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Parental Support of Self-Regulation Among Children at Risk for Externalizing Symptoms: Developmental Trajectories of Physiological Regulation and Behavioral Adjustment

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Children with externalizing symptoms typically show dysregulated arousal when facing emotional challenges and are at risk for antisocial outcomes later in life. The model of emotion socialization (Eisenberg, Cumberland, & Spinrad, 1998) points to supportive emotion-related parenting as central to promoting children's regulatory capability and behavioral adjustment. However, the role of emotion-related parenting is less clear for children living in disadvantaged conditions and already displaying behavioral problems, and little is known about how these parenting practices shape the physiological underpinnings of behavioral adjustment. This study examined the relation between supportive emotion-related parenting and the trajectories of physiological regulation and externalizing symptoms across early school years among 207 children (66% male) from high-risk urban communities, who showed aggressive/oppositional behaviors at school entry. Mothers' supportive emotion-related parenting was observed in kindergarten during structured interactions. Children's respiratory sinus arrhythmia (RSA), an indicator of parasympathetic influence over cardiac arousal, was measured at rest and during an anger scene each year from kindergarten to the 2nd grade. Teacher ratings of externalizing symptoms were also obtained every year. Over time, supportive emotion-related parenting was related to a developmental trend from RSA augmentation toward RSA withdrawal during the anger scene as well as lower risk for escalating externalizing symptoms. The developmental changes of RSA reactivity partially accounted for the relation between parenting and trajectories of externalizing symptoms. Findings underscore the potential of supportive emotion-related parenting for diverting at-risk children from antisocial trajectories by shaping their physiological regulation and behavioral adjustment.

Keywords: supportive emotion-related parenting, externalizing symptoms, physiological regulation, RSA, developmental trajectory

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In early childhood, regulation of emotions and behaviors depends largely on parental support, which is thought to create the foundation for the emergence and development of self-regulation capability (Eisenberg, Cumberland, & Spinrad, 1998; Morris, Silk, Steinberg, Myers, & Robinson, 2007). As children transition into formal schooling, they are expected to demonstrate more independent self-regulation in the classroom context, with limited access to caregiver scaffolding (Raver, 2003). Research has consistently shown that children exposed to greater adversity often fall behind their peers in self-regulation capability (Evans & Kim, 2013; Raver, 2004), a risk factor for externalizing behavior problems (Eisenberg, Spinrad, & Eggum, 2010). Behavior problems at this early stage risk a self-sustaining cascade in which hyper-reactive and disruptive behaviors alienate adult and peer sources of support and impede children's ability to acquire adaptive regulatory strategies. Despite the substantial long-term risk early onset externalizing symptoms represent, longitudinal research has also indicated that as many as 50% of children who present with early symptoms desist from a persistent or escalating trajectory over time (Fanti & Henrich, 2010). Although a myriad of factors likely contribute to a child's developmental trajectory, the ability of parents to engage positively with their child, despite the additional challenges that children with behavior problems present, may be an important factor in diverting children from escalating symptoms. Supportive parental emotion socialization practices have been shown to promote children's self-regulation capability and reduce risk for externalizing symptoms (e.g., Eisenberg et al., 2005; Valiente, Lemery-Chalfant, & Reiser, 2007). However, fewer studies have examined the role of parental emotional support in promoting regulatory capability in children living in high-risk contexts who may face major emotional challenges in their daily life, and specifically whether and how supportive parenting contributes

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to de-escalation among children with early onset externalizing behavior. The current study employs the family emotion socialization framework, originally introduced by Eisenberg and colleagues in 1998, to examine whether supportive emotion-related parenting shapes children's externalizing symptoms across early school years, as well as whether parenting influences children's developmental trajectories of physiological regulation of emotional arousal.

The Role of Family Context in Children's Behavioral Adjustment

In their foundational article, Eisenberg and colleagues (1998) presented a model of emotion socialization, in which families influence children's emotional competence through three primary pathways. The first of these pathways is parents' emotional expressiveness in the family, which is thought to shape children's schemas about how emotions are expressed and their attributions of emotions in terms of what they mean and whether they are "acceptable." The second pathway is parents' discussion of emotions with children, such as talking about the causes and consequences of emotions, which may help children understand their experiences in a broader social context. These discussions can be noncontingent to child behaviors, occurring during every day activities (e.g., while reading a book to the child or talking about an emotionally salient event). Finally, the third pathway, parental reactions to children's emotions, serves to socialize children's expression, understanding, and regulation of emotions. Parent reactions to emotions can range from being supportive of emotional experiences and scaffolding adaptive expressions, to minimizing or punitive responses aimed at terminating the emotional expression or experience.

Guided by this model, we focused on parents' constructive expression of emotions, supportive reaction to children's emotions, and discussion of emotions or emotion regulation strategies, which we refer to as supportive emotion-related parenting. This includes labeling and validating children's positive or negative emotions, encouraging emotion expression, verbalizing or explaining parents' or other individuals' emotions, and providing guidance and support around regulation strategies; factors shown to be associated with positive behavioral adjustment in typically developing children (Davidov & Grusec, 2006; Wilson, Havighurst, & Harley, 2012). Effective emotional socialization may be more challenging for children living in high-risk environments in which they are exposed to more extreme and more frequent stressors (e.g., encountering community violence; Ceballo, Dahl, Aretakis, & Ramirez, 2001; Evans & Kim, 2013). Exposure to these challenges may tax children's self-regulation capacity and increase risk for behavioral maladjustment (Raver, 2004). Research suggests that family processes may mitigate the effects that these adverse exposures can have on increasing the risk of developing externalizing symptoms (Yule, Houston, & Grych, 2019). However, additional research is needed to understand the mechanism through which these parenting practices relate to how children react in emotional situations, particularly over critical developmental periods.

Physiological Functioning and the Development of Self-Regulation

Eisenberg and colleagues (1998) proposed that children's physiological regulation of arousal may be a mediating mechanism between emotion-related parenting and behavioral adjustment. Children's externalizing behaviors are usually underpinned by difficulties in managing physiological states of arousal in response to emotionally challenging experiences, such as anger and frustration (Calkins, 2009). Extensive research has examined the role of parasympathetic regulation of arousal, quantified as respiratory sinus arrhythmia (RSA), in affective psychopathology (Beauchaine, 2015). RSA captures variability in heart rate occurring in conjunction with the respiration cycle, and reflects the inhibitory control of the parasympathetic system on cardiac arousal. Higher levels of RSA reflect a lower level of arousal, supportive of physiologically restorative processes and socially affiliative engagement (Berntson et al., 1997; Porges, 2001). Withdrawal of the inhibitory parasympathetic input, observed as reductions in RSA, during challenge tasks provides an increase in physiological arousal needed to support cognitive and behavioral engagement. Parasympathetic withdrawal is thought to reflect a more adaptive approach to increasing arousal than engaging the sympathetic system because it can be rapidly reengaged as needed, allowing for a more regulated approach to mobilization and engagement (Porges, 2007).

