Impact of attention biases to threat and effortful control on individual variations in negative affect and social withdrawal in very young children

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Abstract

Early temperamental sensitivity may form the basis for the later development of socioemotional maladjustment. In particular, temperamental negative affect places children at risk for the development of anxiety. However, not all children who show negative affect go on to develop anxiety or extreme social withdrawal. Recent research indicates that reactive control, in the form of attention to threat, may serve as a bridge between early temperament and the development of later social difficulties. In addition, variation in effortful control may also modulate this trajectory. Children (mean age = 5.57 years) were assessed for attention bias to threatening and pleasant faces using a dot–probe paradigm. Attention bias to threatening (but not happy) faces moderated the direct positive relation between negative affect and social withdrawal. Children with threat biases showed a significant link between negative affect and social withdrawal, whereas children who avoided threat did not. In contrast, effortful control did not moderate the relation between negative affect and social withdrawal. Rather, there was a direct negative relation between effortful control and social withdrawal. The findings from this short report indicate that the relations among temperament, attention bias, and social withdrawal appears early in life and point to early emerging specificity in reactive and regulatory functioning.

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Introduction

Early temperamental sensitivity may lay the foundation for the later development of social anxiety (Biederman et al., 2001; Chronis-Tuscano et al., 2009; Rosenbaum et al., 1993; Rubin & Burgess, 2001), particularly for children who display negative affect. The antecedents of social anxiety are marked by high levels of social withdrawal prior to the emergence of the disorder (Rapee & Spence, 2004). However, not all children who show increased negative affect go on to develop anxiety or extreme social withdrawal (Degnan & Fox, 2007). Recent research indicates that attention may act as a developmental tether linking early temperamental risk to the later emergence of social difficulties (Pérez-Edgar, Taber-Thomas, Auday, & Morales, 2014; Pérez-Edgar et al., 2010). Attention to threat may reflect individual differences in reactive control (Rueda, 2012), which can take on a regulatory function (Todd, Cunningham, Anderson, & Thompson, 2012). In addition, strong effortful control skills may also impact this developmental link (Lonigan & Vasey, 2009). This study aimed to examine the association among early temperament (negative affect), attention bias to salient stimuli (reactive control), effortful control, and levels of social withdrawal in a normative sample of young children. These data provide insight into varied regulatory mechanisms involved in typically observed patterns of socioemotional functioning that may also subserve maladaptive patterns of anxious behavior (Fox & Pine, 2012).

Rothbart and Derryberry (1981) characterized temperament as a set of stable, biologically based individual differences in reactivity and regulation. In this model, emotional reactivity works in concert with regulation processes to provide the basis of observed behavior in children (Goldsmith et al., 1987). These two components of temperament, along with environmental factors and individualized experiences, shape the child’s personality (Rothbart, 2012). Much of the literature investigating the development of psychopathology has focused on negative reactivity—negative emotional and motoric responses produced when a person is exposed to novel environmental stimuli (Derryberry & Reed, 2002). These can include feelings of anger, distress, agitation, sadness, and fear and associated behaviors (Davidson, Putnam, & Larson, 2000; Rothbart, Ahadi, Hershey, & Fisher, 2001). Observed patterns of negative reactivity are supported by specific patterns of functioning in both the central nervous system and the limbic system, often marked by a hyperactive amygdala response (Pérez-Edgar et al., 2007; Thomas et al., 2001).

Although negative affect has been directly linked to the development of anxiety, this trait does not work alone to shape observed patterns of behavior. Rather, individual differences in initial reactivity are coupled with individual differences in regulatory skills, which can serve as variably effective or robust checks on reactivity. Regulation processes emerge relatively slowly over the course of childhood (Cole, Michel, & Teti, 1994). As children grow, they shift from using external sources to provide regulation of their emotions (e.g., parents, pacifiers) to employing internal regulatory mechanisms (e.g., attention shifting, thought suppression) to control their immediate emotional responses (Rueda, 2012).

Functionally, one can parse regulatory behavior into reactive and effortful control mechanisms. Reactive control is motivated by immediate incentives and is sufficiently spontaneous to not be considered deliberate (Martel & Nigg, 2006). This implicit evaluation then triggers relatively automatic or reflexive response strategies that can indicate approach or withdrawal behavior (Rueda, 2012). Todd et al. (2012) suggested that affect-biased attention can act as a reactive form of emotion regulation. This bias may be particularly acute for social (vs. nonsocial) threats (LoBue & Pérez-Edgar, 2014). Negatively reactive individuals are also slower to disengage their attention from these stimuli relative to less reactive individuals (Fox, Russo, Bowles, & Dutton, 2001). Negative affect, coupled with reactive threat bias, may place individuals at even greater risk for anxiety and social withdrawal (Pérez-Edgar & Fox, 2005; Pérez-Edgar et al., 2014).

