Published in final edited form as:
Dev Psychol. 2015 January ; 51(1): 17–25. doi:10.1037/a0038189.

Respiratory Sinus Arrhythmia, Effortful Control, and Parenting as Predictors of Children's Sympathy Across Early Childhood

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Abstract

The goal of this study was to examine physiological and environmental predictors of children's sympathy (an emotional response consisting of feelings of concern or sorrow for others who are distressed or in need) and whether temperamental effortful control mediated these relations. Specifically, in a study of 192 children (23% Hispanic; 54% male), respiratory sinus arrhythmia (RSA), a measure thought to reflect physiological regulation, and observed authoritative parenting (both at 42 months) were examined as predictors of children's effortful control (at 54 months) and, in turn, children's sympathy (at 72 and 84 months). Measures of both baseline RSA and RSA suppression were examined. In a structural equation model, observed parenting was positively related to children's subsequent sympathy through its positive relation to effortful control. Furthermore, the indirect path from baseline RSA to higher sympathy through effortful control was marginally significant. Authoritative parenting and baseline RSA uniquely predicted individual differences in children's effortful control. Findings highlight the potential role of both authoritative parenting and physiological regulation in the development of children's sympathy.

Keywords

sympathy; respiratory sinus arrhythmia (RSA); effortful control; parenting; early childhood

Developmental researchers are increasingly examining how children's biology, as well as their socialization, is associated with their capacity to think and act in ways that demonstrate concern for the well-being of others. Such "other-focused" emotions and actions include the separate, but interrelated, affective states of compassion, sympathy, and empathy. Compassion is the feeling that arises when witnessing another's suffering and that motivates a subsequent desire to help (Goetz, Keltner, & Simon-Thomas, 2010). Sympathy is an emotional response that is likely closely linked to compassion because it involves the feeling

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of concern or sorrow for others who are distressed or in need (Goetz et al., 2010). However, sympathy refers primarily to feelings of concern or sorrow and may not always involve the desire to act prosocially, especially if it is difficult or impossible to assist (although sympathy is believed to frequently provide the motivation to help; Batson, 2001; Eisenberg, Spinrad, & Knafo, in press). In contrast, compassion tends to be defined as explicitly involving the desire to help the distressed or needy person (Goetz et al., 2010). Thus, sympathy and compassion are quite similar constructs; however, few investigators in studies of children have explicitly assessed the desire to help another (rather than concern or actual prosocial behavior). Both compassion and sympathy differ from empathy, which refers to the vicarious experiencing of an emotion very similar to another's emotions (or another's expected emotion, based on the context). Empathy is believed to frequently lead to sympathy, but it also can result in feelings of personal distress (an aversive reaction to vicariously experiencing another's emotion, such as discomfort; Eisenberg et al., in press).

Compassion and sympathy are believed to share central features, such as similar antecedents as well as physiological and behavioral responses (Goetz et al., 2010; Hastings, Miller, Kahle, & Zahn-Waxler, 2014). For example, physiological responses such as heart rate deceleration, level of skin conductance, and respiration-linked variability in heart rate or respiratory sinus arrhythmia (RSA) have been shown to occur in situations that evoke both compassion and sympathy (for a review, see Goetz et al., 2010).

Sympathy has been positively associated with various aspects of positive adjustment, such as peer competence, lower levels of externalizing and internalizing symptoms, and prosocial behaviors (see Eisenberg, Fabes, & Spinrad, 2006; Eisenberg, Huerta, & Edwards, 2012; Eisenberg et al., in press). Thus, examining factors that are associated with the development of sympathy in early childhood could have important implications for children's later socioemotional adjustment and moral development, as well as for understanding compassion.

Antecedents to Children's Sympathy

Antecedents to the development of children's sympathy, (and other similar dispositional traits), likely involve socialization processes such as parenting behaviors, as well as biological and temperamental factors related to the regulation of emotion. Emotion regulation is "the process of initiating, maintaining, modulating, or changing the occurrence, intensity, or duration of internal feeling states and emotion-related physiological processes" (Eisenberg, Fabes, Guthrie, & Reiser, 2000, p. 137). In particular, how children regulate their own emotions in response to another's distress is believed to relate to whether children respond sympathetically (Eisenberg, Shea, Carlo, & Knight, 1991). Children who become overaroused in response to another's emotions appear more likely to experience personal distress and less likely to experience sympathy or compassion because they become overwhelmed and self-focused (Eisenberg, 2010; Eisenberg et al., 1996; Valiente et al., 2004). Conversely, children who are better able to regulate their emotions are more likely to respond sympathetically in response to another's distress (e.g., Eisenberg et al., 1996, 2007; Valiente et al., 2004).

Based on prior theory and research (e.g., Eisenberg et al., 1991; Roeser et al., 2014), we hypothesized that early biological foundations (e.g., autonomic physiological responses, genetics, and neurophysiology) and socialization processes (e.g., parenting quality and behaviors) support the development of self-regulation (including regulation of emotion), and, in turn, children's prosocial dispositions, including sympathy (see Figure 1). In the present study, we focused primarily on sympathy as an indicator of a prosocial disposition, effortful control as an indicator of emotion-relevant self-regulation, authoritative parenting as an indicator of parental socialization, and RSA as an indicator of biological responding. However, the model is relevant to other aspects of biological and parenting indices, as well as to sympathy and compassion. The literature supporting these predictions is discussed next.