Although resting RSA is presumed to reflect a trait-like capacity for regulating emotional arousal (Beauchaine, 2001), associations between resting RSA and psychopathological symptoms are more consistently observed among older children and adolescence (Chapman, Woltering, Lamm, & Lewis, 2010; Cui et al., 2015) than among younger children. In samples of younger children, RSA reactivity may be more likely to reflect an association with symptoms of psychopathology (e.g., Calkins & Keane, 2004; Fortunato, Gatzke-Kopp, & Ram, 2013). However, the nature of the associations between RSA reactivity and symptoms of psychopathology has not been consistent across studies. Some studies have found associations between greater RSA withdrawal in response to negative emotional challenges (e.g., negative emotional stimuli, stressful social context) and better emotion regulation skills and fewer psychopathological symptoms (Calkins & Keane, 2004; Gentzler, Santucci, Kovacs, & Fox, 2009), consistent with the proposition that RSA withdrawal reflects an adaptive and regulated approach to responding to challenge. However, several studies have reported opposing findings, such that greater RSA withdrawal correlated with more psychopathological symptoms and lower social competence (Blair, 2003; Fortunato et al., 2013). In these studies, RSA withdrawal was interpreted as reflecting active engagement with the stimuli, and proposed to reflect a greater susceptibility to the negative affectivity of the stimuli. It is possible that the relative adaptive or maladaptive implications of greater RSA withdrawal are moderated by the nature of the individuals, with samples drawn from higher risk contexts being more likely to demonstrate maladaptive associations with greater RSA withdrawal (Graziano & Derefinko, 2013). These findings call for caution in extrapolating conclusions across samples varying in risk status, and suggest that the adaptive value of greater engagement with emotional contexts (i.e., indicated by RSA withdrawal) is not absolute, but rather may be influenced by the extent to which the

individual masters regulatory skills to respond to the negative context.

Supportive Emotion-Related Parenting and Children's Physiological Regulation

Because Eisenberg et al. (1998) specified the mediation model, specific supportive emotion-related parenting practices have been proposed to promote children's neurophysiological regulation of arousal through multiple channels. For instance, when parents validate children's emotional experience or encourage them to talk about emotions, they help structure a secure and accepting interpersonal context that may help children develop more adaptive perceptions of environmental threats and their own emotions, thus avoiding defensive arousal (Diamond & Hicks, 2005). Furthermore, prior research suggests that supportive conversations about emotional experience and emotion regulation strategies in parent–child dyads may help children understand emotions and master regulatory strategies (e.g., verbal expression of feelings, self-distraction; Cole, Dennis, Smith-Simon, & Cohen, 2009; Perlman, Camras, & Pelphrey, 2008). The growth in regulatory skills may be facilitated by, or emerge in parallel with, the development of neurophysiological regulation of arousal in emotionally challenging situations. For children who demonstrate adjustment difficulties at school entry, supports from parents may help them internalize regulatory capabilities and engage neurophysiological regulation more independently over time.

Research examining the association between parental emotional support and children's RSA has produced inconsistent results. Several studies have failed to detect concurrent associations between supportive emotion-related parenting and children's RSA (e.g., Hastings, Klimes-Dougan, Kendziora, Brand, & Zahn-Waxler, 2014; Perry, Calkins, Nelson, Leerkes, & Marcovitch, 2012). However, some longitudinal studies have found that associations change or emerge over time. One study found that, among children who demonstrated early onset externalizing behaviors at age 2, general supportive parenting (measured as warm/sensitive parenting, low parental hostility, and low parenting stress) was associated with greater RSA withdrawal during emotionally challenging tasks later at age 5 (Calkins, Graziano, Berdan, Keane, & Degnan, 2008). These findings indicate the importance of considering the timeframe in which parenting shapes children's physiology. In a study of typically developing preschoolers, maternal emotional support was related to greater RSA withdrawal during a frustration task at age 3, but this effect was no longer evident at age 5, as children whose mothers were lower in emotional support on average showed increase in the amplitude of RSA withdrawal over time (Perry et al., 2013). Interpreting these developmental patterns is difficult in the absence of behavioral measures, given the evidence that patterns of RSA reactivity do not denote an inherently adaptive or maladaptive behavioral profile. For instance, the greater RSA withdrawal observed among children receiving more supportive parenting may be consistent with findings that RSA withdrawal has adaptive associations (Calkins & Keane, 2004), whereas the growth in RSA withdrawal observed among children with low emotional support may be consistent with findings that greater RSA withdrawal has maladaptive associations (e.g., Fortunato et al., 2013).

The Current Study

Building on preliminary evidence linking supportive emotion-related parenting and RSA reactivity over time, there are important next steps to better understand the role of physiological regulation in the relation between parenting and child behavioral adjustment proposed in the model of emotion socialization (Eisenberg et al., 1998). First, research is needed to understand the relation between supportive emotion-related parenting and the development of children's physiological regulation in at-risk samples that may be characterized by contextual disadvantage (e.g., poverty, violence exposure) and behavioral risk indicators (e.g., early onset externalizing symptoms). Second, longitudinal methods are needed to examine the trajectories of physiological regulation across the years following school entry, which is a critical developmental period characterized by new demands for self-regulation. Third, when investigating the relation between supportive emotion-related parenting and developmental changes in child RSA, it is important to explicitly examine the role of such effect in the trajectories of children's behavioral adjustment. The current study seeks to address these issues in a sample of children in a demographically high-risk school district and identified as having elevated rates of externalizing behaviors upon school entry. Children were assessed in kindergarten, first and second grade, to examine the following questions: (a) whether greater supportive emotion-related parenting in kindergarten would be associated with higher resting RSA and greater RSA withdrawal to an anger scene consistently across all 3 years, as well as (b) a linear decline in externalizing symptom severity over this time, and (c) whether trajectories of RSA reactivity would be associated with trajectories of externalizing symptoms. To inspect the specificity of findings, we further examined whether parental warmth was associated with the outcome measures, as well as the role of RSA reactivity to other emotions (i.e., sadness and fear) in the current sample. To provide a more complete picture of the sample's psychosocial adjustment, we also presented results on the roles of parenting and RSA reactivity in relation to children's internalizing symptoms in the online supplemental materials.

Method

Participants

Data were collected as a part of a larger project examining a socioemotional curriculum for children in a high-risk school district (see Gatzke-Kopp, Greenberg, Fortunato, & Coccia, 2012 for details). In the fall of 2008 (Cohort I) and 2009 (Cohort II), teachers in 10 elementary schools completed a screening form for all children in their kindergarten classrooms (n = 1,192) using a 10-item questionnaire assessing oppositional, aggressive, and internalizing symptoms (adapted from the Teacher Observation of Child Adaptation-Revised; Werthamer-Larsson, Kellam, & Wheeler, 1991). Families of children scoring in the top quartile of aggressive/oppositional behaviors within each classroom were contacted for study recruitment, and 207 families were enrolled. A comparison group was also recruited, but because no family assessments were made in this group they are not included in the current analyses. All children received a socioemotional curriculum in their classrooms during kindergarten and first grade, and half of

the children were randomly assigned to an augmented intervention condition that included friendship groups and some parent education. Parenting data examined here were taken from the preintervention baseline. As intervention effects were not the focus of this study, intervention status was entered as a covariate in all analyses. Before the assessments, parents and children were informed of the purpose and procedures. Parents signed consent forms, and children were asked to provide verbal assent at each assessment. All study procedures were approved by The Pennsylvania State University Internal Review Board (Project Name: PATHS to Success; Protocol Number: 28697).