Emerging data suggest that threat avoidance, marked by attention bias away from threat, is also associated with the development of anxiety (Shechner et al., 2012). Direction may reflect diagnostic boundaries; distress disorders have shown a significant bias toward threat, whereas children with fear disorders show an attention bias away from threat (Waters, Bradley, & Mogg, 2014). Patterns of
anxiety-linked vigilance and avoidance are also evident in the temperament literature, with 5-year-old children characterized for dysregulated fear as toddlers displaying attentional avoidance of emotion faces (Morales, Pérez-Edgar, & Buss, 2015). However, bias scores were still positively associated with anxiety. Consistent biases toward or away from threat may have distinct implications for adaptive functioning, resulting in heightened or diminished exposure to threat when processing social information, respectively.

Effortful control mechanisms, in contrast, bring to bear more deliberate or conscious processing, interpretation, and manipulation of these initial reactive tendencies (Rothbart & Bates, 2007) and may ameliorate the relation between negative affect and social withdrawal, as well as the relation between negative affect and attention bias. In particular, Lonigan, Vasey, Phillips, and Hazen (2004) suggested that when stimuli are consciously perceived (presentation times of $\geq 500$ ms), individuals can employ effortful control mechanisms to shift their attention away from anxiety-producing stimuli. Indeed, Lonigan and Vasey (2009) found that attention biases to threat were evident only in children who both were negatively reactive and had low levels of effortful control. Children who were negatively reactive but had high levels of effortful control did not show a bias to threatening stimuli. In turn, others have found that attention bias is associated with anxiety only in children with low levels of attentional control (Susa, Pitică, Benga, & Miclea, 2012). Thus, negative affect, reactive control, and effortful control reflect distinct (but linked) components of our response to environmental stimuli.

Few studies have concurrently examined the interaction among temperament (negative affect), attention bias to salient stimuli (reactive control), effortful control, and levels of social withdrawal within a young normative sample. This could provide insight into the role these factors play in shaping typically observed variations in behavior prior to, or independent of, the emergence of disorder. This refinement is important because reactive and regulatory mechanisms may differentially impact developmental trajectories (Mogg et al., 2015; Rueda, 2012).

To examine the impact of these factors on social withdrawal, children were asked to perform a dot-probe task incorporating threatening, happy, and neutral faces. Faces were used in order to capture social concerns in an ecologically valid manner (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). In general, studies have focused on patterns of attention bias to threat. Studies including happy or positive faces often do so in order to have a comparison condition. Among children, many studies have found that the relation between attention bias to happy and temperamental negative affect is fairly weak, with generally nonsignificant relations pointing both toward and away (Morales et al., 2015; Pérez-Edgar et al., 2011). However, others have found that attention bias away from happy increases risk for anxiety (White et al., in press) and training attention towards happy decreases risk (Britton et al., 2013; Waters, Pittaway, Mogg, Bradley, & Pine, 2013). Previous work has found stronger connections between attention bias to happy faces and temperamental exuberance (Frewen, Dozois, Joanisse, & Neufeld, 2008; Morales, Pérez-Edgar, & Buss, in press; Shechner et al., 2012). In the current study, separate bias scores were created for happy and threatening faces to probe for affective specificity.

Given our young sample and moderate sample size, we took a measured approach to the analyses, examining only core relations supported by the current literature. Based on past research indicating that negative affect is related to attention biases toward threat (Hadwin et al., 2003; Öhman, Flykt, & Esteves, 2001), we predicted that higher levels of negative affect would be associated with greater attention biases toward threatening (but not pleasant) stimuli. We hypothesized that attention bias to threatening faces would serve as a moderator between negative affect and social withdrawal, such that children higher in negative affect who display biases toward threatening faces would be more socially withdrawn (Pérez-Edgar et al., 2011). Previous work (Lonigan & Vasey, 2009; Susa et al., 2012) suggests that higher levels of effortful control can disrupt the relation between negative affect and social withdrawal as well as the link between negative affect and attention bias. However, we were cautious with respect to the impact of effortful control in the current study because the available data have focused on older children and effortful control processes may be fragile or unreliable in young children (Luna, Padmanabhan, & O’Hearn, 2010; Rueda, 2012).
Method