Parental Socialization of Sympathy

The first construct in our conceptual model is parental socialization. Path A represents the hypothesis that parental socialization has a direct influence on the development of sympathy. Parents' socialization practices can reflect parents' genetic makeup, which is passed on to children and might relate to whether children respond sympathetically (Hastings et al., 2014). However, children's sympathy is also likely to be associated with parenting behaviors and practices above and beyond any influence of genetics (see Deater-Deckard et al., 2001; Eisenberg et al., 2006). We focus on authoritative parenting, a style of parenting characterized by rules and limit setting, combined with reasoning and being responsive and sensitive to children's needs (Baumrind, 1991).

Sympathy is expected to be fostered through high-quality relationships with caregivers, partly because these positive relationships foster a sense of connection and attachment to others, model caring behavior, and satisfy children's needs so they can focus on others. In particular, parents who are responsive to their children's distress are expected to model compassion and sympathy, thus fostering children's own sympathetic responses to others (Davidov & Grusec, 2006; Eisenberg & Fabes, 1998).

Hoffman (2000) also argued that parents who use inductive practices, such as reasoning, contribute to their children's sympathy (and other sympathy-related responses, such as empathy) because this component of authoritative parenting orients children to the needs of others without them becoming overly aroused and self-oriented. Supporting this, researchers have found that children's sympathy and empathy are positively associated with parental use of inductive practices (Carlo, Knight, McGinley, & Hayes, 2011; Carlo, McGinley, Hayes, Batenhorst, & Wilkinson, 2007; Laible, Eye, & Carlo, 2008; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992). Moreover, authoritative parenting has generally been associated with prosocial behaviors (e.g., Padilla-Walker, Carlo, Christensen, & Yorgason, 2012), which tend to be correlated with, and predicted by, sympathy (Eisenberg et al., 2006).

Relatively few researchers have examined the direct effects of positive parenting behaviors on sympathy, although, generally, the direct relation is positive (Eisenberg et al., 2006, in press). For example, Spinrad and colleagues (1999) found that maternal positive affect and encouragement during a stressful task were positively associated with sympathy in children aged 5 to 7 years. High levels of maternal support have sometimes been positively related to

adolescents' self-reports of sympathy (Labile & Carlo, 2004; Soenens, Duriez, Vansteenkiste, & Goossens, 2007), although significant relations between parental support and adolescents' sympathy have not always been found (Carlo et al., 2007).

Although not the focus of the present article, it is also likely that parenting and children's biological processes are associated in terms of influencing one another in bidirectional ways, as shown by Path C in Figure 1. For example, researchers have found affective and autonomic synchrony to be present in parent–infant interactions (for a review, see Feldman, 2012), and bidirectional longitudinal relations between children's physiological regulation and maternal sensitivity across early childhood (Perry, Mackler, Calkins, & Keane, 2014). Hastings and colleagues (2008) also reported that mothers who used more negative control had children with lower levels of RSA.

Parental socialization of sympathy may also be mediated through its relation to self-regulated capacities (Paths B and F). As discussed previously, how children control and regulate their own emotional responses appear to relate to whether they react sympathetically to someone in distress or need (see Eisenberg, 2010; Eisenberg et al., 2006, in press, for reviews). Individual differences in self-regulatory processes used in regulating emotion are evident in studies examining temperamental self-regulation or effortful control. Effortful control is a temperamental characteristic that includes being able to voluntarily or willfully focus and shift attention, to inhibit or initiate behaviors, to plan, and to detect errors (Rothbart & Bates, 2006). These abilities can be viewed as tools that help modulate emotion and behavior; consequently, individuals with high effortful control would be expected to have an advantage in regard to managing and controlling distressful emotions.

There is mounting evidence that supportive, sensitive parenting is predictive of higher levels of effortful control in children (Calkins, Dedmon, Gill, Lomax, & Johnson, 2002; Kochanska & Knaack, 2003; see Eisenberg, Smith, & Spinrad, 2011, for a review). Thus, such parenting might have an indirect effect on children's sympathy by helping them to avoid empathic over-arousal (i.e., personal distress) when exposed to others' negative emotions or neediness. Consistent with this view, Eisenberg, Liew, and Pidada (2001) found that effortful control cross-sectionally mediated the relation between positive parental expression of emotion and Indonesian school-aged children's sympathy. Additionally, Davidov and Grusec (2006) reported that effective regulation of negative emotion mediated the relation between maternal responsiveness to distress and empathy in children aged 6 to 8 years.

In summary, researchers have found some support for both direct and indirect effects of parenting on children's sympathy. Overall, it appears that parents who are warm and sensitive, and who use reasoning and other forms of authoritative discipline, are likely to raise sympathetic children. There is some evidence that effortful control and other markers of emotion regulation mediate the relations between parenting behaviors and measures of prosocial dispositions. However, to our knowledge, this mediated sequence has not been examined with longitudinal data or for young children in regard to sympathy.

Physiological Processes and Sympathy

The second part of our conceptual model focuses on how biological processes relate to sympathy (Path E), as well as whether temperamental markers of emotion regulation mediate this relation (Paths D and F). Although many biological processes, such as genetics and neurophysiology, have been associated with sympathy (for a review, see Hastings et al., 2014), we focus on RSA.

