Mothers' responses to children's negative emotions and child emotion regulation: The moderating role of vagal suppression

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Abstract:

The current study examined the moderating effect of children's cardiac vagal suppression on the association between maternal socialization of negative emotions (supportive and nonsupportive responses) and children's emotion regulation behaviors. One hundred and ninety-seven 4-year-olds and their mothers participated. Mothers reported on their reactions to children's negative emotions and children's regulatory behaviors. Observed distraction, an adaptive self-regulatory strategy, and vagal suppression were assessed during a laboratory task designed to elicit frustration. Results indicated that children's vagal suppression moderated the association between mothers' nonsupportive emotion socialization and children's emotion regulation behaviors such that nonsupportive reactions to negative emotions predicted lower observed distraction and lower reported emotion regulation behaviors when children displayed lower levels of vagal suppression. No interaction was found between supportive maternal emotion socialization and vagal suppression for children's emotion regulation behaviors. Results suggest physiological regulation may serve as a buffer against nonsupportive emotion socialization.

Keywords: vagal suppression | vagal tone | emotion regulation | physiological regulation | emotion socialization | negative emotions | preschool | RSA

Article:

INTRODUCTION

The preschool period is a critical time for children's emotional development such that socioemotional skills of preschoolers predict later school adjustment and overall emotional competence (Denham et al., 2003; Rubin, Coplan, Fox, & Calkins, 1995). During the last two decades, researchers have linked children's lack of adaptive emotion regulation skills to deficits in other developmental domains including physiological adjustment, the presence of externalizing, and internalizing behavior problems (Calkins, 1994; Hill, Degnan, Calkins, & Keane, 2006), low social competence (Mendez, Fantuzzo, & Cicchetti, 2002; Spinrad et

al., 2006), and poor school readiness (Denham, 2006; Denham et al., 2003). Thus, understanding the factors that contribute to early emotion regulation skills is of critical importance.

Emotion regulation refers to "behaviors, skills, and strategies, whether conscious or unconscious, automatic or effortful, that allow children to modulate, inhibit, or enhance emotional expressions and experiences" (Calkins & Hill, 2007, p. 229). Calkins (1994) described levels of emotion regulation including a neuro-regulatory biological level as well as a behavioral level and acknowledged that the levels act interdependently and are influential in explaining individual differences in emotion regulation. Further, both behavioral and biological levels of emotion regulation have been linked to environmental influences (Calkins, Graziano, Berdan, Keane, & Degan, 2008; Eisenberg, Fabes, Carlo, & Troyer, 1992); thus, a better understanding of individual differences in emotion regulation can be gained by examining factors intrinsic and extrinsic to the child (Calkins & Fox, 2002). Therefore, models containing multiple levels of emotion regulation as well as environmental contexts are needed in order to expand the current emotion regulation literature.

It has been proposed that individual differences in emotion regulation behaviors stem from both biological and environmental factors that enable children to cope with heightened emotional arousal (Calkins & Howse, 2004; Posner & Rothbart, 2000). Although a substantial amount of evidence suggests that intrinsic and extrinsic factors contribute separately to the development of emotion regulation (Maughan, Cicchetti, Toth, & Rogosch, 2007; Santucci et al., 2008), little is known about the effect that the interaction between extrinsic factors such as parenting, and intrinsic factors such as physiological regulation, may have on preschoolers' emotion regulation behaviors. The extent to which parents provide their children with support in emotionally arousing contexts may be of varying importance in relation to children's behavioral regulation depending on children's ability to physiologically regulate.

The importance of interactions between biological and environmental factors for development has been supported by multiple theories including relational developmental systems theory, which asserts that no one individual component (i.e., biological, psychological, or environmental) is more important for overall development and psychological systems self-regulate using both biological and environmental contexts as resources (Overton, 2010). Further, biological and environmental interactions are often highlighted as core features of psychobiological models of development including Gottlieb and Lickliter's (2007) metatheoretical model of probabilistic epigenesis. Thus, the focus of the current study was to examine the interaction between maternal emotion socialization of children's negative emotions and children's physiological regulation, as indexed by cardiac vagal suppression, in the development of children's observed and reported emotion regulation behaviors. Specifically, the current study aimed to investigate the extent to which physiological regulation is implicated in behavioral regulation for children of parents engaging in different responses to negative emotion.

