Maternal socialization of child emotion and adolescent adjustment: Indirect effects through emotion regulation

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Abstract:

A fundamental question in developmental science is how parental emotion socialization processes are associated with children's subsequent adaptation. Few extant studies have examined this question across multiple developmental periods and levels of analysis. Here, we tested whether mothers' supportive and nonsupportive reactions to their 5-year-old children's negative emotions were associated with teacher and adolescent self-reported adjustment at age 15 via children's physiological and behavioral emotion regulation at age 10 (N = 404). Results showed that maternal supportive reactions to their children's negative emotions were associated with children's greater emotion regulation in a laboratory task and also a composite of mother and teacher reports of emotion regulation at age 10. Maternal nonsupportive reactions to their children's negative emotions were uncorrelated with supportive reactions, but were associated with poorer child physiological regulation and also poorer mother- and teacher-reported emotion regulation at age 10. In turn, better physiological regulation at age 10 was associated with more adolescent-reported social competence at age 15. Furthermore, teacher and mother reports of emotion regulation at age 10 were associated with increased adolescent adjustment across all domains. Mediational effects from nonsupportive and supportive reactions to adolescent adjustment tested via bootstrapping were significant. Our findings suggest that mothers' reactions to their children's negative emotions in early childhood may play a role in their children's ability to regulate their arousal both physiologically and behaviorally in middle childhood, which in turn may play a role in their ability to manage their emotions and behaviors and to navigate increasingly complex social contexts in adolescence.

Keywords: parenting | development | emotion socialization | emotion regulation

Article:

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Saarni (1985) posited that parents' beliefs and expectations for children's emotional competence are conveyed though both indirect processes (i.e., identification, imitation, social learning) and direct processes (i.e., reinforcement, dyadic teaching); through these methods of emotion socialization, children are thought to develop emotional skills that are adaptive and appropriate within their family and cultural context. A fundamental question that developmental scientists are particularly interested in is how emotion socialization processes are associated with children's subsequent adaptation. Over two decades ago, Eisenberg, Cumberland, and Spinrad (1998) put forth one of the most influential conceptual models centered on the socialization of emotion and links to child adjustment; this model underscores the importance of emotion regulation as a mediating mechanism. Specifically, they posit that characteristics of the child, parent, culture, and context predict parental emotion socialization behaviors. In turn, emotion socialization behaviors lay the foundation for social and emotional competence through their impact on children's emotional displays, arousal, and regulation. This theoretical framework has set the stage for multiple developmental studies that have produced important findings (e.g., Jin, Zhang, & Han, 2017; Williams & Woodruff-Borden, 2015).

In their model, Eisenberg and colleagues acknowledge that the ability to modulate the intensity, frequency, and duration of emotion is both behavioral and physiological in nature, and that control of emotion at the physiological and behavioral level are associated with one another and subsequent social and emotional outcomes. To our knowledge, however, no study has tested behavioral and physiological components of this model in combination with one another across multiple developmental periods. Thus, it is unclear whether various parental emotion socialization behaviors are uniquely associated with subsequent behavioral and physiological emotion regulation. Moreover, much of this work has been conducted in early childhood and has not tested these associations during the span from early childhood into adolescence. In addition, it is not understood whether physiological and behavioral emotion regulation are unique mediators in the association between early parental emotion socialization behaviors and adjustment in adolescence. In the current study, we address these gaps by taking a longitudinal biopsychosocial approach, which advocates investigation across biological, behavioral, and social levels of analysis to account for the emergence of patterns of adjustment. Specifically, we use data spanning 10 years to assess whether maternal reactions to children's negative emotions in early childhood are associated with adolescent adjustment via their association with children's biological and behavioral emotion regulation abilities in middle childhood.

Emotion Socialization and Emotion Regulation

Emotion regulation, defined as a set of biological and behavioral processes that serve to modulate, maintain, or enhance the intensity and valence of emotional experiences to achieve a desired goal, has been conceptualized as a core component of emotional competence (Calkins & Hill, 2007). Effectively reducing heightened emotional arousal at the biological and behavioral level increases a child's ability to manage frustration in the face of social and academic challenges, manage potential anxieties, and control thoughts and behavior; all of which are necessary for navigating the school context, eliciting positive social interactions, mental health, and adaptive functioning. Thus, effective emotion socialization strategies that foster the development of biobehavioral emotion regulation abilities are critical.

Caregivers' reactions to children's negative emotions and how they are associated with children's regulation has been the focus of much emotion socialization work. It is theorized that nonsupportive reactions, characterized by dismissing, minimizing, or punishing the display of negative emotion, may intensify and prolong children's physiological arousal in emotion-eliciting situations, increasing the likelihood of dysregulated behavior (Eisenberg, Fabes, & Murphy, 1996). Punishment of negative emotion might be particularly detrimental because it communicates nonacceptance and may limit children's opportunities to practice regulating their negative emotions in the presence of an emotionally supportive caregiver who can assist and guide them should the situation become too overwhelming for them to manage independently (Eisenberg et al., 1998). In contrast, supportive reactions may reduce negative arousal and communicate acceptance and safety. By supporting the display of negative emotions, caregivers can help children label their emotions and identify potential strategies that may be useful when attempting to reduce arousal on their own (Garner, Dunsmore, & Southam-Gerrow, 2008); this likely creates a supportive emotional context in which children feel safe to experience negative emotions and are therefore better able to learn appropriate expectations regarding the display and control of negative emotion.

Empirical research supports these hypotheses. For example, preschoolers who received more maternal emotional support when distressed recognized more behavioral strategies for regulating anger than those receiving lower emotional support (P. M. Cole, Dennis, Smith-Simon, & Cohen, 2009). In a middle school sample, mothers' acceptance of children's negative emotions and reappraisal of negative events predicted children's ability to regulate negative emotions (Rogers, Halberstadt, Castro, MacCormack, & Garrett-Peters, 2016). Finally, supportive reactions to negative emotions at age 5 were associated with increases in children's emotion regulation skills from age 5 to age 7, while nonsupportive reactions were associated with decreases (Blair et al., 2014).

