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Predictors of Risk and Resilience in Emotion Regulation:
The Effects of Person and Context in Three High-Risk Samples

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Psychology

by

Amanda Nicol Noroña

2018

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ABSTRACT OF THE DISSERTATION

Predictors of Risk and Resilience in Emotion Regulation:
The Effects of Person and Context in Three High-Risk Samples

by

Amanda Nicol Noroña

Doctor of Philosophy in Psychology

University of California, Los Angeles, 2018

Professor Bruce L. Baker, Chair

We examined emotion regulation (ER) processes in three high-risk samples, with two primary aims: (1) to examine the effects of concentric levels of influence on ER, from within the individual (i.e., genotype, temperament), to aspects of the proximal environment (i.e., parenting behaviors), and to broader contextual factors (e.g., income, family composition); and (2) to determine whether various levels of influence affect developmental *trajectories* of ER, in addition to initial levels. We advanced these aims in samples of children with and without developmental delay, low-income children enrolled in Early Head Start, and children adopted from foster care.

In Study 1, we used latent growth curve modeling (LGCM) to model yearly change in emotion dysregulation from child age 3 to 6 years and to test predictors of initial levels of and change in dysregulation. Dysregulation was found to decrease overall across early childhood, and serotonin transporter genotype X parenting interactions predicted individual differences in growth curves. Dysregulation trajectories of children with the SL/LL genotype were minimally related to positive and negative parenting behavior, whereas dysregulation decreased more

precipitously among children with the SS genotype when exposed to low negative parenting or high positive parenting.

In Study 2, latent class growth analysis (LCGA) was used to identify trajectory groups of ER across toddlerhood and examine predictors of those trajectory groups from child temperament, parenting behaviors, and environmental risk. LCGA supported a three-class model, with a Stable-High ER group, a Low-to-High group, and a High-to-Low group. The Stable-High group was characterized by high positive parenting, the Low-to-High group by high child negative emotionality, and the High-to-Low group by high negative parenting and high environmental risk. Lastly, membership in these trajectory groups was found to be predictive of resilient functioning in the 5th grade.

In Study 3, we examined factors that predict ER among children adopted from foster care, at the time of the adoptive placement and then 5 years post-placement. Among child temperament, pre/perinatal risk, and pre-placement environmental risk, reactive temperament emerged as the sole predictor of ER at the time of adoptive placement. When looking at ER after 5 years of adoptive placement, aspects of the adoptive family environment predicted changes in ER, though the nature of the changes depended on the temperament of the child.

Results from the three studies were discussed in terms of theoretical and practical implications.

The dissertation of Amanda Nicol Noroña is approved.

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2018

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Lastly, I am grateful to my friends and family, for the years of support and enthusiasm throughout this journey.

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Chapter 1

General introduction

The ability to modulate emotional reactions is critical for one's psychological and physical health, as well as one's social relationships (Aldao, Nolen-Hoeksema, & Schweizer, 2010). Each one of us is presented with emotionally evocative stimuli on a daily basis, and in order to proceed toward our current goals, it is sometimes necessary to suppress or heighten our expression or experience of those emotions. For a simple example, imagine a 12-year-old child unwrapping a gift from his aunt and finding an undesired sweater. In order to achieve the goals of not hurting his aunt's feelings and behaving in a polite manner, that 12-year-old must summon his emotion regulation (ER) skills.

Understanding regulation has been identified as the "single most critical goal" for understanding development and psychopathology (Posner & Rothbart, 2000). Indeed, difficulty with ER has been integrated into many models of psychopathology, including major depressive disorder, bipolar disorder, anxiety disorders, eating disorders, and various personality disorders (Aldao et al., 2010; Cole & Deater-Deckard, 2009). Additionally, as individuals age and experience changes in social, biological, and cognitive systems, it is increasingly important to navigate the social world with a toolbox of reliable, flexible, and reflexive strategies for modulating emotional reactions.

Despite widespread agreement on the importance of ER, the field still lacks agreement on a definition of ER. Thompson (1994) stated that researchers "know ER when they see it" (p. 29) but struggle with providing a clear operational definition. Despite heterogeneity in definitions across studies, there certainly are critical elements that are commonly incorporated. We believe Eisenberg and Spinrad's (2004) definition to be the most comprehensive in the field today, and it is from this definition that this research is grounded. Eisenberg and Spinrad defined ER as "the process of initiating, avoiding, inhibiting, maintaining, or modulating the occurrence, form, intensity, or duration of internal feeling states, emotion-related physiological,

attentional processes, motivational states, and/or the behavioral concomitants of emotion in the service of accomplishing affect-related biological or social adaptation or achieving individual goals” (p. 338). Working from this somewhat long-winded definition, in response to the gift opening situation described above, the 12-year-old with well-developed ER abilities would be able to inhibit his expression of disappointment, heighten his expression of joy, and say, “Thank you!” in the service of his goal to express appreciation to his aunt. On the other hand, the 12-year-old with poorly developed ER skills might express his feelings of disappointment and displeasure and unintentionally hurt his aunt’s feelings.

Given that ER is critical to many domains of functioning, it is especially important to direct research efforts toward unraveling its development. In a seminal paper synthesizing research on the sources of individual differences in ER, Calkins (1994) presented a model of internal and external components that contribute to ER across development. Factors internal to the individual included neuroregulatory reactivity, behavioral traits, and cognitive ability. Factors external to the individual were primarily rooted in the family system, such as caregiving styles and explicit training of ER. Prior to and following Calkins’s review, researchers have extensively studied a multitude of factors as predictors of ER (e.g., Cole, Zahn-Waxler, Fox, Usher, & Welsh, 1996; Feldman, 2009; Hoffman, Crnic, & Baker, 2006; Mangelsdorf, Shapiro, & Marzolf, 1995). In order to parse out the signal from the noise among the decades of research on the development of ER, we will be working from the framework of the Bioecological Systems Theory (Bronfenbrenner, 1995, 1999; Bronfenbrenner & Ceci, 1994).

The Bioecological Systems Theory

After the wide-ranging success of his original theory of Ecological Systems (Bronfenbrenner, 1974), Bronfenbrenner noted a “surfeit of studies on ‘context without development’” (Bronfenbrenner, 1986, p. 288). While researchers were no longer studying “the strange behavior of children in strange situations with strange adults for the briefest possible period of time,” (Bronfenbrenner, 1977, p. 513) many failed to take into account the critical role

of development and the individual both as a producer and product of development. The resultant framework is comprised of dynamic, interactive relationships among four principal components, and for this reason, the Bioecological Systems Theory is also referred to as the Process-Person-Context-Time (PPCT) model. (1) *Process* is considered the core of the new model. Bronfenbrenner asserted that proximal processes, defined as interactions between the individual and the environment that occur over time, are the main mechanism producing human development. In order to be considered a “proximal process,” the interactions must occur within the immediate environment, on a regular basis, and over an extended period of the time. Importantly, the form, power, content, and direction of the proximal process will vary as a function of the individual (Person), the environment (Context), and the historical period (Time). (2) *Person* refers to characteristics within the individual that shape the course of development. Specifically, Bronfenbrenner discussed the role of dispositions, resources (e.g., ability, skills, experience, knowledge), and demand characteristics (i.e., how the individual’s behaviors affect the others’ behaviors toward the individual). Included here, as well, are age, gender, and ethnicity. (3) *Context*, as in the Ecological Systems Theory (1979), is comprised of nested systems of the environment, ranging from the microsystem to the macrosystem. (4) *Time* is also differentiated into different levels, specifically micro-time (i.e., continuity/discontinuity during specific episodes of proximal processes), meso-time (i.e., frequency of the episodes in terms of days, weeks, etc.), and macro-time (i.e., shifting events and expectancies in the broader culture) (Bronfenbrenner & Morris, 2007).

The Bioecological Systems Model is an elegant framework for organizing research findings on factors that contribute to the development of ER, especially in tandem with Calkins’s (1994) synthesis of internal and external sources of individual differences in ER. The overall conceptual foundation rests on the theory that ER abilities are ever evolving as an individual and that individual’s environment engage in reciprocal, synergistic interrelations over time. Characteristics of the environment shape characteristics of the individual, and vice versa.

Furthermore, the environment can be disaggregated into its component levels, ranging from those most proximal to the individual and those most distal, with the effects of the more proximal environmental factors exerting different effects on ER, depending on more distal factors. With the Bioecological Systems Theory as our reference framework, we will review the literature regarding sources of individual differences in ER.

Process and Context and ER Development

Extensive research has been done on environmental influences on ER, with the vast majority of this area of research focusing on the family system. Parenting behaviors, such as sensitivity (Feldman, 2007; Fogel, 1993; Leerkes, Blankson, & O'Brien, 2009) and scaffolding (Bernier, Carlson, & Whipple, 2010; Gulsrud, Jahromi, & Kasari, 2009; Hoffman et al., 2006; Lengua, Honorado, & Bush, 2007), have been shown to have significant effects on a child's emergent ER abilities. Strong theoretical and empirical support for the effects of parenting on the early development of ER can be found in research on attachment, which has been explicitly defined as "the dyadic regulation of emotion" (Sroufe, 1997, p. 192). The theory of attachment asserts that sensitive and consistent caregiver responses to infant distress promotes confidence in the reliability of caregiving and facilitates the development of confidence in oneself and the world (Sroufe, 1997). Empirically, researchers have found that attached infants, who presumably experienced sensitive and consistent caregiving, expressed lower levels of distress and more frequently used strategies that involved social referencing or expressing a need for caregiver involvement. Alternatively, infants with an insecure attachment orientation were more likely to engage in self-soothing or solitary play (Leerkes and Wong 2012; Braungart and Stifter 1991; Nachmias et al. 1996). As one's attachment style is theorized to be a result of an accumulation of parent-child interactions over infancy, attachment is an excellent measure of the Bioecological Systems Theory's "proximal process."

Staying in the microsystem, the family environment has been found to affect ER, as well. In a review of the role of the family context in the development of ER, Morris et al. (2007)

discussed direct effects and interactions among the following three socialization processes of ER in the family context: observation/modeling, parenting practices, and the emotional climate of the family. In terms of observation and modeling, children learn about emotions and ER via observation of their parents' emotional displays and interactions. In observing parental modeling of emotional expression in certain situations, children learn how they "should" react to those situations in the future (Denham, Mitchell-Copeland, Strandberg, Auerbach, & Blair, 1997). In addition, the emotional climate of the family, as reflected in parent-child and marital relationships and the daily expression of positive and negative emotions toward members of the family, contributes to the development of ER. For example, Eisenberg and colleagues (2001) found that positive and negative expressed family emotion was associated with child ER in the expected directions and that child ER mediated the relationship between parental expressiveness and child social competence. Exposure to "background anger" is associated with social and emotional difficulties in children, even in circumstances in which children are not direct recipients of the anger (Lemerise & Dodge, 2008). Lastly, parent characteristics (e.g., temperament, mental health, stress level) and child characteristics (e.g., temperament, gender, developmental status) affect the relationships between the family emotional environment and child ER.

Moving to the exosystem, little is known about the effects of environmental factors more distal than the family system. While there is limited research on the link between environmental factors and ER, specifically, it is reasonable to conjecture that such a link exists, given the established associations between factors such as poverty, neighborhood risk, household density, and residential instability and socioemotional functioning (Evans & English, 2002). In a recent 6-month longitudinal study of preschoolers, Lengua, Honorado, and Bush (2007) found that contextual risk predicted relatively lower increases in effortful control over time. Further, parenting practices (i.e., limit setting, scaffolding) were found to mediate this effect. While effortful control is not synonymous with ER, it is considered a central aspect of self-regulation.

Lengua and colleagues' findings provide support for the use of the Bioecological Systems Theory framework, as the effect of the exosystem on the child's development was mediated by the microsystem. In Bronfenbrenner's words, "proximal processes not only lead to higher levels of developmental functioning but also serve to reduce and act as a buffer against effects of disadvantaged and disruptive environments" (Bronfenbrenner & Morris, 2007).

Person and ER Development

In addition to the extensive research on the environmental contributors to ER outcomes, characteristics within the individual have been studied as well.

Temperament, defined as "constitutionally based individual differences in reactivity and self-regulation, in the domains of affect, activity, and attention" (Rothbart & Bates, 2006), is perhaps the most widely studied *Person* construct in the field of ER. As regulation is an aspect of temperament, there are clear theoretical links between early temperament and later ER. Several studies have examined infant emotionality and ER and have consistently found links between temperamental reactivity (behavioral and physiological) and ER (S. D. Calkins, 1997; Gunnar, Porter, Wolf, Rigatuso, & Larson, 1995; Stifter & Braungart, 1995). Calkins and Johnson (1998), for example, found an association between temperamental emotional arousal and aggressive-acting-out behaviors, an index of emotion dysregulation.

In a more recent line of research, scholars have examined the influence of the promoter polymorphism of the serotonin transporter gene (5-HTTLPR) on ER (see Hariri & Holmes, 2006, for a review). Studies have long demonstrated that serotonin (5-HT) plays a critical role in biological substrates associated with emotion modulation (Lucki, 1998). This association is supported by the findings that (a) individuals with mood and/or anxiety disorders exhibit abnormalities in serotonin function (Owens & Nemeroff, 1998), (b) medications that successfully ameliorate symptoms of anxiety and depression act on the serotonin system (Ballenger, 1999), and (c) serotonin neurons and receptors play a critical role in the corticolimbic pathways that mediate emotional behaviors (H. R. Smith, Daunais, Nader, &

Porrino, 1999). 5-HTTLPR has been found to encode two allelic forms, a short (S) variant and a long (L) variant, and these variants have been associated with differing levels of serotonin transcription, expression, and function (Lesch et al., 1996). Importantly, the S allele has been linked with higher levels of anxiety (Hariri et al., 2005; Lesch et al., 1996), vulnerability to life stress (Caspi et al., 2003; Champoux et al., 2002), and amygdala hyper-reactivity (Hariri et al., 2002; Heinz et al., 2005). Of note, there is inconsistency in replicating these gene effects on ER-related phenomena, which may be attributable to more complex relationships between genes and phenotypes.

“The main effects are in the interactions”

Thus far, we have reviewed the literature on internal and external sources of individual differences in ER. Development, however, is much more complex than a series of cause and effect relationships. At the end of Calkins’ influential review, she urged researchers to consider the interplay among the internal and external factors (Calkins, 1994). Bronfenbrenner (1979) also proclaimed, “In ecological research, the principal main effects are likely to be interactions” (p. 38). Further, the core of the Bioecological Systems Theory stipulates that the effects of proximal processes will vary as a function of the individual and the environment. Along these lines, the effects of *Proximal Processes* (i.e., parenting) on ER should vary by *Person* factors (e.g., temperament, genotype) and *Context* factors (e.g., family emotional climate, socio-economic status). While studies on ER that examine multiple levels of environment (i.e., both proximal processes and contextual factors) are few and far between, studies examining interactions between *Person* and *Environment* are more common, with perhaps the strongest support coming from research on the diathesis-stress/dual-risk model and, more recently, the differential susceptibility hypothesis.

The diathesis stress model asserts that some individuals are disproportionately (or exclusively) likely to be negatively affected by environmental stressors. This increased vulnerability is due to temperamental (e.g., negative emotionality), physiological (e.g.,

corticolimbic reactivity), or genetic (e.g., 5-HTTLPR, DRD4, OXT-R) factors (Belsky & Pluess, 2009a). Well-studied environmental stressors in this field include childhood maltreatment, negative life events, and insensitive parenting.

About a decade ago, researchers such as Belsky, Pluess, Ellis, and Boyce raised concern that the diathesis stress model may be overlooking a crucial piece of the puzzle (Belsky, 1997; Belsky & Pluess, 2009a; Boyce & Ellis, 2005). As psychopathological research primarily addresses the factors that increase the likelihood of disease, research efforts were solely directed at negative environmental agents. However, the spectrum of possible environments ranges widely from abuse and neglect to support and warmth. Thus, could it be true that those individuals who were found to be more “vulnerable” to negative life events would have flourished the most under positive environmental circumstances?

Evidence for differential susceptibility has accumulated since Belsky and colleagues initially proposed the hypothesis, especially in predicting externalizing behaviors (Bakermans-Kranenburg & van IJzendoorn, 2006; Belsky, Hsieh, & Crnic, 1998; Bradley & Corwyn, 2007). Recently, researchers have started to examine gene-environment interactions, probing for diathesis-stress and/or differential susceptibility, in predicting ER. For example, Chang, Shelleby, Cheong, and Shaw (2012) recently examined the additive and interactive effects of cumulative environmental risk, child negative emotionality, and emotion dysregulation. Their results indicated that early negative emotionality amplified the association between environmental risk and emotion dysregulation, thus providing support for difficult temperament as a vulnerability factor.

In addition, recent studies found support for a serotonin-transporter genotype-by-attachment interaction in predicting ER in preschool children (Kochanska, Philibert, & Barry, 2009) and adolescents (Zimmermann, Mohr, & Spangler, 2009). The results from the study with preschool children are consistent with the diathesis-stress model, such that children with an S allele and insecure attachment developed poor ER capacities, whereas children with an S

allele and secure attachment developed ER capacities similar to children with the LL genotype. Results from adolescent study, on the other hand, appear to support the differential susceptibility hypothesis. Adolescents carrying an S allele with secure attachment exhibited more agreeable and less hostile behaviors in interactions with parents, compared to S allele carrying adolescents with insecure attachment. Zimmermann, Mohr, and Spangler did not compare the S allele group to the LL group nor formally test for evidence of differential susceptibility, but the data presented suggest that S carriers benefitted more from secure attachment (i.e., displayed more agreeable behavior) and were more negatively affected by insecure attachment (i.e., displayed more hostile behavior) than LL carriers, whose agreeable and hostile behaviors did not seem to differ due to attachment style.

Present Studies

The goal of the proposed dissertation was to extend the Bioecological Systems Theory to three high-risk samples, with two primary aims: (1) to examine the effects of concentric levels of influence on ER, from within the individual (i.e., serotonin transporter genotype, temperament), to aspects of the proximal environment (i.e., parenting behaviors), and to broader contextual factors (e.g., income, family composition); and (2) to assess the ontogenetic effects of the levels of influence and determine whether these internal and external factors affect developmental *trajectories* of ER, in addition to predicting initial levels.

- **Study 1** – *Developmental patterns of child emotion dysregulation as predicted by serotonin transporter genotype and parenting* – examined how serotonin transporter genotype interacted with parenting behaviors in predicting the trajectory of ER across middle childhood, in a sample of children with and without intellectual disabilities.
- **Study 2** – *Developmental patterns of emotion regulation in toddlerhood: Examining predictors of change and long-term resilience* – assessed the effects of temperament, proximal parenting behaviors, and family environmental factors on the trajectory of ER across early childhood, in a sample of children and families involved in the Early Head

Start Research and Evaluation project. We identified distinct trajectory groups of ER and factors that predict membership in these groups. We also explored predictions of long-term resilience from the identified trajectory groups.

- **Study 3** – *Predicting emotion regulation among children adopted from foster care: Contributions of temperament, pre-placement risk, and adoptive family environment* – explored the impact of exposure to two distinct ecological systems, as in the case of adoption. In a sample of families who adopted children from foster care, we used the cumulative risk approach to examine the effects of temperament, prenatal and perinatal risk, pre-placement risk, and adoptive family parenting behaviors, on ER.

Chapter 2

Developmental patterns of child emotion dysregulation as predicted by serotonin transporter genotype and parenting (Study 1)¹

Abstract

Individual differences in emotion regulation are central to social, academic, occupational, and psychological development, and emotion dysregulation (ED) in childhood is a risk factor for numerous developmental outcomes. The present study aimed to (a) describe the developmental trajectory of ED across early childhood (3-6 years) and (b) examine its sensitivity to youth serotonin transporter genotype, positive and negative parenting behaviors, and their interaction. Participants were 99 families in the Collaborative Family Study, a longitudinal study of children with or without developmental delays. Child ED and early parenting were coded from parent-child laboratory interactions.

