

Shyness Trajectories across the First Four Decades Predict Mental Health Outcomes

Alva Tang¹ · Ryan J. Van Lieshout² · Ayelet Lahat¹ · Eric Duku² · Michael H. Boyle² · Saroj Saigal³ · Louis A. Schmidt¹

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Abstract Although childhood shyness is presumed to predict mental health problems in adulthood, no prospective studies have examined these outcomes beyond emerging adulthood. As well, existing studies have been limited by retrospective and cross-sectional designs and/or have examined shyness as a dichotomous construct. The present prospective longitudinal study ($N = 160$; 55 males, 105 females) examined shyness trajectories from childhood to the fourth decade of life and mental health outcomes. Shyness was assessed using parent- and self-rated measures from childhood to adulthood, once every decade at ages 8, 12–16, 22–26, and 30–35. At age 30–35, participants completed a structured psychiatric interview and an experimental task examining attentional biases to facial emotions. We found 3 trajectories of shyness, including a low-stable trajectory (59.4%), an increasing shy trajectory from adolescence to adulthood (23.1%), and a decreasing shy trajectory from childhood to adulthood (17.5%). Relative to the low-stable trajectory, the increasing, but not the decreasing, trajectory was at higher risk for clinical social anxiety, mood, and substance-use disorders and was hypervigilant to angry faces. We found that the development of emotional

problems in adulthood among the increasing shy trajectory might be explained in part by adverse peer and social influences during adolescence. Our findings suggest different pathways for early and later developing shyness and that not all shy children grow up to have psychiatric and emotional problems, nor do they all continue to be shy.

Keywords Shyness · Trajectories · Social anxiety · Attention bias · Mental health

Shyness reflects an anxious preoccupation with the self to real or imagined social situations (Melchior and Cheek 1990). Although this definition appears to be a unitary dimension, shyness is a broad multi-component phenomenon. In theory, shyness ranges from features of temperament to self-concept. Shyness has been proposed to include cognitive (e.g., self-consciousness, self-preoccupation in social situations), affective (e.g., social anxiety, somatic symptoms), and behavioral (e.g., social inhibition, avoidance, and reticence) components, with some individuals experiencing only one or two of the three components considered as shy (Cheek and Briggs 1990). Because these aspects overlap with symptoms of social anxiety (Beidel and Turner 1999), shyness can be viewed as a sub-syndromal form of social anxiety. In assessment, shyness questionnaires include items tapping cognitive, affective, and behavioral aspects that decompose into factors labeled as social avoidance/distress, social facility, and difficulties being assertive, and are correlated with measures of social anxiety, anxiety and depression, as well as personality dimensions, such as introversion and neuroticism (Hopko et al. 2005; Jones et al. 1986).

The past several decades of scientific investigations and popular writings on childhood shyness have highlighted deleterious effects of childhood shyness on adult life course

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✉ Alva Tang
tanga6@mcmaster.ca

¹ Department of Psychology, Neuroscience & Behaviour, McMaster University, 1280 Main Street West, Hamilton, ON, Canada L8S 4K1

² Department of Psychiatry and Behavioural Neurosciences, McMaster University, Hamilton, ON, Canada

³ Department of Pediatrics, McMaster University, Hamilton, ON, Canada

outcomes. For example, shy children tended to delay marriage, parenthood, and stable career establishment when examined in their 30s (Caspi et al. 1988; also see, Dennissen et al. 2008; Kerr et al. 1996). Others found that when shy children reached emerging adulthood, they exhibited lower social competence (Grose and Coplan 2015), and more aggression if they also lacked social support from their parents in adolescence (Hutteman et al. 2009) relative to their non-shy peers. While some shy compared to non-shy children face more socioemotional challenges on a daily basis (see Rubin et al. 2009; Schmidt and Buss 2010, for reviews), a popular belief is that childhood shyness is a problem that requires intervention as it increases the risk for developing social anxiety disorder (SAD; see Crozier 2014; Lane 2008). Surprisingly, no prospective studies have, however, repeatedly assessed shyness across development and beyond emerging adulthood to examine whether childhood shyness predicts mental health in adulthood.

Much of the research on the association between childhood shyness and adult mental disorders exhibits methodological weaknesses, including the use of cross-sectional designs, retrospective reports, and limited conceptualization and measurement of shyness across the lifespan. For example, in a sample of 5877 participants aged 15–54, 26% of women and 19% of men retrospectively identified themselves as being “very shy” during childhood, but only a minority of these shy women (28%) and shy men (21%) met lifetime SAD diagnosis of the DSM-III-R (Cox et al. 2005). Likewise, in a national sample of adolescents (ages 13–18), 47% of the sample identified themselves as shy, but only 12.4% of these shy adolescents met criteria for lifetime diagnosis of SAD of the DSM-IV (Burnstein et al. 2011). Furthermore, in a cross-sectional study of 200 adults, Heiser et al. (2003) found that among the 20 individuals who met DSM-IV criteria for SAD, 17 were shy, while 3 were non-shy. Notably, the distributions of shyness scores overlapped between shy adults who met criteria for SAD and shy adults who had not met criteria, suggesting that SAD is not merely extreme shyness. Also, shyness did not only predict a diagnosis of SAD, but a range of psychiatric disorders, as a greater proportion of the shy group (67%) relative to the non-shy group (42%) met diagnostic criteria for either an Axis I or II DSM disorder, predominantly anxiety, mood, or avoidant personality disorders (Heiser et al. 2003). Taken together, these findings suggest an increased likelihood of some shy individuals being diagnosed with SAD, but this association is neither direct, nor specific. As well, these retrospective and cross-sectional studies suggest that while shy children and adolescents are more likely to develop SAD, the majority of shy children do not develop SAD, and some will develop SAD without being shy.

A major limitation of studies relying on retrospective reports of shyness in clinical populations is that participants’ recall and interpretation are susceptible to negative cognitive

biases. In contrast, prospective longitudinal studies can avoid such confounds. However, many of the existing longitudinal studies of childhood shyness use only a single measurement of shyness during middle childhood to predict outcomes in adulthood (e.g., Caspi et al. 1988; Grose and Coplan 2015; Kerr et al. 1996). Some of these studies also rely on a single item to measure shyness (e.g., Burnstein et al. 2011; Cox et al. 2005; Grose and Coplan 2015), do not account for shyness in adulthood (Grose and Coplan 2015), and assign participants to dichotomized (shy, not shy) groups, overlooking possible developmental changes and heterogeneity within shyness.