Nonsupportive and supportive parental reactions to children's negative emotions may also be associated with emotion regulation processes at the physiological level. Of particular interest for emotion regulation researchers is withdrawal of vagal input on the heart during emotionally charged situations. During nonchallenging situations, the vagus nerve inhibits the sympathetic nervous system's influence on cardiac activity through increased parasympathetic influence, thus producing a relaxed and restorative state (Porges, 1995). During an environmentally challenging situation, vagal influence is withdrawn to support an increase in heart rate and increased attention to the environment, which allow individuals to employ behaviors necessary to reduce arousal and cope with challenging situations. To assess vagal input, researchers have measured respiratory sinus arrhythmia (RSA), which reflects variability in heart rate that occurs at the frequency of breathing. Vagal withdrawal therefore reflects the difference between RSA at a baseline state and RSA during an emotion-eliciting task and is used as an indicator of children's physiological regulation of emotion.

It is theorized that warm and supportive responses to negative emotions may aid in the organization and development of physiological systems to achieve regulation and reduce negative affect (Moore et al., 2009); they may also help children find a balance between down-regulating their physiological response to distress and generating an effective coping strategy (Spangler & Grossmann, 1993). In contrast, nonsupportive responses may intensify children's

physiological arousal (Eisenberg, Fabes, & Murphy, 1996) and may therefore limit children's ability to generate an adaptive response.

Preliminary evidence suggests that children's effective parasympathetic regulation of emotion is promoted by supportive socialization. Maternal emotional warmth and supportiveness when their infants were 5 months old was associated with better physiological regulation (i.e., greater vagal withdrawal) at 10 months, which in turn was concurrently associated with more adaptive behavioral regulatory strategies (Perry, Calkins, & Bell, 2016). In addition, children of mothers who provided greater emotional support at age 3 had greater levels of vagal withdrawal at age 3 and age 4 when compared to children of mothers displaying lower emotional support (Perry et al., 2013). Although this work provides an important first step, no study to our knowledge has examined parental emotion socialization behaviors during early childhood, when children's emotional skills are developing rapidly and have lasting associations with adaptive functioning across developmental domains into adolescence and early adulthood. If so, it is important to better understand the mechanisms through which this association takes place.

Emotion Regulation and Adolescent Adjustment

The transition from middle childhood to adolescence is characterized by increasingly complex social relationships, greater academic challenges and expectations, and increased pressure to succeed. Adequate emotion regulation may be a key ingredient necessary for managing this transition successfully. There is a vast literature indicating that emotion regulation is associated with multiple aspects of adjustment and maladjustment including social competence, behavior problems, and academic success across childhood. For example, children who are better able to down-regulate their negative emotions are better able to use their social skills in a range of complex social situations (Eisenberg, Fabes, & Spinrad, 2006), and are more successful in peer groups (Eisenberg et al., 1997; McDowell, O'Neil, & Parke, 2000). With regard to behavior problems, Hessler and Katz (2010) found that adolescents with poor emotion regulation were more likely to engage in risk-taking behaviors such as using hard drugs, suggesting that young people with poor emotion regulation may engage in substance use to deal with their intense experience of negative emotion.

The association between emotion regulation and internalizing symptoms is somewhat less clear in the literature. Children with internalizing symptoms such as depression, anxiety, and social withdrawal are sometimes labeled as overcontrolled, implying that they regulate emotions in a hypervigilant way to suppress the expression of negative affect (Eisenberg, Spinrad, & Eggum, 2010). Indeed, among children and adolescents, the suppression of negative emotion has been linked to higher incidence of internalizing symptoms. (e.g., Eastabrook, Flynn, & Hollenstein, 2014; Hughes, Gullone, & Watson, 2011). However, other work has found no association between emotion regulation and internalizing symptoms (e.g., Halligan et al., 2013).

Finally, a growing body of work has linked emotion regulation with academic adjustment (e.g., Campbell, Spieker, Burchinal, Poe, & The NICHD Early Child Care Research Network, 2006; Oram, Ryan, Rogers, & Heath, 2017). Poor emotion regulation may make it difficult for children to meet increasingly difficult academic demands that elicit frustration, anxiety, fear, and excitement. Thus, an ability to regulate emotions in an effective way may allow children to stay

on task, finish tasks, and focus attention on learning, all of which may set the stage for greater academic achievement.

Although emotion regulation has been theoretically and empirically linked across developmental domains, long-term longitudinal work examining both biological and behavioral emotion regulation processes to multiple adolescent outcomes is relatively scarce. Short-term longitudinal studies that have been conducted are beneficial in helping uncover potential mechanisms underlying the link between emotion regulation and adaptive functioning; however, longitudinal studies spanning multiple development periods are needed to better understand whether the associations between children's emotion regulation and adjustment are long lasting and through which developmental mechanisms these associations emerge.

Emotion Regulation as a Mechanism in Emotion Socialization–Adjustment Associations

A key hypothesis in the model put forth by Eisenberg and colleagues (1998) is that parental emotion socialization behaviors may be associated with children's subsequent adjustment through children's regulation of emotional arousal. There is some empirical work supporting this theory. Using a Chinese American sample, Jin et al. (2017) found that parent-reported emotion regulation mediated the association between parents' reactions to negative emotions and children's psychopathological symptoms in middle childhood. However, this finding was only evident for parent–child dyads displaying higher-level collaboration during a laboratory task. In middle childhood, Williams and Woodruff-Borden (2015) found that physiological regulation to challenge mediated the association between nonsupportive reactions to children's negative emotions and children's emotion regulation abilities.

Taken together, there is some evidence that facilitating the development of emotion regulation at the biological and behavioral level may be one avenue through which emotion socialization is associated with subsequent adjustment. However, most of this work assesses the association between parenting behaviors and one aspect of emotion regulation, without considering how parental emotion socialization may be uniquely associated with both physiological and behavioral emotion regulation processes, and how emotion regulation at each of these levels may uniquely predict various aspects of adjustment.

