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Development of inhibitory control during childhood and its relations to early temperament and later social anxiety: unique insights provided by latent growth modeling and signal detection theory

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Background: Children with the temperament of behavioral inhibition (BI) face increased risk for social anxiety. However, not all children with BI develop anxiety symptoms. Inhibitory control (IC) has been suggested as a moderator of the pathway between BI and social anxiety. This study uses longitudinal data to characterize development of IC and tests the hypothesis that IC moderates associations between early BI and later social anxiety symptoms. **Methods:** Children completed a Go/Nogo task at ages 5, 7, and 10 years as part of a longitudinal study of BI (measured at 2–3 years) and social anxiety symptoms (measured at 12 years). To assess IC development, response strategy (criterion) and inhibitory performance (d') were characterized using signal detection theory. Latent growth models were used to characterize the development of IC and examine relations among BI, IC parameters, and social anxiety symptoms. **Results:** IC response strategy did not change between 5 and 10 years of age, whereas IC performance improved over time. BI scores in toddlerhood predicted neither initial levels (intercept) nor changes (slope) in IC response strategy or IC performance. However, between ages 5 and 10, rate of change in IC performance, but not response strategy, moderated relations between BI and later parent-reported social anxiety symptoms. Specifically, greater age-related improvements in IC performance predicted higher levels of social anxiety in high BI children. **Conclusions:** IC development in childhood occurs independent of BI levels. However, rapid increases in IC performance moderate risk for social anxiety symptoms in children with BI. Implications for theory and practice are discussed. **Keywords:** Inhibitory control; behavioral inhibition; social anxiety; Go/Nogo; signal detection theory.

Introduction

Behavioral inhibition (BI) is characterized in toddlerhood by heightened reactivity and negative affect to novel people and situations (Fox, Henderson, Marshall, Nichols, & Ghera, 2005), and predicts both social reticence in childhood (Degnan et al., 2014) and social anxiety disorder symptoms in adolescence (Chronis-Tuscano et al., 2009; Clauss & Blackford, 2012). However, not all BI children display social anxiety symptoms in adolescence (Degnan & Fox, 2007), and evidence suggests individual differences in cognitive control throughout childhood may influence risk for developing later anxiety (Buzzell et al., 2017; Troller-Renfree, Buzzell, Pine, Henderson, & Fox, 2019). This study examines how development of inhibitory control (IC) moderates relations between early BI and later social anxiety symptoms.

Three broad classes of executive functions observed in typically developing children are working memory, attention shifting, and IC. IC refers to the ability to inhibit prepotent responses (Davidson, Amso, Anderson, & Diamond, 2006; Miyake et al., 2000). IC emerges early in life (Vaughn, Kopp, & Krakow, 1984), develops throughout childhood (Williams, Ponesse, Schachar, Logan, & Tannock, 1999), and predicts a host of positive outcomes (Diamond & Lee, 2011; Welsh, Nix, Blair, Bierman, & Nelson, 2010). However, in BI children, enhanced IC can exacerbate risk for later anxiety (Thorell, Bohlin, & Rydell, 2004; White, McDermott, Degnan, Henderson, & Fox, 2011).

In two separate studies, high levels of IC increased risk for anxiety symptoms during early childhood (ages 4–5 years) for high BI children (Thorell et al., 2004; White et al., 2011). One hypothesis for this relation is that high BI children use IC to regulate negative emotions stemming from an overactive fear system (Derryberry & Rothbart, 1997; White et al., 2011), which may drive overcontrolled and inflexible behavior (Carver, 2005). Prior studies in children have found the effect of BI and IC on later anxiety to be combinatorial (i.e., moderation), with children high in both BI and IC exhibiting later anxiety. This finding, which suggests BI and IC are independently developing constructs that only interact to predict

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increased anxiety risk is inconsistent with the broader literature, which suggests that better IC *alone* (i.e., out of the context of BI or anxiety) is adaptive for children (Diamond & Lee, 2011; Welsh et al., 2010). Thus, longitudinal assessment of IC and its relation to age-appropriate assessments of anxiety and BI are needed to clarify such inconsistencies.

