



Published in final edited form as:

*Infancy*. 2011 ; 16(5): 490–507. doi:10.1111/j.1532-7078.2011.00068.x.

## The Association Between Infants' Attention Control and Social Inhibition is Moderated by Genetic and Environmental Risk for Anxiety

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### Abstract

Infant social inhibition is associated with increased risk for anxiety later in life. Although both genetic and environmental factors are associated with anxiety, little empirical work has addressed how developing regulatory abilities work with genetic and environmental risk to exacerbate or mitigate problem behaviors. The current study was aimed at addressing this gap in research by investigating an early-emerging regulatory behavior, attention control, in association with genetic and environmental risk for anxiety.

Participants included 9-month-old adopted infants, their birth mothers, and adoptive parents ( $n = 361$ ). Lifetime diagnosis of birth mother social phobia was obtained using structured interviews. Adoptive parents completed self-report measures of anxiety symptoms. Infant social inhibition and attention control were coded during a stranger interaction and a barrier task, respectively. Neither adoptive nor birth parent anxiety were directly associated with social inhibition. The association of attention control with social inhibition in infants was moderated by birth and adoptive parent anxiety symptoms. When infants of birth mothers with social phobia were raised by adoptive parents with high self-reported anxiety symptoms, greater attention control was associated with greater social inhibition. However, when raised by adoptive parents with low self-reported anxiety, greater attention control was associated with less social inhibition.

### Introduction

Most adult emotional disorders are preceded by internalizing symptoms during childhood (Pine, Cohen, Gurley, Brook, & Ma, 1998). Nearly 20% of children endorse some level of anxiety symptoms (Albano, Chorpita, & Barlow, 2003; Bell-Dolan, Last, & Strauss, 1990)

and the risk for developing clinical levels of anxiety is high for behaviorally inhibited children (Kagan, 1994; Biederman et al., 1993; 2001). Shyness and social inhibition, robust markers of early behavioral inhibition (Kagan, Reznick, & Snidman, 1988), are visible early in life as social withdrawal and are also linked to greater numbers of anxiety symptoms during childhood (Fordham & Stevenson-Hinde, 1999; Prior, Smart, Sanson, & Obkerlaid, 2000). Studies during preschool and childhood suggest that anxiety problems associated with early shyness are both genetically influenced (Eley, Bolton, O'Connor, Perrin, Smith, & Plomin, 2003) and impacted by familial and other environmental factors (Arcus & McCartney, 1989; Wood, McLeod, Sigman, Hwang, & Chu, 2003).

It is not clear, however, how genetic and environmental factors operate together to increase a child's risk for disorder. For example, the heritability of shyness typically accounts for nearly half of the total variance in anxious behaviors in preschoolers and young children (Eley et al., 2003; Goldsmith & Lemery, 2000). However, it is also likely that early rearing environments are structured in ways that contribute to children's anxiety risk. Parents scaffold the early environment for young children, typically promoting strategies for regulating emotions and modeling adaptive versus maladaptive ways of coping with their own emotions (Calkins, 1994; Kopp, 1989). In fact, anxious adults are less adept at regulating their own negative emotions than those who are not anxious (Cole, Michel, & Teti, 1994; Gross, 1998). Given their own deficits, anxious parents may confer an environmental risk for anxiety upon young children by failing to structure effective emotion regulation, promoting ineffective regulatory strategies, or by modeling maladaptive ways of dealing with periods of distress. This transmission of risk is compounded when anxious parents share genes with their children, though contemporary methods do not support the disentanglement of genetic and environmental influences on factors such as anxiety risk in typical community samples.

One early-emerging strategy for regulating negative emotions is attention control (Mangelsdorf et al., 1995; Rueda, Posner, & Rothbart, 2004). By three to six months of age, infants can shift and focus their attention (Rothbart, Posner, & Boylan, 1990) to disengage from threatening stimuli and engage in other activities (Rothbart, Ziaie, & O'Boyle, 1992). Attention control is linked to children's positive adjustment (Belsky, Friedman, & Hsieh, 2001; Lawson & Ruff, 2004) and the mitigation of anxiety risk (Derryberry & Reed, 2002).