The final sample (n = 207, M_{age} = 5.62 years old at kindergarten entry, SD_{age} = 0.37; 66% male) consisted of 73% African American, 19% Latino, 8% European American, and less than 1% Asian American children. The majority of the sample lived in households with low socioeconomic status, with 72% having incomes below the federal poverty threshold. While 65% of the parents completed high school, only 2% held a college degree at the time of the kindergarten assessment. At the time of the assessment, 15% of the children lived with parents who were married. The primary caregiver (89% mothers, 3% grandmothers, 3% fathers, and 5% others including foster parents and relatives) participated in the assessments.

Observational Measures of Parent–Child Interactions

In the fall of the kindergarten year, each family participated in an initial assessment in their home. During the visit, the parent and child were videotaped while participating in structured interaction consisting of three 5-min tasks presented in a fixed order: joint book-reading, free play, and a challenging puzzle task. During the book-reading task the parent was provided with a picture book to read together with the child. During the free-play task, the parent–child dyad was presented with a large interactive castle, and the parent was instructed to play with the child as they usually did. Finally, during the puzzle task, the parent was instructed to help the child complete challenging tangram puzzles by providing only verbal guidance.

Videos of the interactions were coded by research assistants who completed a 2-day training workshop, and achieved criterion (minimum of 80% agreement with the master coder on all coding categories) on a set of practice videos. Throughout the coding process the master coder selected approximately 20% of the participant videos to double code to ensure sustained reliability. Overall interrater percent agreement ranged from .87 to .96. Coders rated each segment (book reading, castle play, puzzles) separately, but sequentially.

Supportive emotion-related parenting. Trained research assistants watched each videotape segment twice to orient themselves to the interaction quality and then independently rated supportive emotion-related parenting using a 5-point scale. This global measure of supportive emotion-related parenting is informed by the three key dimensions of emotional socialization in the Eisenberg et al. (1998) model and focused on the aspects of parent emotional expression, reactions to children's emotions, and discussion of emotions that are supportive of children's emotion understanding, expression, and regulation. The higher end of the scale (e.g., 5) was applied to parents who consistently provided emotional support throughout the interaction. These included discussing children's emotions and using feeling words within the context of the activities (e.g., talking about a character's feelings during book-reading), as well as facilitating children's expression of both positive and negative feelings through encouragement, emotion labeling, and validation (e.g., commenting on excitement during the castle play, or acknowledging frustration during the tangram task). Parents' expression or modeling of emotions in constructive manners (e.g., verbalizing own feelings or explaining the cause) was also included. Although less frequently elicited by the observation tasks, parents could also provide guidance around self-calming strategies (e.g., suggesting a deep breath to calm down if frustrated during the tangram task.). Low scores on this scale were applied to parents who did not talk with their children about emotions during the task and failed to respond supportively when a child expressed or exhibited feelings. Across the three tasks, scores were highly related (α = .73), and were averaged into an overall score.

Parental warmth. Research assistants also provided a global rating for parental warmth using a 5-point scale. This measure captured the extent of parents' use of verbal and nonverbal praise and affection, and their enjoyment of the interaction. Parents who scored low (e.g., 1) on this scale appeared disinterested, distant, or sarcastic during the interaction. They either did not display positive affection or did so in a perfunctory way. Parents who scored high (e.g., 5) were completely engaged and interested in the interaction, and expressed genuine praise and positive affection frequently and spontaneously. Across the three tasks, scores were highly related (α = .79), and were averaged into an overall score.

Teacher Ratings of Child Externalizing Symptoms

In the winter of the kindergarten year and the spring of first and second grade, teachers completed questionnaires assessing the emotional and behavioral adjustment of each participating child. Teachers received a $15 gift card as compensation upon returning the questionnaires. Externalizing symptoms were measured through the Conduct Problems subscale of the Strengths and Difficulties Questionnaires (Goodman, 1997). This subscale included five items that were rated on a 3-point Likert scale from 0 (*not true*) to 2 (*certainly true*), assessing children's aggressive/oppositional behaviors (e.g., "Often fights with other children and bullies them") and antisocial behaviors (e.g., "Often lies or cheats"). This subscale demonstrated satisfactory internal reliability in all 3 years' assessments (α = .81–.82). Descriptive statistics of child externalizing symptoms are presented in Table 1.

Physiological Assessments

Anger movie. At each assessment, children watched a 12-min movie clip consisting of four emotional scenes from *The Lion King* movie (Hahn, Allers, & Minkoff, 1994). Each scene lasted 2−3 min, and were presented in a fixed order consistent with the timeline of the movie: fear, sad, happy, and anger. Each scene was immediately followed by a 30-second neutral scene that did not depict any particular emotion, but indicated the resolution of negative emotions in the prior scene. The neutral scene was followed by a 30-s fixation baseline before the start of the next emotion. Presentation was controlled using E-Prime 2 software (Psychological Software Tools, Inc., Sharpsburg, PA).

Table 1
Means, Standard Deviations, and Ranges of Main Study Variables

Variable	Kindergarten		First grade		Second grade	
	M (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range
Age	5.98 (.39)	5.18–7.33	7.18 (.41)	6.35–8.66	8.07 (.48)	7.24–9.58
Supportive emotion-related parenting	1.97 (.67)	1.00–4.33	—		—	
Parental warmth	2.90 (.83)	1.00–5.00	—		—	
Externalizing symptoms	3.88 (2.83)	.00–10.00	3.79 (2.88)	.00–10.00	3.86 (2.82)	.00–10.00
Average RSA during resting baseline	7.05 (1.31)	3.15–10.02	7.21 (1.28)	4.38–10.89	7.42 (1.20)	5.02–10.33
Average RSA during anger movie	7.06 (1.34)	2.75–10.16	7.09 (1.32)	3.93–10.36	7.20 (1.30)	4.06–10.50
RSA reactivity	−.03 (.76)	−2.16–3.39	−.12 (.73)	−3.61–1.64	−.21 (.64)	−2.90–1.68

Note. Age = age at each year's physiological assessment; RSA = respiratory sinus arrhythmia. Positive values represent RSA augmentation, while negative values represent RSA withdrawal during the anger scene compared to baseline.

These stimuli have been demonstrated to effectively elicit physiological responses among children of similar ages (e.g., Gentzler et al., 2009). A previous study from the current sample (Gatzke-Kopp, Jetha, & Segalowitz, 2014) found that increased arousal, reflected in both sympathetic and parasympathetic indices, was significantly higher during the anger scene relative to all other emotions. The effectiveness of the anger scene in inducing arousal, along with the face validity of this emotion for the study of externalizing behaviors, led to the selection of the anger scene as the primary focus for the present hypotheses. RSA reactivity to the other two negative emotions (fear and sad) are included in supplementary analyses to inspect the specificity of the findings. Prior to the start of the movie scenes children were instructed to sit quietly and watch a 2-min video of moving star field to establish a resting baseline. This baseline was used as the reference for computing reactivity to each emotion clip.

