



# Parenting and Adjustment Problems among Preschoolers during COVID-19

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## Abstract

A critical area of developmental science explores factors that confer risk or protection as young children and their families experience stressful circumstances related to sociohistorical events. This study contributes to this important area by assessing relations between family context and child adjustment as children transitioned from preschool to home learning during COVID-19, and whether children higher in stress levels, indexed by morning basal cortisol, were more strongly affected. Parents of 74 children ( $M_{age} = 53.56$  months,  $SD_{age} = 3.68$  months) completed reports spanning the home learning transition; children's pre-COVID-19 transition salivary cortisol levels were assessed. Path analyses were used to test the preregistered study aims. Significant interactions were decomposed using simple slopes and Preacher's Regions of Significance (ROS) method. Across the COVID-19 transition to home-based school, children with higher morning basal cortisol experienced the sharpest increase in anger when exposed to harsh/inconsistent parenting contexts. Importantly, these effects held when controlling for household chaos, socioeconomic resources, and supportive parenting. Parallel models with supportive parenting were also tested and are discussed. This study is one of the first to test and provide support for biological sensitivity to context theory within the context of a natural experiment like COVID-19.

**Keywords** COVID-19 · Parenting · Household chaos · Child adjustment · Stress · Preschool

## Highlights

- This study examined children's transition from preschool to home learning during COVID-19.
- Children higher in cortisol had the sharpest increase in anger when exposed to harsh/inconsistent parenting.
- Effects held when controlling for household chaos, SES resources, and supportive parenting.

In developmental science, both theory and empirical support highlight the short- and long-term impact of sociohistorical events, such as pandemics, on children's adjustment (Benner & Mistry, 2020). The novel coronavirus

(COVID-19) pandemic presents a natural experiment to examine critical questions regarding factors that support or undermine children's functioning as they cope with significant transitions and stressors. Pandemics may influence children via their effects on family stressors and supports, which serve as critical contexts for development (Bronfenbrenner, 1979). Further, some children may be more affected by family factors than others. As high physiological stress activity is hypothesized to serve as an index of sensitivity to environmental effects (Berry et al., 2017; Ellis et al., 2011), family factors may be especially important in adjustment to the pandemic among youth exhibiting high stress levels. Although effects of pandemics are likely to vary developmentally, to date, limited research has investigated the effects of pandemics during early childhood (Benner & Mistry, 2020), a foundational developmental

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period for subsequent outcomes (Sroufe, 2013). The purpose of this study was to examine how family factors relate to adjustment in young children across the pandemic-related transition from school to home-based learning, and to identify factors that may make youth particularly sensitive to these family factors. Specifically, we investigated the longitudinal association between harsh/inconsistent and supportive (i.e., warmth/support/reasoning) parenting, as well as household chaos, and young children's adjustment to the transition to home-based learning during the COVID-19 lockdown. In addition, we examined whether children exhibiting higher basal morning cortisol levels were more susceptible to these family effects.

## Biological Sensitivity to Context Theory

Biological sensitivity to context (BSC) theory (see also the related evolutionary theory of differential susceptibility; Belsky & Pluess, 2009) suggests that high stress reactivity serves as an index of plasticity, with highly reactive youth being more strongly affected by their environments than their peers “for better *and* for worse” (Ellis et al., 2011, p. 14; see also Belsky et al., 2007). This approach contrasts with diathesis-stress theory, which proposes that a genetic predisposition for stress reactivity serves as a vulnerability factor specifically for adverse stressful experiences (e.g., Heim & Nemeroff, 1999). Although both diathesis-stress and BSC theories suggest that reactive individuals are neurobiologically vulnerable to stress and will exhibit the most negative outcomes in the context of adversity, according to BSC, these same individuals exhibit the most adaptive outcomes in the context of supportive environments (Ellis & Boyce, 2008). Thus, to adequately test BSC theory, it is critical to assess both adverse and supportive contexts (Ellis et al., 2011). Further, BSC theory suggests that statistical cross-over effects are expected (Roisman et al., 2012). In effect, increased stress reactivity in the context of harsh/inconsistent parenting is theorized to contribute to psychosocial maladjustment (Shakiba et al., 2020). However, in the context of supportive parenting, higher reactivity is theorized to maximize the child's susceptibility to the benefits of being in a positive, development-enhancing environment (Shakiba et al., 2020).

Phenotypic indicators of high BSC include stress-reactive temperaments (Phillips et al., 2012) and heightened physiological stress responses in the adrenocortical system (Ellis & Boyce, 2008), such as the production of cortisol, a glucocorticoid released by the adrenal gland that has widespread effects in the human body (Lakhan-Pal & Gunnar, 2020). In fact, mounting evidence indicates that individual differences in cortisol reactivity moderate the

association between environmental experiences and child adjustment. Importantly, in keeping with BSC theory, a cross-over effect has often been documented in this work, suggesting that highly reactive children exhibit the worst outcomes in negative contexts but the best outcomes in positive contexts (e.g., Kalomiris et al., 2019; Obradović et al., 2010). As BSC is hypothesized to occur among individuals who exhibit sustained stress responses (Ellis & Boyce, 2008), high levels of basal cortisol may similarly serve as an index of BSC (Shirtcliff & Essex, 2008). Basal cortisol is thought to capture trait-like set points and exhibits moderate stability across the course of a year in early childhood (Sturge-Apple et al., 2017). Berry and colleagues (2017) argue that early experiences calibrate hypothalamic-pituitary-adrenal (HPA) axis functioning, resulting in differences in basal cortisol levels that reflect sensitivity to context.

In fact, Rudolph et al. (2010) found that peer victimization was positively associated with aggression among youth exhibiting higher pre-task cortisol. More recently, Davies et al. (2020) reported that cortisol output across baseline and family conflict tasks moderated associations between family adversity (including destructive parent-child interactions) and changes in negative emotional reactivity (e.g., angry reactions) over one year in a sample of adolescents. Consistent with BSC, adolescents exhibiting high cortisol output exhibited the highest negative emotional reactivity over time in the context of high family adversity, but the lowest levels of negative emotional reactivity in the context of low family adversity. Interestingly, cortisol *reactivity* to tasks did not serve as a moderator in this study; the authors suggest that high cortisol output may facilitate learning and memory consolidation during emotionally evocative events, ultimately increasing reactivity to these experiences. Further, Shirtcliff and Essex (2008) suggest that higher basal cortisol places youth at risk for experiencing difficulties across stressful transitions. In fact, a negative (but not positive) transition experience to middle school was more strongly related to mental health difficulties among adolescents with high morning cortisol (Zandstra et al., 2015). In preschoolers, high basal morning cortisol across the transition to preschool, relative to home, was related to aggressive and angry behavior (de Haan et al., 1998). Thus, higher basal cortisol may play a critical role in modulating children's transition to home-based learning during COVID-19.

However, not all researchers have found that heightened cortisol serves as an indicator of greater susceptibility to environmental effects. For example, in a preschool sample, Vaillancourt et al. (2018) provided evidence that peer victimization was most strongly associated with physical aggression among preschool children with *low* basal cortisol. These authors suggest that although most research to

date indicates that high stress arousal serves as an indicator of higher plasticity, low cortisol may at times reflect greater plasticity as well, given evidence that both high and low levels of cortisol portend developmental risk (Vaillancourt et al., 2018). Nevertheless, given the preponderance of evidence to date, in the present study, we expected and preregistered the hypothesis that associations between parenting and child adjustment following the transition to home-based learning during COVID-19 would be strongest among preschoolers with high levels of basal cortisol.