To examine serotonin transporter genotype as a moderator between parenting and child ED, children with the homozygous short (SS) genotype were compared to children with the homozygous long (LL) or heterozygous (SL) genotype. We used Latent Growth Curve Modeling (LGCM) to model yearly change in ED from child age 3 to 6 years. LGCM revealed that ED decreased overall across early childhood. In addition, we observed separate genotype x positive and genotype x negative parenting behavior interactions in predictions of ED growth curves. Children with the SL/LL genotype had ED trajectories that were minimally related to positive and negative parenting behavior, whereas ED decreased more precipitously among children with the SS genotype when exposed to low negative parenting or high positive parenting. These findings provide evidence for gene x environment interactions in the development of ED in a manner that is conceptually consistent with vantage sensitivity, and they improve inferences afforded by prospective designs.

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Developmental patterns of child emotion dysregulation as predicted by serotonin transporter genotype and parenting

Individual differences in emotion regulation reliably predict numerous long-term psychological, emotional, and physical outcomes. Emotion regulation, defined as “behaviors, skills, and strategies, whether conscious or unconscious, automatic or effortful, that serve to modulate, inhibit, and enhance emotional experiences and expressions,” (Calkins & Hill, 2007, p. 229) is a broad construct that can range from very poor regulation (i.e., emotion dysregulation) to very high regulation. Emotion dysregulation (ED), defined by emotional expression that is inappropriate to the context in terms of intensity and duration, and interferes with functioning (Hoffman et al., 2006), is central to heuristic models of psychopathology, including major depressive disorder, bipolar disorder, anxiety disorders, eating disorders, and personality disorders (Aldao et al., 2010; Cole & Deater-Deckard, 2009). Of note, while not precisely opposite constructs, emotion regulation has been found to increase as ED and related constructs decrease (Blandon, Calkins, Keane, & O’Brien, 2008).

The majority of research on ED and psychopathology, however, is cross-sectional and thus compromises directional inferences. However, in one short-term (7 months) longitudinal study, McLaughlin et al. (2011) found that ED predicted increased anxiety, aggression, and eating pathology, even with control of baseline psychopathology. Thus, as ED has been identified as a key cross-diagnostic factor for psychopathology, understanding the development of ED is critical for understanding the etiology, maintenance, and treatment of psychological disorders. The current study focuses on predictors of change in ED during early childhood, toward a better understanding of the processes that underlie the development of this crucial risk factor.

Emotion regulation development

Given associations with several domains of long-term functioning, the independent regulation of emotional reactions is considered a major developmental milestone of childhood

(Cicchetti, Ganiban, & Barnett, 1991; Kopp, 1982). Surprisingly then, while many cross-sectional studies have examined emotion regulation in children, relatively few studies have studied the development of emotion regulation longitudinally. Understanding longitudinal growth in emotion regulation is critical, given rapid changes in socio-emotional, linguistic, cognitive, and biological development in early childhood (Bandon et al., 2008; Fox, 1994). Prior prospective examinations of developmental change in emotion regulation and ED-related constructs suggest that, in early childhood, emotion regulation behaviors increase (Bandon et al., 2008), and ED behaviors decrease (Fabes, Hanish, Martin, & Eisenberg, 2002; Murphy, Eisenberg, Fabes, Shepard, & Guthrie, 1999). Of note, only one of these studies examined change in observed behavior, and focused on change over only a three month period (Fabes et al., 2002). These findings provide support for theoretical assertions and cross-sectional findings in this developmental stage, including findings that preschoolers demonstrate emerging abilities to use problem-solving skills to directly address their source of distress, positively reframe upsetting situations, and flexibly employ different regulation strategies (Kalpidou, Power, Cherry, & Gottfried, 2004; Stansbury & Sigman, 2000). Together, these studies highlight the importance of further studying behaviorally observed regulation and dysregulation in early childhood and suggest that early childhood may be an especially formative period for emotional development.

In studies examining predictors of emotion regulation development, two broad factors have been found to be central to the development and maintenance of emotion regulation: influences external to the individual, and influences internal to the individual (for the seminal review, see Calkins, 1994). Extensive research has been done on environmental (i.e., external) influences on emotion regulation, with the vast majority focusing on the family system. Positive parenting behaviors, such as sensitivity (Feldman, 2007; Fogel, 1993; Leerkes et al., 2009), scaffolding (Bernier et al., 2010; Gulrud et al., 2009; Hoffman et al., 2006; Lengua et al., 2007), and expression of positive affect (Cumberland-Li, Eisenberg, Champion, Gershoff, & Fabes, 2003; Eisenberg et al., 2001) influence emergent youth emotion regulation, such that the

presence of positive parenting behaviors facilitates emotion regulation development, whereas the absence hinders it (NICHD Early Child Care Research Network, 2004).

Conversely, ED in childhood has been predicted by negative parenting behaviors, such as intrusiveness (Cabrera, Shannon, & Tamis-LeMonda, 2007; Graziano, Keane, & Calkins, 2010; Stevenson & Crnic, 2013) and parental expression of negative emotions (Morris et al., 2007). The majority of previous research has focused on either positive *or* negative parenting behavior. The present study examined and compared the contributions of broad measures of positive and negative parenting to trajectories of ED across childhood.

In addition to research on the environmental contributors to ED, characteristics within the individual have been studied. Researchers have theorized and provided empirical evidence for the effects of neuroregulatory reactivity (Dennis & Hajcak, 2009; Fox, 1994; Stansbury & Gunnar, 1994), behavioral traits (e.g., temperament, Calkins, 1997; Gunnar, Porter, Wolf, Rigatuso, & Larson, 1995; Stifter & Braungart, 1995), and cognitive ability (Crnic, Hoffman, Gaze, & Edelbrock, 2004; Norona & Baker, 2016) on ED. In different line of study, researchers have examined the influence of genes on ED (see Hariri & Holmes, 2006, for a review).

Genetics and ED

Among genetic variants linked to ED, the promoter polymorphism in the serotonin transporter gene is the most common variant studied. As serotonin is a key neurotransmitter in mood regulating systems, such as the Hypothalamic-Pituitary-Adrenal (HPA) axis, it is not surprising that the serotonin transporter genotype is associated with mood, attention, and psychopathology (Auerbach, Faroy, Ebstein, Kahana, & Levine, 2001; Champoux et al., 2002; Lucki, 1998; Soubrie, 1986; Van Goozen, Fairchild, Snoek, & Harold, 2007). 5-HTTLPR has two allelic forms, a short (S) variant and a long (L) variant. The S variant has been associated with reduced serotonin transporter transcription, lower serotonin transporter protein levels, and diminished serotonin re-uptake (Lesch et al., 1996). Further, the S allele has been identified as a potential genetic “risk” factor, as having the SS (short-short) or SL (short-long) genotype have

been linked with outcomes closely related to ED, such as higher levels of anxiety (Hariri et al., 2005; Lesch et al., 1996), vulnerability to life stress (Caspi et al., 2003; Champoux et al., 2002), and amygdala hyper-reactivity (Hariri et al., 2002; Heinz et al., 2005). Thus, the S allele may represent a risk factor for ED, with individuals with the SS genotype at highest risk (Kendler, Kuhn, Vittum, Prescott, & Riley, 2005). Some researchers, however, have failed to replicate these genetic “risk” effects (e.g., Gillespie, Whitfield, Williams, Heath, & Martin, 2005; Surtees et al., 2006; Willis-Owen et al., 2005). Researchers have suggested that the inconsistency in findings is due to complex relationships between genes and phenotypes, the difficulty of operationalizing complex phenotypes such as ED, and/or small effect sizes (Canli & Lesch, 2007; Hariri & Holmes, 2006).

One area of research that has provided some clarity in regards to inconsistent findings for genetic “risk” effects examines gene-environment interaction (GxE). This line of research directly answers questions regarding the complexity between genetic predisposition and phenotypic expression. It asserts that inconsistency in risk findings is due to interplay between genotypes and the amount of adversity or nurturance in the individual’s environment; this has yielded meaningful findings in investigations of psychopathological outcomes associated with ED (e.g., depression, externalizing behaviors). Thus, investigating the development of ED using the GxE framework is a necessary follow-up.

GxE and ED

The effects of early caregiving environments on ED trajectories may be moderated by serotonin transporter genotype through GxE. Two studies have found support for a serotonin transporter genotype-by-attachment interaction in predicting ED, one in preschool children (Kochanska et al., 2009) and the other in adolescents (Zimmermann et al., 2009), with secure attachment conceptualized as an indicator of early positive and sensitive parenting. Kochanska et al. (2009) found that preschool children with insecure attachment and an S allele developed increased ED whereas securely attached children with an S allele exhibited ED similar to LL

genotype children. These findings suggest that serotonin transporter genotype may increase a child's vulnerability to insecure attachment in the preschool years. Results from the adolescent study tell a somewhat different story. Similar to the preschool findings, S allele carriers with insecure attachment displayed less agreeable and more hostile behaviors with parents, compared to S allele carriers with secure attachment. When compared to adolescents with the LL (long-long) genotype, however, the S allele carriers appeared to benefit more from secure attachment (i.e., displayed more agreeable behavior) and exhibit more impairment from insecure attachment (i.e., displayed more hostile behavior) (Zimmermann et al., 2009).

These two studies highlight an area of inconsistency in GxE research in developmental psychopathology. While convergent evidence seems to support that individuals differ in genetic plasticity to environmental influences, researchers have yet to identify the mechanism of this plasticity. Some studies' findings (e.g., Kochanska et al., 2009) support the *diathesis-stress* (a.k.a. *dual risk*) model, which asserts that certain characteristics (e.g., genotype, temperament, etc.) predispose certain individuals to be more vulnerable to the effects of adverse environments (Monroe & Simons, 1991; Sameroff & Seifer, 1983; Zuckerman, 1999). Other studies, however, (e.g., (Zimmermann et al., 2009) provide support for the *differential susceptibility* hypothesis, which states that these individuals who, under the diathesis-stress framework are more vulnerable to negative environments, are also more sensitive to the positive effects of enriched environments (Belsky, 1997; Belsky & Pluess, 2009a; Boyce & Ellis, 2005). *Vantage sensitivity* is another proposed variation of GxE, by which certain individuals are disproportionately likely to be solely positively affected by positive contextual conditions. Emotion regulation and/or dysregulation have not yet been studied in the context of vantage sensitivity, though 5-HTTLPR has been identified as a genetic marker of this type of plasticity for related constructs, such as positive emotionality (Hankin et al., 2011) and anxiety disorders (Eley et al., 2012). While a literature base is still accumulating for GxE and ED, studies that have examined the effects of the S allele within developmental psychopathology and temperament have consistently

demonstrated that, as compared to individuals with LL (and oftentimes SL) genotype, individuals with the SS genotype evidence greater plasticity. Further research will elucidate the nature of the plasticity, whether in conferring dual risk, differential susceptibility, or vantage sensitivity.

The present study extends the literature base by exploratory analysis of GxE effects on the trajectory of ED. To our knowledge, no study to date has tested GxE in predicting ED trajectories. It is critical to address this empirical gap, given that ED processes are fundamentally dynamic, particularly in early childhood, and that genetic plasticity to the environment is likely effective across the lifespan, as opposed to a single time point (Ellis, Boyce, Belsky, Bakermans-Kranenburg, & van Ijzendoorn, 2011). Further, identifying GxE underlying individual differences in ED trajectories has the potential to inform identification, prevention, and intervention efforts in childhood psychopathology. While researchers have yet to specifically examine GxE effects on emotion regulation or dysregulation trajectories, evidence has been presented on GxE effects on trajectories of constructs theoretically tied to ED, such as negative emotionality (Lipscomb et al., 2012) and externalizing behavior problems (Brett et al., 2015; Trucco, Villafuerte, Heitzeg, Burmeister, & Zucker, 2016; Tung & Lee, 2016).

The current study

The current study investigated the development of ED, with two primary aims: (a) to identify the developmental trajectory of ED across early childhood, from child age 3 to 6 years; (b) to examine how serotonin transporter genotype and positive and negative parenting behaviors independently and interactively affect individual differences in trajectories of ED.

We hypothesized that ED would decrease across early childhood. Further, we hypothesized that genotype and parenting would have independent effects on ED and that serotonin transporter genotype would moderate the association between parenting and ED. In terms of age 3 (intercept) ED, we expected effects of positive and negative parenting but not of genotype or GxE, such that positive parenting would be associated with lower initial ED, and

negative parenting with higher ED. For yearly change in ED from age 3 to 6 (slope), we predicted a continued main effect of parenting and that genotype would moderate its effects, such that children with the SS genotype, as compared to children with the SL/LL genotype, would demonstrate more sensitivity (i.e., faster decline in ED for high positive and low negative parenting and increase in ED for low positive and high negative parenting).

This study addresses critical limitations in the literature. First, the majority of studies examine the deleterious effects of the negative early environment. We have taken a holistic approach to the environment, using observationally obtained measures of positive *and* negative parenting behaviors. This approach has the potential to provide important nuance to the current literature on GxE processes. Second, the field lacks an empirical examination of longitudinal effects of GxE in the context of ED. It is critical to take this developmental approach, considering the dynamic nature of ED across childhood. Third, most GxE investigations have focused on complex clinical phenotypes such as depression, antisocial behavior, and ADHD. These findings may be confounded because these disorders share underlying traits, including ED. Thus we directly targeted intermediate phenotypes, herein ED, that may be closer to the GxE process.

Method

Participants

Participants were 99 families enrolled in the Collaborative Family Study, a longitudinal study of children with and without developmental delays (DD) and their families, conducted by the Universities of California, Los Angeles and Riverside, and Pennsylvania State University. The samples, drawn from Southern California and Central Pennsylvania, were followed from child age 3 to 15 years. Informed consent was obtained from participating parents and assent from the children. The present sample was comprised of all families for whom data were available on at least one of the primary measures (i.e., ED, positive parenting, negative parenting) at child ages 3-6, as well as genetic data, which was collected at age 13. The initial

sample was comprised of 238 families. Our combination of measure criteria reduced the sample to 99 families, who had consistent participation in the study for a decade. In addition to families dropping out of the study over time, other reasons for missing data included youth declining to continue with participation, video/audio recording malfunctions, and poor saliva sample for genotyping. The present sample did not differ from families who were no longer available on demographic factors (i.e., ethnicity, marital status, socioeconomic status, parental education, parent age) or any measure of interest (i.e., genotype or sex distribution, IQ, positive parenting, negative parenting, ED at any age). Among the 99 participants in the current sample, 83 participants (83.8%) had complete data, 15 participants (15.2%) had missing data for 1 key variables (with 13 of those missing age 6 ED), and 1 participant (1%) had missing data for 2 key variables.

Families were recruited at child age 3 years. Families of children with DD came primarily from agencies that provide diagnostic and intervention services for this population. Children with autism were excluded from the study. Families of children with typical development (TD) were recruited through local preschools and day care programs. Selection criteria were that the child scored in the range of normal cognitive development and had not been born prematurely or had any known developmental disability.

Table 1 shows the sample demographic characteristics at child age 3. Among the children, 43.4% were female and about half were Caucasian, non-Hispanic (56.6%), followed by Hispanic (18.2%), “Other” (15.2%), African American (8.1%), and Asian (2.0%). Mothers’ race/ethnicity was primarily Caucasian, non-Hispanic (60.6%) or Hispanic (24.2%), with others African American (9.1%), Asian (3.0%), Native American (2.0%) or self-identified as other (1.0%). The vast majority of mothers were married (87.9%), as recruitment initially focused on married parents. Family socio-economic status was generally high; 59.6% of families had an annual income above \$50,000 (in year 2000 U.S. dollars), and mothers’ and fathers’ average years of schooling was two years of college.

Procedures

In recruiting participants, school and agency personnel mailed brochures describing the study to families who met selection criteria and interested parents contacted the research center closest to them. The family was visited at age 3 for an in-home confirmation of the child's development. Then the primary parent and child were assessed in the research center and/or home setting at ages 3-6, and demographic assessment and observational measures of the child's behavior and parent-child interactions were completed. Children's cognitive abilities were measured again at age 5, using the Stanford-Binet IV (Thorndike et al. 1986), and we used this measure of IQ as a covariate in our analyses.² At each time point, families were monetarily compensated with \$50 for their participation. To maintain study engagement among the participant families, annual holiday and birthday cards were mailed to the families.

Saliva samples were collected from the participants at the age 13 visit and genotyped. Adolescents deposited their saliva into a vial, which was then transported to the UCLA Genotyping and Sequencing Core Facility for genotyping. Technicians were masked to diagnostic status and confidentiality was protected by labeling each sample with a unique case identifier known only to the authors. Genomic DNA was isolated from buccal cells using standard methods.

For the observations of ED and parenting in the research center, parents and children were guided by an experimenter through a series of activities, which were videotaped for later coding. Three of the activities were problem solving tasks ranging from easy to difficult. The easy task was designed to be easily completed by the child within a short amount of time (e.g., inset foam puzzle), with little or no help from the mother; the medium-level task was designed to be complex enough to warrant most children needing at least some assistance from their

² Though we obtained a measure of IQ at age 3 and acknowledge that a covariate before or at the baseline measure is ideal, we elected to use the age 5 measure given the variability in earlier measures. Within our research center, we have found that the age 5 Stanford Binet index is more consistent with assessment of DD at older ages. In addition, previous researchers have urged caution in drawing predictive conclusions regarding delay using the Bayley Scales (Crowe, Deitz, & Bennett, 1987; Hack et al., 2005).

mothers (e.g., constructing a Lego tower); and the difficult task was designed to be sufficiently difficult that it could not be solved by the child alone and always required the mother's assistance (e.g., manipulating two metal rods to get a metal ball to roll up an incline and drop into a designated hole). Developmental psychologists with extensive experience with young children were involved in the selection of the tasks, and the materials were adjusted for the children based on age and cognitive status to keep the difficulty level consistent across ages and groups.

Measures

Serotonin transporter genotype. The serotonin transporter genotype variable was a composite of 5-HTTLPR and rs25531. 5-HTTLPR encodes two allelic variants, a short (S) variant and a long (L) variant, and the S variant has been associated with lower levels of serotonin transcription, expression, and function (Lesch et al., 1996). In addition, rs25531 encodes two variants as well, an A nucleotide and a G nucleotide. Researchers have found that the G variant of rs25531 functionally transforms a 5-HTTLPR L allele into an S. In accordance with previous studies (Cervilla et al., 2007; Kendler et al., 2005), we compared individuals with two-low expression alleles (i.e., SS, SL_G, L_GL_G) with all others. In all analyses, children with the SS genotype were coded as "1" and children with the LL or SL genotype were coded as "0".

Emotion Dysregulation codes (Hoffman et al., 2006). ED was coded at child ages 3, 4, 5, and 6 years, from observations of the child's behavior during the three parent-child problem-solving tasks (the age 6 visit only consisted of two problem-solving tasks) of increasing difficulty, using the Dysregulation Coding System. This consists of Behavior Dysregulation and Emotion Dysregulation subscales, though the present study examines only the Emotion Dysregulation subscale, as trajectories of ED is the focus of this paper. Each child was rated on ED for each problem-solving task, and the task ratings were averaged together to create a composite score of ED at each age. The ED ratings were significantly correlated within each time point (range = .30-.45). The coding, described below, was held consistent across the time points.

