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# Physiological Regulation and Fearfulness as Predictors of Young Children's Empathy-related Reactions

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**Abstract**

*Indices of physiological regulation (i.e., resting respiratory sinus arrhythmia [RSA] and RSA suppression) and observed fearfulness were tested as predictors of empathy-related reactions to an unfamiliar person's simulated distress within and across 18 (T1, N = 247) and 30 (T2, N = 216) months of age. Controlling for T1 helping, high RSA suppression and low fearfulness at T1 predicted T2 helping. In a structural model, empathic concern was marginally positively related to resting RSA at both assessments whereas personal distress was related to RSA suppression within time (marginally positively at T1 and significantly negatively at T2). Fearfulness was associated with self-oriented, distress-related reactions within time. Comfort seeking (an index of personal distress) declined in mean level with age whereas helping increased, and both behaviors exhibited differential continuity (as did resting RSA). Individual, as well as developmental, differences in the types of reactions that young children exhibit when witnessing others' suffering and distress were discussed.*

*Keywords*: empathy; emotion regulation; respiratory sinus arrhythmia; fear

## Introduction

Researchers tend to agree that humans are born with the capacity for empathy (Hastings, Zahn-Waxler, & McShane, 2006; Knafo, Zahn-Waxler, Van Hulle, Robinson, & Rhee, 2008). Thus, it is not surprising that even infants and toddlers can display simple forms of empathy-related behavior, especially with familiar people such as their mothers (Spinrad & Stifter, 2006; Zahn-Waxler & Radke-Yarrow, 1990). Although empathy-related behavior tends to increase in both frequency and complexity with age (Eisenberg, Fabes, & Spinrad, 2006), much remains to be learned about the role of temperamental characteristics such as negative emotionality and regulation in empathy-related behavior across early childhood. Thus, the present study examined

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concurrent and longitudinal relations of 18- to 30-month-olds' empathy-related reactions to their physiological regulation and fearfulness. In addition, mean-level change and rank-order consistency across one year in physiological indices of regulation/reactivity, fearfulness, and empathy-related reactions were assessed.

Emotionality and self-regulatory processes are important correlates of empathy-related responding (Eisenberg et al., 2006). Fearful children, relative to children who are not predisposed to fearfulness or behavioral inhibition, may become upset or distressed more easily in evocative situations such as being confronted by an unfamiliar person (Rubin, Burgess, & Hastings, 2002). Because emotionality and self-regulatory processes are related but unique aspects of temperament (Rothbart, Ahadi, Hershey, & Fisher, 2001), individual differences in physiological regulation might contribute to empathy-related responding independent of contributions from fearfulness.

Cardiac vagal tone and cardiac vagal suppression are viewed as indices of individuals' physiological capacities that contribute to emotion regulation (Porges, Doussard-Roosevelt, & Maiti, 1994a). Vagal responding is often measured with a cardiorespiratory measure called respiratory sinus arrhythmia (RSA; Grossman & Taylor, 2007). In the present study, toddlers' physiological regulation (i.e., RSA to a neutral film [resting RSA] or RSA suppression to an empathy-eliciting film) and fearfulness were examined as constitutionally based characteristics potentially related to empathy-related reactions in early childhood.

## Empathy and Empathy-related Reactions

*Empathy* has been defined as 'an affective response that stems from the apprehension of another's emotional state' (Eisenberg & Liew, 2009, p. 316; also see Eisenberg et al., 2006). Two reactions that may stem from empathy are personal distress and sympathy. *Personal distress* is an aversive emotional reaction accompanied by self-focus, avoidance of other people in distress, or seeking of comfort or help for the self (Batson, 1991). Personal distress is expected to result from empathic overarousal (Eisenberg et al., 1994), defined as 'an involuntary process that occurs when an observer's empathic distress becomes so painful and intolerable that it is transformed into an intense feeling of personal distress' (Hoffman, 2000, p. 198). Personal distress is expected to accompany comfort or help for others only if doing so alleviates one's own distress. In contrast, *sympathy* is the feeling of empathic concern or sorrow for others who are distressed or in need; it does not necessarily involve experiencing the same feelings as another, although it does involve feelings of concern. Sympathy involves other-oriented attention or motivation and is expected to motivate *prosocial behavior* (i.e., voluntary behavior intended to benefit another) such as other-oriented comforting or helping (Eisenberg et al., 2006).

With both their mother and with an unfamiliar adult simulating distress, children as young as 14 months are able to exhibit empathic concern and prosocial behavior such as helping or comforting (Howes & Farver, 1987; Knafo et al., 2008; Young, Fox, & Zahn-Waxler, 1999). In meta-analyses (Eisenberg & Fabes, 1998), prosocial responding increased with age in early childhood and empathy/sympathy also increased with age. Mean-level increases in prosocial behavior were especially evident within infancy and across the preschooler to adolescent years, with no significant increase from infancy to the preschool years.

In addition to mean-level change, there is also relative stability in individuals' prosocial responding across development (Eisenberg et al., 2006). Moreover,

sympathy generally has been positively related, whereas personal distress has been inversely related, to prosocial behavior (Eisenberg et al., 2006). This pattern of findings has been found in various parts of the world, including with Western (e.g., in Germany and Israel) and Southeast Asian (e.g., in Indonesia and Malaysia) preschoolers (Trommsdorff, Friedlmeier, & Mayer, 2007). Thus, it is reasonable to expect young children's empathic concern to be positively related to their prosocial behavior and negatively related to their personal distress (e.g., Knafo et al., 2008).

### Physiological Regulation and Empathy-related Reactions

Eisenberg and colleagues (e.g., Eisenberg et al., 1994, 2006) have argued that a person who is well-regulated is relatively unlikely to become overly aroused and self-focused when witnessing another's distress (i.e., to experience personal distress) and is relatively likely to experience other-oriented sympathy (and thus, to help the object of that sympathy). Consistent with this prediction, numerous researchers who use questionnaire or behavioral measures to assess self-regulation have found relatively consistent positive associations between preschool or school-aged children's adult-rated attentional and behavioral regulation and their sympathy or prosocial behavior (Eisenberg et al., 1996b, 1998, 2007; Eisenberg, Liew, & Pidada, 2004; Ladd & Profilet, 1996; see Eisenberg et al., 2006). Thus, there are conceptual and empirical reasons for physiological regulation to be a predictor of low self-focused, distressed reactions and high other-oriented affect or prosocial behavior.

One method for assessing physiological regulation involves RSA, the rhythmic fluctuations in heart rate that accompany respiration. Although RSA taps primarily parasympathetic arousal (Akselrod et al., 1981; Porges et al., 1994a), it can be influenced by sympathetic arousal (Grossman, Karemaker, & Wieling, 1991). And even though RSA is not the same as cardiac vagal tone, RSA often is used as a marker of cardiac vagal tone because vagal tone is influenced by RSA (Grossman & Taylor, 2007).

