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Maternal Self-Regulation, Relationship Adjustment, and Home Chaos: Contributions to Infant Negative Emotionality

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Abstract

There has been increasing interest in the direct and indirect effects of parental self-regulation on children's outcomes. In the present investigation, the effects of maternal self-regulation, home chaos, and inter-parental relationship adjustment on broad and specific indicators of infant negative emotionality (NE) were examined. A sample of maternal caregivers and their 4-month-old infants (N = 85) from a rural community participated. Results demonstrated that better maternal self-regulation was associated with lower infant NE broadly, as well as with lower infant sadness and distress to limitations/frustration and better falling reactivity (i.e. emotion regulation), specifically. Maternal self-regulation also predicted less chaotic home environments and better maternal inter-parental relationship adjustment. Findings also supported the indirect effects of maternal self-regulation on broad and specific indicators of infant NE through home chaos and maternal relationship adjustment. Some differential effects were also identified. Elevated home chaos appeared to specifically affect infant frustration/distress to limitations whereas maternal relationship adjustment affected broad infant NE, as well as several specific indicators of infant NE: frustration/distress to limitations, sadness, and falling reactivity. In conjunction with other recent investigations that have reported the effects of maternal self-regulation on parenting, the findings in the present investigation suggest that parental self-regulation may influence children's outcomes through several proximal environmental pathways.

The importance of temperament (i.e. biologically based, individual differences in self-regulation, attention, and emotionality reactivity, that are influenced by maturation, heredity, and the environment; Goldsmith et al., 1987; Rothbart, Derryberry, & Posner, 1994) in models of developmental psychopathology has been increasingly recognized (Caspi, Henry, McGee, Moffitt, & Silva, 1995; Gartstein et al., 2010; Oldehinkel, Hartman, De Winter, Veenstra, & Ormel, 2004; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005). In particular, negative emotionality (NE), one aspect of temperament that emerges in the first year of life (Rothbart, 1989), has been consistently associated with adverse child outcomes. Higher NE in early childhood has been associated with subsequently elevated levels of behavioral and social adjustment problems, as well as academic difficulties (Caspi, et al., 1995; Crawford, Schrock, & Woodruff-Borden, 2011; Kim, Walden, Harris, Karrass, & Catron, 2007; Strait, Gallagher, & Kelley, 2008). Similarly, there is increasing evidence that elevated NE early in life may compromise children's developing attentional and self-regulatory skills (Bridgett et al., 2009; Leve et al., In Press; Stifter & Spinrad, 2002).

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Given the implications of elevated levels of early NE for later child outcomes, as well as evidence that temperament early in life may be particularly malleable (van den Akker, Dekovic, Prinzie, & Asscher, 2010), prior work has examined and identified a number of predictors of infant NE, such as maternal depression and anxiety (Gartstein et al., 2010; Pauli-Pott, Mertesacker, & Beckmann, 2004). However, the contributions of other maternal characteristics, such as maternal self-regulation, have not received as much attention. Likewise, other more proximal influences that may contribute to infant NE, such as home chaos and inter-parental relationship adjustment, particularly when children are infants, have also been infrequently considered. Finally, while the effects of maternal self-regulation on infant NE may be direct, such effects could be mediated by aspects of the proximal environment that are themselves influenced by maternal self-regulation (e.g., home chaos and inter-parental relationship adjustment). However, to our knowledge, no studies have considered this possibility. Thus, the goal of the current investigation is to examine the direct contributions of maternal self-regulation, home chaos, and maternal relationship adjustment to infant NE. Furthermore, the indirect effects of maternal self-regulation on infant NE through inter-parental relationship adjustment and home chaos will be examined.

Development of Negative Emotionality in Infancy

During infancy, measures of broad NE are frequently comprised of discrete negative emotions such as sadness, frustration/distress to limitations, and fearfulness (Gartstein & Rothbart, 2003; Goldsmith et al., 1987; Putnam, Gartstein, & Rothbart, 2006). Factor analytic work has also identified falling reactivity, or the ability to recover/calm down from peak levels of distress, as an additional component of early NE (Gartstein & Rothbart, 2003). Insomuch as falling reactivity reflects the ability to recover from distress, this construct may also be considered an early marker of emotion regulation (i.e. the ability to maintain, decrease, or increase the intensity of an emotional experience; Cole, Martin, & Dennis, 2004).

Developmentally, NE is one of the earliest emerging manifestations of temperament, and can be measured within the first few months of life (Lemery, Goldsmith, Klinnert, & Mrazek, 1999; Putnam, Ellis, & Rothbart, 2001; Rothbart, 1989). Prior to 24 months of age, several studies have noted that NE appears to increase across development (e.g., Bridgett et al., 2009; Leve et al., In press), reaching relative mean level stability by the time children are approximately two years of age. Importantly, during this early period of development, studies have found that changes in NE may be under the influence of environmental mechanisms, such as maternal characteristics (Bridgett et al., 2009; Pauli-Pott et al., 2004; Tronick & Reck, 2009; van den Akker et al., 2010). However, the influence of some characteristics have been more often considered (e.g., maternal depression) than others, such as maternal self-regulation.

Maternal Self-Regulation: Links with Infant NE, Home Chaos, & Maternal Relationship Adjustment

Broadly, self-regulation represents an individual's ability to regulate their emotions, behaviors, and cognitions (Karoly, 1993; Rueda, Posner, & Rothbart, 2005). Self-regulation also encompasses the ability to engage in organized, goal-directed behavior and monitor one's actions, in addition to being able to think and behave flexibly (Burges, 1997). In adults, better self-regulation has been linked with fewer feelings and expressions of negative affectivity (e.g., Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013), increased self-esteem, and more intimate personal relationships (Busch & Hofer, 2012). Similarly, better self-regulation has been associated with lower aggression, fewer symptoms of psychopathology, and higher grade point averages (DeWall, Baumeister, Stillman, &

Gailliot, 2007; Tangney, Baumeister, & Boone, 2004). Thus, self-regulation is important for a range of behaviors.

Given that self-regulation emerges early in life (Rothbart, Posner, & Kieras, 2006; Rothbart, Sheese, Rueda, & Posner, 2011) and undergoes significant development and organization between early childhood and adulthood (Best, Miller, & Jones, 2009; Bridgett & Mayes, 2011; Casey, Giedd, & Thomas, 2000; Williams, Ponesse, Schachar, Logan, & Tannock, 1999), by the time most adults have children, they are potentially equipped with self-regulatory mechanisms that can be employed to influence children and aspects of the family environment. One way that parental self-regulation may influence children is through more direct effect mechanisms. For example, Davenport, Yap, Simmons, Sheeber, and Allen (2011) noted an association between maternal effortful control and adolescent NE. Similarly, Leve et al. (In Press) reported a negative zero-order association between maternal inhibition, an aspect of executive functioning, and toddler NE at 27 months of age. Although mechanisms of direct effects have not frequently been considered, two possibilities include prenatal (e.g., Schuetze & Rina, 2007) or genetic (e.g., Bell & Deater-Deckard, 2007) mechanisms. However, indirect, or mediated effects, wherein parental self-regulation influences aspects of the home environment, which subsequently act to influence children, represents another potential mechanism of influence.