Participants

The sample consisted of 53 children (30 boys) ages 4 to 7 years (M = 5.57 years, SD = 0.64). Based on parental identification, 79.2% of participants were White non-Hispanic, 9.4% were Asian Pacific Islander, 7.5% were Hispanic, and 3.8% were African American. Participants were recruited from mailing lists provided by Experian Marketing Solutions (Schaumburg, IL, USA), and we requested contact information for households in designated zip codes with children in our age range of interest. Parents were monetarily compensated for their family’s participation in a larger study. Child participants received a small toy as a prize for their assistance in the study. The university institutional review board approved all procedures, and families consented to participate.

After excluding children with poor dot–probe performance (see below), 47 children were included in the analyses (27 boys; M_age = 5.57 years, SD = 0.65). The children who did not reach the accuracy criterion did not significantly differ from the included sample in age (p = .68) or on measures of negative affect, effortful control, and social withdrawal (ps > .45). They also did not differ in reaction times (RTs) across trials (ps > .35), suggesting that poor performance was not due to an underlying accuracy–speed trade-off.

Negative affect

To construct a robust measure of negative affect, we applied a multi-method approach integrating maternal report and laboratory observations of behavior. Parents completed the Child Behavior Questionnaire–Short Form (CBQ; Putnam & Rothbart, 2006), which consists of 94 questions scored on a 7-point Likert scale from 1 (extremely untrue) to 7 (extremely true). The questionnaire asked caregivers to decide whether each listed statement was like or unlike a behavior their children had displayed during the previous 6 months. A score was created to assess participants’ level of negative reactivity by combining the subscales of Discomfort, Sadness, Fear, Anger/Frustration, and Soothability (reverse scored) and then standardized (Cronbach’s α = .843).

As part of the larger study, participants also completed a disappointing toy task (Saarni, 1984). On arrival to the lab, children were asked to rank-order attractive and broken toys and were told that they would receive their highest ranked prize after completing the full lab visit. The children were then given the lowest ranked toy at the completion of the visit. Based on video-recording, positive, negative, and transitional behaviors were coded in 5-s intervals as 1/0 events (i.e., a 1 was given if the behavior occurred at any time within the window, and a 0 was given if the behavior did not occur) across the task. Interrater reliability showed good agreement (κ = .70).

Given the relation between the negative affect measures (r = .399, p = .003), scores from each were standardized and then averaged to create a negative affect score.

Effortful control

Based on the literature (Putnam & Rothbart, 2006), we assessed Effortful Control by combining the CBQ subscales of Inhibitory Control, Attention Focusing, Low Intensity Pleasure, and Perceptual Sensitivity (Cronbach’s α = .837).

Social withdrawal

The Child Behavior Checklist preschool version (CBCL; Achenbach & Rescorla, 2000) consists of 99 parental report questions scored on a 3-point Likert scale from 0 (not true) to 2 (very true/often true). The checklist asked parents to rate a list of behaviors in relation to their children’s actions during the previous 2 months. We focused on the Withdrawn subscale of the Syndrome Scale, which consisted of 8 items and included behaviors such as “withdrawn, doesn’t get involved with others,” “avoids looking others in the eye,” and “doesn’t answer when people talk to him/her.”
Participants completed a computer-based dot–probe task that consisted of 96 presentation trials split into two 48-trial blocks. At the beginning of each trial, participants were presented with a fixation cross for 500 ms and then presented with a pair of adult faces oriented in a side-by-side format. Face pairs consisted of a happy face paired with a neutral face, an angry face paired with a neutral face, or two neutral faces. Faces (50% male) were taken from the NimStim collection of stimuli (Tottenham et al., 2009). The face pairs were presented for 500 ms, after which a probe (white asterisk) appeared in one of the previous face locations. Participants were instructed to press a button as quickly as possible to indicate whether the probe location was on the right or left side of the computer screen.

Trials were characterized as congruent or incongruent. On congruent trials, the probe appeared in the location of the emotive face (either happy or angry). On incongruent trials, the probe appeared in the location of the neutral face. Trials with two neutral faces appearing simultaneously were used as control trials. Trial congruency was counterbalanced throughout the task. Raw behavioral data were cleaned to remove incorrect trials and outliers (±2 standard deviations from the children’s mean RTs). Children with less than 60% accuracy on the dot–probe task were removed from the full analyses (3 boys and 3 girls).