In general, then, the ability to appropriately control attention is associated with fewer numbers of both internalizing and externalizing behavior problems during childhood (Belsky, et al., 2001; Crockenberg, Leerkes, & Bárrig J6, 2008; Eisenberg et al., 2009). However, global levels of attention control are somewhat uninformative in absence of information about children's contexts. For example, if attention control is used to fixate attention on, rather than away from, distressing aspects of the environment, high levels of attention control may actually exacerbate negative emotional arousal. Indeed, work has shown that as early as 6 months of age, orienting away from negative stimuli is associated with decreases in distress, but orienting toward negative stimuli is associated with increases in observed distress and more negative outcomes (Crockenberg et al., 2008; Johnson, Posner, & Rothbart, 1991; Kiel & Buss, 2010; Rothbart et al., 1990). In fact, habitually shifting attention to and/or focusing attention on *threatening* stimuli has been thought to indicate an attentional bias toward threat and linked to the onset and maintenance of anxiety symptoms in adults (Fox, Russo, & Dutton, 2002; Mogg & Bradley, 1998) and in children (Roy et al., 2008; Vasey, Daleiden, Williams, & Brown, 1995). Thus, individual differences in attentional control may either buffer or exacerbate the risk for anxiety associated with early shyness and social inhibition depending on the context.

It is important to note that because most examinations of emotion regulation in infancy have not used genetically-informed designs, the partitioning of genetic and environmental contributions to anxiety risk remains unclear. Adoption designs enable some level of disentanglement of these effects (Leve et al., 2007). Because adoptive mothers and fathers are biologically unrelated to their adopted children, direct parental influences on children's behavior are by necessity environmental in nature. Similarly, because biological parents are not rearing the adopted child, associations between birth parent characteristics and the adopted child's behavior are best explained, controlling for prenatal influences for birth mothers, by genes shared with the child.

The current study is centered around a theoretical possibility that genetic risk for anxiety was moderated by the rearing environment and that attentional control was a mechanism by which these interactions manifest. Specifically, we focused on examining (1) genetic and environmental contributions to risk for anxiety marked behaviorally by social inhibition and (2) to test whether the association between infants' attention control and social inhibition, a known behavioral marker of anxiety risk in childhood, is moderated by birth and adoptive parent anxiety. These associations will be examined during the first year of life, which is an important period for the development of attention control. We hypothesized that (1) greater risk in the form of birth and adoptive parent anxiety would be associated with greater social inhibition and that (2) the link between infant attention control and social inhibition would be impacted by levels of birth and adoptive parent anxiety.

## Methods

### Participants

The sample consisted of participants in the Early Growth and Development Study (EGDS), an ongoing, multisite, longitudinal sample of adopted children, adoptive parents and birth parents. The primary goal of the parent study is to study the impact of genotype by environment interaction (GxE) and correlation ( $rGE$ ) on adopted children's social and emotional development. Study participants were recruited through adoption agencies in the United States. In order to participate, the following criteria had to be met: (1) the adoption placement had to be domestic, (2) adopted infants had to be placed in their adoptive homes within 3 months postpartum, (3) adopted infants had to be placed with an unrelated adoptive family, (4) the adopted infant had to have had no known major medical conditions such as extreme prematurity or extensive medical surgeries, and (5) the birth and adoptive parents had to be able to read or understand English at the 8th-grade level. The majority of birth mothers were Caucasian (Caucasian = 71.7%, African-American = 11.1%, American Indian/Alaska Native = 2.9%, Asian-American = 1.7%, Native Hawaiian/Pacific Islander = 0.3%, more than 1 race = 4.6%, Unknown/did not report = 0.9%), as were birth fathers (Caucasian = 28.4%, African-American = 3.6%, American Indian/Alaska Native = 0.3%, more than 1 race = 2.0%, Unknown/did not report = 62.1%). Roughly seven percent (6.9%) of birth mothers and 3.6% of birth fathers were Hispanic. Three percent (3.4%) of birth mothers and 0.6% of birth fathers did not report an annual household income. More reported their highest level of education as high school or a high school equivalency degree (Birth Mothers = 50.5%, Birth Fathers = 62.9%). Of those birth parents that reported their annual household income, most reported earnings of less than \$15,000 per year (Birth Mothers = 43.7%, Birth Fathers = 42.1%).