## Parenting and Stress on Child Adjustment

Parents may serve as both a source of risk and protection and have direct as well as indirect influences on the HPA axis and developing children's stress systems (see Gunnar, 2020). As parenting is related to children's adjustment across developmental transitions such as beginning formal schooling (e.g., Olson et al., 2011), parenting may similarly play a critical role in influencing young children's adaptation and adjustment to the challenges and transitions associated with COVID-19. Prior developmental theory and empirical work highlights links between parenting behaviors, such as harsh/inconsistent and supportive parenting, and young children's adjustment (e.g., Clark & Frick, 2018; Lansford et al., 2010; Prendergast & MacPhee, 2018; Sturge-Apple et al., 2012). In fact, an extensive literature has implicated harsh and inconsistent parenting practices (i.e., hostile, intrusive, controlling parenting) in increased risk for the development of children's emotional and behavioral problems. For example, for preschoolers, harsh/inconsistent parenting practices predict higher levels of externalizing problems (e.g., Thompson et al., 2003) and general dysregulation across emotional and behavioral domains (e.g., Kim et al., 2012). In a recent early childhood sample, parenting characterized by harsh discipline and lack of sensitivity predicted children's physical and relational aggression as well as negative peer playground interactions six months later (Haskett & Willoughby, 2007).

By contrast, supportive parenting (i.e., responsive, warm) is thought to encourage the development of child self-regulation (e.g., Blair et al., 2011; Morris et al., 2007), and predicts more positive outcomes across socioemotional, cognitive, and behavioral domains (e.g., Blair et al., 2011). In one recent study, parental warmth and responsiveness, but not harsh and inconsistent parenting, were negatively associated with teacher-reported conduct problems in a sample of six-year-olds (Clark & Frick, 2018). These facets of parenting also appear important in children's adjustment to COVID-19; for instance, a recent study on the impact of the COVID-19 outbreak in Brazil found that parenting marked by high levels of demandingness without support

was associated with child behavior problems among young children (Oliveira et al., 2021). Finally, in a recent study documenting that cortisol output moderated associations between family adversity and negative emotional reactivity, family adversity was operationalized to include high hostility, intrusiveness, and psychological control, as well as low warmth, positive reinforcement, and relationship quality (Davies et al., 2020). Collectively, this work underscores the importance of examining both harsh/inconsistent and supportive aspects of parenting when testing BSC models of children's adjustment during COVID-19.

Additional aspects of the broader family context also have implications for child risk. In particular, higher levels of household chaos (i.e., a disorganized household environment with high levels of noise and distraction; Deater-Deckard et al., 2012) predicts difficulties with regulating negative emotions, higher levels of externalizing behavior problems, and poorer academic and cognitive development in early childhood (e.g., Raver et al., 2015). Importantly, although more chaotic household environments frequently covary with hostile parenting practices and lower family SES, effects of chaotic home environments have been found to operate independently of these additional family context risk factors (e.g., Raver et al., 2015). Household chaos has also been shown to predict bedtime salivary cortisol levels among preschoolers (Tarullo et al., 2020). Thus, in addition to parenting, household chaos may have important implications for children's adjustment to home-based schooling during COVID-19.

Family factors such as parenting and household chaos may have especially pronounced impacts on children in the context of high stress environments, which may include disruption of family routines, structure, or the home environment. In fact, family stress has been shown to predict problem behaviors into late childhood even after controlling for levels in early childhood (Womack et al., 2019), highlighting the potential longevity that early childhood family stress may have on adjustment problems. Given the multitude of stressors accompanying the COVID-19 pandemic, including potential family financial insecurity, health concerns, and school closures (Prime et al., 2020), family factors may provide a critical foundation for supporting, or undermining, children's adjustment during the pandemic.

Studies testing BSC, in particular those that address adjustment problems among children, often consider the role of family and child factors that may need to be controlled (e.g., Obradović et al., 2010). Gender is often theorized as playing an important role in the development and manifestation of externalizing and associated problems among children (Crick & Zahn-Waxler, 2003). Moreover, low SES and associated contextual factors are often implicated in stress system dysregulation among young children (e.g., Tarullo et al., 2020). For these reasons, gender, SES,

and number of children in the home were selected a priori and preregistered as possible covariates.

## Current Study

In the present study, there were five preregistered a priori hypotheses that were tested within the context of a short-term, multi-method longitudinal design that collected data prior to and after the transition to home-based learning due to COVID-19. Consistent with prior literature on the role of family adversity on child adjustment, we hypothesized (hypothesis 1) that children who experienced adversity in the family context prior to COVID-19, including harsh/inconsistent parenting and household chaos, would exhibit the greatest increases in maladjustment across the transition. Although the preregistration included hyperactivity/distractibility, anger (i.e., anger/frustration), and depressed affect as indices of maladjustment, the present study focused on hyperactivity/distractibility problems and anger due to low internal consistency of the depressed affect measure (see supplemental materials). As part of our preregistered hypotheses, we conceptualized anger as a potential indicator of externalizing behavior alongside hyperactivity/distractibility because anger is a negatively-valenced emotion associated with approach responses to threat or blocked goal attainment (see Leibenluft and Stoddard 2013), it is positively associated with externalizing behavior among young children (Smith & Day, 2018), and it is included in conceptualizations of externalizing behavior or youth oppositional behavior (e.g., as part of defiance or irritability, Evans et al., 2020). However, following our preregistered plan, results from the confirmatory factor analyses (see below) indicated that hyperactivity/distractibility and anger were best treated as separate constructs; thus, hypotheses specify these as distinct outcomes. We predicted (hypothesis 2) that supportive parenting would be associated with reductions in hyperactivity/distractibility and anger across the transition to home learning. We hypothesized (hypothesis 3) that stress dysregulation, as indexed by higher basal morning salivary cortisol levels, would be associated with increases in hyperactivity/distractibility and anger across this transition. Finally, in keeping with BSC, we predicted (hypothesis 4a) that harsh/inconsistent parenting and household chaos would be more strongly associated with increases in hyperactivity/distractibility and anger across the COVID-19 transition among children exhibiting heightened morning basal salivary cortisol levels. Given the importance of including supportive contexts in studies of BSC (Ellis et al., 2011), we assessed (hypothesis 4b) whether, in the context of supportive parenting prior to COVID-19, youth with higher basal morning salivary cortisol levels exhibited the largest decreases in

hyperactivity/distractibility and anger problems during the COVID-19 transition to home-based learning. For hypotheses 4a and 4b, we anticipated cross-over interactions such that preschoolers with elevated basal cortisol would show the highest levels of Time 2 hyperactivity/distractibility and anger difficulties in the context of adversity (i.e., high harsh/inconsistent parenting and household chaos, low supportive parenting), but the lowest levels in supportive contexts (i.e., low harsh/inconsistent parenting and household chaos, high supportive parenting).

## Method

### Participants

Seventy-four children and their parent(s) were recruited from nine preschools accredited or recently accredited by the National Association for the Education of Young Children in a large city in the northeastern United States. There were nearly equal numbers of boys and girls (51.4% boys), and participants were approximately four and a half years old ( $M = 53.56$  months old;  $SD = 3.68$  months) at the time of the first parent report. Parents reported on their child's race (12.2% Asian/Pacific Islander, 2.7% Black/African American, 12.2% multiracial, 70.3% White, 1.3% other, 1.3% missing data) and ethnicity (4.1% Hispanic/Latinx). The majority of parent reports were completed by mothers (89.7% at Time 1; 89.9% at Time 2). Parents reported on their annual household income (12.2% between \$25,000–\$49,999, 16.2% between \$50,000–\$99,999, 63.5% over \$100,000, and 8.1% were missing income data), which suggests that despite a large range, the majority of families were middle to upper middle class. Teachers ( $N = 21$ ) were also asked to complete reports for each participating child in their classroom (see supplemental materials).