Examining IC within a longitudinal framework, using signal detection theory (Green & Swets, 1966) to decompose IC into performance and response strategy, may further elucidate relations between BI, IC, and anxiety. On a Go/Nogo task, *IC performance* indexes participants' ability to distinguish 'go' from 'nogo' trials, taking into account correctly inhibited nogo responses, noninhibited nogo responses (errors of commission), and lack of response to go stimuli (errors of omission). In contrast, *response strategy* reflects participants' ability to respond on any trial, regardless of the stimulus, and indexes whether participants approach trials with permissive (likely to respond) or strict (unlikely to respond) strategies. This approach has been used in multiple developmental studies, (e.g., Conners, Epstein, Angold, & Klaric, 2003; Fortenbaugh et al., 2015), and allows extraction of more nuanced understanding of how BI and features of IC may interact to predict social anxiety. Specifically, whereas interaction of BI with IC performance would indicate increased vigilance and/or aversion to errors, interaction with response strategy, might indicate differences in rigidity/permissiveness during the task.

The present study applies latent growth curve modeling to longitudinal assessments of IC performance and response strategy, along with assessment of the BI phenotype and later social anxiety symptoms to address three questions. First, how do IC performance and response strategy develop *longitudinally* in children across three time points (5, 7, and 10 years of age)? Given prior work demonstrating IC improvements across childhood, we hypothesized linear increases in IC performance between ages 5 and 10. Given limited research into response strategy development, we did not have an explicit hypothesis regarding the developmental trajectory of response strategy. Second, does early BI predict response strategy and IC performance development? In line with prior research (White et al., 2011), we predicted BI and measures of IC would not be significantly related. Finally, in a series of exploratory analyses, we examine the degree to which longitudinal measures (i.e., intercept and slope) of IC performance and response strategy moderate relations between toddlerhood BI and the emergence of social anxiety symptoms in early adolescence. Consistent with prior research (Thorell et al., 2004; White et al., 2011), we predicted high levels of BI and IC performance would interact to predict increased social anxiety symptoms at age 12. However, given the present study is the first to examine this question in a longitudinal framework, we did not have specific hypotheses about whether IC performance intercept or slope in particular would interact with BI to predict later anxiety symptoms.

Methods

Participants and ethical considerations

Participants were recruited as part of a longitudinal study examining temperament and relations to emergence of social anxiety (see Table 1). At 4 months of age, 779 infants completed in-laboratory temperament screening (Fox, Henderson, Rubin, Calkins, & Schmidt, 2001). Subsequently, 291 infants (134 male) were selected to continue the study based on temperamental classifications, which were positive reactive (n = 106), negative reactive (n = 116), and an unselected group (n = 69). Reactivity group is controlled for in all moderation analyses. Children continued to participate in assessments of socioemotional development at 2, 3, 4, 5, 7, 10, and 12 years. Informed consent and assent (when appropriate) were obtained at each assessment and visit protocols were approved by the University of Maryland Institutional Review Board. Children with data at each time point did not significantly differ in sex, race, gender, ethnicity, maternal education, or 4-month reactivity classification when compared to children missing data (see Appendix S1).

BI assessment

Behavioral inhibition was assessed at 24 and 36 months of age using behavioral coding of laboratory assessments and parental report. Children were presented with unfamiliar persons and objects and behaviors coded (Calkins, Fox, & Marshall, 1996; Fox et al., 2001). Maternal report of social fear was collected using the Toddler Behavior Assessment Questionnaire (TBAQ; Goldsmith, 1996). Behavioral coding and parental reports of BI were significantly associated ($r(240)$ = .411, p < .001). Measures across different contexts, informants, and

Table 1 Statistics at each assessment for children included in growth model of inhibitory control