The majority of adoptive mothers were also Caucasian (Caucasian = 92.3%, African-American = 3.7%, American Indian/Alaska Native = 0.3%, Asian-American = 0.6%, more than 1 race = 1.1%), as were adoptive fathers (Caucasian = 91.0%, African-American = 5.2%, Asian-American = 0.6%, Native Hawaiian/Pacific Islander = 0.3%, more than 1 race = 1.2%). Roughly 2 percent (2.0%) of adoptive mothers and 1.7% of adoptive fathers were

Hispanic. Three percent (3.1%) of adoptive families did not report an annual household income. Of the adoptive parents who reported an annual household income, roughly half (53.0%) reported earning more than \$100,000 per year. When reporting their highest level of education completed, most adoptive mothers reported earning a 4-year college degree (43.0%) and most adoptive fathers reported earning a graduate degree (36.6%). Eligible families who agreed to participate in the study did not differ from those who did not agree to participate on a number of demographic variables, including education level, income, and age.

The mean age of placement for adopted children was 7.29 days ( $SD = 13.46$ ). Ninety-two percent of adopted children (92.3%) were placed in their adoptive homes within one month of birth. Infants who were placed in their adopted homes prior to 1 month of age did not differ from those infants placed between 1 and 3 months of age in any of the variables for the current study ( $ts < .92$ ,  $ps > .10$ ). A full description of the EGDS study recruitment procedures, sample, and assessment strategy can be found elsewhere (Leve et al., 2007).

The current sample includes data from 361 birth mothers, adoptive mothers, adoptive fathers, and adopted children (207 males). Ages of children during the 9 month assessment ranged from 6 – 18 months, though most children (90.4%) were 8 or 9 months of age ( $M = 8.81$ ;  $SD = .96$ ;  $median = 9$  months).

## Procedure

**Stranger interaction**—During a home visit when children were 9 months old, adopted children participated in a 2-minute interaction designed to measure responses to new people. For the first 30 seconds of the interaction, a stranger sat quietly and neutrally on the floor near the child. For the following 30 seconds, the stranger remained neutral while playing with a tower of stacked cups, then invited the child to play. Children were given to 5 seconds to engage in play. If they did not, the stranger unstacked the cups. For the final 30 seconds, the stranger fully interacted with the child by smiling and encouraging him/her to participate in building and knocking down the tower. At the end of this time period, the stranger thanked the child and moved on to the next activity.

Videotapes were scored for three variables related to early social inhibition adapted from a previously established coding scheme (Kochanska, 1991). Children were rated on 4-point interval scales for their proximity to their caregiver (1 = *does not approach caregiver*; 4 = *consistently approaches*); inhibition to stranger (1 = *plays comfortably*; 4 = *rejects, retreats from stranger*), and inhibition of exploration (1 = *much active exploration*, 4 = *no active exploration*). Ratings were assigned by four independent coders. Each coder was required to achieve a minimum reliability of Pearson's  $r = 0.85$  with a master coder before coding cases independently. Fifteen percent of the videos were double coded in order to calculate inter-coder reliabilities and prevent coding drift. The average reliability across all coders for scales used in the social inhibition composite were as follows: Proximity to caregiver:  $r = .94$ , Inhibition to stranger:  $r = .91$ , Inhibition of exploration:  $r = .79$ . Scores were assigned in 30-second intervals and then collapsed across the interaction.

These three scales ( $\alpha = .86$ ) were entered into a principal components analysis to create scores of social inhibition for each child. A one-factor solution was returned, which accounted for 79% of the variance in the model. Factor loadings ranged from .82 to .91 across all items. Factor scores from this solution were used as indices of children's social inhibition at 9 months of age.

**Toy behind the barricade**—Also during the 9 month home visit, adopted children participated in a 3-minute activity designed to assess children's emotional responses during

periods of frustration. The experimenter showed the child an attractive toy with which s/he was allowed to play. Once the child was engaged with the toy for 30 seconds, the first frustration trial began. To do this, the experimenter placed the toy out of the child's reach (i.e., behind a clear barricade), where it remained until the end of the trial 30 seconds later. After this time, the experimenter began the first neutral trial by removing the barricade and allowing the child to play with the toy for 30 seconds. This sequence was repeated 3 times, alternating 30-second frustration trials in which the toy was removed from the child with 30-second neutral trials where the child was allowed to play with the toy. In every case, the episode ended with the child being able to play with the toy.

