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Multidimensional Emotion Regulation Moderates the Relation Between Behavioral Inhibition at Age 2 and Social Reticence with Unfamiliar Peers at Age 4

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Behavioral inhibition (BI), a temperament trait characterized by fearful and wary responses to novelty, has been consistently identified as one of the primary precursors of the behavioral expression of anxious, socially reticent behavior with unfamiliar peers (Fox, Henderson, Marshall, Nichols, & Ghera, 2005). In turn, it has been proposed that the tendency to demonstrate fearful, wary behavior and refrain from interacting with unfamiliar peers may be a key antecedent to social withdrawal, the tendency to avoid social interaction when in the presence of familiar peers (Rubin, Coplan, & Bowker, 2009). Social withdrawal predicts a variety of negative social and emotional outcomes throughout childhood and adolescence. For instance, socially withdrawn children often experience peer rejection and exclusion (e.g. Gazelle & Spangler, 2007), perhaps because they are less socially competent and they demonstrate poor social-cognitive reasoning abilities relative to their non-withdrawn peers (e.g., Burgess, Wojslawowicz, Rubin, Rose-Krasnor, & Booth-LaForce, 2006; Stewart & Rubin, 1995). Perhaps as a result of these difficulties, socially withdrawn children come to perceive themselves as less socially competent and experience heightened loneliness, anxiety, and depressive symptoms relative to their non-withdrawn peers (e.g., Ladd, 2006; see Rubin et al., 2009 for a relevant transactional model of the developmental course of social withdrawal). As a result, it is essential to investigate factors that may disrupt the association between early BI and childhood social reticence in order to better understand

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how to prevent later social withdrawal and its associated negative social and emotional consequences.

Fortunately, researchers have identified a variety of protective factors that buffer BI children against displaying later social reticence and withdrawal. For example, Hane, Cheah, Rubin, and Fox (2008) found that a shy, inhibited temperament in early childhood did not predict later social reticence with unfamiliar peers if mothers displayed high levels of positive, supportive behavior during parent-child interactions. Similarly, Degnan, Henderson, Fox, and Rubin (2008) showed that BI toddlers did not demonstrate heightened levels of social reticence with unfamiliar peers in early childhood if their mothers were relatively low in neuroticism and depressive symptoms. In an examination of child characteristics that may moderate relations between inhibition and later social reticence, Lamm, Walker, and colleagues (2014) demonstrated that BI was unrelated to social reticence with an unfamiliar peer when children displayed adaptive patterns of neural activation related to cognitive control and regulation. Therefore, several aspects of children's social environments and intrapersonal characteristics appear to reduce associations between early BI and later social difficulties.

These different protective factors may all operate, in part, by supporting the development of emotion regulation (ER) abilities. Supportive parenting behavior, maternal emotional stability, and strong cognitive control may all facilitate children's ability to effectively regulate their emotions, and this ER ability may enable BI children to manage their fearful responses to novelty. Rubin and Coplan (2004) have argued that the capacity to regulate negative emotions may allow BI children to refrain from displaying anxious and avoidant behavior when experiencing social fear. In addition, the subconscious capacity to regulate physiological responses to emotions, as indexed by markers such as high respiratory sinus arrhythmia, may prevent BI children from experiencing intense distress in response to social novelty and therefore facilitate appropriate engagement in social interactions. However, researchers have yet to examine the simultaneous effects of behaviorally-manifested and physiological regulation as moderators of the relation between BI and the later display of social reticence. Consequently, in the present study, we investigated whether behaviorally-manifested and/or physiological capacities to regulate negative emotion moderated the relation between BI at age 2 years and the display of socially reticent behavior with unfamiliar peers at age 4 years.

Behavioral Inhibition and Social Reticence

It has been proposed that negative reactions to novelty in infancy and BI in toddlerhood are among the strongest predictors of the later display of social reticence and anxious withdrawal. Fox, Henderson, Rubin, Calkins, and Schmidt (2001) have theorized that the temperamental predisposition to react to unfamiliar social stimuli with fear may develop into feelings of anxiety in social situations that motivate children to avoid social interaction. For instance, observed negative reactivity in response to novelty at 4 months of age, a key precursor to behavioral inhibition, predicts consistent BI and observed reticence and avoidance of unfamiliar peers in early childhood, although some highly reactive infants become less inhibited and reticent over time (Fox et al., 2001). BI in early childhood is

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associated with the concurrent display of reticent, anxious behavior during interactions with unfamiliar peers (Coplan, Rubin, Fox, Calkins, & Stewart, 1994; Rubin, Hastings, Stewart, Henderson, & Chen, 1997). In addition, BI at ages 2 and 3 longitudinally predicts high levels of observed and mother-reported social reticence with unfamiliar peers at age 5, particularly for BI children who demonstrate heightened responsiveness to threatening cues (Perez-Edgar et al., 2011). Likewise, observed BI at age 2 is associated with mother-reported social withdrawal at age 5 (Buss, 2011). Moreover, children who display high levels of fear in low-threat novel contexts at age 2 engage in more observed socially reticent behavior with unfamiliar peers at age 5 (Buss et al., 2013). Early BI even predicts social withdrawal in adolescence, as inhibition in early childhood is positively associated with parent-reported social withdrawal at age 15 years among adolescents with high levels of attention bias to threat (Perez-Edgar et al., 2010).

However, some researchers have found that associations between BI and social behavior with peers may not be consistent across contexts or informants. For instance, Asendorpf (1990) found that parent-rated BI with unfamiliar peers and adults during the preschool years was associated with observed reticence in interactions with unfamiliar peers but was not related to reticence with familiar peers. Similarly, Gazelle and Faldowski (2014) showed that parent-rated social inhibition with familiar and unfamiliar peers when children were 25 months old positively predicted observed social reticence with familiar peers when children were 30 months old, but teacher-reported social inhibition with familiar and unfamiliar peers did not predict reticence in interaction with familiar peers. These conflicting findings about associations between BI and later social outcomes suggest that BI children may experience different developmental pathways in different contexts and conditions. It is essential to identify characteristics that promote the more positive social and emotional trajectories for BI children in order to inform efforts to prevent maladjustment for children high in BI.

