HHS Public Access

Author manuscript

J Child Psychol Psychiatry. Author manuscript; available in PMC 2016 October 01.

Published in final edited form as:

J Child Psychol Psychiatry. 2015 October ; 56(10): 1065–1073. doi:10.1111/jcpp.12390.

Early childhood behavioral inhibition, adult psychopathology and the buffering effects of adolescent social networks: a twenty-year prospective study

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Abstract

Background—We examined whether the temperament of behavioral inhibition is a significant marker for psychopathology in early adulthood and whether such risk is buffered by peer social networks.

Methods—Participants (N=165) were from a prospective study spanning the first 2 decades of life. Temperament was characterized during infancy and early childhood. Extent of involvement in peer social networks was measured during adolescence, and psychopathology was assessed in early adulthood. Latent Class Analyses generated comprehensive variables at each of three study time-points. Regressions assessed (a) the direct effect of early behavioral inhibition on adult psychopathology (b) the moderating effect of adolescent involvement in social peer networks on the link between temperamental risk and adult psychopathology.

Results—Stable behavioral inhibition in early childhood was negatively associated with adult mental health (R^2=0.07, *p*=0.005, β = −0.26), specifically increasing risk for adult anxiety disorders (R^2=0.04, *p*=0.037, β=0.19). These temperament-pathology relations were significantly moderated by adolescent peer group social involvement and network size (Total R^2=0.13, p=0.027, β=−0.22). Temperament predicted heightened risk for adult anxiety when adolescent social involvement was low (*p*=0.002, β=0.43), but not when adolescent social involvement was high.

Conclusions—Stable behavioral inhibition throughout early childhood is a risk factor for adult anxiety disorders and interacts with adolescent social involvement to moderate risk. This is the first study to demonstrate the critical role of adolescent involvement in socially active networks in

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The authors have declared that they have no potential or competing conflicts of interest.

moderating long-lasting temperamental risk over the course of two decades, thus informing prevention/intervention approaches.

Keywords

Child Temperament; Adult Psychopathology; Anxiety; Adolescence; Social Networks

Introduction

Current models of developmental psychopathology highlight the interactive influences of temperament and environmental factors in shaping risk for anxiety. Temperament refers to individual differences in reactivity that arise in the first years of life (Rothbart & Bates, 2006; Shiner et al., 2012). The temperament of 'behavioral inhibition' (BI), seen in approximately 15-20% of children, is the best known predictor of risk for later anxiety (Biederman et al., 2001; Clauss & Blackford, 2012; Kagan, 1998, 2001; Perez-Edgar & Fox, 2005). Almost 50% of inhibited children develop anxiety disorders (Degnan & Fox, 2007). Stable BI across infancy and early childhood is a particularly robust risk factor for anxiety (Chronis-Tuscano et al., 2009; Hirshfeld et al., 1992). Importantly, BI is associated with unique physiological and neural response patterns (Fox, Henderson, Marshall, Nichols, & Ghera, 2005), as well as salient behavioral characteristics that manifest over time and emerge early in life in everyday settings (e.g. the home, the playground) (Rothbart & Hwang, 2002). This includes heightened reactivity and negative affect in response to novelty in infancy (Kagan, Resnick, Clarke, Snidman, & Garcia-Coll, 1984), and withdrawn, socially-reticent behavior in unfamiliar social situations throughout childhood (Calkins, Fox, & Marshall, 1996; Fox, Henderson, Rubin, Calkins, & Schmidt, 2001; Rubin, Burgess, & Hastings, 2002). The salience of these characteristics together with their well-established links to later psychopathology make BI a particularly important and clinically relevant risk marker.

Importantly, the relations between BI and pathological outcomes may be influenced by the environment (Lewis-Morrarty et al., 2012; Rapee, Kennedy, Ingram, Edwards, & Sweeney, 2010). In adolescence, the peer group emerges as a particularly salient source of socialization, exerting the greatest influence during middle adolescence and gradually declining thereafter (e.g. Collins & Steinberg, 2006; Rubin, Bukowski, & Parker, 2006). The emergence of the peer group as a salient influence in adolescence coincides with a sharp increase in risk behaviors and the onset of psychiatric disorders (Nelson, Leibenluft, McClure, & Pine, 2005) The coinciding increase of peer group salience and rates of psychopathology raises the possibility that peer networks influence mental health. Adolescence thus serves as an inflection point, providing an ideal time to study characteristics of the peer social network, their impact on psychosocial trajectories, and implications for adult mental health.

