

Trajectories of socially anxious behavior from age 5 to 13: Temperamental and sociocognitive pathways

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Funding information

This writing of this paper was supported by a Social Sciences and Humanities Research Council of Canada (SSHRC) Postdoctoral Fellowship awarded to KLP, and the research was supported by the National Institutes of Health (NIH) funding awarded to NAF. The authors thank the children for participating in this research.

Abstract

The authors examined temperamental and sociocognitive predictors of socially anxious behavior from preschool to early adolescence. Children ($N = 227$; 59% male; 69% White) completed a speech task at ages 5, 7, 10, and 13 and socially anxious behaviors were coded. Behavioral inhibition (BI) was assessed at ages 2/3 and Theory of Mind (ToM) was assessed at age 4. Data collection occurred between 2003 and 2016. Three trajectories of socially anxious behavior were identified: high stable, average increasing, and low stable. Higher BI was related to the high stable trajectory, whereas lower ToM was related to the increasing trajectory of socially anxious behavior. There are heterogeneous pathways of socially anxious behavior, which may be uniquely influenced by early temperamental and sociocognitive factors.

KEYWORDS

behavioral inhibition, children, longitudinal study, social anxiety, theory of mind

Social anxiety is characterized by fear and nervousness in social situations, particularly in contexts that include a social-evaluative component (Morrison & Heimberg, 2013). Although extremely high levels of social anxiety may result in impairments and interference across several domains reflective of a psychiatric disorder (i.e., social anxiety disorder; American Psychiatric Association, 2013), social anxiety as a trait exists along a continuum reflecting natural variations across the population. Social anxiety is a multidimensional phenomenon with underlying cognitive (e.g., fear), physiological (e.g., blushing, racing heart), and behavioral (e.g., reduced speech, avoidance) components (Beidel et al., 1985; Ollendick & Hirshfeld-Becker, 2002).

Although the experience of social-evaluative concerns is a part of typical development, there are individual differences in the intensity, developmental antecedents, onset, and stability of socially anxious behavior (Ollendick &

Hirshfeld-Becker, 2002; Ollendick et al., 1989). For example, research has found that some children display social fearfulness beginning very early in development, while other children begin to manifest increases in social-evaluative concerns during late childhood and early adolescence due to the onset of puberty, self-conscious emotion development, and an increased importance of peer acceptance (Booth-LaForce & Oxford, 2008; Cheek et al., 1986; Cheek & Krasnoperova, 1999; Tang et al., 2017; Westenberg et al., 2004). Previous work has illustrated that social anxiety is heritable (Stein et al., 2002), and there is evidence that biologically based temperament is a factor in the emergence of early developing social anxiety for some individuals (Clauss & Blackford, 2012). However, considerably less attention has been paid to individuals who may develop social anxiety later in development due to additional environmental or experiential

factors. Despite the heterogeneity in the developmental onset and development stability of socially anxious behavior, relatively little empirical work has charted these heterogeneous patterns or examined the early antecedents of distinct developmental pathways.

Some previous work has used person-oriented, data-driven methodologies to identify heterogeneous trajectories of social anxiety symptoms among typically developing children and adolescents. In one longitudinal study, parents of a community sample of children reported on children's social anxiety across three assessments from age 6 to 8 (on average) and four stable trajectories were identified: very high, high, average, and low social anxiety symptoms (Broeren et al., 2013). The finding of stable trajectories likely reflects developmental consistency or stability in social anxiety during early childhood over a relatively short period of time. An additional study using an accelerated longitudinal design to study girls aged 5–13 years identified five trajectories of parent-reported social anxiety including: high-stable, high-decreasing, moderate-stable, moderate-decreasing, and low-increasing (Marmorstein et al., 2010). These findings illustrate evidence of both stability and instability of social anxiety when assessed across a longer developmental period. One longitudinal study assessed self-reported social anxiety in a sample of adolescents from 13.5 to 17.5 years of age and found three trajectories of self-reported social anxiety including: high and changing, moderate and decreasing, low and decreasing (Miers et al., 2013). Collectively, these studies provide evidence for individual differences in the developmental stability and age of onset of socially anxiety from early childhood through to adolescence. Although these studies are informative, there are several unanswered questions in this literature examining developmental trajectories of social anxiety.

First, most of the above studies span a relatively narrow developmental period, which limits our understanding of developmental changes in socially anxious behavior from early childhood to adolescence. This is particularly important to address given that there are changes in social-evaluative concerns across these developmental periods which may be reflected in behavioral manifestations preceding the typical onset of clinical levels of social anxiety in late adolescence (Ollendick & Hirshfeld-Becker, 2002). The only study that does span early childhood to early adolescence is restricted to a sample of girls, preventing generalizability to boys. Second, the above studies rely on parent- or self-reported measures of social anxiety. Although not inherently problematic, we know comparably little about how children may behave when placed in contexts thought to elicit social-evaluative and self-conscious emotions, such as performing or speaking in front of others, including peers, which mimics the types of situations children are likely to be confronted with, for example, at school. It is critical to assess behavioral manifestations of social anxiety because socially anxious behaviors are often directly observed by children's peers

(Shell et al., 2014), and importantly, peers' responses to these behaviors may influence the quality and/or quantity of children's social experiences (Henderson et al., 2018). By assessing children's behavioral responses to the same laboratory task across repeated assessments, we are able to examine trajectories of change or stability in observed social behavior across development (Degnan et al., 2014; Poole et al., 2020).