RSA. Electrocardiograph data were collected through Biolab 2.4 (Mindware, Westerville, OH) during the baseline and emotion movie tasks. Three electrodes were placed at children's distal right collar bone, lower left rib, and lower right rib, respectively. The electrocardiograph signals were recorded at 500 Hz and passed through a microcomputer with a 16-bit analog-to-digital converter. Artifacts of the signals (wrongly identified or missed heartbeats) were edited through visual checks and manual corrections using the Mindware HRV 3.0.15 software. RSA was then computed using spectral analysis to extract power in the 0.12- to 1.04-Hz frequency band. Respiration rate was estimated through impedance cardiography collected through four additional electrodes to verify that respiration remained within the targeted frequency band.

RSA was output in 30-s epochs and then averaged over the 2-min resting baseline session and the 2.5-min anger scene. RSA reactivity in each year was computed as the difference score between mean RSA levels during the baseline and the anger scene (i.e., RSA reactivity = RSA during anger scene – RSA during baseline). Thus, positive values of RSA reactivity indicated RSA augmentation, while negative values indicated RSA withdrawal during the anger scene compared to baseline. Descriptive statistics of RSA measures are presented in Table 1. Paired-sample *t* tests indicated that RSA during the anger scene did not significantly differ from baseline at the kindergarten assessment, $t(158) = 0.56$, $p = .57$. However, RSA was significantly lower during the anger scene compared to baseline in both first and second grade, first grade: $t(156) = 2.05$, $p = .04$; second grade: $t(143) = 3.83$, $p < .001$. Thus, RSA withdrawal during anger scene was evidence across the sample in the latter 2 years, but not in kindergarten.

Missing Data

The inclusion of multiple informants and repeated assessments in the current study introduced opportunities for missing data due to various reasons. Parenting data were not available for 34 families who did not complete the home visit. These families did not differ from the rest of the sample in child sex or behavioral and physiological outcome measures. However, families of Latino children were more likely to be missing parenting data, $\chi^2(2) = 6.84$, $p = .03$; as were families randomly assigned to the control condition, $\chi^2(1) = 4.15$, $p = .04$.

Data missing from teacher reports was due to some teachers refusing to participate. As participants recruitment was stratified by classrooms, classroom-wise missingness due to teacher refusal was not systematically associated with child characteristics. In the current study, $n = 106$ children had complete data on externalizing symptoms for all 3 years, $n = 62$ had data for 2 years, and $n = 39$ had data for 1 year ($n = 35$) or none ($n = 4$). These three groups did not differ significantly in demographic variables, intervention status, parenting, or RSA measures.

Physiological data were also missing for multiple reasons including families moving out the district, children being repeatedly absent or refusing the electrodes, and low-quality signal due to experimenter error or movement artifacts. RSA reactivity scores were available for $n = 105$ children for all 3 years, $n = 55$ for 2 years, $n = 35$ for 1 year, while $n = 12$ had no data in any year. No significant differences were found across the groups in demographic variables, intervention status, parenting, or externalizing symptoms.

Across the main study variables (i.e., parenting, externalizing symptoms, and RSA reactivity), 62 children had complete data across all years, and another 64 children had parenting measures and at least 2 years' data on both outcome measures. These 126 children, who can be considered as more sufficiently represented in the analyses, did not differ from the rest of the sample in demographic variables, parenting, or the outcome measures in any year. The only statistically significant difference was with intervention status, $\chi^2(1) = 5.17$, $p = .02$; children in the intervention

group were more likely to be in the "sufficiently represented" subsample. This may be because families in the control group were more likely to be missing parenting data.

Analytic Strategies

Preliminary analyses were conducted to obtain the bivariate correlations among study variables (see Table 2) and to examine the concurrent associations of parenting with child physiology and behavior in kindergarten through multiple regression. Then, a series of linear growth models were run within a multilevel modeling framework to examine the associations of parenting with the developmental trajectories of children's physiological regulation and externalizing symptoms, as well as how the changes in physiology were related to changes in externalizing symptoms. At the within-individual level, a "Time" variable was entered as −2, −1, and 0 for kindergarten, first grade, and second grade, respectively, to obtain estimations of within-individual linear changes as well as the levels of outcomes in second grade.

Pertaining to the first study aim, equations used to estimate within-individual changes in resting RSA or RSA reactivity over time (Equation 1) and between-individual differences in within-individual trajectories (Equations 2 and 3) are presented below. Supportive emotion-related parenting, child sex, and intervention status were entered as between-individual variables to predict the intercept (b_{0i}; set to reflect the level in second grade) and linear change (b_{1i}) of resting RSA or RSA reactivity. In the model predicting RSA reactivity, children's resting RSA in each year was controlled for as a time-varying within-person covariate (b_{2i}).

$$\text{Child Resting RSA/RSA Reactivity}_{ti} = b_{0i} + b_{1i}\text{Time}_{ti}(+b_{2i}\,\text{Resting RSA}_{ti}) + \varepsilon_{ti} \quad (1)$$

$$b_{0i} = \gamma_{00} + \gamma_{01}\,\text{Intervention Status}_i + \gamma_{02}\,\text{Child Sex}_i + \gamma_{03}\,\text{Parenting}_i + \upsilon_{0i} \quad (2)$$

$$b_{1i} = \gamma_{10} + \gamma_{11}\,\text{Intervention Status}_i + \gamma_{12}\,\text{Child Sex}_i + \gamma_{13}\,\text{Parenting}_i + \upsilon_{1i} \quad (3)$$

$$(b_{2i} = \gamma_{20}) \quad (4)$$

Similar formulation was used for the second study aim to examine parenting in relation to the linear change and second-grade level of externalizing symptoms. The third study aim examined whether change in one domain was related to change in the other. Specifically, change scores for physiology were computed by subtracting the resting RSA/RSA reactivity value in kindergarten from that in second grade, such that positive change scores indicated increases in the value over time. Therefore, negative values in the change score of RSA reactivity indicated that individuals showed a greater degree of RSA withdrawal to anger scene in second grade relative to how they reacted in kindergarten. Then, the change scores of resting RSA and RSA reactivity were entered into the model predicting linear changes of externalizing symptoms.

Covariates in the models were selected based on their theoretical relevance to the constructs of interest and correlations with study variables in the current sample. Children's resting RSA was negatively correlated with RSA reactivity within each year (see Table 2), thus was included as a within-individual covariate in the models with RSA reactivity. Child sex (coded as 1 for male and 0 for female) and intervention status (coded as 1 for intervention group and 0 for control group) were entered as covariates in all models. We also explored whether child sex and intervention status served as moderators for the relation between parenting and child outcomes. However, the interaction terms were removed from the final model if they were not statistically significant and did not influence the main findings. Additionally, there was a significant correlation between RSA reactivity in kindergarten and supportive emotion-related parenting (see Table 2). Thus, RSA reactivity in kindergarten was entered as a covariate in the model predicting behavioral trajectories, so as to examine the unique relations of parenting with changes of externalizing symptoms.

