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STUDIES ON PARENTING BEHAVIOUR IN MOTHERS OF YOUNG CHILDREN

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ABSTRACT
The goal of this paper is to examine the associations between the autonomic nervous system (ANS), adrenocortical system, and positive and negative caregiving behaviors among mothers of young children. These dimensions of early caregiving behavior have been repeatedly identified as critical predictors of multiple domains of child development.

KEYWORDS: *human; mothers; parenting; cortisol; RSA; vagal.*

INTRODUCTION

Conversely, negative and intrusive caregiving behaviors have been associated with internalizing (Pike & Plomin, 1996) and externalizing problems (Heller & Baker, 2000; Rubin, Burgess, Sawyer, & Hastings, 2003), low academic competence (Culp, Hubbs-Tait, Culp, & Starost, 2001), and poor social adjustment to peer groups (Cookston, Harrist, & Ainslie, 2003; Romano, Tremblay, Boulerice, & Swisher, 2005). To date, early parenting has been studied in relation to the psychosocial characteristics of the caregiver (Crockenberg & Leerkes, 2003; Espinosa, Beckwith, Howard, Tyler, & Swanson, 2001), experiences of daily stress (Hummer & Samuels, 1988), family relationships (Cox & Paley, 2003), parenting beliefs (NICHD ECCRN, 2004), parental internal working models (Crockenberg & Leerkes, 2003), and influence of child temperament (Belsky, 1984; Leerkes & Crockenberg, 2002). By comparison, there has been limited examination of the psychophysiological correlates of sensitive and nonharsh parenting behaviors (Bardi, French, Ramirez, & Brent, 2004; Leckman & Herman, 2002).

There is, however, growing evidence in support of a physiological component to early caregiving behaviors. Research on autonomic and endocrine functioning in mothers has found that women reporting low perceived power in the parent–child relationship exhibited increases in heart rate and cortisol levels in response to elevated vocal pitch by infants (Lin, Bugental, Turek, Martorell, & Olster, 2002) and that elevated cortisol during challenging situations mediated the association between maternal powerlessness in the face of difficult child temperament and mothers' reports of harsh parenting practices (Martorell & Bugental, 2006). These findings suggest that for some mothers, the demands of parenting are quite stressful, especially if they experience a lack of control. The perceived inability to meet the demands of caring for a child is likely to be highly stressful to parents (Crnic & Low, 2002). However, Although research in this domain is steadily increasing, more work is needed to identify specific patterns of psychophysiological functioning as related to sensitive and negative-intrusive parenting behaviors. To this effect, we believe that utilizing a multi-system approach is integral for better understanding the intricate relationships between psychophysiological systems and complex goaldirected behaviors such as parenting. As such, the current study examines the independent and joint effects of adrenocortical (as measured by baseline cortisol levels) and vagal activity (as measured by change in respiratory sinus arrhythmia [RSA]) as psychophysiological predictors of sensitive and negative-intrusive parenting of young infants.

The HPA System

One widely researched component of the stress response system is the hypothalamic–pituitary–adrenal (HPA) axis. In behavioral research, the stress hormone cortisol is the most frequently measured peripheral marker of HPA axis activation. The release of cortisol is one of many ways by which the organism prepares itself to deal with physical or psychological challenges (Sapolsky, Romero, & Munck, 2000). Interestingly, both high and low levels of circulating cortisol have been associated with nonoptimal adult outcomes (Hsu, Garside, Massey, McAllister, & Williams, 2003; Lupien, Gillin, & Hauger, 1999; Young, Sahakian, Robbins, & Cowen, 1999), thus creating a U-shaped function relating cortisol levels to behavioral risk (see Aardal-Eriksson, Eriksson, & Thorell, 2001; Kristenson, Eriksen, Sluiter, Starke, & Ursin, 2004; Mason et al., 2001; Yehuda, Boisoneau, Lowy, & Giller, 1995).