Behaviorally-Manifested Emotion Regulation and Social Reticence

One potential factor that may buffer BI children against later social difficulties is emotion regulation (ER), given that the ability to regulate affect has been linked to positive developmental outcomes. Eisenberg and Spinrad (2004) defined ER as “the process of initiating, avoiding, inhibiting, maintaining, or modulating the occurrence, form, intensity, or duration of internal feeling states, emotion-related physiological, attentional processes, motivational states, and/or the behavioral concomitants of emotion” (p. 338). Thus, the construct of ER encompasses a broad array of abilities including the control of the intensity of internal emotional states, refraining from engaging in desired but forbidden behaviors, and restricting outward behavioral expressions of emotion. The present study focused specifically on two forms of *behaviorally-manifested ER*, which refers to children’s observable ability to manage their emotional responses across a variety of contexts. Eisenberg, Fabes, Guthrie, and Reiser (2000) have posited that ER skills may be engaged at different stages of the emotional response, with some ER processes modulating the initial experience and expression of emotion and other regulatory processes controlling subsequent responses to emotional reactivity. Both of these aspects of ER may be evident to observers, with the former emerging in the frequency and strength of children’s emotional responses to fear-inducing social stimuli (e.g., an unfamiliar peer) and the latter appearing in children’s

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ability to modulate strong emotional reactions when they occur. Therefore, behaviorally-manifested ER encompasses behaviors reflecting children's tendency to minimize initial emotional expressions, as well as behaviors reflecting their capacity to manage and recover from strong emotional reactions. These two aspects of behaviorally-manifested ER parallel the temperamental constructs of (low) negative emotionality and soothability, respectively (Rothbart & Sheese, 2007).

Emotion regulation (ER) promotes socially competent behavior with peers. For example, Denham and colleagues (2003) found that observed and mother-reported ER during the preschool years positively predicted teacher- and peer-reported social competence in kindergarten. Miller, Gouley, Seifer, Dickstein, and Shields (2004) observed children's regulation of emotions in the classroom setting and found that effective ER was associated with teacher-reported social competence and fewer observed conflicts with peers. Penela, Walker, Degnan, Fox, and Henderson (2015) showed that the use of competent ER strategies at age 5 was positively associated with greater social competence during unfamiliar peer interaction several years later, and that ER mediated associations between BI in toddlerhood and social competence in middle childhood among highly inhibited children. And Izard and colleagues (2008) tested the efficacy of an intervention designed to increase ER among Head Start preschool students and found that the intervention resulted in increased teacher-rated social competence. Thus, the ability to regulate emotional responses appears to be a critical factor that supports children's positive social interactions, and it may be a modifiable ability that could be targeted for intervention.

Emotion regulation (ER) may play a particularly important role in preventing social reticence and withdrawal because it helps children manage strong emotions during social interactions. Accordingly, several researchers have suggested that ineffective ER may contribute to the development of social reticence and withdrawal. For example, Rubin, Coplan, Fox, and Calkins (1995) found that preschoolers who engaged in few social interactions with unfamiliar peers also displayed more reticent behavior and had more internalizing problems than socially typical children, but only if they also had poor mother-reported ER; relatively well-regulated but asocial preschoolers did not demonstrate elevated reticence or internalizing problems. Similarly, teacher-reported ER has been negatively associated with preschoolers' socially reticent behavior with familiar peers (Cohen & Mendez, 2009). Domitrovich, Cortes, and Greenberg (2007) showed that Head Start preschoolers who had completed an intervention designed in part to improve children's self-regulation abilities were rated by teachers as less socially withdrawn than their counterparts in a waitlist control group. These studies suggest that the ability to regulate emotions is associated with a decreased likelihood of withdrawing from peer interactions.

Despite the established links between ER and children's adaptive interactions with peers, researchers have yet to fully examine behaviorally-manifested ER as a moderator of relations between BI and later social reticence. The capacity to regulate emotion may enable BI children to display positive social behavior and interact appropriately with peers even while experiencing social fear. As a result, BI but well-regulated children may not engage frequently in socially reticent behavior despite their fearful temperament, whereas those who

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lack the capacity to appropriately regulate their negative emotions may tend to withdraw from unfamiliar peers.

Physiological Regulation and Social Reticence

Like behaviorally-manifested ER, *physiological regulation* has been linked to children's socially competent behavior. Physiological regulation is often assessed using such indices as respiratory sinus arrhythmia (RSA), which is an index of parasympathetic regulation via the inhibitory influence of the vagus nerve on heart rate (Porges, 2007). Baseline RSA has been conceptualized as a relatively stable measure of individual differences in the capacity to maintain homeostasis and regulate physiological responses to emotions, with high baseline RSA reflecting flexible and effective regulation. High RSA is robustly associated with the ability to regulate behavior during social interaction and with lower levels of distress and anxiety in response to stressors, as it allows individuals to respond flexibly to different situational demands and emotional experiences (see Porges, 2007, for a review).

Accordingly, among preschool children, high baseline RSA is positively associated with teacher-reported social competence with peers (Blair & Peters, 2003). Socially wary children display less social competence with peers if they have low baseline RSA combined with other risk factors such as overprotective parenting (Hastings, Kahle, & Nuselovici, 2014).Furthermore, preschool children who display reticent behavior and withdraw from social interaction with unfamiliar peers have lower baseline RSA than children who primarily engage in solitary constructive or social play (Henderson, Marshall, Fox, & Rubin, 2004), and mother-reported social fearfulness and observed wariness in novel social situations are negatively associated with baseline RSA in toddlers (Hastings, Rubin, & DeRose, 2005). The subconscious capacity to regulate physiological responses to emotion may enable BI children to experience less intense distress in response to novel social stimuli, as high RSA has been linked to lower levels of negative emotions in stressful situations (Porges, 2007). Consequently, BI children with high baseline RSA may be able to interact competently with peers, whereas those with low baseline RSA may become so distressed that they withdraw from novel social interactions.

The Current Study

Previous studies suggest consistent links between adult-reported and physiologically assessed ER and socially competent interactions with peers. However, researchers have not yet examined whether both of these forms of ER moderate the relation between early BI and later social reticence with unfamiliar peers. It is important to investigate behaviorally-manifested and physiological regulation simultaneously because both capacities have been independently linked to positive social behavior, and examining them together enables us to distinguish whether both forms of regulatory capacities may be required to protect children against later reticence or whether behaviorally-manifested or physiological regulation alone is sufficient. In addition, it is important to examine whether different behaviorally-manifested ER abilities have different moderating effects on the link between BI and social reticence. Therefore, the goal of the present study was to investigate whether mother-reported negative emotionality and soothability, as well as physiologically assessed ER,

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moderate the association between BI at age 2 years and socially reticent behavior with unfamiliar peers at age 4 years. We hypothesized that toddler BI would positively predict social reticence with unfamiliar peers at age 4 years, but that this relation would be moderated by both behaviorally-manifested ER and baseline RSA. We expected that either low negative emotionality, high soothability, or high baseline RSA would be sufficient to protect against social reticence, such that BI would not predict social reticence among unfamiliar peers at adaptive levels of either form of behaviorally-manifested ER (low negative emotionality or high soothability) or high baseline RSA, and would only predict social reticence at less optimal levels of behaviorally-manifested ER (high negative emotionality or low soothability) and low baseline RSA.