RSA assessed during individuals' resting and reactive states likely reflect somewhat different aspects of self-regulatory functioning (Porges et al., 1994a). Resting or basal vagal tone is believed to tap the ability to regulate internal bodily processes (Porges, 1996) as well as temperamental reactivity/emotionality and information processing (Beauchaine, 2001). By two and three years of age, resting RSA has been shown to be associated with appropriate levels of (positive) reactivity and low negative emotionality (Calkins, 1997). In response to evocative or challenging events, vagal or RSA suppression, as indicated by a reduction in RSA, is conceptualized as releasing the 'vagal brake' (to reduce or withdraw vagal parasympathetic influence) so an organism can attend and respond to environmental demands (Beauchaine, Gatzke-Kopp, & Mead, 2006; Porges, Doussard-Roosevelt, Portales, & Greenspan, 1996). Thus, vagal or RSA suppression represents the readiness to cope with the environment and appears to reflect attention and context-dependent emotion regulation (Calkins & Keane, 2004; Porges et al., 1996). Consistent with this view, two- and three-year-olds' RSA suppression during challenging tasks (e.g., keeping children away from or asking children to wait and not touch attractive items) has been associated with other-oriented and self-regulatory behaviors such as visually and verbally engaging with an adult (Calkins, 1997).

Findings on the associations between young children's resting RSA or RSA suppression and their empathy-related responding have been mixed. In a series of studies using measures of resting RSA or vagal tone in response to empathy-eliciting stimuli

(e.g., films of crying infants or frightened children) with children ranging from kindergarteners to third graders, Eisenberg and colleagues found that children who exhibited high vagal responding were likely to exhibit empathic concern or helping. The majority of their findings were primarily for boys, perhaps partly because of restricted variability in measures of girls' vagal responding and social behavior (Eisenberg et al., 1995; Fabes, Eisenberg, & Eisenbud, 1993; Fabes, Eisenberg, Karbon, Troyer, & Switzer, 1994).

Few researchers have examined resting RSA or basal vagal tone as a predictor of empathy-related responding or prosocial behavior in toddlers. With regard to vagal suppression to empathy-eliciting stimuli, two-year-olds' vagal suppression was associated with their low expressions of concern and low freezing toward a distressed adult stranger (Gill & Calkins, 2003). Because toddlers heard, but did not witness, another's distress, vagal suppression may have protected them from becoming emotionally aroused (i.e., concerned) and behaviorally affected (i.e., low freezing). Typically, hearing may often be less evocative than both seeing and hearing another's distress. Thus, hearing and seeing likely elicit somewhat different physiological responding from toddlers. In four- and five-year-olds, Zahn-Waxler, Cole, Welsh, and Fox (1995) found that heart rate deceleration (i.e., a negative heart rate difference score that would be expected to be somewhat related to vagal responding) while viewing an empathy-inducing film was associated with high levels of other-oriented prosocial responding to others' distress. Furthermore, five-year-olds who exhibited vagal suppression during problem-solving tasks were likely to be viewed by their peers as prosocial or likely to share (Graziano, Keane, & Calkins, 2007). Similarly, vagal suppression to a distressing film predicted quantity of observed verbal comfort offered to a crying baby (heard through a speaker) in third through sixth graders (Eisenberg et al., 1996a).

Based on the aforementioned research and theory on RSA responding and empathy-related behavior, we expected that both resting RSA and RSA suppression would serve as indices of physiological regulation and consequently, tentatively hypothesized that they would be associated with low personal distress and high empathic concern and helping at 18 and 30 months of age. We further predicted that resting RSA and RSA suppression at 18 months would predict low personal distress and high empathic concern for, and helping of, a distressed stranger at 30 months when controlling for across-time stability of the measures. We also expected age-related increases in mean-level of RSA suppression as participants matured because self-regulatory abilities improve in early childhood (Kochanska, Coy, & Murray, 2001; Posner & Rothbart, 2000). Resting RSA, because of its temperamental basis, was expected be somewhat more stable in mean level and with regard to individual differences (correlational) than RSA suppression.

### Fearfulness and Empathy-related Reactions

Although physiological regulation may protect children from experiencing empathic overarousal when confronted by another's distress, temperamental fearfulness may predispose children to react to the same situation with personal distress. Fear is a basic emotion elicited by perceived threat or danger, with the manifestation of fear often including freezing, withdrawal, or preparation for fleeing, fighting, or hiding (Rothbart & Bates, 2006). Subsumed under the temperament dimension of *negative emotionality*, temperament fearfulness has been defined as predisposition for 'negative affectivity, including unease, worry, or nervousness, which is related to pain or distress and/or potentially threatening situations' (Rothbart et al., 2001, p. 1406). Goldsmith, Buss,

 

and Lemery (1997) found significant genetic underpinnings for preschoolers' temperamental fearfulness using the children's behavior questionnaire (Rothbart & Ahadi, 1994; Rothbart, Ahadi, & Hershey, 1994), but a significant shared environmental, rather than genetic, effect was found for toddlers' social fear using the toddler behavior assessment questionnaire (Goldsmith, 1996). Goldsmith et al. (1997) speculated that the differences in the findings may be partly attributed to age-related changes but also noted that social fear may have tapped aspects of shyness. Thus, evidence tentatively suggests a genetic basis for temperamental fearfulness, but its stability across ages may depend on environmental factors, particularly for social fear.

Children who are high on temperamental fearfulness may be easily overaroused by novel or distressing situations and react to such situations with inhibition or distress (Goldsmith & Campos, 1990; Theall-Honey & Schmidt, 2006; Zimmermann & Stansbury, 2004). If fearful children are prone to overarousal, fearfulness is likely associated with both poor physiological regulation and the experience of personal distress. Moreover, because personal distress is an aversive feeling that often is accompanied by a self-focus (Batson, 1991), fearfulness may be associated with self-oriented behavior such as seeking of comfort for the self rather than engaging in other-oriented expressions of empathic concern or helping (e.g., Eisenberg et al., 2007).

Few researchers have examined fearfulness as a predictor of empathy-related reactions toward a distressed stranger. Spinrad and Stifter (2006) found that fear at 10 months predicted personal distress to mothers', but not a stranger's, simulated distress at 18 months. Infants' fear was unrelated to toddlers' helping behavior but was unexpectedly associated with high concerned attention toward a distressed stranger (marginally) and toward their distressed mothers during toddlerhood (Spinrad & Stifter, 2006). Spinrad and Stifter speculated that fearful infants may be more attuned to, or vigilant of, another's distress. Alternatively, fearful infants may have fixated on (i.e., been unable to avert their gaze from) the distressed person so what appears to be concerned attention may have been involuntary behavior indicative of personal distress.

Somewhat consistent with Spinrad and Stifter's (2006) findings, in a longitudinal study that followed children from 22 to 45 months, Kochanska, Gross, Lin, and Nichols (2002) found that fearful children were likely to internalize moral emotions such as empathy or guilt involving negative or aversive emotional states. Moreover, Rothbart et al. (1994) found that fearfulness was positively related to six- to seven-year-olds' empathy. In contrast, Young et al. (1999) found that social inhibition (which generally involves timidity or fearfulness) was inversely related to sympathy/helping. In addition, numerous researchers have found that negative emotionality more generally has been associated with low levels of children's sympathy and/or high levels of personal distress (see Eisenberg et al., 2006, for a review). Thus, although relations between young children's fearfulness and their empathy-related reactions have been somewhat mixed, the overall pattern provided some support for the prediction that fearfulness would be positively associated with distressed, self-oriented empathy-related reactions. Especially at young ages, fearfulness might also be related to empathic concern, but this relation might be expected to reverse itself with age. Because infants' fearfulness was unrelated to toddlers' helping behavior in prior work (Spinrad & Stifter, 2006), we were unsure if fearfulness would interfere with prosocial behavior at 18 and 30 months of age, although such a relation would seem logical.