To date, most studies of resting cortisol levels and parenting behaviors have reported associations between higher circulating cortisol and less optimal caregiving. In nonhuman primates, high maternal basal cortisol levels have been shown to predict low frequencies of contact between mother and infants (Bardi et al., 2004), higher frequencies of infant-directed freezing behaviors (Kalin, Shelton, Rickman,&Davidson, 1998), and restrictiveness (Cleveland, Westergaard, Trenkle, & Higley, 2004). In human studies, Giardino, Gonzalez, Steiner, and Fleming (2008) reported that, as compared to older mothers, teen mothers exhibited both higher resting cortisol levels and less involved and attentive caregiving behaviors. Conversely, Schechter et al. (2004) reported that, among mothers with post traumatic stress disorder, lower cortisol levels were associated with more atypical styles of maternal behavior, including insensitive and negativeintrusive caregiving behavior. Given the limited, but compelling, evidence from the animal and human literatures, insensitive and negative-intrusive parenting behaviors can be expected among mothers with very high and very low basal cortisol levels. However, since the current research is based on a convenience community sample and not selected according to psychological or clinical referral (as was the case with Schechter et al., 2004), it is hypothesized that higher levels of basal cortisol will be associated with less sensitive and more negativeintrusive caregiving behaviors.

The Vagal System

A second physiological system that has gained considerable attention among stress and coping researchers is the vagal system, a neurophysiological system that exerts parasympathetic control (via the ANS) over cardiac functioning and has implications for self-regulation, temperament, affect, attention, and metabolic demands (Bornstein & Suess, 2000; Porges, 1995, 1996; Porges, Doussard-Roosevelt, & Maiti, 1994). Researchers have found that resting vagal tone is an index of parasympathetic neural control of the heart, as well as an index of underlying regulatory abilities in mammals (Porges, 1996). During periods of relative quiescence when there are few demands to sustain or promote engagement with the environment, vagal tone is activated, contributing to a slowing of heart rate and allowing a focus on internal, homeostatic processes. During situations that present some type of demand or challenge, these internal processes are disrupted and the autonomic nervous system increases cardiac output to initiate coping behaviors. As part of the coping process, vagal tone is typically inhibited or withdrawn (i.e., vagal tone reduction) when the environment requires active (rather than passive) participation and/or requires coping and self-regulatory behaviors. Functionally, vagal tone is operationalized as the amplitude of RSA. Recent research has identified the reduction of RSA (vagal withdrawal) during emotional tasks as an important component of the body's regulatory functioning. Porges (1996) has suggested that decreases in RSA during environmental demands may be associated with increased behavioral and emotional control and may underlie the behavioral attention strategies necessary for regulation of arousal (Huffman et al., 1998; Posner & Rothbart, 2000).

Previously reported findings from the current sample suggest that greater maternal RSA reduction in response to infant negativity is related to less maternal harshness, especially among mothers of children with avoidant attachments (Mills-Koonce et al., 2007). In this context, it is argued that more RSA reduction facilitated attentional and regulatory processes that support responsive caregiving to a distressed child. Moore et al. (in press) have reported similar findings linking maternal sensitivity to maternal change in RSA during a parenting task. Specifically, more sensitive mothers were observed to have significant decreases in RSA from baseline while soothing their children following a child emotion challenge procedure. If it is the case that greater RSA reduction is associated with greater behavioral and emotional control, it stands to reason that mothers who exhibit reduced RSA in response to children's emotional demands are more likely to maintain a pattern of positive and nonnegative caregiving behaviors across mother– child interactive contexts.

Multi-System Associations With Parenting Behavior: The Current Study

The current research examines the associations between parental cortisol levels, RSA reduction and parenting behaviors among mothers of young infants. The HPA axis and the parasympathetic nervous system (as part of the ANS) represent the two major components of the psychobiology of human stress response (Chrousos & Golds, 1992); however, these systems exhibit different patterns of activity and utility (Schommer, Hellhammer, &Kirschbaum, 2003). It should be noted that much of this research is based on sympathetic rather than parasympathetic functioning in the autonomic nervous system, and previous research on the HPA and vagal systems in 6- to 24-week postpartum mothers suggests that they are not highly correlated and exhibit different patterns of activation in response to mild stressors (Altemus, Redwine, & Leong, 2001). As such, different patterns of cortisol and RSA function are likely to represent different physiological and behavioral tendencies among mothers. Based on previous research we first hypothesized that higher levels of cortisol would be associated with less positively engaged parenting and more negative intrusiveness by mothers. Similarly, following previous research on changes in RSA and parenting (i.e., Mills-Koonce et al., 2007; Moore et al., in press), our second hypothesis was that mothers who exhibited RSA reduction during a soothing task with their infants would display more positive engagement and less negative-intrusiveness during parent–child interactions.