In early adolescence, peer social networks grow in complexity and size (Collins & Steinberg, 2006). High levels of social integration, indexed by social network size, are positively associated with psychosocial health (e.g. Ennet et al., 2006; Ueno, 2005). Additionally, the peer group with which individuals affiliate, and particularly individual's

perceptions of peer group norms, become important factors through which attitudes and behavior are influenced (Bukowski, Brendgen, & Vitaro, 2007; Terry, Hogg, & White, 2000). Specifically, the social norms of the peer group (e.g., level of peer group involvement in social activities) both influence and reflect an individual's own level of involvement in social activities. Together, social network size and level of peer group social involvement may index levels of social involvement and consequent exposure to peer interactions.

The extent of peer group social involvement may have unique effects on adolescents with a history of BI. Inhibited children avoid social encounters with unfamiliar peers and isolate themselves from peer group interactions. Moreover, they tend to affiliate with similarly-inhibited peers (Rubin et al., 2006), perhaps due to selection processes based on principles of 'homophily' (i.e., the notion that children are attracted to and become friends with others who are similar to them) (Ennet and Bauman, 1994; McPherson, Smith-Lovin and Cook, 2001; Simons-Morton, 2007). Specifically, for adolescents with a history of BI, involvement in socially active peer groups could modulate social avoidance, contribute to adaptive regulatory capacities, and increase resilience in the face of BI-related risk for anxiety. Modulation of BI-related risk by peer involvement is in line with previous findings regarding the moderating effects of early childhood social experience on continuity of BI (Almas et al., 2011; Fox et al., 2001).

Few samples characterized for temperamental risk in infancy have been followed over the course of more than two decades into adulthood (Caspi, Moffitt, Newman, & Silva, 1996; Schwartz, Snidman, & Kagan, 1999; Schwartz, Wright, Shin, Kagan, & Rauch, 2003). Those that have been followed have not considered the potential moderating role of adolescent peer social networks on risk. Identification of adolescent social influences that interact with temperamental dispositions to buffer risk has broad implications for prevention and intervention. The current study examined the association between childhood BI and young adult psychopathology, while also evaluating the modulating effect of adolescent social involvement on this temperament-psychopathology relationship. Furthermore, level of adolescent social involvement may be influenced by additional factors during adolescence (e.g. adolescent anxiety and/or history of therapeutic intervention). Hence, we evaluated the modulating effect of social involvement on BI-related risk while controlling for these potential confounds. Based on previous literature (e,g, Clauss & Blackford, 2012), stable childhood BI was expected to predict psychopathology, particularly anxiety disorders, and adolescent social involvement was expected to buffer this risk.

Method

Design

In the present 20-year longitudinal study, we assessed BI from 14 months through 7 years of age. We examined the extent of social involvement and social network size between the ages of 14-16 years and we assessed adult mental health outcomes when participants were 18-21 years old.

Participants

Subjects were repeatedly assessed across the first 20 years of life (Calkins, et al., 1996; Chronis-Tuscano, et al., 2009; Fox, et al., 2001; Lewis-Morrarty, et al., 2012). For the original sample, 165 participants (50.09% female), recruited across the years 1989-1993, provided temperament data either observationally and/or via maternal report questionnaires from infancy through childhood. 117 participants (53.85% female, age range: 14-16 years) provided social involvement and social network data in adolescence between the years 2003-2007. 129 participants (55.81% female, age range: 18-21 years) provided adult psychopathology data between the years 2009-2012.

For analyses examining the relations between childhood BI and young adult psychopathology, we included participants if they had both temperament and psychopathology data (n=116; 56.03% female). Included participants did not differ from excluded participants on BI (p>0.60). For moderation analyses, we included participants if they had temperament, adolescent social involvement and social network, and adult psychopathology data (n=94; 57.45% female). Included participants did not differ from excluded participants on BI and/or adolescent social data (ps>0.36). All participants were White, Non-Hispanic/Latino and initially from two-parent, middle-to-upper class families (Chronis-Tuscano, et al., 2009; Lewis-Morrarty, et al., 2012). Of those who provided demographic data regarding level of education at the adult time point (n=125; 96.89%), 11.6% (n=15) completed high school education (without college education), and 85.3% (n=110) were in college at the time of the young adult assessment.