Attention to the toy was scored by independent raters for all trials on an interval scale ranging from 1 (*child may briefly look at toy before quickly losing interest*) to 9 (*child spends all of allotted time exploring the toy without encouragement from others*), according to the procedures established by Dogan and colleagues (2005). Thirty-five percent of infants were double coded by independent raters in order to establish reliability on coded behaviors (ICCs .91–.97). Observer ratings were standardized within trial. An exploratory factor analysis with oblique rotation returned a two-factor solution that distinguished between neutral and frustration trials. Factor loadings for neutral trials ranged from .72 to .83. Factor loadings for frustration trials ranged from .82 to .90. Attention during neutral and attention during frustration trials have also been established as independent factors in a previous study (Leve et al., 2010). Attention control was characterized as the degree to which children could engage in play during neutral trials. A score of attention control was created for each child as the mean of standardized ratings on neutral trials ( $\alpha = .77$ ).

Defining attention control in this way distinguishes our measure from traditional observational measures of attention by directly assessing attention following a period of elicited frustration. During frustration trials, both attention to the task and also displays of distress may be regulatory in nature, given different goals of the child (e.g., persistence in the former and elicitation of a caregiver or the experimenter's aid in the later). However, during the neutral trials, the goal of the task is not to engage with a removed or forbidden object, but to regulate in order to engage with a readily available toy. In this case, displays of distress or disengagement indicate an inability to disengage from the frustration elicited by the previous trial, would be in direct opposition to the goal of the task at hand.

On average, children showed better attention control during neutral ( $M = 4.97, SD = 1.47$ ) than during frustration trials ( $M = 3.19, SD = 1.35$ ). A paired samples t-test showed that negative affect was actually greater during neutral ( $M = 1.57, SD = .83$ ) than during frustration trials ( $M = 1.45, SD = .85; t = 3.07, p < .01$ ). In fact, less than half of the sample was rated as rarely showing negative affect during the neutral trials and over 40% showed some level of frustration. Thus, the variance in individual responding during neutral trials can be used to indicate infant regulation associated with disengagement from the preceding frustration trial.

**Parent anxiety**—Levels of anxiety symptoms in adoptive mothers and fathers were assessed using self-report on the Beck Anxiety Inventory (BAI; Beck & Steer, 1993) when children were 9 months of age. Respondents were asked to indicate the degree to which they experienced symptoms of anxiety (i.e., numbness, sweating) on a 4-point interval scale (1 = *not at all*, 4 = *severely*). Scores for the BAI were created by summing scores for all items.

BAI scores from 0–7 are interpreted as *minimal anxiety*, 8–15 as *mild anxiety*, 16–25 as *moderate anxiety*, and 26–63 as *severe anxiety*. Scores for adoptive mothers ( $n = 375$ ) ranged from 0 to 17 ( $M = 3.00, SD = 3.51$ ). Scores for adoptive fathers ( $n = 358$ ) ranged from 0 to 19 ( $M = 3.05, SD = 3.12$ ). Although anxiety scores for adoptive mothers and



fathers were uncorrelated ( $r = .08, p > .10$ ), mothers and fathers both contribute to levels of anxiety in the environment of the adopted child. Thus, the maximum BAI score across maternal and paternal report was used to represent adopted children's environmental risk for anxiety.

Lifetime birth parent anxiety was assessed using the Composite International Diagnostic Interview (CIDI – WHO, 1990; Kessler & Üstün, 2004) when children were 18 months of age. The CIDI is a comprehensive, fully-standardized interview that can be used to assess 17 major diagnostic areas according to the definitions and criteria of the tenth revision of the International Classification of Diseases (ICD) and the fourth edition of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association 1994). This highly-structured interview was created for use by non-clinical staff. All interviewers were trained at the CIDI Training and Reference Center in Ann Arbor, MI. Interviewers were required to reach a minimum reliability with the trainer before independently administering the CIDI.

