# Cortisol in Early Childhood Moderates the Association Between Family Routines and Observed Affective Balance in Children from Low-Income Backgrounds

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**Data Availability Statement**

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

**Conflict of Interest**

The authors declare that there is no conflict of interest.

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**Abstract**

The study of emotion regulation often addresses control of negative emotion. Researchers have proposed that affective balance is an indicator of emotion regulation that incorporates the role of positive emotion in the context of negative emotional experiences. Environmental and individual factors, such as family processes and biological stress regulation, are known to shape emotion regulation. The present study investigated whether child diurnal cortisol, an indicator of biological stress regulation, moderated the association between family routines and observed affective balance. Children (*N*=222; *M* age=4.70 years, *SD*=0.60) from low-income households provided saliva samples to measure diurnal cortisol and completed a behavioral task designed to elicit negative emotions. Affective balance was defined as the difference score between the proportion of positive and negative emotional expressions displayed during the task. A higher affective balance score indicated greater positive compared to negative emotional displays. Simple slope analyses indicated that for children with a low morning cortisol intercept, more frequent family routines were associated with more affective balance. This pattern was not observed in children with average or high morning cortisol. Positive family routines may play an important role in shaping affective balance among children with disrupted cortisol levels from low-income backgrounds.

Keywords: diurnal cortisol, emotion regulation, family routine, observational coding

# Cortisol in Early Childhood Moderates the Association Between Family Routines and Observed Affective Balance in Children from Low-Income Backgrounds

Emotion regulation is the process of identifying and recognizing emotions as well as using strategies to maintain, enhance, or inhibit these emotions (Harrington et al., 2020). These strategies allow children to manage stress, tolerate negative affect, and engage positively with others. As such, emotion regulation involves not only reducing negative affect, but also maintaining positive affect (McRae & Gross, 2020) which, in turn, may foster resiliency when faced with stressors (Abravanel & Sinha, 2015; Cooley et al., 2020; Howell et al., 2010). Indeed, researchers have suggested that maintaining a high ratio of positive to negative affect is important for fostering well-being, and that the distinguishing factor of those who are flourishing is not necessarily differences in negative emotional responding, but rather characterized by higher positive emotional responding (Catalino & Fredrickson, 2011). Research suggests that there is something unique to positive emotions, specifically in the context of stressful situations; thus, assessing the disposition to display positive versus negative emotions, known as *affective balance*, may be important to capturing emotion regulation skills.

While many studies have investigated outcomes associated with positive affect and negative affect, less is known about what shapes higher *affective balance* in children. Affective balance measures a holistic aspect of emotion regulation by capturing both an individual's tendency toward positive and negative emotional expression to maintain a homeostatic balance. The capacity to display positive emotions may be particularly important when faced with a stressor as a way to promote a favorable appraisal of the situation, thus preserving more coping resources (Khosla, 2006) and promoting resilient responses in the face of stressor (Fredrickson, 2001; Tugade & Fredrickson, 2007). Although the bulk of empirical research on emotion regulation in early childhood relies on parent-reported measures (Lo et al., 2015), questionnaire measures are insufficient for assessing the dynamic nature of emotion regulation. Instead, observational assessments allow for capturing emotion regulation in the moment. One of the few studies to use observational methods to assess affective balance in children found that preschool-aged children with more affective balance (i.e., higher propensity to display positive versus negative emotions) were rated as more prosocial and, in turn, more likeable by peers (Denham et al., 1990). Evidence indicates what when faced with a stressor, those who experience more positive emotions also score higher on ego resilience (Block & Kremen, 1996). Follow-up studies suggest that this experience of positive emotions accounts for individuals to have greater capacity (i.e., resilience) to bounce back in the face of stress and prevent symptoms of depression (e.g., Fredrickson et al., 2003; Ong et al., 2006; Tugade & Fredrickson, 2004). Taken together, it is possible that observing affective balance in the context of stress may be an indicator of effective emotion regulation. Identifying factors that shape affective balance may prove useful for fostering emotion regulation skills in early childhood.

The capacity for emotion regulation is a critical developmental achievement of early childhood (Brophy-Herb et al., 2013; Hernández et al., 2017; Kwon et al., 2017) that has both biological and behavioral substrates that are influenced by social context and developmental stage (Perry & Calkins, 2018; Wagner et al., 2019). As children spend most of their time with family during early childhood, it is unsurprising that the family environment influences a child's emotion regulation during this developmental period, which is increasingly important as children face stressors when away from their parents (Eisenberg et al., 2010). According to the tripartite model developed by Morris et al. (2007), children learn about regulation of positive and negative emotions through the family environment via three mechanisms: observing parents' emotional interactions, the overall emotional climate of the family, and emotion-related parenting practices such as emotion socialization. Family routines, defined as regularly repeated events involving communication between family members (Spagnola & Fiese, 2007), are one aspect of the family environment that may influence child emotion regulation through the aforementioned mechanisms (Bridley & Jordan, 2012; Ferretti & Bub, 2014; Zajicek-Farber et al., 2012). Family routines provide parents with opportunities to scaffold their child's emotion regulation skills, by allowing children to practice expressing different emotions and receive feedback in a structured, predictable environment (Spagnola & Fiese, 2007). Engaging in routines such as saying hello, goodbye, and reading together (particularly at bedtime) allow the child and parent to reconnect and reflect on the day's activities, including experiences that may have been challenging, which can promote emotion coping skills. Reading and talking about how characters manage difficult situations is also a powerful way for a young child to learn about and practice emotion regulation skills; indeed, this is a key technique for many emotion regulation promotion programs at this age (e.g., the Incredible Years Series, the PATHS program). Finally, family routines allow parents to model emotion regulation skills, for example through positive emotional interactions during mealtimes, which can also help build emotion regulation skills in children. Children growing up in low-income households have been noted to experience more difficulties with emotion regulation than their middle-income peers on average (Evans et al., 2005; Raver, 2004), yet there is variation in emotion regulation among children from low-income environments that associates with a range of child outcomes such as executive control, school adjustment, and observed socioemotional behavior during kindergarten (Denham et al., 2013).

Many studies have investigated environmental influences on emotion regulation; however, fewer have also considered biological vulnerability, or sensitivity to context among children as a potential moderator when assessing such influences. The biological sensitivity to context theory posits that there are individual differences in susceptibility to environmental input that may play a role in understanding divergent trajectories stemming from early development (Ellis et al., 2011). Cortisol is a marker of hypothalamic-pituitary-adrenal (HPA) activity and thought to reflect biological sensitivity. Research suggests that cortisol output may modify the impact of early experiences on the development of emotion regulation (Blair & Raver, 2012; Miller et al., 2017; Vaillancourt et al., 2018). Cascading processes within the HPA axis activate the release of glucocorticoid hormones that prepare the body to cope with stress, which in turn may impair brain regions needed to support emotion regulation (Erickson et al., 2003) such as the prefrontal cortex and amygdala (Bonnet et al., 2015; Quirk & Beer, 2006), regions of the brain which have a high density of glucocorticoid receptors. Under normal conditions, the release of cortisol in response to stress (i.e., reactive cortisol output) is followed by a recovery to baseline, a process governed by feedback loops to ensure adequate regulation (Aschbacher et al., 2013). Typically, a well-functioning HPA axis also demonstrates a diurnal pattern such that levels of cortisol production rise in the morning with awakening, and decline across the day to reach a nadir by the evening hours, along with sleep onset

(Buckley & Schatzberg, 2005). Both reactive and diurnal cortisol output can influence how a child regulates emotional arousal in the face of a stressor. Studies examining cortisol in relation to emotion regulation in children have shown associations in opposing directions, namely that both higher cortisol reactivity and lower morning cortisol are related to poorer emotion regulation (e.g., Gunnar & Vazquez, 2015; Miller et al., 2017; Poon et al., 2016). Either profile may result in suboptimal emotional responses, for instance, high levels of cortisol and hypersensitivity to environmental input (i.e., hyperarousal) may lead to oversaturation, making it difficult to enact emotion regulation skills, whereas low levels of cortisol may reflect hyposensitivity to environmental input (i.e., hypo-arousal) and low activation of brain regions essential to emotion regulation (Blair et al., 2013). Based on these findings, it is not clear what levels of sensitivity, as indexed by cortisol, may be optimal both for responding to positive environmental inputs and effectively managing emotion regulation challenges.