The ED subscale was adapted from the parameters presented by Cole, Michel, & Teti (1994). This scale was designed to measure the appropriateness of the type, duration, and intensity of emotional expressions as well as the lability and soothability exhibited by the child. ED ratings, therefore, involved emotional expressions exhibited by the children, but as Cole and colleagues (Cole, Martin, & Dennis, 2004) suggested, ratings also captured more process-level features of the expressions and their relationship to the context, rather than simply considering the valence of the emotional expression.

The children were assigned scores ranging from 0 (no evidence of dysregulation) to 4 (significant dysregulation). A score of 1 reflected a low degree of ED and described children who (a) displayed only one or two brief emotional expressions that were inappropriate to the situation and who were able to regroup on their own or (b) displayed one or two brief instances of emotional lability and/or variability in intensity of emotional expression and usually recovered quickly from inappropriate emotional experiences. In contrast, a child receiving a score of 4 showed significant dysregulation in that he or she displayed several intense emotional expressions or displayed less intense but frequent emotional expressions for the majority of the segment, was virtually unable to regroup without the help of the parent, and was very labile, showing extreme variability in the intensity of emotion and/or very slow recovery from emotional experiences. For the purposes of this study, dysregulation of various emotions (i.e., negative vs. positive) were not examined separately, as we were interested in assessing ED at a more macro level. At each time point, six coders who were blind to the study hypotheses coded in pairs, first coding independently and then coming to consensus. Twenty percent of a pair's codes were compared against a master coder, and reliability was achieved and maintained when agreement was exact for 70% of the codes, and within 1 point for the remaining 30%. The overall reliability of the Dysregulation Coding System was quite high, $r = .90$. Analyses indicated that the ED subscale also had good reliability, $r = .79$.

Parent-Child Interaction Rating Scale (PCIRS; Belsky, Crnic, & Woodworth, 1995).

Parenting was coded from research center and home observations of mother and child, at child ages 3 and 4. The PCIRS measures six dimensions of parenting: positive affect, negative affect, sensitivity, stimulation of cognition, intrusiveness, and detachment. Coding teams rated each mother in each dimension using a 5-point Likert scale (1=not at all characteristic, 5=highly characteristic) for all dyadic interaction activities. The sum of these scores were converted into z-scores and combined into two composites, positive parenting and negative parenting, using a previously derived factor structure (Fenning, Baker, Baker, & Crnic, 2007). Positive parenting consisted of positive affect + sensitivity + stimulation of cognition - detachment. Negative parenting consisted of intrusiveness + negative affect. Each mother-child dyad was assigned scores for the research center observations and home observations at child ages 3 and 4, and the final scores used for analysis were the average across age 3 and 4 scores from the research center and home.

Research assistants were trained by watching videotaped lab observations until reliability was established, defined as reaching a criterion over 70% exact agreement and 95% agreement within one scale point with the criterion coder. Once reliable, two research assistants were paired to code the tapes as a team. To maintain inter-reliability within and across contexts, a master coder, usually an advanced graduate student, was designated. Reliability was collected for 30% of the tapes. Kappa for inter-rater reliability was 0.71 (range = .68 – .77), which is considered moderate (McHugh, 2012).

The home observations, on the other hand, were rated live, during observation of family interactions. This coding included six 15-min segments, for a total of 90 minutes of coded interaction. Coders observed for 10 min, followed by a 5-min coding period; ratings were averaged across observation periods. Coders were trained on videotapes of home observations and attended live home observations with an experienced coder until reliability met the criterion of over 70% exact agreement with the master coder and 95% agreement within one scale point.

To maintain reliability within and across the two project sites, a primary coder was designated at each site. Reliability was regularly re-determined through videotapes and live home observations. Kappa coefficients were .61 and .60 for within-site reliability at the UCLA and PSU sites and .64 for cross-site reliability, which are all in the moderate range (McHugh, 2012).

Data analytic plan

Latent growth curve modeling (LGCM) was used to examine (a) yearly change in ED from age 3 to 6 and (b) individual and interactive effects between serotonin-transporter genotype (G) and parenting behaviors (positive and negative) in predicting ED change. To this end, we implemented three latent growth curve models. The first model was an unconditional model which examined growth in ED, without any predictors or covariates. The second model examined the effects of *G x Negative Parenting* on growth curves of ED, and the third examined the effects of *G x Positive Parenting* on growth curves of ED.

LGCM allows for examining individual differences in change over time and exploring what factors are associated with, or potentially causal to, these (Cheong, MacKinnon, & Khoo, 2003; Krull & Arruda, 2015; Raudenbush, 2001). LGCM uses the Structural Equation Modeling framework, with repeated measures of the outcome construct (i.e., ED) serving as indicators of latent growth factors. Several latent growth factors were estimated, including mean ED at each time point (i.e., intercept), the linear change in ED across time points (i.e., slope), as well as a quadratic trend of this growth. In contrast to multilevel modeling growth models, separate error variances are estimated for each observation of the outcome construct (Krull & Arruda, 2015). Mplus software (Muthén & Muthén, 2009) was used to estimate LGCM. All models initially included only the intercept and linear slope latent factors, and then a quadratic factor was added to examine whether it significantly improved the fit of the model. Three criteria were employed to evaluate model fit: the chi-square test, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). A nonsignificant chi-square value indicates adequate model fit, as do CFI values above .95 (range = 0–1.00) and RMSEA values below .06.

To examine ED change over time, regardless of genotype and parenting, we fit an unconditional LGCM. Then, to examine how change in ED over time is affected by serotonin transporter genotype, parenting, and their interaction, we fit conditional LGCMs, and these factors were included as predictors, controlling for child sex, IQ, DD status, and the other type of parenting (e.g., positive parenting in the negative parenting model). Sex was included as a covariate due to prior research finding significant differences in sensitivity to context by sex (Yates, Obradović, & Egeland, 2010). A significant path coefficient from serotonin transporter genotype (G), parenting (E), or the GxE interaction term to the latent intercept would indicate effects on baseline (age 3) ED, whereas a significant path coefficient leading to the grown factor(s) would reveal change in the trajectories of ED over time (Simons-Morton, Chen, Abrams, & Haynie, 2004). Multiple interaction terms were not included simultaneously because inclusion of multiple higher-order terms introduces multicollinearity and instability in equations (Cohen, Cohen, West, & Aiken, 2003). Lastly, Little's test determined data missingness to be Missing Completely at Random, $\chi^2(19, N = 99) = 20.08, p = ns$, Full Information Maximum Likelihood (FIML) was used to estimate missing data. Compared to using listwise deletion, FIML leads to less biased estimates for coefficients and standard errors and decreases the likelihood of Type I error.

To aid the interpretation and presentation of our findings, graphs were made in Excel. We constructed growth curves of ED for the positive and negative parenting models within each genotype group. Coefficients for intercept, linear slope, and quadratic slope generated in each LGCM were used to calculate expected values of ED at the mean, +/-1 SD, and +/-2 SDs of positive and negative parenting.

Results

Descriptive statistics

Of the 99 participants, 18 (18.2%) were homozygous for the high-expression allele (La), 58 (58.6%) had the heterozygous genotype, and 23 (23.2%) were homozygous for the low-

expression allele (S or Lg). This genotype distribution did not deviate from the Hardy-Weinberg equilibrium ($p > .05$). Thus 23 participants were in the SS genotype group, and 76 were in the SL/LL genotype group. In addition, 80 participants were designated as typically developing (TD; IQ > 75), and 19 as developmentally delayed (DD; IQ < 76). Table 1 shows means, standard deviations, and Pearson correlations among model variables. The average level of ED appeared to decrease across the four time points, from .96 to .29. The ED scores ranged similarly across time, from 0 to 3.5 overall. Sex was dummy-coded (0 = boys; 1 = girls) so that the average score for sex in Table 1 reflects the proportion of girls in the sample; likewise with DD status, with DD coded as 1, and with genotype, with the SS genotype coded as 1. Serotonin transporter genotype was not correlated with ED, and child sex correlated only with age 3 ED (with girls having lower ED than boys). IQ was negatively associated with ED at all time points, though not significantly at age 6. Positive parenting was not correlated with ED, whereas negative parenting positively correlated with ED at 2 of the time points.

LGCM results

Change over time. The unconditional (without covariates) model indicated that ED significantly decreased from age 3 to 6. Without genotype and parenting in the model, a negative linear slope was found to best capture yearly change in ED across this developmental period (Intercept: $B = 1.03$, $SE = .07$, $p < .001$; Slope: $B = -.24$, $SE = .03$, $p < .001$). The unconditional model was determined to have excellent fit with the data $\chi^2(7, N = 99) = 8.59$, ns, CFI = .95, RMSEA = 0.048.

Negative parenting model. In the negative parenting model, a negative quadratic slope best captured change in ED. A model with linear slope only was determined to have poor fit with the data ($\chi^2[21, N = 99] = 36.29$, $p = .02$, CFI = .74, RMSEA = 0.09), thus a quadratic slope was added to the model. The final negative parenting model, with quadratic slope, was determined to have excellent fit with the data $\chi^2(13, N = 99) = 13.85$, ns, CFI = .99, RMSEA = 0.03. Negative parenting was the only predictor of initial levels (age 3) of ED, such that higher

levels of negative parenting were associated with higher ED (Table 2). The intercept was not predicted by child IQ, DD status, sex, genotype, or positive parenting. Change over time (linear and quadratic slope) was significantly predicted by child IQ, negative parenting, child genotype, and GxE. In addition, linear and quadratic slope were significantly correlated ($r = -.99$) and thus should not be interpreted independently of one another. In examining the generated graphs, for children with the SL/LL genotype, lower levels of negative parenting appeared to be related to a slightly steeper decrease (Figure 1a). In contrast, for children with the SS genotype, high negative parenting appeared to predict stable ED over time, whereas lower negative parenting predicted decreases in ED (Figure 1b). Further, this decrease appeared to be steeper as compared to children with the SL/LL genotype.

Positive parenting model. The positive parenting model was largely consistent with the negative parenting model. Again, change in ED was best captured by a negative quadratic slope. A model with linear slope only was determined to have poor fit with the data ($\chi^2[21, N = 99] = 32.29, p = .05, CFI = .81, RMSEA = 0.07$), thus a quadratic slope was added to the model. The final positive parenting model, with quadratic slope, had excellent fit with the data ($\chi^2(13, N = 99) = 12.66, ns, CFI = 1.00, RMSEA = 0.00$). In addition, negative parenting was the only predictor of initial levels (age 3) of ED, such that higher levels of negative parenting were associated with higher ED (Table 3). The intercept was not predicted by child IQ, DD status, sex, genotype, or positive parenting. Change over time (linear and/or quadratic slope) was significantly predicted by negative parenting, child genotype, and GxE. In addition, linear and quadratic slope were again significantly correlated ($r = -.98$) and thus should not be interpreted independently of one another. Upon examination of the graphs, for children with the SL/LL genotype, positive parenting did not appear to have an effect on the trajectory of ED (Figure 2a). For children with the SS genotype, higher levels of positive parenting seemed to be associated with steeper decrease in ED. (Figure 2b).

Discussion

We examined the effects of serotonin transporter genotype and parenting behaviors on the trajectory of emotion dysregulation (ED) across early childhood. We addressed important gaps in the literature by directly modeling change over time in ED and examining differential contributions of positive *and* negative parenting. The study extends the research on genetic plasticity to the environment by examining ED, a factor critically underlying many poor outcomes commonly studied in this framework.

Trajectory of ED

Our first aim was to identify the developmental trajectory of ED across early childhood. Using Latent Growth Curve Modeling (LGCM), on average, ED decreased from age 3 to 6 years. A negative slope best fit this trajectory, which is consistent with previous studies that examined change in regulation and related constructs over time (Bandon et al., 2008; Fabes et al., 2002; Murphy et al., 1999) and with theoretical propositions set forth by researchers in the emotion regulation field (Blair, 2002; Kopp, 1982). Decreases in ED have been proposed to reflect neurobiological and social developmental milestones. For example, brain regions (i.e., prefrontal cortex, anterior cingulate cortex, amygdala) associated with higher-order cognitive functioning undergo marked maturation across childhood (Fox, 1994; Ochsner & Gross, 2005; Ochsner, Bunge, Gross, & Gabrieli, 2002). Maturation of these brain regions affords increased ability to recognize emotional states, positively reappraise distressing situations, and plan for decreased exposure to distressing stimuli (Bandon et al., 2008; Larsen & Prizmic, 2004). Simultaneously, from age 3 to 6, children experience changes in their social environments. At school, children are more frequently exposed to emotionally charged situations but also a plethora of strategies utilized by peers and coached by teachers for managing those emotions. Further, there is an increase in demands on children in school to independently regulate their behavior and emotions with larger class sizes and decreased supervision (Bronson, Tivnan, & Seppanen, 1995; Rimm-Kaufman & Pianta, 2000). Thus, due to brain maturation, exposure to emotionally-charged but safe peer interactions, social modeling/coaching of emotion regulation

strategies, and more opportunities to practice regulatory behaviors, early childhood seems to be structured to optimally support emotion regulation development. Importantly, our empirical evidence of change in ED over time underscores the dynamic nature of this construct and thus the continued need for longitudinal investigations of ED.

An important note regarding our trajectory results is that predicted values of ED at certain levels of parenting at ages 5 and 6 fell below zero, while the range of the ED measure was 0-4. Statistically, it is not uncommon for linear growth models to predict values that are out of the bounds of the actual outcome measure. As long as model assumptions hold (as is the case in the current study), estimates are believed to be unbiased, consistent, and efficient (Suen, Lei, & Li, 2011). In terms of real-world implications of negative predicted values, it appears that the children who went on to have the lowest (most negative) predicted dysregulation at ages 5 and 6 were predicted to score a zero at an earlier age in comparison to children with higher predicted dysregulation at ages 5 and 6. This means that these children, during a frustrating task, evidenced no emotional reactions that were inappropriate to the situation (e.g., tantrums, outbursts) at age 4, for example, while other children continued to display inappropriate behaviors after age 5. Beyond this interpretation, we can speculate that negative scores potentially indicate the development and implementation of positive emotion regulation strategies/skills. Our measure was of dysregulation and thus we cannot definitively make this assertion, but displaying no tantrums or outbursts during a frustrating task likely requires some degree of conscious or automatic efforts to regulate. Future studies that include a measure that ranges from dysregulated to regulated emotional behavior are encouraged to examine this shift.

Effects of GxE on ED trajectories

Next, we set out to examine the effects of serotonin transporter genotype (G), positive and negative parenting behaviors (E), and GxE on initial levels of ED and change in ED over time. Negative parenting emerged as the only predictor of initial levels of ED in the expected direction, such that higher negative parenting scores were associated with higher ED at age 3.

When looking at yearly change in ED from age 3 to 6 years, main effects for serotonin transporter genotype and negative parenting emerged, and significant interactions emerged for GxNegative Parenting and GxPositive Parenting. For children with the SL/LL genotype, negative parenting affected the trajectory of ED to a small degree, and positive parenting appeared to have *no* effect on the trajectory of ED. However, for children with the SS genotype, negative and positive parenting behaviors predicted change in ED over this developmental period, above and beyond the effect of the other type of parenting behavior. That is, in the SS genotype group, when examining the effect of negative parenting while controlling for positive parenting, lower negative parenting predicted faster declines in ED over time, whereas high negative parenting predicted no improvement in ED from age 3 to 6. Similarly, when examining positive parenting, children in the SS group appeared to demonstrate a steeper decrease in ED with higher levels of positive parenting.

Drawing from the GxE literature, these interactive effects provide conceptual support for the recently proposed *vantage sensitivity* framework, which asserts that certain individuals demonstrate increased sensitivity to the beneficial effects of positive environments and experiences (Pluess & Belsky, 2013; Sweitzer et al., 2013). This theory serves as a complement to dominant GxE frameworks, as vantage sensitivity focuses solely on individual differences in sensitivity (vs. resistance) to positive environments, while diathesis-stress focuses solely on negative experiences and differential-susceptibility examines the positive and negative in tandem. Our results suggest that individuals with the SS genotype exhibited the fastest decline in ED under conditions of low levels of negative parenting and high levels of positive parenting. They did not, however, seem to evidence comparatively worse functioning under conditions of high negative and low positive parenting; thus, individuals with the SS genotype appeared to have heightened sensitivity primarily to positive, nurturing environmental conditions. These findings emphasize the importance for researchers to continue to incorporate measures of negative *and* positive environments. In addition, most GxE studies have examined outcomes at

one time-point, even though biological sensitivity to the environment likely extends across time to continuously affect phenotypic outcomes across development (Ellis et al., 2011). Our study shows that for children with the SS genotype, the environment was particularly influential in shaping the developmental *pattern* of ED from age 3 to age 6, a critical period of change for ED. This supports the idea that GxE effects are developmentally meaningful with respect to how outcomes change across time. It will be important for future studies to examine GxE in the context of development and growth.

Our findings also suggest that, though modestly inversely correlated, negative and positive parenting behaviors are not simply opposite ends of the same spectrum, but have unique effects. Specifically, after controlling for the effect of one type of parenting (e.g., positive) on ED, the other type of parenting (e.g., negative) continued to interact with genotype to predict ED trajectories. This is consistent with previous findings showing that positive and negative parenting are orthogonal constructs that can have separable effects on child psychopathology (Dallaire et al., 2006; Eamon, 2002) and ED (Eisenberg et al., 2001). In the context of intervention programs, these results support the use of a “two-pronged” approach to treatment, in which therapists help parents simultaneously increase their use of positive parenting strategies (e.g., praise, rewards, one-on-one time) while decreasing negative parenting strategies (e.g., criticism, harsh or inconsistent discipline). Evidence-based parenting programs, such as Parent-Child Interaction Therapy (PCIT; Eyberg, 1988) and Incredible Years (IY; Webster-Stratton, 2015), are grounded in this two-pronged approach. IY, for example, first focuses on increasing positive parenting behaviors (e.g., positive affect, child-led play, praise, encouragement) and then shifts to strategies for managing behavior problems (e.g., limit setting, consequences). Positive interactions between parents and children are framed as “money in the bank,” from which parents can draw when setting limits and expectations (Henderson & Sargent, 2005). Therefore, in addition to receiving instruction in strategies for increasing positive parenting behaviors, parents enrolled in IY also develop strategies to replace

negative parenting behaviors. On the other hand, other parenting interventions primarily focus on symptom reduction, and a holistic (i.e., targeting positive *and* negative parenting behaviors) approach can be implied but is not explicitly targeted. For example, while a parent of an oppositional child (who also exhibits ED) may receive training on rewards and consequences, consequences are a good replacement strategy for negative behaviors such as criticism, but rewards are not necessarily equivalent to increasing the parent's expression of positive affect more globally. Parenting training interventions would benefit from more explicit differentiation of positive and negative parenting and addressing these behaviors separately. This may be particularly important for children who are at heightened genetic "risk" for ED (e.g., children with the SS genotype), because they will be particularly responsive to shifts in positive and negative parenting.

Lastly, this study is one of the few studies that have examined GxE in the context of ED. Most studies look at complex clinical phenotypes, such as psychiatric disorders, many of which are hypothesized to have ED underpinnings. Given that our results are conceptually consistent with the psychopathology GxE literature, our findings suggest that ED may be a critical mediator to psychopathology *through* these GxE effects. As such, they provide support for the Research Domain Criteria (RDoC; Insel et al., 2010) initiative and suggest that ED may be a reliable and measurable phenotype, with clear links to both biological and behavioral components, that underlie psychopathological outcomes. Future studies should directly test this theory, using statistical approaches such as moderated mediation, which would allow investigation of ED mediating GxE pathways to later complex clinical outcomes.

