Published in final edited form as:

Dev Psychobiol. 2019 May ; 61(4): 557–572. doi:10.1002/dev.21828.

Emotion Regulation and Cortisol Reactivity during a Social Evaluative Stressor: A Study of Post-institutionalized Youth

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Abstract

In the current study we compared emotion regulation abilities between post-institutionalized (PI; N = 124) and never-institutionalized non-adopted (NA; N = 172) children and adolescents (7–15 years-old). We assessed cortisol reactivity and coded emotion regulation during the speech portion of Trier Social Stress Test (TSST-M). Parents reported on their children's social, academic, and behavioral adjustment. Results suggest that emotion regulation abilities increased with age, but this increase was greater for NA than PI youth. With regard to cortisol, piecewise growth modeling revealed that at higher levels of emotion regulation PI youth had greater baseline values (after a period of time allowing for acclimation to the lab) and had steeper recovery slopes than NA youth. There was also a main effect of emotion regulation on the reactivity slope suggesting that for both groups, as emotion regulation increased, the cortisol reactivity slope decreased. Finally, greater emotion regulation predicted fewer internalizing behavior problems for PI youth but not for NA youth.

Keywords

Cortisol; Emotion Regulation; Adjustment; Post-Institutionalized; Childhood

Emotion regulation reflects the ability to modulate, maintain, inhibit, or enhance the intensity and valence of emotional experiences in an effort to accomplish an individual's goals (Calkins & Hill, 2007; Cole, Martin, & Dennis, 2004). Children who are unable to regulate anger and frustration are more likely to lack behavioral control and engage in externalizing-type behaviors such as aggression and defiance (Gilliom & Shaw, 2004; Keenan and Shaw, 2003). Ineffective regulation of fear and anxiety can also lead to rumination over the source of distress or the suppression of negative affect, both underlying internalizing-type behaviors (e.g., Eastabrook, Flynn, Hollenstein, 2013; Hsieh, & Stright, 2012). The lack of behavioral control and the inability to down-regulate negative emotions makes engaging in socially appropriate interactions with peers and teachers more difficult (Kim & Cicchetti, 2010; Roorda, Koomen, Spilt, Thijis, & Oort, 2013), and it also hinders children's ability to engage with increasingly challenging academic and social tasks that become more frequent as children progress through school (Bornstein, Hahn, Haynes, 2010;

Eisenberg, Fabes, & Spinrad, 2006; Campbell, Spieker, Burchinal, & Poe, 2006). Thus, emotion regulation is one of the most fundamental skills children acquire and is linked to adjustment in behavioral, social, and academic domains.

Emotion Regulation and Early Adversity

Children adopted internationally after experiencing early institutional care (post-institutionalized, PI) have been found to struggle academically, socially, and behaviorally (Hoksbergen, Rijik, Van Dijkum, & Teer Laak, 2004; Juffer & van IJzendoorn, 2005; Tarullo & Gunnar, 2005; van IJzendoorn, Juffer, & Poelhuis, 2005). It has been argued that one reason for this is because they have difficulty regulating negative emotions (Burkholder et al., 2016; Smyke et al., 2007; Stellern, Esposito, Mliner, Pears, & Gunnar, 2014). Although research has suggested that PI children may have greater difficulty regulating their emotions than their peers, very little research has compared PI and never-institutionalized non-adopted (NA) children on emotion regulation abilities. Thus, the extent to which the development of emotion regulation differs across PI and NA children is not fully understood.

In the existing literature, Stellern et al. (2014) found that soon after being adopted, PI children demonstrated more freezing behavior to a novel fear-eliciting task, thought to result from children having fewer skills and resources to deal with increased emotional arousal in a fear context (Zuddas, 2012). Tottenham et al. (2010) examined emotion regulation in a small sample of 8- to 10-year-old PI youth by having them perform an emotional go-nogo task and examining their capacity to respond appropriately in the face of emotional stimuli, one way of assessing emotion regulation. PI children showed slower reaction times than NA children when responding to emotional versus neutral faces and made more errors when threatening versus neutral faces were involved. In an additional study, Burkholder and colleagues (2016) videotaped the speech and math portions of the Trier Social Stress Test for Children (TSST-M; modified from Buske-Kirschbaum et al., 1997) and coded children (9–10 years) and adolescents (15–16 years) for expressions of nervousness and anxiety during these two combined segments. PI youth expressed more nervous/anxious behavior than their NA counterparts, even after controlling for physiological stress responses, suggesting a greater difficulty in inhibiting expressions of nervousness during the task (Burkholder et al., 2016).

Although previous work comparing emotion regulation in PI and NA youth is meager, the extant studies do highlight gaps in the literature. First, Tottenham et al., (2010) examined the extent to which the quality of performance suffered in emotionally-arousing contexts, while Burkholder et al., (2016) and Stellern et al., (2014) examined whether children inhibited behavioral displays of fear reactivity and anxiety during emotional challenge. Therefore, each of these studies provided a snapshot of different aspects of emotion regulation; emotional reactivity and goal-directed behavior. Emotion regulation is defined as modulating one's emotions or emotional experiences in an effort to accomplish one's goals. Thus, children may suppress their anxiety, but it does not necessarily mean they are able to regulate their emotions to perform the task and accomplish the goal of delivering a socially engaging speech. Thus, studying goal-directed behavior in combination with emotional reactivity in the context of emotional challenge is important to better understand differences in emotion regulation across PI and NA youth. In the current study, and like Burkholder et

al., (2016), we coded the TSST-M for behavioral expressions of anxiety in addition to coding the extent to which they produced a positively engaging speech.

Second, Burkholder et al., (2016) noted that older children (aged 15–16) revealed less anxiety than younger children even though they self-reported similar levels of stress. Given the sample size, they were unable to examine whether differences between PI and NA youth in inhibiting the expression of anxiety increased or decreased with age. Studies of behavioral and emotional problems in PI children have shown that these problems may increase with adolescence more so in PI than in NA youth (Colvert et al., 2008; Hawk & McCall, 2010). Therefore, it may be that even though NA and PI youth show increasing emotion regulation skills with development, PI youth may lag behind resulting in an increasing gap in emotion regulation at later ages. Although this question would be best to study longitudinally, cross-sectional analyses would provide a road map for future longitudinal analyses.

Given that we know relatively little regarding how PI children's emotion regulation compares to that of their non-adopted peers, and whether potential deficits in emotion regulation continue to persist into adolescence, the first aim of the current study was to compare PI and NA youth on their ability to regulate expressions of anxiety and perform an engaging speech during the TSST-M, while also examining whether the comparison between groups changes as a function of child age.