Most existing work examining the influence of parent self-regulation on children has focused on maternal parenting (e.g., Bridgett et al., 2011; Deater-Deckard, Sewell, Petrill, & Thompson, 2010), noting that better maternal self-regulation is associated with more adaptive parenting practices. However, parental self-regulation may provide support for other important aspects of the environment, such as less chaos in the home. Chaotic homes tend to be noisier, less organized, more crowded, and tend to have fewer structured routines (Wachs & Evans, 2010) relative to less chaotic homes. Parents with better self-regulation will likely be better equipped to provide regular routines, structure, and general management of the home environment (e.g., monitor noise levels) in ways that promote child development. Nevertheless, only two studies have considered these possibilities. Valiente, Lemery-Chalfant, and Reiser (2007) found that better parental effortful control, a key self-regulation construct within a temperament framework (Evans & Rothbart, 2007), was associated with less chaotic homes in a sample of families with school-aged children. Similarly, another investigation (Deater-Deckard, Chen, Wang, & Bell, 2012) reported that poor maternal executive functioning, a construct with considerable similarity to effortful control (Bridgett et al., 2013; Zhou et al., 2012), was associated with elevated home chaos.

Self-regulation also may influence inter-parental relationship adjustment. At the extreme, there is evidence that self-regulatory difficulties (e.g., poor executive functioning) place individuals at risk for engaging in intimate partner violence (e.g., Finkel, DeWall, Slotter, Oaten, & Foshee, 2009; Pinto et al., 2010). Despite this potentially compelling evidence, these studies considered an extreme form of relational dysfunction (i.e. intimate partner violence), and did so in samples that were not selected on the basis of parental status (e.g., college students; Finkel et al., 2009). Nevertheless, it is likely that individual differences in parental self-regulation influence a wide range of functional (e.g., intimacy) and/or dysfunctional (e.g., verbal arguing/aggression) inter-parental behaviors shown to influence children as early as infancy (Crockenberg et al., 2007). However, existing research has yet to examine the possibility that self-regulation may influence parental relationship adjustment, outside of the extreme of intimate partner violence.

Inter-Parental Relationship Adjustment and Home Chaos as Contributors to Infant NE

Alongside evidence for relations between parental self-regulation and inter-parental relationship adjustment, there is also evidence suggesting that inter-parental relationship adjustment may influence children's NE. It has been noted that poor parental relationship adjustment results in increased parental distress and preoccupation with the problematic relationship (e.g., Cox, Paley, & Harter, 2001). Subsequently, this process results in the disruption of the parent's ability to be emotionally available to their children (Mahoney, Boggio, & Jouriles, 1996; Sturge-Apple, Davies, & Cummings, 2006) who may be more prone to increased emotional arousal and reactivity, and to losing a sense of emotional security within the family system as a result of exposure to maladaptive inter-parental relationships (Cummings, El-Sheikh, Kours, Buckhalt, 2009; Cummings, Schermerhorn, Davies, Goeke-Morey, & Cummings, 2006; Davies & Cummings, 1994). Despite support for these processes, most studies have examined the effects of inter-parental relationship adjustment on samples of pre-school-aged and older children. This is a particularly noteworthy gap in the existing literature given that infants and toddlers, relative to older children, are much more dependent upon caregivers for assistance with the regulation of emotional arousal (Bernier, Carlson, & Whipple, 2010; Crockenberg & Leerkes, 2004; Kopp, 1989; Propper & Moore, 2006), making them more susceptible to disruptions in parental ability to be emotionally available.

Consistent with the possibility that parental relationship adjustment influences young children, some investigations in older children have noted the detrimental effects of problematic inter-parental relationships on children's NE (e.g., Crockenberg & Langrock, 2001). Only a few studies, however, have reported evidence of the effects of problematic inter-parental relationship adjustment on infants. For example, Bridgett et al. (2009) reported a positive association between higher maternal relationship stress and increased infant NE. Similarly, another study reported that infants exposed to high levels of verbal aggression between parents engaged in more withdrawal and exhibited greater distress in response to novelty (Crockenberg, Leerkes, & Lekka, 2007), which are behaviors potentially consistent with elevated levels of sadness and fearfulness, respectively (Gartstein & Rothbart, 2003). Collectively, theoretical considerations, as well as the few existing empirical examples, suggest that inter-parental relationship adjustment may be an important environmental influence on children's NE early in life.

Chaotic home environments have also been consistently linked with adverse child outcomes. Most commonly, children being raised in home environments characterized by high levels of chaos are at greater risk of externalizing behavior problems (Coldwell, Pike, & Dunn, 2006; Hardaway, Wilson, Shaw, & Dishion, 2012). Chaotic home environments have also been linked with poor academic performance and internalizing problems (Evans, Gonnella, Marcynyszyn, Gentile, & Salpekar, 2005; Hanscombe, Haworth, Davis, Jaffee, & Plomin, 2011). While few studies have considered the potential influence of home chaos on young children's temperament, those studies that have considered such effects have typically noted a negative influence. For example, Dumas et al. (2005) reported that young children in chaotic environments exhibited more anger-aggressive emotion and behavior, increased impulsivity, and worse attentional focusing. However, studies have not considered the effects of home chaos on aspects of infant temperament, such as NE.

The Current Study

Prior work has linked maternal self-regulation to aspects of temperament, such as NE, and has noted the importance of adult's self-regulation for adequate functioning in interpersonal

relationships. Better parental self-regulation has also been associated with less chaotic homes. However, despite some evidence for these effects, few studies have examined the contributions of maternal self-regulation to infant NE and to the home environment in which young children are raised. Likewise, although inter-parental relationship adjustment and home chaos have been linked to children's outcomes, the majority of these studies have not focused on the effects of these proximal environmental influences on infants. Finally, no studies, to our knowledge, have considered the possibility that the effects of maternal self-regulation on infant NE may occur indirectly through chaotic home environments and maternal inter-parental relationship adjustment.

Consistent with existing studies noting associations between maternal self-regulation and aspects of children's temperament (Bridgett et al., 2011; Davenport et al., 2011), in the current investigation, it was anticipated that better maternal self-regulation would be associated with lower infant NE measured two months later. In light of existing evidence (e.g., Busch & Hofer, 2012; Deater-Deckard et al., 2012; Finkel et al., 2009; Pinto et al, 2009; Valiente et al., 2007), albeit limited, it was also expected that better maternal self-regulation would be associated with lower home chaos, and better inter-parental relationship adjustment. Next, the indirect effects of maternal self-regulation, through home chaos and inter-parental relationship adjustment, on infant NE were considered. It was anticipated that these proximal home environment factors would at least partially account for associations between maternal self-regulation and infant NE.