An additional gap in this body of research is that relatively little longitudinal work has examined the developmental antecedents of different trajectories of social anxiety. One of the most widely established and studied early predictors of prospective socially anxious tendencies is temperamental behavioral inhibition (Chronis-Tuscano et al., 2009; Clauss & Blackford, 2012; Ollendick & Hirshfeld-Becker, 2002). Behavioral inhibition (BI) is a biologically based temperament that emerges in the first few years of life and is characterized by heightened vigilance and fear sensitivity in response to novel stimuli such as strangers, toys, objects, and places (Garcia-Coll et al., 1984; Kagan et al., 1987, 1988). A robust finding is that higher levels of BI in toddlerhood are associated with higher levels of prospective social anxiety in middle childhood (Hirshfeld-Becker et al., 2007), adolescence (Schwartz et al., 1999), and adulthood (Mick & Telch, 1998). These relations, however, are typically analyzed at single follow-up assessments, limiting our understanding of how early BI may be associated with the *development* of socially anxious behavior (i.e., stability or change) assessed across multiple repeated assessments. Some exceptions include one study that found higher parent-reported BI at age 6 predicted membership in a high-stable trajectory of parent-reported social anxiety from age 6 to 8 (Broeren et al., 2013), while another found no relation between parent-reported BI at age 13.5 years and trajectories of self-reported social anxiety from age 13.5 to 17.5 years (Miers et al., 2013). This work regarding temperament-based pathways of social anxiety supports the notion that this phenotype is relatively stable across development for some individuals.

It is important to note, however, that not all behaviorally inhibited children go on to show symptoms of social anxiety or a diagnosis of social anxiety disorder (e.g., Chronis-Tuscano et al., 2009; Fox et al., 2001), and likewise, only approximately half of individuals who do manifest symptoms of social anxiety in early adolescence have a history of early childhood inhibition (e.g., Prior et al., 2000). This provides support that there are multiple pathways to social anxiety. An additional factor that has been proposed as being related to the development of social anxiety is an individual's social cognitive ability (Banerjee & Henderson, 2001; see Nikolić, 2020 for a recent review). Theory of Mind (ToM) is an assessment of social cognition that encompasses the ability to understand, predict, and explain the behavior of others based on their mental states (Wellman, 1992). Relatively consistent across studies,

work has found social anxiety and its temperamental precursors (e.g., Suway et al., 2012) to be correlated with poorer social cognitive abilities during childhood and adolescence, though this may be particularly true for some aspects of ToM such as self-presentational display (Pearcey et al., 2020). For example, in one cross-sectional study, self-reported social anxiety was inversely related to sociocognitive abilities (i.e., faux pas and understanding self-presentational displays in social situations) during middle childhood, particularly if the child had high levels of negative affect (Banerjee & Henderson, 2001). A recent study likewise found that higher ToM at age 11 predicted lower levels of self-reported social anxiety 6 months later (Ronchi et al., 2020). Furthermore, a recent study found a nonlinear relation between ToM and social anxiety in late childhood, such that both lower and higher ToM were related to greater symptoms of social anxiety assessed using a parent- and child-report composite (Nikolić et al., 2019).

Although these studies are informative, to our knowledge, no studies have examined how individual differences in ToM development during the preschool years are related to the trajectory of socially anxious behavior across early childhood through to early adolescence. One study by Broeren et al. (2013) found that ToM at age 6 was unrelated to trajectories of social anxiety symptoms across the following 2 years. Although there was no relation reported during early childhood, it is possible that social cognitive ability may exert different influences on the timing of children's experience and expression of social anxiety. A recent meta-analysis consolidated previous work on children's social cognition (this encompassed multiple domains of ToM including false belief, self-presentational displays, and faux pas) and social anxiety and found that there was no significant relation between children's social cognition and social anxiety during early childhood (<7 years old), but there was a significant negative relation between social cognition and social anxiety during later childhood (7–12 years old; Pearcey et al., 2020). This may be due, in part, to the fact that as children reach middle to late childhood, the understanding of social signals from peers may be particularly influential on socially anxious tendencies given the importance of peer acceptance during this developmental period (Banerjee & Watling, 2005). Specifically, children with poorer social cognition may display fewer socially competent behaviors and a poorer understanding of social cues (Lane & Bowman, 2021), both of which may not be noticed or viewed negatively by peers until later childhood, or simply become more salient with age (Hymel et al., 1990; Rubin & Mills, 1988). Thus, as children enter late childhood, relatively poorer sociocognitive abilities may result in ineffective production and understanding of social signals, poorer social interactions, negative feedback from peers, and

subsequent sensitivity to situations in which one might be evaluated by peers.

In the current study, we wished to address gaps in the existing body of work examining relations between temperament, social cognition, and children's displays of socially anxious behaviors over the course of childhood and early adolescence by addressing two objectives. The first objective was to identify latent trajectories of observed socially anxious behavior during a speech task across repeated assessments in early childhood (age 5), middle childhood (age 7), late childhood (age 10), and early adolescence (age 13). The second objective was to test whether early temperament (BI) and ToM were related to these trajectories of socially anxious behavior.

We hypothesized that the majority of children would follow a trajectory of relatively low, stable levels of socially anxious behavior. We further hypothesized that there would be at least two trajectories of socially anxious children, including those with high, stable levels across development, and those with a later-onset as indicated by average levels in early childhood with an increase across childhood and into early adolescence (Booth-LaForce & Oxford, 2008; Cheek et al., 1986; Cheek & Krasnoperova, 1999; Tang et al., 2017; Westenberg et al., 2004). Given the lack of research examining trajectories of observed socially anxious behavior from early childhood to adolescence, the number of identified trajectories was considered exploratory. Furthermore, based on previous work examining symptoms of social anxiety, we expected that higher BI in toddlerhood would be related to the stable high trajectory of socially anxious behavior (Chronis-Tuscano et al., 2009). Given the large body of work examining the relation between BI and social anxiety, this analysis was considered confirmatory. Finally, we hypothesized that lower levels of ToM would be related to a pattern of increasing socially anxious behavior beginning later in childhood (Pearcey et al., 2020). Given the lack of research examining the relation between ToM and prospective trajectories of socially anxious behavior, this analysis was considered exploratory.