Limitations

As in all studies, there are limitations that should be noted. First, this sample was over-selected for DD and thus may not be representative of community samples of children and families. As child cognitive ability has been implicated in ED (Crnic et al., 2004), we controlled for child IQ and DD status in all analyses, however it is nonetheless possible that the

generalizability of our findings may be somewhat limited. Second, in this longitudinal study, we employed similar yet somewhat different ED tasks at different ages, and different teams coded the tasks at different ages. It is possible, therefore, that some change over time can be attributed to methodological shifts between laboratory visits and coding teams. It is also possible, and perhaps more likely, that these shifts added random variance and therefore reduced the consistency of the findings. Of note, considerable efforts were made to standardize the laboratory tasks and coding methods; all tasks were puzzles completed by parent-child dyads, and coding was completed with a thoroughly specified manual across all visits. In addition, our findings that ED decreased across this developmental period are consistent with theoretical assertions and previous empirical investigations (Blandon et al., 2008; Fabes et al., 2002; Murphy et al., 1999). Thus, as we achieved replication across measures and studies, we are confident that our findings regarding change in ED over time reflect a real developmental process. Third, the sample size is an additional limitation of this study, relative to the complexity of the analyses. We encourage other researchers with sample sizes of more substantial statistical power to examine the relationships presented in this study further. Lastly, our results are conceptually consistent with vantage sensitivity, as serotonin transporter genotype appeared to moderate the effects of parenting on ED in more adaptive conditions (i.e., higher positive parenting and lower negative parenting). However, we did not employ formal statistical testing of differences among estimated trajectories. As few studies have examined GxE in a way that accounts for the developmental nature of phenotypes, researchers have not yet established the quantitative methods needed to test for GxE within a longitudinal framework. Given the accumulating evidence for GxE effects on developmental patterns, it is important for researchers to work toward establishing methods for quantitative evaluation of such effects.

Conclusions

Study results indicated that child ED decreases across early childhood (age 3 to 6 years) and that individual differences in developmental trajectories of emotion regulation are, in part,

attributed to gene-environment interactions. Serotonin transporter genotype interacted with both negative and positive parenting behaviors in predicting growth curves of ED. Children with the SS genotype appeared to decrease in ED at a faster rate, under conditions of low negative parenting or high positive parenting. Children with the SL/LL genotype had trajectories of ED that were minimally affected by parenting. These findings provide conceptual support for the vantage sensitivity framework and highlight the importance of examining outcomes in the context developmental growth, as opposed to a single time point. In addition, our results underscore the importance of programs for parents of young children with ED. Specifically, interventions should be targeted at increasing positive parenting *and* decreasing negative parenting, as the two were found to have unique effects on ED.

Acknowledgements

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Table 1-1

Means, standard deviations, and correlations among key variables

Variable	M	SD	1	2	3	4	5	6	7	8	9
1. Genotype ^a	.23	.42	1								
2. Sex ^b	.43	.49	.15	1							
3. DD Status ^c	.19	.40	.10	.01	1						
4. IQ	94.50	21.3	-.11	.03	-.79**	1					
5. Positive parenting	12.00	1.93	-.08	.11	-.14	.34**	1				
6. Negative parenting	3.31	3.20	-.05	-.16	.19	-.41**	-.43**	1			
7. Age 3 ED	.96	.80	-.03	-.24*	.15	-.23*	-.17	.35**	1		
8. Age 4 ED	.87	.71	.10	.05	.29**	-.32**	.02	.19	.28**	1	
9. Age 5 ED	.53	.58	.07	-.02	.24*	-.31**	.05	-.00	.33**	.38**	1
10. Age 6 ED	.29	.58	-.00	-.01	.09	-.12	-.02	.26*	.18	.25*	.18

Notes. DD = Developmental Delay. ED = Emotion Dysregulation. ^a 0 = SL or LL genotype; 1 = SS

genotype. ^b 0 = boy; 1 = girl. ^c 0 = typically developing; 1 = developmentally delayed. * $p < .05$.

** $p < .01$.

Table 1-2

Negative Parenting Latent Growth Model

	Intercept ^a		Linear Slope ^b		Quadratic Slope ^c	
	B	SE	B	SE	B	SE
Intercept	-.652	1.048	2.404	1.323	-.827*	.413
Effect of:						
Child DD Status	.097	.301	-.179	.384	.057	.121
Child IQ	-.002	.006	-.016*	.008	.006*	.002
Child Sex	.261	.146	-.219	.185	.047	.057
Positive Parenting	.007	.043	.067	.054	-.019	.017
SS Genotype (G)	-.072	1.036	2.870*	1.337	-1.006*	.432
Negative Parenting (E)	.402**	.138	-.442*	.173	.127*	.054
GxE	.031	.314	-.857*	.408	.320*	.133

Notes. GxE = Gene-Environment Interaction between SS Genotype and Negative Parenting. ^a at age 3. ^b Linear change per year from age 3 to 6 years. ^c Quadratic change per year from age 3 to 6 years. * $p < .05$, ** $p < .01$.

Table 1-3

Positive Parenting Latent Growth Model

	Intercept ^a		Linear Slope ^b		Quadratic Slope ^c	
	B	SE	B	SE	B	SE
Intercept	-.501	1.052	3.079*	1.328	1.103**	.413
Effect of:						
Child DD Status	.167	.308	-.051	.392	.005	.124
Child IQ	-.002	.006	-.013	.008	.005	.002
Child Sex	.267	.145	-.239	.183	.052	.057
Negative Parenting	.395**	.132	-.561**	.167	.171**	.052
SS Genotype (G)	-1.118	1.232	-2.331	1.576	1.020*	.501
Positive Parenting (E)	-.010	.046	.020	.059	.000	.018
GxE	.097	.104	.205	.132	-.089*	.042

Notes. GxE = Gene-Environment Interaction between SS Genotype and Positive Parenting. ^a at age 3. ^b Linear change per year from age 3 to 6 years. ^c Quadratic change per year from age 3 to 6 years. * $p < .05$, ** $p < .01$.

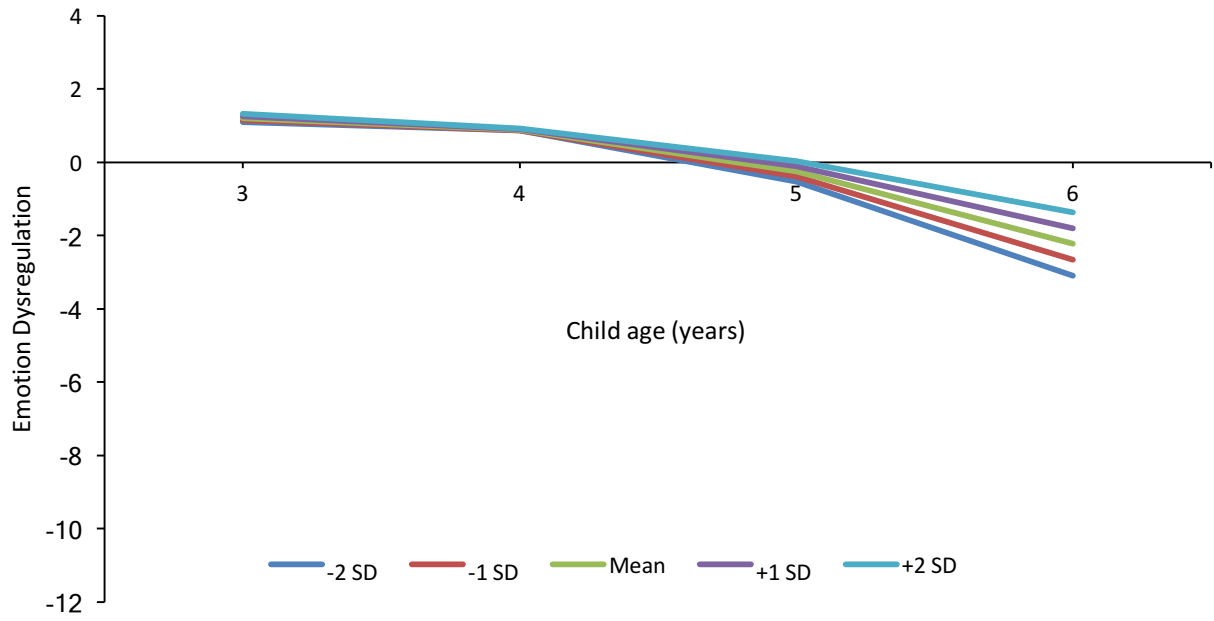


Figure 1-1. Negative parenting in predicting change in ED among children in the SL/LL genotype group

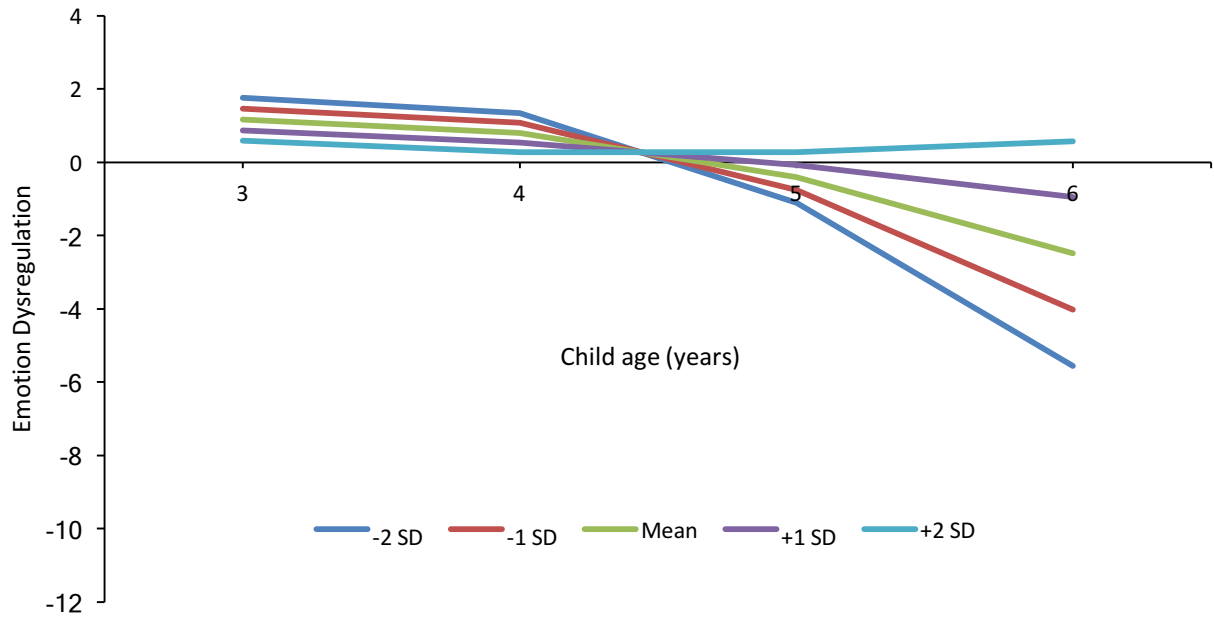


Figure 1-2. Negative parenting in predicting change in ED among children with the SS genotype

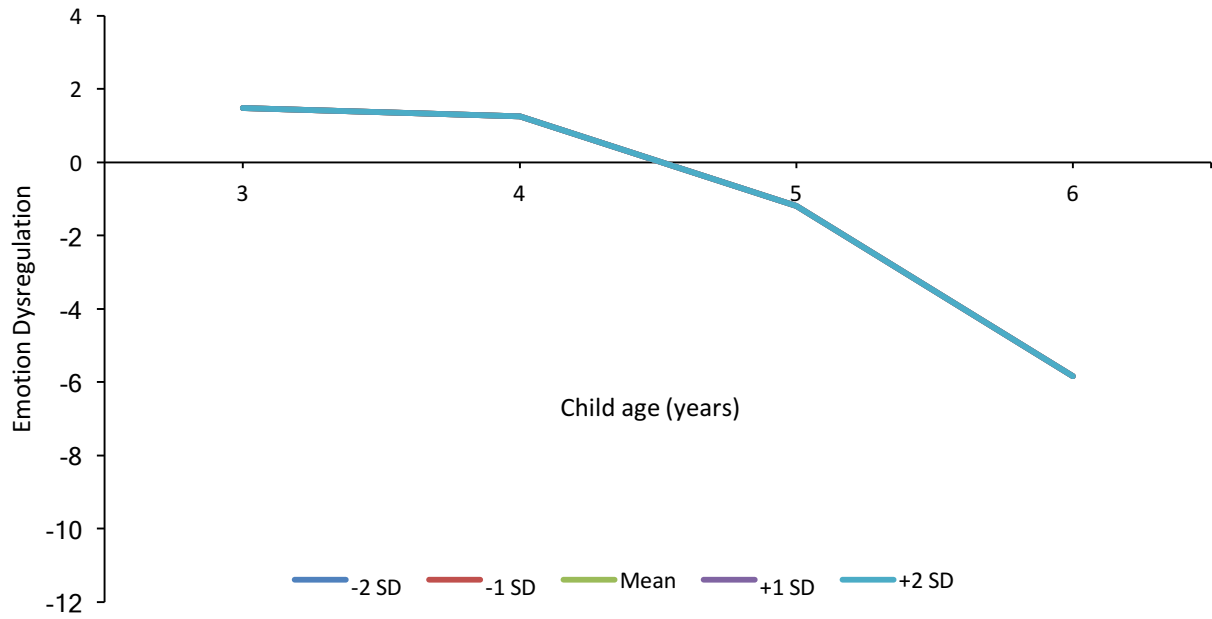


Figure 1-3. Positive parenting in predicting change in ED among children with the SL/LL genotype

Note. Only one line is visible because all lines are overlapping.

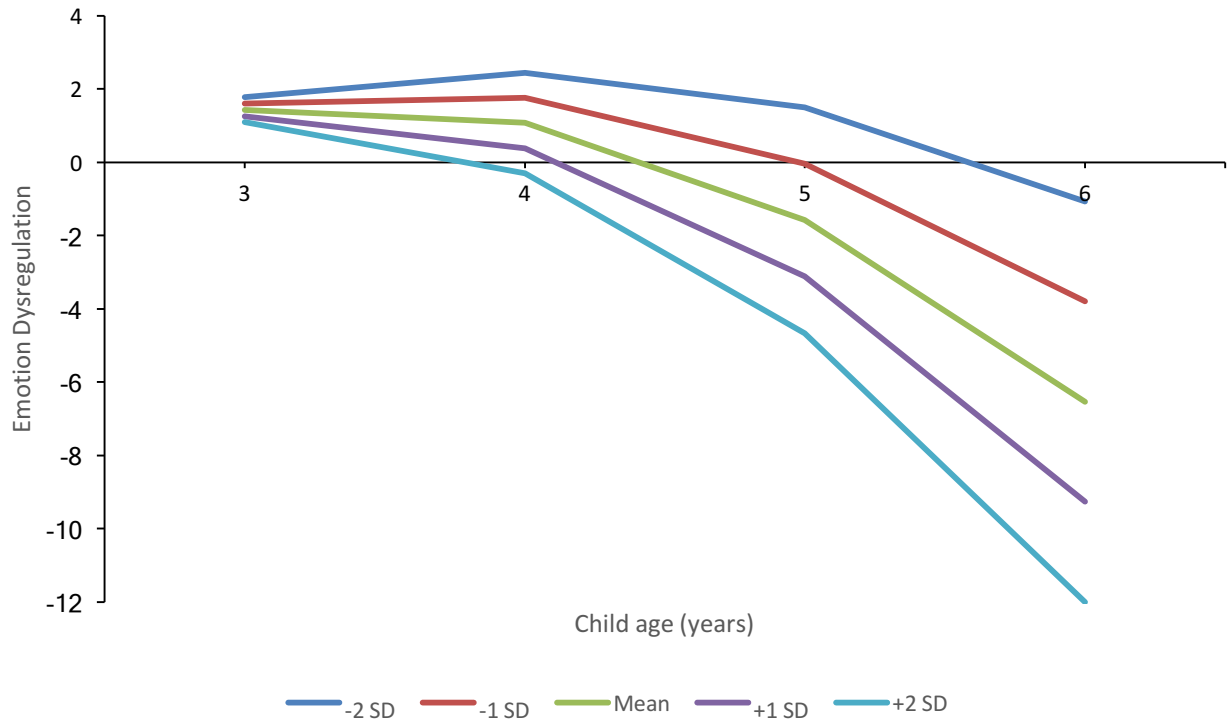


Figure 1-4. Positive parenting in predicting change in ED among children with the SS genotype

Chapter 3

Developmental patterns of emotion regulation in toddlerhood: Examining predictors of change and long-term resilience (Study 2)

Abstract

Emotion regulation (ER) is critical for optimal functioning across a wide range of domains, and may be even more important for individuals in high-risk environments. While evidence suggests that childhood is generally a period of ER growth and development, research is needed to examine factors that may contribute to deviations from this trajectory.

In a prospective study of 1,905 children involved in the *Early Head Start Research and Evaluation Project*, our objectives were: (1) to identify trajectory groups of ER across toddlerhood (age 14-36 months); (2) to examine predictors of those trajectory groups from child temperament, parenting behaviors, and environmental risk at baseline, and (3) to explore predictions of resilience in 5th grade from the identified trajectory groups. Measures of ER and parenting were obtained from behavioral observations, and our global resilience measure spanned academic, cognitive, physical health, and socio-emotional domains.

Latent class growth analysis (LCGA) supported a three-class model, with a Stable-High ER group, a Low-to-High group, and a High-to-Low group. Child negative emotionality, positive parenting, negative parenting, and environmental risk significantly predicted group membership. The Stable-High group was characterized by high positive parenting, the Low-to-high group by high child negative emotionality, and the High-to-Low group by high negative parenting and high environmental risk. These ER trajectory groups over the first three years of life were predictive of child resilient functioning in the 5th grade. Our findings highlight the importance of utilizing developmental models of ER and provide implications for prevention and early intervention services for high-risk children.

Developmental patterns of emotion regulation in toddlerhood:

Examining predictors of ER patterns and long-term resilience

The development of emotion regulation (ER) is a critical milestone of childhood (Cicchetti et al., 1991; Kopp, 1982). Childhood is rife with opportunities optimally structured to provide youngsters with low-risk experiences and encounters for learning in this domain, via observation, reinforcement, direct instruction, and trial and error (S. D. Calkins, 1994; Morris et al., 2007). As children get older, and social and academic/occupational demands increase, it is advantageous to approach these new demands with a toolbox of reliable, flexible, and reflexive strategies for modulating emotional reactions. Further, for children in high-risk environments (e.g., poverty, neighborhood violence, residential instability), it may be even more critical to have strong ER (Raver, 2004), as ER has been identified as a predictor of resilience following adversity (Cicchetti, Rogosch, Lynch, & Holt, 1993). Thus, having a solid foundation in ER that starts to develop early in life helps set individuals up for successfully navigating upcoming challenges.

Beyond its robust predictions of resilient outcomes, ER itself is a dynamic and malleable construct theorized to be sensitive to developmental changes across time. Empirical studies modeling ER change across development support theoretical propositions that ER generally increases over this span (Bandon et al., 2008; McRae et al., 2012) and emotion dysregulation generally decreases (Fabes, Hanish, Martin, & Eisenberg, 2002; Murphy, Eisenberg, Fabes, Shepard, & Guthrie, 1999; Norona, Tung, Lee, Blacher, Crnic, & Baker, in press). In one study, Feldman (2009) found that measures of ER were correlated across the first 5 years of life. Importantly, while these relationships were significant, they were of low magnitude. Feldman wrote that this finding “points to the malleability of trajectories of regulatory functioning during the plastic period of early development” (p. 556).

It is unlikely, however, that such ER trajectories are similar across all children. Are there subgroups of children who exhibit more rapid increases or even perhaps *decrease* in ER?