Studies have generally found that children who experience high levels of early life stress display less of an increase in cortisol when faced with acute stress (Raffington et al., 2018) and have low diurnal cortisol levels throughout the day (Zalewski et al., 2012), which may ultimately increase risk for emotion regulation difficulties. Although blunted cortisol output may protect against excessive cortisol production, low cortisol secretion has been associated with negative health outcomes and externalizing problems over time (Taylor et al., 2011). Blunted cortisol may lead to reduced engagement with positive, rewarding activities or a limited capacity to rise to challenges (Ginty, 2013; Raffington et al., 2018), which can be problematic for development of social-emotional and coping skills. Moreover, recent evidence suggests a U-shape, curvilinear association between early stressful experiences and cortisol reactivity or responsivity to stress such that reactivity profiles differ based on level of stress exposure (Shakiba et al., 2020). Researchers have also found that adolescents who display a more normative, steeper decline in diurnal cortisol levels tend to have greater levels of high arousal positive affect, reflected in higher activity levels and alertness (Hoyt et al., 2015). Findings in the literature are somewhat inconsistent with regard to whether morning cortisol levels or diurnal decline are most strongly associated with emotion regulation (Laurent et al., 2013; O'Brien et al., 2020; Zalewski et al., 2012). However, it stands to reason that blunted cortisol and hypo-arousal may reduce children's ability to access positive emotional experiences or demonstrate positive affect in the face of challenge, which may result in more limited positive regulation skills over time. Yet, children's biological sensitivity to positive family environments, such as regular family routines, has not been considered in understanding individual differences in emotion regulation among children living in poverty.

Articulating the interplay between the social environment, specifically family routines, and emotion-related physiological processes, such as the HPA axis, will allow for better understanding of the environmental factors most important to shaping the development of emotion regulation, specifically affective balance, during early childhood. Family routines may help to mitigate the effects of chronic stress by establishing predictability and structure within the environment (Larsen & Jordan, 2020). Indeed, multiple research teams have identified associations between household chaos and child HPA axis functioning (e.g., Brown et al., 2019; Doom et al., 2018; Tarullo et al., 2020). For example, experiencing more household chaos during preschool has been found to predict a more blunted diurnal cortisol slope during middle childhood (Doom et al., 2018; Larsen & Jordan, 2020). In a separate study, higher household chaos was associated with mothers' reports of better child emotion regulation during middle childhood (Hong et al., 2020). The absence of chaos, however, does not indicate the presence of routines, and fewer studies have considered how the presence of family routines in the home relates to emotion regulation, and whether child HPA axis functioning may moderate these associations given differences in biological susceptibility. One study, which included some of the same participants as the current study, found that a lack of home routines was most strongly associated with poor parent-reported emotion regulation (i.e., higher negative lability or lower positive regulation) among preschool-aged children with low diurnal cortisol output, specifically morning cortisol level (*citation withheld for review).* It is important to note, however, that this previous study assessed emotion regulation via parent report, which fails to capture the dynamic nature of emotion regulation and has shown discrepancies with observed (Olino et al., 2013) and child-reported measures of emotion regulation (Hourigan et al., 2011). Further, the previous study did not assess affective balance, a more holistic measure of emotion regulation that captures the disposition to display positive versus negative emotions.

The present study aims to build upon previous findings by examining whether household routines interacts with diurnal cortisol levels to predict observed affective balance in response to a task designed to elicit negative emotions among preschool-aged children living in poverty. Given associations with both emotion regulation and cortisol in children, maternal depression and household chaos were included as covariates (Doom et al., 2018; Leppert et al., 2018; Martin et al., 2012). Findings may have implications for whether family routines benefit children with specific types of stress reactivity profiles, which may be particularly important for families living in poverty given research that they tend to experience chronic stress and adverse experiences (Steele et al., 2016). It is possible that family routines are promotive (e.g., decreases in problematic outcomes) for all children or protective (e.g., buffering children in the face of risk or stress).

## Methods

### Study Design and Participants

Participants included 222 preschool-age children (*M*=4.70, *SD*=0.60; female=52%) living in the Midwest region of the United States. Children were attending Head Start, a free and federally-funded program for families from low-income backgrounds, and participating in a longitudinal study of eating behavior where they provided diurnal cortisol samples (see details below; *citation withheld for review)*. Families were invited to participate in a follow-up that provided data for the current study, which assessed emotion regulation using behavioral tasks and was described as a study of how children respond to challenging situations. Children participated in the follow-up on average 5.9 (SD 3.8) months following their initial participation. Families were eligible to participate if the parent had < 4-year college degree; parent and child both spoke English; child was not in foster care, did not have food allergies or significant medical problems or perinatal complications; and children were ≥ 35-weeks gestation at birth. The sample described in this study includes participants with complete data for all covariates, predictor, moderator, and outcome variables in the reported analysis (n=222). This study and its procedures were approved by the [blinded] Institutional Review Board.

Children in the final sample had data for diurnal cortisol and the behavioral tasks. Caregivers identified the race and ethnicity of their children, which were as follows: 56.3% non-Latinx White, 17.1% Black, 0.5% American Indian or Alaska Native, 14.0% Biracial, and 12.2% Latinx, any race. Regarding highest level of maternal education, 15.8% of mothers did not graduate from high school, 21.6% had a high school degree, 10.4% had a Generalized Equivalency Diploma (GED), 41.0% had experience taking some college courses, and 11.3% had a 2-year college degree. The average family income-to-needs ratio was calculated as annual pre-tax income divided by the poverty threshold for a family of the same size between 2009 and 2011, when the data were initially collected. The mean income-to-needs ratio of 0.82 (*SD*=0.81) for this sample indicated that families were generally living in poverty.

**Procedures and Measures**

For each study assessment, developmentally-appropriate assent was obtained from children and caregivers were provided written informed consent. Compensation was provided for the family's time. Trained study staff administered questionnaire-based measures to parents and worked with children to administer tasks and collect saliva samples either in the home or Head Start setting.

**Behavioral Challenge Tasks**

Children completed a set of behavioral tasks designed to elicit a mild-to-moderate level of challenge (Gunnar et al., 2009; Kryski et al., 2011). We assessed affective balance specifically in the *Disappointing Gift* task, a task designed to elicit emotions in response to a disappointment (Cole, 1986). Prior to this, children were invited into a separate room from their parent and engaged in free play for 20 minutes with the examiner. The child rated six prizes from the most preferred (e.g., toy car or doll) to least preferred (e.g., broken comb or deflated ball) and was told they could have the most preferred prize as a gift later. The examiner then removed the most preferred prize from the room. After the child played two additional games (Perfect Circles and Puzzle; Goldsmith & Rothbart, 1999), the examiner informed the child that they could now have their previously selected prize, but the examiner first needed to gift wrap it. The child then waited for 1.5 minutes while the examiner pretended to wrap the gift behind a screen by crinkling paper. Following this, the child participated in the Disappointing Gift task (Cole, 1986). All behavioral tasks were videotaped for later coding.

**Disappointing Gift Task (Cole, 1986).** The examiner presented the child with the wrapped gift box containing the least preferred prize (e.g., broken comb or deflated ball) instead of the anticipated most preferred prize (e.g., toy car or doll). The child opened the gift box, and the examiner remained unresponsive for 30 seconds while the child reacted to the disappointing gift. After 30 seconds, the examiner “realized” the mistake, apologized for the “mistake”, and retrieved the “correct” preferred prize for the child, which the child was allowed to take home as a gift. After this, the child engaged in quiet free play with the examiner or watched an age-appropriate children’s movie.

**Affective Balance**

Child emotion responses in the Disappointing Gift task were coded in 5-second intervals by research assistants trained to reliability and using behavioral coding software (Mangold, 1998). An adapted emotion coding scheme (Miller & Olson, 2000) was used for this study. Presence and absence of emotion displays were coded for every 5-second interval of the Disappointing Gift task; coders were trained on all codes by independently coding subsets of videos until reliability was achieved (i.e., $\kappa \geq 0.7$), and 20% of tapes were coded after reliability was achieved to ensure that no coder drift occurred over time. Coders analyzed the child's facial expressions, vocal tone, verbal content, and behavioral expressions of emotion to determine presence or absence of emotional displays (none/neutral, joy/positive, mild negative affect/distress, sadness, anger, crying). Displays of interest in the current study were joy/happiness (final $\kappa$=.87), and negative emotional displays (mild distress, sadness, anger, and crying), which were infrequently observed and therefore combined into a negative composite code (final $\kappa$=.87), as is common in behavioral coding studies (e.g., Arellano et al., 2018). With the exception of none/neutral, codes were not mutually exclusive; for example, a child could be coded as exhibiting joy and anger simultaneously during the same interval. However, there were no instances of negative and positive displays simultaneously within the same 5-second interval. To ensure that no coder drift occurred over time, 20% of videos were double coded by different coders.