	5 Year	7 Year	10 Year
Participants (N)	209	169	144
Age (years)	5.21 (0.30)	7.63 (0.22)	10.27 (0.34)
Sex (Female)	115 (55%)	93 (55%)	78 (54.2%)
Mother's education level			
High School Graduate	34 (16.4%)	25 (15.0%)	23 (16.2%)
College Graduate	88 (42.5%)	77 (46.1%)	65 (45.6%)
Graduate Degree	77 (37.2%)	60 (35.9%)	47 (33.1%)
Other	8 (3.9%)	5 (3.0%)	7 (4.9%)
Race at age 12			
Caucasian	99 (66.4%)	83 (64.8%)	78 (65.5%)
Go accuracy	.95 (.067)	.96 (.05)	0.97 (.05)
Performance (d')	1.71 (1.13)	1.94 (0.73)	2.18 (.67)
Response strategy (Criterion)	−.96 (.56)	−.91 (.30)	−.94 (.25)

Data presented as frequency (%) or mean (SD). Additionally, it is important to note that FIML estimation was used to account for missing data in the latent growth model. Analysis of missingness can be found in the Supplementary Materials.

ages 24 and 36 months were standardized and averaged, creating a 'BI composite' that better reflects the child's temperament (e.g., Walker, Henderson, Degnan, Penela, & Fox, 2014).

MacArthur Health and Behavior Questionnaire (HBQ v1.0)

Each participant's parent completed the MacArthur HBQ (Armstrong & Goldstein, 2003) at the 5-year visit, assessing mental health and related factors across 107 items. Given this study's focus on emergence of anxiety in later childhood, the overanxious scale from the HBQ at age 5 was used as a covariate measure to control for early anxiety symptoms. Parent responding on the overanxious subscale had good internal consistency (alpha = .720).

Go/Nogo task

Children completed a modified Go/Nogo task called the Zoo Game (based on Durston et al., 2002) at the 5-, 7-, and 10-year assessments. During the Zoo Game, children were instructed to help the zookeeper catch animals that escaped from the zoo, but not catch monkeys (5-year task) or orangutans (7- and 10-year tasks) because they were the zookeeper's assistants. Participants pressed the button on a handheld button box as quickly as possible when they saw any animal that was not a monkey or orangutan (go trials), withholding responses for monkeys or orangutans (nogo trials). The task consisted of 75% go trials and 25% nogo trials (see Appendix S2 for further details).

Anticipatory responses (reaction times under 200 ms) were removed before computing accuracy measures. Data were inspected for outliers (±3 *SD*s on go accuracy); none were identified at any assessment point. If a participant did not achieve at least 50% accuracy on go trials at any given time point, their data were coded as missing at that time point.

To isolate changes in IC performance from response strategy, raw Go/Nogo accuracy was decomposed into IC performance (d') and response strategy (criterion; Green & Swets, 1966). First, the inverse of the normal cumulative distribution (with a mean of 0 and *SD* of 1) was calculated for false alarms and hit rates, with go trials designated as targets; d' was calculated by subtracting the z-transform of hits from the z-transform of false alarms. Response strategy (criterion) was calculated by summing the z-transform of hits and the z-transform of false alarms and dividing by two. Thus, d' reflects a direct measure of underlying *IC performance* (ability), whereas criterion reflects a measure of *response strategy* (i.e., tendency to respond overall). A more positive value for IC performance reflects an improved ability to successfully inhibit responses on nogo trials. A negative value for response strategy suggests increased likelihood to respond (rather than not), which is expected given go trials outnumber nogo trials.

Screen for Child Anxiety Related Emotional Disorders (SCARED)

Each subject and their parent completed the SCARED questionnaire at the 12-year assessment. The SCARED is comprised of 41, 3-point Likert scale (0 = almost never, 1 = sometimes, 2 = often) items. The within-sample internal consistency was very good for both parent (alpha = .924) and child report (alpha = .921). Given that BI has been related to the emergence of social anxiety specifically, the social phobia subscale at the 12-year assessment was used as the outcome measure of social anxiety. Only participants who completed the questionnaire in full were included for analysis.