All analyses were performed in R (R Core Team, 2016). The multilevel models were fit using the *nlme* package Version 3.1–128 (Pinheiro, Bates, DebRoy, Sarkar, & R Core Team, 2016). Parameters were estimated using the restricted maximum likelihood approach, which is capable of handling incomplete data and takes all available information into account. Confidence intervals

Table 2
Bivariate Correlations Among Study Variables

Variable	1	2	3	4	5	6	7	8	9
1. E-R parenting	—								
2. Externalizing symptoms K	.09	—							
3. Externalizing symptoms G1	−.17†	.39**	—						
4. Externalizing symptoms G2	−.07	.32**	.57**	—					
5. Resting RSA K	−.02	−.06	−.11	−.09	—				
6. Resting RSA G1	−.09	−.04	−.05	−.07	.68**	—			
7. Resting RSA G2	.01	−.06	−.27**	−.06	.44**	.50**	—		
8. RSA reactivity K	.21*	.14	−.09	−.11	−.21**	−.07	.07	—	
9. RSA reactivity G1	.16†	.15†	−.12	−.23**	−.09	−.23**	−.16	.28**	—
10. RSA reactivity G2	−.15†	−.14	.05	.15†	−.10	.02	−.10	.01	.04

Note. E-R parenting = supportive emotion-related parenting; K = kindergarten; G1 = first grade; G2 = second grade; RSA = respiratory sinus arrhythmia. Positive values of RSA reactivity represent RSA augmentation, while negative values represent RSA withdrawal during the anger scene compared to baseline.
† $p < .10$. * $p < .05$. ** $p < .01$.

(CI) of random effect coefficients at the level of 95% were estimated through bootstrapping method with $N = 1{,}000$ resampling. Simple slopes of the interactions in the multilevel models were estimated using the *reghelper* package Version 0.3.4 (Hughes, 2017).

Results

Descriptive statistics for all variables are provided in Table 1. Supportive emotion-related parenting scores ranged widely from 1 to 4.33 in this sample, although overall, mean levels were fairly low. When averaged across the three tasks, 19 (11.0%) parents had the lowest score, reflecting a lack of any indicator of supportive emotion-related parenting during the three tasks. Only 17 of the parents in this sample (9.8%) scored 3 or above on supportive emotion-related parenting by demonstrating relatively consistent use of supportive reactions to child emotions or discussion of emotions. Rates of observed warmth were higher, averaging nearly 3.

Concurrent Associations Between Parenting and Child Regulatory Capability

Regression analysis showed that there was no significant cross-sectional association between supportive emotion-related parenting and externalizing symptoms in kindergarten ($\beta = 0.12$, $p = .19$), when child sex, intervention status, and RSA reactivity at kindergarten were entered as covariates. This indicates that in this sample of children screened for elevated externalizing problems, exposure to more supportive emotion-related parenting was not related to lower symptom severity in kindergarten. Supportive emotion-related parenting was not related to children's resting RSA in kindergarten ($\beta = -0.03$, $p = .75$), but was associated with RSA reactivity ($\beta = 0.21$, $p = .02$). More supportive emotion-related parenting was related to RSA augmentation to the anger scene in kindergarten. No significant concurrent associations were found between parental warmth and any of the outcome measures.

Parenting and Trajectories of Resting RSA and RSA Reactivity

As indicated in Table 2, children demonstrated modest to high rank-order stability over time for resting RSA (rs = .50–.68 between consecutive years), but not for RSA reactivity (rs = .04–.28). Trajectories of change in RSA were examined by first running the multilevel models without parenting entered as a predictor, so as to estimate variations in the linear slopes of resting RSA and RSA reactivity after accounting for covariates. Results showed that the standard deviation of the random slope was 0.41 (95% CI [0.25, 0.59]) for the model predicting resting RSA, and 0.19 (95% CI [0.01, 0.31]) for the model predicting RSA reactivity. Thus, after controlling for all covariates, there were still significant between-individual variations in the linear changes of resting RSA and RSA reactivity to be further explained by other variables.

Supportive emotion-related parenting was then entered as a predictor, and results of the full models predicting the linear growth and intercept (i.e., set to reflect second grade level) of resting RSA (Model 1a) and RSA reactivity (Model 1b) are presented in Table 3. For resting RSA, there was a significant main effect of time, indicating that children in the current sample demonstrated increasing resting RSA from kindergarten to second grade. However, supportive emotion-related parenting was not associated with the growth of resting RSA over time or the level in second grade. There were no significant interactions between parenting and child sex or intervention status in predicting the trajectories of resting RSA.

In the model predicting RSA reactivity, there was a significant negative effect of resting RSA, such that higher resting RSA was related to greater RSA withdrawal to the anger scene. Parenting significantly interacted with time, such that supportive emotion-related parenting in kindergarten predicted the linear change of RSA reactivity from kindergarten to second grade (although prediction to the second grade intercept was not significant). As evident in the prior analysis of concurrent relations, and illustrated in Figure 1a, more supportive emotion-related parenting was associated with RSA augmentation to the anger scene in kindergarten; but when examined longitudinally, post hoc probing showed that children who received at least some supportive emotion-related parenting (score >2.01; region of significance was depicted in Figure 1b) on average showed significant decreases in RSA reactivity from kindergarten to second grade, indicating a shift from RSA augmentation to RSA withdrawal over time. In contrast, children who experienced little supportive emotion-related parenting on average showed RSA withdrawal to the anger scene from kindergarten to second grade, and there was no evidence of averaged developmental changes in their RSA reactivity

Table 3
Estimations of Models Predicting Developmental Trajectories of Child Resting Respiratory Sinus Arrhythmia (RSA) and Reactivity During Anger Movie

	Model 1a: Resting RSA		Model 1b: RSA Reactivity	
Fixed effect	*B* (*SE*)	*p*	*B* (*SE*)	*p*
b_0 (second-grade level)				
γ_{00} (Intercept)	**7.41 (.10)**	**<.001**	**.51 (.22)**	**.02**
γ_{01} (Intervention)	−.30 (.20)	.14	−.04 (.11)	.74
γ_{02} (Sex)	−.31 (.22)	.16	−.12 (.12)	.35
γ_{03} (E-R parenting)	−.03 (.15)	.82	−.10 (.08)	.20
b_1 (Linear change)				
γ_{10} (Time)	**.15 (.06)**	**.01**	−.07 (.04)	.10
γ_{11} (Intervention × Time)	.07 (.12)	.56	−.11 (.09)	.21
γ_{12} (Sex × Time)	−.03 (.13)	.83	−.10 (.09)	.28
γ_{13} (E-R Parenting × Time)	.05 (.09)	.61	**−.19 (.06)**	**.004**
b_2 (Baseline effect)				
γ_{20} (Resting RSA)	—	—	**−.10 (.03)**	**.001**

Random effect	*SD*	95% CI	*SD*	95% CI
$\sigma_{\upsilon 0}$ (Intercept)	.91	[.71, 1.11]	.10	[−.02, .15]
$\sigma_{\upsilon 1}$ (Linear change)	.39	[.20, .64]	.14	[−.05, .25]
σ_{ϵ} (Residual)	.77	[.68, .89]	.65	[.61, .74]

Note. E-R parenting = supportive emotion-related parenting; CI = confidence interval. Statistically significant fixed effects ($p < .05$) are bolded. Positive values of RSA reactivity represent RSA augmentation, while negative values represent RSA withdrawal during the anger scene compared to baseline.