Emotion Regulation, Early Adversity, and Adjustment

Emotion regulation is believed to develop most rapidly during infancy and early childhood and is theorized to be embedded within the caregiver-child dyad (Kopp, 1989; Sroufe, 1996). Across early childhood, and through repeated interactions, emotion regulation skills, strategies, and abilities that were once facilitated by caregiver support are thought to become engrained in the child's own self-regulatory skillset (Sameroff, 2009). Because young children in institutions have minimal one-on-one interactions with caregivers during this time of rapid emotional development (National Scientific Council on the Developing Child, 2012), they have far fewer opportunities to develop and practice effective emotion regulation skills from within a warm and supportive caregiver relationship. Subsequently, this may result in a more general problem of heightened emotional reactivity, or an increased likelihood to respond negatively to emotionally taxing situations, and may even alter the development of neurobiological responses to emotional distress. Indeed, PI children have been shown to have an increased prevalence of anxiety disorders (Ellis, Fisher, & Zaharie, 2004) and behavior problems such as aggression (Merz & McCall, 2010) that may stem from heightened emotional arousal. If PI children are more emotionally reactive, the ability to regulate this increased negative arousal, or emotion regulation, may be particularly critical for their adjustment. Eisenberg and colleagues have consistently shown that children high in anger reactivity but lacking behavioral regulation of emotion are more likely to have angry outbursts, conflict with peers, and behavior problems (Eisenberg et al., 2001; Eisenberg et al., 1996), and children high in anxiety but lacking the ability to down-regulate that arousal are more likely to suppress the expression of negative affect or internalize these negative emotions (Eisenberg, Spinrad, & Eggum, 2010). Thus, given potentially heightened emotional reactivity, learning to regulate negative reactivity might be particularly important

for PI kids to manage their behavior and navigate social and academic contexts in adaptive ways. Therefore, second aim of the current study was to test whether early life adversity moderated the association between emotion regulation and academic, social, and behavioral adjustment.

Emotion Regulation, Early Adversity, and HPA Functioning

Theoretical and empirical work has underscored the importance of underlying physiological processes in the regulation of emotion. Most of this work has focused on the role of the autonomic nervous system with far fewer empirical studies assessing the links between hypothalamic-pituitary-adrenocortical (HPA) responding and concurrent emotion regulation. Threats to our well-being, whether actual or perceived, lead to a cascade of events within the HPA system resulting in increased cortisol, a hormone that serves to promote survival by contributing to optimal brain and body functioning. The cortico-limbic networks central to emotion regulation interact with fear- and stress-response systems (Egloff, Schmukle, Burns, Schwerdtfeger, 2006; Gross & Levenson, 1993; Root et al., 2009), and are subsequently associated with HPA axis reactivity (Cunningham-Bussel et al., 2009; Thomason, Hamilton, & Gotlib, 2011). Thus, although cortisol is necessary for survival, when it is not regulated properly, it can have deleterious consequences for health and emotional functioning (Gunnar & Adam, 2012). Importantly, although we know HPA dysregulation has implications for emotional development, emotions do not drive HPA functioning nor are they the direct result of HPA reactivity. Nonetheless, HPA activity can provide insight into emotions and their associations with neurobehavioral development.

Of the work assessing the association between emotion regulation and HPA stress reactivity, there is evidence that as children develop self-regulatory skills, the association between the emotional salience of a stressful situation and children's cortisol response to that situation may reflect self-regulatory abilities. Smeekens and colleagues (2007), for example, demonstrated that children with fewer cognitive, affective, and behavioral self-regulatory skills showed stronger cortisol reactions than children with greater self-regulatory abilities during distress (Smeekens, Riksen-Walraven, & van Bakel, 2007). Unlike during early childhood, strategies used in middle childhood and adolescence are less overt and become more internal and cognitively based (Calkins & Bell, 2010). If children have the cognitive resources to reappraise the situation's emotional significance by generating neutral or positive interpretations of distressing contexts, they may be able to reduce arousal (Gross, 1998; Werner & Gross, 2010) and subsequent HPA reactivity. That is, youth can reappraise by changing the emotional impact of the speech (e.g., it's just pretend), or changing their belief in the extent to which they can handle delivering the speech (e.g., I'm good at speaking in front of people). In turn, this may reduce stress associated with the challenge and result in a smaller cortisol response.

Other studies have found no concurrent association between emotion regulation and HPA reactivity. In a sample of 10-year-olds, de Veld and colleagues (2012) tested associations between children's self-reported spontaneous use of emotion regulation strategies and cortisol reactivity during the TSST. Researchers found no association between self-reported

cognitive reappraisal and cortisol responses. However, for girls only, suppressing emotions was associated with lower cortisol.

Finally, there is some evidence that greater emotion regulation may increase HPA reactivity. Regardless of the strategy used, regulation of emotion requires effort at a physiological level. Researchers have shown that asking children to reappraise to up-regulate (i.e., pretend stimulus is right in front of them) or down-regulate arousal (i.e., pretend stimulus is fake), is associated with distinct patterns of cortical-limbic brain activation in response to a disgust-inducing image (Pitskel, Bolling, Kaiser, Crowley, & Pelphrey, 2011). Thus, there is evidence that the cognitive effort and attentional control processes used in the regulation of emotion may lead to increased activation in cortical-limbic structures and subsequent increases in activation of HPA reactivity. Indeed, among adults, trait measures of the use of both cognitive reappraisal and suppression are related to larger cortisol responses to the TSST (Lam et al., 2009).

Because little empirical work has compared emotion regulation abilities across PI and NA children, it is not surprising that there is no work, to our knowledge, that has examined whether emotion regulation is associated with concurrent HPA reactivity similarly for PI and NA youth. Thus, this is the first study to assess observed emotion regulation and its association with concurrent cortisol in PI youth. A large body of research in animals and humans demonstrates that early life stress, characterized by the lack of a responsive caregiver, can affect the development of the HPA axis and alters stress responses (Koss et al., 2016; McLaughlin et al., 2015). If early adversity has altered the development of the HPA system, it is possible that the association between children's emotion regulation and their HPA stress response differs as a result. Examining these differences is critical to better understand the way in which emotion regulation at both a biological and behavioral level can facilitate adaptive functioning for at-risk children.

Given the mixed findings in previous work regarding the association between emotion regulation and HPA reactivity, and the gap in the literature comparing this association across PI and NA youth, the third and final aim of the current study was to examine the relation between experimenter-rated emotion regulation and cortisol reactivity during the TSST-M and test whether early adversity moderated this link.

The Current Study

In the current study we compared emotion regulation abilities between post-institutionalized (PI) and never-institutionalized non-adopted (NA) youth. We coded children and adolescents' emotion regulation during the TSST-M. Because our definition of emotion regulation consists of modulating arousal to achieve a desired goal, and the goal of the speech portion of the TSST-M was to deliver a good speech that would be judged by adults and other students, emotion regulation was coded as children's positive engagement with the speech. Our goal was to better understand the nature of the associations between early adversity, emotion regulation, HPA reactivity, and children's adjustment.

Three hypotheses were tested. First, because studies of behavioral and emotional problems in PI children have shown that these problems may increase with adolescence more so in PI than in NA youth, we hypothesized that NA children would show greater emotion regulation at older ages than PI children, resulting in a larger gap in performance among older than younger children. Second, because PI youth have been found to have heightened emotional reactivity in previous work, we hypothesized that the ability to regulate emotions would be more strongly related to academic, social, and behavioral adjustment for PI youth compared to NA youth. Finally, we hypothesized that the association between HPA reactivity and emotion regulation may differ for NA and PI youth. However, given the mixed findings within the current literature and the lack of work comparing PI and NA children, we did not hypothesize the nature of this association.