### Procedures

Consent forms were distributed in the Fall of 2019 at Time 1 (T1) to preschools in order to recruit families with children who were anticipated to begin kindergarten in Fall 2020. If parents were interested, they returned completed written consent forms. Teachers also provided written active consent prior to completing teacher reports. Parent and teacher reports were typically administered via the secure, encrypted, online Qualtrics survey platform; however, some chose to complete paper versions at T1. Before all three saliva collections at T1, children were shown the collection materials and procedures and were asked for their verbal assent before participating. Timing of collection was scheduled so that children had refrained from eating, drinking, engaging in vigorous exercise (e.g., running),

sleeping, and brushing teeth within the prior hour. Children experiencing symptoms of illness within the past 24 h as reported by their teachers did not participate in saliva collection. Efforts were made to schedule saliva collection on days that represented a typical school day (e.g., avoiding holidays or field-trip days). Collections typically took place between 9:30 and 10:30 a.m. ( $M = 10:02$  a.m.,  $SD = 29.88$  min) to account for the diurnal rhythm of cortisol production; all children were at the center for a minimum of 30 min prior to collection. A variable was created to reflect the amount of time in minutes between the median parent-reported wake time in the sample (7:00 a.m.) and basal cortisol collection time at school. As time since waking was not correlated with basal cortisol levels ( $r = 0.004$ ,  $p = 0.98$ ), it was not included as a covariate in analyses. Procedures were approved by the local institutional review board (IRB). Time 2 (T2) occurred in the Spring/Summer of 2020 after the onset of COVID-19 mitigation efforts and school closures in the local community. These closures represent the first of such school closures in the local community and there were no other known local COVID-related stressors prior to this point. The average time between T1 and T2 parent reports was 4.89 months. Parent reports of harsh/inconsistent parenting, supportive parenting, and household chaos were collected at T1, and parent reports of hyperactivity/distractibility and anger were collected at T1 and T2. Parents received \$40 gift cards for completing each parent report and teachers received a \$5 gift card for each child report they completed. If teachers gave permission, children received stickers for each saliva collection and a certificate upon completing all three samples at T1.

## Measures

### Harsh/Inconsistent and Supportive Parenting at T1

Harsh/inconsistent and supportive parenting were calculated as composite factors using subscales (see below for details in the data analysis and results sections) from two parent-reported parenting measures – the Parenting Styles and Dimensions Questionnaire (PSDQ; Robinson et al., 2001) and Alabama Parenting Questionnaire (APQ; Hawes & Dadds, 2006; Shelton et al., 1996).

**PSDQ** Parents completed the Verbal Hostility (4 items, e.g., “I yell or shout when my child misbehaves”), Punitive/Nonreasoning (4 items, e.g., “I use threats as punishment with little or no justification”), Warmth and Support (5 items, e.g., “I have warm and intimate times together with my child”), and Reasoning/Induction (5 items, e.g., “I emphasize to my child the reasons for the rules”) subscales of the PSDQ (Robinson et al., 2001).

Responses were on a 5-point scale from 1 (*Never*) to 5 (*Always*) and were averaged within subscale. The measure has been used extensively in prior work, with evidence for reliability and validity for larger parenting style subscales (e.g., authoritative parenting) and these smaller subscales (Olivari et al., 2013). In the present study, these subscales showed acceptable, but lower than conventional, internal consistency (Cronbach’s  $\alpha$ s = 0.63–0.68), with the exception of the Inconsistent Discipline scale ( $\alpha = 0.54$ ). Removing one item (“When my child asks why they have to conform, I state, ‘Because I said so,’ or, ‘because I am your parent and I want you to’”) improved the reliability of this subscale (Cronbach’s  $\alpha = 0.62$ ). Therefore, consistent with the study’s preregistration, this item was dropped and all PSDQ subscales were retained and used with caution. Moreover, this measure was included in a larger composite with the APQ (see below) to enhance the reliability of the parenting variables used in the present study.

**APQ** Parents also completed the Inconsistent Discipline (6 items, e.g., “You let your children out of a punishment early [like lift restrictions earlier than you originally said]”) and Positive Parenting (6 items, e.g., “You praise your child if they behave well”) subscales of the APQ (Hawes & Dadds, 2006; Shelton et al., 1996). Responses are on a 5-point scale from 1 (*Never*) to 5 (*Always*), and items were summed within each subscale. Prior work has supported the psychometric properties of these subscales (Hawes & Dadds, 2006), and both subscales showed good internal consistency in the current study (Cronbach’s  $\alpha$ s = 0.72, 0.76).

### Household Chaos at T1

Household chaos was measured using parent report of a modified version of the Confusion, Hubbub, and Order Scale (CHAOS; Deater-Deckard et al., 2012; Matheny et al., 1995). The scale contains 6 items (e.g., “You can’t hear yourself think in our home”) that are measured on a 5-point Likert scale from 1 (*Definitely untrue*) to 5 (*Definitely true*) and averaged. In prior work, the CHAOS scale has been found to be reliable, correlated with observational methods of environmental confusion, and the original scale has demonstrated inter-rater agreement between parents living in the same house (e.g., Matheny et al., 1995). In the current study, the scale’s internal consistency was below conventional levels with all items included (Cronbach’s  $\alpha = 0.62$ ), although this is consistent with prior uses of the scale (Deater-Deckard et al., 2012). Consistent with our preregistration, we dropped one item (“There is usually a television turned on somewhere in our home”) to improve reliability (Cronbach’s  $\alpha = 0.71$ ).

## Hyperactivity/Distractibility and Anger at T1 and T2

Hyperactivity/distractibility and anger were assessed at T1 and T2 from parent reports (see Confirmatory Factor Analysis, CFA, below). The Hyperactive/Distractible subscale (4 items; e.g., “Squirmy, fidgety child”) from the Child Behavior Scale (CBS; Ladd & Profilet, 1996) was rated on a 3-point scale from 1 (*Doesn't Apply*) to 3 (*Certainly Applies*). This subscale has demonstrated acceptable reliability and validity in the past (Ladd & Profilet, 1996); in the present study, internal consistency was acceptable at both timepoints (Cronbach's  $\alpha = 0.74, 0.79$ ). Parents rated children's anger (4 items; e.g., “Expresses anger with peers”) using items adapted from Hubbard et al. (2004; see Ostrov et al., 2013) which were rated on a four-point Likert scale from 1 (*Never*) to 4 (*Almost Always*). Past research has supported the internal consistency of this measure (e.g., Ostrov et al., 2013); in the current study, internal consistency was slightly below the conventional 0.70 threshold at both timepoints (Cronbach's  $\alpha_s = 0.64, 0.67$ ). Parents also reported on the Anger/Frustration subscale (6 items e.g., “Gets quite frustrated when prevented from doing something they want to do”) of the Child Behavior Questionnaire – Short Form (CBQ-SF; Putnam & Rothbart, 2006; Rothbart et al., 2001). Items were rated from 1 (*Extremely Untrue*) to 7 (*Extremely True*). Psychometric properties of this measure have been supported in the past (Putnam & Rothbart, 2006), and the scale showed good internal consistency in the present study at both timepoints (Cronbach's  $\alpha_s = 0.81, 0.84$ ).

## Salivary Basal Cortisol

**School-Based Collection at Time 1** Salivary basal cortisol was collected across three consecutive weekday mornings at school (i.e., one sample per day). Consistent with Sturge-Apple et al. (2017), basal cortisol was collected in a narrow timeframe each morning to control for diurnal effects and provide a stable measure of basal cortisol during early childhood. Trained staff and research assistants (RAs) wore gloves and held SalivaBio Children's Swabs (Salimetrics, State College, PA) made from an inert polymer under children's tongues for 90 sec timed via stopwatch. Collection at T1 typically occurred in small groups inside or directly outside children's classrooms with one RA attending to one or two children at a time. During this time, children viewed pictures of food on an iPad and indicated whether they liked the food with a thumbs up or down. Following 90 sec, swabs were placed into labeled Swab Storage Tubes (Salimetrics, State College, PA) which were immediately stored in a cooler with ice packs for transportation back to the laboratory. The manufacturer's protocol was followed strictly by staff (Salimetrics 2013).

Samples were stored at  $-27^{\circ}\text{C}$  in a laboratory freezer. Samples were sent packaged with dry ice for assay within six months of collection. Samples were assayed at the Salimetrics SalivaLab (Carlsbad, CA) using the Salimetrics Salivary Cortisol Assay Kit (Cat. No. 1-3002), without modifications to the manufacturers' protocol. Before assay, samples were thawed, vortexed, and centrifuged. The assay involved a high sensitivity enzyme immunoassay, during which 25 microliters of saliva were extracted from each sample and tested using a lower sensitivity limit of  $0.007\ \mu\text{g/dL}$ ,  $0.012\text{--}3.0\ \mu\text{g/dL}$  standard curve range, a 4.6% average intra-assay coefficient of variation (CV), and a 6% inter-assay CV. These criteria have been determined to be accurate by Salimetrics SalivaLab and exceed guidelines set by the National Institutes of Health. Each sample was tested twice and values were averaged. Additionally, values for the same child were averaged across days for use in subsequent analyses. The cortisol values were reliable across the three days of collection (Cronbach's  $\alpha = 0.83$ ).