The Current Study

In the current study, we added to extant research by using a biopsychosocial approach to longitudinally test several aspects of the theoretical model presented by Eisenberg and colleagues (1998). We used data spanning from early childhood to adolescence to test three hypotheses. First, we hypothesized that mothers' nonsupportive reactions in early childhood would be associated with children's poorer physiological and behavioral regulation in middle childhood, and that mothers' supportive reactions in early childhood would be associated with children's greater behavioral and physiological regulation in middle childhood. Second, we hypothesized that children's biological and behavioral emotion regulation in middle childhood would be associated with greater adjustment across multiple domains in adolescence. When deciding which adolescent outcomes to examine, we chose specific measures that tapped social, academic, behavioral, and psychological domains of functioning. Including functioning across all these

domains was important given their well-established links to emotion regulation. Rather than assessing broad composites like "positive" and "negative" functioning, we believe it is imperative to examine individual components of development separately, yet in the same model. Looking at adjustment in this way allows for a clearer examination regarding how developmental mechanisms are associated with specific competencies or problems across domains, which has greater application and intervention implications. Finally, as theorized in Eisenberg's model we hypothesized that maternal emotion socialization behaviors in early childhood would be associated with adjustment across domains in adolescence via children's emotion regulation abilities in middle childhood.

Method

Participants

This study utilized data from three cohorts of children who were part of a longitudinal study of social and emotional development. The Right Track study was approved by the Institutional Review Board at The University of North Carolina at Greensboro (IRB protocol number 07–0194). The goal for recruitment was to obtain a sample of children who were at risk for developing future externalizing behavior problems, and who were representative of the surrounding community in terms of race and socioeconomic status (SES). All cohorts were recruited through child day care centers, the County Health Department, and the local Women, Infants, and Children (WIC) program. Potential participants for cohorts 1 and 2 were recruited at 2 years of age (cohort 1: 1994–1996, and cohort 2: 2000–2001) and screened using the Child Behavior Checklist (CBCL 2–3; Achenbach, 1992), completed by the mother, in order to oversample for externalizing behavior problems. Children were identified as being at risk for future externalizing behaviors if they received an externalizing *T* score of 60 or above. Efforts were made to obtain approximately equal numbers of boys and girls. This recruitment effort resulted in a total of 307 children. Cohort 3 was initially recruited when infants were 6 months of age (in 1998) for their level of frustration, based on laboratory observation and parent report, and was followed through the toddler period (see Calkins, Dedmon, Gill, Lomax, & Johnson, 2002 for more information). Children from Cohort 3 whose mothers completed the CBCL at 2 years of age ($N = 140$) were then included in the larger study. Of the entire sample ($N = 447$), 37% of children were identified as being at risk for future externalizing problems at age 2. There were no significant demographic differences between cohorts with regard to gender, race, or 2-year SES.

Of the 447 originally selected participants, 6 were dropped because they did not participate in any data collection at 2 years old. An additional 12 families participated at recruitment, did not participate at 2-year, but did participate at later years. At age 5, 365 families participated. There were no significant differences between families who did and did not participate in terms of gender, race, 2-year SES, and 2-year externalizing *T* score. At age 10, 357 families participated. No significant differences were noted between families who did and did not participate in the 10-year assessment in terms of child gender, race, 2-year SES, and 2-year externalizing *T* score. At age 15, 327 families participated. No significant differences were noted between families who did and did not participate in the 10-year assessment in terms of child race, 2-year SES, and 2-

year externalizing *T* score. However, boys were less likely to participate in the 15-year assessment $\chi^2(1, N = 447) = 9.31, p = .002$.

The sample for the current study included 404 children (53% girls, 47% boys) who had available data for at least one time point; 66% of the sample was European American, 28% African American, 4% biracial, and 2% identified as "other." Four participants were dropped from the current study due to developmental delays. Families were economically diverse based on Hollingshead (1975) scores at the 2-year assessment, with a range from 14 to 66 (M = 39.73, SD = 10.92), thus representing families from each level of social strata typically captured by this scale. Hollingshead scores that range from 40 to 54 reflect minor professional and technical occupations considered to be representative of middle class. Three percent of mothers did not graduate from high school, 13% of mothers completed high school, 35% had attended some college, 37% graduated from college, and 12% obtained an advanced degree; 81% of mothers were married.

Procedure

The current analyses include data collected when children were 5, 10, and 15 years of age. We chose to use a measure of maternal reactions to negative emotions at age 5 because early childhood is characterized by the most rapid growth in children's emotional skills (Kopp, 1989). Thus, supportive and nonsupportive reactions to negative emotions during this time period may be particularly salient and have long-lasting associations with adjustment. At age 10, children came into the laboratory and participated in multiple behavioral tasks. Children's observed emotion regulation and physiological regulation during a frustration task were used in the current study. Children were videotaped participating in laboratory tasks, and videotapes were used for behavioral coding. Mothers and teachers also reported on children's emotion regulation when children were 10 years old. We chose age 10 to measure child regulation given that this is the closest assessment we had to the transition to middle school, a time of increased cognitive and emotional challenge during which children's regulatory skills may be strongly predictive of future adjustment. At the 15-year assessment, teachers and adolescents completed questionnaires reporting on adolescents' functioning. We chose to look at outcomes at age 15 because this age is associated with the transition to high school, during which adjustment is correlated with functioning into adulthood (Trzesniewski et al., 2006). Only the measures relevant for the current study are reported here.

Measures

Maternal reactions to negative emotions at age 5

Mothers completed the Coping with Children's Negative Emotions Scale (Fabes, Eisenberg, & Bernzweig, 1990) designed to assess the ways in which they respond to their child's emotional distress. Mothers are provided with 12 scenarios in which their child experiences a negative emotion (e.g., angry or sad) and are asked to indicate the likelihood that they would respond in a minimizing, punishing, dismissing, problem-focused, emotion-focused, or expressive way. This measure yields six subscales: distress reactions, punitive responses, minimization reactions, expressive encouragement, emotion focused reactions, and problem focused reactions. Higher

scores on each subscale indicate more frequent use of that particular response. Following previous research, two aggregates, supportive and nonsupportive reactions, were calculated by averaging the items from the subscales (Denham & Kochanoff, 2002). Nonsupportive reactions include the minimizing, punitive, and distress reaction scales; supportive reactions include the encouraging, emotion-focused, and problem-focused reaction scales. There was high internal reliability for both subscales (supportive $\alpha = .88$; nonsupportive $\alpha = .83$).