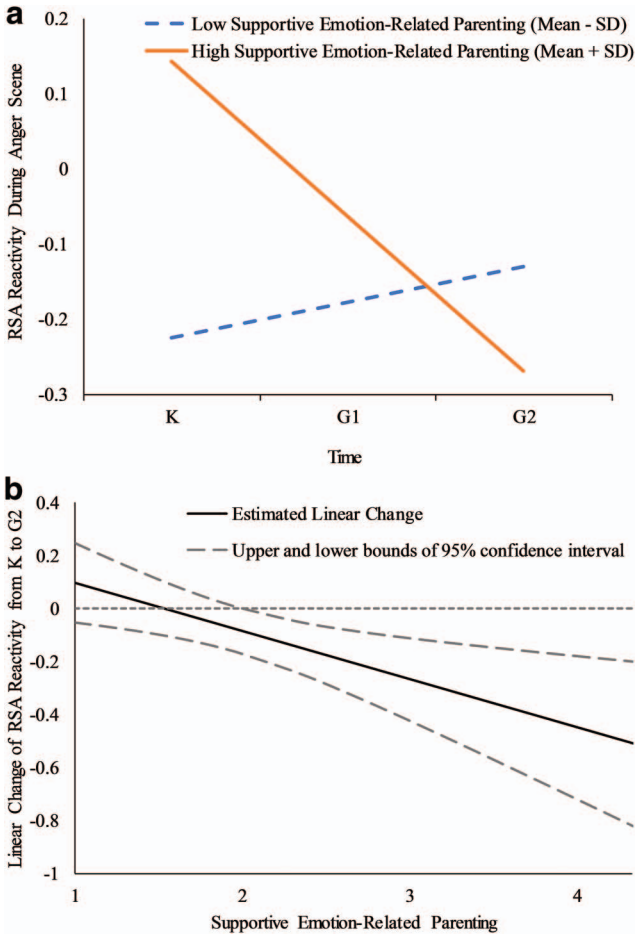

Figure 1. (a) Supportive emotion-related parenting predicting trajectories of children's respiratory sinus arrhythmia (RSA) reactivity during the anger scene in *The Lion King* movie. Negative values of RSA reactivity represent RSA withdrawal, and negative values represent RSA withdrawal during the anger scene compared to baseline. (b) Estimated relation between parenting and the linear change of RSA reactivity from kindergarten (K) to Grade 2 (G2). Negative linear change represents a developmental trend toward RSA withdrawal from K to G2. G1 = Grade 1. See the online article for the color version of this figure.

over time (see Figure 1). The association between parenting and RSA reactivity was not moderated by child sex or intervention status.

Supplementary analyses indicate that effects were specific to supportive emotion-related parenting and did not emerge when examining parental warmth. Further analyses probed the specificity of these findings to the anger scene by examining associations between supportive emotion-related parenting and RSA reactivity to the other negative emotion scenes (fear and sad). No significant effects emerged.

Parenting and Trajectories of Externalizing Behaviors

Although externalizing behaviors were reported by a different teacher each year, thus reducing bias from shared rater variance, children's externalizing symptoms showed moderate levels of stability across consecutive years (r = .39–.57). We then examined the degree to which supportive emotion-related parenting was related to the linear growth and second grade level of externalizing symptoms. As a first step, a model with the covariates (but not parenting) entered as predictors was run to examine the variations in the linear growth of externalizing symptoms. The estimated standard deviation of the random linear slope was 0.85 (95% CI [0.39, 1.43]), indicating between-individual differences in the linear growth of externalizing symptoms from kindergarten to second grade after accounting for the effects of covariates.

We then computed the full model with parenting included (Table 4, Model 2), and a significant association between parenting and the linear growth of externalizing symptoms emerged (see Figure 2a). Post hoc probing indicated that with very low levels of supportive emotion-related parenting (score <1.95; region of significance was depicted in Figure 2b), children tended to show significant increases in externalizing symptoms from kindergarten to second grade. In contrast, when parents showed relatively more supportive emotion-related parenting, children's levels of externalizing symptoms were averagely not escalating, and more supportive emotion-related parenting was marginally related to lower levels of externalizing symptoms in second grade. Child sex or intervention status did not moderate the associations between parenting and externalizing symptoms. Parental warmth was negatively related to growth in externalizing symptoms in a similar way as supportive emotion-related parenting.

Associations Between Physiological and Behavioral Changes

Externalizing symptoms were not significantly correlated with resting RSA or RSA reactivity within each year. However, the

Table 4
Estimations of the Model Predicting Developmental Trajectories of Child Externalizing Symptoms

	Model 2: Externalizing symptoms	
Fixed effect	*B* (*SE*)	*p*
b_0 (Intercept)		
γ_{00} (Intercept)	**4.07 (.30)**	**<.001**
γ_{01} (Intervention)	−.67 (.60)	.27
γ_{02} (Sex)	.94 (.62)	.14
γ_{03} (RSAre at K)	−.34 (.39)	.38
γ_{04} (E-R parenting)	−.88 (.48)	.07
b_1 (Linear change)		
γ_{10} (Time)	.32 (.16)	.05
γ_{11} (Intervention × Time)	−.52 (.32)	.11
γ_{12} (Sex × Time)	.02 (.34)	.96
γ_{13} (RSAre at K × Time)	−.22 (.21)	.26
γ_{14} (E-R Parenting × Time)	**−.54 (.26)**	**.04**
Random effect	*SD*	95% CI
σ_{u0} (Intercept)	2.38	[1.70, 2.90]
σ_{u1} (Linear change)	.74	[.18, 1.32]
σ_{ϵ} (Residual)	1.94	[1.75, 2.29]

Note. E-R Parenting = supportive emotion-related parenting; CI = confidence interval; RSAre = respiratory sinus arrhythmia reactivity score; K = kindergarten. Statistically significant fixed effects (p < .05) are bolded.