It is likely that underlying physiological mechanisms contribute to individual differences in emotion regulation (e.g., Beauchaine, Gatzke-Kopp, & Mead, 2007; Graziano & Derefinko, 2013; Porges, 2007). Variations in biological processes relating to the autonomic nervous system (ANS), such as blood pressure, heart rate, and respiration, are important for regulating one's distress or emotion, or for preparing an individual to act or offer assistance to another (Hastings et al., 2014) and provide an objective measure of physiological arousal and regulation. A measure of the ANS that is frequently used as a proxy for reactivity of the parasympathetic nervous system is RSA. RSA is the rhythmic fluctuation in heart rate that accompanies respiration. RSA is considered an approximate marker of vagal tone, which is seen as a physiologic substrate of regulation of emotion and arousal, because vagal tone is influenced by RSA (Grossman & Taylor, 2007).

Individual differences in RSA can be observed using baseline states (i.e., a resting rate that measures stable individual differences), as well as RSA suppression (a measure of how much an individual decreases or increases in RSA in response to an emotional stimulus). In general, albeit not always, it is expected that successful vagal regulation is marked by RSA suppression or withdrawal, which is indicative of an individual successfully coping and regulating challenging states and situations (Graziano & Derefinko, 2013; Porges, 2007). Calkins and Keane (2004) found that RSA is fairly stable across early childhood and that it decreased in magnitude over time, and hypothesized that physiological regulation may be one of the foundations for later, more sophisticated emotion regulation.

Thus, generally, both baseline RSA and RSA suppression are considered a reflection of an individual's physiological and attentional self-regulatory capacity; individuals with higher RSA are believed to cope better and respond flexibly to stressors (Beauchaine, 2001; Porges, 2007). In support of this assumption, in a meta-analysis, Graziano and Derefinko (2013) found positive relations between RSA and various domains of children's adjustment, such as internalizing and externalizing symptoms, and academic and social competence (Graziano & Derefinko, 2013). Given these prior relations, we hypothesized that RSA would be linked to dispositional sympathy as well as to temperamental measures of emotion regulation such as effortful control.

RSA and temperamental regulation—Overall, both measures of RSA (baseline and suppression) have been positively linked to temperamental measures of emotion regulation (Beauchaine, 2001; Beauchaine et al., 2007; Calkins & Keane, 2004; Hastings et al., 2008; Sulik, Eisenberg, Silva, Spinrad, & Kupfer, 2013). For example, Gurthrie and colleagues (1997) found support for dispositional measures of emotion regulation being related to situational indices of sympathy, as measured by reports, facial expressions, and heart rate in children in kindergarten through third grade. Calkins and Keane (2004) found that preschool

children with a pattern of stable and high RSA suppression were less emotionally negative. Hastings and colleagues (2014) also found that children with higher RSA suppression had higher behavioral self-regulation. However, Blair and Peters (2003) reported positive relations between teacher-reported on-task behavior and RSA suppression in preschool children, but negative relations with baseline RSA (and no relations of either with a measure of executive functioning). It has also been hypothesized that these two states may reflect different aspects of self-regulatory functioning, with resting or baseline RSA tapping the ability to regulate internal bodily processes and temperamental reactivity/emotionality, and RSA suppression representing a readiness to cope with environmental stimuli that reflects context-dependent emotion regulation (Liew et al., 2011).

RSA and sympathy—RSA has also been found to directly relate to sympathy and other prosocial/empathic responses. Heart-rate deceleration has been shown to occur in contexts that evoke a sympathetic/compassionate response, whereas heart-rate acceleration occurs in contexts that evoke distress (see Eisenberg et al., 2006; Goetz et al., 2010). Moreover, researchers have sometimes found that higher levels of baseline RSA (or heart-rate variability) were associated with higher levels of empathy or sympathy (Diamond, Fagundes, & Butterworth, 2012; Liew et al., 2011), low personal distress (Fabes, Eisenberg, & Eisenbud, 1993), and prosocial behavior (Fabes, Eisenberg, Karbon, Troyer, & Switzer, 1994). However, other researchers have not found support, or have found mixed support, for these relations (Graziano, Keane, & Calkins, 2007; Hastings, Zahn-Waxler, Robinson, Usher, & Bridges, 2000; Zahn-Waxler, Cole, Welsh, & Fox, 1995). Only a few researchers have examined whether RSA suppression is associated with children's sympathy or empathic responses, with some finding a positive association (Graziano et al., 2007) or a positive relation to helping, but not sympathy (Liew et al., 2011), and one reporting that RSA suppression to a video recording of a toddler crying predicted less empathic concern in 2-year-olds (Gill & Calkins, 2003).

Overall, the literature regarding the prediction of sympathy is more consistent for baseline RSA than for RSA suppression (Hastings et al., 2014), but those results are not particularly consistent for either. Hastings et al. (2000) suggested that RSA responding might mark the threshold for arousal, such that children with high RSA might be unresponsive to distress in others because such distress is not a strong enough stimulus to evoke sympathy. Of note, few existing studies are longitudinal, and nearly all studies measured sympathy/empathy in toddlers/preschoolers and/or kindergartners to second graders. To our knowledge, only Diamond et al. (2012) and Hastings et al. (2000) measured outcomes primarily for children aged 6 to 7 years or older. Perhaps RSA functioning has more positive relations with sympathy in older children because of stronger positive relations with variables such as regulation. Thus, more developmental research is needed assessing relations of RSA to sympathy.