Research suggests that parent and child reports of social anxiety are both valid but are only moderately associated (r = .20 to .47; Birmaher et al., 1997). The social phobia subscale of the SCARED exhibits the lowest concordance between reporters (r = .20), and evidence suggests parent report shows better discrimination between social phobia and other anxiety disorders compared to child self-report (Birmaher et al., 1997). In the present sample, toddler BI significantly predicted parent report of social anxiety symptoms (r = .264, p = .001), but not child report (r = .033, p = .665). Taken together with other work suggesting parent reports might reflect a better measure of a child's actual overall levels of anxiety in late childhood (Rappaport, Pagliaccioa, Pine, Klein, & Jarcho, 2017), the moderating effects of IC on relations between BI and anxiety were only examined for parent report (see Appendix S3 for examination of child report).

Statistical methods

Two separate latent growth curve models (LGMs) were estimated for IC performance and response strategy using Mplus (Muthén & Muthén, 2010). Given that Little's MCAR test (Little & Rubin, 1989) suggested data were missing completely at random, $\chi^2(41) = 48.50$, p = .196, full information maximum likelihood (FIML) was employed to produce unbiased parameter estimates and standard errors (Enders & Bandalos, 2001). Participants were excluded from the LGM if they did not complete the Go/Nogo task with sufficient accuracy for at least one of the three time points (n = 69).

Separate models were constructed for IC performance and response strategy (see Figure 1). For both models, the latent intercept variable, representing either IC performance or response strategy at age 5, was estimated by constraining the paths at 5, 7, and 10 years to be 1. The latent slope variable representing linear change in either IC performance or response strategy was estimated by setting the paths to each observed score at 5, 7, and 10 years to be 0, 2, and 5, respectively, to conform to the time between assessments. Means for the intercept and slope factors were estimated. To maintain adequate identification of the model, error terms of the measured variables were not allowed to covary. After fitting

Table 2 Zero-order correlations between measures of interest

	1	2	3	4	5	6	7
1. BI (age 2–3)	—						
2. HBQ overanxious (age 5)	.041	—					
3. Response strategy (criterion) intercept	.014	.080	—				
4. Response strategy (criterion) slope	.069	.039	.379**	—			
5. Performance (d') intercept	−.088	.175*	.273**	.093	—		
6. Performance (d') slope	.037	−.156*	−.274**	−.011	−.618**	—	
7. Parent report of social anxiety (SCARED)	.264**	.243**	.168*	.040	−.066	−.017	—
M	−.007	.253	−.925	−.004	1.733	.093	3.850
SD	.77	.22	.03	.03	.29	.02	3.46

*p < .05; **p < .01.

the growth models, individuals' estimated factor scores for intercept and slope were extracted for further analysis.

Possible moderating effects of IC on relations between BI and anxiety were investigated using PROCESS 2.16.3 (Hayes, 2013). Participants without valid BI composites ($n = 3$), reported 5-year anxiety ($n = 9$), and parent ($n = 63$) social anxiety at the 12-year assessment were excluded from analyses, leaving a total of 147 participants in the final models. Two exploratory multiple additive moderation models were conducted for parent report of social anxiety: one model examining moderating roles of IC performance intercept and slope while controlling for response strategy intercept and slope, and one model examining moderating roles of response strategy intercept and slope while controlling for IC performance intercept and slope. Reactivity group at 4 months and anxiety at age 5 were controlled for in both models. Conditional effects and Johnson–Neyman values are provided for significant interactions. The Johnson–Neyman approach is a way of probing significant interactions and provides a significance region for the moderator within which the conditional effects of BI on anxiety are significant (Hayes, 2013).