Vagal Suppression and Emotion Regulation Behaviors

Emotion regulation theories that include biological and physiological aspects of regulation assume that advanced and adaptive emotion regulation behaviors are a result of the maturation of biological systems across childhood (Calkins and Hill, 2007). One-way researchers have examined biological and physiological development of emotion regulation is by examining maturation of the parasympathetic nervous system. Parasympathetic nervous system maturation is thought to play an important role in individuals' ability to regulate their state, activity, and

emotion (Calkins, Graziano, & Keane, 2007; Kreibig, 2010). Researchers have developed methods to measure the influence of the parasympathetic nervous system (Berntson, Lozano, & Chen, 2005; Porges, 1995) and these measures have been used in multiple studies investigating biological processes involved in emotion. Porges (1995) introduced the polyvagal theory and identified an index of the functional status of the parasympathetic nervous system which reflects the vagal control of the heart, as a measurable organismic variable that accounts for differences in the development of emotional expression and regulation.

The polyvagal theory involves the two subsystems of the autonomic nervous system (ANS): the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). The primary job of the ANS is to maintain the body's homeostasis; therefore, the two subsystems work in conjunction to increase or decrease activity in an organ or system. The SNS promotes metabolic output to deal with environmental challenges and is responsible for accelerated heartbeats and dilated pupils. The function of the PNS is to conserve the body's energy, rest vital organs, constrict pupils, and slow the heart (Porges, 1995). Porges (1995) developed a method that measures the amplitude and period of the oscillations associated with inhalation and exhalation; this measure refers to the variability in heart rate which occurs at the frequency of breathing (respiratory sinus arrhythmia [RSA]) and is thought to reflect the parasympathetic influence on heart rate by way of the vagus nerve. Specifically, the myelinated vagus nerve sends input to the heart and causes changes in cardiac activity that allow the body to transition between sustaining metabolic processes and generating responses to the environment (Porges, 2007). Porges (1991) has termed this measure of heart rate variability vagal tone. Although there are other components of heart rate variability, the RSA measure has been identified as suitable to study the physiological links to behavioral functioning (Stifter & Fox, 1990; Suess, Porges, & Plude, 1994).

According to Porges' (2007) theory, physiological states are associated with different classes of behavior including social engagement and appropriation of emotion. The vagus nerve serves as a vagal brake that can inhibit or disinhibit vagal tone and quickly mobilize or calm an individual. During situations that do not present a challenge, the vagus nerve inhibits the sympathetic nervous system's influence on the heart through increased parasympathetic influence; thus, the activity of the hypothalamic-pituitary adrenal axis is dampened to produce a relaxed state (Porges, 1995). However, during times of challenge, the vagal brake is suppressed to support an increase in heart rate and active coping to environmental challenges.

The vagus nerve's ability to regulate metabolic output in emotionally and behaviorally challenging environmental situations can be assessed by examining the decrease in RSA (vagal suppression) during emotionally charged situations. Vagal suppression is the change in RSA (vagal tone) from a baseline measure to a task measure. Although a small subset of research shows that moderate levels of vagal suppression are most adaptive (Calkins et al., 2007; Gazelle & Druhen, 2009; Marcovitch et al., 2010), the majority of research supports the view that lower levels of vagal suppression appear to be risk factors for poor emotional health and emotion regulation abilities, and higher levels of vagal suppression are most beneficial. For example, Calkins and Keane (2004) found that children who displayed high and stable suppression across the preschool period were less emotionally negative and demonstrated fewer behavior problems and better social skills than other children. Vagal suppression is also associated with optimal emotion regulation behaviors. For example, high-risk children consistently displayed lower vagal suppression during challenging tasks in addition to displaying more dysregulated emotion

behaviors such as intense anger and aggression (Calkins & Dedmon, 2000). Further, in a sample of 3-year-olds, Calkins (1997) found that children with greater vagal suppression engaged in more positive coping strategies during a task designed to elicit negative affect. Finally, in a longitudinal study assessing the association between emotion regulation difficulties and physiological functioning, Vasilev, Crowell, Beauchaine, Mead, and Gatzke-Kopp (2009) found a negative relation between reports of emotion regulation difficulties and longitudinally collected vagal suppression. Specifically, increased vagal suppression from age 1 to 3 was associated with fewer difficulties in emotion regulation. It is likely that when children are unable to physiologically regulate they cannot utilize adaptive regulation behaviors and may require a great deal of parental assistance and support.