Further, if there are indeed subgroups, do established early predictors of ER (e.g., parenting, temperament) predict subgroup membership? Lastly, do the trajectory groups have any predictive validity (i.e., do they predict long-term outcomes)?

Predictors of ER

While infants have a repertoire of regulatory strategies, including gaze redirection, sucking, and engaging in solitary play, by far the most adaptive strategy is to seek comfort from a caregiver (Leerkes et al., 2009). In an ideal dyad, when an infant experiences distress and then expresses that distress through crying or perhaps more subtle cues, her caregiver responds calmly, sensitively, and promptly. An infant who begins to feel hunger, for example, may start to root or bring her hand to her mouth, and a masterful caregiver is attuned to these cues and responds with a ready bottle or breast. However, not all dyads follow this fluid sequence of events all the time, as individual differences in parents, children, and the rearing environment can lead to small or dramatic shifts away from this ideal. Infants particularly at risk for delays or deficits in ER development are those who experience a lower level of parental sensitivity or higher level of negative parenting (Morris et al., 2007) and those with dispositionally higher levels of negative emotionality (Braungart & Stifter, 1991; Mangelsdorf, Shapiro, & Marzolf, 1995). The present study draws from Bronfenbrenner's theory of ecological systems (Bronfenbrenner, 1994) and examines three concentric systems of influence on ER, specifically child temperament, parenting behaviors, and family environment risk.

"Difficult" temperament is a broad factor that encompasses several dimensions, such as negative emotionality and mood, high reactivity, and fearfulness (Bradley & Corwyn, 2008; Rothbart & Bates, 1998). It has been associated with behavior problems and emotion regulation difficulties in childhood (Bates, Wachs, & Emde, 1994; Earls, 1981; Eisenberg et al., 1996; Graham, Rutter, & George, 1973; Lawson & Ruff, 2004). Temperament researchers, however, have discouraged the use of "difficult temperament" as a term and as a construct, highlighting issues with consistency in the construct over time and noting that a characteristic that may pose

as “undesirable” or “difficult” in one setting may be desirable in another (Rothbart, 1982). Thus, it has been proposed that researchers study specific dimensions of temperament instead of a broad difficulty factor. Negative emotionality, examined in the present study, is a measure of an individual’s reactivity and intensity of emotional expressions. Previous investigations have revealed relationships between child negative emotionality and ER (Braungart & Stifter, 1991; S. D. Calkins & Johnson, 1998; Mangelsdorf et al., 1995). Calkins and Johnson (1998), for example, found an association between negative emotionality and aggressive-acting-out behaviors, an index of difficulties with ER.

Parenting behaviors have long been studied as a prominent force in child development. Strong theoretical and empirical support for the effects of parenting on the early development of ER can be found in research on attachment, which has been explicitly defined as “the dyadic regulation of emotion” (Sroufe, 1997, p. 192). The theory of attachment asserts that sensitive and consistent caregiver responses to infant distress promote confidence in the reliability of caregiving and facilitate the development of confidence in oneself and the world (Sroufe, 1997). Empirically, researchers have found that attached infants, who presumably experienced positive, sensitive, and consistent caregiving, expressed lower levels of distress and more frequently used strategies that involved social referencing or expressing a need for caregiver involvement. Alternatively, infants with an insecure attachment orientation were more likely to engage in self-soothing or solitary play (Leerkes and Wong 2012; Braungart and Stifter 1991; Nachmias et al. 1996). Outside of attachment research, positive parenting behaviors, such as sensitivity (Feldman, 2007; Fogel, 1993; Leerkes et al., 2009) and scaffolding (Bernier et al., 2010; Gulsrud et al., 2009; Hoffman et al., 2006; Lengua et al., 2007), have significant effects on a child’s emergent ER. Further, negative parenting behaviors, such as parental expression of negative emotions, predict poorer ER (Morris et al., 2007).

Researchers have long established associations between factors such as poverty, neighborhood risk, household density, or residential instability and broad socioemotional

functioning (Brooks-Gunn, Duncan, & Aber, 1997; Evans & English, 2002; Raver, 2004). Further, parenting under conditions of high environmental risk has been found to be less positive and more negative than parenting in low-risk contexts (Kiernan & Mensah, 2011; Klebanov, Brooks-Gunn, & Duncan, 1994; Pinderhughes, Nix, Foster, & Jones, 2001). Poverty specifically has been associated with higher rates of exposure to domestic violence, parental substance use, psychological distress, and other stressors secondary to economic strain (Buckner, Mezzacappa, & Beardslee, 2003). Importantly, all of these family factors portend poorer child ER; however, direct relationships between environmental risk and ER have received limited attention. In a 6-month longitudinal study of effortful control in preschoolers, Lengua, Honorado, and Bush (2007) found that contextual risk predicted relatively lower increases in effortful control over time. While effortful control is not synonymous with ER, it is considered another central aspect of self-regulation that has a robust link to ER (Morris et al., 2007) and thus highlights that studying ER is the next step.

ER as a protective factor

In a promising line of research directed at resilience, ER, and self-regulation more broadly, have been found to be protective factors for children in high-risk environments, with evidence coming from studies of poverty (Ingoldsby, Shaw, Owens, & Winslow, 1999), maltreatment (Cicchetti et al., 1993), and overall environmental risk (Lengua, 2002). In one such study, self-regulation moderated the association between an environmental risk index and positive adjustment (i.e., social competence, self-worth, life satisfaction), with children low in self-regulation evidencing more vulnerability to risk (Lengua, 2002). The critical next step is to identify predictors of ER in samples of high-risk children, and to provide additional support for ER having long-term implications in this population.

The present study

We simultaneously examined the effects of multiple levels of influence on developmental trajectory groups of ER across toddlerhood, from within the child (temperament) to the child's

family environment, in a sample of high-risk children enrolled in the Early Head Start Research and Evaluation (EHSRE) project (United States Department of Health and Human Services. Administration for Children and Families, 1996-2010). The present study aimed to (1) identify distinct trajectory groups of ER across early development (age 1-3 years), (2) examine predictors of those distinct trajectory groups, including child temperament, parenting behaviors (i.e., support and negativity), and environmental risk (e.g., low income family, single-parent household, parent without high school diploma/GED), (3) explore predictions of long-term global resilient functioning from membership in a trajectory group. This study fills a crucial empirical gap, as no previous studies have investigated trajectory groups of ER nor examined multiple levels of environmental influence.

Method

Participants

Participants were 1,905 children and families involved in the EHSRE project, funded by the Administration on Children, Youth, and Families and conducted by Mathematica Policy Research (MPR) between 1996 and 2010. The EHSRE dataset is public use, made freely available by Child Care & Early Education Research Connections (United States Department of Health and Human Services. Administration for Children and Families, 1996-2010). Low-income families with pregnant mothers or children up to 12 months old at the time of enrollment were recruited for participation. Participants were randomly assigned to the *program group* (received Early Head Start; $n = 1513$) or the *control group* (received community services as usual, $n = 1488$) at the site level. Analyses conducted by MPR revealed that, as expected, baseline characteristics of the two groups were comparable (United States Department of Health and Human Services. Administration for Children and Families, n.d.). The full sample was comprised of 3,001 children and their families, and the present sample was reduced to participants who had data for at least one key study variable.

The EHSRE study was implemented across 17 sites in the United States, representing

diverse program models, racial/ethnic makeup, urban-rural location, program auspice, and program experience in serving infants and toddlers. Three phases comprised the data collection: (1) birth to three, (2) pre-kindergarten follow-up, and (3) elementary school (5th grade) follow-up. The birth to three phase consisted of assessments at child ages 14, 24, and 36 months. The present study utilized data from the first and third phases.

Approximately half (49.2%) of the present sample of target children was female. In terms of ethnicity/race, 39.1% were white (non-Hispanic), 33.5% black/African American, 23.0% of Hispanic origin, and 4.4% from other racial/ethnic groups. Most respondents spoke English as their primary language, but 20.2% did not. Among those who did not speak English as their primary language, 85.0% were Hispanic. The recruited sample is high-risk, as, at baseline, approximately half of the parents involved in the study were unemployed, 72.9% were single parents, 51.8% were receiving welfare, and only 55.4% had graduated from high school or obtained a GED. Lastly, 38.3% of the children were born to teenage mothers.

Procedures

At each visit, parents were interviewed about services, family and child health, child development, and family functioning. In addition, field interviewers recorded information from their observations of child behavior and home environments. Direct child assessments included standardized assessment batteries of cognitive and academic functioning and videotaped semi-structured parent-child interactions. The present study utilized data obtained from the parent interviews, observations of child behavior and home environments, and direct child assessments.

Measures

Temperament. The *Emotionality, Activity, Sociability, and Impulsivity* (EASI; Buss & Plomin, 1984) is a 40-item questionnaire that evaluates respondents based on four temperament factors (i.e., emotionality, activity, sociability, and impulsivity). It was administered during the 14-month parent interview. Parents were asked how accurately

behaviors or personality traits characterized their child. The 5-item emotionality subscale was used in the present study to represent negative emotionality; it consists of items such as “often fusses and cries,” “reacts intensely when upset,” and “tends to be somewhat emotional.” Item response scales range from 1 (not very typical of your child) to 5 (very typical of your child). Each child’s emotionality score was an average of the five item scores.

Emotion regulation. The *Bayley Behavior Rating Scale* (BRS), (Bayley, 1993) is a 30-item scale that rates children's relevant behaviors and measures orientation/engagement, emotional regulation, and motor quality. The examiner completes the BRS immediately following administration of the Bayley Scales of Infant Development (BSID) based on observations made during test administration. The examiner assesses the child's behavior by scoring BRS items on a 5-point scale, with 5 indicating more positive behavior (for example, less frustration and more cooperation). The present used the BRS Emotional Regulation subscale (7 items), which measures the child's ability to change tasks and test materials, negative affect, and frustration with tasks during the assessment. Each child’s Emotion Regulation subscale score is the average of the 7 items. Based on the Bayley-II validation sample, score reliability is moderate to high, with internal consistency coefficients ranging from .73 to .90. For children 24 months of age, test-retest reliability coefficients for the three factor scale scores range from .61 to .71 (Bayley, 1993). The BRS, along with the BSID, was administered at child ages 14, 24, and 36 months.

Parent behavior. Parent behavior was measured during a *parent-child semi-structured play task*. The parent and child were given three bags of toys and asked to play with the toys in sequence. The play task was videotaped, and child and parent behaviors were coded by child development researchers, masked to the program status of each child. This play task was adapted for the EHSRE study from the Three Bag coding scales used in the NICHD Study of Early Child Care (NICHD Early Child Care Research Network, 1999). Four aspects of the

parent's behavior with the child were rated on a seven-point scale, two of which were used in the present study.

Positive parenting. The positive parenting composite is an average of parental sensitivity, cognitive stimulation, and positive regard during play with the child. Behavior consistent with positive parenting includes acknowledgement of the child's affect, vocalizations, and activity, facilitating the child's play, taking advantage of the activities and toys to facilitate learning, development, and achievement, praising the child, expressing affection, and showing clear enjoyment of the child.

Negative parenting. The negative parenting scale measures the parent's expression of discontent with, anger toward, disapproval of, or rejection of the child. High scores on negative regard indicate that the parent used a disapproving or negative tone, showed frustration, anger, physical roughness, or harshness toward the child, threatened the child for failing at a task or not playing the way the parent desired, or belittled the child.

Family environment risk. A family environment risk index score was computed for each child from the five following established risks: (1) birth mother under 20 years of age when child was born; (2) caregiver not employed, in school, or training; (3) caregiver neither married nor cohabitating; (4) caregiver receiving welfare; (5) and caregiver with no high school diploma or GED. Each of these was coded 0 (absent) or 1 (present), and they were summed for the family environmental risk index.

Long-term resilience. The cumulative resilience index, developed by the Mathematica Policy Research group for the ESHRE project, is based on the sum of 16 outcomes from multiple domains including physical health, academic/school performance, cognitive functioning, and socio-emotional functioning. Data were collected from direct assessments of child functioning as well as caregivers' reports of child functioning when participants were in the 5th grade. Each measure was scored from 0 to 1, with 1 indicating competent/resilient

functioning. See Table 1 for descriptions of how measures were coded and used in the resilience index.

Data Analytic Plan

We used Latent Class Growth Analysis (LCGA) to identify distinct trajectory groups for ER, using MPlus version 7 (Muthén & Muthén, 2009). LCGA is a semiparametric group-based approach that can estimate the mean parameter level at a given point in time (i.e., intercept), the rate of increase/decrease over time (i.e., linear slope), and the rate of change of the increase/decrease (i.e., quadratic trend). Unlike hierarchical and growth curve modeling, which assume a continuous distribution of trajectories within the population and describe how growth varies continuously, this semi-parametric group-based approach assumes that the population consists of a number of groups with different trajectories and seeks to identify them (Nagin, 1999). As it is unlikely that the population falls into truly distinct groups, the patterns should be viewed as the best approximation of generally distinct experiences (Kamp Dush, Taylor, & Kroeger, 2008).

We used a single conditional LCGA that tested predictors (i.e., significant covariates, child negative emotionality, parental support, parental negative regard, environmental risk score) of trajectory class membership using multinomial logistic regression to estimate odds ratios (Jung & Wickrama, 2008). The model also included a distal outcome (i.e., resilient functioning in 5th grade), predicted by class membership. Membership in each trajectory group was compared with a reference trajectory group (i.e., the group with most members). By simultaneously including continuous latent variables (intercept and growth slopes) as well as categorical latent variables (trajectory class) in the same conditional LCGA model, we reduced Type 1 error by minimizing multiple testing (Muthen, 2004). Furthermore, multinomial logistic regression within a conditional LCGA enabled predictions of the categorical latent variable “class” by using posterior probabilities to assign each individually fractionally to all classes, rather than forcing a 0/1 classification (Muthen, 2004). This is important because it is unlikely

that any participant has a 100% probability of membership in any particular class, which is an infrequently acknowledged assumption when conducting separate follow-up multinomial logistic regressions outside of the LCGA model. That is, separate multinomial logistic regressions that predict “trajectory class” are actually predicting the most likely trajectory class, without accounting for each individual’s probability of not being a member of this class. By employing multinomial logistic regression within a conditional LCGA framework, the present models directly account for this error (Muthen, 2004).

We compared LCGA models to identify the optimal number of groups, the shape of the trajectory of each group, and the proportion of the sample belonging to each group. We determined the number of groups that best fit the data by evaluating the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Lo, Mendell, and Rubin (2001) likelihood ratio test (LMR-LRT), and the bootstrap likelihood ratio test (BLRT) for a series of models that varied in number of trajectory groups. We started with a model with 1 trajectory group, and increased the group number by 1 in a stepwise fashion. Improved model fit is indicated by smaller AIC and BIC values and significant LMR-LRT and BLRT test statistics, while also maintaining no less than 1% of the sample in each group (Jung & Wickrama, 2008). We utilized full information maximum likelihood (FIML) to account for missing data. Finally, Wald tests were used to detect differences in the distal 5th grade outcome between the trajectory classes.

Results

Descriptive statistics

Table 2 shows means, standard deviations, and Pearson correlations among key variables. Negative emotionality was negatively associated with positive parenting, ER at 14 and 24 months, and long-term resilience, and positively associated with negative parenting and environmental risk. Positive and negative parenting were inversely correlated. Environmental risk was negatively related to ER at all time points. ER demonstrated some stability over time,

with correlations ranging from .27 to .37. Of note, all significant correlations were in the weak range (.07 – .37).

LCGA results

Growth class characterization. Goodness of fit comparisons for the full LCGA model are shown in Table 3. Goodness of fit tests indicated that a three-class model best fit the data. Our largest group ($n = 1225$; 64.2%) was characterized by stable-high ER (intercept $B = 3.95$, $SE = .03$, $p < .001$; linear slope $B = .07$, $SE = .02$, $p < .001$) across the three time points. Another group of children ($n = 354$; 18.6%) appeared to start relatively high (intercept $B = 3.57$, $SE = .06$, $p < .001$) but declined over time (linear slope $B = -.22$, $SE = .06$, $p = .001$). The third group ($n = 326$; 17.1%) started relatively low (intercept $B = 2.71$, $SE = .09$, $p < .001$) but improved over time (linear slope $B = .56$, $SE = .05$, $p < .001$). See Figure 1 for depiction of trajectory group classes.

Predicting trajectory group class membership. We next used latent class multinomial logistic regression to model the probability of membership in each trajectory class from negative emotionality, positive parenting, negative parenting, and environmental risk index, controlling for child sex and ethnicity. Initial evaluation of program status (Early Head Start vs. services as usual) as a covariate revealed that it was not predictive of class membership; thus, program status was excluded from subsequent models for parsimony and power. Table 4 provides the statistics from the multinomial logistic regressions used to predict class membership. Negative emotionality increased likelihood of membership in the Low-to-High Group, when compared to the Stable-High group ($B = .67$, $SE = .10$, $p < .001$) and the High-to-Low Group ($B = .30$, $SE = .13$, $p = .02$). Positive parenting increased likelihood of membership in the Stable-High group when compared to the Low-to-High Group ($B = .44$, $SE = .12$, $p < .001$) and the High-to-Low group ($B = .48$, $SE = .10$, $p < .001$); but positive parenting did not differentiate between the Low-to-High Group and High-to-Low Group. Negative parenting increased likelihood of membership in the High-to-Low Group when compared to the Stable-

High Group ($B = .26, SE = .12, p < .035$) and the Low-to-High Group ($B = .25, SE = .12, p < .043$), but did not distinguish the Stable-High Group from the Low-to-High Group. Lastly, the environmental risk index increased likelihood of membership in the High-to-Low Group as compared to the Stable-High ($B = .38, SE = .10, p < .001$) and Low-to-High ($B = .26, SE = .10, p = .012$) Groups, but did not differentiate the Stable-High Group from the Low-to-High Group.

Predicting long-term resilience from class membership. Lastly, Wald tests were used to compare the trajectory group classes on a long-term resilience variable. Wald tests revealed that the mean resilience score in the Stable-High Group ($M = 13.59, SD = 1.82$) was significantly higher than the Low-to-High Group ($M = 12.81, SD = 1.82$) (Wald = 10.74, $p < .001$) and High-to-Low Group ($M = 9.09, SD = 1.82$) (Wald = 182.80, $p < .001$). Further, the Low-to-High Group was determined to have a higher mean resilience score than the High-to-Low Group (Wald = 105.61, $p < .001$).

Discussion

In a prospective study of high-risk children from the Early Head Start Research and Evaluation (EHSRE) project, we explored whether distinct trajectory groups of emotion regulation (ER) change could be identified across the first three years of life. We further examined predictors of membership in those classes, and explored class membership as a predictor of long-term resilient functioning. Our analyses revealed several main findings. First, latent class growth analysis (LCGA) supported a three-class model, with a Stable-High group, a Low-to-High group that started out lowest but improved over time, and a High-to-Low group that started close to the Stable-High group but declined over time. Second, when examining predictors of group membership, child negative emotionality, positive parenting, negative parenting, and environmental risk significantly predicted group membership. Children in the Stable-High group were the most likely to have high ratings of positive parenting. Children in the Low-to-High group were most likely to have high ratings of negative emotionality. Lastly, children in the High-to-Low group were more likely to have high ratings of negative parenting

and higher environmental risk index scores. Third, trajectory group classes among the first three years of life were predictive of resilient functioning in the 5th grade, on our measure spanning physical, academic, cognitive, and social-emotional functioning. Specifically, children in the Stable-High group exhibited the most resilient functioning, followed by the Low-to-High group, and children in the High-to-Low group had the lowest scores of resilient functioning.