Results

Growth models of inhibition

The LGM for IC performance provided adequate fit, $x^2(1) = .189$, $p = .6638$, RMSEA = 0, SRMR = 0.010 (Hu & Bentler, 1999). The mean initial starting point of IC performance was estimated to be 1.733 and significantly different from 0 ($p < .001$, 95% CI = 1.628, 1.857), and the mean slope was estimated to be .093 and significantly different from zero ($p < .001$, 95% CI = 0.066, 0.120), suggesting that children (on average) improve in IC performance (ability) on the Go/Nogo task between the ages of 5 and 10 years.

Similarly, the LGM for response strategy provided adequate fit, $x^2(1) = 1.822$, $p = .177$, RMSEA = 0.061,

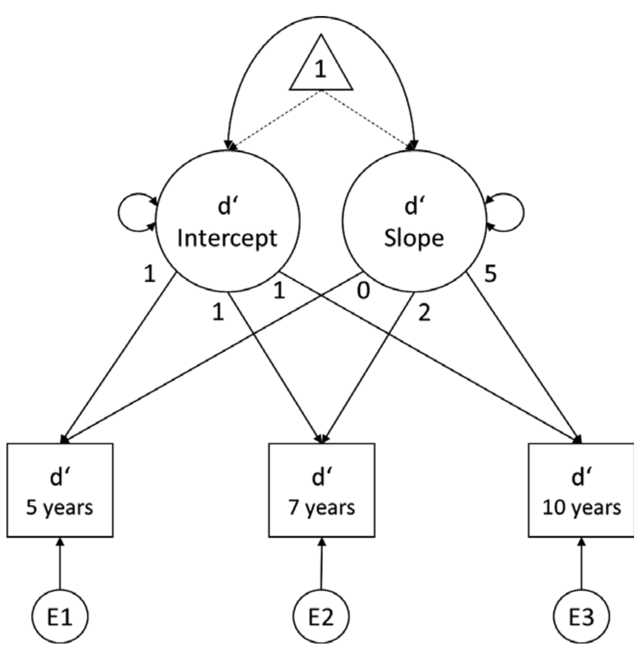

Figure 1 Linear latent growth curve model of IC performance (d'). An identical model was fit for response strategy (criterion)

SRMR = 0.031. The mean initial starting point of response strategy was estimated to be −.925 and significantly different from zero ($p < .001$, CI = −0.971, −0.879) and the mean response strategy slope was estimated to be −.004, which was not significantly different from zero ($p = .627$, 95% CI = −0.016, 0.008). This suggests that children are more likely to respond (than not) on the Go/Nogo task, as would be expected given that go trials outnumber nogo trials and evoke a prepotent response. This pattern showed minimal change (slope, on average) between 5 and 10 years (see Table 2 for correlations between measures of interest).

Relations between BI and IC

To examine relations between BI and IC, a series of regressions were conducted with BI as the predictor and estimated slopes and intercepts for both IC performance and response strategy as outcomes. BI did not significantly predict IC performance intercept ($\beta = -.088$, $t = -1.295$, $p = .197$), IC performance slope ($\beta = .037$, $t = .545$, $p = .586$), response strategy intercept ($\beta = .014$, $t = .303$, $p = .840$), or response strategy slope ($\beta = .069$, $t = 1.014$, $p = .312$).

The moderating role of IC on the relation between BI and social anxiety

To examine whether development of IC performance moderated relations between BI and social anxiety, one exploratory multiple additive moderation model was conducted (Figure 2) with BI as the predictor variable, IC performance intercept and slope as separate moderating variables, and the SCARED social anxiety score as the outcome variable. To ensure that differences in participant response strategy did not influence the results, response strategy intercept and slope, as well as 5-year anxiety and recruitment group, were entered as control variables. This moderation model reached significance ($R^2 = .203$, ($F(9, 137) = 3.873$, $p < .001$) and revealed IC performance slope moderated the relation between BI and social anxiety ($\Delta R^2 = .0268$, $F(1, 137) = 4.601$, $p = .034$), but IC performance intercept did not ($\Delta R^2 = .0002$, $F(1, 137) = .0347$, $p = .853$). Follow-up tests (Table 3) revealed that when longitudinal IC performance slope was steep (1 *SD* above the mean), or moderately steep (mean), there was a positive relationship between BI and social anxiety, whereas when the IC performance slope was shallow, there was no association between BI and anxiety (1 *SD* below the mean). A follow-up analysis revealed a Johnson–Neyman value of −.009 (lower = 38.8%, upper = 61.2%).