## Possible Covariates

An analysis of possible covariates revealed that gender, SES, and number of children in the home emerged as significant correlates of key study variables. As such, these variables were controlled across analyses. The current project used similar procedures as Moran et al. (2017) to create an index of SES based on measures of household annual income, parent occupation, and parent education, each of which were operationalized categorically. Each of these variables was then converted into a proportion ranging from 0 to 1 and averaged. Given that the majority of the sample was conceptualized as middle to upper middle class, this allowed for an SES score that represented more SES resources. Additional details regarding other possible covariates (e.g., teacher-reported academic performance) which were ultimately not included may be found in the supplemental materials. All hypotheses, methods, and the data analysis plan were preregistered prior to analyses on Open Science Framework (OSF; <https://osf.io/ap529>).

## Data Analysis

First, descriptive data and correlations of the measures were obtained. Consistent with our preregistration plan, variables were winsorized (i.e., values brought to  $\pm 3$  SD above the mean) if needed. Skew values ( $-1.66$  to  $1.09$ ) and kurtosis values ( $-0.43$  to  $3.26$ ) were slightly skewed but within accepted ranges for normally distributed variables (Kline, 2016). The analyses for the proposed study were conducted in Mplus version 8.1 (e.g., Muthén & Muthén, 1998–2020). A likelihood ratio  $\chi^2$  test was used to test overall model fit where  $p > 0.05$  indicates good model fit. The following

alternative fit indices were also considered: (a) comparative fit index (CFI), where values greater than 0.95 suggest good fit, (b) standardized root mean-square residual (SRMR) where values less than 0.08 represent mediocre fit, and values less than 0.05 indicate close fit, and (c) root mean square error of approximation (RMSEA), where values less than 0.08 suggest mediocre fit, and values less than 0.05 indicate close fit (Hu & Bentler, 1999).

The maximum likelihood-robust (MLR; Muthén & Muthén, 1998–2020) estimator was used to account for slight deviations from normality, and the relative fit for models were compared using a chi-square difference test for non-normally distributed data (Satorra & Bentler, 2009). The weighted least square mean and variance adjusted estimator (WLMSV) was used when conducting analyses at the item level, given that the CBS contains categorical items. Modification indices (MI; 3.84 was the threshold of what was considered a significant MI) were considered in the event that the overall model fit was lower than conventional levels (see Hu & Bentler, 1999) and to see whether changes could be made to portions of the measurement or structural models. Modifications were only made if they were consistent with theory.

Three separate CFA models investigated whether indicators of harsh/inconsistent parenting at T1 (3 indicators; PSDQ punitive/nonreasoning, APQ inconsistent parenting, PSDQ verbal hostility), supportive parenting at T1 (3 indicators; PSDQ warmth/support, PSDQ reasoning/induction, APQ positive parenting/praise) and hyperactivity/distractibility/anger at T1 and T2 (3 indicators; CBS hyperactivity-distractibility, CBQ anger/frustration; Hubbard anger), loaded onto their respective factors. If model fit was acceptable, we used indicators with significant and substantial factor loadings (loadings of 0.30 or higher; see Brown, 2006) to create composite variables of harsh/inconsistent parenting, supportive parenting, and externalizing problems, respectively. Composite variables were created by standardizing and averaging across relevant indicators. If measures did not load on to a single factor, separate analyses were conducted by measure. Composite variables, rather than latent variables, were used for the primary analyses given the study's relatively small sample size and computational requirements for latent variable interactions.

We ran path analyses to address the primary study aims. T1 outcome variables were included as covariates so that the role of parenting, basal cortisol, and their interaction were assessed in relation to changes in adjustment across the transition to home-based learning. For aim 1, correlated hyperactivity/distractibility and anger at T2 were regressed on T1 household chaos, T1 harsh/inconsistent parenting, and relevant covariates. To address aim 2, a parallel model was run with correlated T2 hyperactivity/distractibility and

anger regressed on T1 supportive parenting and relevant covariates. To address aim 3, we regressed correlated T2 hyperactivity/distractibility and anger on T1 mean cortisol. Robustness tests were run with all variables in the model to ensure that one form of parenting was not driving results. T1 variables were regressed on gender and correlated with continuous covariates for all models. Modification indices were used to determine whether demographic risk covariates were related to T2 hyperactivity/distractibility and anger outcomes over and above their relation with T1 outcomes. To address aim 4, we assessed whether stress system functioning, as indexed by mean morning cortisol at T1, moderated the association between T1 predictors (harsh/inconsistent parenting and household chaos in one model, supportive parenting in the other model), and correlated hyperactivity/distractibility and anger outcome variables at T2. Significant interactions were decomposed using simple slopes and Preacher's Regions of Significance (ROS) method (Preacher et al., 2006). Finally, analyses were conducted to determine whether results were consistent with a diathesis stress or BSC perspective as outlined by Roisman et al. (2012).

## Results

### Preliminary Analyses

Bivariate correlations and descriptive statistics for the key variables in the entire sample are provided in Table 1. Child gender was related to basal cortisol levels at T1, such that girls had lower levels of basal cortisol than boys [ $F(1, 64) = 5.49, p = 0.02, \text{Adjusted } R^2 = 0.07$ ]. Number of children in the home ( $r = -0.39, p = 0.001$ ) and SES resources ( $r = -0.30, p = 0.01$ ) were associated with hyperactivity/distractibility at T2.

Overall, for the present paper, attrition was low at 6.8% (i.e., 5 girls). At T1, 68 (91.9%) parent reports were completed. Sixty-nine (93.2%) parent reports were completed at T2. Two families who completed a parent report at T1 did not complete a parent report at T2. Three families who did not complete a parent report at T1 completed a parent report at T2. All three saliva samples were obtained for 66 (89.2%) of children at T1; for three children only two samples were obtained. Five children had no saliva samples; two of these children did not assent, one parent did not provide consent for saliva, and two were due to children not attending preschool the morning samples were collected. Four children had cortisol values that were outliers due to parent reported steroid medication use and therefore, these cortisol values were excluded from subsequent analyses. Parent reported allergy and other non-steroid medication use (e.g., antibiotics) was considered for exclusion, but was relatively

**Table 1** Descriptive statistics and correlations of key study variables

Demographic Risk	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Children in the home	–									
2. SES resources	0.01	–								
Key variables										
3. Anger T1	0.04	-0.11	–							
4. Hyperactivity T1	-0.19	0.01	0.28*	–						
5. Harsh/inconsistent parenting T1	0.21	-0.21	0.07	0.08	–					
6. Supportive parenting T1	-0.14	0.24*	0.01	-0.19	-0.30*	–				
7. Household chaos T1	0.25*	-0.07	0.26*	0.27*	0.41**	-0.43**	–			
8. Basal cortisol T1	-0.05	0.03	0.26*	0.11	-0.14	0.24	0.04	–		
9. Anger T2	0.05	-0.22	0.67**	0.31*	0.01	-0.08	0.23	0.20	–	
10. Hyperactivity T2	-0.39**	-0.30**	0.27*	0.74**	0.08	-0.18	0.11	0.03	0.48**	–
<i>M</i>	2.03	0.83	0.00	5.82	0.00	0.01	12.44	0.13	0.00	5.93
<i>SD</i>	0.76	0.14	0.82	1.82	0.77	0.81	3.10	0.05	0.84	1.74
Range	1.00–4.00	0.34–1.00	-2.07–1.83	4.00–10.00	-1.01–2.35	-2.50–1.35	6.00–19.20	0.04–0.31	-1.87–2.10	4.00–10.00

