paradigm, which are well-established paradigms in developmental science. These authors were able to elicit an increase in maternal cortisol

levels during these tasks, whereas the PCI paradigm utilized in our study resulted in a significant decrease in cortisol, despite the challenging nature of the tasks. The parent-child interaction paradigm used in this study included a complex multi-step clean-up task during which parents could not provide physical help, which is a challenging every-day parenting task. Similarly, our PCI paradigm included a task during which mothers were instructed to help their children with homework. Difficulty with homework completion is often a primary concern and a daily source of stress for parents of children with ADHD (Raggi, Chronis-Tuscano, Fishbein, & Groomes, 2009). It is possible that the structured, one-to-one, distraction-free environment of the laboratory resulted in less of a need for mothers to keep their children on-task and compliant relative to what would be required in the home environment. As such, mothers may have found that interacting with their children was an enjoyable activity and thus demonstrating lower cortisol levels over time. Future studies may consider selecting a parent-child laboratory paradigm that is more stressful (perhaps by adding an element of evaluation or by standardizing child misbehavior) or conducted in a more naturalistic environment. Researchers can then determine if parenting and cortisol associations observed in the current study remain consistent in the context of increased cortisol.

It is also possible that the directionality of cortisol and parenting discrepancies are linked to methodological differences in how reactivity is estimated. More specifically, Martorell and colleagues (2006) and Kiel and Buss (2013) studies utilized within-subject repeated measures ANOVA, which is a statistical method for analyzing repeated

measures over time. A drawback to this statistical method is that it yields a single estimate of change in cortisol. It does not differentiate associations between parenting and child temperament specific to AUCg versus AUCi levels (Pruessner et al., 2003) and thus may lose valuable information contained in both components of a stress response. When we examined differences in AUCg and AUCi in our study, AUCg did in fact yield similar associations in the direction found by Martorell et al. (2006) and Kiel et al. (2013). Unlike these studies, however, we were also able to extend this finding by demonstrating differential associations with AUCi, providing valuable information about the components of maternal physiological stress response and parenting.

Finally, the association between maternal cortisol reactivity and parenting may be specific to different levels of cortisol wherein the association between challenging parenting contexts and quality of parenting is specific to mothers who show high (exaggerated) or low (blunted) cortisol reactivity. It is possible that mothers of children with ADHD who evidence attenuated/exaggerated stress responses, a marker of physiological dysregulation, show more problematic/adaptive parenting, whereas mothers who demonstrate moderate reactivity (marker for typical physiological regulation; Sturge-Apple et al., 2011) show no differences in parenting specific to child ADHD group. Future studies should thus utilize the Johnson-Neyman guidelines for testing regions of significance (Johnson & Fay, 1950; Merwin et al., 2015) to determine at what level cortisol moderates the association between child ADHD group and parenting.

Results of Aim III analyses were generally consistent with our predictions. Greater self-reported parenting stress was associated with less of a decrease in cortisol levels during the PCI only. Interestingly, greater maternal ADHD symptoms and lack of emotional awareness predicted lower PCI baseline and AUCg cortisol levels. In this context, inattentiveness and lack of emotional awareness may be protective against elevated physiological stress, at least temporarily, such that mothers may notice or attend to fewer stressors in their environment. Moreover, inattention or lack of emotional awareness may represent one aspect of emotion regulation wherein mothers cope with stress through interpersonal disengagement (Sturge-Apple et al., 2009). This strategy may be less effective in the parenting context as it has been associated with greater inconsistent and psychologically controlling parenting among mothers of six-year-old children (Sturge-Apple et al., 2009). Additional studies can build upon the results of this study to examine the moderating role of maternal stress reactivity on the association between maternal ADHD symptoms and parenting. Moreover, future studies should examine the effectiveness of withdrawal or disengagement as an emotion regulation strategy in the context of parenting a child with ADHD, particularly among parents with ADHD symptoms (Mazursky-Horowitz et al., 2014). Contrary to our hypothesis, greater parent-reported difficult child stress was negatively associated with baseline cortisol levels. This association again replicates findings of previous studies wherein mothers of toddlers and preschoolers with difficult temperaments demonstrated lower cortisol levels (Lovell et al., 2013; Merwin et al., 2015). Finally, we did not observe significant

associations between maternal cortisol and maternal depressive symptoms, which may be attributed to the relatively limited range of symptoms endorsed.

Contrary to our hypotheses, we did not find significant main effects of child ADHD group on cortisol reactivity during the PCI or the TSST. Conversely, when we examined child symptoms continuously, we observed significant positive associations between parent-reported hyperactivity/impulsivity symptoms and change in cortisol during the PCI. One explanation may be that we had greater statistical power to detect associations using continuous symptom ratings of the entire sample (Frazier, Youngstrom, & Naugle, 2007). Our conceptualization of ADHD may also account for our lack of main effects. Taxometric analyses have found strong evidence that ADHD is best represented dimensionally rather than categorically (Marcus & Barry, 2011). Another potential explanation may be that child behavior problems and hyperactivity/impulsivity symptoms predict greater parenting stress than ADHD symptoms alone (Theule et al., 2013). On the other hand, utilizing diagnostic group as a moderator likely maximized our likelihood of finding group differences between comparison mothers and mothers of children with ADHD. Children in the ADHD group were required to demonstrate clinically significant symptoms of ADHD that result in significant functional impairment in at least two settings. We expected that this level of impairment would be related to significant maternal stress. It may be important for future studies to consider the association between both continuous and categorical classification of child ADHD symptoms. Future studies should also examine the specificity of the association between

child ADHD and disruptive behavior disorder symptoms and maternal physiological stress reactivity.

Results of this study should be considered in light of numerous limitations. First, we did not assess lifetime history of trauma or early life adversity. Childhood abuse among mothers has been shown to predict HPA axis functioning in adulthood (Brand, Brennan, Newport, Smith, Weiss, & Stowe, 2010). Thus, it is important to account for the effect of trauma and life adversity on maternal physiological stress reactivity (for review see Frodl & O'Keane, 2013) and parenting (Gonzalez, Jenkins, Steiner, & Fleming, 2012). Next, the study was likely underpowered. Given the large number of marginal findings, it is likely that a larger sample size would have increased our ability detect significant group differences. We were also unable to standardize child misbehavior during the parent-child interaction, which was associated with differences in maternal stress reactivity during the PCI. Future studies should consider standardizing child behavior (e.g., perhaps through use of child confederates/actors; Pelham et al., 1999) during the PCI to control for the effects of child behavior on maternal stress during the PCI. Also, we were unable to exclude participants on the basis of use of oral contraceptives, antidepressants, corticosteroids, and stimulants among mothers, which is considered a more conservative approach (Granger et al., 2009). However, there are significant drawbacks to this approach for our population that would have negatively impacted the generalizability of our study. Approximately 8.7 to 16.9% of women between the ages of 25 and 44 use oral contraceptives (Daniels, Daugherty, & Jones,

2014), and 9.2 to 22.8% of women between the ages of 18 and 59 take antidepressant medication (Pratt, Brody, Qiuping, & Gu, 2011), thus representing a significant proportion of mothers of children in our age group. Among mothers of children with clinical disorders, there are likely to be far higher rates of psychopathology (Chronis et al., 2003). Thus excluding on the basis of medication would exclude an important segment of the population of interest. Future studies should consider the costs and benefits of excluding mothers on the basis of medication use, particularly for clinical samples.