Physiological regulation at age 10

Parasympathetic regulation, as indexed by vagal activity, was used to assess physiological regulation. To measure vagal activity, EKG was recorded during a baseline procedure in which children watched an emotionally neutral 5-min video and during the puzzle box frustration task (Eisenberg, Fabes, Guthrie et al., 1996; see description of task below). Electrodes were connected to a preamplifier, the output of which was transmitted to a vagal tone monitor (VTM-I, Delta Biometrics, Inc, Bethesda, MD) for R-wave detection. The vagal tone monitor computed and displayed an estimate of vagal activity every 30 s. This epoch duration was used to maximize the use of available data from each task and is typical for studies with tasks of short duration (Calkins & Keane, 2004; Doussard-Roosevelt, Montgomery, & Porges, 2003).

Estimates of vagal activity were calculated using Porges's (1995) method of analyzing interbeat interval (IBI) data. This method applies an algorithm to the sequential heart period data. The algorithm uses a moving 21-point polynomial to detrend periodicities in heart period (HP) slower than RSA. A bandpass filter then extracts the variance of HP within the frequency band of spontaneous respiration (.12–1.0 Hz) in children. This frequency band has been consistently examined and identified as having associations with child functioning (Stifter & Fox, 1990). The MXEDIT software was used to analyze and edit IBI files. Editing the files consisted of scanning the data for outlier points relative to adjacent data and replacing those points by dividing them or summing them so that they would be consistent with the surrounding data. Data files that required editing of more than 10% of the data were not included in the analyses (17 files were removed due to artifact at age 10).

Parasympathetic physiological regulation is thought to be indexed by vagal withdrawal (a decrease in RSA) during situations where emotional regulation is necessary. Thus, to calculate vagal withdrawal, vagal tone during the frustrating puzzle task was subtracted from vagal tone during the baseline task such that positive values indicate greater withdrawal and increased physiological regulation.

Observed emotion regulation at age 10

Children's emotion regulation skills were observed during the puzzle box task (Eisenberg, Fabes, Guthrie et al., 1996). A puzzle box was placed in front of the child that contained Plexiglas in the back of a box, and draping cloth with sleeves in it at the front of the box. The child was instructed to stick their arms through the sleeves and attempt to put together a puzzle in the box without looking (the sleeves can easily be lifted). The current study employed measures of physical venting and verbal negativity when completing the task. Physical venting included deliberate aggressive behaviors that indicate frustration (i.e., slight stomps, banging hands/fists

on table) and was coded dichotomously (0 = no physical venting, 1 = physical venting present). Verbal negative expressions included any negative comments that reflected the child's distress about the puzzle (i.e., "This is hard," "She is mean"). The scale ranged from 0 (*no negative expressions*) to 3 [*a lot (4 or more) of negative expressions*]. Behaviors were coded in 30-s intervals and summed to create overall physical venting and negative verbal expression scores. Two coders trained by working together on 15% of the videotaped sessions and independently scoring another 15% for reliability purposes. Cohen's kappa for physical venting and verbal negative expressions was .81 and .88, respectively. The physical venting and negative expressions scales were summed, and the composite was multiplied by −1 so that higher scores reflected fewer physical and verbal venting and better emotion regulation. This composite was log-transformed to address skew (before transformation skew = 3.12, after log transformation skew = −1.81).

Reported emotion regulation at age 10

Mothers and teachers completed the Emotion Regulation Checklist (Shields & Cicchetti, 1997). This measure assesses reporters' perception of the child's negative lability and regulation and includes 24 items rated on a 4-point Likert scale indicating how frequently the behaviors occur (1 = *almost always* to 4 = *never*). Given our greater interest in the regulation of negative emotion, we used only the lability/negativity subscale. Questions from the lability/negativity subscale include "Is easily frustrated" and "Transitions well from one activity to another without becoming anxious, angry, or distressed." We used mean composites of mothers' and teachers' reports, which were positively correlated, $r = .43$, $p < .001$ and had adequate internal reliability (mothers $\alpha = .87$; teachers $\alpha = .90$). This composite across two informants was chosen in order to capture children's emotion regulation across the home and school contexts. For greater interpretability, we multiplied the composite by −1 so that higher scores reflected better emotion regulation.

It is important to note that our measures do not allow us to make a distinction between emotional reactivity and regulation. Unfortunately, this is a consistent problem with most emotion regulation measures in the field (P. M. Cole, Martin, & Dennis, 2004). Because we were interested in the association between maternal reactions to negative emotions, and how they were associated with the subsequent regulation of negative emotion, we chose measures of physical and verbal venting, as well as the lability/negativity subscale of the ERC, because we believe they best assessed children's inability to regulate their negative arousal. As such, less negative emotional reactivity in both measures is reflective of better emotion regulation.

Internalizing problems at age 15

Adolescents completed the Self-Report of Personality (SRP-A) adolescent version of the Behavior Assessment System for Children (BASC-2; Reynolds & Kamphaus, 2004) at the 15-year assessment. This 176-item questionnaire assesses how the adolescent perceives themselves, including their behavior, emotions, and personality characteristics. The Internalizing Problems composite includes seven subscales, Atypicality (e.g., unusual perceptions and behaviors a child may have), Anxiety (e.g., child's frequency and level of perfectionism, nervousness, and feelings of worry and fear), Depression (e.g., depressive symptoms such as crying easily, loneliness,

feeling sad, and having the desire to harm or kill oneself), Locus of Control (e.g., belief that rewards and punishments are influenced by external events or people), Social Stress (e.g., worry or distress related to social situations sense of inadequacy), Sense of Inadequacy (e.g., adolescent's perception that he or she is unsuccessful in school, unable to achieve goals, and generally inadequate), and Somatization (e.g., physical aches and pains). This subscale had adequate internal reliability (59 items; $\alpha = .96$).