Although some studies have attempted to track the developmental trajectories of shyness and related constructs (e.g., behavioral inhibition and social withdrawal) during the early school age years (Degnan et al. 2014; Grady et al. 2012) and adolescence (e.g., Karevold et al. 2012; Oh et al. 2008), none have reported on mental health outcomes beyond emerging adulthood. As well, the timing of the onset of shyness and corresponding life-course sequelae have received little attention.

The development of early versus later onset of shyness is potentially linked to different long-term consequences. Buss (1986) posited that there are at least two types of shyness: early and later developing shyness which he conceptualized as fearful and self-conscious shyness, respectively. Early shyness resembles behavioral inhibition, a biologically based temperamental antecedent to shyness characterized by reactivity that is undifferentiated in social and non-social contexts in early infancy (Kagan 1994). Based on retrospective reports from young adults, early developing shyness involves more physiological anxiety symptoms than later developing shyness (Cheek and Krasnoperova 1999; Cheek et al. 1986). In contrast, later versus early shyness reflects a broader personality phenotype that is largely driven by social contexts and the development of the self-concept, self-awareness, self-conscious emotions (e.g., shame, embarrassment), and a fear of negative evaluation, all of which require perspective taking skills and knowledge of social standards in early to middle childhood (Flavell 2000; Harter 2012; Lagattuta and Thompson 2007). It is important to point out, however, that some behavioral signs of early self-conscious shyness begin in and increase across toddlerhood (Eggum-Wilkens et al. 2015), suggesting that self-conscious shyness may appear earlier in life than originally proposed by Buss (1986).

Shyness is hypothesized to be intensified during adolescence as social fears and self-awareness increase when social and peer relationships become more valued (Beidel and Alfano 2011). Indeed, trajectory studies of social withdrawal extended into early adolescence have documented an increasing trajectory that resembles the self-conscious type of shyness (Oh et al. 2008). However, the related construct of social withdrawal refers to a behavioral style characterized by a lack of engagement in social interactions and social isolation, such

as playing alone, watching peers from afar, and being unoccupied (Rubin et al. 2003). Shyness overlaps with social withdrawal as some shy children are afraid and anxious to interact, some may lack motivation and avoid interactions (Coplan et al. 2004), but social withdrawal can result from other reasons, including peer rejection for child's immaturity or aggressiveness or a preference to be alone (Pope et al. 1991; Rubin and Mills 1988), or a combination of these reasons.

Still, in adolescence and adulthood, other shy subtypes based on different interpersonal (e.g., levels of sociability) and attachment styles can distinguish shy people who prefer involvement in social interactions from those who are withdrawn and depressed (Cheek and Buss 1981), as well as shy people who are more well-adjusted, less shy, less depressed and lonely in family relationships and friendships (Cheek and Krasnoperova 1999). Accordingly, it is important to track shyness over time as its expression, correlates, and consequences may differ depending on its onset.

Relatively few studies, however, have tracked and repeatedly assessed the phenomenon of shyness longitudinally. There are some researchers who have investigated constructs related to shyness longitudinally, such as behavioral inhibition and social withdrawal. For example, Degnan and Fox (2007) found that behavioral inhibition was only modestly stable across childhood. Similarly, social withdrawal has been reported to be moderately stable from early to middle childhood (Hymel et al. 1990; Rubin et al. 1995) and during late childhood to adolescence (Schneider et al. 1998). In adulthood, approximately 50% of non-shy college students reported being shy during early adolescence (Bruch et al. 1986), and 90% of the general population reported being shy at one point in their lives (Zimbardo et al. 1975). Interestingly, a recent prospective study showed that individuals whose behavioral inhibition remained high and stable across childhood were at greater risk for SAD in adolescence (Chronis-Tuscano et al. 2009) and anxiety disorders in emerging adulthood (i.e., late teens-early 20's; Frenkel et al. 2015). Whether these patterns extend to the fourth decade of life remains an empirical question.

It is also important to point out that social skills and peer relations are important contexts that should be examined in understanding the development of shyness and later psychopathology, as shy children often face greater peer rejection, victimization, and loneliness than their non-shy peers (Rubin et al. 2009). Positive and negative peer experiences may have different effects. Shy children who are socially excluded face a higher risk of internalizing problems (e.g., Gazelle and Ladd 2003; Gazelle and Rudolph 2004; Ladd 2006). Likewise, positive and negative peer influences during adolescence can buffer or exacerbate mental health problems in young adults who were classified as behaviorally inhibited in childhood (Frenkel et al. 2015).

In addition to influences from the peer context, sex differences may also play a role in the development of shyness.

Relative to shy girls, shy boys tend to face more peer exclusion and internalizing problems, although the latter involves mixed findings (see review, Doey et al. 2014). There also appears to be mixed findings regarding the effects of sex differences on the long term consequences of childhood shyness (Asendorpf et al. 2008; Caspi et al. 1988; Kerr et al. 1996).

The Present Study

We prospectively followed a cohort of individuals born between years of 1977 to 1982 and assessed shyness in each of the first four decades of life (at ages 8, 12–16, 22–26, and 30–35). At the most recent assessment (age 30–35), participants completed a structured psychiatric diagnostic interview and an attentional task assessing emotion processing biases.

There were three primary objectives in the present study. The first was to classify trajectories of shyness across the first four decades of life, because shyness varies on a continuous dimension but subgroups can be captured by patterns of stability (i.e., how shyness changes across time) within the population. Second, we examined whether these trajectories predicted mental health outcomes at age 30–35 years. Finally, given the trajectory analyses generated two shyness trajectories resembling early and later developing shyness, we conducted exploratory analyses to test whether potential social contexts moderated the links between shyness trajectories and mental health problems in adulthood.