The version of the CIDI used in the current study was the Computer Assisted Personal Interviewing model (CAPI), which is a computerized administration system used to limit any errors in scoring that may be introduced by interviewers. The CAPI also includes the standardized coding to be used by statistical programs to generate DSM-IV diagnoses, which guards against scoring errors and prevents interviewers from having to make decisions regarding clinical diagnoses. This interview was created for use by non-clinical staff and shows good test-retest reliabilities.

Given that early social inhibition is associated with a risk for social anxiety in particular, the present set of analyses focus on the Social Phobia scale of the CIDI. The social phobia scale contains 41 questions that ask about feelings and experiences in social situations. Birth mothers received a CIDI score of "1" if they met DSM-IV criteria for a diagnosis of Social Phobia ( $n = 31$ ) and a score of "0" if they did not ( $n = 284$ ). Studies comparing the Social Phobia scale of the CIDI to diagnoses of Social Phobia from other established interviews (e.g., SCID) have returned kappas ranging from .68 to .95 (Kessler et al., 1997).

**Missing data**—Families in which birth mothers and adoptive parents agreed to participate are included in the current study ( $n = 361$ ). Forty-six birth mothers were missing CIDI social phobia scores. Scores of attention regulation were not calculated for two children who completed only one trial of the barricade task. An analysis of the patterns of missingness suggested that data were missing completely at random (Little's MCAR = 40.43,  $p > .10$ ). No variables were missing more than 15% of cases missing. Given that missing variables were MCAR, missing data were imputed for continuous variables using a maximum likelihood EM algorithm in SPSS 18.0 ( $n$  imputations = 10).

## Results

### Descriptive Statistics

Descriptive statistics for study variables are shown in Table 1. Adoptive Parent anxiety and Birth Mother social phobia were uncorrelated with both infants' attention control and social inhibition at 9 months of age. Correlations between study variables can be seen in Table 2.

### Attention regulation and Risk for Anxiety

Zero-order correlations between children's birth mother anxiety, adoptive parent anxiety, and social inhibition were unexpectedly nonsignificant. However, given that main effects can be obscured in cases of moderation, a hierarchical linear regression model was used to

test whether the link between infants' attention control and early social inhibition might be moderated by levels of birth and adoptive parent anxiety. A three-step model was used such that main effects for birth mother and adoptive parent anxiety and attention control were entered in Step 1, all two-way interaction were entered in Step 2, and the three-way interaction between birth mother anxiety, adoptive parent anxiety, and attention control was entered in Step 3. All continuous variables were centered prior to the creation of interaction terms.

As shown in Table 3, there was a significant interaction between birth mother social phobia, adoptive parent anxiety, and attention control ( $\beta = .13, t = 2.11, p < .05$ ) predicting social inhibition at nine months of age. This three-way interaction was probed in two steps. In each case, following the suggestions of Aiken and West (1991), the moderating variable was recentered at low ( $-1 SD$ ), mean, and high ( $+1 SD$ ) levels. In the first step, adoptive parent anxiety was recentered to determine the levels at which the interaction between birth parent anxiety and attention control were significant. This interaction was significant at high levels of adoptive parent anxiety ( $\beta = .19, t = 2.05, p < .05$ ), but not at low ( $\beta = -.09, t = -1.04, p > .10$ ) or mean ( $\beta = .05, t = .79, p > .10$ ) levels of adoptive parent anxiety. However, noting the change in direction of the association, we also examined the interaction at very low levels ( $-2 SD$ ) of adoptive parent anxiety. When adoptive parent anxiety was very low, the interaction between birth parent social phobia and attention control was marginally associated with children's social inhibition ( $\beta = -.23, t = -1.61, p < .10$ ).

In the second step, with data centered at high and very low levels of adoptive parent anxiety, we probed the association between attention control and social withdrawal for children whose mothers did and did not have social phobia. To do this, the regression analysis was rerun with the Social Phobia variable recoded so that birth mothers with social phobia served as the reference group. Examining the interaction in this way revealed that, at both high and very low levels of adoptive parent anxiety, attention control was associated with social inhibition only for children whose biological mothers met criteria for social phobia (Figure 1). The nature of this interaction was such that greater attention control was associated with significantly greater social inhibition when levels of adoptive parent anxiety were high ( $\beta = .58, t = 2.15, p < .05$ ) and significantly less social inhibition when levels of adoptive parent anxiety were very low ( $\beta = -.87, t = -2.06, p < .05$ ). For children whose biological mothers did not meet criteria for social phobia, attention control was unrelated to social inhibition at both very low ( $\beta = -.16, t = -1.25, p > .10$ ) and high ( $\beta = .00, t = .04, p > .10$ ) levels of adoptive parent anxiety.