Parental Emotion Socialization and Emotion Regulation

By the time children enter preschool, it is paramount that they rely less on their parents and learn to interact in unfamiliar environments and develop social connections with people outside of their homes. Parents use a variety of socialization practices to help their children to understand the cultural norms of emotional behavior and appropriate strategies for regulating their negative emotions (Sroufe, 1996). Parents serve as models for children, demonstrating appropriate expression, display, and reactions to emotion. For example, parents can re-direct their children's attention teaching the child self-initiated redirection, or distraction, in emotionally charged situations. Parents' responses to children's negative emotions also provide opportunities for children to learn which emotions are acceptable and which are not.

Some parental socialization practices may also hinder the development of children's emotion regulation behaviors. Parental nonsupportive reactions to their children's emotions may influence subsequent emotional responses and decrease the amount of emotional resources children can draw from when they are acting independently (Denham, 1989; Denham, Mitchell-Copeland, Strandberg, Auerbach, & Blair, 1997). For example, if a child's negative emotions are ignored and they are left to cry in frustration after a parent removes a desired toy, children may be unable to generate independently a more appropriate way to deal with a similar situation in a classroom setting (Calkins & Hill, 2007). Therefore, many differences in children's regulatory behaviors in emotionally charged situations may be linked to parental emotion socialization practices.

The investigation of the socialization of negative emotions is particularly important because the task of coping with negative affect, such as anger, sadness, or fear, is more developmentally difficult for children than coping with positive affect such as excitement or happiness (Ramsden & Hubbard, 2002). Empirical research has suggested that parental emotion-socialization practices that include nonsupportive and punitive reactions to negative emotional displays (e.g., anger and sadness) are associated with negative emotional outcomes for children. Eisenberg, Fabes, and Murphy (1996) proposed that negative reactions to children's displays of negative emotions are likely to intensify and prolong children's arousal in emotion-eliciting situations, increasing the likelihood of dysregulated behavior. For example, in a study of preschoolers, parental punitive reactions to children's negative emotions were associated with avoidant (i.e., avoiding rather than coping with an emotionally arousing situation) and inappropriate emotion regulation strategies (Eisenberg et al., 1992).

Eisenberg, Fabes, Schaller, and Carlo (1991) have hypothesized that nonsupportive parental response to negative emotions increases children's personal distress. Eisenberg and colleagues found that boys exposed to negative parental reactions to their negative emotions seemed prone

to experience personal distress rather than sympathy, and displayed more inappropriate regulation strategies when confronted with other children's distress. In preschool and kindergarten, children exposed to punitive reactions to emotions have been found to seek revenge or run from real life situations that involve anger and are not able to express their own emotions (Eisenberg & Fabes, 1994). Given these findings, it is clear that parent emotion socialization practices, particularly to negative emotions, are associated with children's behavioral regulation abilities; however, the way in which parental emotion socialization and physiological regulation interact to explain variability in children's emotion regulation has received much less attention.

Parental Emotion Socialization and Vagal Suppression Interaction

Given that physiological vulnerability, as measured by lower vagal suppression, characterizes children who are lacking the ability to regulate internally and participate in active coping, children with lower physiological regulation may depend more on parental socialization to acquire necessary social and emotional competence than children with more adaptive physiological functioning. Moreover, according to Porges' polyvagal theory, a well-functioning parasympathetic nervous system allows children to internally regulate state, arousal, and emotion independent from external assistance. Thus, physiological regulation may serve as a buffer against nonsupportive emotion socialization such that children's emotion regulation abilities may not be as negatively influenced by nonsupportive parental emotion socialization when they can physiologically regulate themselves.

To our knowledge, two prior studies have examined the moderating role of vagal suppression on the association between parental socialization, vagal suppression, and children's socioemotional development. Hastings et al. (2008) found support for the moderating role of parasympathetic cardiac function in the association between parental over-control and supportiveness and children's social wariness, social inhibition, and behavior problems in a sample of 133 preschoolers. Interestingly, vagal suppression only moderated the link between fathers' socialization and children's anxious adjustment such that children were more vulnerable to the effects of over controlling and nonsupportive paternal parenting when they displayed lower vagal suppression. In an additional study, Hastings and De (2008) found that baseline vagal tone, which is often thought to reflect more temperamental reactivity, moderated the relation between parent's emotion socialization and children's behavior problems and social competence. Specifically, both maternal and paternal emotion socialization responses to negative emotions were more strongly associated with preschooler's behavior and adjustment for children with fewer parasympathetic self-regulatory skills than children with increased physiological regulation. Hastings et al. and Hastings and De primarily focused on social outcomes and behavior problems. It is still unclear how and if maternal socialization interacts with vagal suppression to predict emotional competence. Focusing on emotional outcomes by expanding the contextual setting of the physiological and behavioral self-regulatory processes to an emotionally challenging task designed to elicit frustration, will broaden and deepen our understanding of the role parental emotion socialization has on specific aspects of children's social and emotional development.