METHOD

Participants

Participants were recruited at age 4 months as part of a larger longitudinal study. A total of 779 4-month-old infants were screened for temperamental reactions to novelty using laboratory assessments, and subsequently 291 infants (135 boys) were selected based on temperament classifications including positive reactive ($n = 106$), negative reactive ($n = 116$), and a nonreactive group ($n = 69$; see Fox et al., 2001). When infants were 4 months of age, mothers reported themselves as primarily White (69%), followed by Black (17%), Asian (3%), Hispanic (7%), other (3%), or did not report on their ethnicity (<1%).

The majority of mothers reported being college graduates (42%), followed by graduate school graduates (36%), high school graduates (16%), other (6%), or did not report on their educational attainment (1%).

Procedures

Families were followed longitudinally and children completed multi-method assessments of socioemotional functioning at age 2 ($M_{\text{age}} = 2.20$, $SD = 0.22$), age 3 ($M_{\text{age}} = 3.03$, $SD = 0.11$), age 4 ($M_{\text{age}} = 4.10$, $SD = 0.11$), age 5 ($M_{\text{age}} = 5.29$, $SD = 0.32$), age 7 ($M_{\text{age}} = 7.65$, $SD = 0.22$), age 10 ($M_{\text{age}} = 9.97$, $SD = 0.37$), and age 13 ($M_{\text{age}} = 13.15$, $SD = 0.63$) years. Measures of interest for the current study include children's observed BI at age 2/3 years, assessment of ToM at age 4, and observed behavior during a speech task at age 5, 7, 10, and 13 years (described below). Data collection for these assessments occurred between 2003 and 2016.

At each visit, families were greeted by an undergraduate or graduate research assistant and informed consent and assent (when appropriate) were obtained in a private room. Children were then brought into a play room and began a series of structured and unstructured tasks. Parents were not in the room but were able to observe via a one-way mirror. Research assistants followed a script for each visit in order to ensure consistency in the administration of tasks. All study protocols were approved by the University of Maryland Institutional Review Board.

Measures

Behavioral inhibition (ages 2 and 3)

Behavioral inhibition was assessed at ages 2 and 3 using behavioral coding in the laboratory and maternal reports. Children were observed in the laboratory while they participated in three episodes in which they were presented with unfamiliar objects (e.g., robot, tunnel) and persons (i.e., stranger; Fox et al., 2001). For each episode, two independent observers coded children's latency to vocalize, latency to approach/touch the stimuli, and duration of time spent in proximity to their mother. Coders overlapped on approximately 20% of the videos to ensure inter-rater reliability (age 2: ICCs = .72 to .98, age 3: ICCs = .93 to 1.00). Mothers also completed the 19-item social fear subscale from the Toddler Behavior Assessment Questionnaire (TBAQ), which assesses the child's reactions to unfamiliar adults and contexts (Goldsmith, 1996). This scale demonstrated good internal consistency in our sample at each assessment ($\alpha > .84$). Behavioral coding and parental reports across different contexts, informants, and ages were standardized and averaged to create a BI composite in line with previous work (see Troller-Renfree et al., 2019; Walker et al., 2014).

Theory of mind (age 4)

Children completed four Theory of Mind (ToM) tasks. The first three tasks were based on tasks developed by Wellman and Liu (2004). The *deceptive container task* involved showing the child a box of bandages with a toy pig inside. The child was asked what another person would think is inside: bandages or a pig (Suway et al., 2012). The *knowledge access task* involved showing the child a drawer and asking him/her what was inside. Afterward, the experimenter showed the child that there was a toy dog inside the drawer. If the child had guessed a dog, another type of figurine was shown in the drawer. The experimenter then asked if a girl, Polly, knew what was in the drawer (Suway et al., 2012). The *explicit false-belief task* involved a story about a boy, Scott, who was looking for his mittens. The child was told that Scott thinks his mittens are in his backpack, but they are actually in the closet. The child was then asked where Scott would look for his mittens (Suway et al., 2012). The *unexpected transfer task* involved a story about a boy named Max who puts chocolate in a blue cabinet and then goes outside to play. While Max was outside, his mother moved the chocolate to a green cabinet. The child was asked where Max would look for his chocolate when he came back inside (Suway et al., 2012). This task was based on those developed by Perner and Wimmer (1988).

All four tasks included target questions and a memory question about the story. The memory question was a control to ensure that the child understood the story being told. For example, for the deceptive container task, the child was asked if Peter saw what was inside the box. For a child to pass a task, he/she had to answer the target and memory questions correctly. For each of the four tasks, children were assigned a pass (1) or a fail (0), and a summed composite ToM score was computed. A principal component analysis confirmed that all four ToM tasks loaded onto a single factor (eigenvalue = 1.98) and accounted for 49.81% of the variance.

Covariate: verbal ability (age 4)

Children were administered the vocabulary subscale from Wechsler Preschool and Primary Scale of Intelligence (WPPSI) in the laboratory by a trained research assistant (Wechsler, 2002). This subscale is designed to assess the child's vocabulary knowledge and language development. This subscale includes 25 items, including five picture items and 20 verbal items. For the picture items, the child gives the name of a photo displayed in the stimulus book, and for the verbal items, the examiner reads a word aloud and the child gives the definition. Verbal ability was used as a covariate given this can affect ToM development and speech production (Milligan et al., 2007). Table S3 contains results without

verbal ability as a covariate which is statically comparable to the below findings.