We predicted that compared to low-stable and/or decreasing shyness trajectories in adulthood (age 30–35), a high-stable and/or increasing shyness trajectories would be associated with 1) higher risk for anxiety and mood disorders, particularly SAD (e.g., Chronis-Tuscano et al. 2009; Frenkel et al. 2015), substance-use and alcohol-use disorders as shy individuals may self-medicate with substances to cope with their shyness and use alcohol to facilitate social interactions (e.g., Carducci 2009; Lahat et al. 2012; Lewis and O'Neill 2000; Santesso et al. 2004). Given the converging evidence in a series of electrocortical (Jetha et al. 2012, 2013), neuroimaging (Beaton et al. 2008; Tang et al. 2014) and behavioral (Pérez-Edgar et al. 2010, 2011) studies that suggest shy and behaviorally inhibited individuals have affect-related attentional biases reflecting their hypervigilance to social threat (in the form of angry facial expressions), we also predicted that high-stable and/or increasing shyness trajectories would be associated with 2) greater attentional bias to angry facial expressions. On the other hand, we predicted that individuals who were shy in childhood but who became less shy over time (i.e., those who “outgrew” their shyness) would not be at risk for these problems.

As our secondary goal, we explored potential 1) social contexts (e.g., peer victimization and social competence in childhood and adolescence) that may be linked to different

shyness trajectories, 2) sex differences by shyness trajectory interactions, and 3) shyness trajectories by social competence by peer victimization interactions for the risk of mental disorders and attention bias to angry faces in adulthood.

Method

Participants and Overview

Participants were part of a larger longitudinal birth cohort study examining the development of extremely low birth weight (ELBW) and normal birth weight (NBW) children born from 1977 to 1982 in central-west Ontario (Saigal et al. 1984). The initial sample of ELBW at birth included 179 individuals. One hundred forty five NBW controls were recruited at age 8 and matched with the ELBW group on age, race, sex, and socioeconomic status (SES) (Saigal et al. 1991). At age 12–16, 141 ELBW and 122 NBW participated; at age 22–26, 149 ELBW and 133 NBW participated; finally at age 30–35, 100 ELBW and 89 NBW participated. Among the initial sample who were eligible to participate, 160/309 (52%) nonimpaired participants (n for ELBW = 80, n for NBW = 80; 55 males, 105 females; M age = 32.29) had complete data for shyness across all four visits and were included in the trajectory analyses. Participants' birth weight and sex were extracted from their medical charts, and parental SES at age 8 was defined using the 2-factor Hollingshead Index (Hollingshead 1969). Because ELBW and NBW groups did not differ on shyness at the initial assessment $t(158) = 0.27$, $p = 0.79$, and assignment in shyness-trajectories did not depend on birth weight $\chi^2(2) = 4.36$, $p = 0.11$, we collapsed the two groups. Importantly, we controlled for birth weight and childhood caregiving environment in all analyses, and ensured that the derived trajectories were not disproportionately represented by ELBW versus NBW participants on any of the outcome measures ($ps > 0.05$). We also controlled for any neurosensory impairments.

Participants were assessed at four time points: childhood (age 8), adolescence (age 12–16), young adulthood (age 22–26), and adulthood (age 30–35). Parent- and self-report questionnaires of emotional and behavioral problems were obtained across four time points using the Achenbach System of Empirically Based Assessment (Achenbach 1991, 1997). Study procedures at each assessment were approved by the Hamilton Health Sciences Research Ethics Board.

Shyness Composites

At ages 8 and 12–16 years, parents completed the 113-item Child Behavior Checklist (CBCL) and the Ontario Child Health Study-revised scales (OCHS-R) (Boyle et al. 1993; Saigal et al. 2003) that contained some items adapted from

the CBCL (Achenbach 1991). At ages 22–26 and 30–35 years, participants completed the 130-item Young Adult Self Report (YASR) (Achenbach 1997). We created composite measures of shyness at ages 8, 22–26, and 30–35, by summing z -scores of six interrelated items at age 8 that were conceptually related to shyness, and used the same six items at later time points to maintain measurement consistency. Because two of these items were unavailable at age 12–16 as the full CBCL was not used at this assessment, the shyness composite was created by summing z -scores of 4 items. Table 1 summarizes the items used to create the shyness composites at each time point. All four shyness composites were intercorrelated at each assessment, each was correlated with the widely used Cheek and Buss shyness scale (Cheek and Buss 1981) measured in adulthood, and each had acceptable Cronbach alpha's, providing reliability and convergent validity of our construct. The construct captures the behavioral and cognitive aspects of shyness (see Supplemental Materials Online for details on factor structure). Baseline anxiety and depressive symptoms at age 8 was obtained from the CBCL anxious/depressed subscale (excluding the "self-conscious/easily embarrassed" item in our shyness composite) and used as a covariate in further analyses.

Outcome Measures in Adulthood (age 30–35 years)

MINI International Neuropsychiatric Interview The MINI is a structured diagnostic interview that assesses psychiatric disorders in a manner consistent with the DSM-IV and the International Classification of Diseases, 10th Revision. It shows strong agreement with the Structured Clinical Interview for DSM-IV disorders and World Health Organization Composite International Diagnostic Interview, and strong interrater reliability (Sheehan et al. 1998). As the MINI focuses on current psychiatric disorders, we added modules from the MINI-Plus (Sheehan et al. 1998) to assess both current and lifetime prevalence of a subset of psychiatric disorders (Van Lieshout et al. 2015). Given our a priori hypotheses for examining anxiety-, mood-, and substance-related disorders and to maintain a minimum frequency of diagnoses (> 5), we included current SAD (generalized and non-generalized subtypes), agoraphobia, and generalized anxiety disorder, both current and lifetime panic disorder, major depressive disorder (MDD), alcohol abuse and dependence, and substance abuse and dependence. The MINI was administered by doctoral psychology students who were trained and blinded to the study's hypotheses.