A separate exploratory multiple additive moderation model was also conducted to determine if response strategy slope or intercept moderated the relation between BI and parent report of social

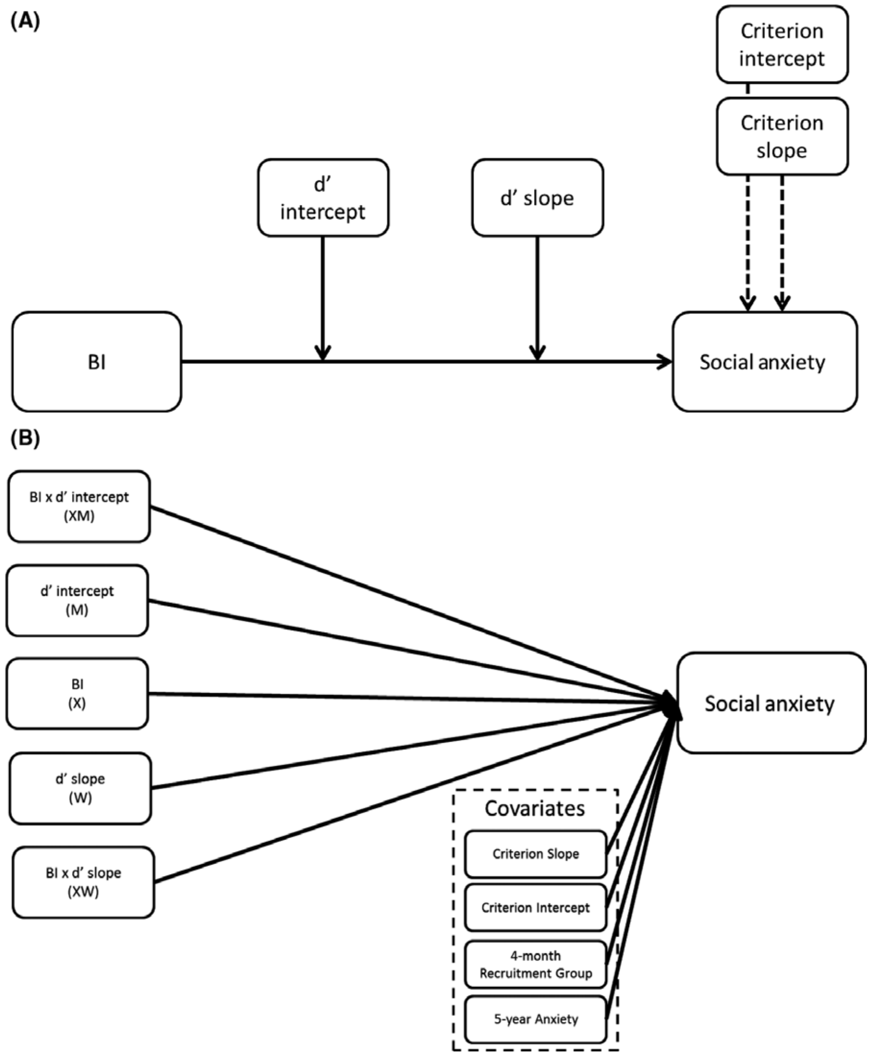

Figure 2 (A) Depicts the conceptual diagram examining the moderating role of IC performance (*d′*) intercept and slope on the relation between BI and social anxiety. (B) Depicts the statistical diagram for the model depicted in A. An identical model was examined reversing the roles of response strategy and performance

Table 3 Conditional effects of inhibitory control performance on the relation between BI and parent report of social anxiety