The three trajectory groups revealed by our exploratory LCGA provide interesting insights. First, over half of the toddlers were in the Stable-High group, suggesting that most children exhibit high levels of ER that are maintained across at least the first three years of life. The remaining toddlers were just about evenly split between the other two groups, which were quite disparate in their trajectories. While the Low-to-High group started out the lowest of the three, they improved steadily over the next two years and appeared to almost catch up to the Stable-High toddlers. As previous investigations have found increases in ER over this period (Blandon et al., 2008; McRae et al., 2012), it is possible that these toddlers are experiencing developmentally expected improvement in ER over time. On the other hand, the High-to-Low group looked quite similar to the Stable-High group at 14 months, but exhibited a precipitous decline in ER over the next two years. This group is particularly perplexing, given that they contrast developmental expectations. Examining predictions of membership in this group could have important implications for risk factors and intervention targets.

When examining predictors of group membership, an even more intriguing story unfolds. Toddlers in the Stable-High group were characterized by higher ratings of positive parenting and lower ratings of child negative emotionality. Thus, this group had the lowest internal risk (temperament) and low risk in the proximal environment (parenting), both of which portended positive ER development in previous studies (S. D. Calkins, 1994). It makes sense, then, that these children who are dispositionally more positive and have more positivity in their parenting environment exhibit good ER initially and continue in the same vein.

In contrast, children in the Low-to-High group had ample room for improvement in ER. Likelihood of membership in this group was predicted by high ratings of child negative emotionality. Interestingly, this group did *not* differ from the Stable-High group in terms of negative parenting or environmental risk. These findings suggest that while these children had internal risk that had apparent early effects, the environment afforded them ample opportunities to develop strong ER over time. With low rates of negative parenting and low environmental risk, it is likely that toddlers in the Low-to-High group were exposed to a family environment typified by the factors long-established to promote ER development, such as sensitive and responsive parenting and modeling of ER (Feldman, 2007; Leerkes et al., 2009; Morris et al., 2007). Further, children with higher dispositional negative emotionality have been found to be more susceptible to parenting influences (Chang et al., 2012; Kim & Kochanska, 2012); thus, children in the Low-to-High group may be poised to benefit the most from their family environments.

Likelihood of membership in the High-to-Low group was predicted by the poorest constellation of environmental factors (i.e., low positive parenting, high negative parenting, and high environmental risk). These results suggest that the effects of such environmental factors are perhaps not immediately apparent in early toddlerhood, but instead are revealed over time. Conceptually, it makes sense that consequences of environmental risks are incurred after an infant/toddler interacts with his environment overtime and is faced with less than ideal contingencies. For example, when an infant in the High-to-Low group experiences and expresses distress (perhaps due to hunger or fatigue), these findings suggest that his caregivers may be less likely to respond sensitively and more likely to respond with negativity. His caregivers may ignore his cries and/or express anger at his distress, and in turn, he is unable to trust that his environment will meet his needs and thus experiences more chronic distress.

Another interpretation of these High-to-Low group findings comes from previous propositions that, under certain risk conditions, ER poses as a “double-edged sword”

(Thompson & Calkins, 1996). In their thought-provoking piece, Thompson and Calkins discussed that, for some children, certain behaviors may regulate emotions in the short-term but have long-term negative consequences. They described how a child growing up with a depressed caregiver, for example, may try to alleviate her caregiver's depression by being highly empathic and engaging in caretaking behaviors. The consequence of these short-term regulating strategies, however, include being preoccupied with and feeling responsible for the emotional well-being of others, which in turn, interferes with the child's own emotional well-being. Thus, toddlers in the High-to-Low group, due to their non-optimal rearing environments, may engage in regulatory behaviors that serve immediate goals but impair long-term functioning. It is possible to imagine how this played out in the present study. One of the dimensions of poor ER as presently measured was resistance to change. Infants and toddlers with higher environmental risk may evidence more distress when transitioning between activities because of more instability in their higher-risk rearing environment. Transitioning from an activity that feels safe and calm may be even more distressing, as they do not know if the next situation will be similarly safe and calm. This may be a good way to increase exposure to safe environments in the short run, but in repeated difficulties with change may increase long-term psychological distress, particularly anxiety.

These interpretations are consistent with our long-term resilience findings. We found that the trajectory classes of ER in toddlerhood were predictive of a global resilience factor in the 5th grade. Unsurprisingly, the Stable-High group had the highest average resilience ratings. Importantly, improvements and declines made in the Low-to-High and High-to-Low groups, respectively, extended to functioning seven years later. These results are consistent with previous findings that ER may serve as a protective factor that fosters resilience in at-risk populations of children (Buckner et al., 2003; Cicchetti et al., 1993; Herbers, 2011; Lengua, 2002).

Several theoretical implications should be noted. Most importantly, our findings highlight the importance of developmental investigations of ER, as ER was determined to be dynamic over the course of early childhood for all children, and trajectory groups (not initial levels) were meaningful predictors of long-term resilience. Second, positive and negative parenting, though moderately correlated, had separable effects on ER trajectories. This underscores the importance of examining these constructs independently, as opposed to the spectrum approach which suggests that parenting lies on a continuum of negative to positive, and is consistent with previous studies who have parsed the two apart (Dallaire et al., 2006; Eamon, 2002; Eisenberg et al., 2001b). Third, our environmental risk index had independent effects on ER, over and above the effects of parenting. While it is certainly the case that environmental risk affects children through parenting (Pinderhughes et al., 2001), our findings suggest that it has direct effects on child development as well, though a mediation model is needed to explicitly test this effect. Future research should continue to examine environmental factors more distal than parenting behaviors, as it may provide important nuance to our understanding of child development.

These findings have implications for intervention, as they provide support for the longstanding notion that prevention and early intervention services have long-term effects (e.g., Aronen & Kurkela, 1996; Barnett, 1995; Olds et al., 1998; Reynolds, Temple, Robertson, & Mann, 2001). Prevention and early intervention may be even more impactful for children in high-risk environments, thus programs such as Head Start and Early Head Start provide an important and much needed service. Further, the Chicago Schools Readiness Program (CSRP; Raver et al., 2011) is a program designed to promote school readiness in low-income children through self-regulation. Our findings suggest that programs such as CSRP, in addition to more immediate effects on school readiness through regulation, may also have long-term global effects. In addition to programs that support ER development directly, our findings suggest that both positive and negative parenting behaviors should also be targeted in families of high

environmental risk. Through changes in caregivers' responsivity to the children's emotions and more appropriate behavioral management and modeling, children's ER will likely improve.

The present findings should be interpreted in the context of several limitations. First, though there was variability in the sample in terms of environmental risk, the children and families enrolled in the Early Head Start Research and Evaluation project were of higher environmental risk, as that is the target population of the program. Thus, it is possible that our trajectories of ER are specific to children with high environmental risk and that children in low-risk families may follow different developmental patterns. Our study is the first to our knowledge to examine trajectory groups of ER, thus it is critical for future studies to extend these research questions to a more general group of children.

In this study, we utilized a prospective, longitudinal design with multi-informant, multi-method measurement of child and parent behavior to examine developmental trajectories of ER in toddlerhood. Our findings highlight the dynamic nature of ER in this developmental stage and speak to the different systems of contributors to ER, ranging from within the child (temperament), to the child's proximal environment (parenting), and finally the context in which the family is embedded (environmental risk). Lastly, our findings illustrate that developmental trajectories of ER in toddlerhood may have important consequences for long-term global functioning; thus, prevention and early intervention services to target ER in at-risk populations should be further studied and disseminated. While considerable evidence supports ER as a protective factor across many domains, much more remains to be uncovered about how to provide children with optimal support for ER development.

Table 2-1

Measures included in the long-term resilience index

Domain	Measure	Instrument	Description	Scoring
Physical	Healthy weight	Body Measurement Index (BMI)	Direct measurement of child's weight	1 if BMI below 95 th percentile
	No chronic illness	--	Parent report	1 if no chronic illness
	Good general health	--	Parent report	1 if good general health
School/Academics	Consistent attendance	--	Parent report	1 if 0-2 absences during the school year .5 if 3 absences during the school year
	No Individualized Education Plan (IEP)	--	Parent report	1 if no IEP
	No grade retention	--	Parent report	1 if no retention
	Math achievement	Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K; Tourangeau et al., 2015)	Assessment of child's number sense, properties, and operations, measurement, geometry and spatial sense, data analysis, statistics, and probability, and patterns, algebra, and functions	1 if standard score above 16 th percentile
	Reading achievement	ECLS-K (Tourangeau et al., 2015)	Assessment of child's initial understanding, developing interpretation, personal reflection, and critical stance	1 if standard score above 16 th percentile
Cognitive	Vocabulary	PPVT-III (Dunn & Dunn, 1997)	Assessment of child's receptive vocabulary	1 if standard score above 16 th percentile
	Fluid reasoning	WISC-IV Matrix Reasoning subscale (Wechsler, 2003)	Assessment of child's fluid/conceptual reasoning	1 if standard score above 16 th percentile
Social-emotional	Internalizing problems	Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001)	Parent report of internalizing problems	1 if t-score below the borderline range were coded as 1; .5 if t-score in the borderline range
	Externalizing problems	CBCL (Achenbach & Rescorla, 2001)	Parent report of externalizing problems	1 if t-score below the borderline range were coded as 1;

				.5 if t-score in the borderline range
	Attention problems	CBCL (Achenbach & Rescorla, 2001)	Parent report of attention problems	1 if t-score below the borderline range were coded as 1; .5 if t-score in the borderline range
	Infrequent bullying	Panel Study of Income Dynamics – Child Development Supplement, Wave 2 (PSID-CDS2) Bullying Scale	Child’s self-report of the frequency of bullying at school	1 if bullied 0-2 times in the last month
	Infrequent delinquent behaviors	Developed by EHSRE researchers; drew from the work of Loeber, Stouthamer-Loeber, Van Kammen, and Farrington (1991) and the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development	Child’s self-report of delinquent behaviors, e.g., stealing, property damage, smoking	1 if fewer than 3 delinquent behaviors .5 if 3 delinquent behaviors

Table 2-2

Means, standard deviations, and correlations among key variables

Variable	M	SD	1	2	3	4	5	6	7
1. Reactive temperament – T1	2.96	.95	1						
2. Positive parenting – T1	3.94	1.06	-.13*	1					
3. Negative parenting – T1	1.46	.79	.08*	-.38*	1				
4. Environmental risk index – T1	2.64	1.19	.10*	-.27*	.15*	1			
5. Emotion regulation – T1	3.69	.69	-.16*	.16*	-.10*	-.07*	1		
6. Emotion regulation – T2	3.64	.80	-.09*	.22*	-.13*	-.10*	.27*	1	
7. Emotion regulation – T3	3.93	.76	-.05	.16*	-.11*	-.12*	.12*	.37*	1
8. Resilience index – 5 th grade	12.60	2.47	-.13*	.19*	-.13*	-.23*	.12*	.23*	.30*

Notes. T1 at child age 14 months. T2 at child age 24 months. T3 at child age 36 months. * $p < .05$.

Table 2-3

Fit indices for LCGA models with 1 to 4 classes

Number of classes	AIC	BIC	LMR Test <i>p</i>	BLRT Test <i>p</i>
1	56156.54	56312.51	--	--
2	15015.96	15138.11	<.001	<.001
3	14859.05	15047.83	<.001	<.001
4	14794.54	15049.94	.53	<.001

Notes. Bold indicates the best fitting model. AIC = Akaike information criterion; BIC = Bayesian information criterion; LMR = Lo-Mendell-Rubin likelihood ratio test.

Table 2-4

LCGA multinomial logistic regression predicting class membership

	Low-to-High vs. Stable-High			High-to-Low vs. Stable-High			Low-to-High vs. High-to-Low		
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>B</i>	<i>SE</i>	<i>OR</i>	<i>B</i>	<i>SE</i>	<i>OR</i>
Sex (covariate) ^a	.86***	.20	1.23***	1.23***	.25	3.43	-1.23**	.25	.29
Ethnicity (covariate)									
Black	.08	.24	-.20	-.20	.25	.82	.20	.25	1.23
Latino	-.73**	.27	-.62*	-.62*	.27	.54	.62*	.27	1.86
Other	-.39	.47	-2.23	-2.23	2.05	.11	2.23	2.05	9.34
Negative Emotionality	.67***	.10	.37**	.37**	.12	1.44	-.37**	.12	.69
Positive Parenting	-.44***	.12	-.48***	-.48***	.11	.62	.48***	.11	1.61
Negative Parenting	.01	.13	.26*	.26*	.12	1.30	-.26*	.12	.77
Environmental Risk Index	.12	.09	.38***	.38***	.10	1.46	-.38***	.10	.69

Notes. ^a0=female, 1=male. *OR* = odds ratio. **p* < .05 ***p* < .01 ****p* < .001

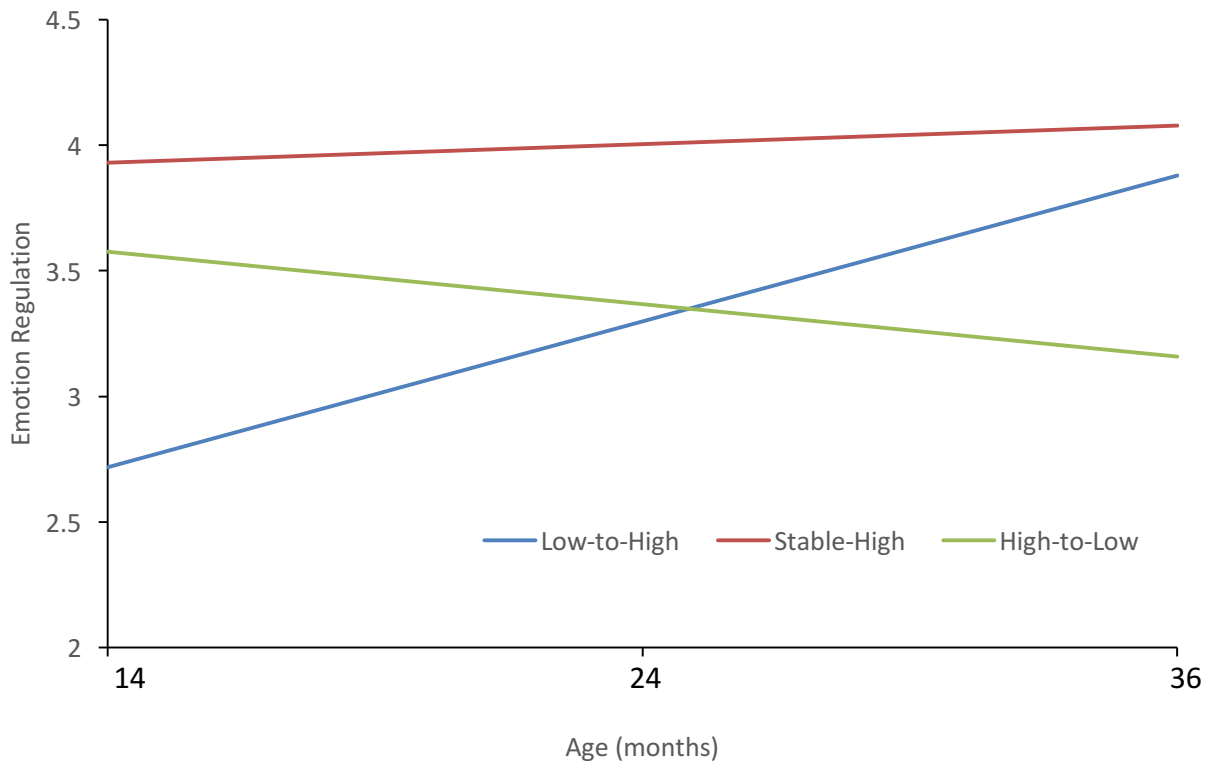


Figure 2-1. Developmental patterns of ER in the first three years of life as identified by latent class growth analysis.

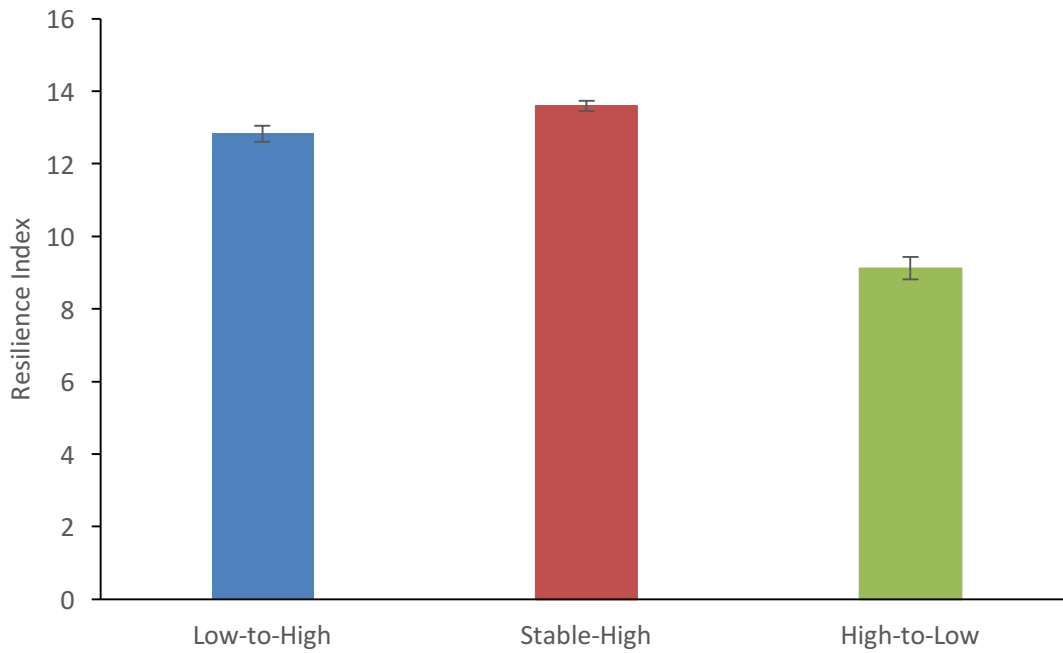


Figure 2-2. Global resilience index in the 5th grade as predicted by developmental patterns of ER in toddlerhood. Significant differences between all groups.

Chapter 4

Predicting emotion regulation among children adopted from foster care: Contributions of temperament, pre-placement risk, and adoptive family environment (Study 3)

Abstract

While children with a history of foster care are at higher risk for poor outcomes in childhood and adulthood, many children show tremendous resilience in response to this species-atypical rearing experience. Among predictors of resilience, emotion regulation (ER) is a critical protective factor. The current prospective, longitudinal study of 82 children adopted from foster care set out to examine the independent and interactive effects of child temperament and environmental factors on ER at the time of the adoptive placement and five years post-adoptive placement.

Multiple regression analyses revealed that among child temperament, pre/perinatal risk, and pre-placement environmental risk, reactive temperament (e.g., negative emotionality) was the sole predictor of ER when children were initially placed with their adoptive families. When predicting change in ER 5 years into the adoptive placement, temperament moderated the relationships between family expressiveness and ER, and family control and ER. At low levels of family expressiveness, children with reactive temperament had higher levels of ER than children with easy temperament, however the reverse was true for families with high levels of expressiveness. Further, at low levels of family control, children with reactive temperament had lower levels of ER than children with easy temperament, but higher levels of ER when family control was high. Neither family conflict nor family cohesion predicted change in ER. Overall, the findings suggest that aspects of the adoptive family environment predict changes in ER, though the nature of the changes depends on the temperament of the child.