Finally, due to the cross sectional nature of the study, we are unable to draw causal conclusions regarding the nature of child ADHD group, maternal cortisol reactivity, and parenting. Specifically, we are unable to determine if parenting a child with ADHD causes differences in maternal cortisol responses above and beyond other factors such as early life adversity and shared genetic effects. Alternatively, we are unable to determine if mothers who frequently engage in directive, avoidant, inconsistent, or negative parenting maintain or exacerbate problem behaviors among their children (Patterson et al., 1982), which then over time shape maternal stress and well-being (Raposa et al., 2011). Longitudinal studies are needed to examine parenting and maternal physiological stress over time in order to establish causal relationships. Moreover, longitudinal studies should include measures of early life adversity and trauma history to control for the effects of early life experiences on current maternal reactivity. Finally, we did not assess maternal genetics as predictors of cortisol reactivity and positive parenting. Future studies may consider the contribution of maternal genetics on cortisol reactivity

(for review see Miller, Wankerl, Stalder, Kirschbaum, & Alexander, 2013) and positive parenting among mothers of children with and without ADHD (Lee et al., 2010; Michaslska et al., 2014).

Despite these limitations, this study had a number of methodological strengths. First, this study utilized comprehensive, gold-standard assessment methods for child ADHD. The current study was the first to assess maternal cortisol stress reactivity across two tasks, an established laboratory stressor paradigm and an ecologically-valid parent-child interaction, each yielding differential associations with parenting. Greater total cortisol output and greater increase in cortisol during the TSST were associated with decreased positive parenting and increased negative and directive parenting, with the exception of parental involvement, which was associated with increased cortisol output during the TSST. Conversely, cortisol output during the PCI was associated with increased positive parenting, increased parental involvement, and decreased negative parenting. In contrast to the TSST, a greater decrease in cortisol during the PCI indicated more positive parenting and parental involvement. These associations were specific to mothers of children with ADHD, with the exception of maternal directiveness, which was specific to comparison mothers. Our findings underscore the importance of assessing maternal cortisol reactivity across different contexts in order to gain a comprehensive picture of the relationship between maternal physiological regulation and parenting.

Another strength of the current study was the multi-method assessment of parenting. The use of both self-report and observational parenting measures allowed us to

capture both parenting behavior and cortisol reactivity in real-time, free of reporting bias. This study also utilized self-reported measures of parenting stress and positive and negative affect during the laboratory tasks. This provided valuable information about the relationship between subjective measures of distress and cortisol reactivity which can inform our interpretation and understanding of biological markers of stress.

In sum, the current study extended the current literature examining associations between maternal physiological reactivity and parenting among school aged children with and without ADHD. These findings underscore the importance of maternal physiological regulation and parenting, particularly among mothers of children with ADHD. Specifically, child characteristics and contextual challenges appear to play a key role in the relationship between maternal responses to stress (in general as well as in parenting contexts) and the quality of parenting. Results also support the integration of maternal stress regulation strategies into standard behavioral parent training programs, particularly for mothers of children with ADHD. Studies should integrate strategies such as relaxation and pleasant activity scheduling to reduce parental stress, decrease negative/harsh parenting as well as improve discipline and increase positive parenting and engagement (Chronis-Tuscano et al, 2013; Chronis-Tuscano, Lewis-Morrarty, Woods, O'Brien, Mazursky-Horowitz, & Thomas, 2014; Maliken & Katz, 2013).

Appendix A. Tables and Figures

Table 1

Baseline Demographic and Clinical Characteristics by Group

	Comparison (n=36)		ADHD (n=24)		Total (n=60)		Test Statistic (χ^2 , <i>F</i>)	<i>p</i> -value
<u>Child Characteristics</u>								
Child Male Gender <i>n</i> (%)	20	55.6	18	75	38	64.4	3.16	0.08
Child Age <i>M</i> (<i>SD</i>)	7.25	1.93	7.55	2.48	7.37	0.28	0.28	0.60
Child Symptoms <i>M</i> (<i>SD</i>)								
ADHD-Inattentive	1.00	1.70	6.65	2.13	3.06	3.31	116.68	0.00
ADHD-H/I	1.63	2.02	5.50	2.35	3.04	2.84	41.58	0.00
ODD/CD	0.14	0.49	0.60	1.19	0.31	0.84	4.02	0.05
Impairment	0.87	1.07	2.80	1.06	1.56	1.41	45.85	0.00
Observed Child Deviance	7.37	8.25	9.05	6.37	8.02	7.56	1.84	0.18
Child Medicated <i>n</i> (%)	0	0	11	18.3	3	4.9	20.69	0.00
<u>Maternal Characteristics</u>								
Married <i>n</i> (%)	31	86.1	14	58.3	45	76.3	5.84	0.12
Maternal Age <i>M</i> (<i>SD</i>)	39.89	6.42	42.83	5.92	41.05	6.34	3.09	0.08
Race <i>n</i> (%)							0.04	0.85
White/Caucasian	20	55.6	13	54	33	55.0		
Black/African-American	10	27.2	6	25	16	26.7		
Hispanic or Latino	1	2.8	0	0	1	1.6		
Multiracial	2	5.6	5	21	7	11.7		
Asian	3	8.3	0	0	3	5.0		
Maternal Education <i>n</i> (%)							8.23	0.14
High School	0	0	2	8.7	3	5.1		
Some College	1	2.8	4	17.3	4	6.8		
Bachelor's Degree	11	30.6	7	30.4	18	30.5		
Master's Degree	20	55.6	8	34.8	28	47.5		
Doctorate	4	11.1	2	8.7	6	10.2		
Medicated <i>n</i> , %	8	21.6	3	12.5	11	18	0.82	0.37
BMI <i>M</i> (<i>SD</i>)	25.52	6.26	30.75	8.03	27.63	7.42	7.62	0.01
<u>Self-reported Parenting</u>								
APQ <i>M</i> (<i>SD</i>)								
Involvement <i>M</i> (<i>SD</i>)	31.118	5.00	32	4.11	31.47	4.64	0.49	0.49
Positive <i>M</i> (<i>SD</i>)	19.1	3.3	19.0	2.6	19.1	3.0	0.0	0.99
Poor Monitor/Superv. <i>M</i> (<i>SD</i>)	2.4	2.2	4.3	4.2	3.2	3.2	5.17	0.03
Inconsistent Discipline <i>M</i> (<i>SD</i>)	7.2	3.7	7.8	3.1	7.5	3.5	0.43	0.51
Corporal Punishment <i>M</i> (<i>SD</i>)	0.9	1.2	1.3	1.5	1.1	1.3	1.10	0.30
<u>Observed Parenting</u>								

Positive <i>M (SD)</i>	29.27	31.52	21.91	15.89	26.39	26.62	0.35	0.56
Negative <i>M (SD)</i>	6.96	5.19	11.06	6.29	8.55	5.95	5.54	0.02
Commands <i>M (SD)</i>	36.81	23.34	42.78	20.73	39.14	22.37	1.50	0.23
No Opportunity to Comply <i>M (SD)</i>	21.12	13.83	24.54	13.09	22.45	13.54	1.39	0.24
<u>Maternal Clinical Characteristics</u>								
BDI <i>M (SD)</i>	8.35	6.88	11.18	7.56	9.46	7.23	2.09	.15
CAARS Inattentive <i>M (SD)</i>	37.90	14.09	38.65	13.33	38.20	13.67	0.04	.85
CAARS Hyper/Imp <i>M (SD)</i>	29.29	11.12	33.10	15.49	30.78	13.00	1.05	.31
CAARS Total <i>M (SD)</i>	67.19	22.33	71.75	25.40	68.98	23.44	0.45	.50
DERs awareness <i>M (SD)</i>	12.71	4.01	13.05	5.79	12.84	4.74	0.07	.80
DERs clarity <i>M (SD)</i>	8.62	2.67	8.86	2.74	8.71	2.68	0.10	.75
DERs goals <i>M (SD)</i>	11.47	4.53	13.23	4.87	12.16	4.70	1.90	.17
DERs impulse <i>M (SD)</i>	9.21	3.71	11.36	4.85	10.05	4.28	3.55	.07
DERs nonaccept <i>M (SD)</i>	11.68	5.07	12.05	6.93	11.82	5.82	0.05	.82
DERs strategy <i>M (SD)</i>	13.50	5.34	15.23	5.85	14.18	5.56	1.30	.26
DERs total <i>M (SD)</i>	67.18	19.53	73.36	25.69	69.61	22.14	1.04	.31
PSI Difficult Child <i>M (SD)</i>	30.97	7.85	39.00	8.84	34.13	9.08	12.65	.00
PSI Distress <i>M (SD)</i>	27.00	8.32	28.96	10.14	27.79	9.06	0.64	.43
PSI PCDI <i>M (SD)</i>	21.41	5.02	27.30	6.72	23.79	6.41	14.37	.00
PSI Total <i>M (SD)</i>	79.38	17.08	93.57	22.79	85.11	20.62	7.21	.01
<u>Cortisol <i>M (SD)</i></u>								
TSST Baseline (nmol/L)	2.52	1.99	2.41	1.54	2.47	1.82	0.08	0.78
PCI Baseline (nmol/L)	2.16	1.01	2.01	0.98	2.10	0.99	0.21	0.65
TSST AUCg (nmol/L)	13.28	9.26	13.71	8.46	13.45	8.88	0.03	0.86
TSST AUCi (nmol/L)	2.15	8.69	2.93	5.59	2.46	7.57	1.02	0.31
PCI AUCg (nmol/L)	9.65	4.25	9.63	4.64	9.64	4.37	0.25	0.62
PCI AUCi (nmol/L)	-1.88	1.52	-1.19	2.56	-1.61	2.01	0.15	0.7