Finally, to our knowledge, this is the first study to jointly examine these two physiological systems and their potential interaction as a predictor of maternal behaviors. In determining our hypothesis for how this interaction may be associated with parenting, we considered the global and chronic nature of the possible environmental and psychosocial causes of atypical resting levels of cortisol in young mothers. Risk factors such as poverty, depression, and PTSD all may predict both HPA functioning and parenting behavior, and as such, atypical cortisol levels may be a broad marker for parenting risk in some mothers. For these mothers, the ability to utilize autonomic support to establish and maintain positive social engagement with their children may be a critical buffer for preventing the global stresses associated with atypical HPA functioning from interfering with the mobilization of effective and supportive parenting behavior. Thus, our third hypothesis was that greater RSA reduction would attenuate the association between atypical levels of cortisol and less positive and more negative parenting behaviors. Lastly, we will examine associations between maternal behaviors and psychophysiological measures across the following two tasks: a soothing task (mother–child reunion after a child challenge procedure) and a nondistress task (mother– child semi-structured free play). Because this is the first study to our knowledge to examine parenting behavior in relation to these two physiological systems with the additional complexity of looking across two unique interactive contexts, these final analyses are largely exploratory and no specific hypotheses were proposed.

METHODS

Participants

The participants were biological mothers of 6-month-old infants recruited by the Durham Child Health and Development Study. A total of 206 families were drawn from a largely urban community. Of these, 175 families completed a majority of the data collection protocols and were used in the final analyses. The final sample included 100 African-American families and 75 European-American families. The average income-to-needs ratio was 3.03 (SD¼2.66), the average level of education was 14.4 years (sd¼2.70), and the average age was 28.3 years (sd¼5.60). All of the mothers in this sample were 18 years of age or older and none were above the age of 40.

Procedures

The 6-month home and laboratory visits were initiated once the child turned 6 months of age. For a majority of families (74%) the home visits occurred prior to the lab visits (based upon family availability), and over 90% of the home visits occurred within 2 weeks of the laboratory assessment. Because families had participated in assessments during an earlier 3-month visit and because tasks varied between the home and the laboratory assessments, we did not expect that order of home and lab visits would affect findings. The average age of the child at the lab visit was 7.3 months (SD¼.55 months) and over 90% of visits occurred before the child was 8.5 months of age.

Six-Month Home Visit

Free Play Observations. At the home visit, mothers were provided with a set of standardized toys and asked to play with their children using these toys as they normally would during 10 min of free time during the day (see Barnett et al., 2008). The standardized toy set included a set of stacking rings, noisemakers and rattles, soft building blocks, rubber balls, a jack-in the box, and stuffed animals. These interactions were videotaped for later coding of parenting behaviors.

Six-Month Laboratory Visit

During the laboratory visits, mothers and children were equipped with cardiac monitors upon arrival and saliva was obtained from both. Next, with the help of the mother, the children participated in a series of cognitive tasks prior to participating in the Face-to-Face Still Face Paradigm (FFSFP).

Face-to-Face Still Face Paradigm. At the laboratory visit, mothers were asked to participate in the FFSFP (Tronick, Als, Adamson, Wise, & Brazelton, 1978), which served as a stress task for the child. Mothers were asked to secure their child into an infant car seat attached to an examination table. Mothers were positioned approximately 1 ft in front of their children and asked to interact with their children normally for 2 min. Next, mothers were asked to turn 90^0 to their right and not make eye contact with their children for 15 s. Mothers were then asked to face their children and maintain a fixed stare while refraining from facial movements, displays of affect, and bodily contact for 2 min. Mothers were then asked to turn to the side for another 15 s, and then asked to respond to their children as they felt necessary during a 2 min reunion episode to conclude the task. The mother–child interaction during the reunion episode of the FFSFP was later coded for maternal caregiving behaviors. This procedure was terminated if the child cried for 20 s at any point during the protocol or if the mother requested termination.