Similar to other measures of behaviorally coded affective balance (Denham et al., 1990) we generated proportion scores of positive and negative emotions based on the number of 5-second intervals in which children expressed each emotion. Proportion scores therefore reflected the number of intervals that contained an emotional display divided by the number of total intervals in the episode (typically 6 intervals). The difference between positive proportion scores and negative proportion scores, hereafter called affective balance, was calculated. Specifically, affective balance was the standardized score for proportion of negative emotional displays subtracted from the standardized score for proportion of positive emotional displays (i.e., joy/happiness), as defined by previous studies (Denham et al., 1990, 2001) and consistent with positivity ratio literature that focuses primarily on positive emotional expression rather than negative or neutral expressions (e.g., Catalino & Fredrickson, 2011; Fredrickson, 2013). Thus, higher affective balance score was operationalized as more positive compared to negative emotion displays, whereas lower affective balance score was operationalized as more negative compared to positive emotion displays.

**Diurnal Cortisol**

Children provided saliva samples three times per day (upon arrival at preschool, prior to breakfast around 8:30AM; prior to lunch around 11AM; and 3:30PM) for three weekdays within a given week. Research assistants collected the saliva samples by drooling in a tube or chewing on a piece of braided, cotton dental roll devoid of additives. For each saliva sample day, caregivers provided information on child medication regimen, sickness, overall daily experience (i.e., an unusually good or bad day), wake time and whether this was the child’s typical wake time. Caregivers or Head Start teachers, as appropriate, were also asked if the child engaged in napping or eating prior to every saliva sample. Saliva samples were stored in a -20 °C freezer until extraction and assaying for cortisol using an Expanded High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics LLC, Carlsbad, CA) with a detection limit of .003 μg/dl. Intra- and inter-assay coefficients of variation (CV) were 7%. Data cleaning procedures for cortisol values were the same as those reported in Miller et al., 2016. Values were excluded if the child took medication known to affect cortisol on a sampling day. Values were also excluded if they were either >3 standard deviations from the sample mean or >2 standard deviations from the sample mean and an unusual event was reported for the child (e.g., flu) for that time point. Only 2.2% (n=66) of the samples assayed were excluded for these stated reasons. Children with at least five valid cortisol timepoints across at least two days were included in analysis. On average, children had 8.4 (SD=1.2) cortisol data points. Morning samples were collected an average of 1.5 hours post waking (SD=0.6), midday samples 3.9 hours post waking (SD=0.6), and afternoon samples 8.5 hours post waking (SD=0.8). The information collected regarding medication use, illness, unusually positive/negative events, napping or eating prior to sample, exact morning waking time and if it was typical for the child were collected in a saliva log. These indices were not associated with cortisol diurnal pattern and were thus not used as covariates.

Hierarchical linear modeling (HLM) and restricted maximum likelihood method (REML) were used to generate random parameters to capture aspects of the diurnal cortisol curve for each participant (Lumeng et al., 2014**)**. To estimate morning cortisol level, we used HLM with random intercept and slope on log-transformed cortisol values as the outcome and minutes post-awakening at the time of sample collection as the independent variable. This modeling allowed for estimating the random intercept as an estimate of the expected cortisol level at 60 minutes after awakening for a given participant. Random slope reflects the expected decay rate of cortisol 60 minutes post-awakening. Sample day did not contribute to the prediction ($p$=.42), and therefore, was not included as a predictor in the HLM model. However, each cortisol sample for each day was included in the model with the corresponding time post-awakening based on wake time that day, and time that sample was collected. The random intercept estimates from the HLM analysis (intercept and slope) were then standardized to a mean of 0 and standard deviation of 1 and used as individual-level predictor variables.

**Questionnaire measures**

Caregivers completed questionnaires to assess demographic covariates and family routines at the assessment when diurnal cortisol was obtained. Family routines were assessed using the 14-item Child Routines Inventory (Jordan, 2003) to assess how regularly the child participated in family routines that included engagement with or supervision by a caregiver (e.g., spending time reading together; saying goodbye; engaging in the same activities prior to bedtime; eating together). Items were rated on a 5-point Likert scale from 0 ("never") to 4 ("nearly always"). The sum of these responses was used to calculate a total score where higher values indicate greater presence of family routines ($\alpha$=0.70).

**Covariates**

Caregivers provided information about the child's sex, date of birth (from which age was calculated), race/ethnicity, and maternal education level (categorized as more than a high school diploma versus not). Self-reported maternal depression symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), which is a 20-item scale with responses ranging from 1 (rarely; less than one day per week) to 4 (most of the time; greater than or equal to five days per week). The sum of the items on this scale yields a total depression score, with higher scores indicating more symptoms of depression (α=.89). Caregivers reported household chaos, defined as the level of confusion and disorganization in the child's household using the Confusion, Hubbub, and Order Scale (CHAOS; Matheny et al., 1995), which consists of 15 statements answered as true (1) or false (0). Total score was calculated by summing responses (higher score indicated higher chaos; α=.81). These variables are associated with key study variables based on prior literature, hence they were used as covariates in the analyses (Doom et al., 2018; Leppert et al., 2018; Martin et al., 2012).

**Statistical Analyses**

SPSS (Version 24.0) was used for the present analyses. Descriptive statistics were assessed to characterize the sample (Table 1). One-way ANOVAs were conducted to evaluate whether key study variables varied by child sex, child race/ethnicity, or maternal education level. Bivariate correlations were used to examine associations between study variables and continuous covariates.

The PROCESS macro (Hayes, 2017) for SPSS was used for moderation analyses. PROCESS is a widely-used path analysis modeling tool for estimating interaction effects in moderation analyses and probing interactions by testing simple slopes. All variables were mean-centered for cross product construction. Child morning cortisol intercept was tested as a moderator of the association between family routines and observed affective balance during the Disappointing Gift task. The diurnal decline over the course of the day, or cortisol slope, was tested using the same moderation model. Covariates included child sex, race/ethnicity, age, maternal education level, maternal symptoms of depression, and household chaos. Interaction effects with $p$-values < 0.10 were further probed using simple slope analyses at the following conditioning values: $16^{th}$, $50^{th}$, and $84^{th}$ percentiles (Hayes, 2017).

## Results

### Descriptive and Bivariate Analyses

One-way ANOVA results suggested that key study variables (family routines, morning cortisol intercept, cortisol slope, and affective balance) did not significantly differ by maternal education level ($0.07<ps<0.64$). All key study variables, with the exception of cortisol slope, did not differ significantly by child race and ethnicity. Cortisol slope in children identified as Latinx and any race ($M$=0.34, $SD$=1.05) was significantly less rapidly declining or blunter compared to children identified as Black and non-Latinx ($M$=-0.35, $SD$=1.17; $F(3, 220)=3.32$, $p$=0.02). Affective balance in the disappointing gift task differed by child sex ($F(1, 220)=5.27$, $p$=0.02) such that boys exhibited lower affective balance scores ($M$=-0.26, $SD$=1.50) compared to girls ($M$=0.20, $SD$=1.47). No other key study variables differed by child sex. Results from bivariate analyses (Table 2) indicated a positive association between maternal symptoms of depression and household chaos ($r$=0.15, *p*=.03). Household chaos was negatively associated with morning cortisol intercept level (*r*=-0.16, *p*=.02), family routines (*r*=-0.21, *p*=.002), and affective balance scores (*r*=-0.13, *p*=.05) such that more chaotic home environment was related to a lower child morning cortisol levels, less frequent family routines, and lower affective balance scores. We included covariates in our moderation analysis due to these associations.