Method

Participants

Participants in this longitudinal study included 88 children (46 males, 42 females) and their mothers who participated in laboratory visits when children were 2 and 4 years old. One hundred and eight families were originally recruited when children were 2 years old, and 88 of those families chose to continue participating in the study two years later. Families who participated at Time 2 did not differ from those who stopped participating on toddler-assessed BI, $t(105) = 0.93$ $p = .36$ or on demographic variables such as child gender, $\chi^2(1) = 0.98$ $p = .32$, or maternal education, $\chi^2(5) = 5.68$ $p = .34$.

The 88 children who comprised the final sample were an average of 25.10 months old ($SD = 1.21$) at Time 1 and 49.83 months old ($SD = 1.25$) at Time 2. Mothers were 31.14 years old ($SD = 4.11$) on average at Time 1. All mothers identified as Caucasian at Time 2, except two mothers who did not report their ethnicity. At Time 2, 1% of mothers reported having completed less than a high school education, 25% of mothers had completed high school, 8% had completed some college education, 61% had completed a university degree, and 5% had earned a graduate degree. Ethics approval for this study was provided by the institutional review board at the University of Waterloo Ontario, and all mothers provided informed consent to participate.

Procedure at Age 2 Years

Participants were initially identified from birth announcements in a local newspaper and contacted via telephone solicitation in a suburban region of Southern Ontario, Canada. Seventy-five percent of eligible families who were contacted agreed to participate. Participating mothers and children first visited the laboratory when children were 2 years old. During this visit, the families completed an adapted version of the Behavioral Inhibition Paradigm (Garcia Koll, Kagan, & Reznick, 1984). Children were first invited to play with an assortment of toys in an unfamiliar room while their mother filled out a questionnaire. After 10 minutes, a familiar female experimenter entered and asked the child to clean up the toys. The experimenter left the room while the child cleaned up, then returned and removed the basket of toys. An unfamiliar female experimenter then entered the room with a dump truck and some blocks. After sitting quietly for one minute, she played with the truck for one minute and then invited the child to play with her if they hadn’t already approached. After

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one more minute, the experimenter left the room and returned with a robot that made noise, moved around, and emitted smoke. The experimenter watched silently for 30 seconds, then invited the child to play with the robot for one minute. Then, she left the room and returned with an inflatable tunnel and encouraged the child to crawl through it. After the experimenter left the room again, another female experimenter entered the room dressed as a clown and stood silently for 30 seconds. The clown then invited the child to play with her for one minute before removing the clown disguise and revealing to the child that she was an experimenter the child had met previously. The mother and child then engaged in three minutes of free play before the mother left the room and a stranger entered and attempted to interact with the child for 3 minutes. Lastly, the mother returned and the mother and child engaged in free play for 6 minutes.

Procedure at Age 4 Years

When children were 4 years old, mothers and children visited the laboratory on two occasions. For the first session, four same-sex children and their mothers were invited to the laboratory at the same time so that the children could be observed interacting with one another. The quartets of children were created such that one of the children had displayed a high level of BI, two of the children had displayed an average level of BI, and one child had displayed a very low level of BI at age 2 years. The children were unfamiliar with one another prior to the laboratory interaction. The children first played freely, in the absence of their mothers, in a playroom with age-appropriate toys for 15 minutes. After completing a clean-up task, a show-and-tell speechmaking task, and a collaborative paper-sorting task, children again engaged in unstructured free play for 15 minutes.

During the second visit, mothers and children returned to the laboratory to complete assessments of children's baseline RSA. Child baseline RSA was assessed by attaching three disposable electrodes to the child's chest in a triangular pattern. Children sat next to their mothers and watched a blank screen for one minute in order to evaluate their baseline RSA. At the end of this visit, questionnaires were distributed for the mothers to complete.

Measures

Behavioral Inhibition at Age 2 Years.—Children's displays of BI were coded from videotapes during the visit at age 2 years. Coders rated the amount of time that toddlers spent in physical contact with their mother during the two free play periods and the truck, robot, and tunnel episodes, as well their latency to approach the stranger, truck, robot, and tunnel. The clown episode was not included in analyses because very few children approached the clown. Reliability was assessed for 10% of the sample, and the average inter-coder agreement was 89.8%. Children's scores for each episode were Z-transformed and aggregated to form a single continuous score for BI. BI scores ranged from −0.70 to 1.69.

Behaviorally-Manifested Emotion Regulation at Age 4 Years.—Mothers reported on children's ability to regulate emotions at age 4 years using the *Colorado Child Temperament Inventory* (Buss & Plomin, 1984), a 30-item questionnaire designed to capture children's temperament traits. The *negative emotionality* subscale consisted of five items describing children's tendency to display negative affect. While BI describes a specific

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tendency to display fearful reactions to novel stimuli, negative emotionality captures a broader tendency to display negative emotional reactions such as fear, anger, or sadness under a variety of circumstances. This subscale includes some items that primarily tap children's emotional reactivity, such as "child tends to be somewhat emotional." The scale also contains several items that imply both a tendency to react strongly to stimuli and an inability to regulate negative emotional reactions. For instance, the items "child often fusses and cries" and "child reacts intensely when upset" suggest a high level of reactivity to negative events, but they also suggest an inability to regulate responses to minor stressors. A child who often becomes upset or reacts very intensely to everyday situations likely lacks a strong ability to modulate emotional responses to minor negative experiences. Therefore, low negative emotionality captures the ability to regulate initial responses to stressful events, while high negative emotionality suggests some difficulty in regulating the initial response to negative experiences. The *soothability* subscale consisted of five items describing children's ability to recover from intense negative emotional experiences, such as "when upset by an unexpected situation, child quickly calms down" and "if talked to, child stops crying." Thus, the soothability subscale measures children's ability to regulate emotions and calm down after a strong emotional reaction to a stressor has occurred. The negative emotionality and soothability subscales each measure a distinct aspect of ER: negative emotionality captures children's ability to regulate initial responses to stressful events, while soothability captures their ability to regulate their emotional displays once a strong emotional reaction has already occurred. Cronbach's alpha for the negative emotionality scale was 0.63 and alpha for the soothability scale was 0.64. Negative emotionality scores ranged from 1.40 to 4.40 and soothability scores ranged from 1.40 to 4.60. Negative emotionality and soothability were significantly negatively intercorrelated, but neither construct correlated significantly with baseline RSA.