Risk-taking at age 15

Adolescents reported on their own engagement in risky behavior. The measure was adapted from multiple risk-taking self-report questionnaires (i.e., Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004; Halpern-Felsher, Cornell, Kropp, & Tschann, 2005) and consisted of 27 items. Both minor risky behaviors (i.e., "drunk a bottle or glass of beer or other alcohol") and major (sometimes considered antisocial) risky behaviors (i.e., "purposely set a fire in a building or in any other place") were included. Adolescents reported on how frequently they have engaged in each behavior (0 = *not at all* to 2 = *more than twice*). A total risk-taking score was derived by summing across the items.

Social competence at age 15

Adolescents completed the Friendship Quality Questionnaire (FQQ; Parker & Asher, 1993) to assess their perceptions of their closest friendship. This 40-item measure asks the child to rate the quality of a specific relationship and includes items such as "always tell each other our problems" and "makes me feel good about my ideas," rated on a 5-point Likert scale (0 = *not at all* to 4 = *always*). The FQQ contains six subscales: conflict/betrayal, caring/validation, companionship/recreation, intimate disclosure, conflict resolution, and help/guidance. When necessary, items were reverse scored, and these subscales were used to create an overall friendship quality variable ($\alpha = .79$). Higher scores were indicative of greater friendship quality.

Adolescents also completed the Social Skills Rating System (Gresham & Elliott, 1990) secondary level questionnaire for Grades 7–12. The adolescent was asked to rate how often he or she exhibits a behavior. Ratings ranged from 0 (*never*) to 2 (*very often*). We used the social skills scale (40 items; $\alpha = .81$), which is a mean composite of the assertion (i.e., initiating behaviors), cooperation (i.e., helping others), empathy (i.e., show concern or respect for others' feelings and viewpoints), and self-control (i.e., behaviors that emerge in conflict situations) subscales. Higher scores were indicative of greater social skills.

Because social competence comprises both quality of relationships and social skills (Hinde, 1987), we standardized the friendship quality and social skills subscales and created a mean composite ($\alpha = .50$).

School problems at age 15

Adolescents' 10th-grade teachers used the Teacher Rating Scales (TRS) from the BASC-2 (Reynolds & Kamphaus, 2004) to report on children's school problems. The teacher-reported School Problems index (15 items; $\alpha = .83$) includes the attention problems subscale (e.g., how

well a child is able to listen and pay attention to important stimuli, how well s/he can sustain their attention) and the learning problems subscale (e.g., how well a child is functioning in school with class assignments and overall comprehension of the material).

Results

Preliminary Analyses

Descriptive statistics and correlations for primary study variables are presented in Table 1. Maternal supportive and nonsupportive reactions were not correlated, indicating that they represent distinct constructs and are not on the same continuum. Maternal supportive reactions were associated with greater child observed emotion regulation in the laboratory, better child emotion regulation as reported by teachers and mothers, fewer adolescent-reported internalizing behaviors, and greater adolescent-reported social competence. Maternal nonsupportive reactions were associated with poorer child physiological regulation (i.e., lower vagal withdrawal scores), poorer child emotion regulation as reported by mothers and teachers, less social competence as reported by adolescents, and greater adolescent self-reported risk-taking behaviors.

Table 1. Correlations and Descriptive Statistics

Study variable	1	2	3	4	5	6	7	8	9	10	11
1. SES	—										
2. 2yr externalizing	–.16*	—									
3. 5yr supportive reactions	.03	.05	—								
4. 5yr non-supportive reactions	–.03	.22*	.07	—							
5. 10yr vagal withdrawal	–.01	.00	.01	–.18*	—						
6. 10yr Obs ER	–.06	.02	.13*	.02	.15*	—					
7. 10yr MR/TR ER	.15*	–.46*	.15*	–.27*	.04	.05	—				
8. 15yr AR internalizing	–.08	.20*	–.14*	.05	–.07	–.04	–.24*	—			
9. 15yr AR risk-taking	–.11*	.17*	–.04	.16*	–.03	–.05	–.30*	.31*	—		
10. 15yr AR social competence	.15	–.07	.12*	–.15*	.17*	.15*	.31*	–.22*	–.24*	—	
11. 15yr TR school problems	–.15*	.14*	–.04	.11	–.08	–.17*	–.37*	.23*	.29*	–.31*	—
Mean	39.73	53.06	5.46	2.65	.80	3.76	1.64	332.64	4.20	30.08	51.11
Standard deviation	11.11	9.87	.62	.56	.79	1.87	.39	53.12	3.66	8.01	9.94
Minimum	14.00	30.00	2.53	1.56	–2.11	–1.39	1.00	253	.00	.41	39.00
Maximum	66.00	91.00	6.78	4.91	3.36	4.61	3.07	528	19	67	90.00
Skew	–.17	.27	–.78	.58	.09	–1.81	.89	1.13	1.29	.01	1.52
(SE)	(*.12*)	(*.12*)	(*.13*)	(*.13*)	(*.16*)	(*.15*)	(*.13*)	(*.14*)	(*.14*)	(*.14*)	(*.16*)
N	404	404	342	342	247	282	339	299	299	300	214

Note. SES = socioeconomic status; ER = emotion regulation; Obs = observed; MR = mother reported; TR = teacher reported; AR = adolescent reported.
* $p < .05$.

Primary Analyses

A path analysis was conducted to examine associations between maternal supportive and nonsupportive reactions at age 5, children's emotion regulation (i.e., physiological, observed, and reported) at age 10, and adolescent adjustment (teacher- and self-reported) at age 15. Mplus (Version 8; Muthén & Muthén, 2017) was used to conduct the analyses, and Full Information Maximum Likelihood (FIML) was used to handle missing data.