Assessments

Cortisol Levels. Immediately upon arrival to the laboratory (times ranged from 9:30 am to 5:00 pm with the average time of collection being 12:30 pm and a standard deviation of 2.7 hr) mothers were asked to chew on a sterile cotton rope for 1 min. Using a syringe, mother's saliva was expressed into vials and frozen for storage. All samples were assayed in duplicates by Salimetrics (University Park, PA). All samples were assayed in the same batch to eliminate within-subject interassay variance. Salimetrics used a high-sensitive enzyme immunoassay designed for measuring cortisol in saliva. This test has a range of sensitivity of .007–1.8 mg/dl, and an average intra- and interassay coefficient of variation less than 10% and 15%, respectively. The duplicate values obtained for all samples varied by less than 7%. The mean of these two values was used in subsequent analyses. Following Gunnar, Mangelsdorf, Larson, and Hertsgaard (1989), we checked to ensure that no cortisol concentrations greater than 3 SDs above or below the mean were included in analysis (no values outside of the acceptable range were found). Saliva was sampled in the laboratory visit only; no measures of cortisol were collected during the home visit.

Vagal Tone (RSA). Electrodes were placed on the mother's chest and were connected to a preamplifier, the output of which was transmitted to a heart rate monitor (VTM-1, Delta Biometrics, Inc., Bethesda, MD) for R-wave detection. Following saliva collection, mothers were asked to sit for 2 min in order to collect a baseline measure of cardiac data. These data were also collected throughout all episodes of the FFSFP to measure reactivity. A data file containing the heart interbeat intervals (IBIs) for the entire period of collection was transferred to a computer for editing artifacts that result from excess movement. Artifacts are fairly common in cardiac data collected in this manner because bodily movements are also detected and erroneously recorded as cardiac data. IBI files were edited by MXEdit-reliable researchers and analyzed using MXEdit software (Delta Biometrics, Inc.). Data files that required editing of more than 10% of the data were not included in the analyses. After editing and processing the IBI files, measures of RSA (or vagal tone) were extracted using Porges' (1995) method. This procedure applies an algorithm to the sequential IBI data using a moving 21-point polynomial to detrend periodicities in heart period slower than RSA. Then, a band-pass filter extracts the variance of heart period within the frequency band of spontaneous respiration in adults (.12–.40). This estimate of RSA is derived by calculating the natural log of this variance and is reported in units of ln(ms)2. RSA was calculated every 15 s during the episodes of the FFSFP. While these epoch durations are relatively brief, they are typical for studies of short duration tasks and have been validated by previous research (Huffman et al., 1998). Cardiac data were collected in the laboratory visit only; no measures of cardiac data were collected during the home visit.

Computation of DRSA. Following previous research (Calkins, 1997; Moore&Calkins, 2004), difference scores were computed by subtracting reunion episode RSA (while soothing the child) from baseline RSA. This calculation results in either a positive or negative value of DRSA with high positive values indicating greater RSA reduction for mothers while soothing their children during the reunion episode.

Child Negativity. Child negative affect was coded during and following the FFSFP using a 3-point scale adapted from previous coding protocols for child negativity (Haley&Stansbury, 2003). During each 5-s interval of the FFSFP negative affect was coded as either a 1 (little to no facial or vocal negativity), 2 (moderate level of prolonged facial or vocal negativity), or 3 (consistently high levels of facial or vocal negativity). An overall infant negative affect score was calculated as the percentage of 5 s intervals during which the child was rated as 2 or higher in negative affect. The average intraclass correlation across coders for child negativity was .90 (range¼.82–.96) based on double coding 20% of all interactions.

Parenting Behaviors. Parenting behavior was observed during the Free Play interaction in the home visit and during the reunion episode of the FFSFP in the laboratory visit. Five common 5-point subscales were coded by independent observers across the Free Play and FFSFP, including global sensitivity, intrusiveness, detachment, positive regard, and negative regard. Global Sensitivity is a measure of the caregiver's appropriate level of responsiveness to the emotional and physical needs of the child (in both distress and nondistress situations). Intrusiveness indexes the degree to which the caregiver imposes her own agenda on the activity of the child and as such impedes the independent actions of the child. Detachment is a measure of the caregiver's physical involvement with the child and emotional connection to the child. Positive regard is an index of the warmth and affection the caregivers directs towards the child. Negative regard is an index of the physical and verbal harshness directed towards the child.