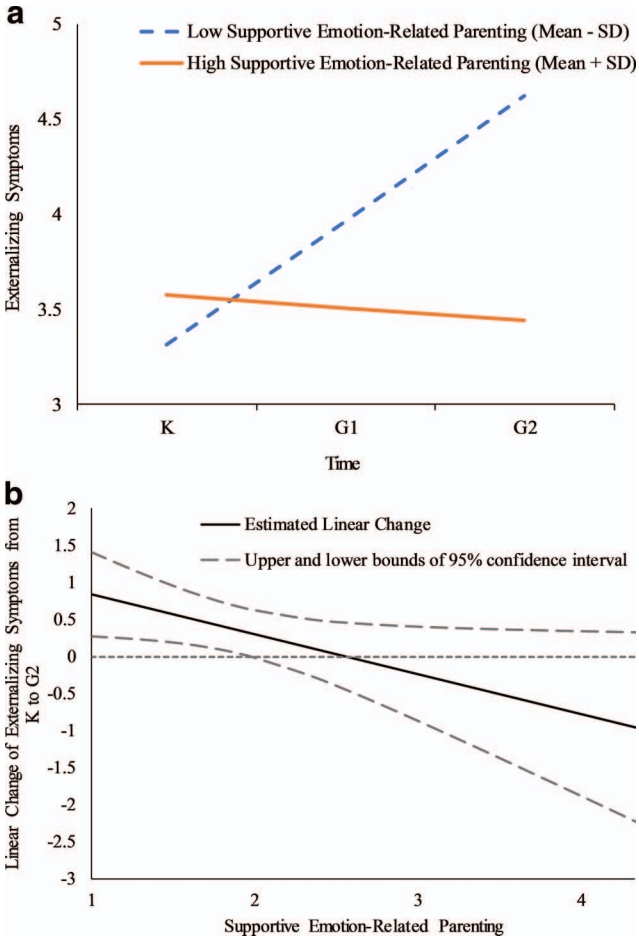

Figure 2. (a) Supportive emotion-related parenting predicting trajectories of children's externalizing symptoms. (b) Estimated relation between parenting and the linear change of externalizing symptoms from kindergarten (K) to Grade 2 (G2). Positive linear change represents increase in externalizing symptoms from K to G2. G1 = Grade 1. See the online article for the color version of this figure.

preceding analyses demonstrated that supportive emotion-related parenting was associated with the longitudinal changes in both RSA reactivity and externalizing symptoms. Thus, exploratory analyses were conducted to examine whether changes in RSA reactivity mediated the relation between parenting and changes in externalizing symptoms. A longitudinal change score in RSA reactivity was computed by subtracting RSA reactivity in kindergarten from that in second grade, so that a negative change score indicated that the child showed greater RSA withdrawal in the second grade compared to kindergarten. This change score was entered into the model examining developmental trajectories of externalizing symptoms along with parenting. A longitudinal change score in resting RSA (from kindergarten to second grade) calculated through the same approach was also entered as a covariate.

Results are presented in Table 5 (Model 3). No significant effect was found for change in resting RSA, thus ruling out the possibility that the effect was driven by developmental changes in baseline RSA. The change in RSA reactivity from kindergarten to the second grade was significantly associated with the linear change in externalizing symptoms. Post hoc probing indicated that children who had lower RSA reactivity score (i.e., greater RSA withdrawal) in second grade than their own kindergarten level (the longitudinal change score of RSA reactivity < -0.023) showed nonescalating externalizing symptoms. However, children whose RSA reactivity score did not change or increased from kindergarten to second grade averagely showed escalating externalizing symptoms. When the change score of RSA reactivity was entered into the model, the association of supportive emotion-related parenting with the linear change of externalizing symptoms was no longer statistically significant. Overall, these results are consistent with the hypothesis that the association between supportive emotion-related parenting and lower risk for escalating externalizing behaviors over time is partially mediated by a developmental trend toward RSA withdrawal in response to an anger scene from kindergarten to second grade.

Supplementary analyses indicated that increases in RSA withdrawal to the sad scene over time was also related to decreases in externalizing symptoms from kindergarten the second grade. However, as the trajectories of RSA reactivity to sadness were not related to parenting, the hypothesized mediation model only held for RSA reactivity during the anger scene.

Table 5
Estimations of the Model Predicting Developmental Trajectories of Child Externalizing Symptoms From Changes in Respiratory Sinus Arrhythmia (RSA) Reactivity

	Model 3: Externalizing symptoms	
Fixed effect	*B* (*SE*)	*p*
b_0 (Intercept)		
γ_{00} (Intercept)	**4.23 (.34)**	**<.001**
γ_{01} (Intervention)	−.52 (.70)	.46
γ_{02} (Sex)	.67 (.76)	.38
γ_{04} (E-R parenting)	−.89 (.58)	.13
γ_{05} (RSAbs dev)	−.13 (.26)	.61
γ_{06} (RSAre dev)	.37 (.37)	.32
b_1 (Linear change)		
γ_{10} (Time)	.33 (.18)	.08
γ_{11} (Intervention × Time)	−.40 (.37)	.28
γ_{12} (Sex × Time)	.06 (.40)	.89
γ_{14} (E-R Parenting × Time)	−.33 (.31)	.29
γ_{05} (RSAbs Dev × Time)	−.01 (.14)	.92
γ_{16} (RSAre Dev × Time)	**.41 (.20)**	**.04**
Random effect	*SD*	95% CI
$\sigma_{\upsilon 0}$ (Intercept)	2.53	[1.83, 3.05]
$\sigma_{\upsilon 1}$ (Linear change)	.78	[.12, 1.30]
σ_{ϵ} (Residual)	1.94	[1.76, 2.32]

Note. E-R parenting = supportive emotion-related parenting; CI = confidence interval. RSAre Dev and RSAbs Dev reflect the developmental change in RSA reactivity or RSA baseline, respectively, calculated by subtracting the value in kindergarten from that in second grade. Positive values of RSAre Dev indicate a developmental shift toward RSA augmentation, while negative values indicate a shift toward RSA withdrawal during the anger scene from kindergarten to second grade. Statistically significant fixed effects ($p < .05$) are bolded.

Discussion

The goal of the current study was to evaluate the role of supportive emotion-related parenting in shaping children's physiological reactivity and externalizing behavioral trajectories across the early school years in a sample of at-risk children. Drawing on Eisenberg and colleagues' (1998) model of emotion socialization, we hypothesized that supportive emotion-related parenting practices, characterized by parents' supportive responding to children's emotions, discussion of emotions with their children, and constructive expression or modeling of emotions, would help promote children's physiological regulation in a way that supports behavioral adjustment. The current study followed children longitudinally across the early school years, and found that higher levels of supportive emotion-related parenting in kindergarten predicted developmental changes in their physiological regulation as well as lower risk for escalating externalizing symptoms over time. These findings further our understanding of how parents' support for emotion regulation may help reduce the likelihood that children with early externalizing problems will escalate to later antisocial trajectories.

Results from the current study highlight how associations between parenting and children's functioning change or emerge over time. At kindergarten, variation in supportive emotion-related parenting was not related to severity of externalizing symptoms, but parenting did predict significantly less escalation in externalizing symptoms over the subsequent 2 years. Although this effect appeared to mitigate the developmental trajectory of escalation in symptom severity, parenting did not predict decreases in symptoms. This may be because supportive emotion-related parenting was rarely observed at a high level within this sample. Our findings indicate that even moderate levels of supportive emotion-related parenting can at least protect children from the escalation of symptoms, suggesting that efforts to further promote these behaviors among parents of at-risk children (e.g., parenting training) may support further developmental gains. Overall, these findings add longitudinal evidence to the model of emotion socialization by demonstrating how the relation between supportive emotion-related parenting and behavioral adjustment may unfold over time.

We further examined whether supportive emotion-related parenting influenced children's RSA, a widely studied psychophysiological index associated with emotion regulation. Our results indicated that children's resting RSA increased over time while maintaining relatively high rank-order stability, consistent with previous studies of low risk samples (e.g., Perry et al., 2013). In contrast to studies that have documented a correlation between adverse family environment (e.g., negative controlling parenting) and resting RSA (Gentzler, Rottenberg, Kovacs, George, & Morey, 2012; Hastings et al., 2008), supportive emotion-related parenting was not related to the level or growth of resting RSA in the current sample. This might be due to the focus on a sample of children exhibiting high rates of externalizing behavior in a high adversity community context, which may have constrained variability in the sample.