Baseline RSA at Age 4 Years.—Preschoolers' heart rate was measured during the second visit at age 4 years using a UFI iso/Fetode signal amplifier connected to a Delta-Biometrics Vagal Tone Monitor-II. The Vagal Tone Monitor captured heart period by locating the peak of the R-wave to the nearest millisecond and recording the time between each R-wave to the nearest millisecond. This heart period data was processed using Mxedit software (Delta-Biometrics, 1989), which displays heart period data visually to allow manual editing of outliers created by movement artifacts. The software also quantifies RSA using Porges' (1985) algorithm, a moving polynomial algorithm with age-specific frequency bandpass parameters, and reports RSA in units of ln $(ms)^2$. The frequency band used to calculate RSA ranged from 0.24 to 1.04 Hz. The mean of the RSA measure for successive 20-second intervals was used as an index of baseline RSA. Baseline RSA scores ranged from 3.11 to 9.14.

Social Reticence with Unfamiliar Peers at Age 4 Years.—Preschoolers' interactions with unfamiliar peers during both free play sessions of the first visit at age 4 years were coded using the *Play Observation Scale* (Rubin, 2001). Coders watched videotapes of the sessions and recorded children's predominant play behavior every 10 seconds, noting whether children were unoccupied, onlooking, or engaged in solitary, parallel, or group play. Social reticence was defined as the proportion of 10-second intervals during which children

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primarily displayed *unoccupied behavior*, not engaging in play or staring into space or wandering aimlessly, or *onlooking behavior*, during which children observed other children without attempting to initiate interaction. The proportion of 10-second intervals in which children displayed these reticent behaviors was calculated for each free play session and then averaged to create a single score for social reticence. Reliability was calculated for 12 randomly selected children, and the kappa coefficient was .74. Interrater disagreements were resolved through review and discussion. Social reticence scores ranged from 0.01 to 0.99.

Results

Correlations and Descriptive Statistics

Correlations and descriptive statistics are presented in Table 1. Negative emotionality and soothability were significantly and negatively correlated with one another. None of the other variables were significantly intercorrelated, although there was a marginally significant positive association between BI and social reticence with unfamiliar peers. Notably, neither negative emotionality nor soothability was significantly correlated with baseline RSA, suggesting that these measures of behaviorally-manifested regulation were tapping aspects of ER distinct from physiological regulation.

Prediction of Social Reticence

Data were analyzed using structural equation models that were modeled using the *lavaan* package in the statistical software R (R Core Team, 2014; Rosseel, 2012). Full information maximum likelihood estimation was used to estimate the model because this method accounts for missing data by utilizing all available data for each participant to estimate variances and covariances between variables. Four participants were missing baseline RSA data: three families did not complete the second visit at age 4 years, and one child's data could not be used due to experimenter error. Fourteen participants were missing negative emotionality and soothability data because mothers did not return the completed questionnaires. Little's MCAR test showed no support for the hypothesis that data were not missing completely at random in the soothability model, χ^2 (10) = 1.40, $P > .99$. Likewise, Little's MCAR test showed no support for the hypothesis that data were not missing completely at random in the negative emotionality model, χ^2 (10) = 2.19, $p = .99$. Standard errors were estimated using robust Huber-White estimation, which ensures that standard errors are robust to non-normality or heteroscedasticity of the variables.

All variables were mean-centered and interaction terms were created before all predictors were entered into the structural equation models. One model examined BI, soothability, and baseline RSA and their interactions as predictors of later social reticence with unfamiliar peers, while the other model examined BI, negative emotionality, and baseline RSA and their interactions as predictors of later reticence. Because all covariances between predictors were freed and all paths from predictors to social reticence were estimated in both models, the models were just identified and exhibited perfect data-model fit. In the model including soothability, the predictors and interaction terms explained 16.3% of the variance in observed social reticence with unfamiliar peers. The predictors in the negative emotionality model explained 22.8% of the variance in social reticence with unfamiliar peers.

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Figure 1 shows a diagram of the soothability model including unstandardized path estimates. Soothability did not significantly predict social reticence with unfamiliar peers at age 4 years. However, there was a significant two-way interaction between BI and baseline RSA predicting social reticence. This interaction was probed with simple slopes tests at high (+1 SD) and low (−1 SD) levels of baseline RSA using the MPlus software (Muthén & Muthén, 1998-2012). At low levels of baseline RSA, the association between BI and social reticence with unfamiliar peers was significant and positive, $b = 0.15$, $z = 2.17$, $p = .03$. At high levels of baseline RSA, the association between BI and social reticence was nonsignificant, $b = -0.07$, $z = -1.45$, $p = .15$. Figure 2 depicts the strength of the association between BI and social reticence with unfamiliar peers at varying levels of baseline RSA.

Figure 3 shows the negative emotionality model with unstandardized path estimates. The previously described two-way interaction between BI and baseline RSA was significant, but this effect was subsumed within a significant three-way interaction between BI, negative emotionality, and baseline RSA. Simple slopes tests of the relation between BI and social reticence at high (+1 SD) and low (−1 SD) levels of negative emotionality and baseline RSA were conducted to probe this interaction using the MPlus software (Muthén & Muthén, 1998-2012). When negative emotionality was low and baseline RSA was high, the relation between BI and social reticence with unfamiliar peers was nonsignificant, $b = 0.08$, $z = 1.04$, $p = .30$. When both negative emotionality and baseline RSA were low, the relation was also nonsignificant, $b = -0.03$, $z = -0.35$, $p = .73$. Unexpectedly, when both negative emotionality and baseline RSA were high, BI was negatively associated with social reticence with unfamiliar peers, $b = -0.34$, $z = -2.03$, $p = .04$. However, when negative emotionality was high and baseline RSA was low, there was a significant, positive association between BI and later social reticence with unfamiliar peers, $b = 0.16$, $z = 2.27$, $p = .02$. Figure 4 displays the strength of the association between BI and social reticence with unfamiliar peers across varying levels of baseline RSA at low and high levels (± 1 SD) of negative emotionality.

The interaction was further probed using slope difference tests conducted using Dawson's (n.d.) tool for calculating slope difference tests for three-way interactions. Table 2 displays the results of the slope difference tests. The slope of the association between BI and social reticence differed significantly between those with high negative emotionality and high baseline vagal tone and those with high negative emotionality and low baseline vagal tone. No other simple slopes differed significantly from one another.

Discussion

Whereas previous research has demonstrated that behaviorally-manifested and physiological emotion regulation (ER) are related to socially competent peer interactions (e.g., Miller et al., 2004; Hastings et al., 2014), researchers have yet to thoroughly examine whether these ER competencies might disrupt associations between early temperamental vulnerabilities for social difficulties and later social reticence during interaction with unfamiliar peers. The results of the current study shed light on this question by demonstrating that ER capacities moderate the relation between BI in toddlerhood and social reticence among unfamiliar age-mates in early childhood. Low negative emotionality and high baseline RSA buffered BI children against later social reticence with unfamiliar peers, as a significant positive

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association between BI and social reticence only emerged when negative emotionality was high and baseline RSA was low. Thus, in accordance with our hypotheses, low negative emotionality and high physiological regulation each seem to protect BI young children against later withdrawal from social interaction with unfamiliar peers. High baseline RSA emerged as a robust protective factor that buffered BI children against displaying later social reticence with unfamiliar peers, particularly for children who were high in negative emotionality.