Methods

Participants

The participants were 296 children, of whom 124 (84 female) were adopted internationally from institutional (i.e., orphanage) care (*post-institutionalized, PI*) and 172 (90 female) non-adopted (*NA*) children who had been born and raised with their biological families. Both groups were drawn from registries of families who have expressed interest in being contacted to participate in research. Although this recruitment method tends to result in higher socioeconomic status participants, it results in well-matched groups since the families of internationally adopted children are generally well resourced. PI children spent at least 50% of their pre-adoption lives in institutionalized care, versus foster care or other arrangements ($M = 95\%$, range 50 to 100%). Age at adoption ranged from 5.5 months to 57 months ($M = 18.5$ months, $SD = 11.65$). The children ranged from 7.08 to 15.12 years at the time of testing, with mean ages not differing for the two groups ($M_{pi} = 11.3$ yrs, $SD = 2.4$ yrs; $M_{na} = 11.2$ yrs, $SD = 2.3$ yrs, $t(294) = .42$, ns). The mean family income for the two groups also did not differ ($\chi(7) = 11.6$, $p = .11$) and was \$100,000-\$150,000 per year. Parental education did not differ between groups, with over 75% of the parents in both groups having a four-year college degree or higher. The groups did differ in race/ethnicity. Parents identified NA youth as 90% White, 7.6% biracial or multiracial, 2% Black, African, or African American, and .6% Asian or Asian American. In contrast, parents identified PI youth as 40% White, 41% Asian or Asian American, 10.5% as Indigenous to the Americas, 5% as Black, African, or African American, and 3.3% as biracial or multiracial. Regarding country of birth, 38% of PI youth were adopted from Russia, 21% from China, 10.5% from India, and 6.5% from Guatemala, 4.8% from Ukraine, 4% from Colombia, 4% from Vietnam, 2.4% from Kazakhstan, and 8.9% from other countries including: Ecuador, Ethiopia, Haiti, Nepal, Philippines, and Slovakia.

Procedures

The children were part of a short-term longitudinal accelerated design examining the association between puberty and stress responding in children with adverse early life histories. The data presented here are from the first session of the study.

Trier Social Stress Test.—Children participated in a modified version of the Trier Social Stress Test (TSST-M; Yim, Quas, Cahill, & Hayakawa, 2010; an adaptation of the TSST for children by Buske-Kirschbaum et al., 1997), a commonly used laboratory procedure to induce psychological stress and changes in cortisol concentration (Kirschbaum, Pirke, & Hellhammer, 1993). In this social evaluative task, participants give a 5-minute speech, pretending to introduce themselves to an imaginary classroom. Participants were given 5 minutes to prepare for their speech and write notes but could not use the notes during the speech period. The speech was given in a small room with a one-way mirror and visible camera. The standard TSST-M has two judges in the room with the child. We used a variant of this procedure introduced by Jansen and colleagues (Jansen et al., 2000), which has been previously used with success in our research group. The experimenter stood behind the mirror, gave instructions through a speaker, and rated the speech for quality and effectiveness. Participants were told that the experimenter was behind the mirror with a teacher who would also be watching and judging their speech. Instructions before the speech were played from a recording of a male's voice (the teacher) to ensure that all participants heard the same instructions and perceived someone else was behind the mirror to judge their speech. The recording also told children that they were being videotaped so that other students could rate them, adding to the social-evaluative stress of the task. If participants stopped their speech before five minutes, they were told to “continue” by the experimenter over the speaker. The experimenters remained neutral which should increase the uncertainty about one's performance. After the speech section, participants performed a verbal arithmetic task aloud for an additional 5 minutes, a standard part of the TSST-M.

Video-taping: The speech portion of the TSST-M was videotaped and retained for later scoring. Of the 320 youth enrolled at year one, malfunction of video equipment/experimenter error, resulted in either no video, or insufficient video, to code (N= 24), leaving the 296 children whose demographics are described above.

Salivary Cortisol.—Saliva samples were collected seven times during the session (–20, 0, +5, +20, +40, +60, and +80 minutes, where 0 represents the end of the acclimation period. Prior research has shown that upon arriving at the laboratory participants, particularly children, show an elevated cortisol response. A minimum of 40 minutes to acclimate to the laboratory setting has been used regularly in studies assessing cortisol reactivity (e.g., Miller et al., 2018). Thus, the first two saliva samples reflect an acclimation period of 40 minutes following arrival (see Figure 1). Because we were only interested in the cortisol response to the TSST-M, we used the last 5 saliva samples in the current study. Sample +5, the beginning of speech prep, is considered the start of the cortisol response window, as previous studies have shown that cortisol production begins in anticipation of the speech (Sumter et al., 2010). Peak salivary cortisol levels are generally reached 20–40 minutes post-stressor onset (Kirschbaum & Hellhammer, 1994), thus we sampled at +20 and +40. Given the time course of cortisol response, these samples presumably largely reflect a response to the speech preparation and speech itself. Subsequent samples +60 and +80 are thought to capture decline back to baseline. Plotted means for all of the cortisol samples are provided in Figure 1 and descriptives for the cortisol samples are provided in Table 1.

In order to control for time of day effects that may emerge from diurnal variation in cortisol levels, all sessions began between 3:00 PM and 4:30 PM and ran for exactly 2 hours. Whole unstimulated samples were obtained. Participants were asked to refrain from eating or drinking shortly before and during the session and reported on recent food, caffeine, and medication intake and recent illness. The samples were stored in a laboratory freezer at -20°C until being shipped to the University of Trier, Germany for assay. All seven saliva samples were assayed for cortisol concentration in duplicate using a time-resolved fluorescence immunoassay (DELFA). The intra-assay coefficients of variation were between 4.0% and 6.7%, and the corresponding inter-assay coefficients of variation were between 7.1% –9.0%. All of the samples from each participant were included in the same assay batch. Biologically implausible cortisol values above $2\text{ }\mu\text{g/dL}$ were removed. Log_{10} transformations were performed for all cortisol values to resolve positive skew.

Parent Report.—Parents filled out questionnaires at the laboratory while the participants were completing the TSST-M. Questionnaires included the MacArthur Health and Behavior Questionnaire (HBQ-P 2.11; Essex et al., 2002), which measures mental health/psychological symptoms, physical health, social functioning, and academic functioning, the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997) which assesses parents' perceptions of their children's emotion regulation and emotionality, and the Maternal Emotional Styles Questionnaire (MESQ; Lagace-Seguin & Coplan, 2005) which assesses parents' awareness of emotions within themselves and their children, and the ability to use this awareness to benefit their children's socialization.

Measures

Behavior during Speech Task.—Because the TSST-M was designed to elicit psychosocial stress and anxiety, the children's behavior during the 5-minute speech was coded on 7 scales to examine anxiety and performance under stress. We chose to code children's behavior during the speech portion rather than the math portion of the TSST-M because it is embedded in a social context that allowed for regulation of emotion to achieve a desired goal (i.e., to deliver a speech that is judged by an audience for its quality). Thus, the speech portion allowed for a wider range of behaviors children could employ to accomplish the goal of delivering a high-quality speech in the face of a stressful, emotional challenge.

The anxiety scales used in the current study were borrowed from a previously developed coding scheme (see Burkholder, Koss, Hostinar, Johnson, & Gunnar, 2016). However, our primary goal was not to assess how anxious the speech made children, but rather to assess children's ability to manage their anxiety in a way that allowed them to still accomplish the goal of delivering a speech that would be well received. Children were asked to imagine they were standing in front of a new classroom, to introduce themselves, and to explain why they would be liked by the other children in class. Thus, social engagement and positive expressivity were appropriate for a successful speech and scales reflecting these behaviors were added to the anxiety scales. Details of these scales are provided below.