Attentional Biases to Facial Emotions Participants completed a visual dot-probe task (Mogg et al. 2004) in a dimly lit, sound attenuated room, sitting ~100 cm away from the monitor (75 Hz vertical refresh rate). Visual stimuli consisted of four models (two females), each posing angry, happy, and neutral facial expressions from the NimStim face database

Table 1 Selected items from the CBCL, YASR, and OCHS-R used to define shyness, intercorrelations among composite measures of shyness, inter-item alphas for each composite measure, and correlations with a valid shyness scale across the four assessments

Item	Age 8 CBCL (parent-rated)	Age 12–16 OCHS-R CBCL (parent-rated)	Age 22–26 and 30–35 YASR (self-rated)	
1	“shy or timid”	“self-conscious or easily embarrassed”	“I am too shy or timid”	
2	“self-conscious or easily embarrassed”	“withdrawn or isolates self”	“I am self-conscious or easily embarrassed”	
3	“likes to be alone”	“overly anxious to please”	“I would rather be alone than with others”	
4	“secretive, keeps things to self”	“doing things less with other kids”	“I am secretive or keep things to myself”	
5	“refuses to talk”		“I refuse to talk”	
6	“doesn’t get involved with others”		“I keep from getting involved with others”	
Shyness composite scores				
	1. Age 8	2. Age 12–16	3. Age 22–26	4. Age 30–35
1	–	0.25**	0.21**	0.15*
2		–	0.18**	0.29**
3			–	0.55**
4				–
Cronbach’s alpha	0.65	0.58	0.72	0.68
Cheek and Buss Shyness scale at age 22–26	0.31**	0.21*	0.61**	0.44**

CBCL Child Behavior Checklist, OCHS-R Ontario Child Health Study-revised scales, YASR Young Adult Self Report 2-tailed, ** $p < 0.01$, * $p < 0.05$

(Tottenham et al. 2009). Each trial unfolded in the following sequence: a) a central fixation cross is presented for 500 ms; b) two faces of the same model were presented side-by side (angry-neutral, happy-neutral) for 104 ms; c) a probe (i.e., an asterisk) is presented in the left or right visual field. Participants were asked to indicate the probe location (left/right) on a custom-labeled response pad as fast and accurate as possible. Participants’ response prompted each subsequent trial, however, trials would automatically begin if no response was recorded within 1500 ms of the probe presentation. Participants completed a practice block prior to the actual task.

A total of 128 trials were divided into 2 blocks. In each block, there were 32 angry-neutral trials and 32 happy-neutral trials. The order of stimulus was randomized for each participant within each block. All trials were balanced for the emotional stimuli and targets to appear with equal probability in the left and right visual fields. The probability (50%) of congruent (probe appears in same position as the emotional face) and incongruent (probe appears in same position as the neutral face) trials was also balanced.

Trials with reaction times faster than 150 ms were removed from the analysis to account for random or anticipatory responses. Attention bias scores for happy and angry faces were calculated as the difference between the mean incongruent reaction time and the mean congruent reaction time for that

emotion. A positive attention bias score indicates vigilance, whereas a negative score indicates avoidance of a stimulus.

Social Relational Measures in Childhood and Adolescence

Peer Victimization Retrospective reports of verbal and physical bullying frequencies throughout childhood to adolescence were obtained from two items adapted from the Childhood Experiences of Violence Questionnaire (Walsh et al. 2008) at age 22–26. The items for verbal and physical bullying included: “Sometimes kids get hassled or picked on by other kids who say hurtful or mean things to them, how many times did this happen to you before age 16?”, and “sometimes kids get pushed around, hit or beaten up by other kids or a group of kids, how many times did this happen to you before age 16?”. Both items were scored on a 5-point scale (1 = never; 5 = more than 10 times).

Social Competence We created a theoretically and empirically derived composite score of social competence with peers by summing z-scores of the social competence scale from the self-perception profile for adolescents (Harter 2012) and reversed z-scores on an item in the OCHS-R that tapped social competence (Saigal et al. 2003), “in the past 6 months, how well have you been getting along with other kids” that was scored on a 5-point scale (1 = very well, no problems; 5 = not

well at all, constant problems). These self-report measures were collected in the adolescent assessment. These two scales were correlated ($r = -0.46, p < 0.001$), suggesting they both tap social competence and abilities to handle peer interactions. Thus, high scores on this composite reflect high self-perceived social competence at adolescence.

Covariates

We included birth weight, participants' sex, presence of neurosensory impairment, anxiety and depressive symptoms from the CBCL subscale and SES at age 8 in all analyses to account for potential differences in the prevalence of psychiatric disorders, emotion processing, and socioeconomic inequalities that may be linked to anxiety and depressive symptoms across the lifespan.

Data Analyses

First, we estimated trajectories of shyness from middle childhood (age 8) to adulthood (age 30–35) with normalized shyness composite scores across the four time points using k-means for longitudinal data in the statistical analysis package R (Genolini and Falissard 2011; Genolini et al. 2015). K-means is an exploratory hill-climbing algorithm that derives clusters of homogenous subgroups within a larger heterogeneous population; simulations demonstrate comparable efficiency to latent class models in Proc Traj (Genolini and Falissard 2011) and usage has been endorsed by other longitudinal studies (e.g., Pingault et al. 2013, 2014). In this procedure, each observation is first arbitrarily assigned to a cluster, then optimal clustering is achieved by repeatedly calculating the mean of each cluster and reassigning each observation to its nearest mean until no further changes occur.

To obtain optimal solutions, we repeated the estimations 400 times, 100 times each for 2-, 3-, 4-, and 5-cluster solutions. We estimated these numbers of clusters as the literature suggests heterogeneous groups of shy people exist, but we do not know how many. To choose the best cluster solution, we considered a combination of fit/quality of partition statistics of the model, including the Calinski-Harabatz, BIC, and the global average of post-probabilities (the probability for each participant to effectively belong to the trajectory he/she was assigned), prior empirical findings, theory, and usefulness of classes.

Second, binary logistic regression models assessed the strength of association between membership in shyness-trajectories and risk for each psychiatric diagnosis, while accounting for sex (male, female), birth weight (ELBW, NBW), neurosensory impairment (yes, no), anxious/depressed symptoms and parental SES at age 8.