Measures

Childhood BI—Observational and maternal-report measures of BI and social reticence were collected at 4 time points: 14 months, 24 months, 4 years and 7 years. At 14 and 24 months, infants' reactions to novel stimuli in the laboratory were observed and coded (Calkins, et al., 1996; Fox, et al., 2001; Kagan, Reznick, & Snidman, 1987; Lewis-Morrarty, et al., 2012). At ages 4 and 7, social reticence was coded in response to unfamiliar peers during same-age, same-sex quartet playgroups in the laboratory (Fox, et al., 2001; Lewis-Morrarty, et al., 2012) using the Play Observation Scale (POS) (Rubin, 1989). At 14 and 24 months, mothers provided ratings of temperament on the Toddler Behavior Assessment Questionnaire (TBAQ) (Goldsmith, 1996) Social Fearfulness scale. At ages 4 and 7, mothers completed the Colorado Children's Temperament Inventory (CCTI) (Buss & Plomin, 1984; Rowe & Plomin, 1977) Shyness/Sociability subscale (Emde et al., 1992). See Lewis-Morrarty et al. (2012) for the psychometric properties of BI measures collected at all 4 study time-points.

Adolescent social involvement and social networks—The Networks of Relationships Inventory (NRI) (Furman & Buhrmester, 1985) provided an index of adolescents' social network size (i.e., number of friends). A modified version of the self-report Hetero-Social Activities Scale (HAS) (Cauffman & Steinberg, 1996; Silverberg & Steinberg, 1990), Social Involvement subscale (α=0.82) was used to assess the extent of the adolescents' peer group involvement in social activities (e.g., how often do they go out in groups or go to a friend's house).

Young adult psychopathology—The Structured Clinical Interview for DSM Disorders (SCID) (First, Spitzer, Gibbon, & Williams, 2002) Mood, Anxiety and Substance Use modules were administered by post-doctoral fellows under the supervision of a licensed clinical psychologist and psychiatrist who were uninformed regarding relevant research data (average kappa=0.99, range 0.89-1.00 from an independent review of audiotapes). Internalizing problems (Anxious/Depressed, Withdrawn, Somatic Complaints, α=0.73), externalizing problems (Aggressive, Rule-Breaking, Intrusive Behaviors, α=0.77), and substance use (i.e., Tobacco, Alcohol, Drugs) were assessed with the Adult Self Report questionnaire (ASR) (Achenbach & Rescorla, 2003). Finally, participants completed the Liebowitz Social Anxiety Scale (LSAS, α=0.91) (Liebowitz, 1987).

Data Analytic Strategy

Latent class analyses—Three Latent Class Analyses (LCAs) were computed to create separate comprehensive variables of: (1) early stable BI (Lewis-Morrarty, et al., 2012); (2) extent of peer group social involvement during adolescence; and (3) adult psychopathology. LCA seeks to identify membership in latent (i.e., unobserved) groups/classes comprised of individuals characterized by a specific profile with regard to a given set of observed variables. Maximum likelihood (ML) estimation within a structural equation modeling (SEM) framework was used for each of the three LCAs, in order to calculate model parameters most likely to account for observed results. Each LCA included all participants that had data on any of the measures which were employed in each of the respective variables. Missing data patterns across measures in each of the LCAs did not violate the assumption that they were missing completely at random as indicated by Little's MCAR, all *p*s > .24 (Little & Rubin, 1987). Thus, data were analyzed in M*plus* V.5 (Muthén & Muthén, 1998-2011) using all available data points . Assessment of best model fit was based on interpretability, in addition to 3 fit indices: Bayesian Information Criteria (BIC), the Lo-Mendell-Rubin Likelihood ratio test (LMRL) (Lo, Mendell, & Rubin, 2001), and the Parametric Bootstrap Likelihood Ratio Test (BLRT) (McLachlan & Peel, 2000). Both ratio tests provide a *p*-value comparing the increase in model fit between the *k*-1and *k* class models. Furthermore, once the number of classes in each model is determined, based on Bayes' theorem, continuous posterior probabilities of membership were computed for each participant for: (1) Childhood BI classes (Lewis-Morrarty, et al., 2012); (2) Adolescent social involvement classes; and (3) Young adult psychopathology classes.

Childhood BI classes: The LCA included all 165 participants who provided BI data at any of the assessments (88.6%, 91%, 82% and 74.3% provided BI data at 14 months, 24 months, 4 years and 7 years respectively. 92% provided data for at least 2 out of 4 time-points). The data did not violate missing data assumptions, Little's MCAR χ2=192.86, p=0.24 (Lewis-Morrarty, et al., 2012). Analyses yielded 2 temperament classes: the 'stable high BI' class represented high average levels of BI across all 4 time points, whereas the 'stable low BI' class represented lower levels of BI across all time points (Lewis-Morrarty et al., 2012). Continuous probabilities of membership in the 'stable high BI' class were used as the 'high BI' variable in all subsequent analyses (*N*=165, *M*=0.16, *SD*=0.33, range=0-1).