The Present Study

Based on prior research and our conceptual model (see Figure 1), the present study examined whether children's RSA (baseline and suppression) and observed authoritative parenting at 42 months (Time 1 [T1]) were associated with effortful control at 54 months

(Time 2 [T2]), and, in turn, children's sympathy at 72 and 84 months (Time 3 [T3]). We hypothesized that authoritative parenting and RSA would be positively associated with effortful control, and perhaps directly related to sympathy. We also expected effortful control to be positively related to sympathy when controlling for prior sympathy. Of most importance, we expected effortful control to at least partially mediate the relations between both parenting and RSA at T1 and sympathy at T3. To the best of our knowledge, this is the first study to test whether effortful control (or any other self-regulatory capacity) mediates the relation between measures of RSA and sympathy.

Our study contributes to the present literature on sympathy by examining whether early socialization and physiological responses contribute to effortful control, and, in turn, the development of sympathy across early childhood. Few investigators (except for Eisenberg et al., 1996) have examined these three constructs together. Longitudinal studies of the socialization of sympathy are also limited in number, and most have not tested additive, unique effects of more than one predictor of sympathy.

Method

Participants (N = 192; 54% male) were families residing in an urban U.S. city who were part of a larger (N = 256) longitudinal study of children's social and emotional development (see Spinrad et al., 2007). At each assessment, mothers and nonparental caregivers (e.g., babysitter, grandparent, teacher) were mailed questionnaires to mail back or return to the laboratory. Mothers and children participated in laboratory sessions lasting 1.5 to 2 hr. The present study used data from families at 42 months (T1), 54 months (T2), and 72 and 84 months (T3). Families were mainly Caucasian (84%), although 23% of the sample was Hispanic. Mean household income was $45,000 to $60,000 (the range was $15,000 to $100,000), and mean parental education was 2 years of college (ranging from grade school to PhD). Attrition analyses were conducted for participants missing data at T3 (n = 39) compared with those with full data at T1. Participants who attrited had lower quality parenting (t = 3.67, degrees of freedom [df] = 190, p < .01; mean difference = .27, standard error [SE] = .07) and maternal education (t = 2.02, df = 147, p < .05; mean difference = .99, SE = .49), and marginally significant higher baseline RSA (t = −1.93, df= 178, p = .55; mean difference = −.01, SE = .01).

Measures

Observed authoritative parenting—This latent construct was constructed of ratings of three aspects of mothers' behavior (warmth, sensitivity, and authoritative control) at 42 months (T1), coded from videotapes of mother– child interactions during a puzzle and free-play task, each lasting 3 min. Warmth was based on the degree to which the mother interacted, responded, and reacted to her child, such as degree of eye contact, using a pleasant tone of voice, the physical proximity and contact between mother and child, display of closeness, friendliness, and the degree of physical affection. Sensitivity was based on how well the mother was tuned in to her child, such as providing an appropriate level of stimulation when needed, appropriate soothing and attention focusing, and encouragement

of the infant's efforts. Authoritative control was the extent to which the mother directed and monitored the child's behavior in a nonforceful and nonangry way.

For the puzzle task, mothers were asked to teach their child to complete a Lego model with whatever strategies they would use at home (adapted from Calkins & Johnson, 1998). Mothers were rated for warmth (every 30 s; 1 = *no warmth* to 5 = *parent is engaged with the child for most of the time*), sensitivity (every 30 s; 1 = *none* to 4 = high), and authoritative control (every 30 s; 1 = *none* to 4 = *strong authoritative control*). During the free-play task, mothers were given a basket of toys and asked to play as they would at home. Mothers were rated for sensitivity during this task (every 15 s; on a scale from 1 = *none* to 4 = *high*). Parenting measures were all significantly correlated, *r*s = .29 to .63, *p*s < .01. Interrater reliabilities (ICCs) were assessed for 24% percent of the sample (.83 = puzzle task sensitivity, .86 = free play, .88 = warmth, and .83 = authoritative control).

Children's RSA—Baseline RSA and RSA suppression were measured at 42 months (T1). Two heart rate electrodes were placed on the child's lower ribs, a ground electrode was placed on their back, and a respiration cord was placed around their abdominal area. The children's heart rate and respiration were recorded during two contiguous films (see Spinrad et al., 2007). The first film lasted 181 s and featured neutral or mildly positive babies, whereas the second film lasted 42 s and featured crying babies. Resting RSA was computed as the mean level of RSA during the neutral film. RSA suppression was indexed by the reversed score of the standardized residualized RSA change score, calculated by computing a regression with RSA during the neutral film as the predictor and RSA during the empathy-eliciting film as outcome, and multiplying that value by −1 (Calkins & Keane, 2004), because standardized, residualized RSA change scores correspond to the inverse of vagal suppression.

Children's effortful control—Effortful control was reported at 54 months (T2) by mothers, teachers, and laboratory observers. The first two indicators used mother and teacher reports of effortful control (1 = *never* to 7 = *always*) using subscales (Attentional Focusing, Attentional Shifting, and Inhibitory Control) from the Children's Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001). Attentional Focusing included 14 items, such as "When picking up toys or doing other tasks, [child] usually keeps at the task until it's done" (mothers α = .77; teachers α = .72). Attentional Shifting included 12 items, such as "My/This child can easily leave off working on a project if asked" (mothers α = .73; teachers α = .82). Inhibitory Control included 13 items, such as "My/This child can wait before entering into new activities if s/he is asked to" (mothers α = .80; teachers α = .83). The third indicator was ratings of children's attention to tasks during the laboratory visit using an item from the Infant Behavior Record (IBR; Bayley, 1993; Stifter & Corey, 2001). Four experimenters/lab assistants rated the degree to which the child remained focused on the tasks, from 1 = *constantly off task, does not attend* to 5 = *long continued absorption in a toy, activity or person*. Reporters were averaged to create the IBR score (ICCs = .74). Reporters of effortful control were significantly correlated (mother with teacher, r = .30, p < .01; mother with observers, r = .28, p < .01; teacher with observers, r = .30, p < .01).