## Discussion

The current study provides evidence that attention control is associated with both increases and decreases in social inhibition as early as 9 months of age. Differences in relations between attention control and social inhibition were dependent on infants' levels of genetic and environmental risk for anxiety.

Birth and adoptive parent anxiety were not directly associated with children's social inhibition in the present study. One explanation for this is that the young age of infants in the current sample may have made it difficult to identify anxious behaviors such as social inhibition in the presence of strangers. A fear of strangers typically emerges between 8 and

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<sup>1</sup>Covariates including prenatal complications, sex of child, maternal age, and openness of adoption were entered into a follow-up of the regression analysis presented here. These factors cumulatively accounted for less than 1% of the total variance in social inhibition and all were nonsignificant. Thus, models are presented without these covariates in order to retain sufficient power to detect significant interactions (Cohen & Cohen, 1983).

12 months of age (Greenberg, Hillman, & Grice, 1973) and peaks between 12 and 18 months (Sroufe, 1977). While children at risk for anxiety are typically more reactive to strangers (e.g., Kagan, 1994), it is unclear whether inhibition to strangers develops earlier or later in these children. Therefore, individual differences in social inhibition as stranger anxiety develops may obscure main effects. Moreover, epigenetic and developmental psychopathology perspectives suggest that gene-related risk factors may lie dormant before manifesting behaviorally (Ogren & Lombroso, 2008; Sroufe & Rutter, 1984). While the moderation seen here makes it unlikely that all mechanisms of risk are inactive at this age, to the degree that anxious behaviors such as social inhibition are multiply determined, such ideas will be important to keep in mind when interpreting the current results.

Results also showed that the association between attention control and social inhibition was moderated by genetic and environmental anxiety risk for anxiety. Note that only skills of attention control in infants with birth mothers who met DSM-IV criteria for social phobia appeared to be influenced by the levels of anxiety in the adoptive household. These results are consistent with the notion that genetic risk might be more accurately depicted as genetically-influenced susceptibility to the environment (Bakermans-Kranenburg & Van IJzendoorn 2007; Belsky & Pleuss, 2009). Per this theory, highly susceptible individuals can be influenced by either negative or positive environmental factors. Consequently, those who have typically been seen as genetically “at risk” in traditional diathesis-stress models show the poorest outcomes in high-risk environments, but show the *best* outcomes in low-risk environments. Likewise, children in the current study who were at risk for anxiety (i.e., had birth mothers who met criteria for social phobia) showed the least inhibition when raised by non-anxious adoptive parents and the greatest inhibition when raised by anxious adoptive parents.

Similarly, it is nontrivial that this link between genetic and environmental risk for anxiety occurred in conjunction with attention control. It may be that non-anxious adoptive parents appropriately scaffold attention control and infants at low genetic risk for anxiety in turn adopt these behaviors more quickly. In contrast, given their propensity toward threat-related attentional biases, anxious adoptive parents may have promoted attentional shifting/focusing toward, rather than away from, threat in their infants.

The present results also provide empirical support for the notion that parents are not only instrumental in scaffolding discrete strategies of regulation for children, but also *how* to use them. Although the current study did not include detailed coding about attention control, results suggest that attention control is not an equivalent strategy for regulating negative emotions across individuals. Some theories of emotion regulation have suggested that putative regulatory behaviors may themselves be regulated products of the emotional experience (Cole, Martin, & Dennis, 2004) and/or indices of distress (Campos, Mumme, Kermoian, & Campos, 1994). In addition, as previously discussed, a biased attention toward threat has been proposed as a possible mechanism for the onset and maintenance of anxiety symptoms. This link is well documented in cognitive models of anxiety (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998), has been widely replicated in adults (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn, 2007) and, over the past decade, has been demonstrated in children (Martin, Horder, & Jones, 1992; Vasey, Daleiden, Williams, & Brown, 1995).