Note. *M* = Mean; *SD* = Standard Deviation; ADHD = Attention-Deficit/Hyperactivity Disorder; H/I =

Hyperactive/Impulsive; PI = Predominately Inattentive; BDI = Beck Depression Inventory; DBD = Disruptive Behavior Disorder includes Conduct Disorder and Oppositional Defiant Disorder symptoms; Dx = Diagnosis.

Contingency table analyses and One-way ANOVAs were conducted. Raw cortisol values are entered in the table. Log transformed cortisol values were used to determine group difference, controlling for maternal menstrual cycle and protocol adherence.

Note. ADHD = Attention-Deficit/Hyperactivity Disorder; H/I = Hyperactive/Impulsive; PI= Predominately Inattentive; BDI = Beck Depression Inventory; CD= Conduct Disorder; ODD= Oppositional Defiant Disorder; Child Dev. = Child Deviance; APQ = Alabama Parenting Questionnaire; TSST = Trier Social Stress Test; PCI = Parent-Child Interaction; AUC = Area Under the Curve .

* $p < .05$. ** $p < .01$ (2-tailed).

Table 3
Main effects of Maternal Cortisol Output on Self-Reported and Observed Parenting

	TSST AUCg				PCI AUCg			
	β	SE	<i>p</i> value	Partial	β	SE	<i>p</i> value	Partial
<u>Self-report</u>								
Involvement	2.11	1.05	0.05	0.27	2.95	1.28	0.03	0.31
Positive	0.51	0.73	0.49	0.1	2.03	0.85	0.02	0.32
Poor Monitor/Super.	0.43	0.7	0.54	0.09	-1.05	0.85	0.22	-0.17
Inconsistent Discipline	0.58	0.82	0.48	0.1	-0.42	0.99	0.68	-0.06
Corporal Punishment	0.51	0.29	0.08	0.24	-0.08	0.37	0.83	0.03
<u>Observed</u>								
Positive	-0.20	0.05	<0.001		0.60	0.07	<0.001	
Negative	1.03	0.23	<0.001		-1.01	0.27	<0.001	
Total Commands	0.01	0.04	0.85		-0.06	0.04	0.15	
No Opportunity to Comply	-0.02	0.05	0.71		0.05	0.06	0.36	

Note. AUCg = Area Under the curve with respect to ground; PCI = Parent-Child Interaction; TSST = Trier

Social Stress Test; AUCi values are transformed. PCI analyses include protocol adherence and maternal menstrual cycle as covariates. Covariates for self-reported parenting were child and maternal medication status. Covariates for observed parenting was observed child deviance.

Table 4
Main effects of Maternal Cortisol Reactivity on Self-Reported and Observed Parenting

	<u>TSST AUCi</u>				<u>PCI AUCi</u>			
	β	<i>SE</i>	<i>p</i> value	Partial correlation	β	<i>SE</i>	<i>p</i> value	Partial correlation
<u>Self-report</u>								
Involvement	0.72	0.68	0.29	0.15	-1.28	0.63	0.04	-0.28
Positive	-0.18	0.45	0.69	-0.06	-0.51	0.51	0.32	-0.14
Poor Monitor/Super.	0.13	0.44	0.78	0.04	0.83	0.43	0.06	0.26
Inconsistent Discipline	0.2	0.51	0.70	0.05	0.6	0.55	0.28	0.16
Corporal Punishment	0.07	0.19	0.72	0.05	0.28	0.19	0.16	0.20
<u>Observed</u>								
Positive	-0.10	0.03	0.00		-0.19	0.02	<.001	
Negative	0.41	0.14	0.00		-0.02	0.04	0.64	
Total Commands	0.05	0.02	0.03		-0.01	0.02	0.75	
No Opportunity to Comply	0.07	0.03	0.02		-0.05	0.03	0.05	

Note. AUCi = Area Under the curve with respect to increase; PCI = Parent-Child Interaction; TSST

= Trier Social Stress Test; AUCi values are transformed. PCI analyses include protocol adherence and maternal menstrual cycle as covariates. Covariates for self-reported parenting were child and maternal medication status. Observed child deviance was included as a covariate in observe parenting analyses.

Table 5
The Interactive Effects Between AUCg and Child ADHD Group on Self-Reported and Observed parenting

	TSST AUCg				PCI AUCg			
	β	<i>SE</i>	Wald χ^2	<i>p</i> value	β	<i>SE</i>	Wald χ^2	<i>p</i> value
<u>Self-report</u>								
Involvement	-0.10	1.06	0.01	0.92	-0.08	1.11	0.01	0.94
Positive	0.02	0.73	0.01	0.98	0.87	2.65	0.11	0.74
Poor Monitor/Super.	-0.14	0.79	0.03	0.86	1.89	0.98	3.72	0.054
Inconsistent Discipline	-0.19	0.80	0.05	0.82	2.47	0.78	10.08	0.002
Corporal Punishment	0.35	0.32	1.18	0.28	0.62	0.35	3.18	0.07
<u>Observed</u>								
Positive	-0.12	0.19	0.395	0.53	0.06	0.26	0.08	0.78
Negative	-0.14	0.13	1.05	0.31	0.36	0.14	6.36	0.01
Total Commands	-0.34	0.13	6.32	0.01	0.0	0.15	0.00	0.98
No Opportunity to Comply	-0.37	0.14	6.98	0.008	0.04	0.16	0.08	0.78

Note. AUCg = Area Under the curve with respect to ground; PCI = Parent-Child Interaction; TSST = Trier Social

Stress Test; AUCi values are transformed. PCI analyses include protocol adherence and maternal menstrual cycle as covariates.

Table 6
The Interactive Effects Between Maternal AUCi and Child ADHD Group on Self-Reported and Observed parenting

	TSST AUCi				PCI AUCi			
	β	<i>SE</i>	Wald χ^2	<i>p</i> value	β	<i>SE</i>	Wald χ^2	<i>p</i> value
<u>Self-report</u>								
Involvement	0.58	1.6	0.12	0.72	-0.09	1.13	0.005	0.94
Positive	2.06	1.11	3.42	0.06	0.95	0.84	1.28	0.26
Poor Monitor/Super.	-1.27	1.09	1.37	0.24	-1.07	0.8	1.8	0.18
Inconsistent Discipline	-2.05	1.21	2.86	0.09	-2.01	0.86	5.49	0.02
Corporal Punishment	-0.22	0.47	0.21	0.65	-0.73	0.33	4.93	0.03
<u>Observed</u>								
Positive	-0.01	0.25	0.001	0.98	-0.55	0.84	0.43	0.51
Negative	-0.11	0.17	0.41	0.52	-0.52	0.53	0.96	0.33
Total Commands	-0.18	0.14	1.59	0.21	-0.41	0.54	0.59	0.44
No Opportunity to Comply	-0.22	0.15	2.20	0.14	-0.55	0.56	0.97	0.33

Note. AUCi = Area Under the curve with respect to increase; PCI = Parent-Child Interaction; TSST =

Trier Social Stress Test; AUCi values are transformed. PCI analyses include protocol adherence and maternal menstrual cycle as covariates. Covariates for self-reported parenting were child and maternal medication status. Observed child deviance was included as a covariate in observe parenting analyses.