Third, separate one-way analysis of variance (ANOVAs) assessed the effect of different shyness-trajectories on each

of the angry and happy attentional bias measures from the dot-probe task and separate social relational indices (i.e., social competence, and frequencies of verbal and physical victimization) as the dependent variable, while accounting for the same covariates. The Sidak post-hoc method assessed pairwise differences among the three shyness-trajectories.

Participant Attrition and Data Loss

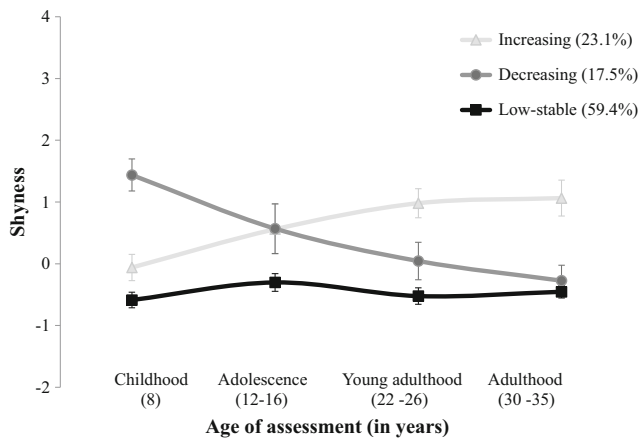
We took a conservative approach in the trajectory analysis and included only participants who participated in the study at all four assessments, and one of these participants was excluded for unusual data ($N = 160$). Although we also imputed missing data for participants with only one missing data point of shyness and obtained largely similar results, there were slight differences (see Supplemental Materials Online for details), and hence we report findings based on the 160 participants with no missing shyness data. Of those who were included in the trajectory analyses versus those who were not, there were no differences in birth weight status, $\chi^2(1) = 3.52, p = 0.074$, or shyness, $\chi^2(1) = 2.37, p = 0.13$. However, males, $\chi^2(1) = 18.07, p < 0.001$, and the lowest and second lowest SES classes, $\chi^2(4) = 15.21, p < 0.001$, were less likely to consistently return to the study.

Of the 160 participants included in the analyses, some did not complete the MINI, the dot-probe task, or had missing data on other measures. Accordingly, the logistic regression analyses included 135 to 139 participants depending on the disorder category. The ANOVAs for the dot-probe task (owing to technical problems) included 119 participants; for the victimization and social competence measures, there were 155 and 144 participants, respectively.

Results

Developmental Trajectories of Shyness

Three developmental trajectories of shyness were identified from the analysis (Fig. 1): 1) a consistently low-stable non-shy trajectory (59.4%), 2) an increasing shy trajectory beginning in adolescence (23.1%), and 3) a decreasing shy trajectory beginning in childhood (17.5%). The y-axis reflects the transformed shyness z-score. Although a z-score of zero reflects average shyness, it is not a good measure of central tendency as the distribution is positively skewed with most of the individuals in the low-stable non-shy trajectory, which we consider a baseline normative group to compare with the two shy trajectories. A multinomial logistic regression model that regressed shyness-trajectories on birth weight, participants' sex, neurosensory impairment, and SES demonstrated these variables were not related to this shyness classification, consistent with the notion that shyness is a normal variation of personality in the population.



Note. Error bars are 95% confidence intervals for the means.

Fig. 1 Mean shyness trajectories from childhood to adulthood. Note. Error bars are 95% confidence intervals for the means

Partition quality criterion for our 3-cluster model: Calinski Harabatz = 57.91, post probability global = 0.90, BIC = -1716.95. Values of the Calinski-Harabatz and posterior global average of post-probabilities across the 100 models for each of the 2-, 3-, 4-, and 5- cluster solutions (see [Supplemental Materials Online](#)) suggested the best fit for a 2-cluster model depicting a stable shy (34.4%) and a stable non-shy (65.6%) trajectories, followed by our 3-cluster solution (i.e., low-stable, increasing and decreasing trajectories), the 4-cluster solution, and lastly the 5-cluster solution. In contrast, values of the BIC suggested that 4- and 5- clusters solutions were best fitting. Due to discordance among fit statistics, we selected the 3-cluster model because theory and the literature suggests at least two different groups of shy people (one that stays relatively stable, and one that decreases over time) and another group characterized by low shyness (e.g., Chronis-Tuscano et al. 2009; Oh et al. 2008). We also believed that a 3-cluster solution was a more useful classification for understanding the development of shyness in association with mental health due to its specificity compared to a 2-cluster solution. Indeed, the two shy trajectories in the 3-cluster solution stem from the high-stable shy trajectory from the 2-cluster solution (see [Supplemental Materials Online](#)). We did not consider the 4- or 5- cluster solutions due to our small sample size, as there were decreases in the number of participants in each trajectory with increases in the number of clusters.

Prediction of Psychiatric Disorders in Adulthood Table 2 displays frequencies and odds-ratios for shyness-trajectories associated with risk for different psychiatric disorders in adulthood. We chose the low-stable trajectory as the reference category due to our interest in examining how the two shy-trajectories contrasted with the larger non-shy trajectory. For anxiety disorders, the increasing trajectory had higher odds for a current diagnosis of SAD. For mood disorders, the

increasing trajectory had higher odds for both current and lifetime diagnoses of MDD. For substance-related disorders, the increasing trajectory had higher odds for both current and lifetime diagnoses of substance abuse and dependence disorders, as well as current alcohol abuse and dependence.¹

Prediction of Attentional Biases to Facial Expressions in Adulthood The ANOVA for attentional bias to angry faces revealed a main effect for shy-trajectories, $F(2, 112) = 3.00$, $p = 0.054$, $\eta p^2 = 0.05$. The increasing trajectory ($M = 14.34$; $SE = 3.96$) showed greater bias for angry faces than the low-stable trajectory ($M = 2.94$; $SE = 2.40$), $p = 0.055$ (see Fig. 2). The decreasing and low-stable trajectories did not differ on attention bias to angry faces in adulthood. There were no differences on attention bias to happy faces.