Speech task (ages 5, 7, 10, 13)

One of the most widely used tasks to elicit social anxiety is a speech task in which an individual must perform a speech in front of a video camera and/or audience (Thomassin et al., 2018). Indeed, previous work has shown that speech tasks place an individual into a social spotlight, pose a threat to the social self, elicit social-evaluative concerns, and reliably produce physiological, subjective, and behavioral stress responses characteristic of anxiety or nervousness in a social context (see Seddon et al., 2020 and Thomassin et al., 2018, for recent reviews). Importantly, speech tasks such as the one used in the current study have been used to elicit verbal and non-verbal behavioral reactions of anxiety and nervousness across developmental periods including childhood (e.g. Burkholder et al., 2016; Schmidt et al., 1999), and adolescence (e.g. Blöte et al., 2015; Burkholder et al., 2016). Accordingly, we used a speech task to elicit socially anxious behaviors in the current study.

At each assessment, children were asked to deliver a videotaped 5-min speech in front of an unfamiliar peer and two experimenters. Children were given 2 min to prepare their speech with a pen and paper, but could not use their notes for the speech delivery. The speech prompt differed across assessments to model developmentally appropriate topics. At age 5 and 7 years, children were asked to talk about their last birthday. At age 10 years, children were asked to talk about why they should be voted class president or they could make an argument about whether homework is good or bad for them, which was counter-balanced across children. At age 13 years, children were asked to talk about what makes them a good leader. At age 5, 7, and 10, observers of the speech were an unfamiliar same-gender same-aged peer and two experimenters, and at age 13 the observers were two unfamiliar same-gender, same-aged peers and two experimenters. The same-gender, same-aged unfamiliar peers were recruited as part of the larger study from the community. Peers were randomized for each assessment in order to maintain the unfamiliar nature of the dyad or triad.

Behavioral coding

Four behaviors of interest were coded including verbal anxiety, physical anxiety, total time speaking, and total task length. Global ratings of verbal and physical anxiety were coded on a 5-point scale which integrated the frequency and intensity of the behavior. Examples of verbal anxiety include stuttering, mumbling, or stumbling over words, while examples of physical anxiety include fidgeting, repeated movements, avoiding eye contact

with observers, and putting hands over face. Total time speaking and task length were both recorded in seconds. From these data, the child's proportion of time speaking was computed by dividing total time speaking by the total task length and then reverse-scored as an indication of speech inhibition.

For the age 5 year assessment, three trained coders overlapped on approximately 20% of total cases to assess interrater reliability (ICCs = .76 to .95). For the age 7 year assessment, three trained coders overlapped on approximately 20% of total cases to assess interrater reliability (ICCs = .76 to .99). For the age 10 year assessment, three trained coders overlapped on approximately 20% of total cases to assess interrater reliability (ICCs = .69 to .95). For the age 13 year assessment, five trained coders overlapped on approximately 20% of total cases to assess interrater reliability (ICCs = .89 to .99). Coders included undergraduate research assistants and graduate students who were trained by a senior graduate student.

Observed socially anxious behavior

For each visit, an observed socially anxious behavior composite was computed by standardizing and summing each measure (i.e., verbal anxiety, physical anxiety, and speech inhibition). At each assessment, a principal component analysis revealed that the three behaviors loaded onto a single component (eigenvalues = 1.78, 1.70, 1.77, and 2.05, for the age 5, 7, 10, and 13 year assessments, respectively), with all factor loadings ≥ 0.66 (see Table S1).

Statistical analyses

To test for individual differences in developmental trajectories of socially anxious behavior across visits, we used a latent class growth curve analysis (LCGA) in Mplus Version 8. We fixed the factor loadings of the slope estimate to 0, 2, 5, and 8 (corresponding to age 5, 7, 10, and 13, respectively) to account for differences in the time between assessments.

At age 5, 200 children had speech behavioral data; at age 7, 172 had speech behavioral data; at age 10, 165 children had speech behavioral data; and at age 13, 145 children had speech behavioral data. We first examined possible differences in demographic and predictor variables for children with missing speech behavioral data across assessments. Boys were more likely than girls to have missing speech data at age 5 only ($p = .057$), but there were no significant differences in maternal education, maternal ethnicity, age 2/3 BI, or age 4 ToM for children with missing versus complete speech behavioral data at any time point. We also examined if there were differences in socially anxious behavior at prior time points for children with missing versus complete speech behavioral data at later time points to see if possible

anxiety-producing experiences related to the speech task predicted subsequent systematic attrition due to participation in the speech task. There were no differences in levels of socially anxious behavior for children with missing versus complete speech behavioral data at any time point, with the exception that children with missing speech data at age 10 had *lower* levels of socially anxious behavior at age 5 ($p = .020$). These results suggest that heightened anxiety during the speech task likely did not serve as a deterrent for continued participation in the longitudinal study. Full information maximum likelihood (FIML) was used to present unbiased estimates for children who had behavioral data for at least one of the visits ($N = 227$). To determine the optimal number of latent classes of observed behavior, we considered various criteria including the Bayesian information criterion (BIC), Akaike information criterion (AIC), Sample Size Adjusted BIC (SSA-BIC), the Bootstrap Likelihood Ratio Test (BLRT), and entropy.