Predicting emotion regulation among children adopted from foster care:

Contributions of temperament, pre-placement risk, and adoptive family environment

The lack or loss of species-typical stimulation from a parent is among the most potent stressors a child can experience early in life (Levine, 2005). Indeed, childhood maltreatment, a significant early stressor, has been associated with a host of behavioral, emotional, academic, cognitive, and interpersonal difficulties (Cicchetti & Valentino, 2006; De Bellis, 2001, 2005; Teicher, Andersen, Polcari, Anderson, & Navalta, 2002). Children in foster care are at increased risk for these poor outcomes, as removal from one's biological parent and subsequent placements in sometimes a number of homes, is far from the typical species experience of rearing. However, not all children with histories of abuse, neglect, and/or foster care are doomed to poor functioning. In fact, a significant proportion of children with these environmental risk factors exhibit tremendous resiliency (Hanson & Gottesman, 2012; Masten, 2001). Importantly, emotion regulation (ER) has been identified as a predictor of resiliency following early adversity (Cicchetti et al., 1993). Thus, it is critical for researchers to study predictors of ER in at-risk populations, such as children with foster care histories. This prospective longitudinal study examined factors that predict adaptive ER abilities among children adopted from foster care, looking at contributions of child temperament, pre-adoptive placement risk, and characteristics of the adoptive family environment.

Prior to adoption, children in the foster care system may be exposed to a variety of stressors. Starting in the womb, children in foster care are more likely to be exposed to prenatal substance use, stress, or maternal depression (Kelley, 1992; Nair et al., 1997; Regan, Ehrlich, & Finnegan, 1987; Smith, Johnson, Pears, Fisher, & DeGarmo, 2007). These prenatal factors predispose infants to be born premature, with low birth weight, and/or with birth complications (Kelly et al., 2002), which predicts long-term emotional and behavioral outcomes (Yumoto, Jacobson, & Jacobson, 2008). Furthermore, these pre- and perinatal factors (prenatal exposure to substances, premature birth, low birth weight, birth complications) predict difficulties with

ER in childhood (Geva & Feldman, 2008). Unfortunately, after birth, many children in foster care continue to experience significant environmental risk. Living with high-risk birth families, experiencing abuse or neglect, being removed from birth family after infancy, and subsequent placement in multiple foster homes, represent significantly stressful life events for children. As such, adoptees are at elevated risk for internalizing and externalizing symptoms and more general emotional difficulties (Juffer & van IJzendoorn, 2005; Miller et al., 2000).

About 20% of children in the foster care system are adopted each year (Children's Bureau, 2014). With adoption comes permanency and stability, and a completely new caregiving environment. Although adoptive homes can range in their quality of parenting and family characteristics, an ideal adoptive home provides children with supportive, sensitive parenting, representing a potent intervention enabling adoptees to "catch up" with their non-adopted peers in various domains of functioning (Van IJzendoorn & Juffer, 2006). As developmental studies of "typically reared" children have robustly demonstrated associations between parent and family factors and ER development (see Morris, Silk, Steinberg, Myers, & Robinson, 2007 for a review), ER is a plausible mechanism through which adoption facilitates the catching up phenomenon.

Children learn about emotions and ER via observation of their caregivers' emotional displays and interactions. In observing parental modeling of emotional expression in certain situations, children learn how they "should" react to those situations in the future (Denham et al., 1997). In addition, the emotional climate of the family, as reflected in parent-child and marital relationships and the daily expression of positive and negative emotions toward members of the family, contributes to the development of emotion regulation. For example, Eisenberg and colleagues (2001) found that positive and negative expressed family emotion was associated with child emotion regulation in the expected directions and that child emotion regulation mediated the relationship between parental expressiveness and child social competence.

Findings regarding family expression of negative emotions have been mixed, however. Some researchers have posited that there may be a curvilinear relationship between negative expressivity and ER, with children's ER and emotional awareness benefitting from moderate levels of expression and subsequent regulation (Morris et al., 2007). In addition, conflict in the family system has been found to have negative consequences for children. Exposure to "background anger," for example, is associated with social and emotional difficulties in children, even in circumstances in which children are not direct recipients of the anger (Lemerise & Dodge, 2008).

Theoretical papers have long suggested that the effects of environmental factors on ER may vary as a function of child temperament. As children high in negative reactivity experience more frequent and intense emotional distress, strong ER skills are essential for managing such distress. Thus, it is even more important that family environments for children high in temperamental reactivity be optimally configured for ER development. Conversely, a non-ideal family environment may cause the most harm on children high in temperamental reactivity (Calkins, 1994; Rothbart & Bates, 1998), which is supported by emerging empirical tests of Temperament x Environment interactions (Kochanska & Kim, 2013). For example, one study found that early negative emotionality exacerbated the association between environmental risk and emotion dysregulation. That is, environmental risk (e.g., teen parent status, low family income, single parenthood, maternal depression) predicted poorer emotion regulation abilities for boys (but not girls) with high levels of negative emotionality (Chang et al., 2012).

Indeed, child temperament is proposed as a moderator of environmental effects across a broad range of child outcomes, including externalizing behaviors, behavioral inhibition, effortful control, and social skills (Belsky & Pluess, 2009b). Some studies' findings support the traditional diathesis-stress framework, whereby reactive temperament is an indicator of increased vulnerability to adverse environmental factors, such as Chang and colleagues' results (2012). Other studies' results are indicative of differential susceptibility. That is, some

researchers have found different temperament to be a marker of increased *sensitivity* to environmental factors, whether positive or negative. For example, Kim and Kochanska (2012) found that infant negative emotionality moderated associations between mother-child dyadic responsiveness and child self-regulation. Highly negative infants were less self-regulated when in unresponsive dyads, but more self-regulated in highly responsive dyads. Infants low in negative emotionality did not exhibit a relationship between dyadic responsiveness and self-regulation. In other words, the “reactive” infants fared worse under poor environmental conditions *and* better under optimal environmental conditions, whereas environment did not seem to impact non-reactive infants. Together, these studies suggest that the effects of the environment on ER may depend on characteristics of the child’s temperament. When a child undergoes a dramatic change in his or her environment, however, do all environments meaningfully impact ER development, or are some more integral than others? And, across these potential effects of different environmental factors, how much individual variation is accounted for by child temperament?

The Present Study

We set out to study the role of child temperament in the development of ER. Importantly, we examined these relationships in a high-risk population of children adopted from foster care. We compared the effects of pre-adoptive risk factors, including pre- and perinatal factors, pre-placement environmental stressors, and aspects of the adoptive family environment. In these comparisons, we applied the cumulative risk approach, which involves adding the number of risk factors to which an individual is exposed, as opposed to examining the effect of individual risk factors. Researchers have advocated looking at the cumulative effects of risk factors as opposed to studying singular risk factors, as (a) the effect of one isolated risk factor compared to multiple is minimal, and (b) a significant proportion of children experience a cluster of risk factors (Evans, Li, & Whipple, 2013). This is particularly salient for older children in foster care, as they are often exposed to a cluster of risk factors, such as prenatal substance

exposure, low birth weight, history of abuse/neglect, and multiple foster placements (Rushton & Dance, 2006).

Our study aimed to address the following questions: First, to what extent do pre/perinatal risk factors (i.e., prenatal substance exposure, premature birth, birth complications, and low birth weight) and pre-placement environmental risk factors (i.e., history of abuse or neglect, age older than two years at placement, whether the child ever lived with the birth mother, and more than two foster placements prior to the adoptive placement) predict children's level of ER at the time of adoptive placement? And how much individual variability in these relationships is due to child temperament? Second, after accounting for baseline ER, to what extent do factors of the adoptive family environment (i.e., cohesion, expressiveness, control, and conflict) predict improvement or decline in ER five years post-placement? And, do these relationships vary by child temperament?

Method

Participants

Participants ($N = 82$) were recruited from the University of California, Los Angeles (UCLA) Training, Intervention, Education, and Services (TIES) for Families program. UCLA TIES for Families aims to facilitate the successful adoption of high-risk children with transitioning from foster care to adoption. It is an interdisciplinary, university-based program that provides services free of charge to adoptive families referred by the Los Angeles Department of Children and Family Services. UCLA TIES for Families provides a wide array of services for families, including individual, collateral, and family therapy, psychological testing, support groups, and infant mental health interventions. Families receiving TIES services between 1996 and 2001 were asked to participate in this 5-year longitudinal study.

Primary parents were predominantly female (72%), with an average age of 41 at time 1. Approximately half were married (52.1%); 31% were single and 16.9% were living with a domestic partner. The majority (66%) of adoptive parents were Caucasian, and 64% had

obtained at least a college degree. The full sample had roughly even numbers of girls and boys (46% female) and the sample of children was ethnically diverse, with 33.3% Latino, 25.9% African American, 20.9% mixed/biracial, 18.5% Caucasian, and 1.2% Asian. About half (51%) of the children were placed in transracial adoptions (non-Caucasian children with Caucasian parents). Children were, on average, 1 year old at detainment, with a range from birth to 6 years old. In addition, average age at adoptive placement was 4 years old, with a range from shortly after birth to 8 years old. The median number of foster placements prior to the adoptive placement was 2, ranging from 0 to 15. Lastly, children's age at the time of adoptive placement ranged from 4 months to 8 years (median = 52 months).

Procedures

The Department of Child and Family Services (DCFS), Division of Adoptions requires potential parents to attend a series of seminars, Model Approach to Partnership in Parenting (MAPP Groups), prior to having a child placed with them. UCLA TIES for Families offered an additional series of three educational meetings aimed at providing psychoeducation regarding parenting strategies for children with prenatal substance exposure in foster care and informing potential adoptive/foster parents of the multidisciplinary services offered at TIES for Families. The research study was mentioned at the third session, though prospective parents were informed that they did not need to participate in the research study to receive TIES services. Families who sought services from TIES for Families subsequent to a foster or prospective adoptive placement were asked if they would like to participate in the study. Research participants were not financially compensated for their participation but were provided annual feedback regarding their children's development. Participants who enrolled were tracked annually for a period of at least 5 years.

Adoptive parents who agreed to participate in the research study granted TIES permission to review the child's records, where information was obtained regarding children's pre-placement risk factors (i.e., prenatal substance exposure, history of abuse or neglect, age at

adoptive placement, number of placements, ever lived with birth family). The families first came into the research center 2 months after the adoptive placement, and then annually for the following five years. At each of these time points, parents completed questionnaires and participated in parent-child interactions, as described below.

Measures

Temperament. Child temperament was assessed one year post-placement by the Cameron-Rice Temperament Scales (Cameron & Rice, 1989), adapted from previous youth temperament rating scales (Carey & McDevitt, 1978; Fullard, McDevitt, & Carey, 1984; McDevitt & Carey, 1978). As the sample ranged in child age, developmentally parallel versions of the scales were administered based on the child's age, namely the Infant Temperament Questionnaire ($n=4$), the Toddler Temperament Questionnaire ($n=14$), and the Preschool/Child Temperament Questionnaire ($n=55$). Primary adoptive parents rated each item on a 6-point scale (1=almost never, 2=rarely, 3=usually does not, 4=usually does, 5=frequently, 6=almost always). A composite score for each temperament subscale was calculated as the average across the items, and for each score, higher values indicated more reactive temperaments (i.e., high activity, high intensity, high withdrawal, low adaptability, high distractibility, high sensitivity, low regularity, low persistence, and low mood). We derived a composite variable of temperament, using Principal Components Analysis, which identified six subscales (low adaptability, negative mood, high sensitivity, high intensity, high activity, low approach) that loaded onto a single dimension (loadings $> .35$) and was conceptually consistent with reactive temperament (Thomas, Chess, & Korn, 1982). This composite measure consisted of the mean of these six subscales, with higher scores representing more reactive temperament.

Pre-placement Cumulative Risk Indices. Two cumulative risk indices were computed for each child, a pre/perinatal risk index and a pre-placement environmental risk index. Information for these indices was gathered from adoption records, including court and medical records and written reports by social workers.

Pre/perinatal risk. We examined prenatal and perinatal risk factors, including (1) prenatal substance exposure, (2) premature birth, (3) birth complications, and (4) low birth weight. Prematurity was defined as 35 weeks or less gestation. Birth complications included drug withdrawal symptoms at birth, as well as other complications of prematurity (i.e., respiratory distress, need for resuscitation at birth, and low birth weight). Low birth weight referred to weight less than 2,500 g (5 lbs. 8 oz.). Each was recorded for their presence or absence and then the four components were summed to create a composite pre/perinatal risk index (0-4).

Pre-placement environmental risk. Environmental risk factors included (1) history of abuse or neglect, (2) age older than 2 at placement, (3) whether the child ever lived with the birth mother, and (4) more than two foster placements prior to the adoptive placement. Placement at age 2 or older was used to signal adoption at relatively older age. The State of California used this age cutoff to denote “special needs” adoptions. In addition, the decision to use more than two prior placements as a risk factor was based on the distribution of prior placements in the sample (i.e., the median number of placements was two). All variables were coded dichotomously and then summed to create a composite pre-placement risk index.

Adoptive Family Environment. We also examined characteristics of the adoptive family environment at one year post-placement, using adoptive parent report on an adapted version of the Family Environment Scale (FES; Moos & Moos, 1994). The original Family Environment Scale is a 90-item True-False questionnaire that measures the social environments of families along 10 key dimensions, including family relationships (e.g. cohesion, expressiveness, and conflict); emphases within the family on aspects of personal development that can be supported by families, and maintenance of the family system (e.g. control). Our adapted version used only the above four highlighted scales, and thus consisted of 36 items. Family cohesion measures the extent to which family members are committed to providing support and help to one another (e.g., “Family members really help and support each other.”).

Family expressiveness is a measure of the extent to which family members are allowed and encouraged to act openly and to express their feelings directly (e.g., “We tell each other about our personal problems.”). Conflict measures the amount of overt anger and discord among family members (e.g., “We fight a lot in our family.”). Lastly, control measures the extent of the rigidity of family rules and procedure (e.g., “There is a strong emphasis on rules in our family.”). Internal consistency for these subscales reported in the original manual, as measured by Cronbach’s alpha, were acceptable (i.e., Cohesion = .78, Expressiveness = .69, Conflict = .75, Control = .67), as were 2-month test-retest reliabilities (ranging from .68 to .86) (Lanz & Maino, 2014).

Emotion Regulation Checklist (ERC). Adoptive parents completed the ERC, which assesses the parent’s perception of the child’s processes central to emotionality and regulation (Shields & Cicchetti, 1997). This measure includes 24 items that are rated on a 4-point Likert scale indicating how frequently the behaviors occur (1=*never* to 4=*almost always*). The Emotion Regulation subscale includes items that assess situationally appropriate emotional displays, empathy, and emotional self-awareness; sample items include “Can say when s/he is feeling sad, angry, mad, fearful or afraid” and “Responds positively to neutral or friendly overtures by peers.” The ER subscale consists of eight items; thus, possible scores range from 8 to 32, with higher scores indicating higher ER. Validity has been established using correlations with observers’ ratings of children’s regulatory abilities and the proportion of expressed positive and negative affect. Shields & Cicchetti (1997) reported that internal consistency was acceptable for both factors (Emotion Regulation subscale $\alpha = .83$; Lability/Negativity subscale $\alpha = .96$). Since its development, the ERC has been used in research on child development, for example on associations between emotion regulation and reactive aggression (Shields & Cicchetti, 1998), specific language impairments (Schwartz & Proctor, 2000), and academic success (Graziano, Reavis, Keane, & Calkins, 2007).

Data Analytic Plan

We used two sets of multiple linear regression analyses to examine the effects of pre-placement factors and adoptive family factors on ER. Set 1 examined predictors of children's ER at the time of their adoptive placement, specifically child temperament, pre/perinatal risk index, and pre-placement environmental risk index. Set 2 examined predictors of children's ER after five years of placement in their adoptive families, looking specifically at the contributions of child temperament and aspects of the adoptive family environment (i.e., cohesion, expression, conflict, and control). Child age and sex were included as covariates in all analyses.

In these regression models, multiple interaction terms were not included simultaneously because inclusion of multiple higher-order terms introduces multicollinearity and instability in regression equations (Cohen, Cohen, West, & Aiken, 2003). Further, as data missingness was determined to be Missing Completely at Random, $\chi^2(280, N = 81) = 292.66, p > .05$, Full Information Maximum Likelihood (FIML) was used to estimate missing data in all analyses. Compared to listwise deletion, FIML leads to less biased estimates for coefficients and standard errors and decreases the likelihood of Type I error.

To probe significant interactions, we estimated regions of significance (RoS) via <http://www.quantpsy.org/> (Preacher, Curran, & Bauer, 2003). RoS are the values of the moderator (herein, reactive temperament) for which the simple slope of the outcome (i.e., ER) on the predictor (e.g., pre-placement risk, family cohesion) is statistically significant. Any value of the moderator within the region corresponds to a nonsignificant effect of the predictor on the outcome, whereas a value outside of the region corresponds to a significant effect (Aiken, West, & Reno, 1991; Curran, Bauer, & Willoughby, 2006). We then estimated RoS for the environmental variable (e.g., pre-placement risk, family cohesion), to determine the values of the environmental variable at which predicted values of ER differed by "easy" and "reactive" temperament.

Results

Descriptive statistics

Table 1 shows means, standard deviations, and Pearson correlations among model variables. Baseline ER was negatively related to reactive temperament and adoptive family conflict and positively related to pre/perinatal risk, while Time 2 ER (5 years post placement) was not significantly correlated with any measures of interest. Reactive temperament was associated with environmental risk and adoptive family conflict. The four FES subscales had some intercorrelation: cohesiveness was positively associated with expressiveness and negatively associated with conflict. FES control was not associated with any other subscale.

Predicting baseline ER from child temperament and pre-placement risk

To examine interactive predictions of temperament and pre-placement risk (i.e., pre/perinatal risk and environmental risk) on ER at the time of the adoptive placement, we utilized two linear regression models. The first model included reactive temperament, pre/perinatal risk index, and a temperament-by-pre/perinatal risk index interaction. In this model, temperament emerged as the sole significant effect ($B = -10.50, p = .01$). The second model replaced pre/perinatal risk index with pre-placement environmental risk index. The environmental risk model also indicated a significant main effect of temperament ($B = -3.73, p = .02$), and no main effect of environmental risk or interaction between temperament and environmental risk.

Predicting ER 5 years post-placement from child temperament and the adoptive family environment

Next, we examined the independent and interactive effects of temperament and the adoptive family environment on ER 5 years post adoptive placement with four linear regression models, one for each subscale of the FES (cohesion, expressiveness, conflict, and control). Child ER at Time 1, child age, and child sex were covaried in all of these analyses.

Neither the conflict nor cohesion models revealed significant effects of key variables.

Table 2 presents the regression analyses for the family expressiveness model. A significant interaction emerged between temperament and expressiveness, as well as main

effects of temperament and expressiveness. RoS testing demonstrated that ER differed significantly by child temperament when family expressiveness was .99 SD below or .54 SD above the mean. In addition, ER differed significantly by family expressiveness at values of temperament .62 SD below or .77 SD above the mean. Examination of Figure 1 shows that, for families with low expressiveness scores ($Z \leq -.99$), children with reactive temperament had significantly higher ER than children with easy temperament. For families with high expressiveness ($Z \geq .54$), children with easy temperaments had significantly higher ER than children with reactive temperaments.

Table 3 presents the regression analyses for the family control model. A significant interaction emerged between temperament and control, as well as main effects of temperament and control. RoS analyses revealed temperament-based group differences in ER when family control was .29 SD below or .47 SD above the mean, and differences in ER by family control when child temperament was .58 SD below or .37 SD above the mean. Examination of Figure 2 shows that, for families with low control ($Z \leq -.29$), children with easy temperaments had higher ER than children with reactive temperaments. For families with high control ($Z \geq .47$), children with reactive temperaments had higher ER than children with easy temperaments.