Adolescent social involvement classes: The LCA included all 117 participants who provided data for either or both adolescent self-report measures on extent of peer group involvement in social activity based on the HAS (data were available for 112 participants) (Cauffman & Steinberg, 1996; Silverberg & Steinberg, 1990) (*M*=14.38, *SD*=3.83), and the number of friends from the NRI (data were available for 117 participants) (Furman & Buhrmester, 1985) (*M*=6.2, *SD*=2.04). The data did not violate missing data assumptions, Little's MCAR $\chi 2=1.27$, $p=0.26$. We estimated models with 1 to 4 classes. Interpretability was highest for the 2-class model. Furthermore, the 4-class model consisted of just 5 participants in one of the classes. The 4-class model was thus rejected based on low interpretability and small class size. BIC was 1134.92 for one class, 1111.19 for two classes and 1097.04 for three classes. BLRT indicated that the 3-class model was significantly better than the 2-class model, however LMRL indicated that the 3-class model was not significantly better than the 2-class model ($p>0.20$). Both BLRT and LMRL indicated that the 2-class model was significantly ($p<0.01$) and marginally ($p=0.08$) better than the 1-class model, respectively. Taking interpretability and all fit indices into account, the 2-class model was chosen as the best-fitting model yielding classes of 'high social involvement and large network size' and 'low social involvement and small network size' (referred to hereafter as 'high social involvement' and 'low social involvement' classes, respectively, for the sake of parsimony). Individual continuous probability scores of belonging to the 'high social involvement' class were estimated and used as the 'social involvement' moderator in subsequent analyses (*n*=117, *M*=0.633; *SD*=0.45; range=0-1).

Young adult psychopathology classes: The LCA included a total of 7 measures: 3 categorical measures of any current SCID Anxiety, Mood and/or Alcohol/Substance diagnosis, (First, et al., 2002), 3 continuous measures of ASR Internalizing, Externalizing, and Substance-Related Problems (Achenbach & Rescorla, 2003), and one continuous measure of social anxiety from the LSAS (Liebowitz, 1987). See Table 1 for descriptive statistics and N's of all psychopathology measures.

LCA included all 129 participants who provided adult psychopathology data on any of the measures, as the data did not violate missing data assumptions, Little's MCAR $\chi 2=5.281$, $p=0.63$. We estimated models with 1 to 4 classes. Interpretability was very low for the 4-class model and highest for the 3-class model. The BIC was 3395.16 for one class, 3364.75 for two classes, 3364.82 for three classes, and 3374.03 for four classes. BLRT indicated that the 3-class model was significantly better than the 2-class model ($p<0.0001$). Both ratio tests indicated that the 2-class model was significantly better than the 1-class model (*ps*<0.05). Given the highest interpretability and all fit indices, the 3-class model was chosen as the best-fitting model, yielding one healthy class, one psychopathology class related to internalizing problems (primarily anxiety), and one psychopathology class related to externalizing problems (primarily alcohol/substance use). For the sake of parsimony, these are referred to as the 'Healthy', 'Anxiety' and 'Substance' classes, respectively. See Figures 1A and 1B for a depiction of the self-report measures and clinical interview psychiatric diagnosis by adult psychopathology classes, respectively. Participants' continuous probability scores of membership in each of the three classes were used as the adult mental

health outcome variables in all subsequent analyses (n=129, ranges=0-1; Healthy class: M=0.64; SD=0.40; Anxiety class: M=0.23, SD=0.35; Substance class: M=0.13, SD=0.28).

Main outcome analyses—Linear regressions were conducted in SPSS to examine whether participants' continuous probability of membership in the high BI class predicted probability scores of membership in adult psychopathology classes. Following that, the moderating effect of adolescent social involvement on the relation between childhood BI and adult psychopathology was tested. Linear regressions were computed to examine whether participants' probability scores of membership in the high BI class, the high social involvement class, and the interaction between the two, predicted participants' probability of inclusion in adult psychopathology classes. Predictor variables were centered prior to moderation analyses. To decompose the factors contributing to the significant interaction effects, the effect of BI on the probability of inclusion in the adult psychopathology class in two separate analyses was examined, one considering the effect of BI when probability of inclusion in the high social involvement class was low (−1 *SD*), and the second considering the effect of BI when probability of inclusion in the high social involvement class was high (+1 *SD*) (Aiken & West, 1991).