Anxiety was coded in the forms of *facial anxiety* (e.g., widened eyes, eyes darting, wincing, facial fear expressions), *vocal anxiety* (e.g., quaking of voice, overly anxious vocal content

such as “Oh shoot” or “I can’t do this”, using back-to-back filler words such as “um, uh, like, and”, and stumbling over words), *gross body anxiety* (e.g., stereotypic swaying, gross self-touch such as rubbing arms, and large body movements), and *fine body anxiety* (e.g., fidgeting with hands or fingers, playing with clothing in non-obvious way such as with sleeves or hem, and twirling hair). Anxiety scores were not mutually exclusive (i.e. a participant could be coded for both high intensity vocal anxiety and gross bodily anxiety if both types of behavior were present). In addition, *global distress* was coded as the coder’s subjective interpretation of how distressed the child appeared taking into account their scores on the individual behavioral codes. To reflect the social nature of the task, *positive expressivity* (e.g., smiling, laughing, conveying positive expression through vocalizations), and *social engagement* (e.g., uses tone and emotion to convey meaning frequently in their speech, gesturing) were added to the coding scheme. These measures are scaled 0 to 3, with 0 reflecting no evidence of the behavior, 1 reflecting low intensity/frequency, 2 reflecting moderate intensity/frequency, and 3 reflecting high intensity/frequency. Thus, each measure received a qualitative score of 0–3 to reflect the speech. To evaluate reliability, 22% of the videotapes were double coded and inter-rater reliability (ICC) ranged from .70 to .83 for each of the behavioral codes.

Given that these scales represented two distinct constructs, anxiety and positive engagement, we created composite scales of each. However, the code for fine motor activity was removed from the anxiety composite because it did not correlate with the other anxiety codes. Internal consistency for each composite scale was examined using Cronbach’s alpha. The alphas were moderate: .72 for anxiety (4 items: facial anxiety, vocal anxiety, gross body anxiety, and global negative arousal), and .74 for positive engagement (2 items: positive expressivity and social engagement). No substantial increases in alpha for any of the scales could have been achieved by eliminating more items. The anxiety and positive engagement scales in the speech were negatively correlated ($r = -.38, p < .001$) suggesting that greater expressed anxiety was predictive of less engagement. Coder reliability (ICC) for these scales were .86 for anxiety and .84 for positive engagement.

Emotion regulation reflects the ability to control emotions in an effort to achieve a desired goal, and the goal the TSST-M is to deliver an engaging speech to an imaginary classroom. Thus, we used our positive engagement composite as our measure of emotion regulation such that higher positive engagement represented better emotion regulation. As a validity check on our interpretation of greater emotion regulation (as indexed by greater positive engagement) reflecting a high-quality speech, we examined the association between emotion regulation as rated and observed by coders, and the experimenter’s in-the-moment overall rating of speech quality. The correlation between the coder’s rating of emotion regulation and the experimenter’s rating of the speech quality was large and significant ($r = .61, p < .001$), suggesting that being able to regulate emotions and positively engage was predictive of an objective measure of speech quality. Expressed anxiety was also correlated with experimenter’s ratings of speech quality ($r = -.64, p < .001$) in the expected direction. Experimenter’s rating of emotion regulation was also correlated with parent-reported emotion regulation ($r = .23, p < .001$), while observed anxiety was not significantly correlated with parent’s rating of children’s emotion regulation ($r = -.07, p = .24$), providing

additional support that positive engagement reflects children's emotion regulation and is distinct from their displays of anxiety.

Maternal-Reported Emotional Styles.—Emotion coaching attitudes were measured through the Maternal Emotional Styles Questionnaire (MESQ; Lagacé-Séguin & Coplan, 2005). This measure assesses emotion coaching and emotion-dismissing perspectives. The questionnaire consists of 14 statements that described parental attitudes and beliefs about their children's emotions, and about child emotion in general. Parents were asked to rate the degree to which they agreed or disagreed with each statement on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Examples of the seven emotion coaching statements (summed for the coaching composite) included, "When my child is sad, it's an opportunity for getting close," and "When my child is angry, I want to know what he/she is thinking." Examples of the seven emotion-dismissing statements included, "When my child is sad, I am expected to fix the world and make it perfect," and "When my child gets angry, my goal is to get him/her to stop." Because we were interested in whether parents across PI and NA groups displayed similar levels of warmth and emotional supportiveness, we used only the emotional coaching scale. Internal reliability for the coaching scale resulted in an alpha of .66.

Maternal-Reported Adjustment.—Mothers reported on children's behavior problems, academic functioning, and prosocial behavior using the MacArthur Health and Behavior Questionnaire (HBQ-P 2.11; Essex et al., 2002). Each of these specific subscales is described below.

Behavior problems. Children's internalizing and externalizing symptoms were assessed using the *Internalizing* and *Externalizing Scales* of the HBQ-P. Internalizing was comprised of three subscales: Depression, Separation Anxiety, and Overanxious Behavior. Externalizing was comprised of four subscales: Opposition/Defiance, Conduct Problems, Overt Hostility, and Relational Aggression. Parents selected "never or not true", "sometimes or somewhat true", or "often or very true" to each question. The internalizing (42 items, $\alpha = .92$) and externalizing (38 items, $\alpha = .90$) subscales had good internal reliability within our sample. Internalizing and externalizing scales were both entered as outcome variables in the model; higher scores reflect greater problem behaviors.

Academic Functioning. Children's academic functioning was assessed using the *Academic Functioning* scale of the HBQ-P. This scale is comprised of two subscales: Academic Competence and School Engagement. The scale had good internal reliability within our sample (15 items, $\alpha = .88$); higher scores reflect greater academic functioning.

Prosocial Behavior. Children's prosocial behavior was assessed via the *Prosocial Behavior* scale of the HBQ-P. This scale involves questions that parents must answer about their child's behavior within the past 6 months. The scale involves a mean of responses to questions such as, "will try to help someone who has been hurt or is feeling sick," and, "shows sympathy to someone who made a mistake". Parents responded with, "rarely applies", "applies somewhat", or "certainly applies." The subscale had good internal

reliability within our sample (10 items, $\alpha = .88$); higher scores reflect greater prosocial behavior.

Data Analytic Plan—All analyses were conducted in Mplus (Version 8; Muthén & Muthén, 2017) and Full Information Maximum Likelihood (FIML) was used to handle missing data. Less than 10% of the data were missing overall. Multivariate regression was conducted to address aim 1 and aim 2 of the current study. Analyzing the regressions simultaneously reduces the chances of type I error and allows correlations among the dependent variables. Child age, sex, and anxiety during the TSST-M were included as covariates. Maternal report of emotional coaching behaviors was also included to attempt to control for the possibility that group differences in emotion regulation may be associated with different levels of parental warmth demonstrated by NA mothers and PI adoptive mothers. Academic functioning, behavior problems, and prosocial behavior were regressed onto sex (female = 0, male = 1), age, group (PI = 1, NA = 0), maternal emotional coaching, anxiety, emotion regulation and group-by-emotion regulation and age-by-group interactions. However, maternal coaching and the age-by-group interaction were not associated with any of the dependent variables and therefore both were removed for parsimony. Emotion regulation was regressed on to sex, age, maternal emotional coaching, anxiety, group, and a group-by-age interaction. Again, maternal emotion coaching was not associated with emotion regulation and was removed for parsimony. Removing the non-significant predictors did not change the model in any meaningful way.