Finally, it is potentially important to consider specific aspects of NE (e.g., fear, sadness, falling reactivity, and frustration/distress to limitations) in studies of emotion and temperament, as opposed to restricting investigations to only broad indicators (e.g., NE factor scores). Consideration of only broad-based indicators of NE may obscure unique associations between predictors and specific emotional processes that fall under the larger umbrella of NE. This possibility is consistent with work that has noted that some child outcomes may be specifically associated with particular aspects of NE (e.g., frustration/anger being related to externalizing problems, or fear being related to anxiousness; Eisenberg et al., 2001; Eisenberg, et al., 2009; Gartstein et al., 2010). Thus, in addition to the primary hypotheses, the influence of home chaos, maternal inter-parental relationship adjustment, and the direct and indirect influence of maternal self-regulation on each fine-grained aspect of NE was also examined. However, given limited evidence for formulating specific predictions regarding differential effects (e.g., maternal relationship adjustment with her partner affects infant frustration/distress to limitations, but not sadness), examination of such effects are exploratory in nature.

Method

Participants and Procedure

Participants—Mothers and their infants, 85 families in total, were recruited from a rural county through a large OB/GYN practice (61%), or though flyers posted in communities located in the county and through birth announcements placed by families in local publications (39%). Eligibility criteria to participate included a full-term pregnancy and delivery with no serious complications, maternal age of at least 17 years, and no developmental concerns about their infant at the time of enrollment. Several months after enrollment, one infant developed a neurological disorder that compromised normal development. This family is not considered in the current investigation, resulting in a final sample size of 84 mother-infant dyads.

Families came from a wide range of backgrounds. Mothers had a mean age of 27.67 (*SD* = 6.66) years (10.7% were teen mothers ages 17 to 19 years), and had completed a mean of

14.53 (*SD* = 2.78) years of education (range = 9 to 20 years; 33.7% reported having complete 12 or fewer years of education). The mean family income-to-needs ratio was 2.44 (*SD* = 1.92), with 21.3% of the families falling at or below the poverty threshold of an income-to-needs ratio of less than or equal to 1.00 (54.6% of participating families were economically stressed, which was defined as an income-to-needs ratio of less than 2.00). Approximately 70% of mothers self-identified as being Caucasian (70.2%); 13.1% identified as Latino, 10.7% as Black, and 6% as coming from other ethnic backgrounds. Most mothers reported being married or in a relationship (86.7%); 13.3% of mothers reported being single. [1] Fifty-eight percent (58.3%) of infants were girls and 41.7% of infants were boys.

Procedure—Two weeks before infants reached four months of age, caregivers were mailed questionnaires assessing aspects of maternal self-regulation and home chaos. Four months postpartum, caregivers attended a laboratory session, during which they returned completed questionnaires, were administered a semi-structured clinical interview and neuropsychological tests of working memory, and completed information regarding their relationship adjustment with their partner. Approximately two months later, participants were mailed a measure of infant temperament. Within a two week time frame around infants' 6 month "birthdays" (+/−1 week), caregivers returned the measure of infant temperament to the laboratory. Families were compensated with $80.00 for their participation.

Measures

Maternal self-regulation—Caregivers completed four measures of self-regulation, two of which were self-report questionnaires, and two of which were individually administered. First, mothers completed the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007), which includes an effortful control factor. The effortful control factor consists of subscales of activation control (i.e., the ability to engage in an undesired action), effortful attention (i.e., the ability to flexibly use and focus attention), and inhibitory control (i.e., the ability to suppress inappropriate behavior). The ATQ assesses temperament within the tradition of the psychobiological model (Evans & Rothbart, 2007) and has demonstrated adequate psychometric characteristics (for a review, see Gartstein, Bridgett, & Low, 2012). In the current investigation, the internal consistency of the effortful control factor was good (α =.79).

Mothers also completed the Behavior Rating Inventory of Executive Function (BRIEF; Roth, Isquith, & Gioia, 2005), adult version, which is a self-report measure of problematic executive functioning that can be used for research and clinical purposes. The BRIEF consists of 75 items comprising two broad indices: the behavioral regulation index and the meta-cognition index. The behavioral regulation index assesses the effectiveness of problem solving and working memory, whereas the meta-cognition index assesses self-regulation of behavior and emotion, flexible use of attention, and self-monitoring. For the purposes of the current investigation, the meta-cognition and behavioral regulation indices, r =.77, p <.01, were 1) reverse scored such that higher scores were consistent with better self-regulation, and 2) were standardized and then averaged so that one index of self-regulation (α = .87) was obtained.

During their laboratory visit, mothers were administered the letter-number sequencing subtest from the Wechsler Adult Intelligence Scale, 4th Edition (WAIS-IV; Wechsler, 2008), which is a measure of working memory frequently used in clinical settings. This task

[1]Maternal caregivers reporting that they were single were not included in analyses examining maternal relationship adjustment. See Analytic Approach section for more details.

required participants to repeat back to an examiner increasingly longer series of mixed numbers and letters, which had been presented at 1 second intervals. When repeating the numbers and letters back to the examiner, participants had to do so such that the numbers were presented from lowest to highest, followed by the letters in alphabetical order. This measure was chosen because it is a frequently used measure of working memory in clinical settings. Furthermore, the letter-number sequencing subtest from the predecessor of the WAIS-IV, the Wechsler Adult Intelligence Scale, 3rd Edition (Wechsler, 1997), has demonstrated associations with more traditional experimental measures of working memory, such as the n-back task (Shelton, Elliot, Calamia, & Gouvier, 2009). Higher scores on the letter-number sequencing subtest are consistent with better working memory.

Caregivers were also administered the verbal fluency test from the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001). This measure was selected as an additional assessment of working memory based on evidence indicating that working memory is the key process involved in facilitating performance on verbal fluency tasks (e.g., Rosen & Engle, 1997; Unsworth, Spillers, & Brewer, 2011). Four indices from the D-KEFS verbal fluency test were obtained: letter fluency, category fluency, category switching correct responses, and category switching accuracy. During the letter fluency condition, participants were required to say as many words as possible that started with “F”, “A”, and “S” in separate 60-second trials. Participants could only use each response once, and could not use numbers, places, or the names of people as responses. The category fluency condition consisted of two 60-second trials. In one trial participants said as many animals as possible, and in the second trial, as many boys’ names as possible. Category switching required participants to switch back and forth between naming a fruit and a piece of furniture in a 60-second trial. During the category fluency and category switching conditions participants could not repeat a previous response. Higher scores during these four tasks are consistent with better working memory. To obtain one index from the D-KEFS verbal fluency measure, the mean of all four standardized scores (mean r = .68) was obtained.

In the current study, the four measures of maternal self-regulation described above were collapsed into a single index by calculating the mean of the four standardized indicators. This was done so that no single measure would differentially weight the self-regulation index. These measures were also combined on the basis of recent work demonstrating that in adults, effortful control and executive functioning show considerable overlap, with specific reference to effortful control and working memory processes (Bridgett et al., 2013). Additionally, the measures described above were all associated in the anticipated direction (See Table 1), with good internal consistency of all the indicators used in forming the maternal self-regulation index (α = .80), and an average inter-item correlation of r = .41.