The negative emotionality model showed that BI did not significantly predict social reticence with unfamiliar peers when negative emotionality was low, although the simple slopes at low negative emotionality did not significantly differ from other simple slopes. This finding suggests that low negative emotionality buffered BI children against heightened social reticence with unfamiliar peers, which is consistent with previous literature suggesting that the ability to regulate emotional responses is associated with socially competent behavior with peers. For instance, Miller and colleagues (2004) showed that effective ER was associated with positive peer interactions and low levels of conflict, while Cohen and Mendez (2009) found that ER was related to less anxious and withdrawn behavior with peers. Extending these previous findings, the current study demonstrated that the ability to regulate initial responses to emotion-evoking stimuli moderates associations between a temperamental predisposition for fearfulness and later withdrawal from interactions with unfamiliar peers, facilitating more appropriate social participation among BI children. The measure of negative emotionality in the present study captured children's ability to refrain from frequently or intensely becoming upset in response to stressful circumstances, and this ability to manage negative emotions without becoming extremely upset may enable BI children to engage in play or interact with peers even while experiencing fear of social novelty, as it prevents them from becoming so upset that they are unable to engage. Thus, the capacity to modulate initial emotional responses may help fearful, BI children overcome their social anxiety with unfamiliar peers.

Notably, soothability did not moderate associations between BI and later social reticence with unfamiliar peers. Therefore, it seems that the ability to recover from a strong negative emotional response does not buffer BI children against withdrawal from interactions with unfamiliar peers. Perhaps this lack of a protective effect for soothability stems from the fact that novel social interactions may present a consistent stream of stressful cues for a BI child. For instance, unexpected social initiations from unfamiliar children, unpredictable responses to the social bids they make to peers, and rapidly changing peer group dynamics may all continually provoke anxiety for children high in BI. As a result, children may not have an opportunity to recover from one stressful cue before encountering another, rendering their ability to calm down after strong emotional responses less useful in this context and leading them to withdraw from social interaction with unfamiliar peers.

Similar to negative emotionality, physiological regulation indexed by baseline cardiac RSA protected BI children against elevated social reticence, as there was no positive association between BI and later reticence among children with high baseline RSA. This finding accords with previous studies suggesting that high baseline RSA is associated with greater social competence and less social withdrawal (e.g., Blair & Peters, 2003; Hastings et al., 2014).

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This buffering effect may arise because individuals with high baseline RSA tend to experience less distress and negative emotion in stressful situations (Porges, 2007). Therefore, while BI children may perceive novel social situations as threatening and fear-inducing, those with high baseline RSA may experience less emotional distress in response to that appraisal and manage to engage in appropriate social behavior as a result. Porges (1995) argued that RSA may promote individuals' ability to flexibly respond to changing environmental cues and situational demands. Therefore, high baseline RSA may support BI children's ability to flexibly direct their attention to relevant features of the social context rather than becoming excessively focused on potentially threatening cues. This ability to focus attention away from potentially fear-inducing stimuli may prevent BI children from becoming extremely distressed and help them to avoid displaying heightened social reticence in the presence of unfamiliar peers.

Surprisingly, a negative association between BI and social reticence with unfamiliar peers emerged among children who exhibited high baseline RSA and high negative emotionality. It is possible that this reversal of the typical positive relation between inhibition and social reticence arose because dysregulated children high in negative emotionality struggle in novel social situations regardless of their inhibition level, but BI children are better able to capitalize on the benefits of high baseline RSA than their less inhibited counterparts. Eisenberg and colleagues (2003) have proposed that the ability to regulate emotional responses may facilitate effective social interaction for a variety of reasons, including greater ability to adapt to changing situational demands, better ability to solve social problems constructively, and more adaptive coping with negative emotions. Children with high negative emotionality who differ on their level of BI may struggle to navigate different aspects of social interaction, as Wachs (2006) has argued that children with different temperamental traits may attend to different environmental features, react differently to environmental stressors, and engage different coping strategies for addressing challenges. Thus, perhaps the fear and wariness in social contexts that characterize BI pose problems for dysregulated, BI children, whereas dysregulated, highly emotional but less inhibited children struggle primarily with poor social problem-solving or externalizing behaviors. As a result, high baseline RSA may help BI children cope with their anxiety by reducing the intensity of the experienced distress, enabling them to avoid displays of socially reticent behavior with unfamiliar peers. On the other hand, the reduction in emotion intensity conferred by high baseline RSA may not help uninhibited children cope with issues such as aggression or impulsivity, which may lead to negative peer experiences and their eventual withdrawal from unfamiliar peer interactions.

The temperament trait of exuberance, characterized by high levels of approach behavior and positive affect in response to novelty, may in part reflect very low levels of BI (Gunnar, Sebanc, Tout, Donzella, & Van Dulmen, 2003). Several researchers have linked exuberance to externalizing problems and eventual social and emotional difficulties. For instance, Morales, Pérez-Edgar, and Buss (2016) showed that toddler exuberance was positively associated with externalizing problems in kindergarten. Similarly, Stifter, Putnam, and Jahromi (2008) found that children who displayed high levels of exuberance as toddlers were rated as having higher levels of externalizing difficulties than low reactive or inhibited children. These externalizing problems may place exuberant children at risk of peer

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rejection, as Gunnar and colleagues (2003) showed that preschoolers high in surgency who lacked strong effortful control tended to be highly aggressive with peers, and highly aggressive children were often rejected by peers. Gunnar and colleagues (2003) further demonstrated an indirect association between poorly-regulated surgency and heightened stress in peer contexts, as highly surgent children low in effortful control who were highly aggressive and rejected by peers had high levels of cortisol, a hormone associated with stress. Baseline RSA may also play a role in associations between exuberance and externalizing problems, as Morales, Beekman, Blandon, Stifter, and Buss (2015) found that exuberance in toddlerhood positively predicted externalizing problems in kindergarten, but this association was moderated by gender and baseline RSA in toddlerhood such that the association was only significant for girls at high levels of baseline RSA. Taken together, these findings suggest that extremely uninhibited children are at risk for developing externalizing problems, particularly if they have high baseline RSA and poor ER skills. These externalizing behaviors may lead to peer rejection and victimization (that is, they may become "provocative victims," Salmivalli & Peets, 2018), which in turn may provoke stress and anxiety during peer interactions that motivate children to engage in reticent behavior with unfamiliar peers. Therefore, BI may be negatively related to social reticence with unfamiliar peers at high baseline RSA and high negative emotionality because children with this combination of ER capacities may develop externalizing problems and poor peer relationships (e.g., victimization).