## The Present Study

In the present study, we examined indices of physiological regulation (i.e., resting RSA and RSA suppression) and fearfulness as predictors of 18- and 30-month-olds' self- and other-oriented empathy-related reactions to and helping of a relatively unfamiliar female (referred hereafter as a stranger) who acted distressed. We expected low resting RSA and low RSA suppression (which we expected to be indices of poor physiological regulation) to be associated with high distress-related (self-oriented) reactions rather than other-oriented reactions such as empathic concern or helping. Fearfulness was expected to predict personal distress reactions; we were unsure if it would relate positively or negatively with empathic concern in the early years. Markers of self-oriented and other-oriented reactions were predicted to be inversely related to one another. In addition, we expected differential continuity in the variables with a temperamental basis (e.g., resting RSA, fearfulness, or personal distress). Not only would children have matured but they would have encountered the experimental procedures before, so we also tentatively predicted mean-level declines for fearfulness and distress-related reactions from 18 to 30 months. Based on the prior research and age-related increases in children's prosocial behavior and regulation (Eisenberg & Fabes, 1998; Rothbart & Bates, 2006), we expected increases in the mean levels of the RSA indices of regulation (especially RSA suppression), empathic concern, and helping with age (Eisenberg et al., 2006; Rothbart & Bates, 2006).

## Method

### *Participants*

Two hundred forty-seven children and their primary caregivers visited the laboratory when the children were 18 months old (T1), 216 of whom also returned a year later (T2). Of the 12.6 percent of families that did not return for the study, the majority of them had either moved or could not be reached, with the minority (less than 8%) choosing not to participate. Because the primary caregivers were nearly all mothers (except for one father and one grandmother), we refer to primary caregivers as mothers hereafter. The same measures were included in both assessments. Measures of children's physiological regulation, observed fearfulness, and observed empathy-related reactions were collected in the laboratory.

The participating families were recruited from postpartum wards of three hospitals in a metropolitan area. Mothers ($M = 29.11$ years) and fathers ($M = 31.09$ years) were at least 18 years old with healthy, full-term infants born without birth complications. At T1, the majority of our sample consisted of White/non-Hispanic (72%) and Hispanic (11%) children. In addition, African American (4%), Asian (2%), Native American (3%), and Mixed or Other ethnicity (8%) children were represented. The majority of the participating families (61%) had annual incomes ranging from $45 000 to $60 000 (median annual income = $15 000 to $30 000) with parents' education ranging from grade school to post-doctoral degree ($M$ = some college education).

### *Procedures*

When the children were approximately 18 months of age ($M = 17.79$ months, $SD = .52$; range = 16.83–19.97), the mothers and their children visited the laboratory where a

 

female experimenter placed two heart rate electrodes on the child's lower lateral ribs and a ground electrode on their back. Respiration was measured by attaching a respiration cord around their abdominal area. A five-channel Bioamp (James Long Company, Caroga Lake, NY) recorded respiration and electrocardiograph (ECG) data. Software (James Long Company, 1999) was used to synchronize and process the respiration and ECG data so that measures of RSA account for arrhythmia due to tonic shifts in heart rate.

With the mothers sitting behind their children (out of children's sight), the children's heart rate and respiration were recorded during two contiguous films that were created for use in the present study. The first film lasted 181 seconds and featured neutral or mildly positive babies whereas the second film lasted 42 seconds and featured distressed, crying babies. The difference between the neutral and distressing portions of the film stimulus is clear because of salient changes in the displays and/or sounds of the babies in neutral or pleasant states vs. the babies in distress or crying. Later, the children's empathy-related reactions to a relatively unfamiliar female who acted distressed were observed. Note that the unfamiliar female had previously interacted with the children by assisting the female experimenter in a series of experimental tasks. Then, the children's fearful reactions to a jumping toy spider were observed. For their participation, the children received a small gift and the mothers were debriefed and compensated.

Approximately one year after their initial visit (when the children were approximately 30 months old; $M = 29.77$ months, $SD = .51$), the mothers and the children returned to the laboratory for a second assessment that included mostly the same procedures and measures from the first visit.

### *Measures*

All measures were collected at 18 (T1) and 30 (T2) months (usually within a month of these ages). For fearfulness and empathy-related reactions, separate teams of two coders rated the participants' behavior (a main coder who coded all the children and a reliability coder who coded at least 25%). Inter-rater reliabilities were calculated with intra-class correlations (for continuous ratings) and Cohen's kappas (for categorical ratings).

*Physiological Self-regulation.* Resting RSA and RSA suppression were indices of physiological self-regulation. Prior to calculations of RSA scores, which were in the metric of 'peak-to-valley' RSA (using James Long software), all heart rate and respiratory data were inspected and corrected for artifacts when needed (which was fairly infrequent). 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 (Hastings et al., 2008b). For scaling purposes (because the values were relatively small), all RSA data were multiplied by a constant value of 10 for analyses. Approximately 60 percent of the children exhibited RSA suppression at T1 and at T2 (Ns = 129 and 117, respectively).

*Fearfulness.* The children's fearfulness was indexed by their behavioral reactions to a jumping toy spider from the laboratory temperament assessment battery (Goldsmith,

Reilly, Lemery, Longley, & Prescott, 1993) while the mother completed questionnaires in a corner of the room. The female experimenter (E) showed the child a toy spider and asked the child to pet it by saying it was soft, nice, and did not bite. If the child reached for the toy, E made it jump when the child's hand was about 2 in from the toy. Then E waited five seconds with a neutral expression before saying, 'Oh, he jumped at you. But that's okay, he really doesn't bite. Go ahead and pet him again.' If the child did not reach for the spider, E prompted, 'He's really nice; he's soft like a bunny. Go ahead and pet him.' The experimenter continued this sequence three additional times, and the task ended if the child reached for the spider all those times. If the child did not reach for the spider, E continued prompting until the task ended (maximum duration of task was 2 minutes).

Ratings for behavioral indicators of fear (children's approach to the toy spider and proximity to their mother) were coded in five-second intervals for two minutes (mean latency to first touch the toy spider = 46.73 seconds, $SD$ = 48.53, range = 0–120 at T1 and 24.26 seconds, $SD$ = 39.71, range = 0–120 at T2). Approximately 67 percent and 53 percent of the children at T1 and T2 were observed for the full 2 minutes because they did not reach for the spider all four times as the experimenter had prompted. Approach to the toy spider was coded 0 = absent, 1 = present (Cohen's kappas at T1 and T2 were .82 and .77, respectively) and proximity to mother was coded on a three-point scale (1 = none, 2 = purposely moving toward mother, and 3 = touching mother; intra-class reliability correlations at T1 and T2 were .95 and .98, respectively). The ratings were averaged across intervals to compute scores for approach to the toy spider and for proximity to the mother at T1 and T2. The scores for approach to the toy spider and proximity to the mother were significantly negatively correlated at T1 and T2, $r$s(243, 213) = −.52 and −.43, $p$s < .01 and .05, respectively. To reduce the number of analyses (particularly for logistic regression), the scores for approach to the toy spider (after reversing scores) and proximity to the mother were standardized and averaged to form composites for observed *fearfulness* separately at T1 and T2. However, we used unstandardized (non-composite) measures in preliminary and descriptive statistics and SEM.