Covariates

In selecting covariates, we considered that parenting is often associated with child sex, race, and income (Hill, 2001; Lytton & Romney, 1991; Nelson, Leerkes, O'Brien, Calkins, & Marcovitch, 2012). SES and child sex were correlated with age 10 negative emotional reactivity measures and many of the age 15 adjustment outcomes. However, race was not correlated with any outcome variable and was therefore not included. Because participants for the current study were oversampled for externalizing behaviors at age 2, and these behaviors were correlated with some of the 10-year and 15-year measures, we also included 2-year externalizing behaviors as a covariate. Finally, because RSA reactivity to a stressor is not independent of baseline RSA functioning (El-Sheikh et al., 2009), we included baseline RSA as a covariate in the model. With regard to model building, child sex, 2-year externalizing behaviors, and family SES were regressed on to all study variables; baseline RSA was only regressed on our measure of vagal withdrawal.

Model fit

Evaluation of model fit was assessed by examining the comparative fit index (CFI; Marsh & Hau, 2007), the standardized root-mean-square residual (SRMR), and the root mean square error of approximation (RMSEA; D. A. Cole & Maxwell, 2003). Values close to or greater than .95 indicate good model fit for the CFI, values less than .06 indicate good model fit for RMSEA, and values less than or equal to .08 indicate good model fit for SRMR (Hu & Bentler, 1999). Based on these criteria, the hypothesized model was an excellent fit to the data, χ^2 (26, N = 404) = 38.59, p = .06, CFI = .97, SRMR = .04, RMSEA = .03 [CI = .00, .06] (standardized coefficients are provided in Figure 1; unstandardized coefficients are provided below).

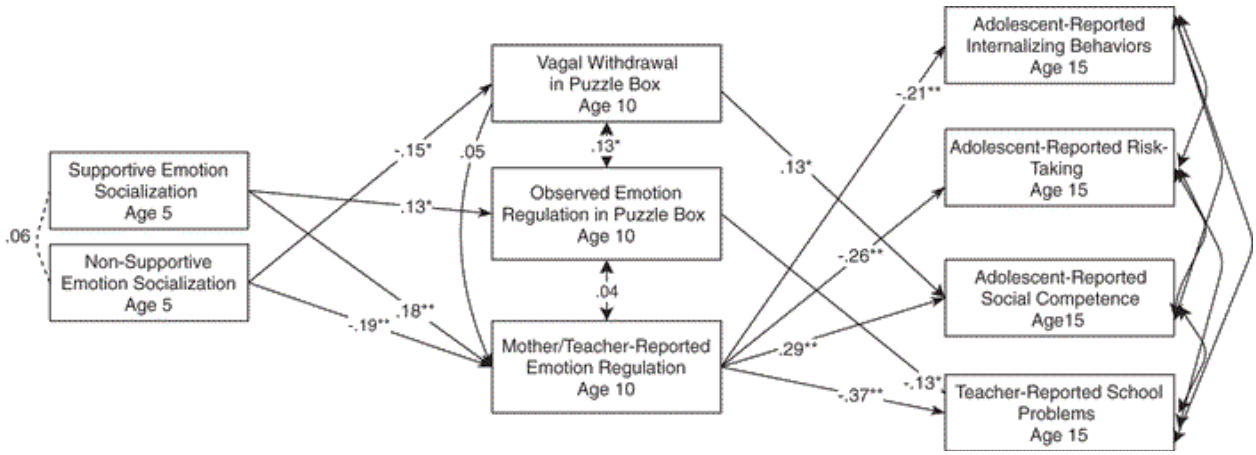

Figure 1. Standardized model estimates. Child sex, 2-year externalizing behaviors, baseline RSA, and SES were used as covariates but are not depicted. The correlations across outcomes were modeled, but coefficients are not shown in the figure for simplicity. All correlations among the outcomes were significant in the expected direction. Only significant longitudinal paths are depicted. * p < .05. ** p < .01.

Aim 1

The first aim of the study was to assess whether maternal supportive and nonsupportive reactions during early childhood were associated with age 10 mother- and teacher-reported emotion regulation, observed emotion regulation, and physiological regulation. Model results revealed maternal supportive reactions when children were age 5 were associated with more observed (B = .39, p = .03) and reported (B = .26, p < .001) emotion regulation at age 10, but were not associated with children's physiological regulation at age 10 (B = .06, p = .43). Maternal nonsupportive reactions at age 5 were associated with less physiological regulation at age 10 (B = −.21, p = .02) and poorer mother- and teacher-reported emotion regulation at age 10 (B = −.29, p < .001), but not with observed emotion regulation at age 10 (B = .08, p = .70).

Aim 2

The second aim of the study was to assess whether children's physiological regulation, observed emotion regulation, and reported emotion regulation at age 10 were associated with adolescent adjustment at age 15. Physiological regulation at age 10 was associated with greater adolescent-reported social competence (B = .15, p = .04) at age 15. Children's observed emotion regulation was associated with fewer teacher-reported school problems at age 15 (B = −.71, p = .04). Mother- and teacher-reported emotion regulation was associated with less adolescent-reported internalizing (B = −12.78, p = .001), adolescent-reported risk-taking behaviors (B = −1.06, p < .001), as well as fewer teacher-reported school problems (B = −4.21, p < .001) and more adolescent self-reported social competence (B = .28, p < .001).

Table 2. Unstandardized Estimates of Significant Indirect Effects, Standard Errors, and 95% Bias-Corrected Bootstrap Confidence Intervals

			Confidence intervals	
Indirect effect pathways	**Estimate**	***SE***	**Lower**	**Upper**
Indirect effects from supportive reactions				
SR(5yr) → RER(10yr) → AR internalizing behaviors (15yr)	–3.18	1.36	–6.59	–1.04
SR(5yr) → RER(10yr) → AR risk-taking (15yr)	–.27	.10	–.54	–.10
SR(5yr) → RER(10yr) → AR social competence (15yr)	.07	.03	.03	.14
SR(5yr) → OER(10yr) → TR school problems (15yr)	–.29	.10	–.94	–.01
SR(5yr) → RER(10yr) → TR school problems (15yr)	–1.07	.36	–2.04	–.38
Indirect effects from non-supportive reactions				
NSR(5yr) → RER(10yr) → AR internalizing behaviors (15yr)	3.75	1.55	1.24	7.70
NSR(5yr) → RER(10yr) → AR risk-taking (15yr)	.31	.12	.11	.63
NSR(5yr) → PR(10yr) → AR social competence (15yr)	–.03	.02	–.10	–.01
NSR(5yr) → RER(10yr) → AR social competence (15yr)	–.08	.03	–.16	–.03
NSR(5yr) → RER(10yr) → TR school problems (15yr)	1.24	.41	.56	2.23

Note. SR = supportive reactions; NSR = non-supportive reactions; RER = reported (mother and teacher) emotional regulation; OER = observed emotion regulation; PR = physiological regulation; AR = adolescent report; TR = teacher report. Non-significant indirect pathways are not shown.