	Comparison	ADHD	Total
Baseline	2.574	2.401	2.492
+ 20 min TSST onset	2.655	2.844	2.714
+ 40 min TSST onset	4.337	4.380	4.302

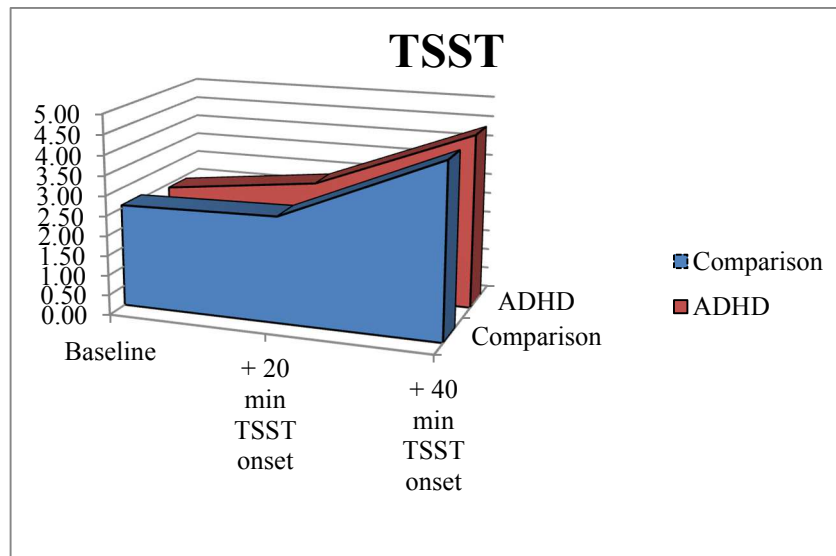


Figure 1. Mean parent cortisol level (nmol/L) during the Trier

Social Stress Test.

The graph shows mean cortisol values across TSST at baseline, 20 minutes post-onset, and 40 minutes post-onset.

	Comparison	ADHD	Total
Baseline	2.292	2.200	2.223
+ 30 min PCI onset	1.806	1.911	1.818
+ 50 min PCI onset	1.603	1.629	1.594

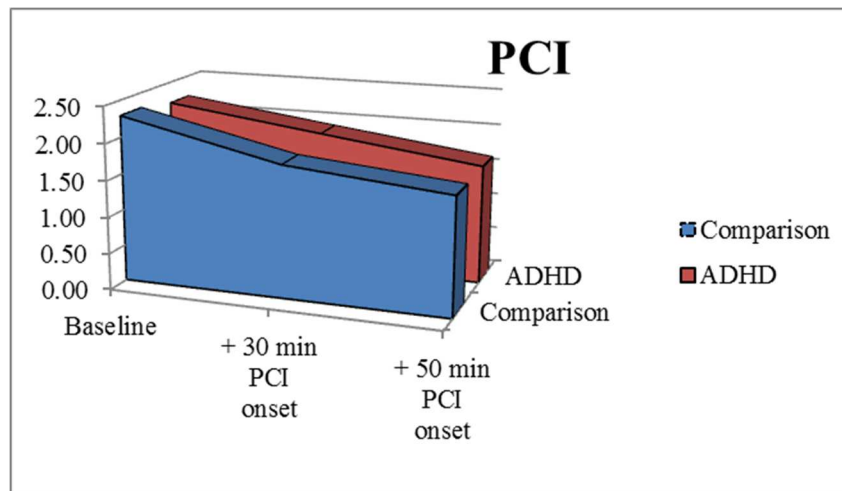


Figure 2. Mean parent cortisol level (nmol/L) during the parent-child interaction.

The graph shows mean cortisol values across PCI at baseline, 30 minutes post-onset, and 50 minutes post-onset.

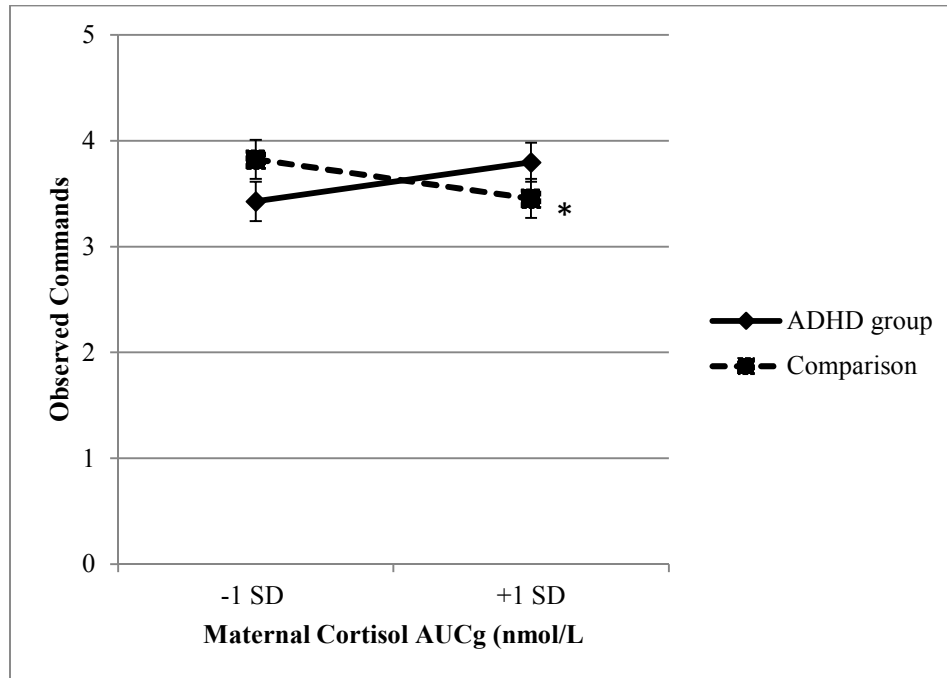


Figure 3. Observed commands as a function of the association between low (one standard deviation below the mean) and high (one standard deviation above the mean) AUCg during the TSST and child ADHD group. AUCg = Area under the curve with respect to ground; SD = Standard Deviation. Error bars represent standard errors.

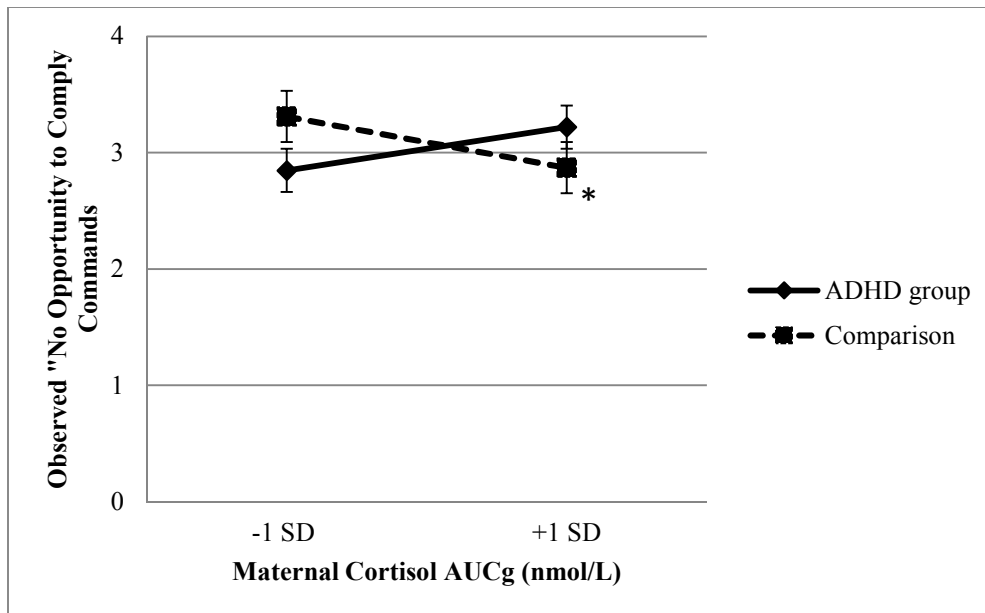


Figure 4. Observed rapid-fire commands as a function of the association between low (one standard deviation below the mean) and high (one standard deviation above the mean) AUCg during the TSST and child ADHD group. AUCg = Area under the curve with respect to ground; SD = Standard Deviation. Error bars represent standard errors.