Subsequently, we tested predictors (i.e., BI and ToM) of membership in the observed socially anxious behavior trajectories using a multinomial logistic regression. Both predictors were modeled simultaneously in order to control for the effect of one variable on the other. Of the 227 children modeled in the LCGA, a total of 224 children had age 2/3 BI data, and 156 children had age 4 ToM data. Analyses controlled for child gender and child's verbal ability given this can affect ToM development (Milligan et al., 2007). Missing data on predictors were imputed using the expectation-maximization algorithm to avoid the biased parameter estimates that can occur with pairwise or listwise deletion (Schafer & Graham, 2002). The main results presented below are modeled for the full sample ($N = 227$).

RESULTS

Descriptive statistics

Table 1 contains descriptive statistics and correlations for main study variables which were computed prior to imputation. All variables were normally distributed. Age 2/3 BI and age 4 ToM were not significantly correlated. Observed socially anxious behaviors across each

assessment period were modestly correlated. Boys and girls did not significantly differ on age 2/3 BI, age 4 ToM, or observed socially anxious behavior at any assessment, $t_s < 1.59$, $p_s > .11$. Furthermore, there was no relation between mother's ethnicity and age 2/3 BI or observed socially anxious behavior at any assessment, $p_s > .10$, but ethnicity was related to age 4 ToM such that children of non-Hispanic, White mothers had higher ToM than children of non-White and/or Hispanic mothers, $p < .001$.

Trajectories of observed socially anxious behavior

The average trajectory across the sample had average initial levels of socially anxious behavior, $B = 0.09$, $SE = 0.137$, $p = .950$, and a nonsignificant slope estimate, $B = -0.02$, $SE = 0.029$, $p = .939$. There was variance in the intercept, $B = 0.984$, $SE = 0.542$, $p = .069$, and slope estimate, $B = 0.042$, $SE = 0.021$, $p = .052$.

Table S2 illustrates fit statistics for models with different number of trajectories. A three class solution was selected due to the best model fit and conceptually distinct linear trajectories. Figure 1 illustrates these three trajectories. The nomenclature we use to label our trajectories was based on the: (a) intercept estimate, and (b) slope estimate (i.e., nonsignificant slopes reflect group-level stability, and significant slopes reflect increasing/decreasing pathways). The first class is described as *high stable* (17.2%, $n = 39$) as reflected by high initial levels of socially anxious behavior, $B = 2.46$, $SE = 0.89$, $p = .006$, and a nonsignificant slope estimate, $B = -0.19$, $SE = 0.17$, $p = .260$. The second class is described as *moderate increasing* (8.4%, $n = 19$) as reflected by average initial levels of socially anxious behavior, $\beta = 0.09$, $SE = 0.56$, $p = .876$, and a significant, positive slope estimate, $B = 0.49$, $SE = 0.18$, $p = .008$. The third class is described as *low stable* (74.4%, $n = 169$) as reflected by low initial levels of socially anxious behavior, $B = -0.65$, $SE = 0.17$, $p < .001$, and a nonsignificant slope estimate, $B = -0.04$, $SE = 0.04$, $p = .230$. There was no relation between trajectory membership and child gender, $X^2 = 2.15$, $p = .341$, reactivity group at 4 months, $X^2 = 2.07$, $p = .722$, mother's ethnicity, $X^2 = 10.60$, $p = .226$, or mother's education, $X^2 = 4.84$, $p = .931$.

TABLE 1 Descriptive statistics for main study variables

	2	3	4	5	6	M (SD)	Range	Skew
1. Age 2/3 BI	.08	.11	.22**	.05	.03	-0.01 (0.98)	-1.93 to 2.30	0.13
2. Age 4 ToM	—	-.13	-.08	-.09	-.08	1.55 (1.35)	0 to 4	0.39
3. Age 5 Observed SA		—	.19*	.17*	.21*	0.00 (2.30)	-4.95 to 6.28	0.63
4. Age 7 Observed SA			—	.19*	.16	0.00 (2.25)	-4.79 to 7.01	0.50
5. Age 10 Observed SA				—	.47**	0.00 (2.30)	-5.49 to 6.66	0.43
6. Age 13 Observed SA					—	0.00 (2.48)	-5.86 to 6.81	0.45

Abbreviations: BI, behavioral inhibition; SA, social anxiety; ToM, theory of mind.

** $p < .001$; * $p < .05$.

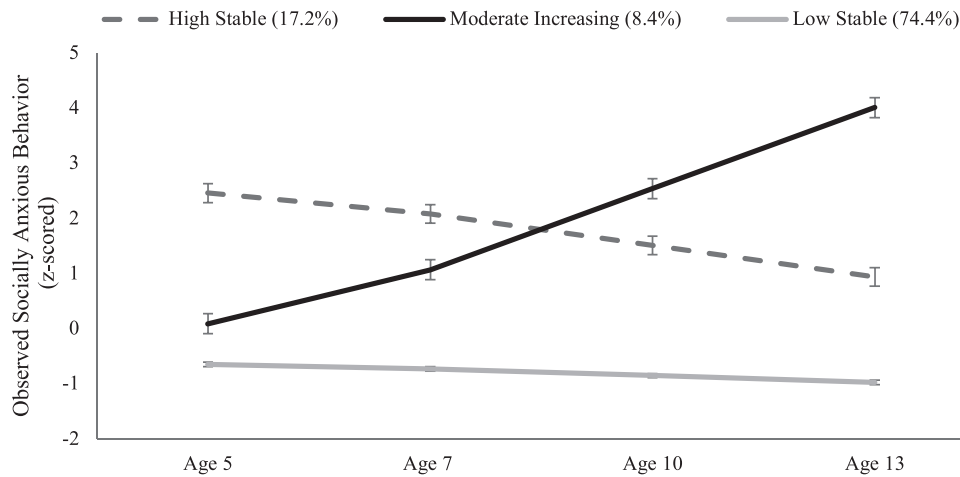


FIGURE 1 Trajectories of observed socially anxious behavior during speech task from age 5 to 13. Estimates from the latent class growth curve analysis are plotted. $N = 227$