Conclusions

Emotion regulation (ER) is a multifaceted construct that encompasses a wide array of capacities, including physiological processes that support emotion perception and modulation, cognitive processes for appraising situations and directing attention, dispositional processes for activating and suppressing emotional responses, and behavioral processes for expressing emotions and overriding emotional impulses (Eisenberg & Spinrad, 2004). While these disparate aspects of ER are often studied separately, the present study demonstrated that different regulatory capacities dynamically interact in the prediction of children's asocial behavior. For instance, the association between BI and later reticence with unfamiliar peers was positive at high levels of negative emotionality and low levels of physiological regulation, but this association was reversed at high levels of negative emotionality and high levels of physiological regulation. Because ER involves such a complex, multilevel system, it is essential to examine how distinct components of the ER system may operate in concert or in opposition to influence children's social outcomes.

The present study highlights the multidimensional nature of ER processes by demonstrating that behaviorally-manifested and physiological regulation were distinct from one another and that some aspects of behaviorally-manifested regulation operated in concert with baseline RSA to predict social reticence with unfamiliar peers while others did not. Specifically, the combination of baseline RSA and negative emotionality predicted distinct patterns of association between BI and later social reticence with unfamiliar peers, while soothability did not play a significant role in the prediction of reticence. Negative emotionality and baseline RSA may work together in predicting social reticence because both of these ER capacities seem to operate in the early stages of processing an emotional

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response to prevent the experience or display of extreme distress. Both of these capacities may support children's ability to flexibly manage their attention and behavior to respond to situational demands without fixating on stressful cues and becoming excessively vigilant and fearful. In contrast, soothability is related to modulating the emotional response after a strong emotional reaction has already occurred, suggesting that it comes into play later in the process than baseline RSA and may not be as helpful in contexts that present a constant stream of potential stressors. These findings imply that theory and future research on ER should take into account how particular dimensions of ER processes may influence other aspects of ER, particularly if the relevant regulatory processes are believed to operate at a similar point in the ER process and impact similar cognitive and behavioral processes.

Encouragingly, the results of the present study suggest that BI in early childhood only places children at heightened risk of later social maladjustment if they remain both physiologically dysregulated and unable to regulate initial responses to negative emotion, as BI only positively predicted later social reticence with unfamiliar peers when baseline RSA was low and negative emotionality was high. This finding implies that one promising intervention strategy for preventing social reticence, social withdrawal, and their accompanying negative social and emotional consequences would involve promoting BI children's ability to regulate emotion effectively (e.g., Chronis-Tuscano, Rubin, et al., 2015). Given that both low negative emotionality and physiological regulation buffer BI children against later reticence and withdrawal, improving children's ability to regulate initial emotional responses may serve as a particularly efficient target for intervention, as previous intervention studies have successfully improved children's ability to manage negative emotional experiences (e.g., Domitrovich et al., 2007), while the potential for altering underlying physiological processes is less clear. However, the fact that soothability did not have a protective effect against later social reticence with unfamiliar peers suggests that such interventions should specifically target children's ability to regulate initial emotional responses in order to prevent them from becoming extremely upset in social situations, rather than focusing on teaching children to calm down after they have become upset. Overall, the results of the present study suggest that the temperament trait of BI only places children at heightened risk of later social difficulties if they fail to develop multiple forms of ER, and that, therefore, BI children may experience several distinct pathways to resilience.

Limitations and Future Directions

The present study had several methodological strengths, particularly the longitudinal design and the use of observational measures to assess BI and social reticence with unfamiliar peers. However, the study had several limitations. The sample was relatively small and homogeneous in terms of ethnicity and socioeconomic status; future studies would do well to evaluate whether similar associations emerge in larger, more demographically diverse samples. In addition, the present study examined only baseline RSA. Vagal withdrawal, or the change in RSA in response to stressful stimuli, has also been identified as an important indicator of the capacity to regulate emotion in response to challenge (Porges, 2007). Thus, researchers should examine whether vagal responses to stress function differently from baseline RSA in terms of their associations with BI and social reticence. Furthermore, it was not possible in the current study to distinguish how the development of behaviorally-

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manifested and physiological regulation may be related to one another over time or to examine potential bidirectional relations between regulation and social behavior. Researchers should measure these constructs at several time points to examine how behaviorally-manifested ER, physiological regulation, and social behavior may influence one another over time. These future studies should examine associations between BI, ER, and social behaviors such as solitary and social play in addition to social reticence in order to understand what kinds of play behavior are displayed by children with different levels of BI, behaviorally-manifested ER, and physiological regulation. Researchers should also investigate whether negative emotionality and physiological regulation capacities moderate associations between BI and social and emotional outcomes in *familiar* peer settings, such as forming high-quality friendships, achieving peer acceptance, and avoiding the experience of being bullied. Significantly, very few investigators of infant and toddler BI have attempted to predict children's social outcomes among *familiar* peers (citation blinded for purposes of review). Finally, researchers should design interventions for BI children focused on improving children's ability to manage initial responses to emotion and test whether such interventions result in greater social competence and lower levels of social reticence and withdrawal.