Children's sympathy—Sympathy was reported at 72 and 84 months (T3) by mothers and teachers (1 = *really false* to 4 = *really true*) using a four-item scale (Eisenberg, Fabes, Schaller, Carlo, & Miller, 1991). Items included "My [this] child rarely feels sympathy for other children who are upset or sad" and "My [this] child usually feels sorry for other children who are being teased" (mothers α = .78 and .78 at 72 and 84 months; teachers α = .83 and .82 at 72 and 84 months). Mothers' and teachers' reports were significantly correlated (ranging from $r = .18$, $p < .05$, to $r = .49$, $p < .01$; mean $r = .30$). Two indicators (mother and teacher report) were created by averaging each reporter's scores across the two time points. We controlled for prior levels of children's sympathy at 42 months (T1) using a manifest variable consisting of mothers' reports of the same sympathy scale as above (α = .71). Nonparental caregivers did not report on children's sympathy at the earlier time point.

Control variables—The following covariates were included: child sex (0 = boys, 1 = girls), household income (1 = *<$15,000* to 7 = *>$100,000*), and mothers' education level (1 = *grade school* to 7 = *PhD or MD*).

Analysis Strategy

We first examined zero-order correlations between constructs. We then used structural equation modeling to evaluate the statistical model using the Mplus software program, Version 6 (Muthén & Muthén, 2010). We specified a structural equation model with six constructs and four control variables (see Figure 2). To address the issue of missing data, we used full information maximum likelihood. To evaluate the fit of a structural model to data, we used the standard chi-square index of statistical fit, as well as the root mean square error of approximation (RMSEA), the Tucker-Lewis index (TLI), and the comparative fit index (CFI). Mediation was tested using the model indirect test in Mplus.

Results

Preliminary Results

Correlations were largely as expected (see Table 1). For example, parenting at T1 was positively correlated with effortful control at T2 and with sympathy at T3. Baseline RSA at T1 was positively associated with sympathy at T1 and at T3, as well as effortful control at T2. RSA suppression was positively associated with sympathy at T3. Effortful control at T2 and sympathy at T3 were significantly positively correlated. Being female was positively correlated with sympathy at T3, both measures of RSA, and effortful control. Income and mothers' education were positively correlated with parenting quality and children's effortful control.

Structural Equation Modeling

We tested a configural model to examine differences by children's sex. We met criteria for partial strong invariance using the chi-square difference test. We constrained all factor loadings and intercepts with the exception of the intercept for teacher report of sympathy at T3. We then tested whether the paths in our model were invariant by sex. All paths, with the exception of the correlational path between RSA suppression and mother report of sympathy at T1 (significant for boys, $b = .29$, $SE = .10$, $p < .01$, but nonsignificant for girls), were able

to be constrained without a significant change in fit. Participants were retained in a single group, given that we were able to constrain all of the predictive paths.

Our final model (see Figure 2) demonstrated adequate fit, $\chi^2(67, N = 192) = 92.89$, $p < .05$, CFI = 0.93; TLI = 0.89; RMSEA = .045. Factor loadings for the latent variables were all significant and ranged from .42 to .69. Control variables (child sex, household income, and mothers' education level) were analyzed in relation to all variables and retained in the analysis if significant. Children's baseline RSA and RSA suppression were positively correlated at T1. Baseline RSA and children's sympathy at T1 were also significantly positively correlated. Across time, observed parenting and baseline RSA at T1 positively predicted effortful control at T2. In turn, effortful control positively predicted sympathy at T3, controlling for prior levels of sympathy at T1. Mediating paths were tested using the model indirect test in Mplus. The indirect path from parenting to sympathy through effortful control was significant ($b = .35$, $SE = .18$, $p < .05$, $z = 2.00$). The indirect path from baseline RSA to sympathy through effortful control was marginally significant ($b = .19$, $SE = .11$, $p = .087$, $z = 1.71$). The following covariates were statistically significant in the model: mothers' education on parenting ($b = .46$, $SE = .09$, $p < .01$) and child sex on baseline RSA ($b = .16$, $SE = .07$, $p < .05$). Child sex on effortful control was marginally significant ($b = .19$, $SE = .10$, $p < .055$).

Discussion

The present study examined whether authoritative and sensitive parenting, as well as temperamental and physiological regulation, were antecedents of children's sympathy during early childhood. Of particular interest was whether the relations of RSA and parenting to sympathy were mediated by effortful control. We did not find any direct associations between observed parenting at T1 and children's sympathy, either cross-sectionally or across time, although observed parenting was positively correlated with sympathy at T3 in the zero-order correlations (see Table 1). However, we did find a significant indirect pathway. Supporting prior concurrent data (Eisenberg et al., 2001), high-quality parenting at T1 (42 months) was indirectly, positively related to sympathy at T3 (72 and 84 months) through its relation to higher effortful control at T2 (54 months). These findings suggest that quality of parenting might have an effect on sympathy over time because of its positive effects on children's self-regulatory skills. Parents who are supportive likely model and scaffold the development of self-regulation; moreover, children of supportive parents may be more inclined than children of hostile or unsupportive parents to try to comply with adults' expectations for self-regulation.