To address aim 3, a piece-wise growth curve model was fit to the five cortisol samples taken at +5, +20, +40, +60, and +80 minutes after the speech preparation. Because previous work has shown cortisol production begins to increase in the anticipation of the speech rather than due to giving the speech itself (Sumter et al., 2010), and peak levels are generally occur at 20–40 minutes post-stressor onset (Kirschbaum & Hellhammer, 1994), the piece-wise modeling approach allowed us to look at both the nature of cortisol reactivity due to speech anticipation, and the nature of the cortisol recovery after the speech was over. Thus, the piecewise approach permits growth rates to change across periods without the necessity of higher order polynomial terms needed to capture this complex relationship. Piece-wise modeling also allows for more flexibility with predictor variables, as covariates may significantly predict the latent growth factors in some time periods but not others (Flora, 2008). We were therefore able to test whether the interaction between emotion regulation and early life adversity was significant for both the reactivity and the recovery period; this addresses the question of whether PI and NA children differ, depending on how well they regulated their emotions, in their cortisol response pre-and post-speech. We defined the reactivity period as time points +5, +20, and +40 minutes post the onset of speech preparation, and the recovery period as time points +40, +60, and +80 minutes post the onset of speech preparation.

We specified a three-factor model with an overall factor intercept and two linear factor slopes (reactivity and recovery). The latent factors were allowed to correlate. We included age, sex, anxiety, and maternal emotional coaching as covariates in the model. Because puberty and medication use were believed to affect cortisol response, we also examined whether Tanner puberty stage and an index of medication should be included as covariates.

However, neither puberty nor medication use were significant in the model and were therefore removed for parsimony. Removing these predictors did not change the model in any meaningful way. The intercept and both slopes were regressed on to the covariates, group, emotion regulation, and the group-by-emotion regulation interaction.

Results

Preliminary analyses

Preliminary analyses were conducted to examine descriptive information for study variables between groups and correlations among model variables (see Table 1 and Table 2). When comparing means of study variables, only academic functioning and behavior problems were significantly different between groups, with PI children reported by their parents to have poorer academic functioning ($t(293) = 4.28, p < .001, d = .49$) and more behavior problems than NA children on average. Specifically, parents reported PI children to have greater internalizing ($t(292) = -3.81, p < .001, d = .46$) and externalizing problems ($t(293) = -4.50, p < .001, d = .46$). To assess whether PI youth in our sample indeed experienced greater negative emotional reactivity than NA youth, we also compared PI and NA youth across specific measures of parent-reported emotional problems (HBQ-P 2.11; Essex et al., 2002). As hypothesized, PI children had greater parent-reported depression ($t(293) = -2.71, p = .01, d = .30$) and anxiety ($t(293) = -2.41, p = .02, d = .29$). Of note, there were no observed mean differences between PI children and NA children with regard to expressed anxiety or emotion regulation in the speech task.

Primary Analyses

Research aim 1.—Theoretical work has suggested that PI children may have poorer emotion regulation skills compared to their NA peers, but relatively little empirical work has compared emotion regulation across PI and NA samples. Thus, we tested whether early life adversity predicted PI and NA children's observed emotion regulation in the TSST-M, and whether any differences were larger among the older children. Results revealed that being female ($\beta = -.18, B = -.37, z \text{ value} = -3.41, p < .001$) was associated with greater emotion regulation, and having greater observed anxiety ($\beta = -.33, B = -.33, z \text{ value} = -6.13, p < .001$) was associated with poorer emotion regulation (see Table 3). A significant group-by-age interaction emerged ($\beta = -.15, B = -.22, z \text{ value} = -2.08, p = .04$), which subsumed the main effects of group and age on emotion regulation (see Table 3). Rather than using a pick-a-point approach such as testing simple slopes (Aiken & West, 1991), in which we would select arbitrary cutoff ages and test the association between group and emotion regulation at each cutoff, we were more interested in understanding at what age within our data we would see a significant difference in emotion regulation between NA and PI groups. Thus, we probed the significant interaction by using a regions of significance plot (Preacher, Curran, & Bauer, 2006) which shows how the association between group and emotion regulation changes across the entire range of child age. A regions of significance plot revealed that when participants were 13 years and older, NA youth were expected to have significantly greater emotion regulation than PI youth (See Figure 2).

Research aim 2.—Because PI youth in our sample and in previous literature are shown to experience greater emotional reactivity than their NA peers, the ability to regulate that reactivity may be particularly critical for PI children. Thus, we tested whether early life adversity moderated the association between emotion regulation and social, academic, and behavioral adjustment outcomes. Results showed a main effect of age ($\beta = -.16$, $B = -.09$, z value = -2.66 , $p = .01$) and group ($\beta = -.24$, $B = -.29$, z value = -4.44 , $p < .001$) for academic functioning such that older children and PI children were more likely to perform less well academically (see Table 3). Sex, anxiety, emotion regulation, and the group-by-emotion regulation interaction did not predict academic functioning.

There were significant main effects for sex ($\beta = -.17$, $B = -.14$, z value = -2.87 , $p = .004$), and group ($\beta = -.12$, $B = -.10$, z value = -2.18 , $p = .03$) predicting prosocial behavior (see Table 3). Being female and being non-adopted were associated with greater prosocial behavior. There were also trend level effects for age ($\beta = -.10$, $B = -.04$, z value = -1.69 , $p = .09$), and emotion regulation ($\beta = .13$, $B = .05$, z value = 1.72 , $p = .09$) predicting prosocial behavior, with younger children and children with greater emotion regulation trended toward showing more prosocial behavior. There was no significant main effect for anxiety and the group-by-emotion regulation interaction was also not significant.

Examining children's externalizing behavior problems, there was a significant main effect for sex ($\beta = .20$, $B = .07$, z value = 3.47 , $p = .001$) and group ($\beta = .28$, $B = .10$, z value = 5.16 , $p < .001$) with boys and PI children exhibiting more externalizing behavior problems (see Table 3). Age, anxiety, and emotion regulation were not significant predictors. The group-by-emotion regulation interaction was not significant.

With regard to internalizing behavior problems, age, sex, and anxiety were not significant predictors. However, the effects of group and emotion regulation were subsumed by a significant group-by-emotion regulation interaction ($\beta = -.15$, $B = -.06$, z value = -2.17 , $p = .03$) (see Table 3). Because we were interested in whether greater emotion regulation was more strongly associated with decreases in behavior problems for PI youth compared to NA youth, and our dichotomous moderator didn't require choosing an arbitrary cutoff (e.g., 1 SD above or below the mean) to test the associations, a test of simple slopes assessing internalizing behaviors on emotion regulation was conducted in NA and PI groups. For NA children, emotion regulation was not associated with internalizing behavior problems ($\beta = .07$, $B = .02$, z value = $.97$, $p = .33$). As hypothesized, greater emotion regulation was associated with decreases in internalizing behavior problems for PI youth ($\beta = -.18$, $B = -.05$, z value = -1.95 , $p = .04$) (see Figure 3).

Research aim 3.—Because of mixed findings regarding how regulating emotional arousal may contribute to biological stress responses produced during emotionally-charged contexts, we tested whether emotion regulation during the TSST-M predicted the post-acclimation baseline cortisol values, cortisol changes across the reactivity period, and cortisol changes across the recovery period. Importantly, we were also interested in whether these associations differed for PI and NA youth. The model fit the data well χ^2 (24, $N=273$) = 26.40, $p = .33$; CFI/TLI = .99/.99, RMSEA/SRMR = .02/.02. Standardized regression coefficients can be found in Table 4.