Peer Victimization and Social Competence in Childhood and Adolescence Retrospective reports of verbal bullying was different among the shyness-trajectories, $F(2, 147) = 6.92$, $p = 0.001$, $\eta p^2 = 0.09$. The increasing trajectory ($M = 4.13$; $SE = 0.25$) reported more verbal bullying than the low-stable trajectory ($M = 3.03$; $SE = 0.16$), $p = 0.001$ (Fig. 3a). However, there were no differences in the frequency of physical bullying among different shyness-trajectories.

There was only a trend depicting differences in self-perceived social competence among shyness-trajectories, $F(2, 137) = 2.43$, $p = 0.092$, $\eta p^2 = 0.034$. The increasing trajectory reported lower social competence than the low-stable trajectory (Fig. 3b).

Interactions among Shyness Trajectories, Social Competence, and Verbal Bullying

We performed logistic and linear regression models for separate binary and linear dependent variables of mental disorders and attention bias to angry faces regressed on predictors, including the highest order term for a three-way interaction (shyness trajectories by social competence by verbal bullying), their two-way interactions and main effects, and our control covariates (birth weight, participants' sex, anxiety/depressive symptoms and SES at age 8, and neurosensory impairments). Conditional effects were probed using the PROCESS macro for SPSS (Hayes 2013) to test simple slopes at low (1 SD below the mean), moderate (the mean), and high (1 SD above the mean) levels of the moderator. The only interactions that emerged are documented below.

¹ Additional analyses examining sex differences by shyness trajectory interactions for outcome measures were performed. However, no sex differences by shyness trajectory interactions emerged for any of the mental health outcomes, attentional bias to angry faces, social competence, and verbal or physical bullying.

Table 2 Logistic regression results predicting anxiety (A), mood (B), and substance-related (C) disorders at adulthood (age 30–35)

DSM diagnosis	No. of cases in shyness trajectories			Odds ratio (95% confidence interval)	
	Low-stable	Decreasing	Increasing	Decreasing	Increasing
(A) Anxiety disorders					
Social anxiety disorder (current)	2 (2.4%)	0	6 (20%)	–	8.76 (1.30–59.11)*
Agoraphobia (current)	3 (3.6%)	0	7 (23.3%)	–	5.16 (0.90–29.45)
Generalized anxiety disorder (current)	6 (7.1%)	1 (4%)	5 (16.7%)	0.45 (0.04–5.03)	2.04 (0.48–8.71)
Panic disorder (current)	2 (2.4%)	1 (4.2%)	2 (6.9%)	1.42 (0.10–22.45)	2.86 (0.25–32.72)
Panic disorder (lifetime)	4 (4.8%)	3 (12%)	6 (20%)	1.07 (0.13–9.17)	3.37 (0.73–15.53)
(B) Mood disorders					
Major depression (current)	2 (2.4%)	0	4 (13.3%)	–	30.16 (1.14–800.84)*
Major depression (lifetime)	13 (15.9%)	4 (16.7%)	16 (55.2%)	0.92 (0.18–4.68)	8.75 (2.60–29.41)*
(C) Substance-related disorders					
Substance abuse and dependence (current)	3 (3.6%)	2 (8%)	6 (20%)	2.33 (0.16–33.11)	13.18 (1.90–91.14)*
Substance abuse and dependence (lifetime)	11 (13.4%)	2 (8.3%)	7 (24.1%)	1.17 (0.16–8.50)	4.18 (1.08–16.15)*
Alcohol abuse and dependence (current)	8 (9.9%)	2 (8.3%)	5 (16.7%)	2.88 (0.36–22.69)	4.93 (1.08–22.53)*
Alcohol abuse and dependence (lifetime)	31 (36.9%)	5 (20%)	8 (26.7%)	0.53 (0.11–2.49)	1.00 (0.32–3.23)

Odds ratios are contrasted with the low-stable reference

DSM Diagnostic and Statistical Manual of mental disorders, No. number

“–” reflect unavailable odds ratios due to zero occurrences of a disorder in a group

Current Agoraphobia There was a 2-way interaction between shyness trajectories by verbal bullying, $b = -1.49$, $SE = 0.69$, $p = 0.03$. At low ($b = 4.51$, $SE = 1.96$, $p = 0.02$) and moderate ($b = 2.34$, $SE = 1.03$, $p = 0.02$) levels of verbal bullying among individuals in the increasing trajectory, there were higher odds for having agoraphobia; In contrast, high levels of verbal bullying did not have different effects on trajectories, $b = 0.17$, $SE = 0.58$, $p = 0.76$ (see interaction in

Supplemental Materials Online). The 3-way interaction was not significant.

Lifetime Alcohol Abuse and Dependence There was a 3-way interaction between shyness trajectories by verbal bullying by social competence, $b = -0.39$, $SE = 0.17$, $p = 0.025$. At low levels of verbal bullying, social competence did not predict differences in the odds of having lifetime alcohol abuse and dependence among shyness trajectories ($b = 0.18$, $SE = 0.34$, $p = 0.58$). However, at high ($b = 0.76$, $SE = 0.40$, $p = 0.054$) and moderate ($b = 0.48$, $SE = 0.24$, $p = 0.046$) levels of verbal bullying among those with higher social competence in the low-stable trajectory, there were higher odds for lifetime alcohol abuse and dependence. On the other hand, there was a trend that higher social competence had a protective effect among those with high verbal bullying in the increasing shy trajectory, as they had lower odds for lifetime alcohol abuse and dependence ($b = -0.62$, $SE = 0.33$, $p = 0.06$) The interaction is displayed in Supplemental Materials Online.