Intercept	Slope	Effect	*p*	95% CI	
One *SD* below	One *SD* below	0.352	.651	−1.182	1.885
At the mean	One *SD* below	0.266	.602	−0.738	1.269
One *SD* above	One *SD* below	0.180	.759	−0.975	1.333
One *SD* below	At the mean	1.155	.043*	0.038	2.271
At the mean	At the mean	1.069	.004**	0.354	1.784
One *SD* above	At the mean	0.983	.108	−0.220	2.185
One *SD* below	One *SD* above	1.958	.001**	0.845	3.071
At the mean	One *SD* above	1.872	.001**	0.817	2.927
One *SD* above	One *SD* above	1.786	.032*	0.156	3.416

*$p \leq .05$; **$p \leq .01$.

anxiety after controlling for IC performance (intercept and slope; see Figure 2 for path diagram). Results indicated that, while the overall model reached significance ($R^2 = .171$, $F(9, 137) = 3.147$, $p = .002$), neither response strategy intercept ($\Delta R^2 = .005$, $F(1, 137)=.813$, $p = .369$) nor slope ($\Delta R^2 < .001$, $F(1, 137) = .069$, $p = .793$) significantly moderated the relation between BI and parent reported social anxiety.

Discussion

This study examined three primary questions: (a) How does IC develop throughout childhood? (b) Does BI in toddlerhood predict IC development throughout childhood? and (c) Do BI and IC development interact to predict later social anxiety? Critically, this study leveraged a signal detection theoretic framework to dissociate response strategy from IC performance on a Go/Nogo task, providing a more refined understanding of how IC development in childhood interacts with early BI to predict risk for social anxiety. We also employed latent growth models to examine both response strategy and IC performance on a Go/NoGo task develop between the ages of 5 and 10 years. Results indicated that IC performance increased between 5 and 10 years, while response strategy remained consistent. While BI exhibited no direct associations with either IC performance at age 5 or development throughout childhood, rapid increases in IC performance between the ages of 5 and 10 years (i.e., steeper slope) for children with a history of high BI yielded an increased risk for social anxiety symptoms in early adolescence. In contrast, response strategy did not impact the relations between BI and anxiety.

To our knowledge, this study is the first to longitudinally model IC development on a Go/Nogo task during childhood using a signal detection theoretic framework, separating response strategy from performance. Interestingly, response strategy and IC performance displayed different developmental patterns. On average, children appeared to have a stable response strategy (i.e., slope was not significantly different from zero) over time, suggesting that whatever response strategy a child utilized at 5 years was similar to their response strategy at 7 and 10 years. In contrast, children (on average) improved in their IC performance between the ages of 5 and 10 years. Future studies should aim to elucidate how response strategy and IC performance develop prior to age 5 and after age 10 in order to understand how a given response strategy first emerges, as well as how response strategies may change throughout adolescence and adulthood.

Prior studies have demonstrated that for children high in BI, increased efficacy in inhibitory-related functions further increases the risk for developing social anxiety (Lamm et al., 2014; Thorell et al., 2004; Troller-Renfree et al., 2019; White et al., 2011). However, a critical limitation of prior research is the inability to identify whether BI in toddlerhood actually changes the developmental trajectory of IC during childhood, that is, whether BI predicts IC, or if these two constructs are developmentally distinct. The findings from this study suggest BI and IC, as assessed with a Go/Nogo task, are not related at age 5 (intercept) and BI does not predict developmental changes in IC between ages 5 and 10 (slope); these null relations held true both for measures of response strategy and IC performance. Therefore, this study provides further evidence that BI does not *prospectively* predict developmental changes in IC.