For the intercept factor, we found that there was a group-by-emotion regulation interaction ($\beta = .18$, $B = .20$, z value = 2.394, $p = .02$), such that PI children with greater emotion regulation had higher cortisol levels at the start of the TSST-M controlling for anxiety, sex, age, and maternal coaching (see Table 4 and Figure 4 part a). Emotion regulation was negatively associated with the reactivity slope ($\beta = -.23$, $B = -.02$, z value = -2.57, $p = .01$), indicating that children with greater emotion regulation did not show as much of a response to the TSST-M (see Table 4 and Figure 4 part b). This effect did not differ by group ($\beta = -.11$, $B = -.01$, z value = -1.57, $p = .63$). Finally, there was a significant group-by-emotion regulation interaction predicting the recovery slope ($\beta = -.20$, $B = -.02$, z value = -2.04, $p = .04$). We probed this interaction using a regions of significance plot and found that at lower levels of emotion regulation (1 SD below the mean of emotion regulation and lower), NA youth have steeper slopes, indicating that they recover faster than PI youth. At higher levels of emotion regulation, the difference between the recovery slopes for NA and PI youth was not significant (see Table 4 and Figure 4 part c).

Discussion

Researchers have hypothesized that one reason PI youth may struggle in academic, social, and behavioral domains is due to difficulties in regulating their emotions. Little empirical work, however, has compared emotion regulation between PI and NA samples. The current study was the first to behaviorally code engagement as well as expressed anxiety in response to a social stress test. In doing so we were able to derive a measure of emotion regulation that reflected children's ability to manage their anxiety and achieve the goal of delivering a socially engaging speech. A significant age-by-group interaction revealed that while older children exhibited more emotion regulation than younger children, the age association was not as marked for the PI youth. This resulted in the PI teens (13 years+) exhibiting significantly less emotion regulation than NA youth. This finding fits with other previous work showing that emotional and behavioral problems tend to increase in adolescence more so for PI children than NA children (Colvert et al., 2008; Hawk & McCall, 2010).

The fact that PI youth do not show significantly lower emotion regulation abilities than NA youth until adolescence suggests that early life adversity is not simply the continuation of problems following adoption, but rather may lead to deficits that become more prevalent or noticeable during adolescence. Adolescence is a critical time characterized by important transitions. Children undergo significant biological changes as they progress through puberty, academic tasks become more challenging, and social interactions with peers become much more complex. Adolescence is also a time during which children are increasingly able to identify social goals that require the regulation of their behavior. Older children, for example, expect that negative emotional displays are damaging to peer relationships; children therefore engage in more sophisticated regulation strategies to manage these negative emotions in front of peers (Shipman, Zeman, & Stegall, 2001; Zeman & Shipman, 1998). We found that parents reported PI children to be socially less-skilled than NA children. Thus, it is possible that one reason PI children begin to lag behind NA children in their regulation of emotion in this social task is because NA children develop a better understanding of the consequences of negative emotional displays to peer relationships earlier than PI children. That is, in early and middle childhood both PI and NA

children increase in their ability to manage their negative emotions and neither group may be particularly skilled at understanding the social impacts of expressing negative emotions. However, during the transition to adolescence NA children may begin to be better able than PI children at recognizing that displays of anxiety and frustration influence how their peers perceive and interact with them, and therefore they may make increased efforts to appear positive and engaging in social tasks (such as the speech task) when experiencing anxiety. In line with this hypothesis, previous work has found PI children to have an impaired ability to recognize facial expressions of emotion in preadolescence (Colvert et al., 2008). Although longitudinal analyses would allow for a clearer investigation of the development of emotion regulation in PI and NA youth, our findings underscore the importance of examining how and why deficits in emotional development may emerge in adolescence for PI children.

Unlike Burkholder et al., 2015, we did not find group differences in expressed anxiety. One reason for this could be that in the current study, we coded expressed anxiety only during the speech portion of the TSST-M, whereas Burkholder and colleagues used a combined measure of anxiety in the speech and arithmetic portion. We focused on the speech rather than on arithmetic for two reasons. First, PI children make more mistakes than NA children in the math segment, thus creating an unequal comparison. Second, our goal was to better understand how children's regulation of emotion, in an effort to meet a desired goal (i.e., delivering a socially engaging speech), was associated with concurrent physiology and adjustment. Of course, it could also be that the sample of children in the present study was not as nervous as those in Burkholder et al. (2016).

Similar to previous work, we also found that PI children were more likely to demonstrate poorer academic functioning, less prosocial behavior, and greater externalizing behavior problems (Caprin, Benedan, Ballarin, & Gallace, 2017; Hawk & McCall, 2010; Lutes, Johnson, & Gunnar, 2016; Wiik et al., 2010). However, emotion regulation was not associated with academic functioning, externalizing behaviors, or prosocial behavior for either group. When looking at internalizing behaviors, a significant group-by-emotion regulation interaction emerged. Probing the interaction using simple slopes revealed that for PI children, greater emotion regulation was associated with fewer internalizing behaviors. For NA youth, however, there was no association between emotion regulation and internalizing behaviors. PI youth have been suggested to have heightened negative emotional reactivity, and in our sample PI children demonstrated greater anxiety and depression than NA youth. Thus, because of increased negative arousal, PI children may have a more difficult time than NA youth when regulating their arousal and managing their own behavior in an effective and socially appropriate way. Thus, developing greater emotion regulation skills may be particularly important for PI children. PI children with greater emotion regulation skills may be able to employ these skills in an effort to reduce arousal and anxiety and therefore may be less likely to end up on pathways toward poorer mental health. Given that we assessed children during an anxiety inducing social-evaluative stressor, it is understandable that emotion regulation of anxiety may be more strongly associated with PI children's internalizing behaviors as opposed to externalizing behaviors. However, additional work is needed to better understand the regulatory mechanisms that may be uniquely associated with both internalizing and externalizing behavior problems. We believe

the current findings are a first step toward identifying the ways emotion regulation may be associated with decreased psychopathology for PI youth.

This study is the first to demonstrate a relation between observed emotion regulation and concurrent cortisol reactivity in a post-institutionalized sample of children and adolescents. When looking at the association between emotion regulation on HPA stress reactivity, some interesting findings emerged. We used piecewise growth modeling to estimate a reactivity and a recovery slope during the TSST-M. In doing so, we were able to examine how emotion regulation was associated with cortisol in response to stress and during stress recovery, while also testing whether groups differed in these associations. We found that at higher levels of emotion regulation, PI youth had higher initial cortisol values than NA youth. Thus, behaviorally well-regulated PI youth exhibited a more substantial anticipatory stress response. While this might suggest some form of dysregulation, it more likely reflects high motivation to perform well. Previous work has shown that adolescents, compared to children, show greater cortisol anticipatory responses to speech-task stressors (Sumter et al., 2010). The interpretation in that study was that social evaluation is more important and meaningful for teens than children. The higher anticipatory response for the PI youth who show better emotion regulation may mean that they are more motivated to perform well, but at the same time are more uncertain that they can, compared to NA youth with high emotion regulation scores. It might also suggest that within the PI population, regulating emotions may come at a higher physiological cost. It is possible that entering an emotionally distressing context with higher physiological arousal helps PI youth prepare to behaviorally handle distress when it does occur. This is supported by the fact that when emotion regulation is below average, PI youth demonstrate considerably lower initial cortisol than NA youth. For NA youth, lower initial cortisol was associated with better emotion regulation and higher initial cortisol was associated with fewer emotion regulation skills. This finding suggests that NA children with high emotion regulation may not need to mount a biological response before a stressor and may be able to cope with the stressor as it occurs. For NA youth, the challenge may not warrant a physiological support response, because they have are more certain that they have the behavioral skills to manage the task. NA children with lower emotion regulation skills may still require the physiological support, demonstrated in their higher initial cortisol levels prior to task onset.