TABLE 2 Parameter estimates for the multinomial regressions contrasting the latent trajectories of socially anxious behavior as predicted by toddlerhood behavioral inhibition and preschool Theory of Mind

Outcome and reference	Predictors	B (SE)	OR	95% CI	p -value
High stable (vs. low stable)	BI	0.86 (0.27)	2.35	1.39–3.98	.001
	ToM	0.08 (0.16)	1.08	0.78–1.49	.641
	Gender	-0.66 (0.38)	0.52	0.25–1.09	.083
	Verbal ability	-0.10 (0.05)	0.91	0.82–1.00	.063
Increasing (vs. low stable)	BI	-0.31 (0.34)	0.73	0.38–1.44	.365
	ToM	-0.56 (0.26)	0.57	0.34–0.95	.032
	Gender	0.22 (0.50)	1.25	0.47–3.34	.657
	Verbal Ability	-0.01 (0.06)	0.99	0.88–1.11	.845
Increasing (vs. high stable)	BI	-1.17 (0.41)	0.31	0.14–0.70	.005
	ToM	-0.63 (0.29)	0.53	0.30–0.94	.030
	Gender	0.88 (0.59)	2.42	0.75–7.74	.137
	Verbal Ability	0.09 (0.07)	1.09	0.94–1.26	.243

Note: $N = 227$.

Abbreviations: BI, behavioral inhibition; CI, confidence interval; OR, odds ratio; SE, standard error; ToM, theory of mind.

Predictors of socially anxious behavior trajectory membership

Full parameter estimates for the multinomial regression models are presented in [Table 2](#).

Behavioral inhibition (age 2/3)

Results revealed that higher levels of BI at age 2/3 was related to an increased likelihood of membership in the high stable trajectory of socially anxious behavior relative to both the low stable (OR: 2.35, 95% CI: 1.39–3.98) and increasing trajectories (OR: 3.21, 95% CI: 1.43–7.21). Toddlerhood BI did not differentially predict membership in the low stable trajectory relative to the increasing trajectory. Although data were analyzed using a

multinomial logistic regression, for illustrative purposes, we present mean scores on age 2/3 BI for each trajectory in [Figure 2a](#).

Theory of mind (age 4)

Results revealed that lower ToM at age 4 was related to an increased likelihood of membership in the increasing trajectory of socially anxious behavior relative to both the low stable (OR: 0.57, 95% CI: 0.34–0.95) and high stable trajectories (OR: 0.53, 95% CI: 0.30–0.94). Age 4 ToM did not differentially predict membership in the low stable relative to the high stable class. Although data were analyzed using a multinomial logistic regression, for illustrative purposes we present mean scores on age 4 ToM for each trajectory in [Figure 2b](#). Supplemental

Materials present models that include the interaction among BI and ToM.

DISCUSSION

We examined developmental trajectories of socially anxious behavior during a speech task from age 5 to 13, and whether there were early temperamental and sociocognitive predictors of these pathways. We found evidence for three developmental trajectories of socially anxious behavior including a low stable class, a high stable class, and a moderate increasing class. Furthermore, we found that higher BI was related to a pattern of high socially anxious behavior across development, while lower ToM in preschool was related to a pattern of increasing socially anxious behavior beginning in later childhood and into early adolescence.

Our findings illustrate that there are heterogeneous patterns of socially anxious behavior from preschool to early adolescence. The majority of children in our study followed a presumably normative pattern of relatively low stable levels of observed socially anxious behavior from early childhood to early adolescence which is consistent with previous work that has examined parent-reported and self-reported social anxiety in children and adolescents (Broeren et al., 2013; Gazelle, & Faldowski, 2019; Miers et al., 2013). There were, however, two additional pathways of socially anxious behavior identified. First, approximately 15% of the sample displayed high levels of socially anxious behavior continuously from early childhood to early adolescence, which may reflect a subset of children with *early-developing* social anxiety. The finding of a high, relatively stable trajectory of socially anxious behavior is consistent with previous work that has examined parent-report of social anxiety during early childhood (Broeren et al., 2013) and from age 5 to

13 in girls (Marmorstein et al., 2010). Second, approximately 10% of the sample started with average levels of social anxiety during early childhood, but manifested increases in social anxiety into early adolescence, capturing a unique subset of children with *later-developing* social anxiety. This is consistent with previous work that has also found evidence of increasing parent-reported social anxiety across a similar developmental range (Marmorstein et al., 2010).

In the current sample, we did not find a subset of children with significant decreases in socially anxious behavior across time, whereas some previous work has found decreasing trajectories of social anxiety in children and adolescents according to parent- and self-report (Marmorstein et al., 2010; Miers et al., 2013). Although we did not find evidence of this subset of children, we anticipate that with a larger sample size, we may have identified a group of children who showed decreases in socially anxious behavior across time. Relatedly, it should be noted that although the slope of the high stable trajectory was nonsignificant, which is indicative of relative stability among this group across development, an inspection of Figure 1 illustrates that levels of socially anxious behavior for the high stable trajectory appear to be lower than that of the children following a pathway of increasing socially anxious behavior by early adolescence. It is possible that by middle to late childhood, children may develop regulatory strategies to mask the overt display of socially anxious behavior which may be reflected in the slow decline over time for the high stable trajectory of children.