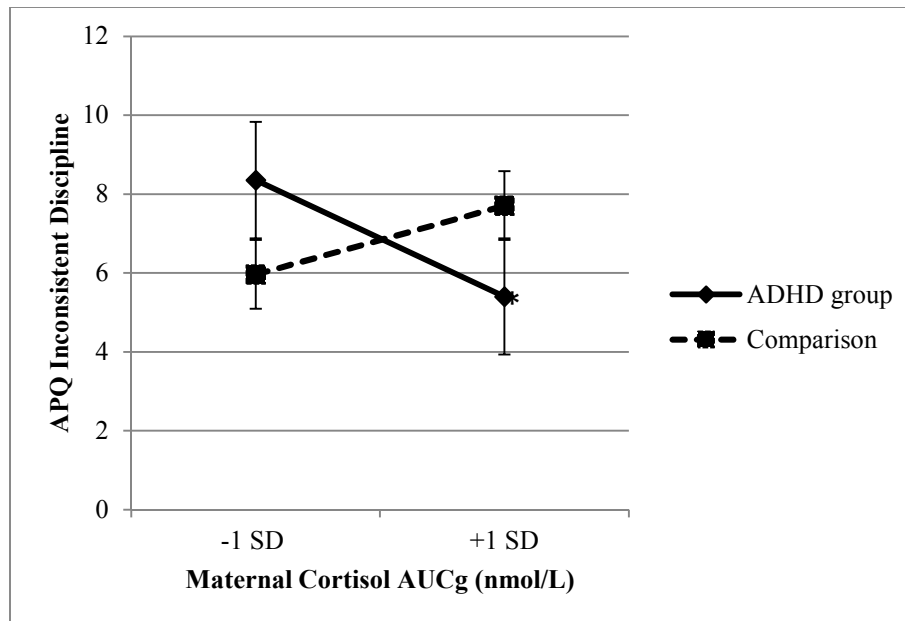


Figure 5. Self-reported inconsistent discipline as a function of the association between low (one standard deviation below the mean) and high (one standard deviation above the mean) AUCg during the PCI and child ADHD status. APQ= Alabama Parenting Questionnaire; AUCg = Area under the curve with respect to ground; SD = Standard Deviation. Error bars represent standard errors.

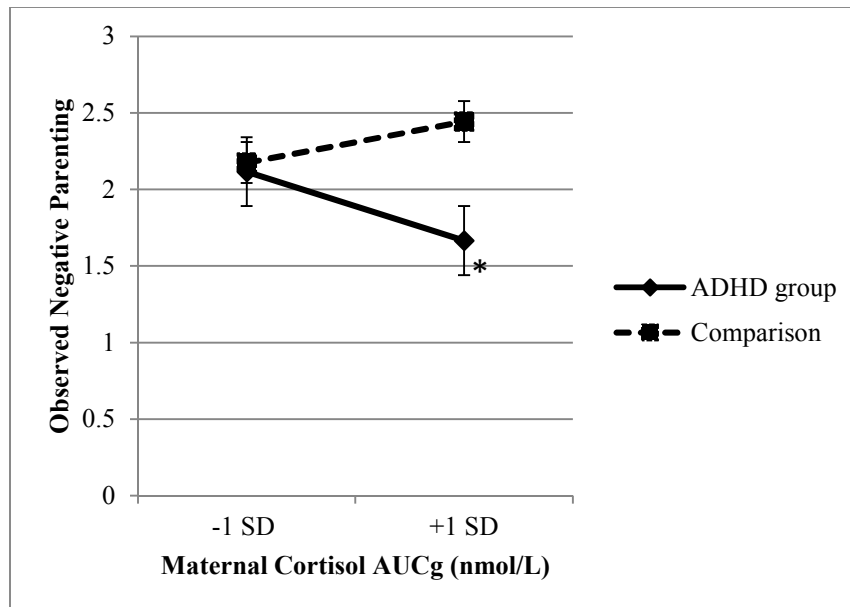


Figure 6. Observed negative parenting as a function of the association between low (one standard deviation below the mean) and high (one standard deviation above the mean) AUCg during the PCI and child ADHD group. AUCg = Area under the curve with respect to ground; SD = Standard Deviation. Error bars represent standard errors.

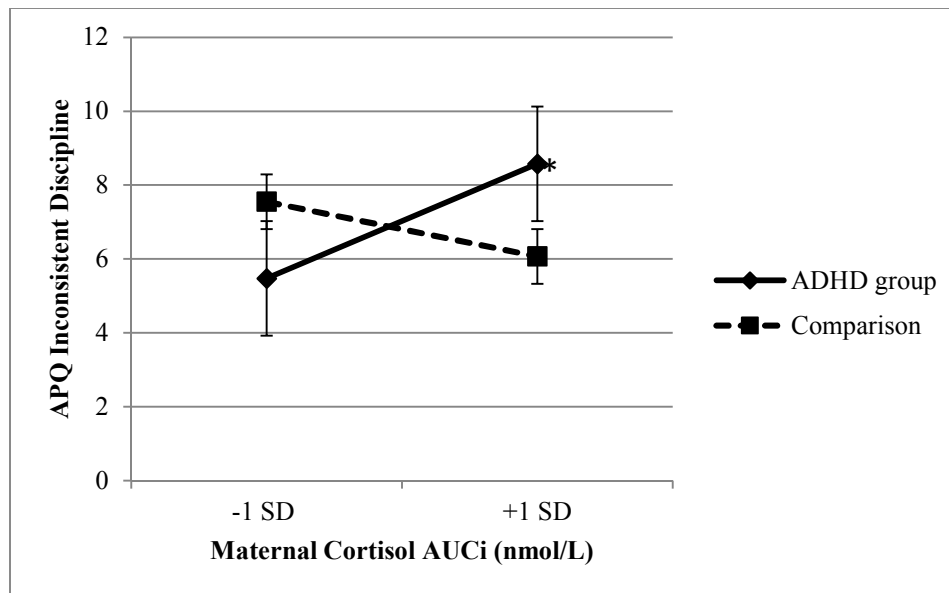


Figure 7. Self-reported inconsistent discipline as a function of the association between low (one standard deviation below the mean) and high (one standard deviation above the mean) AUCi during the PCI and child ADHD status. APQ= Alabama Parenting Questionnaire; AUCi= Area under the curve with respect to increase; SD = Standard Deviation. Error bars represent standard errors.