Controlling variables—Preliminary analyses revealed significant correlations between adolescent social involvement and adolescent anxiety, as well as adolescent anxiety and history of therapeutic intervention (Table 2). In order to examine whether moderating influences of social involvement still held above and beyond these factors, we included adolescent anxiety and history of therapeutic intervention as covariates in the moderation analyses. Since adolescent anxiety and history of therapeutic intervention were both significantly related to anxiety outcomes in young adulthood (Table 2) we re-examined direct effects between BI and adult anxiety while including these as covariates in the regression analysis.

Data regarding presence/absence of prior therapeutic intervention was available for 85 of the 94 participants included in the moderation model. A composite score of history of adolescent anxiety was created for all 94 participants included in the moderation model using any available data on 5 measures (α=0.86): adolescent and parent report on the Screen for Child Anxiety Related Emotional Disorders (SCARED), (Birmaher et al., 1999), normed T-scores for internalizing problems on the Youth Self Report (YSR) (Achenbach & Rescorla, 2001), normed T-scores for internalizing problems reported by parents on the Child Behavior Checklist (CBCL), (Achenbach & Rescorla, 2001), and self-report on the Social Anxiety Scale-Adolescents (SAS-A) (La Greca & Lopez, 1998).

Results

Main effects of BI on young adult psychopathology

High BI was negatively associated with inclusion in the healthy class (β=−0.26, p=0.005), and positively associated with inclusion in the anxiety class (β=0.19, p=0.037; Table 3). High BI was not associated with inclusion in the substance class (p=0.155).

The moderating effect of adolescent social involvement

The interaction model significantly predicted inclusion in the anxiety class (Total R^2=0.13) suggesting that adolescent social involvement moderated the relation between high BI in childhood and anxiety in young adulthood, (β=−0.22, *p*=0.027) (Table 4).

Follow-up analyses revealed that when adolescent social involvement was low, childhood BI significantly predicted heightened risk for adult anxiety (β=0.43, *p*=0.002). However, when adolescent social involvement was high, childhood BI was not related to adult anxiety (β=0.01, *p*=0.946. Comparison of the regression coefficients revealed significant differences between the two models (χ^2=4.85, *p*<0.05), corresponding to a medium effect size (*d*=0.47; Figure 2).

Finally, results remained after other possible factors were controlled. Once controlling for adolescent anxiety, the main effect of child BI on adult anxiety outcomes was reduced (β=0.18, *p*=0.056) as adolescent anxiety accounted for a portion of the variability in adult anxiety (ΔR^2=0.07). Effects of child BI on adult anxiety were still present after controlling for history of therapeutic intervention (β=0.25, *p*=0.009).

Moreover, significant moderating effects of adolescent social involvement on the relation between childhood BI and adult psychopathology were still present (β=−0.21, *p*=0.037), after controlling for a history of therapeutic intervention (β=0.28, *p*=0.007) and adolescent anxiety (β=0.21, *p*=0.044), both of which also predicted risk for adult psychopathology (Table 4). Follow-up analyses were consistent with the initial results, demonstrating that stable BI significantly predicted heightened risk for adult anxiety (β=0.44, *p*=0.001) only when adolescent social involvement was low.

Discussion

Results from this 20-year longitudinal study highlight the long-lasting association between early childhood temperament and adult psychopathology. This study found stable BI to markedly increase risk for adult anxiety disorders, approximately 15 years after the assessment of BI. Identifying such a persistent, early risk marker and the moderating factors associated with adult anxiety disorders has broad implications for targeting preventive approaches and understanding who does and does not develop anxiety.

This study mapped interactive influences between BI and social factors in shaping risk over time. Adolescent involvement in social peer networks moderated the relations between early BI and adult anxiety. Among inhibited children, those who in adolescence were involved in smaller, less socially active peer networks were at heightened risk for adult anxiety, relative to uninhibited children and inhibited children who were involved in larger, more socially active peer networks. Thus, extensive peer social networks and high peer group social involvement during adolescence significantly buffered BI-related risk. This is the first study to demonstrate the critical role of increased involvement in socially active networks in moderating the link between BI and anxiety, within the context of a naturalistic prospective longitudinal study.