A principle components factor analysis suggested two composite measures of maternal behavior (Eigenvalues: 2.77, 1.26, .59). The first composite was labeled positive engagement and was the sum of detachment (reversed scored) and positive regard (6-month factor loadings were .88 and 89, respectively). The second was labeled negative intrusiveness and was the sum of sensitivity (reversed scored), intrusiveness, and negative regard (factor loadings were .73, .92, and .77, respectively). It should be noted that global sensitivity cross-loaded on both positive engagement and negative-intrusiveness, but ultimately it was assigned to the negative intrusiveness composite based on the relative strength of the factor loadings. A similar approach to aggregating parenting observations has been used by the NICHD Early Childcare Research Network (1999) and has demonstrated high predictive validity across a variety of child outcomes. Each of the subscales were double-coded and conferenced by trained and reliable coders, all of which maintained intraclass correlations reliabilities greater than .80 on composite measures (ranging from .81 to .96). The parenting composites from this sample have previously demonstrated strong predictive validity, including the prediction of behavioral (Propper, Willoughby, Halpern, Carbone, & Cox, 2007), affective (Mills-Koonce et al., 2007); psychophysiological (Propper et al., 2008), and language (Pungello, Iruka, Dotterer, Mills-Koonce, & Reznick, 2009) outcomes.

RESULTS

Missing Data and Imputation

The rate of missing data was 15% for cortisol, 35% for baseline RSA, and 28% for RSA during the FFSFP reunion. The primary reason for missing cortisol data was refusal by the mother (7%); secondary reasons include inadequate volume for assaying (4%) and disqualification of a sample due to caregiver usage of prescription or overthe- counter medication (4%), which were excluded based on recommendations by Hibel, Granger, Kivlighan, Blair, and the Family Life Project Investigators (2006). The primary reasons for missing RSA data were either equipment malfunction (13%) or IBI files that required artifact editing of more than 10% of the data (22% for baseline, 15% during FFSFP reunion). There were no differences in missing data as a function of household demographics (income-to-needs ratios, ethnicity) or as a function of specific variables of interest (i.e., cortisol data was not missing as a function of missing RSA data). The problem of missing data was addressed by multiple imputation (MI). This simulation-based approach allows full use of the available data without introducing the biases that can be created by listwise deletion (Schafer, 1997; Schafer & Graham, 2002). A total of 10 imputed datasets were generated using PROC MI in SAS 9.1 (SAS Institute, 2004). With 10 imputations, MI is 95% efficient with 50% missing information, although it should be noted that this method tends to be conservative. Analyses were completed across these 10 imputed datasets using PROC MIANALYZE in SAS. For every analysis completed using imputed data, a corresponding analysis using actual data was conducted for comparison.

Descriptive Statistics and Correlations Among Covariates

Means and standard deviations of all variables are presented in Table 1. Correlations among variables are presented in Table 2. European American mothers reported significantly higher incomes than African American mothers. Positive engagement measures during Free Play and FFSFP reunions were correlated with both ethnicity (lower levels of positive engagement among African American mothers) and income (lower levels of positive engagement among lower income mothers). Negative intrusiveness was correlated with both ethnicity (higher levels of negative intrusiveness among African American mothers) and income (higher levels of negative intrusiveness among lower income mothers), but only so for the Free Play observations. Positive engagement observations in both contexts were negatively correlated with child negativity during the FFSFP reunion. Amodest positive correlation was found between baseline cortisol and negative intrusiveness during Free Play observations (r¼.14, p<.1); no other behaviorphysiology correlations were observed. Because there was modest evidence that higher cortisol levels were associated with parenting but no evidence that lower resting cortisol levels were associated with parenting behaviors, all subsequent analyses treated cortisol as a continuous linear variable. Positive engagement during Free Play was correlated with positive engagement during the FFSFP reunion. Similarly, negative intrusiveness during Free Play was correlated with negative intrusiveness during the FFSFP reunion; however, as compared to Free Play, negative intrusiveness during the FFSFP reunion was significantly lower (t¼4.49, p<.01).