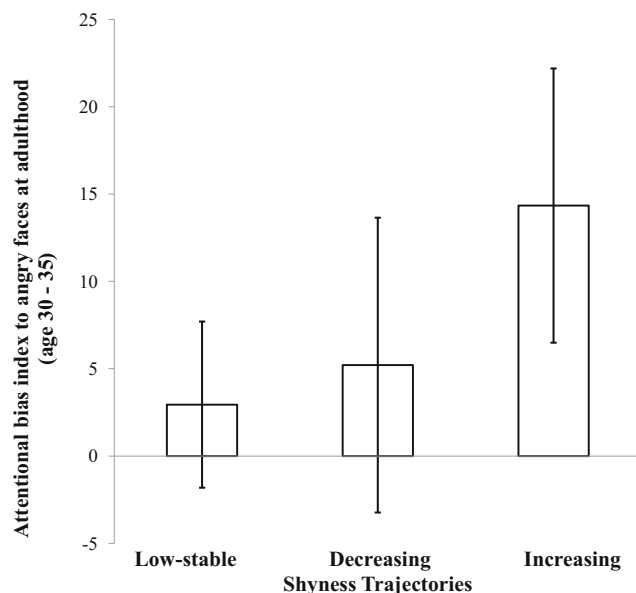
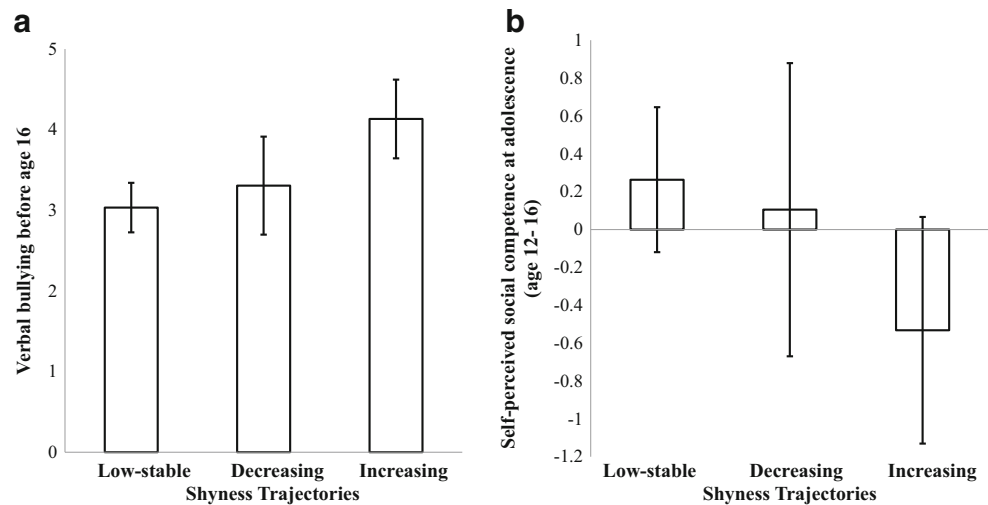


Fig. 2 Attentional biases to angry faces at adulthood (age 30–35). Note. Error bars are standard errors

Discussion

We used a longitudinal prospective design to examine the development of shyness across the first four decades of life in predicting mental health across multiple domains of functioning. The analyses revealed at least four noteworthy findings.

Fig. 3 Differences in verbal bullying incidences (a) and self-perceived social competence at adolescence (b) among shyness-trajectories. *Note.* Error bars are standard errors



First, we identified three trajectories of shyness that included a majority of individuals whose shyness was low and stable, a decreasing shyness trajectory from childhood on, and an increasing shyness trajectory beginning in adolescence. Notably, the decreasing and increasing shy trajectories replicate studies examining trajectories of social withdrawal from middle childhood to adolescence (Booth-LaForce and Oxford 2008; Oh et al. 2008) and extends this finding to the fourth decade in life. However, we speculate that the late divergence in our decreasing and increasing shyness trajectories may respectively capture shyness limited to childhood versus shyness with a later onset. Moreover, the proportions of our trajectories were similar to studies that have observed the majority of the adult population is non-shy while less than half of the population regard themselves as shy (Heiser et al. 2003; Zimbardo 1977).

Second, this three-trajectory model had predictive validity for different mental health outcomes in adulthood across multiple and converging measures. In support of our hypothesis, we found the increasing trajectory had higher risks specifically for SAD, as well as other mood-, and substance-related disorders compared to the low-stable trajectory, including MDD, and substance and alcohol use disorders. These findings converge with previous studies that found shyness and related constructs predicted higher risk for a number of anxiety (particularly SAD) and mood disorders (e.g., Caspi et al. 1996; Chronis-Tuscano et al. 2009; Essex et al. 2010; Gladstone et al. 2005; Heiser et al. 2003; McDermott et al. 2009) in adolescence and emerging adulthood. Further, these findings converge with studies that showed a combination of shyness and impulsive or sensation seeking characteristics are linked to substance-use (e.g., Ensminger et al. 2002; Santesso et al. 2004) and that some shy individuals use alcohol to relieve their anxiety (Carducci 2009; Lewis and O'Neill 2000), though the opposite finding has also been found (e.g., Bruch

et al. 1992). We also note that there was comorbidity among these distinct disorder categories.

Third, we found an increased attentional bias to angry facial expressions in the increasing trajectory that is indicative of hypervigilance to social threat and/or negative emotions. This pattern of attentional bias to threat is a correlate and risk factor for anxiety problems (Bar-Haim et al. 2007) and is consistent with attentional styles associated with social phobia (Bogels and Mansell 2004).

Fourth, we found that the decreasing shy trajectory, characterized by high childhood shyness that attenuated across time (i.e., the decreasing trajectory), was not associated with greater risks for adult psychopathology compared to the low-stable trajectory. These findings suggest that individuals who outgrew their childhood shyness were less likely to develop these psychiatric disorders and problem behaviors in adulthood. This finding is consistent with others who recently argued that most shy children do not grow up to develop SAD (Crozier 2014), nor are shy children at risk for other social-emotional problems in adulthood (Schmidt et al. 2016). However, we note that individuals in the decreasing shy trajectory were indistinguishable from those in the two other trajectories on attentional biases to angry faces.

Why Do some Shy Children Outgrow their Shyness, while Other Children Become Shy in Adolescence?

The emergence of different developmental patterns of shyness allowed us to further probe possible contexts moderating the links between the different shyness trajectories and mental health problems. For example, the increasing and decreasing shy trajectories that crossed during adolescence suggests possible influences in childhood and/or adolescence that might be responsible for reinforcing and/or ameliorating shyness.