Attention bias scores were calculated by subtracting mean RTs on congruent trials from mean RTs on incongruent trials. Positive values indicated that the participants were directing their attention toward the emotional stimuli (vigilance), and negative values indicated that the participants were directing their attention away from the affective stimuli (avoidance). Attention bias scores were calculated for both angry-neutral and happy-neutral face pairs.

Results

Based on the work of Preacher, Rucker, and Hayes (2007), we assessed moderation and mediation patterns among negative affect, attention bias, effortful control, and social withdrawal. Data were analyzed using the SPSS (Version 22; Chicago, IL, USA) macro PROCESS with 5000 bootstrap samples (Hayes, 2012; Preacher et al., 2007) mean centering predictive variables before analysis. Table 1 and Fig. 1 present the zero-order correlations among the variables of interest.

As expected, negative affect was positively associated with social withdrawal \((p = .006)\) and at trend level with attention bias to threat \((p = .075)\). Attention bias to threat showed no other relations approaching significance. Effortful control, in turn, was significantly negatively associated with social withdrawal \((p = .022)\) and attention bias to happy faces \((p = .016)\).

The initial analysis (PROCESS Model 74) probed moderated mediation relations among negative affect, attention bias to threat, and social withdrawal (Table 2 and Fig. 2). As expected, there was a significant relation between negative affect and social withdrawal \((p = .005)\). Although the mediation relation was not supported, there was a negative affect by attention bias interaction \((p = .018)\), such that negative affect was associated with social withdrawal only at high levels of attention bias (see Fig. 3).

Modifying the model to examine the interaction between negative affect and effortful control on social withdrawal found no significant interaction effects \((p = .099); Table 3\). However, the data suggest that the relation between negative affect and social withdrawal is not evident at high levels of effortful control. The individual effects of effortful control \((p = .021)\) and negative affect \((p = .002)\) were significant. Again, there was no indication of mediation.

Given the initial findings, we then probed the impact of effortful control on the relations among negative affect, attention bias to threat, and social withdrawal (PROCESS Model 2; Table 4). As expected, social withdrawal was positively associated with negative affect \((p = .004)\) and negatively associated with effortful control \((p = .025)\). Whereas the negative affect by attention bias interaction was again significant \((p = .025)\), the negative affect by effortful control interaction was not \((p = .426)\).

1 The sample size precluded a direct examination of the omnibus three-way interaction. An additional analysis examining the interaction between attention bias and effortful control did not significantly predict social withdrawal \((p = .27)\).
Table 1
Correlations among negative affect, social withdrawal, attention bias to angry and happy faces, and effortful control.

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Negative affect</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Social withdrawal</td>
<td>.396**</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Attention bias to threat</td>
<td>.262*</td>
<td>.211</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Attention bias to happy</td>
<td>.181</td>
<td>.166</td>
<td>.157</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>5. Effortful control</td>
<td>-.054</td>
<td>– .332*</td>
<td>-.079</td>
<td>– .350*</td>
<td>–</td>
</tr>
</tbody>
</table>

* p < .10.
* p < .05.
** p < .01.

Fig. 1. Scatter plot matrix of negative affect, social withdrawal, effortful control, and attention bias to angry and happy faces.
To examine the specificity of affect, the first and third models were rerun using attention bias to happy faces as a predictor (Tables 2 and 4). There were no significant effects involving bias to happy faces ($p > .49$).

**Discussion**

Previous research has indicated that individuals with anxiety display altered patterns of attention bias (Fox, Russo, & Dutton, 2002; Hadwin et al., 2003; Rapee & Heimberg, 1997) that may play an important role in the development of anxiety by sustaining anxious traits from early childhood through adolescence (Fox & Pine, 2012; White, Helfinstein, Reeb-Sutherland, Degnan, & Fox, 2009).
Fig. 3. Conditional effect of negative affect on social withdrawal probed at −1 SD, mean, and +1 SD for attention bias to threat.

Table 3
Results for the model (PROCESS Model 74) examining potential moderated mediation relations among negative affect, social withdrawal, and effortful control.