Table 1. Means and Standard Deviations by Ethnicity

	African-American			European-American			Total		
Measure	Mean	SD	n	Mean	SD	n	Mean	SD	n
Income-to-needs	3.05	2.47	100	4.22	3.19	75	3.73	2.93	175
Infant negativity	17.8	34.4	95	13.9	34.5	72	15.9	34.3	167
Cortisol level	.25	.20	85	.21	.15	63	.23	.18	148
RSA reduction	−.04	.11	50	.32	1.0	50	.14	1.08	100
Negative intrusiveness (SFP)	7.5	2.1	95	6.8	2.4	72	7.2	2.3	167
Negative intrusiveness (free play)	9.2	2.7	100	7.4	2.0	75	8.4	2.6	175
Positive engagement (SFP)	7.5	1.5	95	8.1	1.6	72	7.7	1.5	167
Positive engagement (free play)	6.7	1.9	100	7.5	1.7	75	7.1	1.8	175

Reduction, and Maternal Behaviors

Because contexts of observation were nested within dyads, models were estimated using the PROC MIXED procedure in SAS version 9.1 in order to appropriately model the covariance structure of nested data (Little & Rubin, 1987) and to maximize the statistical power necessary to test complex interactions (Littel, Milliken, Stroup, & Wolfinger, 1996). Separate models were examined for maternal positive engagement and negative intrusiveness as maternal behavior outcomes. Each model evaluated the main effects and interactions of cortisol levels and RSA reduction, as well as interactions between psychophysiological variables and context of observation. Income and ethnicity were included as controls because of their association with maternal behavior; time of day and (and time-of-day2) were included because the nonlinear diurnal variation in cortisol levels, and child negativity was included as a covariate to control for its effects on the correlations observed between maternal physiology and behavior.

Table 2. Correlations Among Variables

Measure	1	2	3	4	5	6	7	8
1. Income-to-needs								
2. Ethnicity[a]	.28***							
3. Infant negativity	−.18*	−.06						
4. Resting cortisol level	−.08	−.19	.27					
5. RSA reduction	.11	.18	.02	−.12				
6. Negative intrusiveness (SFP reunion)	−.13	−.12	.05	−.06	−.06			
7. Negative intrusiveness (free play)	−.37***	−.33***	.13	.14†	−.08	.24**		
8. Positive engagement (SFP reunion)	.05	.32***	−.23***	.02	−.01	−.30**	−.12	
9. Positive engagement (free play)	.28***	.34***	−.26**	−.09	.12	−.18*	−.39***	.45***

[a]African Americans¼0, European American¼1.

* P<.05.

** P<.01.

***P<.001.

↑P<.1.

Hypothesis 1: Higher cortisol levels will be associated with lower positive engagement and higher negative intrusiveness. There were no observed associations between cortisol levels and positive engagement in either context of observations. There was, however, a positive association between cortisol level and negative intrusiveness [b¼.48; t(338)¼2.41, p<.05].

Hypothesis 2: Greater RSA reduction will be associated with higher positive engagement and lower negative intrusiveness. There were no main effect associations between DRSA and maternal positive engagement or negative intrusiveness.

Hypothesis 3: Greater RSA reduction will attenuate the association between cortisol levels and parenting behaviors. There was no significant interaction between DRSA and resting cortisol levels in the prediction of maternal positive engagement. There was a significant interaction, however, between DRSA and resting cortisol in the prediction of maternal negative intrusiveness [t(348)¼ –2.02, p<.05]. Following procedures outlined by Aiken and West (1991) and Cohen and colleagues (Cohen, Cohen, West, & Aiken, 2003), tests for regions of significance were conducted using interactive calculation software designed to probe interactions within hierarchical linear models (Preacher, Curran & Bauer, 2006). Probing the cortisolDRSA interaction revealed that mothers' reduction of RSA during the FFSFP reunion episode attenuated the association between mothers' cortisol levels and negative intrusiveness (Fig. 1). Based upon tests of regions of significance, it was determined that higher RSA reduction was associated with lower levels of negative intrusiveness among mothers with cortisol levels in the upper quartile [b¼–.52; t(170)¼–2.04, p<.05]. The 75% of mothers outside of the upper quartile of cortisol level did not show an association between DRSA and maternal negative intrusiveness.