It is unclear why supportive and authoritative parenting did not directly relate to children's sympathy in the model, as has been found in prior work (e.g., Spinrad et al., 1999; Spinrad & Stifter, 2006). It is unlikely that all of the relation between supportive and authoritative parenting and sympathy is mediated through effortful control (recall that the latent construct of parenting at T1 was modestly but significantly correlated with T3 sympathy), although that appeared to be the case in this study. Perhaps our observed measure did not adequately capture some facets of parenting believed to be directly associated with children's sympathy, such as using reasoning as discipline (Hoffman, 2000). It is also possible that maternal

responsivity and support are most likely to be directly predictive of sympathy if exhibited when the child is in distress, as in the findings of Davidov and Grusec (2006).

Consistent with some prior research (Beauchaine, 2001; Beauchaine et al., 2007; Sulik et al., 2013), baseline RSA at 42 months positively predicted effortful control at 54 months, even when controlling for quality of parenting and variables assessing socioeconomic status. Baseline RSA did not, however, directly predict children's sympathy once effortful control was included in the model, although baseline RSA and sympathy at T3 were significantly positively correlated (see Table 1). Rather, the relation between baseline RSA and sympathy was near significantly ($p < .087$) mediated by individual differences in effortful control. These findings are consistent with the view that baseline RSA reflects physiological processes related to regulation (Beauchaine, 2001; Porges, 2007), and suggest that because children who have higher baseline RSA are more likely to have the skills to optimally modulate their vicariously induced emotion (empathy), they are prone to experience sympathy (Eisenberg et al., 2006).

Unexpectedly, we did not find significant relations between RSA suppression and either adult-reported effortful control or sympathy, although it is believed that RSA suppression is associated with better emotion regulation (Beauchaine et al., 2007). RSA suppression did, however, show a significant positive relation to sympathy at T3 in the zero-order correlations among the constructs. Because RSA and sympathy at T1 were not correlated, it is unlikely that the lack of prediction in the model was related to controlling for early sympathy. However, only a few investigators have examined the relation of RSA suppression to empathy-related responding and prosocial behavior in children, and it appears that RSA suppression may be more closely linked to prosocial behaviors rather than to empathy or sympathy (Hastings et al., 2014). Additionally, perhaps the context-specific regulation tapped by measuring RSA suppression with only one task was a weak measure of RSA-related regulation.

Of some interest, individual differences in adult-reported sympathy were stable from 30 to 72 and 84 months of age. This stability could reflect both genetic factors and stability in children's social environments across this period of time (see Eisenberg et al., 2006).

Our study has several limitations. First, given the correlational nature of the data, we cannot be certain of the direction of effects, although by controlling for prior levels of sympathy, we provided a more powerful test of potential contributors to sympathy than in most existing studies. Bidirectional effects among parenting, children's effortful control, and sympathy are also plausible. Another limitation is that the measure of early sympathy contained only mothers' reports because nonparental caregivers' and teachers' reports were not available. In addition, our sample was not highly diverse in terms of socioeconomic status or ethnicity. A meta-analysis of prior work with RSA and developmental outcomes of children found that children from clinical or at-risk samples displayed lower absolute levels of RSA compared with children in community samples, and that RSA was only linked to social functioning in community, but not at-risk samples (Graziano & Derefinko, 2013). This suggests our findings should be replicated with more ethnically and socioeconomically diverse samples.

Nevertheless, our findings contribute to a growing literature that suggests that supportive parenting, as well as temperamental and physiological emotion regulation, contribute to children's sympathy, albeit sometimes indirectly. Additional strengths of our study included use of multiple reporters and observational data, physiological measures, and data across three time points.

In future work, investigators might examine the processes that account for the associations of RSA and effortful control with sympathy. An important question is why indices of physiological and temperamental regulation predict individual differences in sympathy (and likely also compassion). As suggested by (Eisenberg and colleagues, in press), regulatory mechanisms might preclude empathic overarousal, which leads to a self-focus. However, other processes may also be involved. For example, attentional control, which might be fostered by high baseline RSA, could assist children in maintaining a focus on others' needs, taking the perspective of another, and/or in accessing relevant information from memory about another's emotions, needs, or condition (e.g., about how it feels to be rejected or lonely). It will also be important for future work to assess RSA at multiple time points in order to better untangle the relation between reports of effortful control and physiological responses.

Following our conceptual model, in future work, researchers could assess whether effortful control mediates the relation of different biological indices and sympathy or compassion. It is likely that other physiological measures associated with the sympathetic and parasympathetic branches of the ANS, such as blood pressure, heart rate, and skin conductance, contribute to regulating children's emotions and distress, and play a role in whether children act sympathetically or not (Hastings et al., 2014) and are motivated to assist others. Also important is to further distinguish the antecedents and precursors to different types of prosocial dispositions. Although constructs such as empathy, sympathy, and compassion are interrelated and share common features, it is possible that biological and socialization processes contribute in unique ways to how they develop and are expressed. However, those differences are not currently well understood.

Last, given that sympathy has been related to various positive indices of competence and adjustment in children (Eisenberg et al., 2012), efforts to improve aspects of children's emotion regulation, such as fostering effortful control, would be of benefit to children. Researchers have found that emotion regulation skills can be cultivated, and have argued that empathy-related responding can be fostered during childhood (Davidson et al., 2012; see also Eisenberg et al., 2006). Insofar as emotion regulation skills can be trained, improvements in sympathetic responding to others in need and distress and compassion might be enhanced.