Time 1 data collection occurred in the Fall of 2019, time 2 data collection occurred in the Spring of 2020. SES resources is a proportion composite of parent education, parent income, and parent occupation, where higher scores represent greater SES resources relative to the rest of the sample. \* $p < 0.05$ , \*\* $p < 0.01$ . T1 = Time 1, T2 = Time 2

infrequent and these participants were retained in the below models if their usage was not associated with biologically implausible cortisol values. Children with less missing data at either time point were more likely to have greater SES resources [ $F(1, 69) = 4.85, p = 0.03, \text{Adjusted } R^2 = 0.05$ ]. Children with missing data at T1 were more likely to have higher hyperactivity/distractibility scores at T2 [ $F(1, 67) = 4.72, p = 0.03, \text{Adjusted } R^2 = 0.05$ ] and higher CBQ anger scores at T2 [ $F(1, 67) = 4.34, p = 0.04, \text{Adjusted } R^2 = 0.05$ ]. No other demographic or key study variable was related to missing data. Additionally, Little's MCAR test demonstrated that the data may be missing completely at random [MCAR;  $\chi^2(22) = 20.85, p = 0.53$ ]. However, given that the study was not designed to have data be MCAR, missing data were likely Missing at Random (MAR; Baraldi & Enders, 2010) and missing data were accommodated using Full Information Maximum Likelihood (FIML) for children who had at least one timepoint of parenting and/or cortisol data.

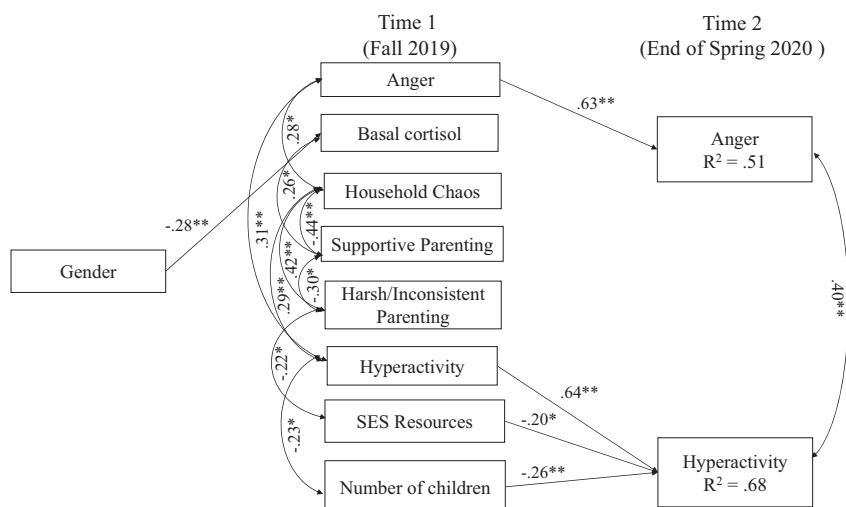
### Confirmatory Factor Analyses

The APQ positive parenting, PSDQ warmth, and PSDQ reasoning subscales loaded on a supportive parenting factor with standardized loadings ranging from 0.68 to 0.78 ( $ps < 0.001$ ). To get a test of model fit the two PSDQ scale factor loadings were constrained to equivalence. The model provided an acceptable fit to the data [ $\chi^2(1) = 0.28, p = 0.60, \text{CFI} = 1.00, \text{RMSEA} = 0.00, \text{SRMR} = 0.09$ ] and the factor was reliable ( $\omega = 0.90$ ). Next, the APQ inconsistent discipline, PSDQ punitive parenting, and PSDQ verbal hostility subscales loaded on a harsh/inconsistent parenting factor with standardized loadings ranging from 0.46 to 0.79 ( $ps < 0.01$ ). To get a test of model fit the two PSDQ scale factor loadings were constrained to equivalence. The model provided a good fit to the data [ $\chi^2(1) = 0.42, p = 0.52, \text{CFI} = 1.00, \text{RMSEA} = 0.00, \text{SRMR} = 0.06$ ] and the factor was reliable ( $\omega = 0.91$ ). Therefore, the harsh/inconsistent parenting and supportive parenting composites were used in subsequent analyses.

Next, the CBQ Anger, Hubbard Anger, and CBS hyperactivity/distractibility subscales at T1 were specified to load on an externalizing problems behavior factor with standardized loadings ranging from 0.38 to 0.65 ( $ps < 0.01$ ). To get a test of model fit the two anger scale factor loadings were constrained to equivalence. This model provided a poor fit to the data [ $\chi^2(1) = 2.29, p = 0.13, \text{CFI} = 0.89, \text{RMSEA} = 0.14, \text{SRMR} = 0.06$ ]. Given this poor fit, two additional models were tested: (1) a factor analysis with externalizing problems factors at T1 and T2 (with a stability path from T1 to T2 and correlated errors for the various measures across time) and (2) a factor analysis at the item level at T1. These analyses are provided in the supplemental



**Fig. 1** Anger and Hyperactivity–Distractibility Path Analysis. Note. All measures were parent report. Paths from demographic risk variables to T2 outcomes were added based on modification indices. Only significant paths are shown. Harsh/inconsistent parenting is a composite of inconsistent discipline, punitive parenting, and verbal hostility subscales, and supportive parenting is a composite of warmth, reasoning, and supportive parenting subscales. Gender is coded 1 = boys, –1 = girls. SES resources is a proportion composite of parent education, parent income, and parent occupation, where higher scores represent greater SES resources relative to the rest of the sample. Number of children = Number of children currently living in the home. \* $p < 0.05$ , \*\* $p < 0.01$



materials. Results demonstrated that a two-factor anger (i.e., CBQ and Hubbard items) and hyperactivity/distractibility (i.e., CBS hyperactivity/distractibility items) model provided an acceptable fit to the data [ $\chi^2(76) = 86.55$ ,  $p = 0.19$ , CFI = 0.94, RMSEA = 0.05, SRMR = 0.11] and a significantly better fit than a one factor externalizing problems model [ $\Delta\chi^2(1) = 13.20$ ,  $p < 0.001$ ]. Therefore, in subsequent models, anger, comprised of the CBQ and Hubbard anger scales, and hyperactivity/distractibility were kept separate but were allowed to correlate. Consistent with our preregistration, the models using an overall externalizing problems behavior composite were still conducted and the results are provided in the supplemental materials.

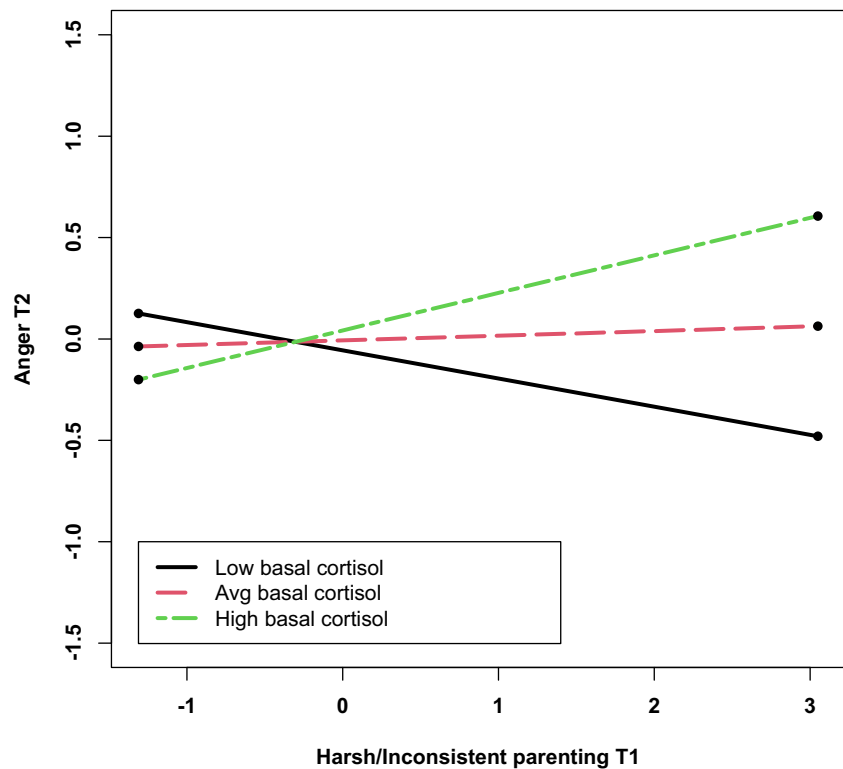
### Anger and Hyperactivity Models

The same parameters emerged as significant in the models examining types of parenting individually, so results from the final combined model are presented for ease of interpretation. T1 harsh/inconsistent parenting, supportive parenting, household chaos, basal cortisol, anger, and hyperactivity/distractibility were correlated with the demographic variables and regressed on gender. Modification indices were used to determine whether demographic variables exerted an effect on anger and hyperactivity/distractibility as children transitioned to at-home care. The model