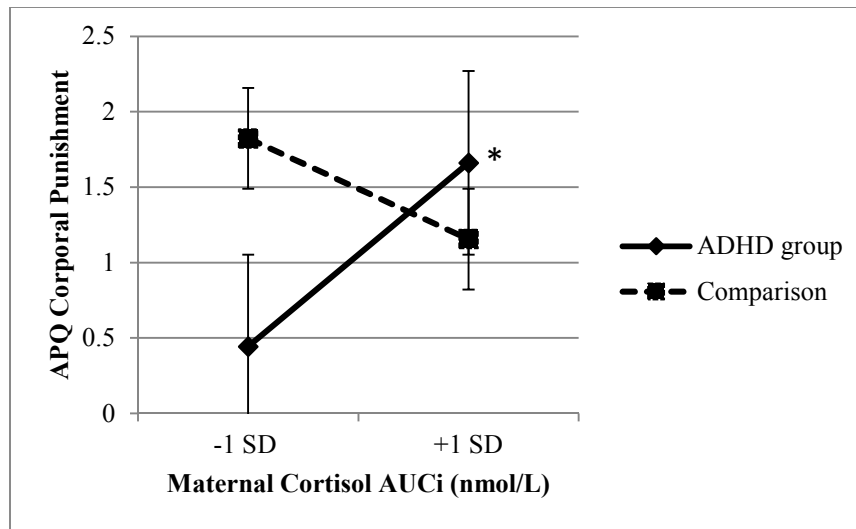


Figure 8. Self-reported corporate punishment as a function of the association between low (one standard deviation below the mean) and high (one standard deviation above the mean) AUCi during the PCI and child ADHD status. APQ= Alabama Parenting Questionnaire; AUCi= Area under the curve with respect to increase; SD = Standard Deviation. Error bars represent standard errors.

Table 7.

Correlations between maternal cortisol reactivity and maternal depression symptoms, ADHD symptoms, parenting stress, and emotion regulation.

	TSST AUCg	TSST AUCi	PCI AUCG	PCI AUCi	TSST Baseline	PCI Baseline	BDI	CAARS Inattentive	CAARS Hyper/Imp	CAARS Total	DERS awareness	DERS clarity	DERS goals	DERS impulse	DERS nonaccept	DERS strategy	DERS Total	PSI Difficult Child	PSI Distress	PSI PCDI	PSI Total
TSST AUCg	1	.343**	.126	-.036	.665**	.127	.135	.010	-.028	-.036	-.136	.211	-.086	.083	-.113	-.122	-.083	.021	-.086	-.022	-.055
TSST AUCi		1	-.003	-.099	-.369**	.014	-.150	-.023	-.036	.006	-.126	-.051	-.145	-.100	-.090	-.136	-.152	-.151	-.096	-.092	-.128
PCI AUCG			1	-.463**	.117	.921**	.038	-.233	.050	-.142	-.275*	-.046	-.134	-.188	-.005	-.064	-.151	-.167	-.134	-.107	-.171
PCI AUCi				1	.097	-.681**	.169	.269	.194	.242	.127	.240	.040	.167	.122	.106	.142	.361**	.136	.283*	.289*
TSST Baseline					1	.074	.193	.055	.022	.010	-.112	.225	-.033	.131	-.045	.012	-.005	.037	-.075	-.103	-.068
PCI Baseline						1	-.072	-.280*	-.022	-.219	-.195	-.118	-.150	-.225	-.045	-.113	-.168	-.294*	-.116	-.176	-.234
BDI							1	.259	.312*	.324*	.361**	.700**	.598**	.679**	.606**	.691**	.756**	.559**	.528**	.418**	.609**
CAARS Inattentive								1	.611**	.885**	.388**	.450**	.546**	.562**	.585**	.562**	.279*	.377**	.394**	.362**	.454**
CAARS Hyper/Imp									1	.872**	.168	.343*	.255	.235	.250	.295*	.272	.297*	.160	.347*	.312*
CAARS Total										1	.159	.255	.281*	.303*	.248	.319*	.314*	.376**	.258	.347*	.389**
DERS awareness											1	.475**	.355**	.414**	.174	.283*	.557**	.154	.187	.171	.204
DERS clarity												1	.508**	.583**	.473**	.579**	.730**	.464**	.336*	.256	.431**
DERS goals													1	.726**	.605**	.689**	.833**	.414**	.447**	.328*	.482**
DERS impulse														1	.668**	.710**	.869**	.505**	.360**	.453**	.523**
DERS nonaccept															1	.792**	.821**	.396**	.507**	.480**	.548**
DERS strategy																1	.880**	.447**	.529**	.344**	.537**
DERS Total																	1	.490**	.522**	.440**	.583**
PSI Difficult Child																		1	.509**	.658**	.871**
PSI Distress																			1	.487**	.777**
PSI PCDI																				1	.806**
PSI Total																					1

Note. M = Mean; SD = Standard Deviation; BDI = Beck Depression Inventory; CAARS = Conners Adult ADHD Rating Scale; DERS = Difficulties with Emotion Regulation Scale; PSI = Parenting Stress Index; PSI PCDI = Parenting Stress Index Parent-Child Difficult Interactions.

Appendix B. Trier Social Stress Test Protocol

Guidelines

1. During the introduction by the Receptionist, do not talk or laugh at any time.
2. All committee members should seek eye contact with the S during the speech; the knowledge that all persons present give him/her their undivided attention further reinforces the seriousness of the situation for the S.

Introduction of TSST

1. Immediately after 'Relaxation Period,' mother will be escorted by Receptionist to the Observation Room. Receptionist will knock on the Testing Room door and wait until "Committee Chair" says to "come in." The mother will be standing in front of the desk, in front of the committee, and the video camera.
2. All committee members should acknowledge the arrival of the mother with a brief nod of the head. Remain expressionless during the encounter and maintain eye contact with the subject throughout. Each of you should have a notepad on a clipboard in front of you.
3. The receptionist will give the mother the instructions to the task. After the instructions are read, the receptionist will lead the mother back into the waiting area. If the mother addresses you, only return the greeting courteously or say "Any questions should be directed to X, rather than to us."
4. Please remain quietly in the observation room until the Receptionist escorted the participant back into the room.

Speech Task

1. The actual task of the committee starts when the S enters the room ten minutes later to deliver his/her speech.
2. Chairperson: Turn on the video camera by hand (make sure you know the operating instructions beforehand). Turn on the small gray audio receiver. Be sure there is a steady blue light.
3. Confederate (Timer): Turn on decoy cassette recorder.
4. Chairperson: Say to participant, "Please pick up the microphone, step on the X, say your name, and begin your speech."
5. Let the S speak for the first three minutes. (In most cases the S will come to the end of the speech even before three minutes have passed. One should give the S then time to formulate additional elaborations.)
 - a. **If they do not begin within 4-5 seconds:**
"You still have some time. Please begin."
 - b. **If they stop or stall, after 3-5 seconds:**

“You still have some time. Please continue.”

- c. **If they continue to remain silent, repeat 18-20 seconds thereafter.**
- d. **If they clearly have nothing further to say, then chairperson asks questions until the end of the time period.**

- i. Why do you think that you are the best applicant for this position?
- ii. What other experiences have you had in this area?
- iii. What about your studies identifies a special aptitude and motivation for this position?
- iv. Where else did you apply? Why?
- v. What would you do, if your application here would not succeed?

****Note:** Questions should not embarrass the mother, be rude, or antagonistic ("Do you have friends?")

- e. **If subject seems to be talking about something impersonal, like school training, or about specific lessons learned during university or job training:**

Chairperson: "We believe you that you know how to execute a market analysis, but we would be more interested to find out why you were so involved in or drawn to this area."

- f. **If subject seems to be talking nonstop for full 4 minutes:**

Chairperson: intervene once between the third and fifth minute to ask 1-3 of the above questions. If time remains, prompt subject to continue by saying "You still have some time. Please continue"

- 6. **After time is up, Confederate (Timer) says**
"Six minutes have passed."

Number Task

- 1. After the five minutes,
 - a. Chairperson: "Thank you very much, that should be enough for now. We now want to ask you to work on a second task. This one is about mental arithmetic. We would now like you to count backwards by 17, starting at 13,278. Go as quickly and correctly as possible. Should you miscalculate, we will point out your mistake and asked to start again at 13,278. Do you have any questions about this? Please begin."
 - b. If applicant asks, let them know that this is indeed a second task that has nothing to do with the application speech.
- 2. During arithmetic
 - a. **If wrong:**
"No, that's wrong. Please begin again at 13,278."

b. Each confederate should say 3 during the 6 minute span and Confederate (Timer) should say these comments at time 0, 2, and 4 minutes.