Acknowledgments

This project was funded by National Institute of Mental Health Grant 5 R01 MH60838 to Nancy Eisenberg and Tracy L. Spinrad.

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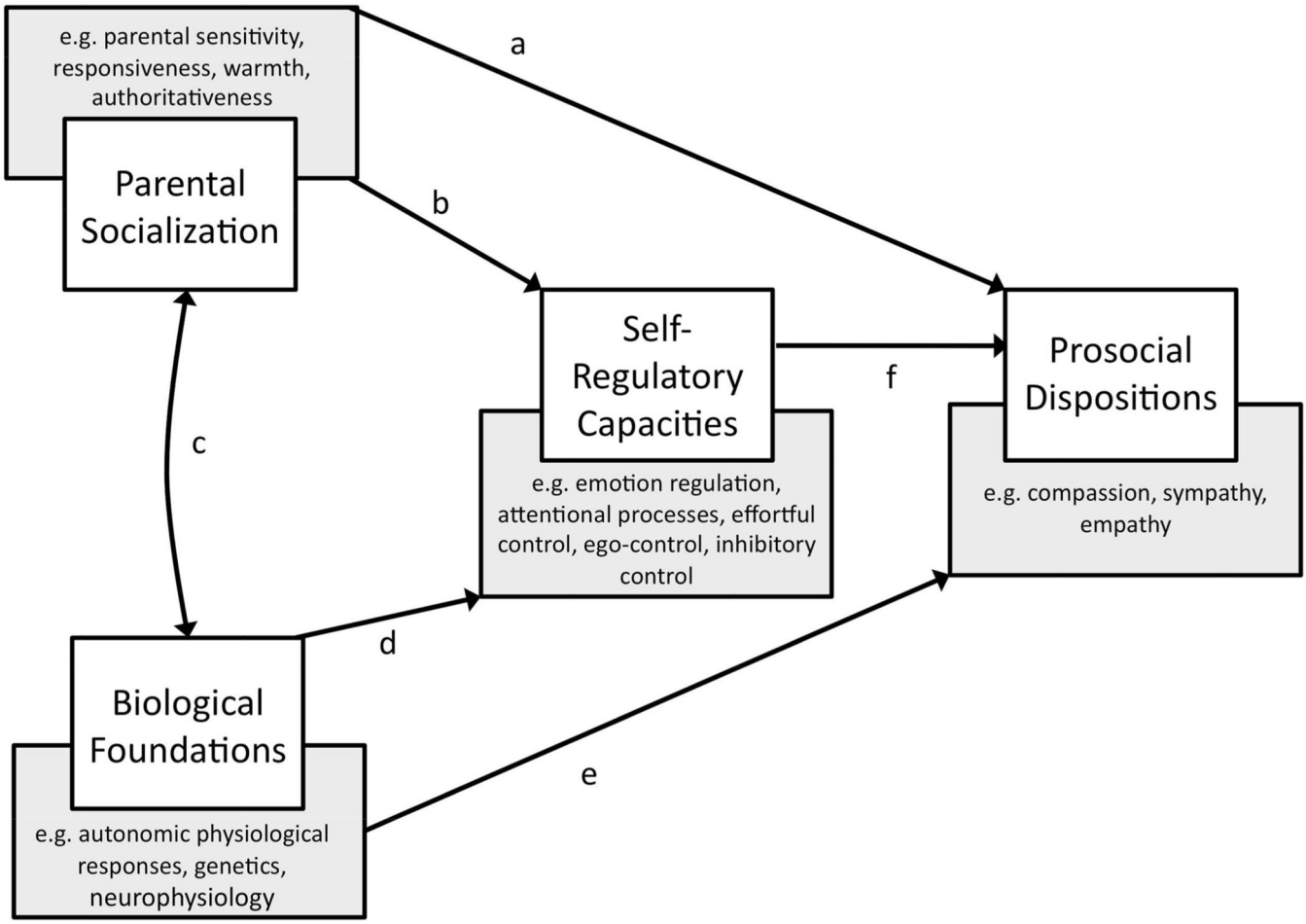

Figure 1.

Conceptual model. A general model hypothesizing that early biological and socialization foundations support the development of emotion regulation and, in turn, children's prosocial dispositions.