Maternal relationship adjustment—As a measure of relationship adjustment with their partners, mothers completed items from the Revised Dyadic Adjustment Scale (RDAS; Busby, Christensen, Crane, & Larson, 1995) comprising the consensus and satisfaction factors. The RDAS was selected based on its history of good psychometric properties and its usefulness for identifying a range of relational functioning (Busby et al., 1995). The consensus scale represents agreement between partners on aspects of relationship functioning (e.g., showing affection) and the satisfaction scale represents stability and conflict within the relationship (e.g., fighting, consideration of relationship dissolution). For the purposes of the current study, an index of overall relationship functioning was created by combining the items comprising the Consensus and Satisfaction scales into a single index of relationship adjustment (α = .84). Higher scores on this measure are consistent with better relationship adjustment.

Home chaos—Mothers completed the 15-item Confusion, Hubbub, and Order Scale (CHAOS), which assesses the degree to which the home environment is disorganized (e.g., "it's a real zoo in our home"), lacks routines ("first thing in the day, we have a regular routine at home", reverse scored), and is noisy ("you can't hear yourself think in our home"; Matheny, Wachs, Ludwig, & Phillips, 1995). This measure has demonstrated validity in terms of associations with observational measures of the home environment (e.g., Matheny et al., 1995), and has been predictive of other important family-related outcomes, such as children's behavior problems (e.g., Dumas et al., 2005). In the present investigation, the internal consistency of the CHAOS scale was good (α = .76), with higher scores being consistent with greater chaos.

Infant negative emotionality—When infants reached 6 months of age, mothers completed the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003), a widely used parent-report measure of infant temperament that has consistently demonstrated good reliability and validity (see Gartstein et al., 2012 for an overview). In the current investigation, the IBQ-R negative emotionality (NE) factor and subscales were used. The broad NE factor (α = .88) consists of the following subscales that measure finer-grained aspects of NE: sadness (α = .84), fear (α = .88), falling reactivity (α = .78), and distress to limitations/frustration (α = .79). Higher scores on the NE factor and the subscales of fear, sadness, and distress to limitations/frustration are consistent with more negative affectivity. On the other hand, lower scores on the falling reactivity subscale are consistent with greater negative affectivity.

Cumulative risk—Cumulative risk, or the presence of multiple individual risk factors, is generally considered to be a more potent risk indicator for children's negative developmental and social-emotional outcomes relative to individual risk factors (Appleyard, Egeland, Van Dulmen, & Sroufe, 2005; Deater-Deckard, Dodge, Bates, & Pettit, 1998). In the current study, a cumulative risk index was calculated, potentially ranging from zero to five. Each participant received one point towards cumulative risk for each of the following: maternal education less than high school completion, teen motherhood, defined as being 17, 18, or 19 years of age, single parent status, a household income falling at or below poverty threshold (i.e. an income-to-needs ratio of 1.00 or less), and a current or past major depressive episode(s) based on the Structured Clinical Interview for DSM-IV (First, Spitzer, Gibbon, & Williams, 2002). Prior work has identified these socio-demographic and maternal factors as placing children at risk for negative developmental outcomes (e.g., Jaffee, Caspi, Moffitt, Belsky, & Silva, 2001; Jones, Forehand, Brody, & Armistead, 2003; Lanza, Rhoades, Greenberg, Cox, & The Family Life Project Key Investigators, 2011). Maternal depression was included in the cumulative risk index on the basis of prior work that has used a similar approach (e.g., Lanza et al.), as well as to account for extreme levels of maternal negative affectivity.

Analytic Approach

In the current study, the potential effects of two mediators (i.e. home chaos and maternal relationship adjustment) of the effect of maternal self-regulation on infant NE were examined. While it would have been ideal to test each model (i.e. one model for broad infant NE, and one model for each of the four finer-grained aspect of infant NE) once, the presence of single mothers in the sample necessitated a different approach. Specifically, in one set of models, when home chaos was considered, the full sample (n = 84) was used. However, in a separate set of models (n = 73), wherein maternal relationship adjustment was considered, single caregivers were excluded from analyses.

Prior to analyses, all variables were examined for normality. Following recommendations made by Tabachnick and Fidell (2007), variables exhibiting significant skew such that $z = +/- 2.00$, based on a z-test calculated by dividing skew by the standard error of skew, were transformed using a logarithmic transformation (See Table 2 for Variable Means and Standard Deviations). Regression analyses were conducted with EQS 6.1 (Bentler, 2006). Direct associations between maternal self-regulation, infant NE, inter-parental relationship adjustment, and home chaos were initially examined, followed by analyses with these variables wherein the indirect effects of maternal self-regulation on broad and specific indicators of infant NE were estimated. Information regarding indirect effects was obtained using the effect decomposition feature of EQS 6.1. In addition to this feature for examining indirect effects, the use of the EQS 6.1 software also permitted the use of full information maximum likelihood estimation to model missing data, resulting in analyses which utilize the entire sample.

Results

Missing Data and Preliminary Analyses

As is frequently the case in longitudinal research, there was some attrition (19.0%) between Time 1 and, two months later, Time 2. To examine the possibility of systematic patterns of missing data, Little's MCAR test (Little, 1988) was conducted, χ^2 (47) = 32.32, $p > .05$. Because Little's MCAR test was not significant, evidence suggests that there are not systematic patterns present that might account for missingness, providing support that data are missing completely at random. Given these findings, full information maximum likelihood estimation was used to estimate missing values.

Analyses were performed to examine the possibility of infant gender differences in temperament attributes, with separate analyses examining associations between cumulative risk and maternal, home, and infant characteristics. No gender differences emerged from these analyses, and as such, infant gender was not considered as a covariate in subsequent analyses. However, there was a significant negative association between maternal self-regulation and cumulative risk, $r=-.33$, $p < .05$ (See Table 3 for Associations between Cumulative Risk and all other Variables). As such, cumulative risk was included as a covariate in tests of direct and indirect effects described below.

Direct Effects

Using maximum likelihood estimation to account for missing data, and controlling for cumulative risk, maternal self-regulation had a significant direct effect on infant NE two months later, $b^*=-.38$, $z= -2.95$, $p < .05$ (See Table 2 for Zero-Order Associations between Study Measures). Maternal self-regulation also predicted infant distress to limitations/frustration, $b^*=-.37$, $z= -2.91$, $p < .05$, falling reactivity, $b^* = .36$, $z = 2.72$, $p < .05$, and sadness, $b^*= -.21$, $z= -1.97$, $p < .05$. Although in the anticipated direction, maternal self-regulation was not a significant predictor of infant fearfulness, $b^* =-.18$, $z= -1.47$, $p > .05$. Next, as anticipated, better maternal self-regulation also predicted less home chaos, $b^*= -.32$, $z= -2.66$, $p < .05$, and better inter-parental relationship adjustment, $b^* = .40$, $z = 3.39$, $p < .05$.