provided a poor fit to the data [ $\chi^2(8) = 25.54$ ,  $p = 0.001$ , CFI = 0.89, RMSEA = 0.17, SRMR = 0.04]. Based on modification indices and change in chi-squared tests, the relation between the two demographic variables (i.e., number of children in the home and SES resources) and T2 hyperactivity were sequentially added. The final model with these paths added provided a good fit to the data [ $\chi^2(6) = 5.77$ ,  $p = 0.45$ , CFI = 1.00, RMSEA = 0.00, SRMR = 0.02]. Results demonstrated that more SES resources ( $\beta = -0.20$ ,  $p = 0.01$ ) and a greater number of children in the home ( $\beta = -0.26$ ,  $p < 0.001$ ) predicted lower levels of hyperactivity/distractibility across the transition to at-home care (see Fig. 1). Additionally, hyperactivity/distractibility ( $\beta = 0.64$ ,  $p < 0.001$ ) and anger ( $\beta = 0.63$ ,  $p < 0.001$ ) were both stable across this transition. In terms of key study hypotheses, basal cortisol was not related to hyperactivity/distractibility at T2 ( $\beta = -0.01$ ,  $p = 0.86$ ) or anger at T2 ( $\beta = 0.06$ ,  $p = 0.44$ ); harsh/inconsistent parenting was not related to hyperactivity/distractibility at T2 ( $\beta = 0.05$ ,  $p = 0.57$ ) or anger at T2 ( $\beta = -0.06$ ,  $p = 0.55$ ); and supportive parenting was not related to hyperactivity/distractibility at T2 ( $\beta = -0.07$ ,  $p = 0.36$ ) or anger at T2 ( $\beta = -0.10$ ,  $p = 0.33$ ).

Next, sequential interaction models were examined with the modifications from the prior model included. Standardized variables were used for the interaction terms. A model

**Fig. 2** Harsh/Inconsistent Parenting and Basal Cortisol Interaction. Note. Harsh/inconsistent parenting at Time 1 (T1) is a composite of inconsistent discipline, punitive parenting, and verbal hostility subscales. Basal cortisol was also collected at T1. Harsh/inconsistent parenting is standardized and shows the minimum value in the sample (1.31 SDs below the mean) to maximum in the sample 3.05 SDs above the mean. Low, Average, and High cortisol represent 1 SD below the mean, the mean, and 1 SD above the mean of basal cortisol respectively. The simple slopes of the harsh/inconsistent parenting at T1 to anger at T2 relation were not significantly different from zero, but the slopes are significantly different from one another. For these prospective analyses, anger and hyperactivity/distractibility at T1 were controlled. \* $p < 0.05$



with an interaction between harsh/inconsistent parenting and basal cortisol at T1, controlling for the covariates and household chaos, provided an acceptable fit to the data [ $\chi^2(11) = 19.55$ ,  $p = 0.05$ ,  $CFI = 0.95$ ,  $RMSEA = 0.10$ ,  $SRMR = 0.06$ ]. Controlling for supportive parenting did not change results so the more parsimonious model was retained. There was a significant interaction between T1 basal cortisol and T1 harsh/inconsistent parenting in predicting anger at T2 ( $b = 0.16$ ,  $SE = 0.07$ ,  $p = 0.02$ ) but not in predicting hyperactivity/distractibility at T2 ( $b = -0.18$ ,  $SE = 0.10$ ,  $p = 0.06$ ), which was not probed in keeping with our preregistered plan for testing interactions. The significant interaction was probed at one standard deviation above and below the mean of the moderator (i.e., cortisol; see Fig. 2). Simple slopes between harsh/inconsistent parenting and anger at T2 were not significant at low levels of basal cortisol ( $b = -0.14$ ,  $SE = 0.10$ ,  $p = 0.15$ ) or high levels of basal cortisol ( $b = 0.19$ ,  $SE = 0.13$ ,  $p = 0.16$ ).

As simple slope analyses are conducted at arbitrary cut-offs, and the choice of cut-off values (e.g.,  $\pm 1$  SDs versus  $\pm 2$  SDs) can change interpretations of findings (Roisman et al., 2012), the regions of significance of the moderator (RoS of Z) were tested using Preacher and colleagues' method (Preacher et al., 2006). The upper bound represents the high value of T1 basal cortisol (moderator; Z) at which the relation between harsh/inconsistent parenting

(IV; X) and anger T2 (DV) becomes significant, and the lower bound represents the low point of T1 basal cortisol at which this relation becomes significant. All variables were standardized so that high and low values represent standard deviations from the mean. The lower bound of the region of significance was  $-1.66$  SDs ( $b = -0.25$ ,  $SE = 0.12$ ,  $p = 0.05$ ), which indicates that for children who had a T1 basal cortisol value 1.66 SDs below the mean or lower (e.g., 2 SD below the mean) there was a significant negative relation between harsh/inconsistent parenting at T1 and subsequent anger as children transitioned to at-home care. The upper bound was 3.01 SDs ( $b = 0.51$ ,  $SE = 0.26$ ,  $p = 0.05$ ), which indicates that for children who had a T1 basal cortisol value 3.01 SDs above the mean or higher there was a significant positive relation between harsh/inconsistent parenting at T1 and subsequent anger as children transitioned to at-home care. Both the lower and upper bound values were within the range for the z-scored basal cortisol variable in this sample (range from  $-1.70$  to  $3.53$ ). Note that the Z-scored basal cortisol was winsorized prior to standardizing. Values are above 3.00 because the high values were corrected based on the original basal cortisol value mean and standard deviation. After these outliers were corrected the new outlier adjusted basal cortisol mean was standardized and used in the current analyses. For children between  $-1.66$  and  $3.01$  SDs from the mean on T1

basal cortisol, there was no relation between T1 harsh/inconsistent parenting and T2 anger.

A model with an interaction between household chaos and basal cortisol at T1, controlling for the covariates and harsh/inconsistent parenting, provided an acceptable fit to the data [ $\chi^2(11) = 16.84$ ,  $p = 0.11$ , CFI = 0.96, RMSEA = 0.09, SRMR = 0.05], but there was not a significant interaction between basal cortisol and household chaos in predicting anger at T2 ( $b = 0.12$ ,  $SE = 0.09$ ,  $p = 0.20$ ) or hyperactivity/distractibility at T2 ( $b = 0.01$ ,  $SE = 0.10$ ,  $p = 0.93$ ). Similarly, a model examining the interaction between supportive parenting and basal cortisol at T1 controlling for the covariates but no other parenting variables provided an acceptable fit to the data [ $\chi^2(10) = 15.36$ ,  $p = 0.12$ , CFI = 0.96, RMSEA = 0.09, SRMR = 0.09], but there was not a significant interaction between basal cortisol and supportive parenting in predicting anger at T2 ( $b = -0.08$ ,  $SE = 0.06$ ,  $p = 0.23$ ) or hyperactivity/distractibility at T2 ( $b = 0.10$ ,  $SE = 0.11$ ,  $p = 0.38$ ).