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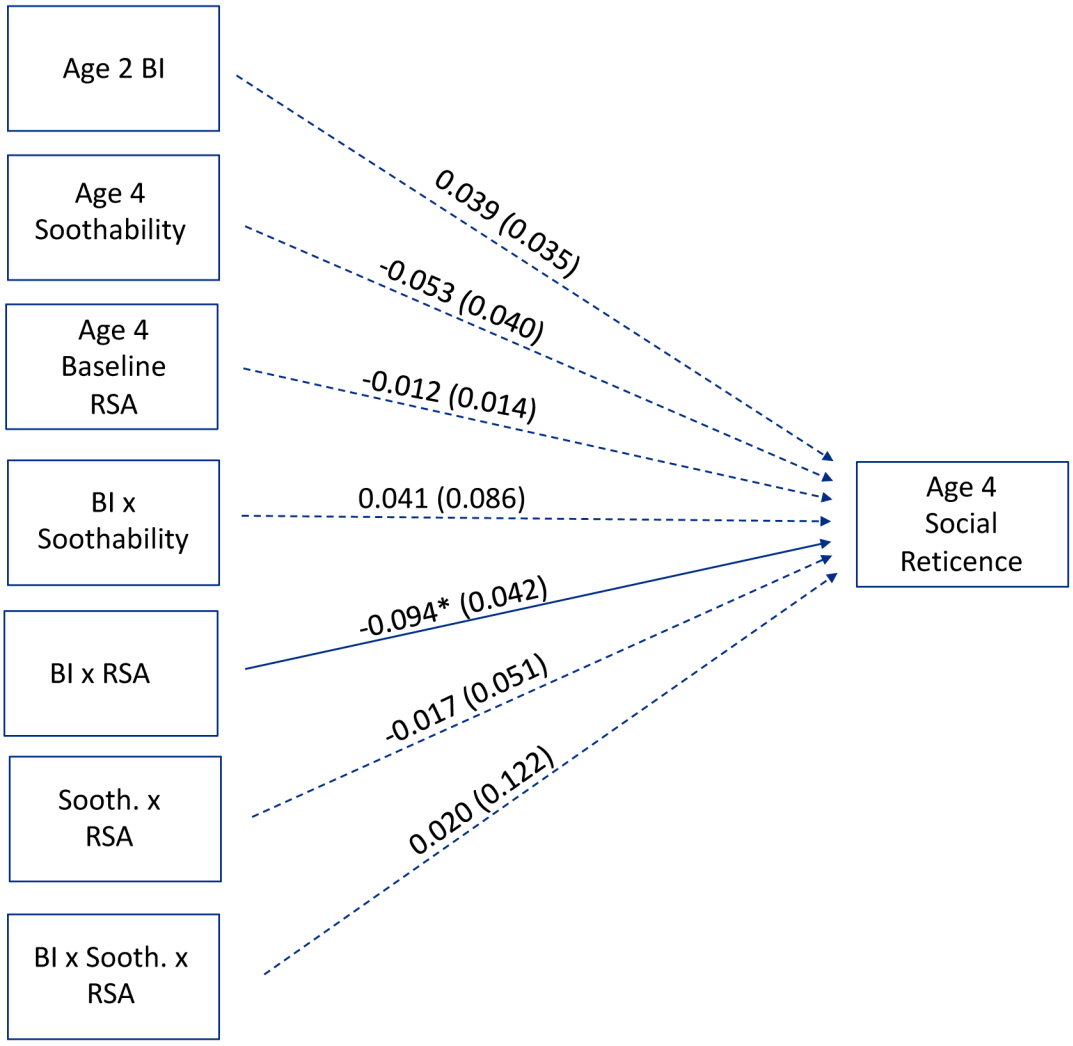

Fig. 1.

Depiction of the structural equation model for soothability with unstandardized path coefficients. Standard errors are displayed in parentheses

Note. *$p < .05$.

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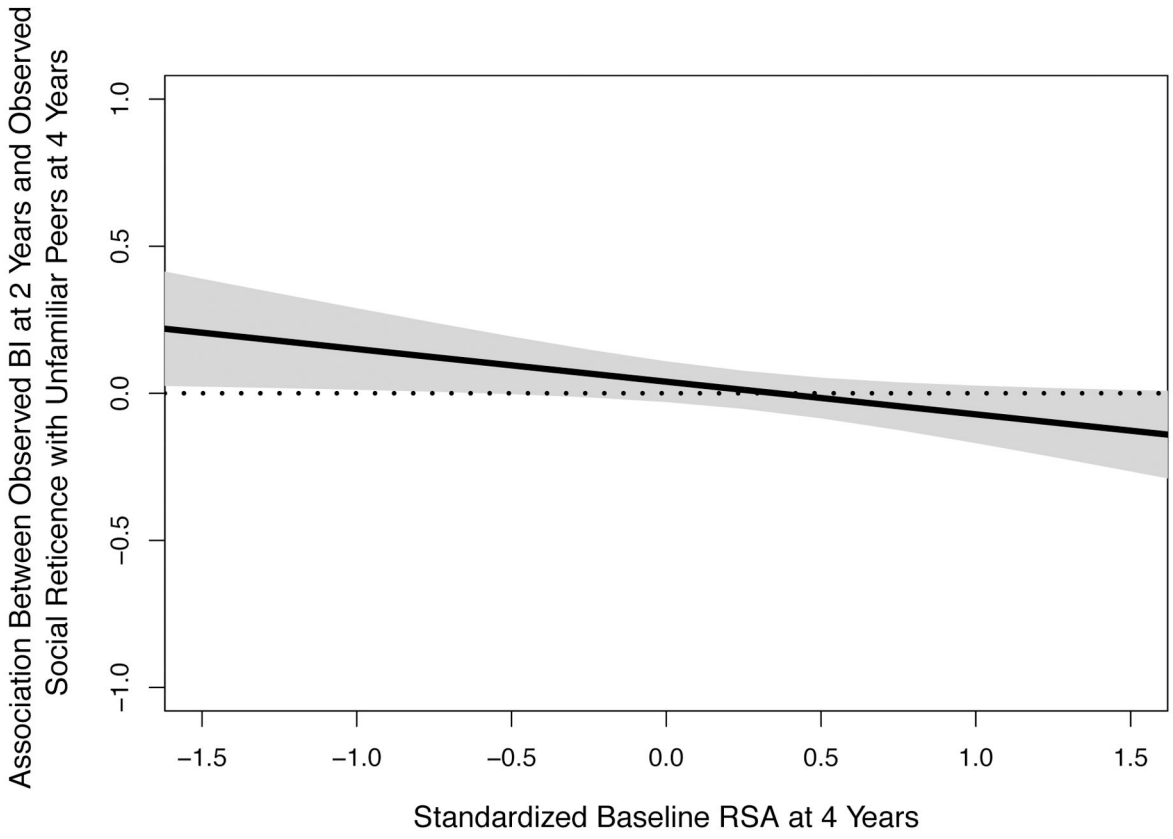

Fig. 2.

Graphical depiction of the two-way interaction between BI and baseline RSA in the soothability model. The solid line shows the estimate of the simple slope of behavioral inhibition predicting social reticence, and the shaded region shows the 95% confidence interval for the slope. The slope is significantly different from zero when the shaded region does not include zero (shown by the dotted line at y=0)