Exploratory hypothesis: Are there differential associations between psychobiological systems and parenting across contexts? There were no differential effects of cortisol, DRSA, or their interaction in the prediction of positive engagement across the free play and soothing contexts. There was, however, an effect of context on the association between cortisol level and negative intrusiveness [t(348)¼2.42, p<.05]. The cortisolcontext interaction was probed by examining differences across context at low (——————————————1 SD) and high (þ1 SD) levels of maternal cortisol. Analyses revealed that lower mean levels of negative intrusiveness were observed during the FFSFP reunion (m¼8.43) as compared to Free Play (m¼10.37) at low levels of maternal cortisol [t(338)¼ 3.33, p<.01; Cohen's d¼.36]. No differences in negative intrusiveness were observed across contexts of observation at high levels of maternal cortisol.

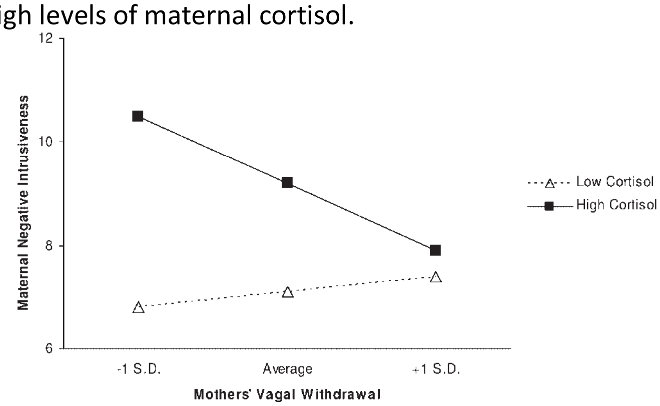

FIGURE 1 Reduction of RSA in mothers during the FFSFP reunion episode was associated with less negative intrusive parenting behavior among mothers with cortisol levels in the upper quartile.

Findings parallel analyses from the original (nonimputed) dataset. Again, PROC MIXED was used to test for main effects and interactions between cortisol and RSA reduction variables across contexts of observation.

No effects were observed in the prediction of maternal positive engagement; however, the same pattern of effects emerged in the prediction of maternal negative intrusiveness. The positive association between cortisol levels and negative intrusive parenting was moderated by maternal RSA reduction [F(1, 204)¼3.73, p¼.055] and by context [F(1, 208)¼3.66, p¼.057]. Probing these interactions revealed comparable effects to those derived from the imputation data. It should also be noted that split-day analyses were conducted for mothers assessed in the morning versus mothers assessed in the afternoon to compare effects that may differ as a function of time of day. Although these analyses did not reach significance, the model parameters aligned with the full sample analyses, suggesting comparable effects for morning and afternoon assessment that likely failed to reach significance due to insufficient power.

DISCUSSION

This study is one of the first to simultaneously examine parental cortisol levels and RSA reduction as psychophysiological correlates of parenting behavior in human mothers. Not surprisingly, the current results indicate that the independent and joint associations between these two physiological systems and maternal behavior are complicated and must be considered with respect to type of maternal behavior and context of observation. There are four main points of interest in these findings. First, there was a positive association between baseline cortisol levels and negative-intrusive caregiving behavior. Second, this effect was attenuated when mothers displayed RSA reduction while soothing their infant during the FFSFP reunion. Third, lower levels of negative-intrusive behaviors were observed during the FFSFP reunion as compared to Free Play observations, however this differences was only observed for mothers with lower cortisol levels. And finally, each of these physiological or contextual associations was limited to maternal negative-intrusiveness; no differences in positive engagement were observed as a function of cortisol levels, RSA reduction, or context of observation. Although income and ethnicity were related to the parenting variables (as has been replicated in numerous studies in the parenting literature), these effects did not influence the current findings.