### Post Hoc Analyses

Post hoc analyses were conducted to determine whether the interaction between basal cortisol and harsh/inconsistent parenting provided evidence for diathesis-stress or BSC theory (e.g., Roisman et al., 2012). For more information and statistics on the post-hoc analyses see the supplemental materials. A RoS on X test investigated whether there was a significant relation between the moderator (i.e., T1 basal cortisol) and the outcome variable (i.e., T2 anger) at high and low points of the focal predictor (i.e., T1 harsh/inconsistent parenting); significant associations at both high and low levels of the focal predictor are consistent with BSC (Roisman et al., 2012). Significant associations between T1 basal cortisol and T2 anger emerged at high levels of harsh/inconsistent parenting; however, the association at low levels of parenting only approached statistical significance ( $p = 0.10$ ). However, as Roisman et al. (2012) note, RoS on X is limited in studies with small sample sizes due to low power, and thus may lead to inaccurate rejection of BSC interpretations in favor of diathesis-stress. In contrast, the Proportion of Interaction (PoI) and Proportion Affected (PA) are not influenced by sample size and thus provide appropriate supplemental tests to RoS on X tests in studies with small sample sizes (Roisman et al., 2012). In the present study, the PoI was 0.36, and the PA index in our sample (i.e., the crossover point) was 0.47; both of these values provide strong evidence for BSC as compared to a diathesis-stress (Roisman et al., 2012). Given the small sample size in the present study, we weighted the PoI and PA more heavily than RoS on X; the findings for these metrics were both strongly indicative of a BSC, rather than diathesis-stress, interpretation.

## Discussion

The present study aimed to explore the role of family factors in child adjustment during the transition from preschool to home-based learning during COVID-19. We hypothesized that higher harsh/inconsistent parenting and household chaos would be associated with poor adjustment to home-based learning, as measured by increases in hyperactivity/distractibility and anger across this transition. Supportive parenting (e.g., warmth, responsiveness) was expected to be associated with better adjustment across this transition. Models were conducted to examine whether basal morning salivary cortisol was related to hyperactivity/distractibility and anger, and whether it acted as a moderator in the relations between the home context (i.e., parenting, household chaos) and these outcomes. We expected that, consistent with BSC theory, children high in basal cortisol would show the worst outcomes under adverse conditions and would show the best outcomes under optimal contexts across the COVID-19 transition to home-based learning.

Interestingly, the main effects of parenting and household chaos on hyperactivity/distractibility and anger were not significant. Although unexpected, this finding is consistent with prior work that demonstrates variable, and often small, effects of parenting on child externalizing behaviors (Ryan & Ollendick, 2018). Similarly, the main effects of heightened cortisol on increases in hyperactivity/distractibility and anger were not significant, which is consistent with studies testing BSC with reactive temperament and externalizing problems in early childhood (Phillips et al., 2012). Instead, consistent with BSC theory (Boyce & Ellis, 2005) and preregistered hypotheses, individuals with high levels of physiological sensitivity, as indexed by high basal cortisol, demonstrated increases in anger during the transition to home schooling in the context of high levels of harsh/inconsistent parenting, and showed decreases in anger in less negative environments (i.e., low harsh/inconsistent parenting). In addition, both the PoI and PA index values provided strong evidence in support of a BSC, rather than diathesis-stress, interpretation; these indices appear to be especially appropriate in studies where sample size is a concern (Roisman et al., 2012), as is the case in the present study. Thus, findings support prior work on biological sensitivity indicating that higher stress arousal conveys greater susceptibility (Boyce & Ellis, 2005). Further, the results highlight the role of BSC in children's adaptation to the COVID-19 pandemic.

Unexpectedly, we found that harsh/inconsistent parenting predicted *decreases* in anger across the transition to home-based learning for those with low basal cortisol. One potential interpretation of these findings is that children with low stress responsivity, indexed by low cortisol, may have been insensitive to the stressors experienced during

COVID-19, such as increased exposure to hostile or inconsistent parenting during quarantine. In fact, according to the Adaptive Calibration Model (Del Giudice et al., 2011), children (especially boys) exposed to early severe stress develop low levels of stress responsivity that are accompanied by emotion deficits and impaired social learning. Although this stress profile may be associated with costs (e.g., aggression), it may also serve adaptive functions in highly stressful contexts because it is accompanied by threat insensitivity (Del Giudice et al., 2011). In the current study, low cortisol may reflect a physiological pattern of threat insensitivity that, in the high stress context of COVID-19, numbed children's emotional reactions. However, this unexpected effect requires replication in future research.

Interestingly, harsh/inconsistent parenting was associated with changes in anger, but not hyperactivity, among preschoolers with high basal cortisol. Harsh/inconsistent parenting included components such as negative affect and hostility, which may be especially related to children's displays of negative emotion and difficulties with emotion regulation (Morris et al., 2007). These findings are also consistent with prior work indicating that high basal cortisol across the transition to preschool was significantly related to teacher-reported disruptive behavior and parent-reported anger, but only marginally related to activity level (de Haan et al., 1998). Additionally, neither household chaos nor supportive parenting was associated with changes in child hyperactivity/distractibility during the transition to home learning. This suggests that children transitioning to home learning due to COVID-19 were especially reactive to exposure to harsh/inconsistent parenting in the home, rather than other aspects of the family context. Findings also suggest that BSC may be more relevant for harsh/inconsistent rather than supportive parenting contexts or household chaos across this transition. It is also possible that supportive parenting practices were less stable as parents experienced increases in childcare burden and stress during the transition to home learning (Prime et al., 2020), and, as a result, expected positive effects may not have persisted across this transition.

### Limitations and Future Directions

This study had several important strengths, including the use of preregistered and theory-derived hypotheses, a longitudinal design across a critical transition to home-based learning, high sample retention during a pandemic, a multi-method approach at multiple levels of analysis, advanced analytic techniques, and attention to an understudied developmental period. Nevertheless, there are several key limitations that should be addressed in future work. First, parenting assessments and household chaos constructs

were not explicitly paired to the stressor of school closures and home-based learning and it is possible that additional COVID-related and non-COVID related stressors may have impacted these constructs and, in turn, children's adjustment. In addition, although natural experiments provide unique opportunities for the psychological sciences (Rutter, 2007), an important limitation of these designs is that replication can be challenging as the work is often situated in unique sociohistorical events. Indeed, although the present study provides important insights into the critical role of harsh/inconsistent parenting and basal cortisol in young children's adjustment to the transition to home learning during COVID-19, developing new studies to replicate findings may prove difficult as families have encountered new circumstances (e.g., access to vaccines, resumption of in-person learning). It is also not clear whether findings will generalize to other salient stressors that disrupt family functioning and routines in the lives of young children. To address these important limitations, conceptual replication and extension of study findings is necessary. For instance, investigations of whether a similar pattern of findings emerges in longitudinal studies of preschoolers' adaptation to divorce, adjustment following natural disasters, or adaptation to kindergarten will provide important insights regarding the replicability and generalizability of findings. Similarly, given the role that peer treatment (e.g., peer rejection) has for heightened cortisol activity in preschool (e.g., Gunnar et al., 2003), it will be important for future research to extend the present findings and test of BSC models within school and peer contexts. Future work will also need to consider the role of parental mental health and child temperament, which could have impacted both parenting strategies and the child's stress response during this transition and were unfortunately not part of the pre-registered plan due to power constraints with the available sample.

It will also be critical for future research to include additional parenting measures. The parenting measures investigated in the present study were selected given prior work highlighting the importance of harsh/inconsistent parenting and supportive parenting in young children's adjustment (e.g., Clark & Frick, 2018; Lansford et al., 2010; Prendergast & MacPhee, 2018; Sturge-Apple et al., 2012), evidence indicating that supportive and demanding parenting are related to children's behavior problems during COVID-19 (Oliveira et al., 2021), and findings that cortisol output moderated associations between a family adversity factor including these facets of parenting and negative emotional reactivity (Davies et al., 2020). However, additional aspects of parenting, such as psychological control, have been documented as potentially relevant in studies of BSC in prior work (Davies et al., 2020) and should be included in future studies. Future work is also needed to

address the lack of reliability among some key constructs in the present study. Items were removed to approach conventional levels of reliability for some self-reported parenting and chaos measures and this is typical within the larger parenting literature (e.g., Deater-Deckard et al., 2012). Future measurement development and use of other informants (e.g., objective home or lab-based observations, q-sorts) is called for to overcome some of the limitations of these existing and widely used measures.