Discussion

In a prospective, longitudinal study of children adopted from foster care, we examined the contributions of child temperament and pre- and post-placement environment on the development of emotion regulation (ER). This study contributes to the literature on ER development by incorporating interactions between children and their rearing environment, as well as examining change in ER subsequent to change in the environment (i.e., prenatal to foster to adoptive). ER is an important outcome to study in this at-risk population, as it has been found to foster resilience (Cicchetti, 2013).

First, we looked at predictions of ER at the time of the adoptive placement, from pre/perinatal risk (e.g., low birth weight, prenatal substance exposure) and pre-placement

environmental risk (e.g., abuse/neglect, multiple foster placements), with child reactive temperament included as a moderator. We found the ER was solely predicted by child temperament, such that higher ratings of reactive temperament were related to lower ER, above and beyond effects of pre/perinatal and preplacement environmental risk. This finding provides support for reactive temperament as a risk factor for poor ER, and is consistent with prior research linking temperamental reactivity (behavioral and physiological) and ER (S. D. Calkins, 1997; Gunnar et al., 1995; Stifter & Braungart, 1995). We were surprised, however, that neither pre/perinatal nor pre-placement environmental risk contributed to ER, as prior studies have found associations between these risks and outcomes associated with ER, such as internalizing and externalizing behavior problems (Nadeem et al., 2016; Yumoto et al., 2008). These studies, however, did not take into account the effect of temperament. It is possible that temperament (when assessed in this study) was affected by pre/perinatal risk and pre-placement risk, and that these risk factors did not have direct effects on ER. Further, in our sample, pre-placement environmental risk was positively correlated with reactive temperament. Thus, when both were included in regression analyses, results suggested that the bulk of the variance in ER was carried by temperament. In other words, when predicting ER, a child's temperament may trump risk factors when entering an adoptive placement.

Next, we predicted ER five years after adoptive placement from dimensions of the adoptive family environment (i.e., cohesion, expressiveness, conflict, and control), controlling for baseline ER, and including temperament as a moderator. These analyses revealed significant interactions between temperament and family expressiveness, and temperament and family control. For family expressiveness, children with reactive temperament had higher ratings of ER when expressiveness was low, and lower ratings when expressiveness was high, as compared to children with easy temperament. One interpretation of this finding is that highly expressive family environments may cause distress for children with reactive temperament, who by definition, are more sensitive, intense, and reactive to their environment. On the other hand,

children with easy temperament may benefit from openly and directly discussing feelings, as those discussions are opportunities to learn and develop more emotional awareness and ER strategies. These findings are reasonable in the context of previous studies, especially as results have been inconsistent for negative expressivity (Morris et al., 2007). As the FES does not differentiate between positive and negative expressivity, our findings suggest that part of the inconsistency in prior research may be due to the lack of accounting for child temperament.

Findings were in the opposite direction for family control, such that children with reactive temperament had higher ratings of ER when control was high, and lower ratings when control was low, as compared to children with easy temperament. Parental control is a multidimensional construct that can range from inappropriately intrusive and authoritarian to more normative variations in home structure and organization (Flynn & Masur, 2007; Green, Caplan, & Baker, 2014). In the present study, the items that comprise the control subscale of the FES (e.g., “There are set ways of doing things at home,” “There is a strong emphasis on following rules in our family”) captures the level of structure or organization present in the family. When considered from this perspective, the findings suggest that children with reactive temperament are more able to develop ER when provided familial structure, which could involve structure around emotional situations. Children with easy temperament, however, may respond better to fewer rules and restrictions. In this context, they have more opportunities to be exposed to emotional situations, and partly due to their easy temperament, are more able to stay calm and/or engage regulation strategies.

Taken together, these interactions between temperament and family environment provide evidence for the importance of goodness of fit between parents and children, and harken back to Bronfenbrenner’s theory of ecological systems. Broadly, the effects of the microsystem depended on the characteristics of the individual (Bronfenbrenner, 1974). Our specific findings suggested that, for expressiveness and control in the family environment, there was no *optimal* level for all children, as their effects differed significantly by child temperament.

In terms of ER development, children with reactive temperament appeared to respond best to family environments with low expressiveness and high control, whereas children with easy temperaments benefitted from high expressiveness and low control. Thus, our findings also have important implications for intervention, especially parent training. They highlight that clinicians should consider child temperament when making treatment planning decisions, as there may not be a “one size fits all” parent training protocol. It is critical that the question “*What works?*” be followed by “*For whom?*”. Treatment decisions are often guided by child age and developmental status based on valuable intervention research, and the current study provides support for examination of child temperament as a moderator of treatment response.

Implications for adoptive families should also be highlighted. Results from our sample of children adopted from foster care show that, after controlling for temperament, pre-placement risk factors may not affect ER, an important predictor of resilience. These findings may provide a sense of optimism to adoptive parents, who are often concerned regarding potential long-term effects of pre-placement risk factors, such as prenatal substance exposure and maltreatment. Further, for children who present with reactive temperaments and thus lower initial ER, the adoptive family environment can be augmented to enhance their ER development.

From a basic science perspective, this study provides unique contribution to research on child development, as studies of children being raised by their biological families involve a confound of a passive relationship between biology and environment. As temperament is genetically and environmentally determined (Rothbart, 2007), a child’s reactive temperament is partly due to shared genetics with the parent and partly due to parenting behaviors that are, in turn, partly due to the parent’s own genetics. Many studies on temperamental moderation of parenting effects fail to control for this confound. In such studies, it is difficult to know whether the relationships between reactive temperament, parenting, and ER were not solely due to underlying genetic factors rather than the observed phenotypes/behaviors. The current study

allows for enhanced confidence that aspects of one's rearing environment can indeed promote change in child outcomes, in this case ER.

A few limitations should be noted. First, the key measures of the study were all parent-report measures, completed by the child's primary caregiver (i.e., the caregiver who spends the most time with the child). As such, shared method variance may account for some of the association among the variables. Second, information regarding pre/perinatal risk and pre-placement environmental risk were obtained from official records and may be subject to report bias and investigation bias (Brown, Cohen, Johnson, & Salzinger, 1998). Lastly, small sample size ($N = 82$) is an additional limitation of this study, and thus it is possible that it was underpowered to detect effects of smaller magnitude. We encourage other researchers with sample sizes of more substantial statistical power and with multi-informant and multi-method measures of ER, temperament, and family environment to further examine the relationships presented in this study.

While children adopted from foster care are at increased risk of poor outcomes across different domains, the current study contributes to the valuable literature on resilience in this population. Our findings suggest that children with reactive temperament are at risk for poor ER development prior to adoption, but after 5 years of adoptive placement, they appeared to benefit significantly from a family environment attuned to their disposition. Research in this area is critical for understanding basic processes underlying ER development, and for informing treatment approaches in this population and children more generally.

Table 3-1

Means, standard deviations, and correlations among key variables

Variable	M	SD	1	2	3	4	5	6	7	8	9
1. Difficult temperament	3.29	0.43	1								
2. Pre/perinatal risk index	2.40	1.34	-.11	1							
3. Environmental risk index	2.73	1.04	.40*	-.29	1						
4. Family cohesiveness	7.95	1.27	-.27	-.15	-.16	1					
5. Family expressiveness	6.36	1.76	-.18	.36	.08	.36*	1				
6. Family conflict	2.89	1.95	.43*	.06	.22	-.48*	-.05	1			
7. Family control	5.29	1.92	.19	-.35	.37*	.00	.00	.28	1		
8. ER at baseline	25.86	3.52	-.41*	.46*	-.18	.22	.08	-.45*	-.15	1	
9. ER 5 years post-placement	27.31	2.92	-.17	-.06	-.09	.03	-.09	-.27	-.18	.37	1

Notes. ER = Emotion regulation. * $p < .05$.

Table 3-2

Linear regression predicting ER 5 years post placement from temperament and family expressiveness

	<i>B</i>	<i>SE</i>	<i>p</i>
Age at adoptive placement	-0.07	0.28	.793
Sex ^a	0.45	0.91	.619
ER at adoptive placement	0.54	0.13	<.001
Difficult Temperament	8.67	2.13	<.001
Family Expressiveness	4.97	1.23	<.001
Temperament x Expressiveness	-1.46	0.33	<.001

Notes. ER = Emotion regulation. ^a 0 = female; 1 = male.

Table 3-3

Linear regression predicting ER 5 years post placement from temperament and family control

	<i>B</i>	<i>SE</i>	<i>p</i>
Age at adoptive placement	0.31	0.22	.174
Sex ^a	0.22	0.80	.782
ER at adoptive placement	0.41	0.11	<.001
Difficult Temperament	-10.73	2.05	<.001
Family Control	-6.26	0.97	<.001
Temperament x Control	1.93	0.31	<.001

Notes. ER = Emotion regulation. ^a 0 = female; 1 = male.

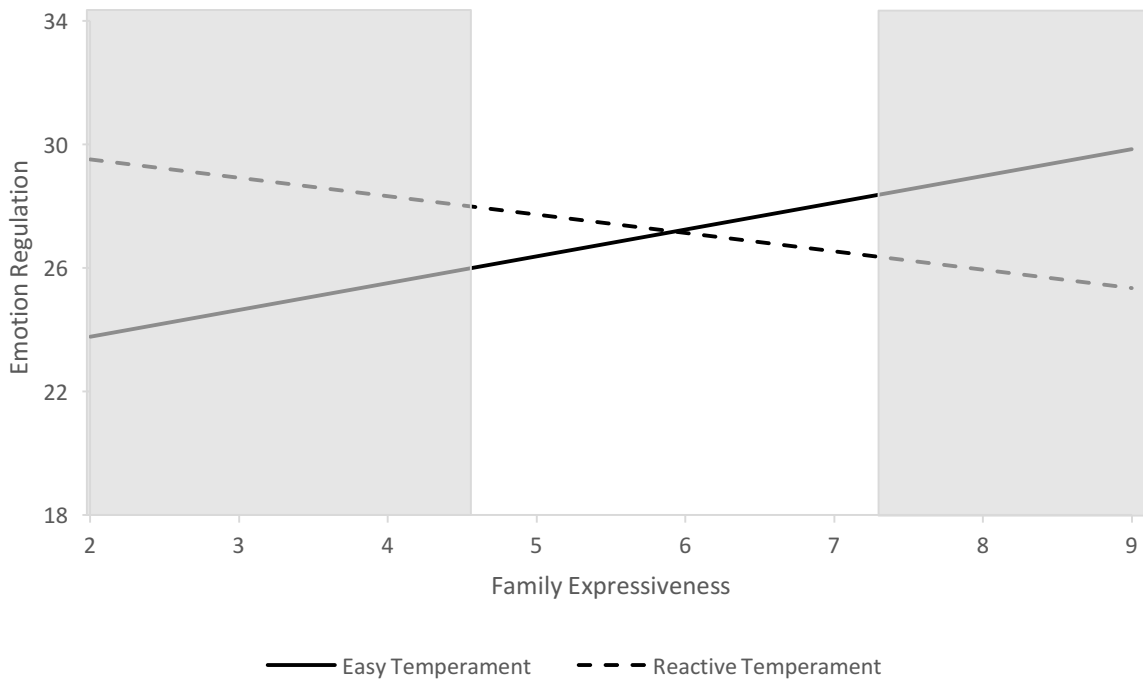


Figure 3-1. Emotion regulation as predicted by Temperament x Family Expressiveness. Gray areas indicate regions where predicted emotion regulation significantly differs by temperament.

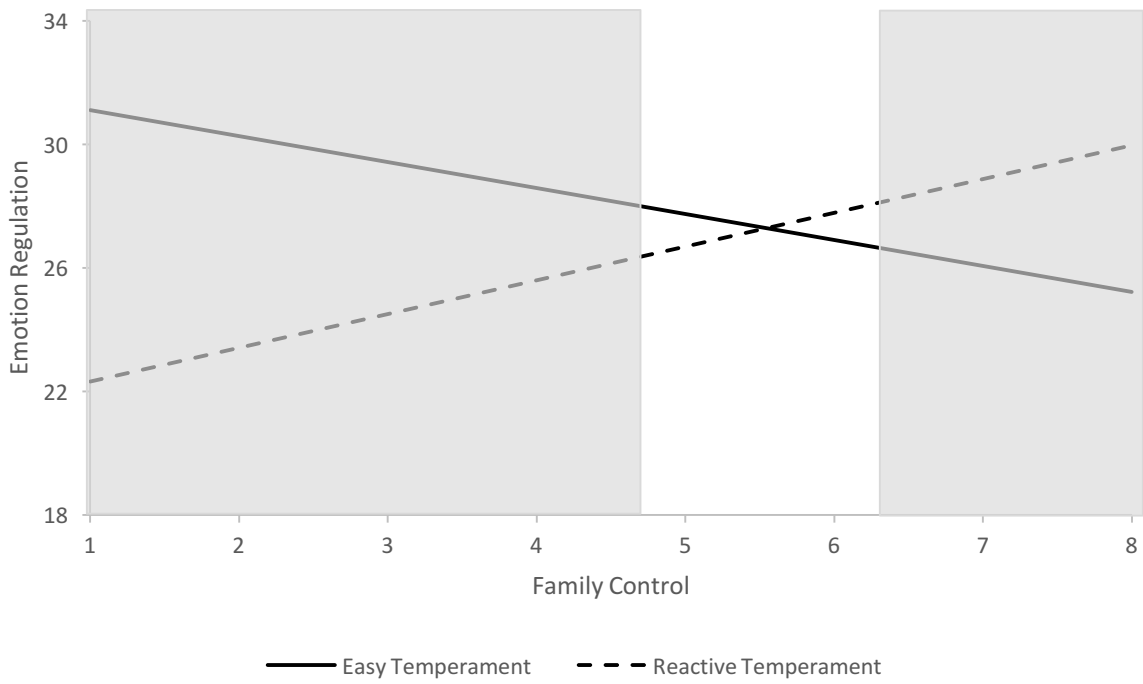


Figure 3-2. Emotion regulation as predicted by Temperament x Family Control. Gray areas indicate regions where predicted emotion regulation significantly differs by temperament.

Chapter 5

General discussion

In a series of studies, we examined emotion regulation (ER) processes in three high-risk samples, with two primary aims: (1) to examine the effects of concentric levels of influence on ER, from within the individual (i.e., serotonin transporter genotype, temperament), to aspects of the proximal environment (i.e., parenting behaviors), and to broader contextual factors (e.g., income, family composition); and (2) to assess the ontogenetic effects of the levels of influence and determine whether these internal and external factors affect developmental *trajectories* of ER, in addition to predicting initial levels. These aims were grounded on the bioecological systems theory of development (Bronfenbrenner & Morris, 2007), which asserts that the environment can be disaggregated into levels, ranging from those most proximal to the individual and those most distal. Further, it is emphasized that an individual and that individual's environment engage in reciprocal, synergistic interrelations over time. Building upon this framework, we advanced our two aims in studies of ER development in samples of children with and without developmental delay, low-income children from the Early Head Start Research and Evaluation project, and children adopted from foster care.

Given the large body of research over several decades that has highlighted the predictive power of ER for many domains of functioning across the lifespan, the present dissertation focused on ER as an outcome. That is, since we can state with a fair degree of certainty that ER poses as an indicator of present and future functioning, increased efforts are now needed to identify predictors of ER. Further, an important avenue of inquiry would be to examine predictors of ER development, as opposed to ER at one time point.

In Study 1, *Developmental patterns of child emotion dysregulation as predicted by serotonin transporter genotype and parenting*, we used latent growth curve modeling (LGCM) to model yearly change in emotion *dysregulation* from child age 3 to 6 years and to test genetic and environmental predictors of initial levels of and change in emotion dysregulation. LGCM

revealed that dysregulation decreased overall across early childhood and that serotonin transporter genotype X parenting interactions predicted dysregulation growth curves. Children with the SL/LL genotype had dysregulation trajectories that were minimally related to positive and negative parenting behavior, whereas dysregulation decreased more precipitously among children with the SS genotype when exposed to low negative parenting or high positive parenting. These findings provide evidence for gene X environment interactions in the development of dysregulation in a manner that is conceptually consistent with the vantage sensitivity hypothesis, which asserts that certain individuals (e.g., children with the SS serotonin transporter genotype) are more responsive to positive environmental agents (Pluess & Belsky, 2013).

In Study 2, *Developmental patterns of emotion regulation in toddlerhood: Examining predictors of change and long-term resilience*, latent class growth analysis (LCGA) was used to identify trajectory groups of ER across toddlerhood (age 14-36 months) and examine predictors of those trajectory groups from child temperament, parenting behaviors, and environmental risk. LCGA supported a three class model, with a Stable-High ER group, a Low-to-High group, and a High-to-Low group. The Stable-High group was characterized by high positive parenting, the Low-to-high group by high child negative emotionality, and the High-to-Low group by high negative parenting and high environmental risk. Lastly, membership in these trajectory groups was found to be predictive of resilient functioning in the 5th grade.

In Study 3, *Predicting emotion regulation among children adopted from foster care: Contributions of temperament, pre-placement risk, and adoptive family environment*, we examined factors that predict ER among children adopted from foster care, looking at ER at the time of the adoptive placement and then 5 years post-placement. Multiple regression analyses revealed that among child temperament, pre/perinatal risk, and pre-placement environmental risk, reactive temperament (e.g., negative emotionality) was the sole predictor of ER when children were initially placed with their adoptive families. When looking at ER after 5 years of

adoptive placement, aspects of the adoptive family environment predicted changes in ER, though the nature of the changes depended on the temperament of the child. Specifically, children with reactive temperament had higher levels of ER than children with easy temperament at low levels of family expressiveness, but lower ER at high levels of family expressiveness. Further, children with reactive temperament at lower levels of ER than children with easy temperament at low levels of family control, but higher ER at high levels of control.

Together, the three present studies provide implications for psychological theory and practice. First, these studies highlight the importance of longitudinal research. Studies 1, 2, and 3 indicated that ER was dynamic over the course of childhood, and importantly, Study 2 found that trajectory groups (and not initial levels) of ER predicted long-term resilience. Second, the present studies support the examination of separable parenting factors, as opposed to one broad parenting measure that ranges from negative to positive. Studies 1 and 2 found that positive and negative parenting, though moderately correlated, had separable effects on ER trajectories. Further, Study 3 indicated effects for some, but not all, aspects of parenting behaviors on ER. Lastly, as environmental risk predicted ER, over and above the effects of parenting, in Study 2, future research should continue to examine environmental factors more distal than parenting behaviors, as it may provide important nuance to our understanding of child development.

This combination of approaches allows for more specificity in findings, which in turn can identify important points of prevention and intervention. Treatment implications of the present studies include strong support for early intervention and parent training programs. All three studies indicated that parenting at one time point predicted *change* in ER over the course of years. The present findings also suggest that parenting interventions should explicitly address different aspects of parenting, such as increasing positive parenting and decreasing negative parenting. Study 3 provides important nuance to this approach, as findings highlighted that children may differentially respond to their parenting environment, depending on

temperament. As such, there may not be a “one size fits all” parent training protocol. Instead, it is critical that the question “*What works?*” be followed by “*For whom?*”.

In sum, the present dissertation utilized prospective, longitudinal designs to examine the dynamic processes of ER development in childhood. Findings indicated that ER generally improves overtime, though this is not necessarily the case for all children. Children in riskier family contexts (e.g., low income) with high levels of negative parenting and low levels of positive parenting may be particularly vulnerable to poor ER development. However, the nature of the relationships between environmental influences and ER may be moderated by the child’s internal attributes, such as serotonin transporter genotype and temperament. While researchers are making considerable progress in elucidating ER processes, much more remains to be uncovered about how to provide children with optimal support for ER development. Studies that employ a developmental approach and examine a range of internal and environmental predictors can most efficiently and effectively work toward this goal.

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