Aim 3

Finally, we used a bias-corrected bootstrapping procedure (10,000 draws) to test the indirect effect of maternal reactions to negative emotion in early childhood on adolescent adjustment, through children's physiological and behavioral regulatory abilities in childhood. This approach has been shown to generate the most accurate confidence intervals for indirect effects, reducing Type I error rates and increasing power over other similar tests (MacKinnon, Lockwood, &

Williams, 2004). All significant indirect effects are provided in Table 2. Overall, the majority of mediational pathways tested in the model were significant, indicating that biological and behavioral (both reported and observed) emotion regulation abilities play unique roles in the association between supportive and nonsupportive maternal emotion socialization behaviors in early childhood and adjustment in adolescence.

Moderation by child sex

We also considered that our model may differ by child sex. To test this, we removed child sex as a covariate and we conducted a multiple group path analyses by comparing a fully unconstrained model, allowing all parameters to vary by child sex, with a constrained model, where paths were set to be equal across the two groups. The constrained model did not differ significantly from the unconstrained model. Thus, this model worked in similar ways for boys and girls.

Discussion

The current study adds to the existing literature by using a developmental cascade framework to examine multiple hypotheses embedded within the model presented by Eisenberg and colleagues (1998). Unlike previous work, we were able to assess how supportive and nonsupportive emotion socialization behaviors when children were 5-years-old were uniquely associated with biological and behavioral emotion regulation at age 10, and subsequently how biological and behavioral emotion regulation at age 10 was differentially related to various aspects of adjustment by age 15. Overall, we found long-term longitudinal support for the model originally presented by Eisenberg and colleagues (1998) and were able to demonstrate how biological and behavioral aspects of emotion regulation may play unique roles in the association between early emotion socialization and later outcomes.

The first aim of the current study was to assess whether maternal supportive and nonsupportive reactions to children's negative emotions at age 5 were associated with mother- and teacher-reported emotion regulation, observed emotion regulation, and physiological regulation when children were 10 years old. As hypothesized, mothers who reacted more supportively to children's negative emotions during early childhood had middle schoolers who were more likely to be rated as having strong emotion regulation abilities, and, on average, these children were also better able to manage their frustration appropriately in a laboratory task. It is likely that supportive reactions assist children in generating behavioral responses to when negatively aroused, which provide children with the tools and opportunities to develop increased behavioral control in early childhood. Over time, these skills may become independent emotion regulation abilities. Interestingly, maternal supportive reactions to negative emotions at age 5 were not associated with children's later physiological regulation at age 10. It is possible that while supportive responses foster the development of effective regulation of behavior, they have less of an effect on the extent to which the individual experiences the emotion. In other words, supportive reactions may help a child control their behavior when emotionally aroused without having an effect on the extent to which a child physiologically experiences emotional arousal.

Nonsupportive reactions to negative emotions in early childhood were associated with children's poorer physiological regulation, as well as a decreased ability to behaviorally regulate arousal as

reported by mothers and teachers in middle childhood. However, nonsupportive reactions were not associated with behavioral regulation observed in the laboratory. Nonsupportive reactions do not provide effective tools for regulating emotions; this could explain the lack of association between nonsupportive reactions and behavioral regulation in the laboratory. Because nonsupportive reactions to negative emotions that are harsh and punitive may exacerbate the intensity of the situation, they may heighten emotional distress and in turn be more strongly associated with children's physiological responses.

These findings highlight that biological and behavioral regulatory processes are related, but distinct, aspects of emotion regulation and may have discrete antecedents. Results also shed light on which types of parenting behaviors are associated with which types of self-regulatory skills. Because biology and behavior work in tandem such that increased physiological regulation likely allows for the generation of adaptive behavior, and effective regulatory behavior likely affects individual's physiological reactivity, it is important to both increase behavioral regulatory skills and facilitate the dampening of a physiological emotional response. Thus, our findings have implications for intervention efforts and suggest that focusing on just increasing supportive responses to negative emotions is not enough; interventions must also reduce the extent to which parents respond to their children's negative emotions in nonsupportive ways.

The second aim of the study was to assess whether physiological regulation, observed emotion regulation, and reported emotion regulation at age 10 were associated with adolescent adjustment at age 15. Consistent with previous work, we found that greater emotion regulation at age 10 was associated with better academic, social, behavioral, and psychological adjustment at age 15. Interestingly, there were some associations that varied depending on the measure of emotion regulation and the specific adjustment outcome in adolescence. Greater physiological regulation was only associated with greater adolescent self-reported social competence. It is unclear why physiological regulation was not associated with adolescent report of internalizing and risk-taking behaviors, or teacher report of adolescents' school problems. It is possible that greater physiological regulation during frustration lowers arousal enough for children to generate adaptive environmental responses and therefore has stronger associations with measures of children's competence than measures of children's maladjustment. It may be that additional factors that contribute to serious maladjustment overpower the potential effects of a single measure of physiological functioning.

Unexpectedly, observed emotion regulation in the laboratory was only associated with fewer teacher-reported school problems. It could be that the laboratory setting is similar to the school setting such that both are controlled environments in which children are asked to perform specific tasks. Children who cannot regulate behavior in these contexts would likely be more disruptive, have a hard time learning, and cause more problems in the classroom. However, why observed regulation in the laboratory is not associated with how adolescents perceive their own adjustment is unclear. Perhaps if we had been able to measure aggression or defiance, constructs more closely related to the physical and verbal venting behaviors measured in the laboratory, associations in the expected direction would have emerged.