Future BSC research focused on adaptation to socio-historical events should also include additional developmental outcomes; in fact, some prior work documented that morning cortisol moderated associations between hostile, overreactive parenting and literacy but not executive functioning or externalizing problems (Lipscomb et al., 2018). In the present study, outcomes focused on hyperactivity/distractibility and anger; however, elements of externalizing behaviors such as subtypes of aggression and delinquency were not included. It is possible, for instance, that main effects of parenting may be more evident for aspects of externalizing problems that are less closely tied to temperamental and neurobiological influences. Further, due to low internal consistency of the measure, we were unable to test hypotheses with respect to internalizing problems (see supplementary material), and future psychometrically strong assessments of both depression and anxiety symptoms are needed. Given evidence that the transition to remote schooling due to COVID-19 was associated with decreases in student learning among primary school students (e.g., Engzell et al., 2021), as well as evidence of BSC processes in associations between parenting and literacy (Lipscomb et al., 2018), future research would also benefit from including academic outcomes. The lack of findings regarding supportive parenting may reflect the focus on negative adjustment outcomes in the present study; in fact, meta-analytic work regarding parenting effects on externalizing problems indicates that harsh control and psychological control exhibit the strongest associations (Pinquart, 2017), and some prior work with older samples suggests that supportive parenting may be more strongly tied to prosocial than antisocial behaviors (Houlberg et al., 2016). Thus, positive behaviors, such as prosocial behavior, should be assessed in future research. Finally, in the present study, teacher reports were not widely available or were turned in late at T2 due to school closures and lack of contact information for several teachers. Future work would benefit from multimethod assessments (e.g., observations, parent-report, and teacher-report), especially given that several subscales in the present study demonstrated marginal internal consistency and potential shared method variance concerns (e.g., parent-reported hyperactivity/distractibility, anger, and parenting).

It will also be important to replicate findings in larger samples with diverse populations. For instance, given some

research indicating that lower cortisol may serve as an index of increased susceptibility to environmental effects (e.g., Vaillancourt et al., 2018), more work is needed to understand the contexts in which low versus high basal cortisol reflect heightened plasticity. In addition, “high” versus “low” levels of cortisol are sample-specific, and a large body of research has documented that early adversity (e.g., poverty, maltreatment) is associated with dysregulations in cortisol (Koss & Gunnar, 2018). Mean cortisol values in the present study are similar to those observed in prior work conducted with normative samples of preschoolers using similar methods (e.g., Tarullo et al., 2011; Wagner et al., 2016); however, the meaning and implications of “high” cortisol may differ in high-risk samples that are likely characterized by cortisol dysregulation. It will be important for future research to investigate study hypotheses in high-risk or clinical samples. Further, although it was not possible to test for gender moderation in the present sample due to power limitations, low morning cortisol has been found to predict context-inappropriate anger in boys but not girls (Locke et al., 2009). Thus, the role of cortisol in moderating associations between harsh/inconsistent parenting and anger may differ by gender. Finally, some work indicates racial and ethnic differences in cortisol functioning, even when controlling for factors such as SES (Martin et al., 2012), and the negative effects of COVID-19 may be greater among families targeted by racism (Prime et al., 2020). Therefore, future research should investigate whether the implications of cortisol functioning for adjustment to COVID-19 differ depending on the racial and ethnic composition of the sample.

Additionally, other indices and markers of HPA axis functioning, such as afternoon cortisol or diurnal slope (e.g., Belsky et al., 2015; Xing & Wang, 2018), as well as chronic exposure to stress as indexed by hair and nail cortisol (Liu & Doan, 2018; Tarullo et al., 2020), may extend this work in important ways. It is also possible that findings would differ if cortisol reactivity had been assessed in response to an acute stressor rather than basal morning levels at preschool; in fact, much of the extant cortisol BSC research has assessed reactivity (e.g., Obradović et al., 2010) rather than basal cortisol levels. As changes in physiological activity in response to peer provocation may be indicative of anger (e.g., Hubbard et al., 2002), including cortisol reactivity will be an important direction for future research. It will also be important for future research to include other indices of BSC, including autonomic stress system functioning (Ellis et al., 2011) and reactive temperament (Phillips et al., 2012).

Finally, longer longitudinal studies that span developmental periods are needed to test the cascading outcomes associated with exposure to harsh parenting environments during the COVID-19 pandemic. In particular, it will be important to document the extent to which the effects

demonstrated in the present study diminish over time, and whether there are long-term implications of children's adaptation to the pandemic for future functioning (Prime et al., 2020). Moreover, the effects reported in the present study are likely bidirectional; in fact, prior literature has demonstrated that young children's externalizing behaviors may promote aspects of parenting like psychological control and physical punishment (Verhoeven et al., 2010). Therefore, future work is needed to examine the dynamic bidirectional influences of parenting on child adjustment as well as challenging child adjustment problems on changes in parenting practices.

## Conclusions and Implications

Despite these limitations, the present study offers one of the first attempts to test BSC theory within the context of a natural experiment like the COVID-19 pandemic (see also Miller et al., 2021) and has several public policy and health implications. Consistent with BSC, across the COVID-19 forced transition to home-based school, children higher in basal stress levels, as indexed by salivary morning cortisol levels at preschool, experienced the sharpest increases in anger when exposed to harsh/inconsistent parenting contexts, but the lowest levels of anger at low levels of harsh/inconsistent parenting. Importantly, these effects held when controlling for household chaos, SES resources, and supportive parenting. Interestingly, this pattern of effects did not emerge when examining supportive parenting and future work is needed to investigate whether these parenting practices are more closely tied to prosocial behaviors.

Taken together, findings underscore the importance of preventative programs that help families build resilience in the face of sociohistorical events that result in stressors and disruptions, such as interruptions in school- or center-based learning. Indeed, the role of harsh/inconsistent parenting may be especially pronounced across sociohistorical stressors such as the COVID-19 transition to at-home schooling, when parents and children are spending increased time together. Further, many families have faced hardships due to COVID-19 such as job loss and financial insecurity (Gassman-Pines & Gennetian, 2020), and parents have reported significantly more stress related to the coronavirus than adults without children (American Psychological Association, 2020). In fact, since the beginning of the COVID-19 outbreak, parents have reported increased exhaustion and stress (Marchetti et al., 2020), and parenting stress is linked with harsh/inconsistent parenting (Mak et al., 2020). Moreover, many children rely on schools for identifying and addressing child mental health and psychological needs, which is a considerable concern given school closures associated with COVID-19 (Phelps & Sperry, 2020). Findings from the present study suggest that

preventative programs focused on reducing hostile and inconsistent parenting may play an especially important role in facilitating children's emotional adaptation to these major stressors and life disruptions. Further, findings underscore the potential negative impact of school disruptions on children's well-being, which may help inform policy decisions related to school closures.

Results from the present study indicate that children with high basal cortisol levels exposed to hostile/inconsistent parenting appear to be at particularly high risk for experiencing anger and frustration following COVID-19 school closures. These findings underscore the benefits of cortisol levels that are well-calibrated to environmental challenges that children face (Del Giudice et al., 2011). Further, findings provide important insights regarding children that may be most at risk for difficulties when encountering major life disruptions and thus who may benefit most from prevention and intervention programs. Indeed, efforts to promote pathways of child resilience during sociohistorical stressors such as COVID-19 may need to adopt tailored approaches that account for both parent and child characteristics (Luthar et al., 2020). Finally, these findings could serve as justification for public policy to promote consistent access to high quality childcare for families with young children with additional resources and evidenced-based programs available for those most at risk for adverse reactions to stressful life events.

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## Compliance with Ethical Standards

**Conflict of Interest** The authors declare no competing interests.

**Informed Consent** Informed consent documents were obtained from all parents and from teachers prior to completing their reports.

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