**Moderation Analyses**

Results from the overall model (see Table 3) that included morning cortisol level as a moderator of the family routines and observed affective balance association suggested a trend-level interaction effect by morning cortisol intercept ($F(1, 212)=5.52$, $\Delta R^2=0.02$, $p=0.06$). As stated in the pre-analysis plan, simple slope analyses were conducted to probe this interaction effect. Results indicated that for children with a low morning cortisol intercept, more frequent routines were associated with more affective balance ($b=0.06$, $SE_b=0.03$, $t=2.20$, $p=0.03$, 95% CI=[0.01, 0.11]), whereas this association was not observed in children with average or high morning cortisol intercepts ($b=0.02$, $SE_b=0.02$, $t=1.31$, $p=0.19$, 95% CI=[-0.01, 0.06]; $b=-0.01$, $SE_b=0.02$, $t=-0.40$, $p=0.69$, 95% CI=[-0.05, 0.04], respectively, see Figure 1). When cortisol slope was tested as a moderator, it was not a significant predictor of observed affective balance ($b=-0.09$, $SE_b=0.11$, $t=-0.85$, $p=0.40$, 95% CI=[-0.30, 0.12]) nor was there an interaction effect between cortisol slope and family routines ($b=0.02$, $SE_b=0.02$, $t=0.80$, $p=0.42$, 95% CI=[-0.02, 0.06]).

## Discussion

Our study examined whether cortisol as a marker of biological sensitivity moderated the association between family routines and emotion regulation, conceptualized as observed affective balance in the Disappointing Gift task. Indeed, morning cortisol intercept moderated the family routines-affective balance association such that more frequent family routines were associated with more affective balance among children with a low morning cortisol intercept. There were no significant associations observed in children with average or high morning cortisol intercepts, and cortisol slope was not a significant moderator of the association between family routines and observed affective balance. These findings support the notion that family routines may be more beneficial for emotion regulation among children experiencing disrupted cortisol levels, specifically blunted morning cortisol (Evans & English, 2002). Importantly, much of the literature on children who have a history of living in poverty has emphasized the detrimental factors of stressors such as adverse childhood events; thus, much less is known about the factors such as family routines that associate with positive thriving and flourishing that may build resilience in the face of adversity such as growing up in an impoverished environment (Bethell et al., 2017).

Results from the present study demonstrate the potential role of family routines on observed emotion regulation skills, specifically affective balance, in preschool-aged children with blunted cortisol who have a history of living in poverty. While family routines and morning cortisol intercept did not differ by child sex, race/ethnicity, or maternal education level, observed affective balance scores were lower in boys compared to girls such that boys displayed less affective balance in response to receiving a disappointing gift. This is consistent with gender differences in expressive control and display rules (Chaplin, 2015). Associations between higher parent-reported home chaos, lower child morning cortisol levels, less frequent family routines, and lower affective balance scores were also consistent with previous research demonstrating that children from low-income households may experience emotion regulation difficulties (Evans et al., 2005; Raver, 2004) and low cortisol secretion (Raffington et al., 2018; Zalewski et al., 2012). Controlling for household chaos, more frequent family routines were associated with more affective balance among children with low morning cortisol, whereas this association was not observed in children with average or high morning cortisol.

Prior studies have found that cortisol is associated with emotion regulation during early childhood (e.g., Fortunato et al., 2008; Miller et al., 2017). Prior research, however, has relied on examining emotion regulation using parent-reported measures (e.g., Bocknek et al., 2018; Caiozzo et al., 2018; Miller et al., 2017) or observational methods that focus on either positive or negative affect rather than the balance of positive and negative emotional expressions (Binder et al., 2020; Hernández et al., 2018; Hernández et al., 2017). In previous work that examined cortisol as a moderator of the relationship between family routines and emotion regulation (Miller et al., 2017), emotion regulation was assessed using parent report and defined as the overall intensity of the child's negative emotions and the child's typical ability to exhibit empathy as well as use words to express emotions. In contrast, the current study operationalized emotion regulation as observed affective balance in a challenging task, and considered both positive and negative affect as two distinct, yet related, aspects of emotion regulation (Gross, 2002). Using observational methods is a strength of the present study and builds upon previous work to eliminate parental bias in reporting that has been shown to contribute to ways that parents view their child's emotional control (Durbin & Wilson, 2012) and capture the dynamic nature of emotional expression that is central to emotion regulation processes. Focusing on positive affect is also an important contribution to the literature given that compared to negative affect, much less work has focused on positive affective experiences particularly in children (Brans et al., 2013). Modulation of both aspects of emotion expression is an important aspect of emotion regulation, since people must down- and up-regulate both positive and negative emotions to reach certain goals (e.g., decreasing positive affect to focus on a competitive task). Affective balance captures both positive and negative emotion expressions, and thus, represents a more holistic aspect of emotion regulation. Furthermore, it is important to understand the role of positive affect specifically in children, given findings (primarily in adults) that highlight the importance of positive emotional expression (rather than negative or neutral expression) in the context of stress-inducing situations (Fredrickson, 2013; Tugade & Fredrickson, 2007).

Considering biological vulnerability or sensitivity to context among children as a moderator of influences on emotion expression is an important approach in order to understand how stress biology profiles may shape child functioning. For instance, a dysregulated stress response system, which is relatively common among children living in poverty, is associated with an increased risk for emotion regulation difficulties (Raffington et al., 2018; Zalewski et al., 2012). Since chronic stress exposes the brain to prolonged periods of elevated stress hormones, it has been posited that chronic stress may disrupt development of brain regions involved in emotion regulation (Loman & Gunnar, 2010). The stress-emotion regulation pathway is also thought to function bidirectionally, where temperament characteristics related to emotionality have consequences on how individuals respond to stress (Krkovic et al., 2018). Findings from the present study support the notion that individual differences in biological stress responses, in this case blunted morning cortisol production, may be important to consider when attempting to model children's emotional responses to external stressors. This may be particularly relevant for children who may have experienced poverty-associated adversity and thus may have more disrupted stress biology patterns (Brown et al., 2019; Zalewski et al., 2012).

Current findings were somewhat counter to some other studies of biological sensitivity to context, which have found that associations between home influences and social-emotional outcomes can be more pronounced among children who have elevated, as opposed to blunted cortisol levels (Ellis et al, 2011). Our finding that children who had more blunted morning cortisol may suggest that routines were potentially protective for children who tend to experience hypo-arousal, in terms of shaping how these children responded to the disappointment task by expressing positive displays. Findings from the current study may help inform future iterations of the biological sensitivity model as evidence suggests that associations between stress reactivity, environment, and social-emotional outcomes may follow a more nuanced curvilinear relation (Shakiba et al., 2020).

Cortisol slope did not moderate the family routines-affective balance association, which is consistent with findings from Miller et al. (2017). It is possible that since we were only able to assess children through late afternoon, the cortisol slope value did not fully capture the nadir of the cortisol decline, and these later evening values have been shown to associate with family environment factors in other research (Laurent et al., 2014). Although both low morning level and flatter diurnal decline may both represent a blunted cortisol pattern, future work using methods that allow time-linked measures, such as ecological momentary assessment, may clarify associations between fluctuations in cortisol levels and home environment factors (Laurent, 2014). Specifically, ecological momentary assessments that allow time-stamped data collection of cortisol samples and specific behaviors in the home could be useful in identifying links between timing of routines and cortisol production.

Early childhood is characterized by increased independence and novel scenarios in which a child must effectively regulate their emotions to navigate different developmental challenges. Many of the competencies needed for success during kindergarten, such as playing well with others and communicating needs, involve regulating both positive and negative emotions (Lin et al., 2003). As children will surely experience disappointments during this period, it is important that children possess tools to respond to new, uncertain contexts. Beyond preparing children to manage their negative emotions, it is also important that children possess tools to enhance their positive emotional experience in order to promote emotional well-being and thriving. Indeed, children who display greater positive emotions are often rated by peers and teachers as more socially competent (e.g., Denham et al, 1990; Hernández et al., 2018). Particularly during the early childhood period, practicing routines in the home environment is a way to establish the expectation that the environment is stable and that challenges can be managed. For example, a regular routine for saying hello and goodbye is important at this age as it allows a child to practice separations and reunions with a parent or caregiver, which can be stressful (e.g., dropping off at childcare). Engaging in these routines, and talking about the routines, is a way for the child to anticipate and learn how to manage emotionally challenging experiences.

Predictable, structured home environments have been proposed to support healthy development, whereas home environments characterized by unpredictability and a lack of structure may interfere with developmental processes (Evans et al., 2005). Emotion regulation is one developmental process thought to be significantly influenced by the structure of the home environment (Fiese & Winter, 2010). Our results support this perspective, finding that consistently engaging in family routines was associated with more affective balance among children with a low morning cortisol level. Home routines may serve as a protective factor among children who have blunted morning cortisol. In concordance with our findings, prior work using the same sample as the current study, found that home environments characterized by routines were associated with better parent-reported emotion regulation among children with a low morning cortisol intercept (*citation withheld for review)*. In this sample of families from low income backgrounds, children with low morning cortisol, which can be an indicator of chronic early life adversity (Bruce et al., 2009; Gunnar & Quevedo, 2006), hence the greater importance of family routines in developing emotion regulation for these children. Future research may seek to build upon these findings by identifying whether promoting family routines can strengthen emotion regulation skills, particularly for more biologically vulnerable children.