Hypothesis

In the current, study we hypothesized that children's vagal suppression would moderate the relation between parents' supportive and nonsupportive responses to children's negative emotions

and children's observed and parent-reported behavioral emotion regulation abilities. When children's physiological functioning is less adaptive, as evidenced by lower vagal suppression during a frustrating situation, parents' socialization practices will be associated with emotion regulation behaviors since children will need to rely more on external assistance to acquire skills that enable them to regulate themselves during emotionally challenging situations. Nonsupportive responses will relate to decreased regulation and supportive responses will relate to increased regulation behaviors. However, when children's physiological functioning is more adaptive, as evidenced by greater vagal suppression during a frustrating situation, parents' socialization practices will not be related to children's behavioral emotion regulation as children will be able to rely on their own internal regulatory capabilities rather than external influences.

METHODS

Participants

Data was used from children participating in an ongoing longitudinal study designed to understand how cognitive and emotional skills interact to predict children's performance in kindergarten. Children were recruited from day care centers in a mid-sized Southeastern US city and efforts were made to recruit an equal number of male and female participants from economically and racially diverse backgrounds. The original sample consisted of 263 3-year-old children ($M = 41.79$, $SD = 2.41$) and their mothers. Of the 263 children who were seen at 3 years, 244 returned for the 4-year visit. Of these, 197 children had heart rate data at 4 years.

Children who did not have heart rate data available either refused to put the electrodes on or compromised the data through excessive touching. *t*-Tests revealed the children who were excluded due to missing heart rate data were no different than the included participants in terms of anxiety, internalizing, and externalizing behavior problems, cooperation, or any of the other key variables included in the analytic models.

The demographics of the current sample are similar to those collected at the 3-year time point. Of the 197 participants, 50% were female, 61% were white, and 53% of mothers had a 4-year college degree or higher. Additionally, 37% of families had income-to-needs ratios less than 2.0, indicating low income, 50% had ratios of 2.0–5.0, indicating middle income, and 13% had ratios greater than 5.0, indicating high income.

Measures

Maternal Report of Emotion Regulation Behaviors. Mothers completed the Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997) which assesses parents' perceptions of their children's emotion regulation and emotionality. The ERC is composed of 24 items rated on a 4-point Likert scale that indicate the frequency of emotion-related behaviors from 1 (never) to 4 (always). The regulation subscale is comprised of eight questions such as “can say when he/she is angry” and “can wait for something when asked to do so” and refers to children's ability to modulate emotional arousal. Higher scores indicate greater regulation. The sum score of the emotion regulation subscale was used as an index of mother report of children's adaptive emotion regulation behaviors because it focuses on children's control of emotional responses. The items used to create this variable had an internal reliability of .56.

Observed Emotion Regulation Behaviors. Observed emotion regulation behaviors were assessed through the *Frustrating Puzzle Task*. The Frustrating Puzzle task is a behavioral observation task

designed to elicit frustration. The child was seated at a small table and was given a wooden toy with many holes. The toy had a string laced through the holes; however the middle of the string was glued to the inside of the toy, thus making it impossible to untangle completely. The experimenter asked the child to untangle the toy while he/she worked on some paper work in the other room. The experimenter left the room for 3 min. Upon return, the experimenter presented a second unglued puzzle to the child and allowed the child to completely unlace the string and solve the puzzle.

The Frustrating Puzzles task was videotaped and behaviors were coded from videotapes to index the child's ability to use regulation behaviors. The measure yields a help-seeking and distraction score that are thought to be indicative of adaptive emotion regulation strategies. Help-seeking behaviors did not occur frequently and therefore the help-seeking score did not have sufficient variability. Thus, only distraction strategies were included in the analyses. The distraction score measures the extent to which the child distracts themselves away from the frustrating event. Verbal distractions (e.g., talking or asking about something unrelated to task) and physical distractions (e.g., standing up, walking away, or playing with unrelated objects in the room) were counted as distraction behaviors. The videos were coded for the frequency of the given behaviors in 30-s intervals and the frequency counts were summed to obtain an overall distraction score for the entire duration of the task. Thus, the total score for each behavior is the frequency of times the child distracted away from the task for the entire 3 min task. To establish reliability, approximately 27% of the videotapes were coded by two coders. The Pearson correlation between the two rater's codes for the distraction score was .95 ($p < .01$).