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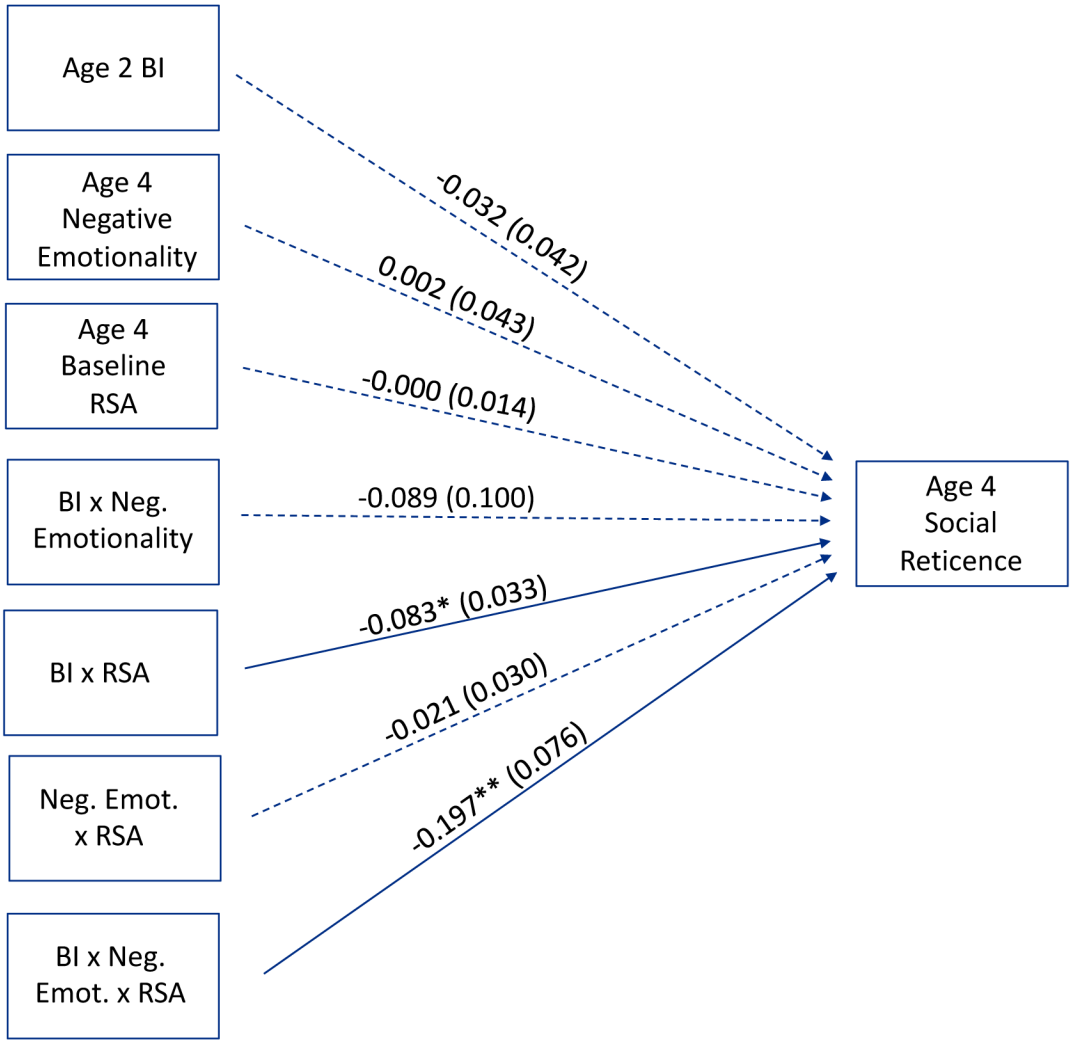

Fig. 3.

Depiction of the structural equation model for negative emotionality with unstandardized path coefficients. Standard errors are displayed in parentheses

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

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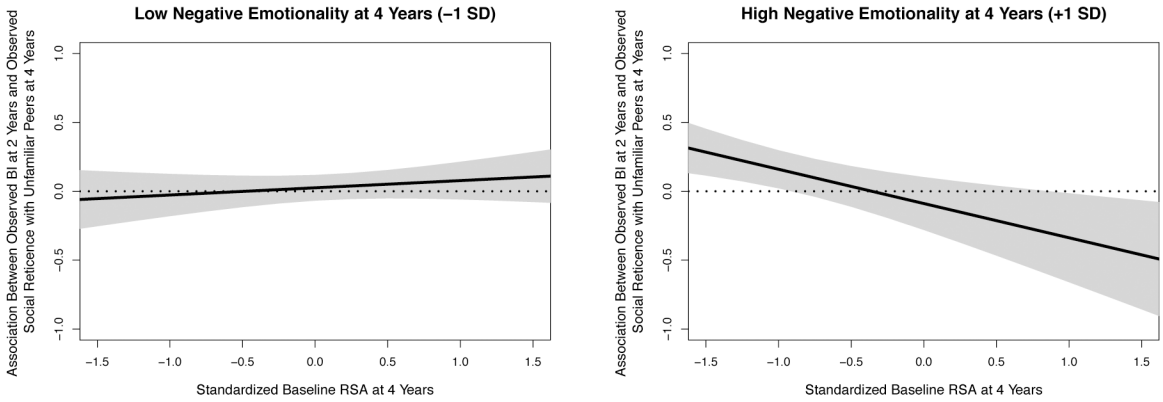

Fig. 4.

Graphical depiction of the three-way interaction between BI, negative emotionality, and baseline RSA. The left graph shows the interaction at low levels of negative emotionality at age 4 years (−1 SD), and the right graph shows the interaction at high levels of negative emotionality at age 4 years (+1 SD). The solid line shows the estimate of the simple slope of behavioral inhibition predicting social reticence, and the shaded region shows the 95% confidence interval for the slope. The slope is significantly different from zero when the shaded region does not include zero (shown by the dotted line at y=0)

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Table 1.

Correlations and Descriptive Statistics

	1	2	3	4	5
1. Observed Behavioral Inhibition at 2 Years	1				
2. Mother-reported Negative Emotionality at 4 Years	.16 *N* = 74	1			
3. Mother-reported Soothability at 4 Years	−.08 *N* = 74	−.35** *N* = 74	1		
4. Observed Baseline RSA at 2 Years	−.03 *N* = 84	−.04 *N* = 73	.07 *N* = 73	1	
5. Observed Social Reticence with Unfamiliar Peers at 4 Years	.20† *N* = 88	.16 *N* = 74	−.16 *N* = 74	−.03 *N* = 84	1
Mean	−0.02	2.63	3.31	6.20	0.18
SD	0.58	0.64	0.56	1.18	0.20

Note.

† $p < .10$.

* $p < .05$.

** $p < .01$.

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Table 2.

Slope Difference *t*-Tests for the BI × Negative Emotionality × Baseline RSA Interaction

First Simple Slope	Second Simple Slope	*t* Value for the Slope Difference	*p* Value for the Slope Difference
High Negative Emotionality, High Baseline RSA	High Negative Emotionality, Low Baseline RSA	−3.09	< .01
High Negative Emotionality, High Baseline RSA	Low Negative Emotionality, High Baseline RSA	−1.89	.06
High Negative Emotionality, High Baseline RSA	Low Negative Emotionality, Low Baseline RSA	−1.71	.09
High Negative Emotionality, Low Baseline RSA	Low Negative Emotionality, High Baseline RSA	0.74	.46
High Negative Emotionality, Low Baseline RSA	Low Negative Emotionality, Low Baseline RSA	1.70	.09
Low Negative Emotionality, High Baseline RSA	Low Negative Emotionality, Low Baseline RSA	0.92	.36