Analyses examining the direct effects of inter-parental relationship adjustment and home chaos on infant NE were also tested. Both inter-parental relationship adjustment, $b^*= -.45$, $z= -3.76$, $p < .05$, and home chaos, $b^*= .28$, $z= 2.37$, $p < .05$, predicted broad infant NE. Better inter-parental relationship adjustment also predicted lower infant distress to limitations/frustration, $b^* = -.38$, $z= -3.15$, $p < .05$, and sadness, $b^*= -.42$, $z = -3.47$, $p < .05$, and better/higher falling reactivity, $b^* = .34$, $z = 2.67$, $p < .05$. There was no direct effect

of maternal inter-parental relationship adjustment on infant fearfulness, $b^*= -.16$, $z= -1.19$, $p > .05$. Although home chaos did not demonstrate a direct effect on infant fearfulness, $b^* = .08$, $z = 0.69$, $p > .05$, sadness, $b^*= .20$, $z = 1.72$, $p > .05$, or falling reactivity, $b^*= -.19$, $z= -1.63$, $p > .05$, the direct effect of home chaos on infant distress to limitations/frustration, $b^* = .36$, $z = 3.16$, $p < .05$, was significant.

Tests of Indirect Effects: Maternal Self-Regulation, Home Chaos, and Infant Negative Emotionality

With home chaos in the model, better maternal self-regulation predicted less chaotic home environments, $b^*= -.34$, $z= -2.49$, $p < .05$, and remained directly related to infant NE, $b^*= -.32$, $z= -2.45$, $p < .05$. However, home chaos was no longer a significant predictor of broad infant NE, $b^* = .19$, $z = 1.77$, $p < .10$ ($R^2 = .16$ for the model predicting infant NE). Furthermore, the indirect effect of maternal self-regulation on infant NE through home chaos, while in the anticipated direction, also was not significant, $b^*= -.06$, $z= -1.39$, $p > .05$.

In the model predicting infant distress to limitations/frustration, the effect of maternal self-regulation remained significant, $z= -2.24$, $p < .05$, but was attenuated with home chaos in the model. Importantly, the test of the indirect effect of maternal self-regulation on infant distress to limitations/frustration was significant, $z= -1.99$, $p < .05$, indicating that home chaos partially accounts for the effect of maternal self-regulation on infant distress to limitations/frustration (See Figure 1). Because there were no direct effects of home chaos on any other aspect of infant NE, tests of additional indirect effects were not considered.

Tests of Indirect Effects: Maternal Self-Regulation, Relationship Adjustment, and Infant Negative Emotionality

With maternal relationship adjustment in the model, maternal self-regulation was no longer a significant predictor of broad infant NE, $z= -0.14$, $p > .05$. However, better maternal self-regulation remained associated with better maternal relationship adjustment, $z = 3.93$, $p < .05$. Similarly, better maternal relationship adjustment remained a significant predictor of lower infant NE two months later, $z= -3.37$, $p < .05$. The test of the indirect effect of maternal self-regulation on infant NE through maternal relationship adjustment was also significant, $z= -2.38$, $p < .05$, indicating that maternal relationship adjustment mediates the relationship between maternal self-regulation and infant NE (See Figure 2).

Findings regarding more specific aspects of infant NE were largely in line with those obtained for broad infant NE. Specifically, direct associations between maternal self-regulation and infant distress to limitations/frustration, $z= -0.44$, $p > .05$, and sadness, $z = 0.68$, $p > .05$, were not significant with maternal inter-parental relationship adjustment included in the model. Although maternal self-regulation remained a significant predictor of infant falling reactivity, $z = 2.27$, $p < .05$, this effect was attenuated with maternal inter-parental relationship adjustment included in the model. Tests of indirect effects were significant for the distress to limitations/frustration, $z = -2.81$, $p < .05$, sadness, $z= -2.40$, $p < .05$, and falling reactivity, $z= 2.00$, $p < .05$, models, indicating that maternal relationship adjustment mediates associations between maternal self-regulation and these specific aspects of infant NE (See Figures 3 and 4). Because maternal self-regulation and inter-parental relationship adjustment were not significant predictors of infant fearfulness, the indirect effect of maternal self-regulation on infant fearfulness was not tested.

Discussion

In the current investigation, associations between maternal self-regulation, home chaos, maternal inter-parental relationship adjustment, and subsequent infant NE were considered. First, our finding that maternal self-regulation was related to infant NE is consistent with other studies noting similar associations (e.g., Davenport et al., 2011), adding to this work by identifying that this association is present as early as infancy. Next, although in the current study home chaos was also a predictor of broad infant NE, based on the pattern of results, this effect appears to be largely driven by the contribution of home chaos to infant distress to limitations/frustration. Given that infants are almost entirely dependent on having their needs met by caregivers, it may be that in a more chaotic environment (i.e. one that is more noisy, and characterized by more commotion, and intrusions), mothers experience difficulties detecting when their infant has an unmet need or have trouble promptly responding to an unmet need, resulting in increased infant frustration. Although this possibility will need to be more closely considered in future work, interventions targeting reductions in home chaos may make caregivers more available to meet the needs of their infant, contributing to lower infant frustration.

Although the influence of chaos on young children's NE has been infrequently considered, the finding of the relatively unique contribution of home chaos to infant distress to limitations/frustration adds to this literature, and is consistent with findings reported by Dumas et al. (2005), who noted that children residing in more chaotic homes exhibited heightened levels of angry/aggressive emotions and behaviors. Finally, insomuch as the frustration/anger aspect of NE has been consistently linked with externalizing problems in older children (e.g., Eisenberg et al., 2001; Eisenberg et al., 2005; Gartstein, Putnam, & Rothbart, 2012; Hayden, Klein, & Durbin, 2005; Zhou, Main, & Wang, 2010), and chaos has been consistently tied to externalizing problems (e.g., Coldwell et al., 2006; Hardaway et al., 2012), our findings suggest that the link between chaos and externalizing problems may be through the effects of chaos on children's frustration. Future studies will need to more directly examine this possibility.

Consistent with prior work in samples of older children (e.g., Crockenberg & Langrock, 2001; Davies, Sturge-Apple, Cicchetti, Manning, & Zale, 2009; El-Sheikh, 2005; Koss et al., 2001; see Crockenberg et al., 2007 for a notable exception in a sample of infants), we also identified a link between lower maternal inter-parental relationship functioning and higher infant NE, including broad NE and the specific negative emotions of sadness and frustration/distress to limitations. Lower maternal relationship functioning was also associated with infant's lower falling reactivity, an early marker of emotion regulation. As noted by Crockenberg et al. (2007), infants who are exposed to worse inter-parental relationships may be prone to experiencing greater negative arousal, a possibility that is also supported by our findings. Our findings are also in line with work suggesting that problematic parental relationships interfere with parents' ability to provide emotional support for their children (e.g., Mahoney et al., 1996; Sturge-Apple et al., 2006), subsequently contributing to more negative emotional arousal and regulatory difficulties.

Next, we considered the potential effects of maternal self-regulation on home chaos and inter-parental relationship adjustment. In this regard, our findings point to an important link between maternal self-regulation and inter-parental relationship adjustment. This finding is consistent with work suggesting that self-regulatory difficulties place individuals at risk for engaging in intimate partner violence (e.g., Finkel et al., 2009; Pinto et al., 2009), and extends existing studies by linking self-regulation to more normative individual differences in inter-parental relationship functioning. Similarly, up to this point, only two prior studies have examined the contributions of parental self-regulation to home chaos (Deater-Deckard

et al., 2012; Valiente et al., 2007), with findings similar to the effect identified in the current investigation. The findings wherein maternal self-regulation influences inter-parental relationship adjustment and home chaos suggest that this maternal characteristic influences multiple aspects of the proximal home environment in which children are raised, adding to a small but growing body of work demonstrating similar effects.