In line with the concept of equifinality (Cicchetti & Rogosch, 1996) which highlights that there may be diverse pathways to similar developmental outcomes, we found that these two trajectories of earlier-developing and later-developing social anxiety had distinct temperamental and sociocognitive antecedents. Specifically,

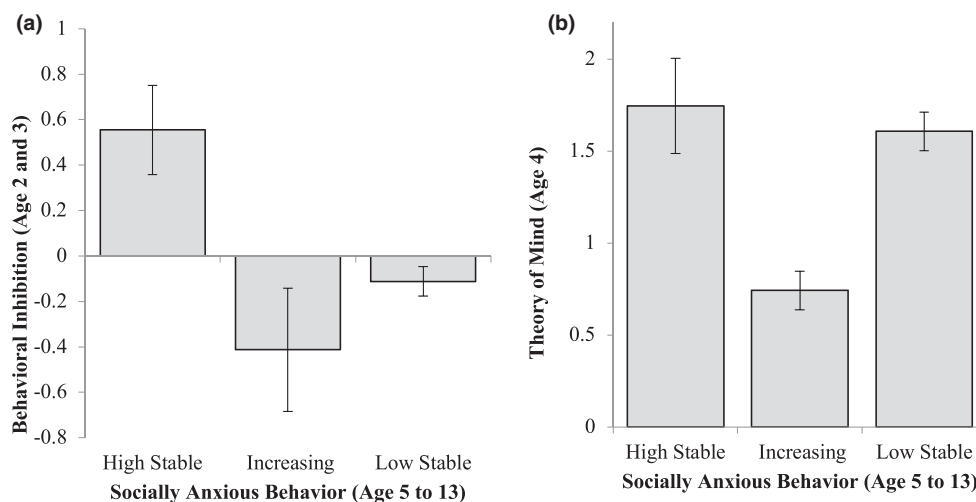


FIGURE 2 Mean scores on age 2/3 behavioral inhibition (a) and age 4 Theory of Mind (b) for each observed socially anxious behavior trajectory. Error bars reflect standard errors of the mean

toddlerhood BI was predictive of high levels of observed socially anxious behavior in early childhood which remained relatively stable across development. In contrast, there were no differences in toddlerhood BI between children who followed an increasing trajectory compared to the low stable trajectory of socially anxious behavior. This finding is consistent with the conceptualization that BI is a relatively stable, biologically based temperamental trait characterized by a lower threshold to become physiologically and behaviorally aroused in response to novelty (Garcia-Coll et al., 1984; Kagan, Reznick, & Snidman, 1987, 1988). As inhibited toddlers reach early childhood, this pattern of arousal is likely to manifest in social contexts, as is the case in the current study (Coplan et al., 1994). Thus, the finding that toddlerhood BI was related to the high stable trajectory of socially anxious behavior may reflect heterotypic continuity and a developmentally appropriate manifestation of early BI. The proportion of children who followed a pattern of stable high observed social anxiety (15%) is similar to the proportion of children who have been described as having a behaviorally inhibited temperament in toddlerhood (Kagan, 2012), and similar to the proportion of children showing stable high observed social reticence during play with unfamiliar peers in early childhood (Degnan et al., 2014). We interpret these findings to suggest that, for some children, one pathway to socially anxious behavior is temperament-based and rooted in early, innate, and relatively stable biological biases underlying a basic fear response (Buss, 1986a, 1986b). Children following this pathway appear to be displaying relatively stable, trait-like behavior (Kagan, 1994), which is consistent with previous work finding mean-level stability in inhibited behavior across development (Karevold et al., 2012; Tang et al., 2020).

We also found that preschool sociocognitive ability distinguished the trajectories of socially anxious behavior in our study. Specifically, we found that lower levels of early ToM were related to a pattern of increasing socially anxious behavior from early childhood into adolescence, suggesting that relative deficits in sociocognitive ability may be an additional factor implicated in a pathway to socially anxious behavior. Of note, children following a high stable trajectory of socially anxious behavior had comparable levels of ToM relative to children following a low stable trajectory of socially anxious behavior, suggesting that the temperament-based pathway was unique. To our knowledge, there have been no previous studies examining the relation of early ToM and prospective changes in social anxiety spanning approximately 10 years from childhood to early adolescence across several repeated assessments. However, some previous cross-sectional or short-term follow-up studies have found an inverse relation between children's social cognition and social anxiety (Banerjee & Henderson, 2001; Colonnese et al., 2017; Nikolić et al., 2019; Ronchi et al., 2020).

Why might lower sociocognitive ability be related to increases of socially anxious behavior into early adolescence beginning around middle to late childhood? Although no empirical studies have directly examined whether there are developmental differences in the relation between social cognition and social anxiety, a recent meta-analysis found support for this hypothesis (Pearcey et al., 2020). Specifically, it was found that, although there was no significant relation between children's social cognition and social anxiety during early childhood, there was a significant inverse relation between social cognition and social anxiety during later childhood for children between the ages of seven and twelve (Pearcey et al., 2020). This developmental period of middle childhood to early adolescence mirrors the range where we see increases in observed socially anxious behavior in children in our sample.