Not surprisingly, mother- and teacher-reported emotion regulation was associated with all adolescent adjustment outcomes in the expected ways. Again, mothers and teachers are able to

report on children's emotion regulation abilities across a variety of contexts, which therefore makes them predictive of adolescents' general adjustment. Thus, findings highlight that mother and teacher reports of child functioning have significant value when longitudinally predicting child outcomes across developmental periods. However, given that significant associations also emerged when simultaneously examining physiology and behavior, current findings underscore that these measures have predictive value as well, although they may be more context specific. For example, knowing that children's behavioral regulation in a laboratory setting predicts teacher-reported school problems 5 years later in adolescence, provides a developmental time period in which interventions may need to focus on bolstering children's behavioral coping to challenge and frustration. Future work measuring physiological and behavioral regulation across a variety of contexts and emotions may show stronger associations with broader adjustment measures.

Our third and final aim was to statistically test whether children's behavioral and biological emotion regulation abilities were mechanisms that linked mothers' supportive and nonsupportive reactions during early childhood with adolescent adjustment. Results provided overwhelming support for this hypothesis, as we found significant indirect effects from both supportive and nonsupportive maternal reactions to multiple domains of adolescent adjustment through both behavioral and physiological regulation of emotion, therefore supporting Eisenberg and colleagues' original model. Importantly, prior work in this area has typically examined these effects across a relatively short span of development. The current study was unique in that it extended work in this area across a 10-year period and investigated emotion regulation at multiple levels of functioning. In doing so, we were able to assess whether biological and behavioral processes are distinct aspects of the construct of emotion regulation and whether they are associated differently with maternal supportive and nonsupportive reactions, as well as adjustment.

Despite the many strengths of this study, it is not without limitations. First, we only examined two aspects of parenting, maternal supportive and nonsupportive reactions to children's negative emotions. The model proposed by Eisenberg and colleagues (1998) also highlighted the role of parental discussion of emotions and parental emotional expressiveness. Thus, although we add considerable evidence to the field regarding how one aspect of emotion-related parenting practices is associated with children's developmental trajectories across multiple developmental periods, additional work is needed to assess these associations over time for other emotion-related parenting practices. It should also be noted that parenting measures at later time points were not included in our model. Thus, it is possible that maternal emotion socialization behaviors at age 10 and age 15 also contributed to adolescents' adaptive functioning. Parenting behaviors, however, are relatively stable over time (Loeber et al., 2000). The finding that emotion socialization behaviors as early as age 5 have significant associations with adolescent adjustment at age 15 sheds light on the critical importance of emotion socialization during early childhood.

In addition, there are many different factors that likely play a role in how mothers respond to their children's emotions that we were beyond the scope of the current investigation. For example, maternal personality characteristics and/or mental health would almost certainly have an effect on the capacity for mothers to consistently respond in a supportive manner (Bornstein, Hahn, & Haynes, 2011; Lovejoy, Graczyk, O'Hare, & Neuman, 2000). Parental beliefs regarding

the appropriate display of emotion were also not measured in the current study but likely play a role in parents' reactions to negative emotion. Moreover, although we controlled for SES, there are likely cultural and economic factors that affect mothers' reactions to children's emotions. A growing body of literature suggests that some punitive and minimizing responses may in fact be adaptive for African American children (Leerkes, Supple, Su, & Cavanaugh, 2015; Nelson et al., 2013). Unfortunately, our sample did not have a sufficiently large African American subgroup to test whether the model worked similarly across African American and European American groups. Thus, this should be considered when interpreting findings.

We also only considered emotion regulation as the primary mechanism in the association between emotion socialization and later adjustment. However, scientists have found associations between emotion socialization and adjustment through other mechanisms such as attachment (Magai, Consedine, Gillespie, O'Neal, & Vilker, 2004) and anxiety (Suveg, Zeman, Flannery-Schroeder, & Cassano, 2005). Although we didn't assess other potential mechanisms, it is important to note that the development of emotion regulation, and parenting behaviors that support its development, have been linked to both internalizing behaviors such as anxiety (e.g., Amstadter, 2008) and attachment patterns (e.g., Cooper, Shaver, & Collins, 1998). Thus, emotion regulation may be a particularly salient explanatory mechanism.

It should also be acknowledged that, much like other work in this area, our measures of emotion regulation are confounded with emotional reactivity. Therefore, although high reactivity that is unable to be regulated is indicative of poorer emotion regulation, when interpreting our findings, we cannot be confident which aspects of our emotion regulation measures (i.e., reactivity or regulation) are associated with emotion socialization or adolescent adjustment.

Unfortunately, we were not able to test bidirectional effects. It is possible that not only do parenting behaviors predict children's physiological and behavioral regulation, but physiological and behavioral regulatory processes may also predict parenting children receive. Indeed, we have found evidence of bidirectional processes with this sample during early childhood (Perry, Mackler, Calkins, & Keane, 2014). Moreover, while greater physiological dysregulation may hinder children's subsequent ability to generate adaptive coping strategies, a linear relationship may not exist, and physiological dysregulation is instead a sign of maladjustment that results from poor functioning within specific environmental contexts (e.g., El-Sheikh et al., 2009). Thus, while the current study highlights unique associations between supportive and nonsupportive emotion socialization behaviors and emotion regulation at multiple levels of functioning, future work is needed to further tease apart the direction of effects across development.

In conclusion, using data spanning a 10-year period, we provided initial evidence that maternal reactions to children's negative emotions in early childhood were associated with various forms of adolescent adjustment through their association with children's emotion regulation abilities, both biological and behavioral, in middle childhood. The results from this study provide a greater understanding of the dynamic, complex process by which parents affect children's development. These results have important implications for preventive interventions. In many cases, parents may not be aware of potential negative effects of not appropriately supporting their children's emotions. Thus, intervention efforts aimed at promoting supportive reactions to children's

negative emotions in early childhood may have lasting effects into adolescence and early adulthood.

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