Finally, we considered the possibility that maternal inter-parental relationship adjustment and home chaos would mediate the effects of maternal self-regulation on broad and specific indicators of infant NE, yielding additional important findings that potentially qualify some of the direct effects described above. Maternal inter-parental relationship functioning mediated the links between maternal self-regulation and broad infant NE, as well as specific aspects of infant NE (with the notable exception of infant fearfulness). This finding supports the notion that poor maternal self-regulation, in part, may compromise infant NE through inter-parental relationship adjustment. Next, the direct effect of maternal self-regulation on infant distress to limitations/frustration was mediated by home chaos. This finding further emphasizes the importance of parental self-regulation for aspects of the home environment, such as maternal ability to plan/manage, structure, and provide consistency to children. Furthermore, these results are some of the first to highlight how maternal self-regulation may influence infant emotionality indirectly through environmental pathways.

Although several expected effects were identified, infant fearfulness was not influenced by maternal self-regulation, inter-parental relationship adjustment, or home chaos. One possibility for these findings may be the later developmental timing of fearfulness. Prior work suggests that fear begins to come online between 6 and 12 months of age, and starts increasing in terms of frequency and intensity of fearful emotional displays during this timeframe (Carnicero, Perez-Lopez, Gonzalez-Salinas, & Martinez-Fuentes, 2000; Rothbart, 1988). A recent investigation employing growth modeling also suggests that extrinsic factors, such as maternal symptoms of depression, may not begin to influence infant fearfulness until 8 to 12 months of age (Gartstein et al., 2010). Thus, maternal and environmental characteristics may not influence earlier manifestations of infant fearfulness, such as at 6 months of age when fearfulness was examined in the current investigation. However, it may be that maternal self-regulation, and/or aspects of the home environment influence infant fearfulness later in infancy, and future studies will need to consider this possibility.

Given the findings and approach used in the current investigation, there is also an important methodological implication. Prior work has noted the differential effects of aspects of NE on children's outcomes (e.g., Eisenberg et al., 2001; Eisenberg, et al., 2009; Gartstein, Putnam, & Rothbart, 2012), suggesting that broad NE, as well as specific aspects of NE, should be considered. Similar to work noting potentially diverging pathways from aspects of infant NE to behavioral difficulties, our findings suggest that there may be risk factors that influence specific aspects of NE (e.g., home chaos influencing distress to limitations/frustration) and risk factors affecting NE more broadly (e.g., inter-parental relationship adjustment). However, while home chaos may initially influence children's frustration/anger during infancy, it might be that the effects of chaos on other aspects of NE emerge later. Moreover, because this is one of the first studies to report findings regarding the differential effects described above, these effects need to be further examined in future studies that not only consider broad NE, but also specific sub-components of NE (e.g. frustration, sadness, and fear).

Conclusion, Limitations, and Future Directions

Prior work examining the contributions of parental self-regulation to the family environment and to children's outcomes has largely focused on parenting (e.g., Bridgett et al.,2011;

Deater-Deckard et al., 2010), noting that poor parental self-regulation places children at risk for experiencing negative, harsh, and reactive parenting practices (e.g., Deater-Deckard et al.). Along with findings in the current study, several studies have also noted that poor parental self-regulation is linked with more chaotic home environments (e.g., Valiente et al., 2007). Finally, we also reported the importance of maternal self-regulation for inter-parental relationship adjustment. Broadly, findings in this study, along with findings in prior work linking parental self-regulation to parenting and home chaos, suggest that parental self-regulation may contribute to children's outcomes through a number of environmental pathways (i.e. parenting behavior, inter-parental relationship adjustment, and home chaos). Nevertheless, consideration of the influence of parental self-regulation on children and the family still represents a largely unexamined area, and additional work is needed to extend our findings and those reported in other recent investigations. Likewise, there may be additional pathways through which parental self-regulation influences children, which should be considered in future studies.

Although the current investigation makes several important contributions, there are several limitations that should be addressed in the future. First, only maternal self-regulation was considered, and work is needed that also considers the effects of paternal self-regulation on children and on the family. Although there is no reason to suspect that paternal self-regulation is more or less important than maternal self-regulation, it may be that paternal self-regulation contributes to different aspects of the family environment, or to different child outcomes relative to maternal self-regulation. It is also possible that the influence of paternal self-regulation on children, through direct or indirect pathways, may be different in terms of the developmental timing of such effects, representing a possibility that should also be considered. Along related lines, the current investigation did not utilize a genetically sensitive design, and it may be that there are genetic links between poor parental self-regulation and infant NE that need to be considered.

Next, in the current investigation, parenting was not considered. Given prior work linking parental self-regulation to parenting (Bridgett et al., 2011; Deater-Deckard et al., 2010), as well as parental relationship adjustment to parenting (e.g., Schoppe-Sullivan, Schermerhorn, & Cummings, 2007), future studies should consider the possibility of complex connections (e.g., multiple mediator models) between parental self-regulation, environmental influences, and young children's emotional development. It is also important to note that maternal self-report measures were used to assess home chaos, maternal inter-parental relationship adjustment, and infant NE, representing another potential limitation. However, in the present study, a multi-method construct was used to assess maternal self-regulation, and infant NE was not concurrently assessed with other measures, which are strengths to the approach used in the current investigation. Moreover, our findings are consistent with findings in a prior investigation that examined the effects of parental relationship adjustment on infant NE and emotion regulation using laboratory procedures (Crockenberg et al., 2007), suggesting that different methods can potentially be employed to accurately examine the effects of maternal functioning and contextual influences on infant NE. Parent self-report methods of examining infant temperament also represent an important approach for examining temperament, and have some advantages over laboratory methods (see Gartstein et al., 2012 for discussion).

In considering our findings, it is also important to note that we did not take into account potential child effects on maternal self-regulation, or on aspects of the home environment, and future studies should consider doing so. It may be that infants who frequently have behavioral/emotional displays of particularly intense negative emotions may contribute to chaos in the home environment, or to increased parental stress that spills over into the inter-parental relationship. However, at least in regard to the latter possibility, Crockenberg et al. (2007) was able to conclude that the direction of effect from inter-parental relationship

adjustment to infant characteristics appeared to be from parent to infant, as they measured marital aggression prenatally. We also measured maternal self-regulation concurrently with inter-parental relationship functioning and home chaos. Although we suspect that parents are able to use self-regulation to manage the home environment, it is possible that stressful inter-parental exchanges and chaos in the home may deplete parental ability to optimally use these skills. Future studies may also want to consider this possibility. Furthermore, it will be important for future work to examine other parental and/or environmental characteristics (e.g., parenting stress) that were not examined in this investigation, either as being influenced by parental self-regulation, influencing early infant NE, or as potentially important covariates.