Interestingly, although there was a group difference in post-acclimation baseline cortisol levels that reflected HPA reactivity before children were even asked to prepare for the speech, there was no group difference on the reactivity slope. There was, however, a main effect of emotion regulation. For both NA and PI children, as emotion regulation levels increased, the reactivity slope got flatter. This suggests that youth with greater emotion regulation showed less cortisol reactivity in response to preparing and giving the speech than children with lower emotion regulation. Because PI children with higher emotion regulation started out at higher levels of cortisol initially, a flatter slope for PI children suggests that they continued to stay at higher levels during speech preparation and when giving the speech. Again, maintaining these higher cortisol levels may help them to behaviorally cope with the task at hand. For NA youth with higher emotion regulation, who had lower cortisol values initially, a flatter reactivity slope may indicate a decreased need to mount a stress response; their behavioral regulatory skills may be enough to effectively navigate the

distressing context. For both NA and PI youth, lower emotion regulation was associated with steeper cortisol reactivity slopes, suggesting that if children do not have effective regulatory skills, a social evaluative stressor elicits greater stress reactivity.

Finally, we found that at lower levels of emotion regulation, NA youth had significantly faster recovery than PI youth; at higher levels of emotion regulation, although PI youth appeared to have faster recovery, the difference in recovery slope between PI and NA children did not reach significance. One reason we may see this somewhat opposite pattern emerge between NA and PI youth with regard to recovery slope, may be due to the fact that a similar opposite pattern emerges when looking at initial cortisol values; at lower levels of emotion regulation, NA youth have higher initial cortisol, and at higher levels of emotion regulation, PI youth have higher initial cortisol. It is possible that starting higher initially, and maintaining levels throughout speech preparation and delivery, taxes the system in such a way that upon completion of a stressful event cortisol levels decrease more rapidly. This could be a function of the negative feedback loop inherent in the HPA system, which keeps cortisol levels in appropriate physiological range. Future work looking at recovery from distress and emotional functioning is needed to better understand this association.

Findings have been mixed in previous work investigating the association between cortisol and emotion regulation, in part because of the conflagration of stress response and emotion response. One strength of this study is the measurement of social engagement in the face of an anxiety provoking context to derive a measure of emotion *regulation*. Previous work also did not examine cortisol reactivity to concurrent emotion regulation; the current study examined cortisol change over time while emotion regulation was observed. Finally, perhaps by including a population of children with an adverse background, we were able to see a range of emotion regulation over a range of development, allowing us to see the coupling of stress response and emotion regulation at the edges of adaptive functioning. We found evidence to support the positive association between emotion regulation and cortisol for PI youth; PI youth with better emotion regulation had higher initial cortisol levels and their cortisol levels stayed relatively stable throughout the stressful context. However, for both PI and NA youth, greater emotion regulation was associated with less reactivity during the stress period. Overall, we believe findings from the current study highlight the complexity of the association between emotion regulation and cortisol and underscore the importance of considering environmental factors including early adversity.

Limitations

Although the current study has several strengths, it is not without limitations. First, although we speculated that children used cognitive reappraisal to turn the task into one that they felt that they could manage, we did not assess which emotion regulation strategies children used during the speech. Additional work is needed to better understand which regulation strategies are most effective when striving to meet both social and non-social goals. It may be that cognitive reappraisal is particularly effective when the goal involves social interaction. We could also only speculate as to why PI children with greater emotion regulation had higher baseline cortisol and a steeper recovery slope. Future work is needed to examine whether neural circuitry underlying emotion regulation differs across PI and NA

groups and whether differences in these neural connections play a role in the association between emotion regulation and HPA reactivity.

Our data were cross-sectional and therefore did not allow us to examine changes within individuals over time. Thus, our findings regarding group by age differences in emotion regulation should be interpreted with caution. Longitudinal work is needed. Coding of the second wave of data is currently underway and may provide insight into these longitudinal associations. We also used parent report of adjustment. It is possible that PI children's adoptive parents focused on their children's weaknesses or were over-reporting their children's problems and under-reporting their child's strengths. They do not see their child in the school context where most academic, social, and behavioral problems would occur. Future work utilizing teacher report might be informative.

Conclusions

Despite the limitations, the results of the present study raise significant questions about emotion regulation for children with adverse early histories. Although there is evidence that PI children's emotion regulation abilities improve over time, our work also suggests that by adolescence, PI children may start to fall behind their non-adopted counterparts. Additional work is needed to identify why deficits in emotional development may emerge in adolescence for PI children. It is also unclear why PI children with greater emotion regulation have higher cortisol before even taking part in the stress paradigm, or why they maintain these levels when stressed. The possibility that successful regulation may come at a higher physiological cost for PI youth deserves attention and, indeed, is reminiscent of evidence that in some instances, resilience may extract a physiological toll (Brody et al., 2013). Finally, the fact that emotion regulation is associated with decreased internalizing behavior problems for PI youth but not NA youth is somewhat puzzling. However, because PI youth are thought to be more at risk for social and emotional problems, emotion regulation may be one area in which intervention and prevention efforts can target.

Acknowledgements

The authors would like to thank the parents and children without whom this study would not have been possible. The authors would also like to thank Shreya Lakhan-Pal for her early work on the coding scheme, as well as Heather Taylor and the undergraduates for their data coding work. This work was supported by grants R01 HD075349 from the National Institute of Child Health and Human Development awarded to Megan Gunnar. Support was provided to Nicole Perry by a National Institute of Mental Health training grant (T32 MH015755) during the preparation of this article.

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Figure 1.

Plotted means of all 7 cortisol samples

Note (bottom): The first 2 cortisol samples reflected 40 minutes of acclimation to the laboratory setting and are not considered part of the TSST-M. The last 5 samples characterized the cortisol response to the TSST-M and were included in analyses.

Figure 2.

Plotted interaction and regions of significance plot probing the interaction between group and age predicting emotion regulation during the TSST-M.

Note (bottom): The plot on the left depicts the significant interaction. The regions of significance plot on the right probes this interaction. In the regions of significance plot, the X axis represents age in years. The Y axis represents the continuous range of values for the adjusted effect of emotion regulation on group (as well as the control variables). The solid center plot line represents the adjusted effect of emotion regulation on group that corresponds to child age. The dash curved lines represent 95% confidence bands around the adjusted effect of emotion regulation on group. When looking where the confidence bands do not include zero, we can see the effect of emotion regulation on group is not significant until age 13 and beyond. Because PI youth are coded 1 and NA youth are coded 0, when participants are 13 years and older, NA youth are expected to have significantly higher emotion regulation than PI youth.

Figure 3. Plotted interaction of the association between group and emotion regulation during the TSST-M predicting parent-reported internalizing behavior problems.

Figure 4.