Moreover, this work underscores the importance of context in determining the adaptiveness of different regulatory strategies (Buss & Goldsmith, 1998). While attention control is an important early strategy of regulation, it is neither appropriate nor effective in every setting. The consideration of context may be one way of reconciling suggestions that attention control is associated with both risk for anxiety (e.g., Ladouceur, Dahl, Birmaher, Axelson, &



Ryan, 2006) and adaptive emotion regulation (e.g., Mangelsdorf et al., 1995). However, additional work should be done to examine associations among the current variables in other contexts.

### Limitations

Despite the presence of a range of risk, this work was conducted in a sample that was not preselected for levels of social or behavioral inhibition. Though likely at some risk for anxiety, no diagnostic tools were used with infants and no direct association between parental risk factors and children's behaviors emerged. We are also somewhat limited in the degree to which we are able to draw conclusions about long-term associations with risk for mental illness. It is possible that this risk is not yet fully manifest in children of this age or that the risk in this group of participants is low. Longitudinal examinations that build on this cross-sectional work and include diagnostic interviews with children are needed to fully characterize trajectories of this association across development.

### Conclusions

Nevertheless, this study makes important contributions to the work on emotion regulation and risk factors for anxiety. Namely, it offers evidence for the importance of an early-emerging regulatory strategy - attention control - in association with genetic and environmental anxiety risk and early social inhibition. Furthermore, it offers empirical support for individual differences in both parental scaffolding of regulatory strategies and susceptibility to environments where such strategies may be used in ways that differentially impact the development of mental illness.

### Acknowledgments

Data collection for this project was supported by R01 HD042608; NICHD, NIDA, and the Office of the Director; NIH; U.S. PHS (PI Years 1–5: David Reiss; PI Years 6–10: Leslie D. Leve). The writing of this manuscript was supported by the first author's fellowship on T32 MH070327, NIMH, NIH, U.S., PHS (PI: Pamela M. Cole), and was partially supported by R01 DA020585, NIDA, NIMH, and the Office of the Director; NIH; U.S. PHS (PI: Jenae M. Neiderhiser). The content is solely the responsibility of the authors and does not necessarily represent the official views of the Eunice Kennedy Shriver National Institute of Child Health and Human Development or the National Institutes of Health.

We thank the adoptive and birth families who participated in this study and the adoption agency staff members who helped with the recruitment of study participants. We would also like to acknowledge the late Xiaojia Ge, close and long time collaborator on this study. His contributions to this study are substantial and we will long feel the loss of our colleague.