Distraction can be used as an effective technique to reduce emotional arousal by averting ones attention away from the source of the distress until arousal decreases and focus can be resumed. Research has indicated that preschoolers view cognitive and behavioral distraction as effective strategies for decreasing negative emotional arousal (Dennis & Kelemen, 2009) and previous studies have used children's self-distraction as an indicator of adaptive emotion regulation (Reijntjes, Stegge, Terwogt, Kamphuis, & Telch, 2006; Stansbury & Sigman, 2000).

Vagal Suppression. EKG was recorded during a baseline procedure in which children watched a 5-min video and during the frustrating puzzle task. Two electrodes were placed on children's chests and stomachs and connected to a preamplifier, the output of which was processed through a vagal tone monitor (Series 2000 Mini-Logger, Mini Mitter Co., Inc., Bend, OR) for R-wave detection. To generate measures of cardiac activity to derive resting RSA (baseline vagal tone) and RSA suppression (resting RSA − challenge RSA = vagal suppression) interbeat interval (IBI) files were edited and analyzed using MXEDIT software (Delta Biometrics, Inc). Editing the files consisted of examining for outlier points and dividing 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.

Estimates of RSA were calculated using Porges' (1985) method of analyzing 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 band-pass filter then extracts the variance of HP within the frequency band of spontaneous respiration (.24–1.04 Hz) in young children. Although lower frequency bands may be studied, research with young children has consistently examined this band and identified associations with child functioning (Huffman et al., 1998; Stifter & Fox, 1990). RSA was calculated every 30 s for the

baseline period and every 15 s for the frustration task. These scores were then averaged within task to yield a single score for the baseline and frustrating task.

Maternal Emotion Socialization. Mothers completed the Coping with Children's Negative Emotions (CCNES; Fabes, Eisenberg, & Bernzweig, 1990) questionnaire designed to assess the ways in which they respond to their children's emotional distress. Mothers are provided with 12 scenarios in which their child experiences a negative emotion (e.g., angry or sad) and asked to indicate the likelihood they would respond in ways listed for each item. Mothers' are asked the likelihood of responding in a minimizing, punishing, dismissing, problem focused, emotion focused, or expressive way. Each response is rated on a 7-point scale ranging from 1 (very unlikely) to 7 (highly likely).

This measure yields six subscales: distress reactions, punitive responses, minimization reactions, expressive encouragement, emotion focused reactions, and problem focused reactions (Fabes, Poulin, Eisenberg, & Madden-Derdich, 2002). Higher scores in each subscale indicate more frequent use of that particular response. Following previous research, two aggregates, supportive and nonsupportive reactions, were calculated by summing the subscales (Denham & Kochanoff, 2002). Nonsupportive reactions include the minimizing, punitive, and distress reaction scales, while supportive reactions include the encouraging, emotion-focused, and problem-focused reaction scales. Alphas for supportive and nonsupportive aggregates are reported at .85 and .74, respectively. The CCNES has demonstrated adequate test–retest reliability and construct and predictive validity (Fabes et al., 2002).

RESULTS

Preliminary Analyses: Descriptives

Preliminary analyses included examining the frequencies and distributions of all study variables; the means, standard deviations, and ranges can be seen in Table 1. Simple correlations among the primary study variables are displayed in Table 2. Due to the fact that maternal report of emotion regulation behaviors was higher for females than males, $t(195) = 2.84$, $p < .05$, and previous research has suggested that parental response to children's negative emotions varies by race (Leerkes & Siepak, 2006; Montague, Magai, Consedine, & Gillespie, 2003), child gender and child race were included as covariates in all analyses.

Table 1. Descriptive Information of Study Variables

		SD	**Range**		**Skewness (*SE*)**
Maternal report of emotion regulation					
Emotion regulation sum score	27.72	2.45	21–32	197	−.28 (.17)
Observed emotion regulation					
Distraction behaviors	8.95	6.75	0–32	197	1.15 (.17)
Maternal emotion socialization					
Supportive	17.34	2.31	8.18–21	197	−.77 (.17)
Nonsupportive	6.73	1.72	3.27–12.18	197	.57 (.17)
Physiological emotion regulation					
Baseline vagal tone	6.60	1.12	2.75–9.23	197	−.30 (.17)
Task vagal tone	5.34	1.07	2.25–8.53	197	.02 (.17)
Vagal suppression	1.26	.73	−.58–3.45	197	.21 (.17)

Table 2. Pearson Correlations Among Study Variables

	2	3	4	5
1. Supportive emotion socialization	−.32**	.35**	.11	−.03
2. Nonsupportive emotion socialization		−.15*	−.06	−.01
3. Emotion regulation (parent report)			−.04	.07
4. Emotion regulation (observed distraction)				−.18*
5. Vagal suppression				

* $p < .05$.
** $p < .01$.