“You need to be faster.”

“We’re off schedule now.”

“You need to be quicker; we’re running out of time.”

c. If they respond to a comment,

Chairperson: “Please continue.”

3. When time is up, the Confederate (Timer) should say:
 - a. “Six minutes have passed.” Note the last number that the participant reached.
4. At the end of the task
 - a. Chairperson: “Thank you for your participation. Please have a seat in the waiting area. X will be with you shortly.”

Adverse Response

1. If at any time the mother appears to be having an adverse reaction, (i.e., begins to cry or seems overly agitated):
2. Chairperson: ask “Are you okay?” “Do you want to stop?” or “Are you okay to continue?”
3. If the subject indicates that they wish to stop, Chairperson should stop the study immediately and notify Sharon that the participant has had an adverse reaction and needs to be debriefed.
4. If you here a knock on the observation window, please ask mom if she would like to continue

Appendix C. Parent-Child Interaction Protocol

1. Introduction

Greeting the mom and bring her and child into observation room

- a. Introduce PCI to mom and Child outside of the observation room
 - i. *"During the next few minutes I will be asking you to participate in some activities with your child. During this time please do not leave the room. Also, please speak-up when you are talking to your child. We also ask that you only speak English for the duration of the task. This is so we will understand you. I will need to take any bags or coats you may have now. I will keep these items for you in my office. Please do not eat or chew gum for the duration of this task."*

2. CLEAN UP

- a. Hand the "Where Things Go" Handout to the mother.
- b. Give "Clean up: instructions"
 - i. *"Please have your child place everything where it goes according to this list. You may not help your child physical. You may only instruct your child where things go. Please stay in this room until I come to get you."*
 - ii. Begin timing 5 minutes

3. FREE PLAY

- a. At the end of 5 minutes, enter the room and praise child and mother for doing a good job.
- b. Place all items on shelving unit.
 - i. Items to be used: Connect-4; Jenga; Trouble; Cars; School bus & school house
- c. Give Instructions to mother
 - i. *"In this situation, tell (child's name) that s/he may play whatever s/he chooses. Let her/him choose any activity s/he wishes. You just follow her/his lead and play along with her/him. Please stay in this room until I come to get you."*
 - ii. *Begin timing 5 minutes*

4. HOMEWORK TASK

- a. At the end of 5 minutes, enter the room. Praise the mother and child for doing well.
- b. Hand math worksheet and pencil to the mother.
- c. Give mother instructions
 - i. *"(Child's name) should complete this worksheet. Please provide as little or as much help as you think is needed. Your child should not skip any problems and do them in order. Please stay in this room until I come to get you."*
- d. After 10 minutes have passed (or if the child finishes early), enter the room and thank the mother and their child for their hard work.

Appendix D. Measures

Parent / Teacher DBD Rating Scale

Child's Name: _____ Form Completed by: _____

Grade: _____ Date of Birth: _____ Sex: _____ Date Completed _____

Check the column that best describes your/this child. Please write DK next to any items for which you don't know the answer.

	Not at All	Just a Little	Pretty Much	Very Much
1. often interrupts or intrudes on others (e.g., butts into conversations or games)				
2. has run away from home overnight at least twice while living in parental or parental surrogate home (or once without returning for a lengthy period)				
3. often argues with adults				
4. often lies to obtain goods or favors or to avoid obligations (i.e., "cons" others)				
5. often initiates physical fights with other members of his or her household				
6. has been physically cruel to people				
7. often talks excessively				
8. has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering; forgery)				
9. is often easily distracted by extraneous stimuli				
10. often engages in physically dangerous activities without considering possible consequences (not for the purpose of thrill-seeking), e.g., runs into street without looking				
11. often truant from school, beginning before age 13 years				
12. often fidgets with hands or feet or squirms in seat				
13. is often spiteful or vindictive				
14. often swears or uses obscene language				
15. often blames others for his or her mistakes or misbehavior				
16. has deliberately destroyed others' property (other than by fire setting)				
17. often actively defies or refuses to comply with adults' requests or rules				
18. often does not seem to listen when spoken to directly				
19. often blurts out answers before questions have been completed				
20. often initiates physical fights with others who do not live in his or her household (e.g., peers at school or in the neighborhood)				
21. often shifts from one uncompleted activity to another				
22. often has difficulty playing or engaging in leisure activities quietly				
23. often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities				
24. is often angry and resentful				
25. often leaves seat in classroom or in other situations in which remaining seated is expected				
26. is often touchy or easily annoyed by others				
27. often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)				
28. often loses temper				
29. often has difficulty sustaining attention in tasks or play activities				
30. often has difficulty awaiting turn				
31. has forced someone into sexual activity				
32. often bullies, threatens, or intimidates others				
33. is often "on the go" or often acts as if "driven by a motor"				
34. often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)				
35. often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)				
36. has been physically cruel to animals				
37. often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)				
38. often stays out at night despite parental prohibitions, beginning before age 13 years				
39. often deliberately annoys people				
40. has stolen while confronting a victim (e.g., mugging, purse snatching, extortion, armed robbery)				
41. has deliberately engaged in fire setting with the intention of causing serious damage				
42. often has difficulty organizing tasks and activities				
43. has broken into someone else's house, building, or car				
44. is often forgetful in daily activities				
45. has used a weapon that can cause serious physical harm to others (e.g., a bat, brick, broken bottle, knife, gun)				

Health Screening Questionnaires

Participant ID _____

Date _____

Session # _____

1. Height: Feet _____ Inches _____

2. Weight _____ lbs

3. Have you eaten in the last hour? Y N

If yes, please list foods and drinks including quantity and time eaten:

4. Have you smoked in the last 4 hours? Y N

5. Have you had any alcohol in the last 24 hours? Y N

6. Have you exercised in the last 4 hours? Y N

7. Have you had caffeine in the last hour? Y N

Describe _____

8. Are you currently taking any medications or vitamins (please include asthma medications, acetaminophen, oral contraceptives, Advil, corticosteroids?

a. Name _____ Date/Time

_____ Dose _____

b. Name _____ Date/Time
 _____ Dose _____

c. Name _____ Date/Time
 _____ Dose _____

d. Name _____ Date/Time
 _____ Dose _____

9. How many hours did you sleep last night? _____

*******Please continue onto next page*******

10. How was your sleep last night?

- a. Very Good
- b. Somewhat Good
- c. Somewhat Bad
- d. Very bad

11. How rested do you feel right?

- a. Very rested
- b. Somewhat rested
- c. Somewhat tired
- d. Very tired

12. Do you have a history of any of the following?

Medical condition	History	Current?
-------------------	---------	----------

Chronic Fatigue Syndrome	Y	N	Y	N
Asthma	Y	N	Y	N
Adrenal Dysfunction	Y	N	Y	N
Unstable thyroid dysfunction	Y	N	Y	N
Asthma, respiratory disease	Y	N	Y	N
Flu/Cold/Bronchitis	Y	N	Y	N
PMDD or Menopause	Y	N	Y	N
Other _____	Y	N	Y	N
Other _____	Y	N	Y	N

13. Date of first day of your last menstrual
cycle _____

DERS (Gratz & Roemer 2004)

Please indicate how often the following statements apply to you by writing the appropriate number from the scale below on the line beside each item:

1	2	3	4	5
Almost never	Sometimes	About half the time	Most of the time	Almost always
(0-10%)	(11-35%)	(36-65%)	(66-90%)	(91-100%)

_____	1) I am clear about my feelings.
_____	2) I pay attention to how I feel.
_____	3) I experience my emotions as overwhelming and out of control.
_____	4) I have no idea how I am feeling.
_____	5) I have difficulty making sense out of my feelings.
_____	6) I am attentive to my feelings.
_____	7) I know exactly how I am feeling.
_____	8) I care about what I am feeling.
_____	9) I am confused about how I feel.
_____	10) When I'm upset, I acknowledge my emotions.
_____	11) When I'm upset, I become angry with myself for feeling that way.
_____	12) When I'm upset, I become embarrassed for feeling that way.
_____	13) When I'm upset, I have difficulty getting work done.
_____	14) When I'm upset, I become out of control.
_____	15) When I'm upset, I believe that I will remain that way for a long time.
_____	16) When I'm upset, I believe that I'll end up feeling very depressed.
_____	17) When I'm upset, I believe that my feelings are valid and important.
_____	18) When I'm upset, I have difficulty focusing on other things.
_____	19) When I'm upset, I feel out of control.
_____	20) When I'm upset, I can still get things done.