Study results should be considered in light of limitations. The current study expands on prior findings, which used an established parent-report measure of emotion regulation (*citation withheld for review),* by examining observed emotion response to a stressor, as measured a few months after the cortisol assessment. Yet, since children may react differently in various contexts, coding emotion displays from a brief task may not be indicative of overall emotion regulation skills. Further, observing emotion displays after receiving a gift may be an index of display rules knowledge, as some children may display positive expressions even after receiving a disliked gift as a form of prosocial behavior. As our focus in this study was on positive emotions, we considered the balance between positive to negative emotion expression as our key construct of interest, but it is possible that children who displayed neither positive nor negative emotions during the disappointing gift task were also engaging in a form of emotion regulation. There are also cross-cultural differences in emotional reactions to disappointing situations (Garrett-Peters & Fox, 2007), so there may be confounding variables which account for the observed associations. To account for some of the potential confounding variables, the analysis covaried key variables such as child sex, which was associated with affective expression in the task. In regards to the lack of effects observed with cortisol slope, it is possible that because saliva sample timing was tied to school day (e.g., sample taken upon arrival to school) rather than wake and bed times, that the full diurnal rhythm of cortisol was not captured. The operationalization of emotion regulation as observed affective balance in the present study does not include a measure of strategies used to manage one's emotions. Therefore, the association between emotion regulation strategies and management was not something captured in the present study and should be included in future investigations.

Consistent with previous literature (e.g., Sytsma et al., 2001), parent reports on the Child Routines Inventory performed well in this population, but are subject to bias and influenced by parent factors that are not easily accounted for. However, parents remain as essential informants regarding their child's development at this age. While probing any trend-level interaction effects was a stated pre-analysis plan, it is worth noting that the overall interaction effect was small (trend-level significance); however, follow-up simple slope analyses indicated a significant finding, which suggested a positive association between family routines and affective balance for children with low morning cortisol. Lastly, while it is critical for more research to focus on vulnerable child populations such as those included here, results from the study may not be applicable to other populations beyond preschool-aged children who have a history of living in poverty.

The current study builds upon existing research regarding the interplay of the social context and physiological factors, revealing that cortisol indeed moderates the family routines-affective balance association in low-income children. It will be important for future research to consider how early childhood factors may not only be protective of adverse outcomes, but promoting of positive development as it relates to emotion regulation. Additionally, future studies should aim to capture emotion regulation more comprehensively, including affective balance in tasks designed to induce positive affect. Taken together, these research initiatives would serve to address how to better understand resilient developmental trajectories and ways to promote positive well-being in early childhood.

**References**

Abravanel, B. T., & Sinha, R. (2015). Emotion dysregulation mediates the relationship between lifetime cumulative adversity and depressive symptomatology. *Journal of Psychiatric Research*, *61*, 89-96. https://doi.org/https://doi.org/10.1016/j.jpsychires.2014.11.012

Arellano, B., Gramszlo, C., & Woodruff-Borden, J. (2018). Parental reactions to children's negative affect: The moderating role of parental GAD. *Journal of Anxiety Disorders*, *53*, 22-29. https://doi.org/https://doi.org/10.1016/j.janxdis.2017.10.006

Aschbacher, K., O'Donovan, A., Wolkowitz, O. M., Dhabhar, F. S., Su, Y., & Epel, E. (2013). Good stress, bad stress and oxidative stress: Insights from anticipatory cortisol reactivity. *Psychoneuroendocrinology*, *38*(9), 1698-1708. https://doi.org/https://doi.org/10.1016/j.psyneuen.2013.02.004

Bethell, C. D., Solloway, M. R., Guinosso, S., Hassink, S., Srivastav, A., Ford, D., & Simpson, L. A. (2017). Prioritizing Possibilities for Child and Family Health: An Agenda to Address Adverse Childhood Experiences and Foster the Social and Emotional Roots of Well-being in Pediatrics. *Academic Pediatrics*, *17*(7, Supplement), S36-S50. https://doi.org/https://doi.org/10.1016/j.acap.2017.06.002

Binder, A. S., Brown, H. R., & Harvey, E. A. (2020). Executive Function and Trajectories of Emotion Dysregulation in Children with Parent-Reported Behavior Problems. *Journal of Abnormal Child Psychology*, *48*(4), 481-493. https://doi.org/10.1007/s10802-019-00616-4

Blair, C., Berry, D., Mills-Koonce, R., & Granger, D. (2013). Cumulative effects of early poverty on cortisol in young children: Moderation by autonomic nervous system activity. *Psychoneuroendocrinology*, *38*(11), 2666-2675. https://doi.org/https://doi.org/10.1016/j.psyneuen.2013.06.025

Blair, C., & Raver, C. C. (2012). Child development in the context of adversity: Experiential canalization of brain and behavior. *American Psychologist*, *67*(4), 309-318. https://doi.org/10.1037/a0027493

Block, J., & Kremen, A. M. (1996). IQ and ego-resiliency: Conceptual and empirical connections and separateness. *Journal of Personality and Social Psychology*, *70*(2), 349-361. https://doi.org/10.1037/0022-3514.70.2.349

Bocknek, E. L., Richardson, P. A., van den Heuvel, M. I., Qipo, T., & Brophy-Herb, H. E. (2018). Sleep moderates the association between routines and emotion regulation for toddlers in poverty. *Journal of Family Psychology*, *32*(7), 966-974. https://doi.org/10.1037/fam0000433

Bonnet, L., Comte, A., Tatu, L., Millot, J.-l., Moulin, T., & Medeiros de Bustos, E. (2015). The role of the amygdala in the perception of positive emotions: an "intensity detector". *Frontiers in Behavioral Neuroscience*, *9*(178). https://doi.org/10.3389/fnbeh.2015.00178

Brans, K., Koval, P., Verduyn, P., Lim, Y. L., & Kuppens, P. (2013). The regulation of negative and positive affect in daily life. *Emotion*, *13*(5), 926-939. https://doi.org/10.1037/a0032400

Bridley, A., & Jordan, S. S. (2012). Child Routines Moderate Daily Hassles and Children's Psychological Adjustment. *Children's Health Care*, *41*(2), 129-144. https://doi.org/10.1080/02739615.2012.657040

Brophy-Herb, H. E., Zajicek-Farber, M. L., Bocknek, E. L., McKelvey, L. M., & Stansbury, K. (2013). Longitudinal Connections of Maternal Supportiveness and Early Emotion Regulation to Children's School Readiness in Low-Income Families. *Journal of the Society for Social Work and Research*, *4*(1), 2-19. https://doi.org/10.5243/jsswr.2013.1

Brown, E. D., Anderson, K. E., Garnett, M. L., & Hill, E. M. (2019). Economic instability and household chaos relate to cortisol for children in poverty. *Journal of Family Psychology*, *33*(6), 629-639. https://doi.org/10.1037/fam0000545

Bruce, J., Fisher, P. A., Pears, K. C., & Levine, S. (2009). Morning cortisol Levels in preschool-aged foster children: Differential effects of maltreatment type. *Developmental Psychobiology*, *51*(1), 14-23. https://doi.org/10.1002/dev.20333

Buckley, T. M., & Schatzberg, A. F. (2005). On the Interactions of the Hypothalamic-Pituitary-Adrenal (HPA) Axis and Sleep: Normal HPA Axis Activity and Circadian Rhythm, Exemplary Sleep Disorders. *The Journal of Clinical Endocrinology & Metabolism*, *90*(5), 3106-3114. https://doi.org/10.1210/jc.2004-1056

Caiozzo, C. N., Yule, K., & Grych, J. (2018). Caregiver behaviors associated with emotion regulation in high-risk preschoolers. *Journal of Family Psychology*, *32*(5), 565-574. https://doi.org/10.1037/fam0000425

Catalino, L. I., & Fredrickson, B. L. (2011). A Tuesday in the life of a flourisher: the role of positive emotional reactivity in optimal mental health. *Emotion*, *11*(4), 938-950. https://doi.org/10.1037/a0024889

Chaplin, T. M. (2015). Gender and Emotion Expression: A Developmental Contextual Perspective. *Emotion Review*, *7*(1), 14-21. https://doi.org/10.1177/1754073914544408

Cole, P. M. (1986). Children's Spontaneous Control of Facial Expression. *Child Development*, *57*(6), 1309-1321. https://doi.org/10.2307/1130411

Cooley, J. L., Blossom, J. B., Tampke, E. C., & Fite, P. J. (2020). Emotion Regulation Attenuates the Prospective Links from Peer Victimization to Internalizing Symptoms during Middle Childhood. *Journal of Clinical Child & Adolescent Psychology*, 1-10. https://doi.org/10.1080/15374416.2020.1731819

Denham, S. A., Bassett, H. H., Sirotkin, Y. S., & Zinsser, K. (2013). Head Start preschoolers' emotional positivity and emotion regulation predict their social-emotion behavior, classroom adjustment, and early school success. *NHSA Dialog*, *16*(2).