*Child Reactions to a Stranger's Simulated Distress.* Reactions to a stranger's simulated distress were observed at 18 and 30 months of age using procedures adapted from Zahn-Waxler and colleagues (e.g., Zahn-Waxler & Radke-Yarrow, 1990). The child was able to walk freely around the room while the mother continued completing questionnaires without interacting with the child. A female E entered the room with a basket of toys and feigned dropping the basket on her foot. Without making eye contact with the child, E simulated pain and distress vocally (e.g., saying 'ouch, I dropped the toys on my foot and it really hurts') and behaviorally (e.g., rubbing her foot) about once every 10 seconds for 60 seconds. Then E vocalized that her foot had fully recovered (11 Es were coded as not dramatic at T1 [kappa = .62; none were at T2]; study results did not change if the 11 cases were excluded so all were included in analyses).

The children's reactions were recorded with hidden cameras and then coded every 10 seconds for 60 seconds. Using adapted coding schemes from Zahn-Waxler and Radke-Yarrow (1990), three broad types of empathy-related reactions were rated: empathic concern, personal distress, and helping.

*Observed child empathic concern.* The children's empathic concern (viewed as indicative of sympathy; see Eisenberg et al., 1996b; Volbrecht, Lemery-Chalfant,

 

Aksan, Zahn-Waxler, & Goldsmith, 2007) was indexed by ratings of *concerned attention* (intra-class *r*s(98, 59) at T1 and T2 = .73 and .80, *p*s < .01, respectively) rated on a four-point scale (1 = none; 4 = intense or sustained indication) and *hypothesis testing* (i.e., attempt to label or understand the problem; intra-class *r*s(98, 59) at T1 and T2 = .67 and .75, *p*s < .01, respectively) rated on a three-point scale (1 = none, 2 = low or looking at distressed person's hurt foot, 3 = sustained or clear indication). Concerned attention and hypothesis testing were positively correlated at T1 and T2, *r*s(239, 214) = .29 and .39, *p*s < .01.

*Observed child (personal) distress.* When E simulated distress, the children's (personal) distress was rated from video recordings on a four-point scale (1 = none; 4 = intense) every 10 seconds. Indicators of personal distress consisted of *self-soothing* (intra-class *r*s[99, 59] at T1 and T2 = .75 and .87, *p*s < .01, respectively) and *comfort seeking* from parent (intra-class *r*s[99, 59] at 18 and 30 months = .93 and .91, *p*s < .01, respectively). Self-soothing/self-comforting included behaviors such as sucking thumb, twirling hair, or rubbing arms or face. Comfort seeking involved the child actively seeking comfort from the parent such as by climbing onto the parent or asking to be held, hugged, or stroked. Self-soothing and avoidance of a stranger (including seeking proximity or comfort from parent) has sometimes been viewed as attempts at emotion regulation (Mangelsdorf, Shapiro, & Marzolf, 1995; Stifter & Braungart, 1995). In the context of witnessing an unfamiliar adult simulate distress, efforts at emotion regulation are likely response-focused (i.e., enacting such behaviors to regulate ongoing emotion such as distress). Therefore, self-soothing and comfort seeking were viewed as indicative of personal distress.

*Observed child helping.* The children's helping of the unfamiliar female experimenter within a 60-second period was coded every 10 seconds for 60 seconds. Helping included physical or direct as well as indirect help. Physical or direct help (i.e., physically helping or offering the experimenter something to comfort or alleviate her pain or distress such as kissing the experimenter's injured foot, patting or hugging the experimenter, or giving the experimenter a toy) was coded as absent (0) or present (1); kappas (101, 61) = 1.00 and 1.00, *p*s < .01, at T1 and T2, respectively). In addition, indirect help toward the experimenter (i.e., getting parent to pay attention to the injured experimenter or trying to get parent to help the injured experimenter) was coded as absent (0) or present (1); kappas (101, 61) = .74 and .90, *p*s < .01, at T1 and T2, respectively. To arrive at a final score of *helping*, the children were coded as 0 or 1 for the absence or presence, respectively, of either direct or indirect helping within the 60-second period.

## Results

Attrition and descriptive analyses are presented first. Within- and across-time correlations between the major variables are then discussed before testing concurrent and longitudinal prediction of empathy-related reactions from RSA and fearfulness measures with structural equation modeling (SEM) and logistic regressions (for continuous measures of empathy-related emotional reactions and dichotomous measures of helping, respectively).

Major variables and composites were screened for normality and outliers (Barnett & Lewis, 1994), and all responses were found to be within reasonable ranges except for

resting RSA. For resting RSA, scores that were three *SD*s above or below the mean (three outliers were found at T1 and 4 outliers were found at T2) were coded as missing so these values were estimated in SEM or multiple imputations procedures. According to the cutoff values of 2 for skew and 7 for kurtosis (West, Finch, & Curran, 1995), measures of concerned attention and self-soothing/self-comforting at T1 and at T2 were modestly positively skewed whereas RSA suppression (standardized, residualized RSA change score) at T2 was modestly negatively skewed. Data transformations were conducted for the skewed variables and used for preliminary (descriptive and correlational) analyses, but final analyses with SEMs and logistic regressions were conducted on non-transformed data.[1]

### *Attrition Analyses*

There were no differences in the means of T1 major variables for the participants who had no vs. some data at T2. With regard to T1 demographic variables, the families who had no laboratory data at T2 tended to be the families with a Hispanic mother and/or Hispanic father who were not White/Non-Hispanic, $\chi^2$s (1) = 5.17 and 4.55, *p*s < .05, and were lower in familial income and lower in level of maternal education (coded as at least grade school education, at least some college education, and graduate education), *F*s(1,217) and (1,229) = 4.26 and 16.48, *p*s < .05 and .01, respectively.

### *Descriptive Statistics*

Means and standard deviations for the major variables (before data transformations) are presented in Table 1.

*Relations of Child and Familial Background with Major Variables.* Relations between child's age, child's sex, parental ethnicity (coded as White/Non-Hispanic or Other), or familial income (coded as $45 000 or less, $45 000 to $75 000, and $75 000 or higher) and the major variables were examined. We examined the parental rather than the child ethnicity because they were often the same. However, when the child and the parental ethnicity differed, we expected that the parental ethnicity, more likely than the child ethnicity, would be associated with differences in parenting practices that may be associated with the child's empathy-related reactions and prosocial behavior. At T1 and T2, the children usually visited the laboratory within one month (either prior to or after) of turning 18 and 30 months old, respectively. Only one relation was found for age: relatively young children were likely to exhibit comfort seeking at T1, $r(240) = -.19$, $p < .01$.

No differences were found in the major variables for parental ethnicity (re-coded as White/Non-Hispanic and Other) and family income, with one exception. Although no differences were found for the fathers' ethnicity, the children with White/Non-Hispanic mothers exhibited more helping at T2 than those with Other ethnicity mothers, $\chi^2(1) = 4.01$, $p = .05$.