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Predictor</th>
<th>Coefficient (SE)</th>
<th>t</th>
<th>LLCI, ULCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effortful control</td>
<td>Constant</td>
<td>0.00 (0.40)</td>
<td>0.00</td>
<td>−0.80, 0.80</td>
</tr>
<tr>
<td></td>
<td>Negative affect</td>
<td>−0.19 (0.52)</td>
<td>−0.36</td>
<td>−1.23, 0.86</td>
</tr>
<tr>
<td>F(1, 45) = 3.31, p = .719, R² = .003</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social withdrawal</td>
<td>Constant</td>
<td>2.00 (0.20)</td>
<td>9.91  **</td>
<td>1.89, 2.41</td>
</tr>
<tr>
<td></td>
<td>Negative affect</td>
<td>0.94 (0.28)</td>
<td>3.37  *</td>
<td>0.38, 1.50</td>
</tr>
<tr>
<td></td>
<td>Effortful control</td>
<td>−0.18 (0.08)</td>
<td>−2.39 *</td>
<td>−0.33, −0.03</td>
</tr>
<tr>
<td></td>
<td>NA × EC</td>
<td>−0.20 (0.12)</td>
<td>−1.69 *</td>
<td>−0.44, 0.04</td>
</tr>
<tr>
<td>F(3, 43) = 5.36, p = .001, R² = .30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. LLCI, ULCI, lower and upper limits of confidence interval; EC, effortful control; NA, negative affect.

* p < .10.
* p < .05.
** p < .01.
Attention patterns also underlie normative variations in socioemotional behavior (LoBue, 2013; Todd et al., 2012). The current study sought to build on previous research by examining the separate roles that reactive and effortful control mechanisms may play in shaping patterns of social behavior. Although negative affect was significantly associated with social withdrawal, this relation was moderated by attention bias to threat. Importantly, the positive relation between negative affect and attention bias to threat, although nonsignificant, was in line with the larger literature. Although some studies have indicated that individuals with greater levels of anxiety or anxious temperaments exhibit greater attention bias to threat (Hadwin et al., 2003; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002; Mogg, Bradley, & Williams, 1995; Pérez-Edgar et al., 2010 ), other studies have not (Hardee et al., 2013; Monk et al., 2006; Pérez-Edgar et al., 2011 ). The current nonsignificant trend between negative affect and attention bias to threat may reflect limited power due to sample size or to the fact that we examined a nonclinical sample. Alternately, this may reflect developmental differences in these core relations, as indicated by relatively weak associations with attention bias to threat in two independent studies of 5-year-olds at risk for depression (Kujawa et al., 2011 ) and anxiety (Pérez-Edgar et al., 2011 ) and a follow-up study with 7-year-olds at risk for anxiety (White et al., in press).

Consistent with previous findings (Morales et al., 2015; Pérez-Edgar et al., 2011; White et al., in press), attention bias to threat moderated the relation between negative affect and social withdrawal in that a significant link was evident only at increased levels of attention bias to threat. In contrast, effortful control did not interact with negative affect to impact social withdrawal. Effortful control begins to rapidly develop during childhood (Cole et al., 1994) and is linked to corresponding physiological developments in brain structures related to the regulation of emotion and behavior (Rothbart & Bates, 2007; Rothbart & Posner, 2006). Because effortful control mechanisms emerge over the course of childhood, it is possible that our young sample was too immature to display effective or stable use of effortful control processes to regulate responses to emotional stimuli. Although Lonigan and Vasey (2009; see also Lonigan et al., 2004) and Susa et al. (2012) have found evidence that effortful control mechanisms moderate the relations among negative reactivity, attention biases, and anxiety, these samples incorporated children considerably older (9–18 years) than the children in our sample.

Interestingly, the current data replicate recent findings (Morales et al., in press) indicating a negative association between effortful control and attention bias to happy faces in kindergarten-age children. The focus of Morales and colleagues’ (in press) study was on the impact of effortful control