Denham, S. A., McKinley, M., Couchoud, E. A., & Holt, R. (1990). Emotional and Behavioral Predictors of Preschool Peer Ratings. *Child Development*, *61*(4), 1145-1152. https://doi.org/10.1111/j.1467-8624.1990.tb02848.x

Doom, J. R., Cook, S. H., Sturza, J., Kaciroti, N., Gearhardt, A. N., Vazquez, D. M., Lumeng, J. C., & Miller, A. L. (2018). Family conflict, chaos, and negative life events predict cortisol activity in low-income children. *Developmental Psychobiology*, *60*(4), 364-379. https://doi.org/10.1002/dev.21602

Durbin, C. E., & Wilson, S. (2012). Convergent validity of and bias in maternal reports of child emotion. Psychological Assessment, 24(3), 647–660. https://doi.org/10.1037/a0026607

Eisenberg, N., Spinrad, T. L., & Eggum, N. D. (2010). Emotion-related self-regulation and its relation to children's maladjustment. *Annu Rev Clin Psychol*, *6*, 495-525. https://doi.org/10.1146/annurev.clinpsy.121208.131208

Ellis, B. J., Shirtcliff, E. A., Boyce, W. T., Deardorff, J., & Essex, M. J. (2011). Quality of early family relationships and the timing and tempo of puberty: Effects depend on biological sensitivity to context. *Development and Psychopathology*, *23*(1), 85-99. https://doi.org/10.1017/S0954579410000660

Erickson, K., Drevets, W., & Schulkin, J. (2003). Glucocorticoid regulation of diverse cognitive functions in normal and pathological emotional states. *Neuroscience & Biobehavioral Reviews*, *27*(3), 233-246. https://doi.org/https://doi.org/10.1016/S0149-7634(03)00033-2

Evans, G. W., & English, K. (2002). The Environment of Poverty: Multiple Stressor Exposure, Psychophysiological Stress, and Socioemotional Adjustment. *Child Development*, *73*(4), 1238-1248. https://doi.org/10.1111/1467-8624.00469

Evans, G. W., Gonnella, C., Marcynyszyn, L. A., Gentile, L., & Salpekar, N. (2005). The Role of Chaos in Poverty and Children's Socioemotional Adjustment. *Psychological Science*, *16*(7), 560-565. https://doi.org/10.1111/j.0956-7976.2005.01575.x

Ferretti, L. K., & Bub, K. L. (2014). The influence of family routines on the resilience of low-income preschoolers. *Journal of Applied Developmental Psychology*, *35*(3), 168-180. https://doi.org/https://doi.org/10.1016/j.appdev.2014.03.003

Fiese, B. H., & Winter, M. A. (2010). The dynamics of family chaos and its relation to children's socioemotional well-being. In *Chaos and its influence on children's development: An ecological perspective.* (pp. 49-66). American Psychological Association. https://doi.org/10.1037/12057-004

Fortunato, C. K., Dribin, A. E., Granger, D. A., & Buss, K. A. (2008). Salivary alpha-amylase and cortisol in toddlers: Differential relations to affective behavior. *Developmental Psychobiology*, *50*(8), 807-818. https://doi.org/10.1002/dev.20326

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*, *56*(3), 218-226. https://doi.org/10.1037/0003-066X.56.3.218

Fredrickson, B. L. (2013). Positive Emotions Broaden and Build. In P. Devine & A. Plant (Eds.), *Advances in Experimental Social Psychology* (Vol. 47, pp. 1-53). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-407236-7.00001-2

Fredrickson, B. L., Tugade, M. M., Waugh, C. E., & Larkin, G. R. (2003). What good are positive emotions in crises? A prospective study of resilience and emotions following the terrorist attacks on the United States on September 11th, 2001. *Journal of Personality and Social Psychology*, *84*(2), 365-376. https://doi.org/10.1037//0022-3514.84.2.365

Garrett-Peters, P. T., & Fox, N. A. (2007). Cross-cultural differences in children's emotional reactions to a disappointing situation. *International Journal of Behavioral Development*, *31*(2), 161-169. https://doi.org/10.1177/0165025407074627

Ginty, A. T. (2013). Blunted responses to stress and reward: Reflections on biological disengagement? *International Journal of Psychophysiology*, *90*(1), 90-94. https://doi.org/https://doi.org/10.1016/j.ijpsycho.2013.06.008

Goldsmith, H. H., & Rothbart, M. K. (1999). The laboratory temperament assessment battery. *Locomotor version*, *3*.

Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology*, *39*(3), 281-291. https://doi.org/10.1017/S0048577201393198

Gunnar, M. R., & Quevedo, K. (2006). The Neurobiology of Stress and Development. *Annual Review of Psychology*, *58*(1), 145-173. https://doi.org/10.1146/annurev.psych.58.110405.085605

Gunnar, M. R., Talge, N. M., & Herrera, A. (2009). Stressor paradigms in developmental studies: What does and does not work to produce mean increases in salivary cortisol. *Psychoneuroendocrinology*, *34*(7), 953-967. https://doi.org/https://doi.org/10.1016/j.psyneuen.2009.02.010

Gunnar, M. R., & Vazquez, D. (2015). Stress Neurobiology and Developmental Psychopathology. In *Developmental Psychopathology* (pp. 533-577). https://doi.org/https://doi.org/10.1002/9780470939390.ch13

Harrington, E. M., Trevino, S. D., Lopez, S., & Giuliani, N. R. (2020). Emotion regulation in early childhood: Implications for socioemotional and academic components of school readiness. *Emotion*, *20*(1), 48-53. https://doi.org/10.1037/emo0000667

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.

Hernández, M. M., Eisenberg, N., Valiente, C., Spinrad, T. L., Berger, R. H., VanSchyndel, S. K., Thompson, M. S., Southworth, J., & Silva, K. M. (2018). Balance in Positive Emotional Expressivity Across School Contexts Relates to Kindergartners' Adjustment. *Early Education and Development*, *29*(1), 1-13. https://doi.org/10.1080/10409289.2017.1364946

Hernández, M. M., Eisenberg, N., Valiente, C., Spinrad, T. L., VanSchyndel, S. K., Diaz, A., Silva, K. M., Berger, R. H., & Southworth, J. (2017). Observed Emotions as Predictors of Quality of Kindergartners' Social Relationships. *Social Development*, *26*(1), 21-39. https://doi.org/10.1111/sode.12179

Hong, Y., McCormick, S. A., Deater-Deckard, K., Calkins, S. D., & Bell, M. A. (2020). Household chaos, parental responses to emotion, and child emotion regulation in middle childhood. *Social Development*. https://doi.org/https://doi.org/10.1111/sode.12500

Hourigan, S. E., Goodman, K. L., & Southam-Gerow, M. A. (2011). Discrepancies in parents' and children's reports of child emotion regulation. *Journal of Experimental Child Psychology*, *110*(2), 198-212. https://doi.org/https://doi.org/10.1016/j.jecp.2011.03.002

Howell, K. H., Graham-Bermann, S. A., Czyz, E., & Lilly, M. (2010). Assessing Resilience in Preschool Children Exposed to Intimate Partner Violence. *Violence Vict*(2), 150-164. https://doi.org/10.1891/0886-6708.25.2.150

Hoyt, L. T., Craske, M. G., Mineka, S., & Adam, E. K. (2015). Positive and negative affect and arousal: cross-sectional and longitudinal associations with adolescent cortisol diurnal rhythms. *Psychosomatic medicine*, *77*(4), 392-401. https://doi.org/10.1097/PSY.0000000000000178

Jordan, S. S. (2003). Further validation of the Child Routines Inventory (CRI): relationship to parenting practices, maternal distress, and child externalizing behavior. Doctoral Dissertation, Louisiana State University.