Maternal reported emotion regulation and observed regulatory distraction behaviors were uncorrelated (see Tab. 2), and retained as separate outcome variables. Previous research has identified nonsupportive and supportive emotion socialization as separate dimensions and therefore they were analyzed in separate analyses (Fabes et al., 2002). Four models were tested to examine the moderating role of vagal suppression in the association between maternal reactions to children's negative emotions and children's emotion regulation (observed distraction and parent report of emotion regulation behaviors). Two models examined the effect of nonsupportive maternal reactions and two models examined the effect of supportive maternal reactions.

Analyses of Nonsupportive Parenting

Examination of direct effects revealed nonsupportive maternal reactions to children's negative emotions to be a significant predictor of maternal-reported emotion regulation (see Tab. 3). However, nonsupportive emotion socialization did not predict observed emotion regulation. Hierarchical regression analyses were used to test whether the relation between nonsupportive maternal reactions to children's negative emotions and children's emotion regulation behaviors depended on children's ability to regulate themselves physiologically during an emotionally charged situation. Interaction effects were calculated by centering vagal suppression and nonsupportive maternal reactions, then multiplying them together. Vagal suppression and nonsupportive maternal reactions to negative emotions were entered in the first block along with the control variables of race and gender; the interaction term was entered in the second block.

Table 3. Hierarchical Multiple Regression of Nonsupportive Maternal Reactions and Emotion Regulation

Predictors	Parent Report			Observed Distraction		
	***B* (*SE*)**		**ΔR^2**	***B* (*SE*)**		**ΔR^2**
Step 1			.05			.07*
Child gender	−.70 (.33)	−.14*		1.09 (.94)	.08	
Child race	.20 (.34)	.04		2.24 (.96)	.16*	
Nonsupportive reactions	−.23 (.09)	−.16*		−.36 (.27)	−.09	
Vagal suppression	.19 (.23)	.06		−1.56 (.64)	−.17*	
Step 2			.06***			.02*
Nonsupportive reactions X Vagal Suppression	.44 (.12)	.25***		.70 (.34)	.14*	

$N = 197$.
*$p < .05$. ***$p < .001$.

A significant interaction was found between vagal suppression and nonsupportive maternal reactions to children's negative emotions in relation to both reported emotion regulation behaviors and observed distraction (see Tab. 3). Follow-up tests of simple slopes (Aiken & West, 1991) revealed that nonsupportive maternal reactions to children's negative emotions predicted lower maternal-report emotion regulation behaviors when children displayed low, $\beta = -.39$, $p < .001$, and moderate levels of vagal suppression, $\beta = -.16$, $p < .05$. In contrast, nonsupportive maternal reactions did not predict maternal report of emotion regulation behaviors when children had greater vagal suppression (see Fig. 1).

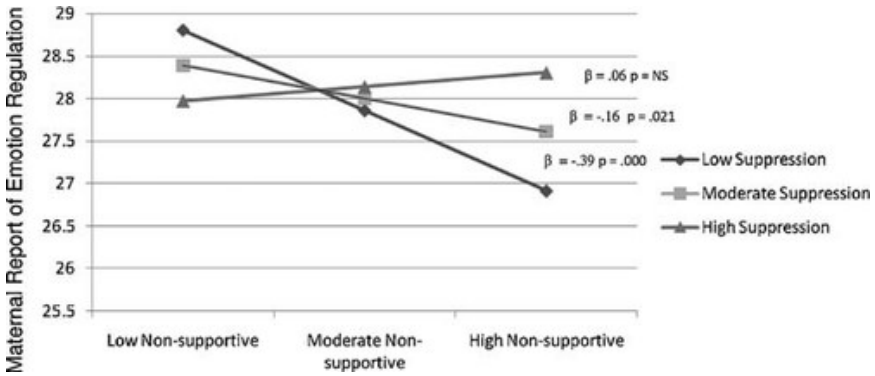

Figure 1. Interaction of vagal suppression and nonsupportive maternal reactions to children's negative emotions in the prediction of maternal report of emotion regulation.