Children with poorer ToM have difficulties understanding and processing their social partner's intentions in social situations (Banerjee & Henderson, 2001; Ronchi et al., 2020). The progression from early childhood to late childhood is accompanied by normative changes in several domains which may result in children with poorer social cognition to display greater social anxiety. For example, concerns with self-presentation become salient during middle childhood due to increases in the development of self-conscious emotions and greater comparison of oneself to peers (Crozier & Burnham, 1990; Harter, 1986; Lagattuta & Thompson, 2007; Piaget, 1970; Schmidt et al., 1999). By middle childhood, children who are ineffective at producing and understanding social signals may feel as if they are unable to accurately predict how social interactions will unfold, resulting in sensitivity to situations in which one might be evaluated or the object of social attention. This may negatively influence the child's self-perceived social efficacy and possibly result in greater social avoidance and concerns related to social evaluation, as captured by the speech task used in our study (Buss, 1986a; Schmidt & Buss, 2010). Over development, there is likely a transaction between a child's ineffective social interactions and their feedback from peers such that a child begins to feel increasingly nervous in future social encounters resulting in increases in social anxiety, and this heightened social anxiety may then result in poorer feedback from peers (Henderson et al., 2018).

A related hypothesis is that children become more likely to evaluate their peers based on external behavior by middle to late childhood compared to early childhood (Hymel et al., 1990; Rubin & Mills, 1988). Children with poorer social cognitive ability tend to show lower social competence (Devine et al., 2016), and previous empirical work has found that this is related to greater peer rejection and lower peer acceptance (Banerjee et al., 2011; Banerjee & Watling, 2005; Hughes & Leekam, 2004; Ronchi et al., 2020). Interestingly, Banerjee and Watling

(2005) noted that there was an inverse relation between children's social cognition and peer-nominated social preference during later childhood (8–9 years old), but not during early childhood (5–6 years old), suggesting that there may be developmental differences for the social interactive implications of relatively poorer socio-cognitive ability. The authors interpreted this finding to possibly reflect the fact that during early childhood, peer relationships are based primarily on play interests, whereas during late childhood there are more complex factors at play such as social evaluation within the peer group (Banerjee & Watling, 2005). It is, therefore, possible that relatively poorer peer relationships may contribute to social-evaluative concerns, and increases in social anxiety during later childhood for children with poorer social cognition.

Although we found a relation between ToM and the trajectory of socially anxious behavior, we acknowledge that the effect sizes were relatively small and should thus be interpreted with appropriate caution and replicated in future studies. The relatively small effect size illustrates that there are indeed additional factors that may influence the relation between preschool ToM and socially anxious behavior across development. For example, in our study, we specifically examined standard ToM tasks (e.g., false belief) administered at age 4. It is possible that the inclusion of other facets of ToM (e.g., faux pas, self-presentational displays) during childhood would help to better account for social anxiety in line with previous work (Banerjee & Henderson, 2001). Furthermore, we specifically examined *behavioral* manifestations of social anxiety. Previous work has shown that the informant (e.g., self-, parent-, teacher-, clinician-reported) of social anxiety may have different effects on the ToM and social anxiety relation (Pearcey et al., 2020). An additional area for future research is to examine whether ToM exerts similar long-term influences on the other components of social anxiety such as the affective and cognitive components.

Limitations and future directions

Our findings should be interpreted in the context of the following limitations and considerations. First, ToM was only assessed during the preschool years. Although ToM largely develops during early childhood and is a relative stable sociocognitive ability (Devine et al., 2016; Lecce et al., 2011), we were unable to investigate the role of ToM into later childhood. Relatedly, we conceptualized ToM as a predictor of prospective trajectories of socially anxious behavior, and we were unable to examine the reciprocal relation. It will be important for future work to examine cross-lagged associations between sociocognitive ability and socially anxious behavior to better understand the bi-directional relations between constructs. Second, our sample was primarily White, limiting generalizability to more ethnically diverse populations. With larger sample sizes and more

ethnically diverse samples, we may be able to more accurately examine whether our pattern of findings may differ as a function of ethnicity. This is particularly important given our preliminary findings that there may be mean-level differences in social cognition in our sample, as well as previous work reporting ethnic differences across temperament and social cognition (e.g., Chen et al., 1998). Third, we assessed children's socially anxious behavior in one context of self-presentation during a structured speech task, and thus it will be important for future work to examine behaviors in additional social contexts such as during unstructured social interaction tasks. Relatedly, we described children's behavioral manifestations as “socially anxious” based on theory and the social context under investigation; however, as is the case with any behavioral coding, it is possible that the expressed behaviors may also reflect other related constructs such as negative emotionality or shyness. Furthermore, although we examined temperamental and sociocognitive predictors of socially anxious behavior, we acknowledge that there are undoubtedly multiple factors that may interact to influence the development of social anxiety that were beyond the scope of this study (e.g., attachment patterns, parental and peer group influences; Lewis-Morrarty et al., 2015; Ollendick & Hirshfeld-Becker, 2002; Wong & Rapee, 2016). Finally, an area for future work is to directly examine the clinical implications of different developmental patterns of socially anxious behavior, as well as if relevant interventions (e.g., social skills training) may serve to mediate or moderate possible clinical correlates of these trajectories.

CONCLUSION

Our findings illustrate that there is heterogeneity in the developmental onset and stability of socially anxious behavior, such that some children show high levels of socially anxious behavior beginning in early childhood that remains relatively stable into early adolescence, while other children show a trajectory of increasing socially anxious beginning around middle childhood into early adolescence. These different developmental patterns of socially anxious behavior may be influenced in part by early biologically based temperamental influences, as well as early sociocognitive abilities. Future work should continue to examine the early antecedents of social behavior across development, as well as the long-term implications of these distinct trajectories for psychosocial functioning.

CONFLICT OF INTEREST

The authors report no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to cite this article: Poole, K. L., Degnan, K. A., Harrewijn, A., Almas, A., Fox, N. A., & Henderson, H. A. (2022). Trajectories of socially anxious behavior from age 5 to 13: Temperamental and sociocognitive pathways. *Child Development*, *93*, 1334–1346. <https://doi.org/10.1111/cdev.13767>