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Predictor</th>
<th>Coefficient (SE)</th>
<th>t</th>
<th>LLCI, ULCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Social withdrawal</td>
<td>Constant</td>
<td>1.86 (0.21)</td>
<td>9.02**</td>
<td>1.44, 2.28</td>
</tr>
<tr>
<td></td>
<td>Negative affect</td>
<td>0.82 (0.27)</td>
<td>3.66**</td>
<td>0.28, 1.35</td>
</tr>
<tr>
<td></td>
<td>Effortful control</td>
<td>−0.17 (0.07)</td>
<td>−2.32</td>
<td>−0.32, −0.02</td>
</tr>
<tr>
<td></td>
<td>AB to angry</td>
<td>0.00 (0.00)</td>
<td>0.85</td>
<td>−0.01, 0.01</td>
</tr>
<tr>
<td></td>
<td>NA × EC</td>
<td>−0.10 (0.13)</td>
<td>−0.81</td>
<td>−0.36, 0.16</td>
</tr>
<tr>
<td></td>
<td>NA × AB angry</td>
<td>0.02 (0.01)</td>
<td>2.33*</td>
<td>0.00, 0.03</td>
</tr>
</tbody>
</table>

F(5, 41) = 4.78, p = .002, R² = .37

| (B) Social withdrawal | Constant | 1.98 (0.22) | 9.01** | 1.54, 2.43 |
| Effortful control | −0.18 (0.09) | −2.15 | −0.36, −0.01 |
| AB to happy | 0.00 (0.00) | −0.07 | −0.01, 0.01 |
| NA × EC | −0.21 (0.13) | −1.54 | −0.48, 0.07 |
| NA × AB happy | 0.00 (0.01) | 0.42 | −0.01, 0.01 |

F(5, 41) = 2.92, p = .024, R² = .26

Note. LLCI, ULCI, lower and upper limits of confidence interval; AB, attention bias; EC, effortful control; NA, negative affect.

* p < .05.

** p < .01.
and attention bias on the relation between temperamental exuberance and externalizing difficulties. Researchers suggested that this relation supports the conceptualization of exuberance as increased activity in the behavioral approach system (attention bias to happy) coupled with diminished activity from the behavioral inhibition system (low effortful control). Our sample was not characterized in such a way that we could test these relations. However, Morales and colleagues’ study does suggest that our sample (assessed with the same parental report measures and behavioral task) is capturing a fairly robust relation during early childhood. It may be that the functional significance of the relation between effortful control and attention bias on outcome is dependent on individual differences in risk profile.

As a whole, the pattern of results from these analyses suggests that the relations among temperament, attention bias, and social behaviors emerge during early childhood. Our data suggest that individual differences in attention bias are linked to patterns of socioemotional functioning in children as young as 5 years. Further work will need to incorporate early childhood time-points in longitudinal studies in order to capture these relations. Developmental models (Field & Lester, 2010) suggest that the relations among temperament, attention, and social behavior should be evident across the lifespan (integral bias model) based on the presence of predisposing traits (e.g., negative affect) or the relation emerges as the presence of negative affect modulates developmental trajectories (moderation model). Finally, the acquisition model suggests that developmental experiences shape the acquisition of an attention bias gradually over time either in tandem or subsequent to the emergence of fear and anxiety. Given that the models point directly to patterns of bias during early infancy, new developmentally appropriate tasks (e.g., LoBue & Rakison, 2013) will need to be designed and validated.

The core study measures were assessed concurrently; therefore, we cannot say with certainty that it is attention bias that is moderating the relation between negative affect and social withdrawal. A longitudinal analysis of these three constructs captured at separate time-points would provide stronger support for the proposed directionality of this relation. Interestingly, one of the first longitudinal studies of attention bias in children found that attention bias to threat was less stable than attention bias to happy faces (White et al., in press), suggesting that threat bias may be more sensitive to children’s current developmental or socioemotional state. In addition, the current sample size limited the complexity and scope of our analyses. Larger samples would be needed to examine higher order relations across measures. However, the data presented here are in line with the current literature and contribute to our understanding of how patterns of reactive and effortful control impact early profiles of socioemotional functioning.

The current study provides evidence for the appropriateness of the dot–probe task as a measure of attention bias in very young children. In addition, it adds to our current understanding of the relations among components of temperament, cognitive control, attention bias, and social behaviors, extending these relations to a normative young sample. The current study replicated previous findings (Morales et al., 2015; Pérez-Edgar, Bar-Haim et al., 2010; Pérez-Edgar et al., 2011; White et al., in press), indicating that attention bias to threat moderates the relation between negative reactivity and social withdrawal. These findings suggest that the relations among negative components of temperament, attention bias, and social behavior emerge during early childhood. Although the relative strength of this trajectory has been suggested by other studies, further research is needed to examine the long-term stability of these findings and the contribution of attention biases to socioemotional profiles throughout development as new regulatory skills emerge (Rueda, 2012; Todd et al., 2012).

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