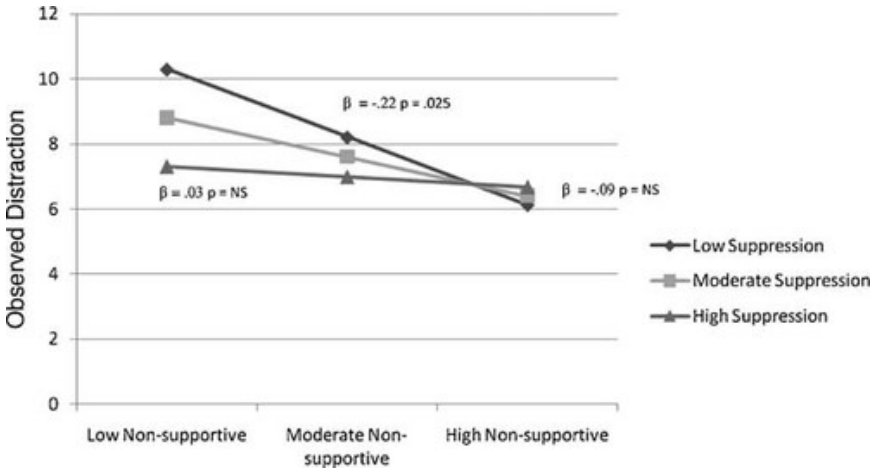

Figure 2. Interaction of vagal suppression and nonsupportive maternal reactions to children's negative emotions in the prediction of observed emotion regulation.

Similar to maternal report of children's emotion regulation behaviors, simple slopes revealed that nonsupportive maternal reactions to children's negative emotions predicted lower observed distraction only when children's vagal suppression was low, $\beta = -.22$, $p < .05$, but not when children had moderate or high levels of vagal suppression (see Fig. 2). Thus, in accordance with our hypotheses, results revealed that nonsupportive maternal reactions did not predict maternal-report of emotion regulation behaviors or observed distraction when children were better

physiologically regulated, but was a significant predictor of children's emotion regulation when children's physiological regulation was less adaptive.

Analyses of Supportive Parenting

Comparable hierarchical regression analyses were used to test whether the relation between supportive maternal reactions to children's negative emotions and children's emotion regulation depended on children's ability to physiologically regulate themselves. As illustrated in Table 4, supportive maternal reactions to children's negative emotions was a significant predictor of maternal-reported emotion regulation behaviors but not a significant predictor of observed distraction. Contrary to the hypothesis, vagal suppression did not moderate the effect of maternal supportive responses on mother reported emotion regulation behaviors or observed distraction (see Tab. 4).

Table 4. Hierarchical Multiple Regression of Supportive Maternal Reactions and Emotion Regulation

Predictors	Parent Report			Observed Distraction		
	***B* (*SE*)**		**ΔR^2**	***B* (*SE*)**		**ΔR^2**
Step 1			.12**			.07***
Child gender	−.79 (.32)	−.15		.98 (.94)	.07	
Child race	.35 (.33)	.07		2.2 (.97)	.16*	
Supportive reactions	.36 (.07)	.34***		.35 (.20)	.12	
Vagal suppression	.10 (.22)	.03		−1.61 (.66)	−.17*	
Step 2			.02			.00
Supportive reactions × vagal suppression	−.18 (.09)	−.13		−.08 (.27)	−.02	

$N = 197$.
*$p < .05$. **$p < .01$. ***$p < .001$.

DISCUSSION

The present study investigated the relation between maternal emotion socialization and children's emotion regulation behaviors, which have been found to be important for children's school readiness, social interactions, and emotional competence. Because emotion regulation is critical to the development of children's socioemotional skills, it is important to understand the way in which parenting behaviors and child characteristics interact to help facilitate or undermine development. The moderating role of vagal suppression, an indicator of physiological emotion regulation, was tested in order to further examine the relationship between maternal emotion socialization to negative emotions and children's emotion regulation behaviors. The findings of the current study highlight the importance of using psychobiological models that incorporate both parent and child contributions to emotional development.

Vagal suppression was found to moderate the association between nonsupportive emotion socialization and reported emotion regulation as well as observed distraction. In both cases, the relation between distressed, minimizing, and punitive maternal reactions to negative emotions and poorer emotion regulation was apparent for children with lower vagal suppression but not for children with greater suppression. That is, when children had poorer physiological regulation and received a high degree of nonsupportive maternal reactions to their negative emotions, they were reported and observed to be less emotionally regulated. In accordance with our buffering hypothesis, there was no association between nonsupportive emotion socialization and observed

distraction or reported emotion regulation for children with higher levels of vagal suppression. Luthar, Cicchetti, & Becker (2000) describe this pattern of resilience as protective stabilizing due to the fact that greater vagal suppression confers stability in observed and reported emotion regulation behaviors despite the increasing risk associated with nonsupportive parenting. It may be that children with greater vagal suppression may have the physiological capabilities to internally regulate themselves and thus their emotion regulation is not vulnerable to nonsupportive maternal socialization influences.