Finally, although our participants consisted of a community sample, some of the characteristics (e.g., number of economically stressed families, and the presence of single mothers) of our sample suggest that, on average, a number of our participants may have been at relatively increased risk. While we accounted for the potential effects of household risk by including cumulative risk as a covariate in all analyses, given our modest sample size, our sample was not large enough for separate, parallel analyses that may have yielded a finer-grained understanding of some of the processes investigated in this study. Future studies, with larger samples, could circumvent this limitation by examining demographically distinct subgroups (e.g., single mothers, those families facing economic risk factors) to determine if processes are similar or dissimilar based on important demographic characteristics.

Despite some limitations, the present study points towards important family environment pathways through which maternal self-regulation may exert effects on infant NE, potentially resulting in children's subsequent risk for behavioral difficulties. Our findings also support the notion that maternal self-regulation, home chaos, and maternal inter-parental relationship adjustment begin to affect children as early as 6 months of age. However, continued work in this area is needed and may identify other pathways affected by parental self-regulation, as well as other mediators and moderators of such effects. Continued work in these areas will have important implications for early temperament development, and how the environment and parents may shape such development, as well as for models of early childhood developmental psychopathology.

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Highlights

1. Chaos and inter-parental relationship adjustment predicted subsequent infant NE.
2. Maternal regulation indirectly affected infant NE through environmental variables.
3. Findings suggest multiple pathways through which parent regulation affects children.

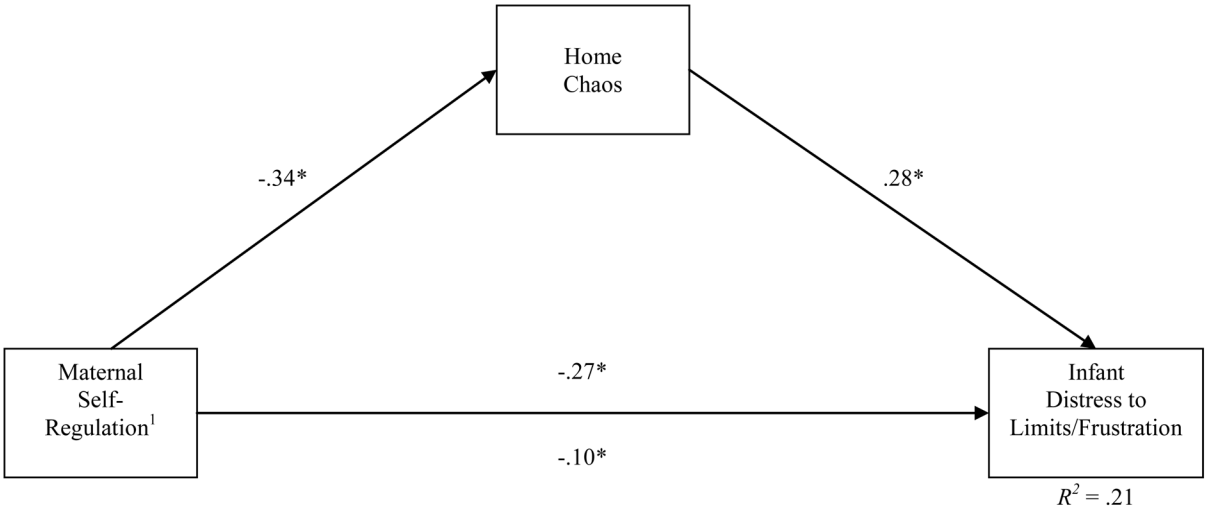

Figure 1.
Indirect Effect of Maternal Self-Regulation on Infant Distress to Limitations/Frustration through Home Chaos.
1. Direct effect, with home chaos in the model, is above the line, while the indirect effect is below the line.
* $p < .05$

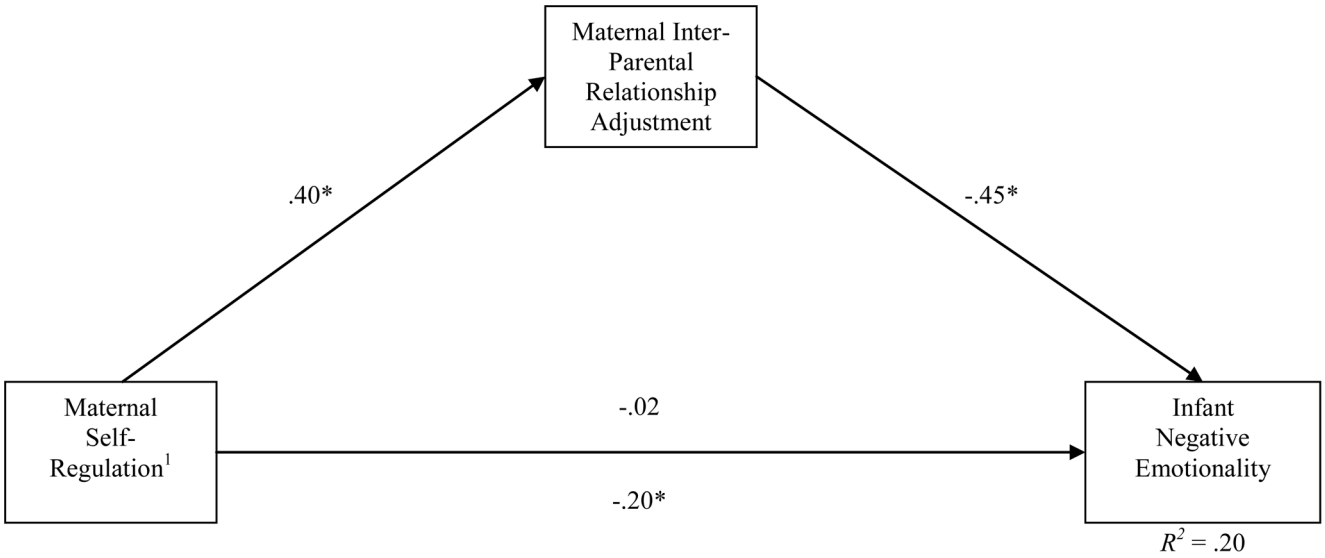

Figure 2.
Indirect Effect of Maternal Self-Regulation on Infant Negative Emotionality through Maternal Inter-Parental Relationship Adjustment.
1. Direct effect, with maternal inter-parental relationship in the model, is above the line, while the indirect effect is below the line.
* $p < .05$