Khosla, M. (2006). Positive affect and coping with stress. *Journal of the Indian Academy of Applied Psychology*, *32*(3), 185-192.

Krkovic, K., Clamor, A., & Lincoln, T. M. (2018). Emotion regulation as a predictor of the endocrine, autonomic, affective, and symptomatic stress response and recovery. *Psychoneuroendocrinology*, *94*, 112-120. https://doi.org/https://doi.org/10.1016/j.psyneuen.2018.04.028

Kryski, K. R., Smith, H. J., Sheikh, H. I., Singh, S. M., & Hayden, E. P. (2011). Assessing stress reactivity indexed via salivary cortisol in preschool-aged children. *Psychoneuroendocrinology*, *36*(8), 1127-1136. https://doi.org/https://doi.org/10.1016/j.psyneuen.2011.02.003

Kwon, K., Hanrahan, A. R., & Kupzyk, K. A. (2017). Emotional expressivity and emotion regulation: Relation to academic functioning among elementary school children [doi:10.1037/spq0000166]. *School Psychology Quarterly*, *32*(1), 75-88. https://doi.org/10.1037/spq0000166

Larsen, K. L., & Jordan, S. S. (2020). Organized Chaos: Daily Routines Link Household Chaos and Child Behavior Problems. *Journal of Child and Family Studies*, *29*(4), 1094-1107. https://doi.org/10.1007/s10826-019-01645-9

Laurent, H. K. (2014). Clarifying the Contours of Emotion Regulation: Insights From Parent–Child Stress Research. *Child Development Perspectives*, *8*(1), 30-35. https://doi.org/10.1111/cdep.12058

Laurent, H. K., Leve, L. D., Neiderhiser, J. M., Natsuaki, M. N., Shaw, D. S., Harold, G. T., & Reiss, D. (2013). Effects of prenatal and postnatal parent depressive symptoms on adopted child HPA regulation: Independent and moderated influences. *Developmental Psychology*, *49*(5), 876-886. https://doi.org/10.1037/a0028800

Leppert, K. A., Smith, V. C., Merwin, S. M., Kushner, M., & Dougherty, L. R. (2018). Cortisol Rhythm in Preschoolers: Relations with Maternal Depression and Child Temperament. *Journal of Psychopathology and Behavioral Assessment*, *40*(3), 386-401. https://doi.org/10.1007/s10862-018-9650-1

Lin, H.-L., Lawrence, F. R., & Gorrell, J. (2003). Kindergarten teachers' views of children's readiness for school. *Early Childhood Research Quarterly*, *18*(2), 225-237. https://doi.org/https://doi.org/10.1016/S0885-2006(03)00028-0

Lo, S. L., Vroman, L. N., & Durbin, C. E. (2015). Ecological validity of laboratory assessments of child temperament: Evidence from parent perspectives. *Psychological Assessment*, *27*(1), 280-290. https://doi.org/10.1037/pas0000033

Loman, M. M., & Gunnar, M. R. (2010). Early experience and the development of stress reactivity and regulation in children. *Neuroscience & Biobehavioral Reviews*, *34*(6), 867-876. https://doi.org/https://doi.org/10.1016/j.neubiorev.2009.05.007

Mangold, P. (1998). Interact [computer software]. *Arnstorf, Germany: Mangold International*.

Martin, C. G., Bruce, J., & Fisher, P. A. (2012). Racial and ethnic differences in diurnal cortisol rhythms in preadolescents: The role of parental psychosocial risk and monitoring. *Hormones and Behavior*, *61*(5), 661-668. https://doi.org/https://doi.org/10.1016/j.yhbeh.2012.02.025

Matheny, A. P., Wachs, T. D., Ludwig, J. L., & Phillips, K. (1995). Bringing order out of chaos: Psychometric characteristics of the confusion, hubbub, and order scale. *Journal of Applied Developmental Psychology*, *16*(3), 429-444. https://doi.org/https://doi.org/10.1016/0193-3973(95)90028-4

McRae, K., & Gross, J. J. (2020). Emotion regulation. *Emotion*, *20*(1), 1-9. https://doi.org/10.1037/emo0000703

Miller, A. L., & Olson, S. L. (2000). Emotional Expressiveness during Peer Conflicts: A Predictor of Social Maladjustment among High-Risk Preschoolers. *Journal of Abnormal Child Psychology*, *28*(4), 339-352. https://doi.org/10.1023/A:1005117009370

Miller, A. L., Song, J.-H., Sturza, J., Lumeng, J. C., Rosenblum, K., Kaciroti, N., & Vazquez, D. M. (2017). Child cortisol moderates the association between family routines and emotion regulation in low-income children. *Developmental Psychobiology*, *59*(1), 99-110. https://doi.org/10.1002/dev.21471

Morris, A. S., Silk, J. S., Steinberg, L., Myers, S. S., & Robinson, L. R. (2007). The Role of the Family Context in the Development of Emotion Regulation. *Social Development*, *16*(2), 361-388. https://doi.org/10.1111/j.1467-9507.2007.00389.x

O'Brien, J. R., Lewis, J. K., & Zalewski, M. (2020). Maternal emotion dysregulation and physiological concordance in mother-preschooler dyads. *Infant and Child Development*, *29*(5), e2184. https://doi.org/10.1002/icd.2184

Olino, T. M., Durbin, C. E., Klein, D. N., Hayden, E. P., & Dyson, M. W. (2013). Gender Differences in Young Children's Temperament Traits: Comparisons Across Observational and Parent-Report Methods. *Journal of Personality*, *81*(2), 119-129. https://doi.org/https://doi.org/10.1111/jopy.12000

Ong, A. D., Bergeman, C. S., Bisconti, T. L., & Wallace, K. A. (2006). Psychological resilience, positive emotions, and successful adaptation to stress in later life. *J Pers Soc Psychol*, *91*(4), 730-749. https://doi.org/10.1037/0022-3514.91.4.730

Perry, N. B., & Calkins, S. D. (2018). A biopsychosocial perspective on the development of emotion regulation across childhood. *Emotion regulation: A matter of time*, 3-30.

Poon, J. A., Turpyn, C. C., Hansen, A., Jacangelo, J., & Chaplin, T. M. (2016). Adolescent Substance Use & Psychopathology: Interactive Effects of Cortisol Reactivity and Emotion Regulation. *Cognitive therapy and research*, *40*(3), 368-380. https://doi.org/10.1007/s10608-015-9729-x

Quirk, G. J., & Beer, J. S. (2006). Prefrontal involvement in the regulation of emotion: convergence of rat and human studies. *Current Opinion in Neurobiology*, *16*(6), 723-727. https://doi.org/https://doi.org/10.1016/j.conb.2006.07.004

Radloff, L. S. (1977). The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Applied Psychological Measurement*, *1*(3), 385-401. https://doi.org/10.1177/014662167700100306

Raffington, L., Prindle, J., Keresztes, A., Binder, J., Heim, C., & Shing, Y. L. (2018). Blunted cortisol stress reactivity in low–income children relates to lower memory function. *Psychoneuroendocrinology*, *90*, 110-121. https://doi.org/https://doi.org/10.1016/j.psyneuen.2018.02.002

Raver, C. C. (2004). Placing Emotional Self-Regulation in Sociocultural and Socioeconomic Contexts. *Child Development*, *75*(2), 346-353. https://doi.org/10.1111/j.1467-8624.2004.00676.x

Shakiba, N., Ellis, B. J., Bush, N. R., & Boyce, W. T. (2020). Biological sensitivity to context: A test of the hypothesized U-shaped relation between early adversity and stress responsivity. *Development and Psychopathology*, *32*(2), 641-660. https://doi.org/10.1017/S0954579419000518

Spagnola, M., & Fiese, B. H. (2007). Family Routines and Rituals: A Context for Development in the Lives of Young Children. *Infants & Young Children*, *20*(4), 284-299. https://doi.org/10.1097/01.IYC.0000290352.32170.5a

Steele, H., Bate, J., Steele, M., Danskin, K., Knafo, H., Nikitiades, A., Dube, S. R., Bonuck, K., Meissner, P., & Murphy, A. (2016). Adverse Childhood Experiences, Poverty, and Parenting Stress. *Canadian Journal of Behavioural Science*, *48*(1), 32-38. https://doi.org/http://dx.doi.org/10.1037/cbs0000034