Although this study found BI and IC to be developmentally distinct, we also found IC on a Go/Nogo task moderates longitudinal relations between toddlerhood BI and social anxiety symptoms in early adolescence. Specifically, this study demonstrated that for children high in BI, rapid increases in IC performance between 5 and 10 years of age (slope) increased risk for developing social anxiety symptoms in early adolescence. Importantly, this finding held after controlling for IC performance at age 5 (intercept), and response strategy (slope and intercept), as well as anxiety symptoms at age 5. Moreover, only IC performance *development*, and not initial IC performance at age 5 (intercept), nor response strategy (slope and intercept), significantly moderated the relation between BI and social anxiety symptoms. Together, these data suggest that for children high in BI, a rapid increase in IC performance, regardless of response strategy, may be a critical risk factor in the emergence of social anxiety later in adolescence. Neither initial levels nor change in response strategy moderated the relations between BI and anxiety, suggesting that how BI children approach the Go/Nogo task (e.g., permissive or strict) does not increase their risk for anxiety. While this study cannot elucidate the mechanism that promotes rapidly increasing IC performance, an increasing aversion to errors may be one possible mechanism, given that high BI children who have deficits in cognitive control, increased error monitoring, and a preoccupation with errors are also at increased risk for anxiety (Buzzell et al., 2017; Troller-Renfree et al., 2019).

With replication, the clinical value in this finding lies in the use of computerized IC assessment as an easy and affordable indicator of risk in those with risk for later social anxiety. Moreover, the prolonged developmental time course of IC opens up possibilities for evidence-based interventions targeting IC performance explicitly. Indeed, emerging evidence suggests IC can be modulated through specified cognitive training interventions (Dowsett & Livesey, 2000; Thorell, Lindqvist, Bergman Nutley, Bohlin, & Klingberg, 2009) or more generalized classroom-based interventions (Diamond, Barnett, Thomas, & Munro, 2007; Riggs, Greenberg, Kusché, & Pentz, 2006). Future research should seek to replicate these findings, ideally using a larger sample size, given that the current study was relatively small and the significance of the reported interaction ($p < .04$) would not survive an across-model correction for multiple comparisons. Additionally, future work should use more broad assessments of IC, as the current findings are limited to a single-task assessment of IC. Also, future work should investigate this mechanism in a sample selected for higher levels of anxiety, since the present sample is relatively low in anxious symptoms overall. Relatedly, future research should examine whether experimentally induced reductions in heightened IC performance are able to decrease social anxiety symptoms for children high in BI.

Conclusion

While children high in BI are at a greater than sevenfold increased risk of developing social anxiety disorder, only approximately half of children high in BI eventually develop SAD (Clauss & Blackford, 2012). The present report makes three important contributions to the existing literature examining relations between behavioral inhibition, inhibitory control, and social anxiety. First, leveraging signal detection theory, this study identified longitudinal trajectories of response strategy and IC performance on a Go/Nogo task between 5 and 10 years of age. Second, utilizing the aforementioned longitudinal trajectories, this study revealed that BI in toddlerhood does not predict initial levels or developmental changes in either response strategy or IC performance; this suggests aberrant trajectories of IC are not a "core feature" of BI. Finally, the present manuscript demonstrates preliminary evidence that combined effects of high BI and a developmental pattern of increasing IC performance between the ages of 5 and 10 heightens risk for developing social anxiety symptoms in early adolescence. Collectively, these findings suggest that for children high in BI, IC performance may be an important risk factor influencing the emergence of social anxiety. Future work should consider IC performance as a potential target in evidence-based interventions for children high in BI.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Data loss by time point.
Appendix S2. Go/Nogo Task Specifications by Age.
Appendix S3. Relations between BI, IC, and child report of anxiety on the SCARED.

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Key points

- This study aims to understand how inhibitory control (IC) interacts with the risk pathway between behavioral inhibition (BI) and social anxiety.
- Measures of IC performance and response strategy were calculated from longitudinal assessments (ages 5, 7, and 10) of a Go/Nogo task and latent growth models were fit to both metrics.
- Results indicate that BI does not predict response strategy or IC performance, suggesting that perturbations in IC are not a core feature of BI.
- Exploratory moderation analyses indicate that rapidly increasing IC performance, but not response strategy, heightens the risk for behaviorally inhibited children to develop social anxiety symptoms.

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