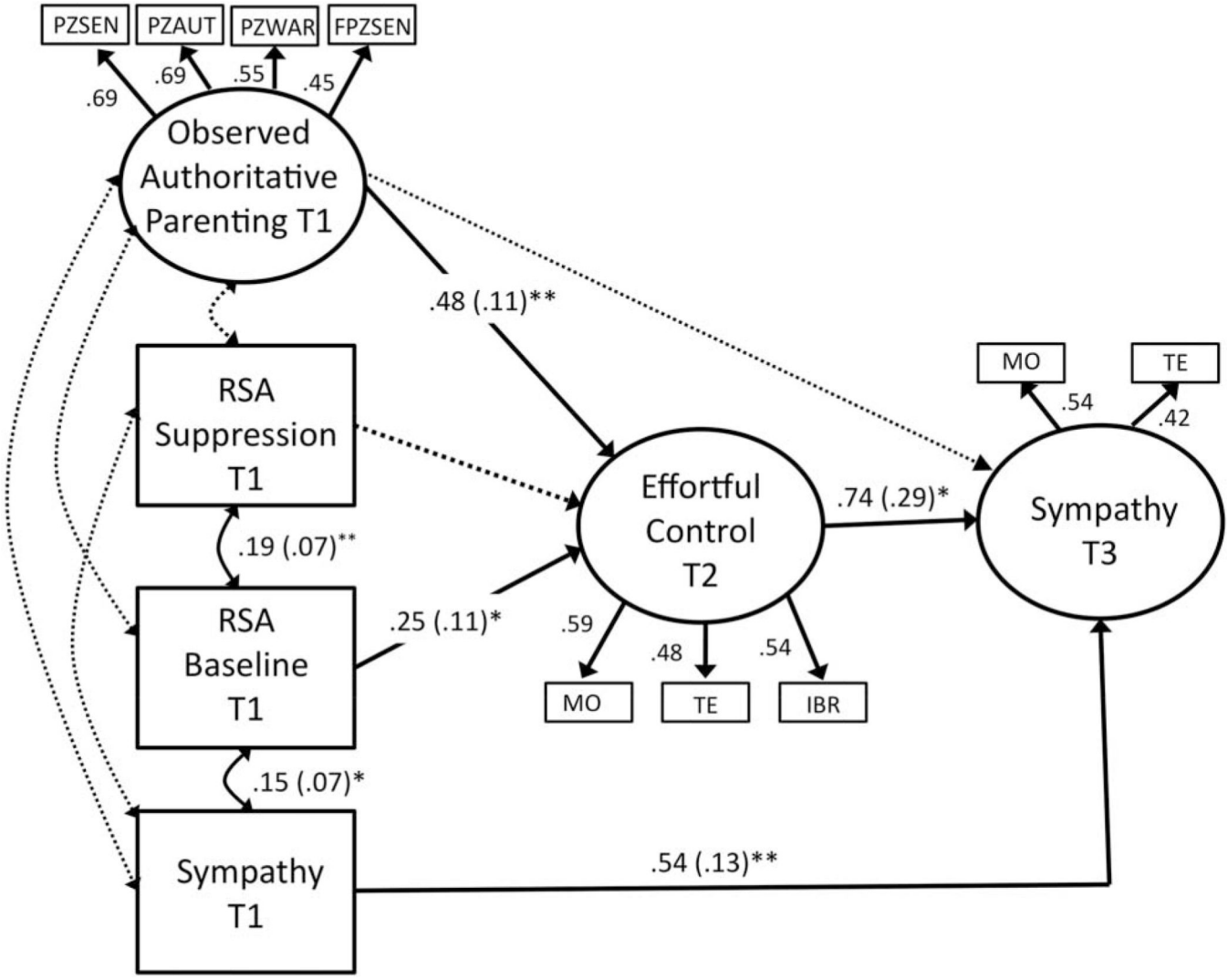

Figure 2.

Results from the structural equation model (N = 192), $\chi^2(67, N = 192) = 92.89$, $p < .05$, comparative fit index = 0.93; Tucker-Lewis index = 0.89; root mean square error of approximation = .045. Results are standardized (with standard errors in parentheses). Dotted lines are nonsignificant. Factor loadings are all significant at $p < .01$. Control variables (household income, mothers' education, and child sex) were regressed on all the variables. Paths from respiratory sinus arrhythmia (RSA) variables to sympathy at T3 were included in the analyses, but were nonsignificant (not shown in Figure 1 for simplicity). The indirect path from parenting to sympathy through effortful control was significant (b = .35, SE = .18, $p < .05$, z = 2.00). The indirect path from baseline RSA to sympathy through effortful control was marginally significant (b = .19, SE = .11, p = .087, z = 1.71). PZSEN = mother's sensitivity, puzzle task; PZAUT = mother's authoritative control, puzzle task; PZWAR = mother's warmth, puzzle task; FPSEN = mother's sensitivity, free-play; RSA = respiratory sinus arrhythmia; T1 = time 1 (42 months); T2 = time 2 (54 months); T3 = time 3 (72 and 84

months). TE = teacher report; MO = mother report; IBR = observer report. *$p < .05$. **$p < .01$.

Table 1

Correlations Among Latent Constructs and Covariates (N = 192)

	1	2	3	4	5	6	7	8	9
1. Parenting T1	1.00								
2. RSA suppression T1	−.10	1.00							
3. RSA baseline T1	−.05	.23	1.00						
4. Sympathy T1	.06	.08	.15*	1.00					
5. Effortful control T2	.46**	.05	.26**	.09	1.00				
6. Sympathy T3	.15*	.28**	.35**	.62**	.73**	1.00			
7. Child sex T1	.00	.19*	.16*	.10	.23**	.37**	1.00		
8. Household income T1	.37**	.00	.03	−.01	.18*	.05	.00	1.00	
9. Mothers' education T1	.52**	−.13†	−.10	.08	.22**	.08	.00	.53**	1.00
Mean	3.01	.04	.05	2.92	4.28	3.11	.46	4.32	4.41
SD	(.39)	(.76)	(.03)	(.45)	(.49)	(.38)	(.50)	(1.80)	(.99)

Note. T1 = time 1 (42 months); T2 = time 2 (54 months); T3 = time 3 (72 and 84 months). RSA = respiratory sinus arrhythmia; child sex (0 = boys, 1 = girls); *SD* = standard deviation.

† $p < .10$.

* $p < .05$.

** $p < .01$.