Studies have shown that socially excluded shy children have more internalizing problems (Gazelle and Ladd 2003; Gazelle and Rudolph 2004; Ladd 2006), and shy children become less socially competent adults (Grose and Coplan 2015). Here, we found that the increasing trajectory retrospectively reported greater incidences of verbal bullying throughout childhood and adolescence and a trend of lower self-perceived social competence in adolescence relative to the low stable trajectory. However, the decreasing shy trajectory was indistinguishable on these social measures in contrast with the other two trajectories. Hence, we speculate that adverse peer relations during childhood and adolescence may reinforce the persistence of and/or ongoing increases in shyness into adulthood among individuals in the increasing trajectory. Perhaps, shy adolescents in the increasing trajectory were not socially skilled to build a social network and were discouraged from building social skills because they were victimized, as negative peer experiences may drive shy individuals to avoid social interactions. For example, shy preschoolers who are excluded by peers prefer to play alone (Coplan et al. 2014). Similarly, children in an increasing shyness-trajectory from grades 1 to 6 and grades 5 to 8 face greater peer exclusion and loneliness (Booth-LaForce and Oxford 2008; Booth-LaForce et al. 2012). In contrast, we found that shy adolescents in the decreasing trajectory reported less verbal bullying, so they might benefit from more peer acceptance and opportunities to build social skills and networks.

Similar recent findings showed that greater social involvement during adolescence buffers against anxiety in adulthood among individuals characterized by high and stable behavioral inhibition across childhood (Frenkel et al. 2015). Accordingly, adolescence may be a key developmental period linked to future adverse psychological and emotional consequences for shy individuals, depending on whether they were socially competent, as teenagers are expected to handle their interactions and initiate plans and activities with their peers rather than relying on their parents to do so. Future research should focus on the role of these social relations in the link between shyness and adult mental health.

With regards to the role of child sex in the development of shyness, we did not find any sex differences by shyness trajectory interactions for any of the outcomes. In examining long-term outcomes of shy children, some studies have reported sex differences in shyness with shy boys experiencing more unfavorable social outcomes in their 30s (Caspi et al. 1988). While some of these findings have been replicated (Kerr et al. 1996), other studies have not found sex differences (Asendorpf et al. 2008). These differences may be due to cultural as well as generational differences in the different cohorts. Also, because many of the prior studies on sex differences in shyness have been cross-sectional (see Doey et al. 2014), it is important for future research to conduct additional longitudinal studies to examine whether sex differences in shyness persist across development.

Strengths and Limitations

A number of strengths should be mentioned. First, we showed initial evidence of different developmental trajectories of shyness across four decades of life and their influence on mental health in adulthood. These detailed descriptions of different developmental trajectories of shyness are important, because they provide a fundamental basis for generating new hypotheses to examine factors, such as genetic, neural, or social processes that may play a role in the development of shyness and later psychopathology. Our study began at age 8 when shyness is fully manifested as a sense of self, self-conscious emotions, and perspective-taking skills, which are central to shyness, develop in early to middle childhood (Flavell 2000; Harter 2012; Lagattuta and Thompson 2007). Second, we used a prospective longitudinal design and repeated assessments of shyness once every decade that allowed us to characterize developmental patterns of shyness and subgroups with greater resolution than prior studies that have used only two time points. Third, although we had hypotheses about how shyness develops in different individuals, the data-driven extraction of longitudinal trajectories was useful as it made no assumptions about the shape of shy trajectories which are not clearly defined in the “real” world, and affirmed our hypotheses. Although shyness showed modest stability across assessments, the trajectory analysis addressed both issues of subgroups and changes across time, as well as reasons for changes among subgroups. Lastly, rather than relying on one diagnostic measure of mental disorders, we established converging evidence in a comprehensive group of assessments, including clinical and behavioral measures.

There were also several limitations. First, although our sample size was more than adequate for trajectory analyses, the relatively small sample size for detecting clinical problems in the population may have contributed to some wide confidence intervals in the odds ratios. Second, we used subjective measures of shyness and different informants which could have possibly led to measurement variance. Although we used a prospective design and our composites at each age were conceptually and empirically derived measures of shyness that were correlated with a widely used shyness measure, it is possible that due to measurement variance, we were measuring other closely related phenomena to shyness, such as social withdrawal, depression, or low self-esteem, since our shyness measures were derived from items from the CBCL and YASR which may have reflected phenotypes related to shyness. Accordingly, it is possible that what we were measuring in the increasing shyness trajectory was a combination of shyness, and related phenomena, such as social withdrawal, anxiety, low self-esteem, and depression that would be obviously linked to our related psychiatric outcomes. Third, we did not measure shyness or its temperamental antecedents (e.g., behavioral inhibition) before age 8 to account for early child development,

so we do not know whether earlier antecedents of shyness (e.g., temperamental inhibition) might be more sensitive predictors of later problems as has been reported in other studies (e.g., Chronis-Tuscano et al. 2009). Should behavioral inhibition overlap with shyness, then a consistently high shy trajectory beginning in infancy would be projected, which would not have confounding onsets of shyness, internalizing symptoms and disorders. Finally, although our sample was a statistically homogenous sample, we used a mixed sample of ELBW and NBW individuals to increase our sample size. Even though the ELBW group was more inhibited than the NBW group in young adulthood (Schmidt et al. 2008) and have more psychiatric problems in adulthood (Van Lieshout et al. 2015), we a) controlled for birth weight in all analyses, b) found evidence of three similar shyness-trajectories in the NBW group only, and c) ensured both classification of trajectories and adult outcomes were not disproportionately represented by ELBW versus NBW participants. Nevertheless, future studies should include a larger, typically developing sample, objective measures of shyness beginning in early childhood to ensure the reliability and generalizability of the present findings.

Conclusion and Implications

The present study appears to be the first prospective longitudinal study to use trajectory analyses to understand mental health outcomes of shyness across the first four decades of life. Our findings showed that only individuals whose shyness increased after adolescence were at greater risks for psychiatric and emotional problems in adulthood. Moreover, the peer and social contexts during adolescence may buffer against or exacerbate shyness, which in turn may be linked to detrimental mental health in adulthood. Finally, our findings not only provide theoretical understanding of how shyness develops overtime in different individuals, but also has clinical implications for interventions to decide whom, when, and what kinds of behaviors to target in order to promote healthy development.

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Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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