While hypotheses were not supported with regard to resting RSA, parenting was associated with change over time in RSA reactivity to the anger scene. Children who experienced more supportive parenting demonstrated greater change over time. In fact, higher supportive parenting was related to an average tendency of RSA augmentation in response to the anger scene in kindergarten, with a transition toward RSA withdrawal in subsequent years. This reversal in the direction of association over time adds to the difficulty in interpreting the inherent psychological meaning of RSA withdrawal. As noted in the introduction, many studies proposed that decreasing RSA in emotionally challenging situations is associated with better emotional and behavioral adjustment (Calkins & Keane, 2004; Porges, 2007), and has been observed among low-risk samples of preschoolers who received more positive parenting (e.g., Calkins et al., 2008; Perry et al., 2013). Interpreted from this perspective, it is possible that among this sample, greater positive emotional support simply took longer to affect children's regulatory abilities, which emerged over time. Indeed, results linked the developmental shift toward RSA withdrawal over time with less increase in externalizing symptoms, suggesting an association between the physiological and behavioral developmental trajectories.

However, it seems unlikely that greater RSA withdrawal to anger is associated with inherently better regulation, as children whose parents showed minimal emotional support evidenced RSA withdrawal since kindergarten. There were likely considerable between-individual variabilities in the trajectories, but these children on average did not show any developmental changes in RSA reactivity over time. This seems consistent with findings from other high-risk samples wherein greater RSA withdrawal was proposed to reflect greater engagement with the negative emotional stimuli rather than regulated response (Blair, 2003; Fortunato et al., 2013). However, in the current sample, RSA reactivity during anger was not concurrently correlated with externalizing symptoms within any year, suggesting that certain directions or amplitudes of RSA reactivity may not be inherently adaptive. For instance, if RSA withdrawal reflects engagement, the extent to which an individual possesses appropriate cognitive skills to respond in a regulated way may moderate the association between RSA reactivity and behavioral adjustment. It is possible that children exposed to supportive socialization around emotions are better equipped to respond constructively when engaged with the emotional context, whereas children who had little support from socialization experiences might respond in disruptive ways when engaged emotionally.

In proposing regulation of arousal as a mediator in the emotion socialization model, Eisenberg and colleagues (1998) suggested that the types or patterns of physiological regulation that might function as mediators may depend on contextual factors and child characteristics. In consideration of this perspective, findings of the current study add specificities to, and expand the model of, emotion socialization in three ways. First, our results specify that for disadvantaged children who demonstrate externalizing symptoms, RSA reactivity when exposed to anger scenes may be a particularly relevant indicator of arousal regulation associated with the development of behavioral adjustment. Second, based on the findings, we argue that there may not be an inherent or invariant interpretation of what direction and amplitude of RSA reactivity at a given age is optimal. Instead, it may be the pattern of within-individual changes that indicates regulatory skill growth and adaptation. In the current sample, a significant developmental change toward RSA withdrawal across the early school years was found to mediate the relation between supportive emotion-related parenting

and lower risk for escalating externalizing symptoms. By contrast, for children who received little parental support, although they showed RSA withdrawal to the anger scene throughout the assessments, the lack of developmental changes in their physiological regulation seemed to be associated with increased maladjustment across the early school years.

Third, the current sample is unique in that it provides an examination of this model in children already demonstrating the dysregulated behaviors that supportive emotion-related parenting is proposed to mitigate. Children in this study resided in a high-risk community, with greater exposure to threat, fewer material resources, and more contextual stressors than the norm. In this context, parenting likely represents only one avenue of influence on children's developing regulatory systems, and it is important to understand whether supportive emotion-related parenting can compensate for other competing influences. Our findings suggest that parenting can serve to mitigate the risk for escalating externalizing symptoms despite the risks. The relatively lower levels of positive emotionally supportive parenting observed in the current sample highlight the need to educate parents and provide coaching around supportive behaviors. Interestingly, the more general construct of parental warmth, while associated with less escalation in externalizing behaviors over time, was not associated with physiological regulation. The specificity of this association is consistent with the model of emotion socialization proposed by Eisenberg et al. (1998), as it suggests that how parents prepare their children to respond to emotional experiences shapes their physiological reactivity when faced with emotional content.

Collectively, our findings suggest that supportive emotion-related parenting may play an important role in the development of physiological regulation among children showing risk for externalizing symptoms at school entry and help them avoid escalating adjustment difficulties. This study was among the first to examine the relation of supportive emotion-related parenting with developmental trajectories of physiological and behavioral outcomes simultaneously. Although rigorous causal relationships cannot be inferred based on the analyses, the longitudinal design enabled us to examine how parental support was related to children's functioning in a longitudinally unfolding manner. However, our findings also showed that the levels of supportive emotion-related parenting were relatively low in this sample, which failed to support children with early risk indicators for a trajectory characterized by significantly decreasing externalizing symptoms. Thus, intervention that facilitates parental support for children's more adaptive emotional expression and regulation may be necessary to promote school adjustment, especially for disadvantaged children who demonstrate early-onset externalizing symptoms.

The current study has some limitations in study design and generalizability that warrant consideration. First, we examined the prospective associations between parenting at kindergarten and children's developmental trajectories in subsequent years. However, parenting was not measured at first or second grade, which limited our ability to examine how parenting behaviors and child regulatory capability reciprocally shape each other. For instance, children who lacked parental support at kindergarten demonstrated increasing behavioral problems over time, which might further reduce parents' ability to engage in supportive emotion-related parenting. Meanwhile, children's persistent regulatory difficulties and parents' lack of support may jointly compromise the quality of parent–child relationship, making it harder for children to benefit from parental attempts in facilitating emotion regulation (Darling & Steinberg, 1993). Future studies could examine these questions with both parenting and child outcomes measured longitudinally.

Second, although supportive emotion-related parenting comprises a range of specific parenting practices (e.g., emotion labeling, encouragement for emotional expression, teaching self-control skills), the current study used a single global rating to reflect it. This limited the opportunity to examine internal reliability of the construct, or to test the potentially unique effects of specific practices. Third, the same stimuli (anger scene from *The Lion King*) was used repeatedly in different years, and many children might have watched this popular movie before. Although the consistency of stimuli ensures the comparability of physiological responses, and the fact that the sample showed greater RSA withdrawal during the anger scene in later years has lessened the concern about habituation, it would have been helpful to measure children's prior exposure to this movie as a potential covariate. Fourth, although our findings have important implications for understanding the development of children with early risk indicators, the lack of a comparison group (i.e., children with low levels of behavior problems at school entry) may have limited the variability in behaviors and physiology. Finally, the sample was characterized by elevated exposure to high-risk ecological factors including poverty and violence, which may have substantial influence on how children respond to and cope with challenges in daily life. Future studies could quantify variations in these factors, and elucidate whether and how broader contextual risks relate to or interact with parenting in shaping children's physiological regulation and behavioral adjustment.

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