Sex and time differences were tested using general linear model (GLM) repeated measures procedures with three sets of variables at T1 and T2: physiological regulation (i.e., resting RSA and RSA suppression), fearfulness, and empathy-related reactions (i.e., concerned attention, hypothesis testing, self-soothing, comfort seeking, and helping). Because standardized, residualized RSA change scores had a mean value of zero, RSA suppression was tested using the difference scores in RSA across the neutral

 

**Table 1. Means, Standard Deviations of Major Variables and Comparison of Means Across T1 and T2**

| | Sample | | Boys | | Girls | |
|---|---|---|---|---|---|---|
| | T1 [%] | T2 [%] | T1 | T2 | T1 | T2 |
| Resting RSA | .19 (.11) | .30 (.17) | .19 (.10) | .29 (.17) | .19 (.11) | .32 (.15) |
| RSA suppression | .00 (.07) | .00 (.07) | .04 (.10) | −.11 (.11) | −.05 (.08) | .14 (.08) |
| Fearfulness | .00 (.87) | .00 (.85) | −.04 (.83) | −.01 (.82) | .04 (.92) | .01 (.88) |
| Concerned attention | 1.09 (.24) [16.7] | 1.13 (.26) [33.5] | 1.09 (.23) [15.8] | 1.16 (.28) [42.4] | 1.09 (.25) [17.8] | 1.09 (.22) [22.7] |
| Hypothesis testing | 1.34 (.47) [54.7] | 1.43 (.57) [50.5] | 1.30 (.40) [51.9] | 1.43 (.58) [48.7] | 1.40 (.55) [58.2] | 1.42 (.55) [52.6] |
| Self-soothing | 1.12 (.45) [11.9] | 1.18 (.41) [27.8] | 1.08 (.39) [8.3] | 1.15 (.36) [26.1] | 1.17 (.51) [16.4] | 1.21 (.46) [29.9] |
| Comfort seeking | 1.21 (.44) [32.9] | 1.12 (.31) [22.2] | 1.33 (.39) [25.6] | 1.11 (.31) [22.7] | 1.33 (.50) [41.8] | 1.11 (.31) [21.6] |
| Helping | .11 (.31) [11.1] | .23 (.42) [23.1] | .13 (.34) [12.8] | .21 (.41) [21.0] | .09 (.29) [9.1] | .26 (.44) [25.8] |

*Note*: T1 = 18 months of age, T2 = 30 months of age. Standard deviations are in parentheses. Percentages of children who exhibited some level of empathy-related behaviors are presented in brackets.

and empathy-eliciting films at T1 and T2 in order to test for mean-level changes across time. For measures of physiological regulation, no main or interaction effects of time and sex were found. For measures of fearfulness (for the two indices before standardization so mean-level changes could be examined), significant differences were found for measures across-time, multivariate $F(2,206) = 9.72$, $p < .01$. Univariate tests indicated that there was a mean-level decrease in proximity to the mother during the toy spider task from 18 to 30 months, $F(1,207) = 18.95$, $p < .01$. For measures of empathy-related reactions, significant mean-level change across time and a marginal sex difference were found, multivariate $F$s(5,198) = 7.45 and 2.04, $p$s < .01 and .10, respectively. According to univariate tests, there was a mean-level decrease in comfort seeking and a mean-level increase in helping across time, $F$s(1,202) = 19.73 and 12.82, $p$s < .01, respectively. Moreover, the girls exhibited marginally more self-soothing than did boys, $F(1,202) = 2.81$, $p < .10$.

### *Correlational Analyses of Major Variables*

Partial correlations controlling for age and sex were computed to examine relations among the predictors (resting RSA, RSA suppression, and fearfulness) and the empathy-related reactions (concerned attention, hypothesis testing, self-soothing, comfort seeking, and helping).

*Across-time Consistencies in the Predictors and Empathy-related Reactions.* Across T1 and T2, there was differential continuity in resting RSA, $r(183) = .32$, $p < .01$, but not RSA suppression or fearfulness. Comfort seeking and helping, but not other empathy-related reactions, also were modestly consistent from T1 to T2, $r$s(204) = .20 and .15, $p$s < .01 and .05, respectively.

*Within-time Correlations among Predictors and among Empathy-related Reactions.* With regard to within-time correlations among the predictors, at T2, RSA suppression and fearfulness were inversely related to one another (see Table 2). As for empathy-related outcomes, hypothesis testing and concerned attention were positively related at T1 and T2 as were self-soothing and comfort seeking (the latter was marginally significant at T2). In addition, hypothesis testing and comfort seeking were marginally inversely related to one another at T1. At T2, concerned attention and hypothesis testing were both positively related to helping.

*Within-time Correlations between Predictors and Empathy-related Reactions.* Resting RSA and hypothesis testing were positively related to one another at T1 (see Table 2). RSA suppression and comfort seeking were positively related to one another at T1 but negatively related at T2. Within time, fearfulness was positively related to comfort seeking.

*Across-time Correlations between T1 Predictors and T2 Empathy-related Reactions.* T1 fearfulness was inversely related to T2 concerned attention and T2 helping (the former being marginally significant), $r$s(207, 204) = −.13 and −.15, $p$s < .10 and .05, respectively. No other correlations between T1 predictors and T2 empathy-related reactions were found.

**Table 2. Within-time Partial Correlations among Major Variables Controlling for Sex and Age**

| Measure | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Resting RSA | — | .00 | .04 | .08 | .17*** | −.05 | .01 | −.04 |
| 2. RSA suppression | .07 | — | .04 | −.02 | −.06 | .02 | .14** | .03 |
| 3. Fearfulness | −.03 | −.22*** | — | .05 | −.07 | .03 | .35*** | −.10 |
| 4. Concerned attention | −.06 | .01 | −.01 | — | .29*** | .01 | .05 | .01 |
| 5. Hypothesis testing | −.10 | .07 | .03 | .39*** | — | .02 | −.12* | −.06 |
| 6. Self-soothing | −.06 | −.02 | .10 | .09 | −.03 | — | .19*** | −.04 |
| 7. Comfort seeking | −.07 | −.19*** | .15** | .00 | −.10 | .12* | — | .08 |
| 8. Helping | −.06 | .03 | −.02 | .17** | .20*** | −.08 | .02 | — |

*Note:* Partial correlations within T1 (18 months) are presented above, whereas within T2 (30 months) are presented below, the main diagonal of the table.
* $p < .10$, ** $p < .05$, *** $p < .01$.

*Longitudinal Prediction of Empathy-related Reactions.* Longitudinal relations between T1 predictors (i.e., resting RSA, RSA suppression, and fearfulness) and continuous measures of T2 empathy-related reactions (i.e., empathic concern and personal distress) were tested with SEM. Prediction of T2 helping (coded as a dichotomous measure) from the same T1 predictors (see above) was tested with logistic regression.[2]

*Prediction of Empathic Concern and Personal Distress: Structural Equation Modeling.* SEMs were conducted using full information maximum likelihood estimation in MPlus (v3.13, Muthén & Muthén, 2004) to deal with missing data due to attrition. Unique relations of resting RSA, RSA suppression, and fearfulness (the predictors) at T1 to empathic concern and personal distress at T2 were tested. Longitudinal paths included autoregressive or across-time consistency paths (for all predictors and reactions) and prediction paths (from T1 predictors to T2 reactions). To account for potential influences of covariates (i.e., child age, child sex, familial income, and maternal ethnicity) on empathy-related reactions, paths were included from covariates to empathic concern and personal distress at T1 and at T2 in SEM. In addition, the predictors and empathy-related reactions were all inter-correlated within time.