Contrary to our hypothesis, vagal suppression was not a significant moderator in the association between supportive emotion socialization and children's observed distraction or reported emotion regulation behaviors. Supportive emotion socialization predicted maternal report of emotion regulation behaviors in the same manner regardless of children's physiological regulatory abilities. The comfort and reassurance that comes with supportive reactions during times of distress may be beneficial to all children. Risk and resiliency research suggests that individual child characteristics make children less vulnerable to the effects of adverse environments (O'Connor & Dvorak, 2001); thus, it is possible that children's physiological regulation only provided a buffer against negative effects of punitive, dismissive, and minimization responses to negative emotions that are known to detract from children's overall emotional development (Bocknek, Brophy-Herb, & Banerjee, 2009; Werner, 2005). Future research is needed to replicate this finding and clarify the role of supportive emotion socialization in the relationship between children's biological and behavioral emotion regulation.

Consistent with previous research (Calkins, 1997; Garner, 2006; Lunkenheimer, Sheilds, & Cortina, 2007), nonsupportive and supportive maternal emotion socialization were significant predictors of maternal-reported emotion regulation behaviors. It is unclear why maternal emotion socialization did not predict observed distraction. Previous research has shown supportive emotion socialization to increase the recognition of emotional strategies but may not increase the employment of these strategies during frustrating episodes (Cole, Smith-Simon, & Cohen, 2009). Cole and colleagues identify supportive emotion socialization as a form of interpersonal regulation that provides reassurance and comfort but does not necessarily provide explicit guidance on how to generate regulatory strategies independently.

Although the current study provides insight into the interaction between maternal emotion socialization and children's physiological regulation in the development of behavioral emotion regulation, it is not without limitations. Only one measure of maternal emotion socialization was used and it was obtained solely from mother-report questionnaires, which could introduce biases of social desirability not addressed in these analyses. However, the fact this measure has correlated with observed indices of parenting in prior research (Gentzler, Contreras-Grau, Kerns, & Weimer, 2005), somewhat offsets this concern. In future research, it will be useful to draw from self-reported and observed indices of maternal emotion socialization. Additionally, the relation between nonsupportive maternal emotion socialization and maternal report of child emotion regulation may be inflated due to shared-reporter bias. However, the fact that the interaction between nonsupportive emotion socialization and vagal suppression was observed when both observed distraction and mother reported regulation were the outcomes, suggests that the effects are not fully accounted for by shared method variance. In addition, although the Emotion Regulation Checklist (Shields & Cicchetti, 1997), our maternal report measure, has demonstrated good psychometric characteristics, the internal reliability was somewhat low in this sample. Valuable information from fathers was not available. Given prior evidence that mothers'

and fathers' responses to child negative emotions jointly affect other social–emotional child outcomes (McElwain, Halberstadt, & Volling, 2007), the inclusion of mothers and fathers in future research of this type is warranted. Future research is also needed to examine other parenting factors such as parental control, sensitivity, and communication, in addition to emotion socialization, to better understand how parenting interacts with biological child factors to facilitate socioemotional development. Finally, children may physiologically regulate differently depending on the negative emotion experienced; therefore, further research examining the interaction between emotion socialization and children's regulation of emotions other than frustration such as sadness or fear is needed.

The current study has provided unique and important information regarding the development of children's emotion regulation. The importance of assessing both nonsupportive and supportive aspects of emotion socialization in order to examine the ways in which they differentially relate to child emotional competence has been highlighted. Additionally, the observed relations underscore the importance of utilizing psychobiological models that incorporate child and parent factors when assessing children's emotional development. The significant negative relationship between nonsupportive emotion socialization and emotion regulation observed for children who were less physiologically regulated, and a lack of this relationship for better physiologically regulated children, suggests that negative parenting factors that are thought to hinder children's socioemotional development, such as nonsupportive maternal emotion socialization, may be more influential when children lack internal resources. Therefore, extending this research not only furthers our knowledge of potential child characteristics that make children less vulnerable to the effects of an adverse home environment, but highlights the importance of supportive emotion socialization during the preschool years.

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