- _____ 21) When I'm upset, I feel ashamed with myself for feeling that way.
- _____ 22) When I'm upset, I know that I can find a way to eventually feel better.
- _____ 23) When I'm upset, I feel like I am weak.

1	2	3	4	5
Almost never	Sometimes	About half the time	Most of the time	Almost always
(0-10%)	(11-35%)	(36-65%)	(66-90%)	(91-100%)

- _____ 24) When I'm upset, I feel like I can remain in control of my behaviors.
- _____ 25) When I'm upset, I feel guilty for feeling that way.
- _____ 26) When I'm upset, I have difficulty concentrating.
- _____ 27) When I'm upset, I have difficulty controlling my behaviors.
- _____ 28) When I'm upset, I believe that there is nothing I can do to make myself feel better.
- _____ 29) When I'm upset, I become irritated with myself for feeling that way.
- _____ 30) When I'm upset, I start to feel very bad about myself.
- _____ 31) When I'm upset, I believe that wallowing in it is all I can do.
- _____ 32) When I'm upset, I lose control over my behaviors.
- _____ 33) When I'm upset, I have difficulty thinking about anything else.
- _____ 34) When I'm upset, I take time to figure out what I'm really feeling.
- _____ 35) When I'm upset, it takes me a long time to feel better.
- _____ 36) When I'm upset, my emotions feel overwhelming.

Narrative Description of Child -- Parent (IRS)

Child's name: _____ Form completed by: _____

Date completed: _____

Instructions: In the spaces below, please describe what you see as your child's primary problems in each area, both at home and at school. Also, please describe how your child's problems have affected each area and complete the rating at the end of each by marking an "X" on the lines at the points that describe how much the child's problems affect each area and *whether he or she needs treatment or special services for the problems* (see sample below).

Example:

No Problem Definitely does not need treatment or special services	_____ X _____	Extreme Problem Definitely needs treatment or special services
--	---------------	---

1a. How your child's problems affect his or her relationship with playmates

No Problem Definitely does not need treatment or special services	_____	Extreme Problem Definitely needs treatment or special services
--	-------	---

1b. Regardless of whether your child is popular or unpopular with peers, does he or she have a special close "best friend" that he or she has kept for more than a few months?

Yes No

1c. How your child's problems affect his or her relationship with brothers or sisters
(If no siblings, check _____ and skip to #2)


No Problem Definitely does not need treatment or special services	_____	Extreme Problem Definitely needs treatment or special services
--	-------	---

2. How your child's problems affect his or her relationship with you (and your spouse if present)


No Problem Definitely does not need treatment or special services	_____	Extreme Problem Definitely needs treatment or special services
--	-------	--

4. How your child's problems affect his or her self-esteem


--

No Problem Definitely does not need treatment or special services		Extreme Problem Definitely needs treatment or special services
--	--	---

5. How your child's problems affect your family in general

No Problem Definitely does not need treatment or special services		Extreme Problem Definitely needs treatment or special services
--	---	---

6. Overall severity of your child's problem in functioning and overall need for treatment

No Problem Definitely does not need treatment or special services		Extreme Problem Definitely needs treatment or special services
--	--	---

The University of New Orleans
Alabama Parenting Questionnaire (APQ)
(Parent Form)

Child's Name: _____ ID#: _____

Parent Completing Form(Circle one): Mother Father Other: _____

Instructions: The following are a number of statements about your family. Please rate each item as to how often it TYPICALLY occurs in your home. The possible answers are Never (1), Almost Never (2), Sometimes (3), Often (4), Always (5). PLEASE ANSWER ALL ITEMS.

	Never	Almost Never	Sometimes	Often	Always
1. You have a friendly talk with your child.	1	2	3	4	5
2. You let your child know when he/she is doing a good job with something.	1	2	3	4	5
3. You threaten to punish your child and then do not actually punish him/her.	1	2	3	4	5
4. You volunteer to help with special activities that your child is involved in (such as sports, boy/girl scouts, church youth groups).	1	2	3	4	5
5. You reward or give something extra to your child for obeying you or behaving well.	1	2	3	4	5
6. Your child fails to leave a note or to let you know where he/she is going.	1	2	3	4	5
7. You play games or do other fun things with your child.	1	2	3	4	5
8. Your child talks you out of being punished after he/she has done something wrong.	1	2	3	4	5

	Never	Almost Never	Sometimes	Often	Always
9. You ask your child about his/her day in school.	1	2	3	4	5
10. Your child stays out in the evening past the time he/she is supposed to be home.	1	2	3	4	5
11. You help your child with his/her homework.	1	2	3	4	5
12. You feel that getting your child to obey you is more trouble than it's worth.	1	2	3	4	5
13. You compliment your child when he/she does something well.	1	2	3	4	5
14. You ask your child what his/her plans are for the coming day.	1	2	3	4	5
15. You drive your child to a special activity.	1	2	3	4	5
16. You praise your child if he/she behaves well.	1	2	3	4	5
17. Your child is out with friends you don't know.	1	2	3	4	5
18. You hug or kiss your child when he/she has done something well.	1	2	3	4	5
19. Your child goes out without a set time to be home.	1	2	3	4	5
20. You talk to your child about his/her friends.	1	2	3	4	5
21. Your child is out after dark without an adult with him/her.	1	2	3	4	5

	Never	Almost Never	Sometimes	Often	Always
22. You let your child out of a punishment early (like lift restrictions earlier than you originally said).	1	2	3	4	5
23. Your child helps plan family activities.	1	2	3	4	5
24. You get so busy that you forget where your child is and what he/she is doing.	1	2	3	4	5
25. Your child is not punished when he/she has done something wrong.	1	2	3	4	5
26. You attend PTA meetings, parent/teacher conferences, or other meetings at your child's school.	1	2	3	4	5
27. You tell your child that you like it when he/she helps out around the house.	1	2	3	4	5
28. You don't check that your child comes home at the time she/he was supposed to.	1	2	3	4	5
29. You don't tell your child where you are going.	1	2	3	4	5
30. Your child comes home from school more than an hour past the time you expect him/her.	1	2	3	4	5
31. The punishment you give your child depends on your mood.	1	2	3	4	5
32. Your child is at home without adult supervision.	1	2	3	4	5

	Never	Almost Never	Sometimes	Often	Always
33. You spank your child with your hand when he/she has done something wrong.	1	2	3	4	5
34. You ignore your child when he/she is misbehaving.	1	2	3	4	5
35. You slap your child when he/she has done something wrong.	1	2	3	4	5
36. You take away privileges or money from your child as a punishment.	1	2	3	4	5
37. You send your child to his/her room as a punishment.	1	2	3	4	5
38. You hit your child with a belt, switch, or other object when he/she has done something wrong.	1	2	3	4	5
39. You yell or scream at your child when he/she has done something wrong.	1	2	3	4	5
40. You calmly explain to your child why his/her behavior was wrong when he/she misbehaves.	1	2	3	4	5
41. You use time out (make him/her sit or stand in a corner) as a punishment.	1	2	3	4	5
42. You give your child extra chores as a punishment.	1	2	3	4	5

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