Using the chi-square difference test, we identified which variable loadings and within-time correlations could be constrained to be equal within time. Four sets of within-time correlations were found to differ and thus, were left unconstrained across-time: RSA suppression and fearfulness; RSA suppression and personal distress; fearfulness and personal distress; and age and personal distress. All other within-time correlations and model-estimated loadings were constrained to be equal across time. This model fit the data well, $\chi^2(99, N = 247) = 104.62$, $p = .33$, confirmatory fit index (CFI) = .97, root mean square error of approximation (RMSEA) = .02 (90% confidence

interval = .00 to .04), standardized root mean square residual (SRMR) = .05, and did not differ from the model that was fully unconstrained, $\Delta\chi^2$ (16) = 21.17, ns.

Empathic concern and personal distress were the latent constructs with multiple indicators (constrained to be equal across-time) and the model-estimated loadings for concerned attention and self-soothing loaded significantly onto their corresponding constructs, $\lambda$s = .18 and .15 (standard errors = .02 and .06), *p*s < .01, respectively (as is generally done, hypothesis testing and comfort seeking were set to 1 on their corresponding latent constructs). Across-time consistency (in the autoregressive paths) was found for resting RSA and personal distress, *b*s = .52 and .12, *z*s = 4.61 and 2.57, *p*s < .01 and .05, respectively, but not for empathic concern and personal distress. For the predictors, RSA suppression was negatively associated with fearfulness at T2, $b = -.19$, $z = -3.06$, $p < .01$, but not at T1, $b = .04$, $z = .70$, ns. In terms of with-time relations, the two empathy-related reactions (i.e., empathic concern and personal distress) were negatively associated with one another at T1 and at T2, $b = -.02$, $z = -2.08$, $p < .05$ (recall that these relations were constrained across-time). Empathic concern was marginally positively associated with resting RSA at both times (recall that these were constrained across-time; see Table 3 and Figure 1). The pattern of associations between personal distress and RSA suppression differed within the two assessments. RSA suppression was marginally positively associated with personal distress at T1, but this association was significant and negative at T2 (see Table 3). Additionally, fearfulness was positively associated with personal distress at T1 and T2 (see Table 3).

*Prediction of Helping: Multiple Logistic Regression.* To test for prediction of T2 helping (coded as absent or present within a 60-second period), multiple logistic regression was conducted (see Table 4). Helping was not included in an SEM because it was coded dichotomously and occurred relatively infrequently. To account for missing data, multiple imputation method was used and regressions were conducted on data from the results averaged across 10 imputations using SAS/STAT® procedure, PROC MI® (Shafter & Graham, 2002; Yuan, 2000). None of the variables in these datasets were significantly skewed according to the cutoff values of 2 for skew and 7 for kurtosis (West et al., 1995). Regressions accounted for potential contributions of covariates (i.e., age, sex, familial income, maternal ethnicity) to T2 helping, with covariates entered in the first step of the analysis and T1 predictors and T1 helping entered in the second step. Although use of the Hosmer and Lemeshow (2000) goodness of fit test is not recommended with a sample size of less than 400, the logistic model's estimates appeared to fit the data at an acceptable level, $\chi^2$s (8) = 4.38, $p = .82$. As indicated by Cox and Snell $R^2$ and Nagelkerke $R^2$ from the second step of the regression, approximately 6.7% to 9.3% of variability in T2 helping was explained by the set of three predictors. Across time, T1 RSA suppression and T1 low fearfulness significantly predicted T2 helping after statistical adjustments for covariates and for T1 helping.

## Discussion

In the present study, there were some relations of RSA and fearfulness with empathy-related reactions and helping. However, the pattern of findings was complex and often modest.

**Table 3. Structural Equation Modeling: Within-time Correlation and Across-time Path Coefficients**

| | T1 | | T2 | | T1 to T2 | |
|---|---|---|---|---|---|---|
| | beta | SE | beta | SE | beta | SE |
| Resting RSA ↔ empathic concern | .01* | .003 | .01* | .003 | −.57 | .37 |
| RSA suppression ↔ empathic concern | .004 | .02 | .004 | .02 | −.002 | .04 |
| Fearfulness ↔ empathic concern | −.004 | .02 | −.004 | .02 | −.06 | .05 |
| Child age → empathic concern | .01 | .05 | .01 | .05 | | |
| Child sex → empathic concern | .06 | .05 | .06 | .05 | | |
| Familial income → empathic concern | .04 | .03 | .04 | .03 | | |
| Maternal ethnicity → empathic concern | .05 | .06 | .05 | .06 | | |
| Resting RSA ↔ personal distress | −.001 | .002 | −.001 | .002 | −.02 | .19 |
| RSA suppression ↔ personal distress | .06* | .03 | −.05** | .02 | −.01 | .03 |
| Fearfulness ↔ personal distress | .14*** | .03 | .04** | .02 | −.001 | .03 |
| Child age → personal distress | −.18*** | .06 | .04 | .04 | | |
| Child sex → personal distress | .03 | .03 | .03 | .03 | | |
| Familial income → personal distress | .04* | .02 | .04 | .02 | | |
| Maternal ethnicity → personal distress | .002 | .04 | .002 | .04 | | |
| Resting RSA ↔ RSA suppression | .001 | .01 | .001 | .01 | | |
| Resting RSA ↔ fearfulness | .002 | .01 | .002 | .01 | | |
| RSA suppression ↔ fearfulness | .04 | .06 | −.19*** | .06 | | |
| Empathic concern ↔ personal distress | −.02** | .01 | −.02** | .01 | | |
| Stability in resting RSA | | | | | .52*** | .11 |
| Stability in RSA suppression | | | | | −.02 | .07 |
| Stability in fearfulness | | | | | .05 | .07 |
| Stability in empathic concern | | | | | .11 | .08 |
| Stability in personal distress | | | | | .12** | .05 |

*Note*: Unstandardized within-time correlation and across-time path coefficients are presented. * $p < .10$, ** $p < .05$, *** $p < .01$. See text for additional relations among predictors.

### *Fearfulness and Empathy-related Reactions*

Toddlers' fearfulness was sometimes associated with their self-oriented, distress-related reactions (personal distress or low helping) within or across age. Consistent with Spinrad and Stifter's (2006) data, at 18 and at 30 months, fearful toddlers were