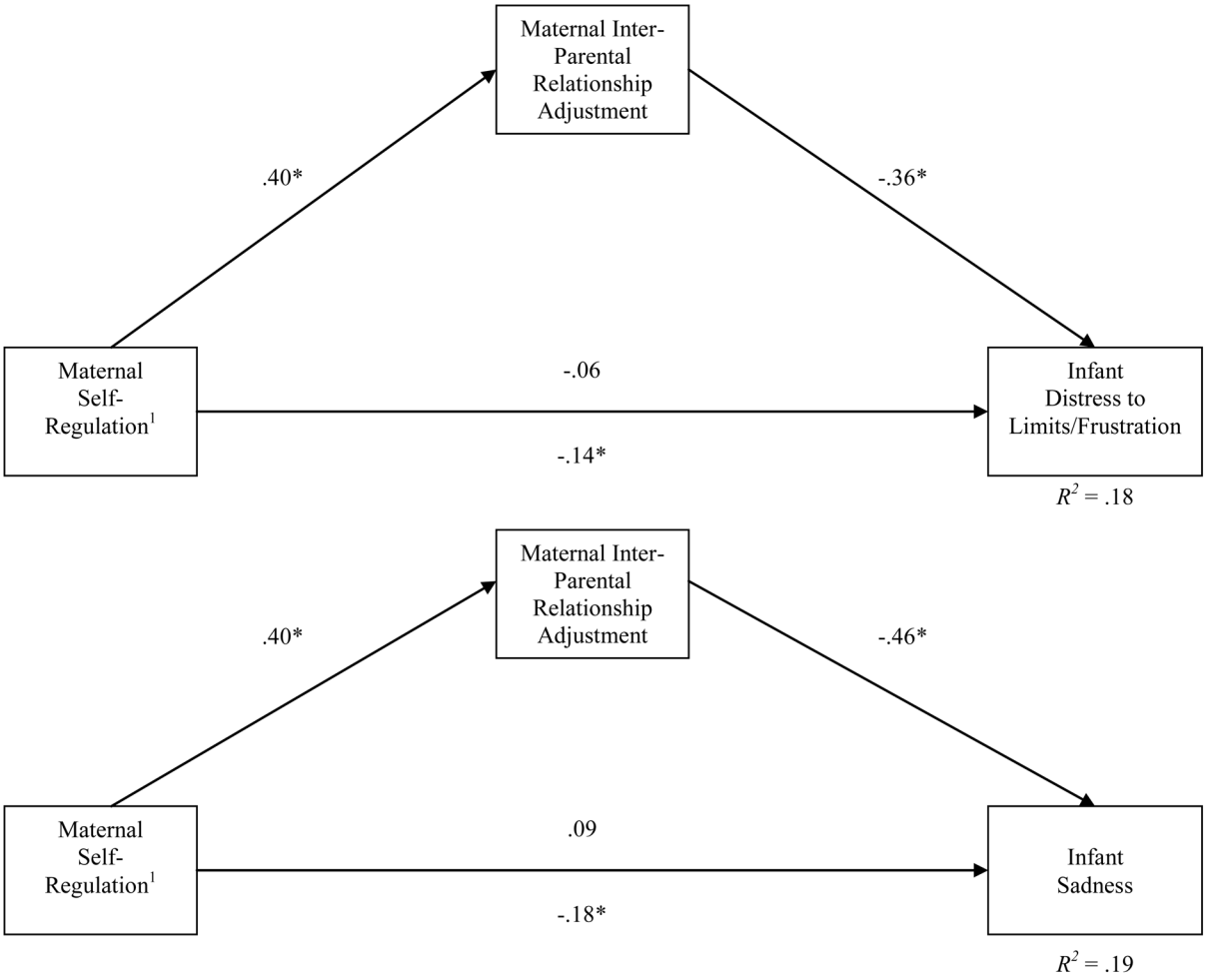

Figure 3.
Indirect Effect of Maternal Self-Regulation on Infant Distress to Limitations/ Frustrationthrough Maternal Inter-Parental Relationship Adjustment (Top Model) and Indirect Effect of Maternal Self-Regulation on Infant Sadness through Maternal Inter-Parental Relationship Adjustment (Bottom Model).
1. Direct effect, with maternal inter-parental relationship in the model, is above the line, while the indirect effect is below the line.
* $p < .05$

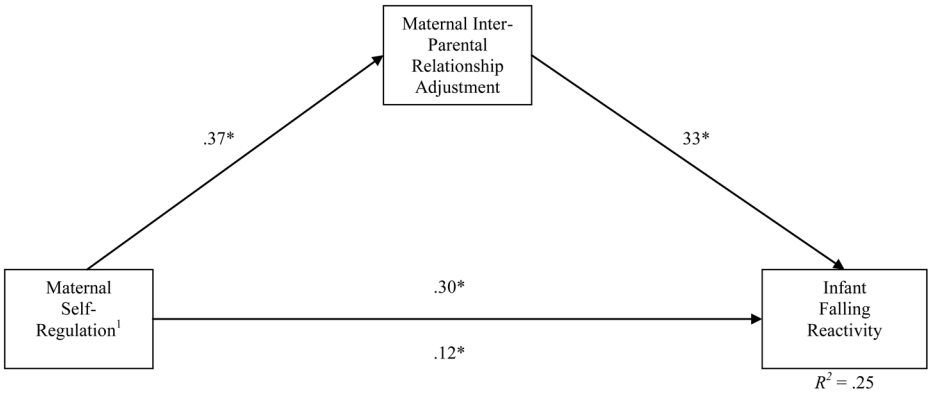

Figure 4.

Indirect Effect of Maternal Self-Regulation on Infant Falling Reactivity through Maternal Inter-Parental Relationship Adjustment.

1. Direct effect, with maternal inter-parental relationship adjustment in the model, is above the line, while the indirect effect is below the line.

* $p < .05$

Table 1

Zero-Order Associations between Self-Regulation Constructs Comprising the Maternal Self-Regulation Index

Self-Regulation Construct	1	2	3
1. ATQ Effortful Control			
2. BRIEF Total Score	.65**		
3. WAIS-IV Letter-Number Seq.	.22*	.25*	
4. D-KEFS Verbal Fluency	.22*	.11	.38**

** $p < .01$

* $p < .05$

Table 2

Variable Means and Standard Deviations

Variable	Mean	Standard Deviation
Cumulative Risk[1]	0.80	0.89
Maternal Self-Regulation[2]	0.85	0.71
Home Chaos[1]	1.21	0.20
Maternal Inter-Parental Relationship Adjustment[1]	3.81	0.66
Infant Negative Emotionality	4.25	2.61
Infant Distress to Limits/Frustration	3.51	0.89
Infant Fear[1]	2.55	0.95
Infant Falling Reactivity	5.12	0.71
Infant Sadness	3.61	1.01

[1] Variables were normalized, due to the presence of significant skew, prior to primary analyses.

[2] Prior to the development of the self-regulation variable, indices from the BRIEF were normalized due to significant skew.

Table 3

Zero-order Associations between Variables[1]

Variables	1	2	3	4	5	6	7	8
1. Cumulative Risk								
2. Maternal Self-Regulation	−.33**							
3. Home Chaos	.11	−.29**						
4. Maternal Inter-Parental Relationship Adjustment	−.08	.37**	−.24*					
5. Infant Negative Emotionality	.01	−.25*	.27*	−.44**				
6. Infant Distress to Limitations/Frustration	.16	−.24+	.36*	−.37**	.78**			
7. Infant Fear	.07	−.19	.09	−.16	.58**	.14		
8. Infant Falling Reactivity	−.01	.21+	−.19	.31*	−.72**	−.59**	−.16	
9. Infant Sadness	−.10	−.11	.19	−.42**	.84**	.58**	.33**	−.50**

[1] Associations are based on listwise deletion for the entire sample

+ $p < .10$;

* $p < .05$;

** $p < .01$