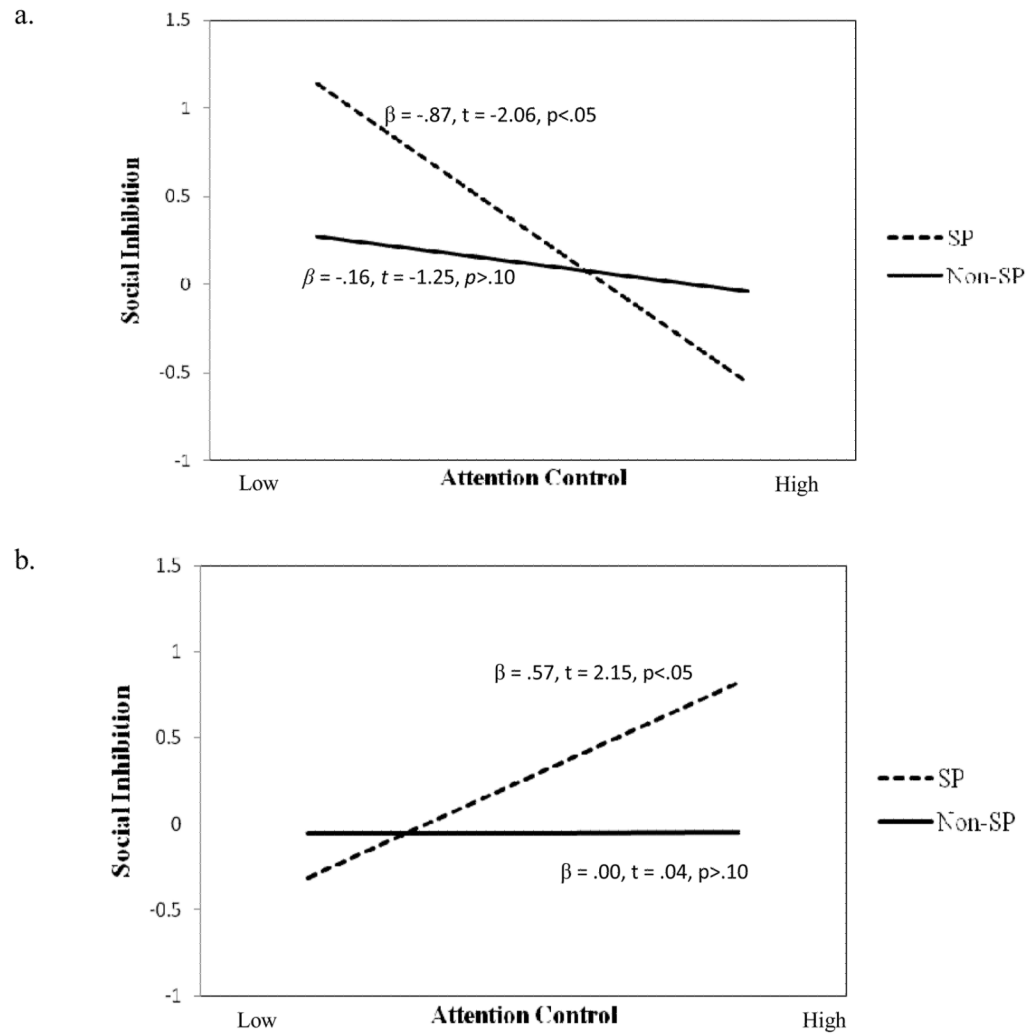
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**Figure 1.** Associations between attention control and social withdrawal as a function of birth mothers' social phobia at (a) very low levels of adoptive parent anxiety and (b) high levels of adoptive parent anxiety  
 Note: SP: Birth mothers meet DSM-IV criteria for Social Phobia; Non-SP: Birth mothers do not meet DSM-IV criteria for Social Phobia



**Table 1**

Means and standard deviations for study variables

	Minimum	Maximum	Mean	SD	Prevalence
Birth Parent Social Phobia	.00	1.00	-	-	11%
Adoptive parent BAI	.00	19.00	5.07	3.53	-
Infant attention regulation	-3.88	2.52	-.00	.94	-
Infant stranger inhibition	-1.21	1.63	.00	1.00	-

**Table 2**

## Correlations among study variables

	1.	2.	3.
1. Birth Parent Social Phobia	--		
2. Adoptive parent BAI	.12*	--	
3. Infant attention regulation	.02	.00	--
4. Infant stranger inhibition	.07	-.00	-.03

\*  
p<.05

**Table 3**

Stepwise Regression Examining the Impact of Biological and Environmental risk and Infants' Attention Control on 9-month Social Inhibition

	<i>B</i>	<i>S.E.(B)</i>	$\beta$	$\Delta R^2$
<b>Step 1</b>				.01
Birth parent social phobia	.24	.18	.76	
Adoptive parent BAI	-.02	.02	-.06	
Infant attention regulation	-.03	.06	-.04	
<b>Step 2</b>				.01
Birth parent social phobia	.25	.19	.08	
Adoptive parent BAI	-.02	.02	-.06	
Infant attention regulation	-.05	.06	-.05	
Birth parent social phobia * Adoptive parent BAI	-.00	.05	.00	
Birth parent social phobia * Infant attention regulation	.13	.18	.04	
Adoptive parent BAI * Infant attention regulation	.02	.02	.09	
<b>Step 3</b>				.05*
Birth parent social phobia	.26	.19	.08	
Adoptive parent BAI	-.02	.02	-.06	
Infant attention regulation	-.05	.06	-.05	
Birth parent social phobia * Adoptive parent BAI	.01	.05	.02	
Birth parent social phobia * Infant attention regulation	.14	.18	.05	
Adoptive parent BAI * Infant attention regulation	.02	.02	.06	
Birth parent social phobia * Adoptive parent BAI * Infant attention regulation	.12	.06	.13*	

\* p<.05