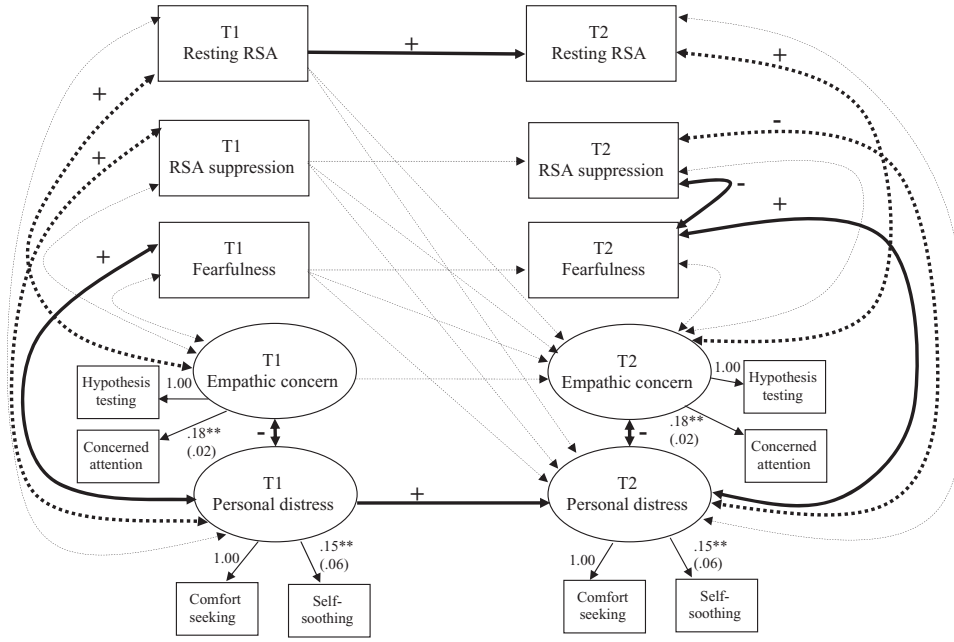


*Figure 1.* SEM: Within- and Across-time Relations of RSA Measures, Fearfulness, Empathic Concern, and Personal Distress at 18 and 30 Months. *Notes.* $\chi^2(99, N = 247) = 104.62$, $p = .33$, CFI = .97, RMSEA = .02 (90% CI = .00 to .04), SRMR = .05. Within T1 and within T2, predictors (i.e., RSA measures and fearfulness), reactions (i.e., empathic concern and personal distress), and predictors and reactions were intercorrelated with one another. Paths from covariates (i.e., age, sex, SES, and maternal ethnicity) to empathic concern and personal distress were included, but only relations between SES and personal distress at T1 and T2 (both marginal) and between age and low T2 personal distress were found but not included in this figure. For readability of figure, significant correlations and model paths are shown as solid lines (marginally significant correlations or paths are shown as bold dotted lines), and coefficients for model paths and correlations are presented in Table 3.

likely to seek comfort from the mother upon witnessing a distressed stranger (in the correlations) and there was a positive relation between the latent constructs of fearfulness and personal distress at 30 months in the SEM. Longitudinally, in logistic regression, fearfulness at 18 months predicted low helping toward a distressed stranger at 30 months.

Although correlational data cannot prove causal relations, these findings are consistent with the conclusion that fearful temperament predisposes children to react with physiological overarousal or personal distress, which may lead them to behaviorally withdraw or disengage from an evocative or challenging situation. This pattern of relations may be partly due to fearful children tending to be low in T2 RSA suppression (see later section), which is believed to be a marker of physiological self-regulation. The relation between fearfulness and personal distress may have held only within time rather than across time because fearfulness was not stable across time.

**Table 4. Multiple Logistic Regression: Across-time Prediction of Helping at 30 Months**

| Parameter | Estimate | *p* value | Odds ratio |
|---|---|---|---|
| Age | .12 | .67 | 1.12 |
| Sex | .24 | .40 | 1.27 |
| SES | .17 | .38 | 1.18 |
| Maternal ethnicity | .32 | .36 | 1.37 |
| T1 Helping | .96 | .02 | 2.60 |
| T1 Resting RSA | .74 | .58 | 2.10 |
| T1 RSA suppression | .36 | .03 | 1.43 |
| T1 Fearfulness | −.35 | .04 | .71 |

*Note*: T1 = 18 months of age, T2 = 30 months of age. Resting RSA, RSA suppression, and fearfulness were entered in the second step of the regression. Multiple imputation method was used to account for missing data, and regression was conducted on data from the scores that were averaged across 10 imputations using SAS/STAT procedure, PROC MI.

### *Physiological Regulation and Empathy-related Reactions*

Our results with resting RSA and RSA suppression appear consistent with the notion that RSA indices reflect putative individual differences in emotionality and self-regulation involving sympathetic and parasympathetic autonomic nervous system processes. Resting RSA appears to reflect trait-like low negative emotionality (at least after early infancy) or appropriate levels of reactivity, soothability, and adaptability (e.g., Beauchaine, 2001; Hastings et al., 2008b; Stifter & Fox, 1990) whereas RSA suppression to an evocative or challenging situation appears to be a marker of parasympathetic responding or effortful regulation (e.g., Calkins, 1997; Porges et al., 1996). Given that measures of low negative emotionality and high self-regulation have been associated with measures of sympathy or prosocial behavior in older children (Eisenberg et al., 2006), RSA or vagal responding would be expected to predict high levels of empathic concern and helping in young children if RSA indices tap individual differences in physiological regulation. Consistent with predictions, in correlations, resting RSA was positively associated with hypothesis testing (an indicator of empathic concern) at 18 months. Similarly, results from the SEM indicate that resting RSA was marginally positively associated with empathic concern at both ages (this relation was constrained to be equal across time). Additionally, in a logistic regression, RSA suppression at 18 months predicted helping at 30 months (when controlling for T1 helping). The overall pattern of findings suggests that resting RSA was weakly associated with indices of empathic concern and that RSA suppression was predictive of increased helping. However, the findings for empathic concern were very modest and require replication.

The relation of RSA suppression with distress-related reactions changed with age. In correlations, RSA suppression and comfort seeking (an indicator of personal distress) were positively related to one another at 18 months but inversely related at 30 months. Similar trends were found in SEM, with RSA suppression and personal distress being marginally positively related to one another at 18 months but significantly inversely

related at 30 months. These results are somewhat consistent with the literature, showing mixed relations between RSA and social behaviors, particularly in the first two years of life (Beauchaine, 2001; Porges et al., 1994a). Moreover, in the context of witnessing a distressed stranger, seeking contact and comfort from the mother may be adaptive and developmentally appropriate at earlier but less so at later ages. Indeed, comfort seeking was exhibited more frequently at 18 than 30 months in our sample, which may suggest that such a behavior is more age-appropriate or functional at younger ages. Overall, our data suggest that there was a developmental shift in the direction of association between RSA suppression and comfort seeking from a positive association at 18 months to a negative association at 30 months.

### *Empathic Concern, Personal Distress, and Helping*

At 18 and at 30 months, results from correlations show that concerned attention and hypothesis testing (indicators of empathic concern) were positively related, as were self-soothing and comfort seeking (indicators of personal distress), although the latter was marginally significant at 30 months. Moreover, in the SEM, sympathy and personal distress were inversely related to one another at both assessments (and in correlations, hypothesis testing and comfort seeking were inversely related at 18 months). Correlations also indicated that concerned attention and hypothesis testing were both positively related to helping at 30 months; recall that helping was not in the SEM with sympathy/personal distress. Helping at 18 months was unrelated to empathy-related responding in the correlations, likely in part because helping was lower in frequency at 18 than 30 months. Although the meaning or function of comfort-seeking behavior at 18–30 months needs to be interpreted with children's developmental needs and capacities in mind, our findings generally support the view that personal distress (e.g., comfort seeking) and other-oriented responding (e.g., hypothesis testing) tend to be inversely related and that sympathetic concern, but not personal distress, is consistently related to prosocial behavior, at least by 30 months of age. This finding is consistent with theoretical expectations and others' findings (e.g., Hoffman, 2000; Knafo et al., 2008). Perhaps personal distress was unrelated to helping in the present study because the indices of personal distress reflected not only distressed responding but also the tendency to try to regulate that distress.