Sytsma, S. E., Kelley, M. L., & Wymer, J. H. (2001). Development and Initial Validation of the Child Routines Inventory. *Journal of Psychopathology and Behavioral Assessment*, *23*(4), 241-251. https://doi.org/10.1023/A:1012727419873

Tarullo, A. R., Tuladhar, C. T., Kao, K., Drury, E. B., & Meyer, J. (2020). Cortisol and socioeconomic status in early childhood: A multidimensional assessment. *Development and Psychopathology*, *32*(5), 1876-1887. https://doi.org/10.1017/s0954579420001315

Tugade, M. M., & Fredrickson, B. L. (2004). Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology*, *86*(2), 320-333. https://doi.org/10.1037/0022-3514.86.2.320

Tugade, M. M., & Fredrickson, B. L. (2007). Regulation of Positive Emotions: Emotion Regulation Strategies that Promote Resilience. *Journal of Happiness Studies*, *8*(3), 311-333. https://doi.org/10.1007/s10902-006-9015-4

Vaillancourt, T., Brittain, H., Haltigan, J. D., Ostrov, J. M., & Muir, C. (2018). Cortisol Moderates the Relation Between Physical Peer Victimization and Physical Aggression in Preschoolers Attending High-Quality Child Care: Evidence of Differential Susceptibility Across Informants. *Merrill-Palmer Quarterly*, *64*(1), 101-134. https://doi.org/10.13110/merrpalmquar1982.64.1.0101

Wagner, N. J., Mills-Koonce, W. R., Willoughby, M. T., Cox, M. J., & Family Life Project, K. I. (2019). Parenting and Cortisol in Infancy Interactively Predict Conduct Problems and Callous–Unemotional Behaviors in Childhood. *Child Development*, *90*(1), 279-297. https://doi.org/10.1111/cdev.12900

Zajicek-Farber, M. L., Mayer, L. M., & Daughtery, L. G. (2012). Connections Among Parental Mental Health, Stress, Child Routines, and Early Emotional Behavioral

Regulation of Preschool Children in Low-Income Families. *Journal of the Society for Social Work and Research*, *3*(1), 31-50. https://doi.org/10.5243/jsswr.2012.3

Zalewski, M., Lengua, L. J., Fisher, P. A., Trancik, A., Bush, N. R., & Meltzoff, A. N. (2012). Poverty and Single Parenting: Relations with Preschoolers' Cortisol and Effortful Control. *Infant and Child Development*, *21*(5), 537-554. https://doi.org/10.1002/icd.1759

Table 1

*Participant Characteristics*

| Demographics and Descriptive Variables | *M* | *SD* |
|---|---|---|
| Mean age (years) | 4.12 | 0.54 |
| Income-to-Needs Ratio | 0.82 | 0.81 |
| CES-D Total Score | 12.80 | 10.44 |
| Home Chaos | 4.27 | 3.22 |
| Cortisol Intercept | 0.01 | 0.99 |
| Cortisol Slope | 0.02 | 0.95 |
| Family Routines | 45.52 | 6.10 |
| Positive Affect Proportion on Disappointing Gift Task | 0.17 | 0.26 |
| Negative Affect Proportion on Disappointing Gift Task | 0.10 | 0.22 |
| Affective Balance on Disappointing Gift Task | 0.08 | 0.36 |

| | *N* | % |
|---|---|---|
| Female | 116 | 52.3 |
| Child Race/Ethnicity | | |
| Non-Latinx White | 125 | 56.3 |
| Black | 38 | 17.1 |
| Biracial | 31 | 14.0 |
| Latinx, any race | 27 | 12.2 |
| American Indian/Alaska Native | 1 | 0.5 |
| Maternal Education | | |
| More than high school/GED | 106 | 47.7 |
| High school/GED or less | 116 | 52.3 |

*Note*. CES-D = Center for Epidemiologic Studies Depression Scale. Cortisol intercept and slope are log-transformed. Positive and Negative Affect Proportion and Affective Balance calculated on the Disappointing Gift Task are unstandardized values.

Table 2

*Bivariate Correlations Between Covariates, Predictor, and Outcome*

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Age | -- | | | | | |
| 2. CES-D | -0.07 | -- | | | | |
| 3. Household Chaos | 0.04 | 0.15* | -- | | | |
| 4. Cortisol Intercept | -0.12 | -0.07 | -0.16* | -- | | |
| 5. Cortisol Slope | -0.03 | 0.02 | 0.04 | 0.22** | -- | |
| 6. Family Routines | 0.03 | 0.09 | -0.21** | -0.05 | .003 | -- |
| 7. Affective Balance | -0.02 | 0.09 | -0.13* | 0.05 | -0.05 | 0.10 |

*Note*. CES-D = Center for Epidemiologic Studies Depression Scale.

† $p \leq 0.10$. * $p \leq 0.05$. ** $p \leq 0.01$.

Table 3

*Results of Regression Analyses Predicting Observed Emotion Regulation and Testing Cortisol Intercept and Slope as a Moderator*

| Variable | *b* | SE | *p* | $\triangle R^2$ | *b* | SE | *p* | $\triangle R^2$ |
|---|---|---|---|---|---|---|---|---|
| Covariate | | | | | | | | |
| Child Age | -0.04 | 0.19 | 0.83 | | 0.04 | 0.19 | 0.85 | |
| Child Sex | -0.47 | 0.20 | 0.02 | | 0.43 | 0.20 | 0.03 | |
| Child Race/Ethnicity | -0.08 | 0.05 | 0.11 | | 0.08 | 0.05 | 0.07 | |
| Maternal Education | 0.06 | 0.08 | 0.43 | | -0.06 | 0.08 | 0.44 | |
| Maternal CES-D | -0.01 | 0.01 | 0.17 | | 0.01 | 0.01 | 0.21 | |
| Household Chaos | 0.05 | 0.03 | 0.16 | | -0.06 | 0.03 | 0.08 | |
| Predictors | | | | | | | | |
| Routines | -0.02 | 0.02 | 0.17 | | 0.02 | 0.02 | 0.27 | |
| Cortisol Intercept | -0.09 | 0.10 | 0.40 | | | | | |
| Routines X Cortisol Intercept | 0.03 | 0.02 | 0.06 | 0.02 | | | | |
| Cortisol Slope | | | | | -0.09 | 0.11 | 0.40 | |
| Routines X Cortisol Slope | | | | | 0.02 | 0.02 | 0.42 | .003 |

*Note*. CES-D = Center for Epidemiologic Studies Depression Scale.

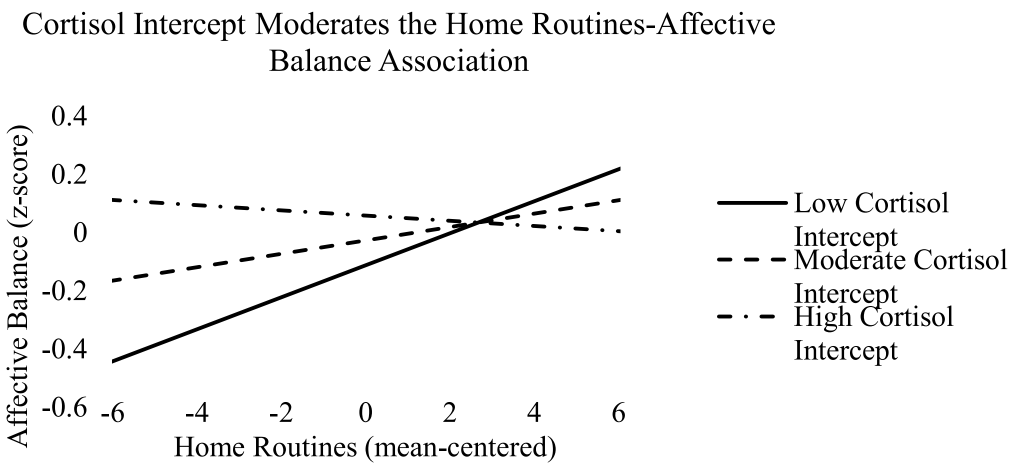


*Figure 1*. Cortisol intercept moderates the home routines-affective balance association. Low, moderate and high cortisol intercept groups were operationalized as the 16th, 50th, and 84th percentiles of the distribution. Variables were mean-centered for construction of interaction product.