On the first point, high levels of cortisol may reflect long- term exposure to environmental or psychosocial stress that has led to a sensitization of the HPA system and thus prolonged or chronic elevations in circulating cortisol. If elevated cortisol levels represent an allostatic load on the HPA system (McEwen, 1998), then this measure may represent a biological marker for chronic stress (Kristenson et al., 2004), psychological distress (Chrousos & Golds, 1992), or both. Mothers in this condition may be particularly sensitized to stress (reflected in consistently high cortisol levels even during times of no challenge) and, as such, it may be of particular importance that they effectively use the vagal system as psychophysiological support to promote appropriate behavioral regulation during times of parenting demand. Alternatively, some mothers may experience anticipatory stress as a function of the laboratory visit itself, and thus higher cortisol levels (even at the beginning of the laboratory visit) may reflect HPA reactivity and not allostatic load. It should also be noted that these two explanations for higher cortisol levels are not mutually exclusive; within this sample some mothers may reflect allostatic load, some may reflect acute responses to anticipatory stress, and some may reflect both. However, the interpretation of the interaction between cortisol and RSA reduction for mothers in either scenario is similar; increased parasympathetic support for emotion regulation during a parenting challenge is important for mothers experiencing either chronic or acute stress.

It is also possible, however, that measures of baseline RSA used in calculating RSA reduction could also have been influenced by anticipatory stress. Such an effect could diminish the degree of RSA reduction since the mother is already experiencing lower RSA at the time of baseline measurement. In this scenario, mothers with low RSA reduction as a function of anticipatory stress would appear similar to mothers with low RSA reduction as a function of the soothing procedure. Thus it is possible that both high parasympathetic response to anticipatory stress as well as low parasympathetic response to the soothing task is associated with more negative-intrusive caregiving among mothers with high resting cortisol levels. Since it is not possible to determine which, if any, mothers experienced enough anticipatory stress to cause changes in baseline cortisol or RSA measures, the inclusion of this caveat is an unavoidable limitation of the current analyses. Beyond these interpretations are other possibilities that may account for both the observed changes in maternal psychophysiology as well as the variations in caregiving behaviors. Replication of these findings, as well as more nuanced and longitudinal measures of stress load and individual regulatory abilities, will be necessary before firm conclusions can be drawn regarding the exact nature of the relationships between these biological and behavioral systems.

REFERENCES

1. Aardal-Eriksson, E., Eriksson, T., & Thorell, L. (2001). Salivary cortisol, posttraumatic stress symptoms, and general health in the acute phase and during 9-month follow-up. Biological Psychiatry, 50(12), 986–993.
2. Aiken, L. S., &West, S. G. (1991). Multiple regression: Testing and interpreting interactions. Thousand Oaks: Sage.
3. Altemus, M., Redwine, L. S., & Leong, Y.-M. (2001). Responses to laboratory psychosocial stress in postpartum women. Psychosomatic Medicine, 63(5), 814–821.
4. Bardi, M., French, J. A., Ramirez, S. M., & Brent, L. (2004). The role of the endocrine system in baboon maternal behavior. Biological Psychiatry, 55(7), 724–732.
5. Barnett, M., Deng, M., Mills-Koonce, W. R., Willoughby, M., & Cox, M. J. (2008). Predicting parenting behavior of mothers and fathers of infants from a family systems perspective. Journal of Family Psychology, 22(4), 561–573.
6. Belsky, J. (1984). The determinants of parenting: A process model. Child Development, 55, 83–96.
7. Booth, A., Carber, K., & Granger, D. A. (2000). Biosocial perspectives on the family. Journal of Marriage and Family, 62, 1018–1034.
8. Bornstein, M. H., & Suess, P. E. (2000). Physiological selfregulation and information processing in infancy: Cardiac vagal tone and habituation. Child Development, 2, 273– 287.
9. Calkins, S. D. (1997). Cardiac vagal tone indices of temperamental reactivity and behavioral regulation in young children. Developmental Psychobiology, 31, 125–135.
10. Chrousos, G. P., & Golds, P. W. (1992). The concepts of stress and stress system disorders. Journal of the American Medical Association, 267, 1244–1252.
11. Cleveland, A., Westergaard, G., Trenkle, M., & Higley, J. (2004). Physiological predictors of reproductive outcome and mother-infant behaviors in captive rhesus macaque females (Macaca mulatta). Neuropsychopharmacology, 29(5), 901–910.
12. Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). Applied multiple regression/correlation analysis for the behavioral sciences (3rd edition). Hillsdale: Erlbaum.