### *Stability and Change between 18 and 30 Months*

Consistent with previous research (Porges, Doussard-Roosevelt, Portales, & Suess, 1994), we found one-year differential (i.e., rank-order) continuity in resting RSA but not RSA suppression. These findings support the view that resting vagal tone reflects temperamental regulation (Beauchaine, 2001) while vagal suppression reflects state-like (dynamic) regulation that is context-dependent (Hastings et al., 2008a; Porges et al., 1996). Moreover, the finding that vagal suppression increased with age is consistent with findings that effortful control improves and increasingly becomes coherent and stable across early childhood (see Kochanska & Knaack, 2003). For example, Kochanska, Murray, and Harlan (2000) found across-time stability in children's effortful control even though children's performance on every observed measure of effortful control improved between 22 and 33 months.

 

Unexpectedly, neither one-year continuity nor mean-level change was found for fearfulness. In a different study of 24-month-olds, Buss, Davidson, Kalin, and Goldsmith (2004) found that children exhibited different amounts of fear behaviors across three different mildly threatening or fear-eliciting contexts that involved an adult stranger. In the present study, even though fearfulness was assessed with a jumping toy spider (a non-social stimulus), the task was administered by a relatively unfamiliar female experimenter. Thus, it is plausible that fearfulness assessed in the context of a social situation may exhibit little or no mean-level change for the group and also low continuity in rank ordering across 18–30 months. As noted by Goldsmith et al. (1997, p. 902), further attention and longitudinal studies are required to examine age-related changes or stability in fearfulness (and social fear).

With regard to the empathy-related reactions, there was differential consistency across one year for both comfort seeking and helping. In addition, one-year stability was found in SEM for the constructs of personal distress and empathic concern (the latter was marginally significant). Relative to distress-related reactions, perhaps empathic concern is less strongly associated with temperament (and hence, less consistent across time); however, the finding that resting RSA was negatively related to empathic concern but not personal distress is not supportive of this idea. It is likely that trait-like appropriate levels of regulation (as suggested by stability in resting RSA), which are associated with empathy-related responding and helping (see Eisenberg et al., 2006), partly account for the stability found in some of the empathy-related reactions.

Further, from 18 to 30 months, there was a mean-level decrease in comfort seeking and an increase in helping. The decrease in distress-related reactions and increase in prosocial behavior may be partly due to improvements in children's abilities for physiological and behavioral self-regulation (Rothbart & Bates, 2006) that allow them to better manage empathic overarousal and distress-related behavior and engage in other-oriented, prosocial behavior. This explanation is consistent with the finding that resting RSA was associated with less distress at T2 (but not at T1) and that T1 RSA suppression (a marker of physiological regulation) was predictive of helping across time.

### *Physiological Regulation and Fearfulness*

Although the relation between RSA responding and fearfulness was not a key issue in this study, the findings on their relation are of interest. In correlations and in the SEM, RSA suppression was negatively related to fearfulness at 30 months. By 30 months, the ability to temporarily suppress RSA in the face of an evocative or challenging event appears to allow for optimal engagement or coping (Beauchaine, 2001; Porges, 1996). This result is consistent with Talge, Donzella, and Gunnar's (2008) finding that temperamentally fearful preschoolers exhibited marginally smaller decreases in RSA to a fear-eliciting film and in particular, were tentative (unlikely to approach or engage in play) with novel objects (no relations were found for some indices of fearfulness and fearfulness was unrelated to resting RSA). However, in studies that involved behavioral indices of effortful regulation or attention, effortful regulation was positively related to fear in infancy (Sheese, Rothbart, Posner, White, & Fraundorf, 2008) and in the preschool years (Aksan & Kochanska, 2004). Discrepant findings may be due to the use of physiological vs. behavioral indices of effortful regulation.

## Limitations and Conclusions

A strength of the present study is that predictors were measured using different modes or methods (i.e., physiological and behavioral measures). Such a multi-modal and multi-rater methodology helped rule out the likelihood that within- and across-time relations between the predictors and the empathy-related reactions were due to shared method variance. With the physiological measures, children's body mass index has sometimes been included as a covariate, but we did not collect data on children's height or weight. However, Calkins, Graziano, and Keane (2007) found no relation between five-year-olds' height or weight and RSA measures (granted that their sample consisted of children with low behavior problems, risk for externalizing problems, and risk for mixed externalizing/internalizing problems). Another limitation is that fearfulness and empathy/helping were each assessed in only one context for a relatively brief period of time; multiple assessments would likely yield a stronger index of the constructs. Particularly for the empathy-related and helping reactions, some toddlers may have offered help to the stranger if given a longer period to respond. In addition, children's attachment styles were not assessed and could be examined in relation to children's tendencies to seek proximity to or comfort from mother, which were used as indices of fearfulness and personal distress, respectively, in the present study. Further, the present sample was composed of primarily White/Non-Hispanic, middle-class families, and the findings may not generalize to other ethnic groups or lower income families. It is unclear if, because of SES or other factors such as familial cultural background, toddlers exposed to different types of social experiences such as childcare services vary in characteristics such as assertiveness or boldness (National Institute of Child and Human Development Early Child Care Research Network, 2003), which in turn influence their reactions to strangers' distress. Cultural or experiential differences could explain the finding that children with White/Non-Hispanic mothers tended to exhibit helping at 30 months more so than children with mothers of Other ethnicity in the present sample. Nonetheless, our overall pattern of findings suggests that physiological regulation and low levels of dispositional fearfulness predicted prosocial behavior. Because previous research indicates that self-regulatory abilities tend to improve with maturation (Kochanska et al., 2000) or with intervention and curriculum targeting social-emotional development (Domitrovich, Cortes, & Greenberg, 2007; Greenberg, Kusché, Cook, & Quamma, 1995), enhancing children's self-regulation might help them manage fearful or distressed reactions as well as enhance their other-oriented empathic and prosocial behavior.

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## Notes

1. SEMs were tested with Mplus (v3.13, Muthén & Muthén, 2004) using bootstrap resampling, or repeatedly sampling from the original sample data to establish an empirical sampling distribution (Nevitt & Hancock, 2001), and the pattern of results was the same as those from non-bootstrap method. Logistic regression was conducted on data from the scores averaged across 10 imputations using SAS/STAT procedure and PROC MI (Shafter & Graham, 2002; Yuan, 2000), and none of the variables was significantly skewed according to the cutoff values of 2 for skew and 7 for kurtosis (West et al., 1995).

2. Potential interactions between indices of physiological regulation (i.e., resting RSA and RSA suppression) and fearfulness on the empathy-related reactions within and across T1 and T2 were tested in SEM and logistic regression, resulting in two significant interactions (T1 RSA suppression × T1 fearfulness → T2 empathic concern and T2 RSA suppression × T2 fearfulness → T2 personal distress). The interaction effects were plotted at three levels (1 standard deviation above the mean/+1*SD*, the mean, and 1 standard deviation below the mean/−1*SD*) of RSA suppression (Aiken & West, 1991). Tests of the three slopes indicated that none of the slopes was statistically different from zero. Thus, the interaction effects do not appear to be meaningful or interpretable.