Model-implied cortisol response by condition and level of emotion regulation. Panel (a) shows the post-acclimation baseline (intercept) difference in cortisol by group and emotion regulation; (b) shows the effect of emotion regulation on the reactivity slope collapsed across PI and NA youth; and (c) shows the interactive effect of group and emotion regulation on the recovery slope.

Note (bottom): NA and PI correspond to the non-adopted and post-institutionalized participants. Below, mean, and above corresponds to emotion regulation levels one standard deviation below the mean, at the mean, and one standard deviation above the mean.

Table 1.

Descriptive Statistics of Study Variables

Study Variables	Post-Institutionalized				Non-Adopted			
	N	Mean	SD	Skew (SE)	N	M	SD	Skew (SE)
Age	124	11.29	2.38	-.12 (.22)	172	11.17	2.29	.07 (.19)
Anxiety	124	1.55	.53	.11 (.22)	172	1.51	.61	.43 (.19)
Emotion Coaching	124	3.82	.43	-.47 (.22)	170	3.83	0.44	-.19 (.19)
Emotion Regulation	124	1.11	.68	.15 (.22)	172	1.16	.81	.33 (.19)
Academic Functioning	124	3.83	.64	-.56 (.22)	171	4.12	.53	-.42 (.19)
Prosocial Behavior	124	1.42	.45	-.40 (.22)	171	1.51	.39	-.85 (.19)
Internalizing Problems	123	.39	.27	1.04 (.22)	171	.28	.20	1.47 (.19)
Externalizing Problems	124	.22	.21	1.39 (.22)	171	.13	.13	1.90 (.19)
Cortisol Sample 1	115	.11	.11	3.98 (.23)	159	.12	0.1	2.85 (.19)
Cortisol Sample 2	115	.10	.12	4.40 (.23)	159	.11	.11	3.40 (.19)
Cortisol Sample 3	115	.08	.09	3.78 (.23)	159	.09	.09	2.68 (.19)
Cortisol Sample 4	115	.09	.08	2.97 (.23)	159	.10	.09	3.02 (.19)
Cortisol Sample 5	115	.10	.10	3.10 (.23)	158	.12	.13	4.05 (.19)
Cortisol Sample 6	114	.08	.06	1.80 (.23)	158	.09	.07	3.13 (.19)
Cortisol Sample 7	115	.06	.05	1.96 (.23)	158	.08	.06	2.69 (.19)

Table 2.

Correlations among primary study variables

PI and NA combined	1	2	3	4	5	6	7
1. Age	--						
2. Anxiety	-.32***	--					
3. Emotion Coaching	-.11	.07	--				
4. Emotion Regulation	.20***	-.37***	.03	--			
5. Academic Functioning	-.13*	-.06	.01	.11	--		
6. Prosocial Behavior	-.07	-.11	.10	.17**	.22***	--	
7. Internalizing Problems	.03	.08	.05	-.06	-.36***	-.04	--
8. Externalizing Problems	.05	.11	-.01	-.13*	-.29***	-.33***	.50***
PI only							
1. Age	--						
2. Anxiety	-.32***	--					
3. Emotion Coaching	-.08	.13	--				
4. Emotion Regulation	.11	-.27**	.07	--			
5. Academic Functioning	-.16	-.09	-.08	.14	--		
6. Prosocial Behavior	-.03	-.05	.08	.13	.12	--	
7. Internalizing Problems	.09	.11	.13	-.18*	-.25***	-.02	--
8. Externalizing Problems	.01	.05	.04	-.14	-.17	-.35***	.45***
NA only							
1. Age	--						
2. Anxiety	-.32***	--					
3. Emotion Coaching	-.13	.04	--				
4. Emotion Regulation	.28***	-.43***	-.01	--			
5. Academic Functioning	-.10	-.02	.09	.08	--		
6. Prosocial Behavior	-.10	-.15*	.11	.21**	.27***	--	

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PI and NA combined	1	2	3	4	5	9	7
7. Internalizing Problems	-.01	.05	-.01	.05	-.42***	-.01	--
8. Externalizing Problems	.09	.18*	-.05	-.12	-.36***	-.26**	.50***

Note.

- * $p < .05$,
- ** $p < .01$,
- *** $p < .001$.

Table 3.

Standardized regression coefficients for predictors of emotion regulation and adjustment

<i>Model Covariates</i>	<i>Estimate (SE)</i>	<i>z-value</i>
<u>Emotion Regulation</u>		
Group	-.05 (.05)	-0.91
Age	.22 (.07)	3.09 **
Sex	-.18 (.05)	-3.41 **
Anxiety	-.33 (.05)	-6.13 ***
Group-by-age	-.15 (.07)	-2.08 *
<u>Academic Functioning</u>		
Group	-.24 (.06)	-4.44 ***
Age	-.16 (.06)	-2.66 **
Sex	-.07 (.06)	-1.17
Anxiety	-.06 (.06)	-0.97
Emotion regulation	.07 (.08)	0.89
Group-by-emotion regulation	.06 (.07)	0.91
<u>Prosocial Behavior</u>		
Group	-.12 (.06)	-2.18 *
Age	-.10 (.06)	-1.69
Sex	-.17 (.06)	-2.87 **
Anxiety	-.08 (.06)	-1.30
Emotion regulation	.13 (.08)	1.72
Group-by-emotion regulation	.10 (.07)	0.13
<u>Internalizing Behavior Problems</u>		
Group	.22 (.06)	4.00 ***
Age	.04 (.06)	0.68
Sex	.05 (.06)	0.84
Anxiety	.08 (.06)	1.27
Emotion regulation	.07 (.08)	0.97
Group-by-emotion regulation	-.15 (.07)	-2.17 *
<u>Externalizing Behavior Problems</u>		
Group	.28 (.05)	5.16 ***
Age	.05 (.06)	0.92
Sex	.20 (.06)	3.47 **
Anxiety	.09 (.06)	1.50
Emotion regulation	-.01 (.07)	-0.13
Group-by-emotion regulation	-.09 (.07)	-1.39

Note

*
 $p < .05$

**
 $p < .01$

 $p < .001$

PI = 1 NA = 0.

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Table 4.

Standardized regression coefficients for predictors of cortisol reactivity and recovery

<i>Model Covariates</i>	<i>Estimate (SE)</i>	<i>z-value</i>
<u>Intercept</u>		
Group	-.08 (.06)	-1.24
Age	.08 (.07)	1.22
Sex	.14 (.06)	2.22 *
Anxiety	.08 (.07)	1.20
Maternal emotion coaching	-.15 (.06)	-2.40 *
Emotion regulation	.08 (.08)	-0.94
Group-by-emotion regulation	.18 (.08)	2.39 *
<u>Reactivity slope</u>		
Group	-.11 (.07)	-1.57
Age	.26 (.07)	3.59 **
Sex	-.13 (.07)	-1.89
Anxiety	-.11 (.08)	-1.39
Maternal emotion coaching	.09 (.07)	1.31
Emotion regulation	-.23 (.09)	-2.57 *
Group-by-emotion regulation	-.04 (.09)	-0.48
<u>Recovery slope</u>		
Group	.07 (.08)	0.84
Age	-.18 (.08)	-2.11 *
Sex	.03 (.08)	0.38
Anxiety	.03 (.09)	0.38
Maternal emotion coaching	-.01 (.08)	-0.06
Emotion regulation	.27 (.10)	2.62 **
Group-by-emotion regulation	-.20 (.10)	-2.04 *

Note.

*
p < .05**
p < .01

PI = 1 NA = 0.