Multiple paths could allow social involvement to interact with childhood BI and shape risk. These could involve effects of the environment that cascade across development. For instance, some behaviorally inhibited children, due to early caregiving influences, may overcome a tendency to avoid social novelty to pursue social interaction and gain access to large social networks in adolescence. Prior data suggest that such a cascade could buffer risk. Young temperamentally fearful children who experience peer group day care are less likely to exhibit social reticence in preschool (Almas, et al, 2011), possibly because such care creates opportunities for exposure, an effective therapy for anxiety (e.g. Silverman, Pina, & Viswesvaran, 2008). In the context of BI, large peer networks and high levels of social involvement may also provide such opportunities, which could promote down-regulation of temperamentally-based reactivity and expose adolescents to the positive effects of friendships, thereby increasing resilience in the face of temperamental risk.

Beyond such cascading effects of the environment, associations among BI, social involvement, and psychopathology could reflect additional intrinsic features of the child, which also have cascading effects across development. For instance, adolescent involvement in social networks may be influenced by intelligence or other cognitive abilities. A recent study found that children with BI who exhibited relatively strong attention shifting abilities were less likely to exhibit social reticence than children with BI who exhibited relatively weak abilities (White, McDermott, Degnan, Henderson, & Fox, 2011). Differences in cognitive flexibility may allow some children with BI to overcome their inhibited disposition as they approach adolescence, engage in social interactions, and pursue friendships, thereby yielding higher levels of social involvement in adolescence. Beyond such cognitive variables, diverse aspects of temperament also may influence social interactions and account for associations observed in the current study. For example, temperament relates to reward processing (Helfinstein, Fox & Pine, 2012), and various reward-related aspects of temperament, such as positive emotionality, could influence social involvement.

Beyond these environmental and intrinsic features, other factors could contribute to mechanisms underlying the moderating effects found in the current study. Future studies might examine how these and other features shape adolescent social involvement and its relationships with temperament and later risk. Additional insights might emerge from interventions that manipulate adolescent social involvement and examine effects on avoidant tendencies and subsequent adjustment.

It is noteworthy that adolescent social involvement and social network data were collected in the current study solely based on participant self-report. This does reduce shared method variance with data on temperament, which relied on parent report and direct observation. Nevertheless, future studies in this area may augment self-report data on social involvement by examining objective reports of social involvement.

Particularly important in the quantification of adult psychopathology data was the use of LCAs, which enabled the creation of comprehensive psychopathology profiles incorporating multiple assessment methods of both clinical and subclinical levels of functioning across various dimensions. This approach limits the number of statistical tests, which

correspondingly balances Type I and Type II errors. Importantly, this approach is in line with current conceptualizations suggesting that psychopathology be examined on several dimensions along a continuum ranging from mild to extreme, with possible comorbidity between dimensions, as opposed to a qualitative split indexed by a mere presence or absence of clinical diagnosis (e.g. Adam, 2013; Cuthbert & Insel, 2010).

Similarly, our measure of adolescent social involvement provided a comprehensive index for the manner in which adolescents navigate their social environment: choosing to affiliate with either a large, socially active peer group, or rather a smaller group that is less socially active. There are generally pronounced individual differences with regard to adolescent social preferences. Whether or not these preferences should be counteracted or accommodated in an adolescent with a history of childhood BI is a question of debate. For instance, the environment could simply accommodate these individual tendencies or rather actively encourage the individual to increase engagement in more extensive and socially active peer groups. The present findings suggest that inhibited and non-inhibited children are differentially responsive to level of social involvement in adolescence. While level of social involvement did not appear to affect anxiety outcomes in non-inhibited children, inhibited children appear to be particularly sensitive to the adverse effects of low social involvement during adolescence. For adolescents characterized in childhood with BI, low social involvement may enhance predisposed avoidant tendencies which in turn, may contribute to the maintenance of anxiety. The present findings have clear implications for treatment, pointing toward the potential benefit of targeting the extent of involvement in peer social networks in intervention approaches when working with adolescents. The findings thus suggest that it may be beneficial to actively increase the extent of social involvement in adolescents who were temperamentally inhibited throughout childhood to buffer risk and enhance mental health outcomes in adulthood.

Acknowledgements

This research was supported in part by NIH Grants R37HD17899 and MH093349 granted to NAF, and by the Intramural Research Program of the National Institute of Mental Health.

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Key points

- Inhibited temperament across infancy and early childhood is a particularly robust risk factor for anxiety.
- Relations between temperament and psychopathology are influenced by environmental circumstances.
- The present data reveal that stable inhibited temperament throughout early childhood significantly increases risk for adult anxiety disorders and interacts with adolescent social involvement to moderate risk over the course of 2-decades.

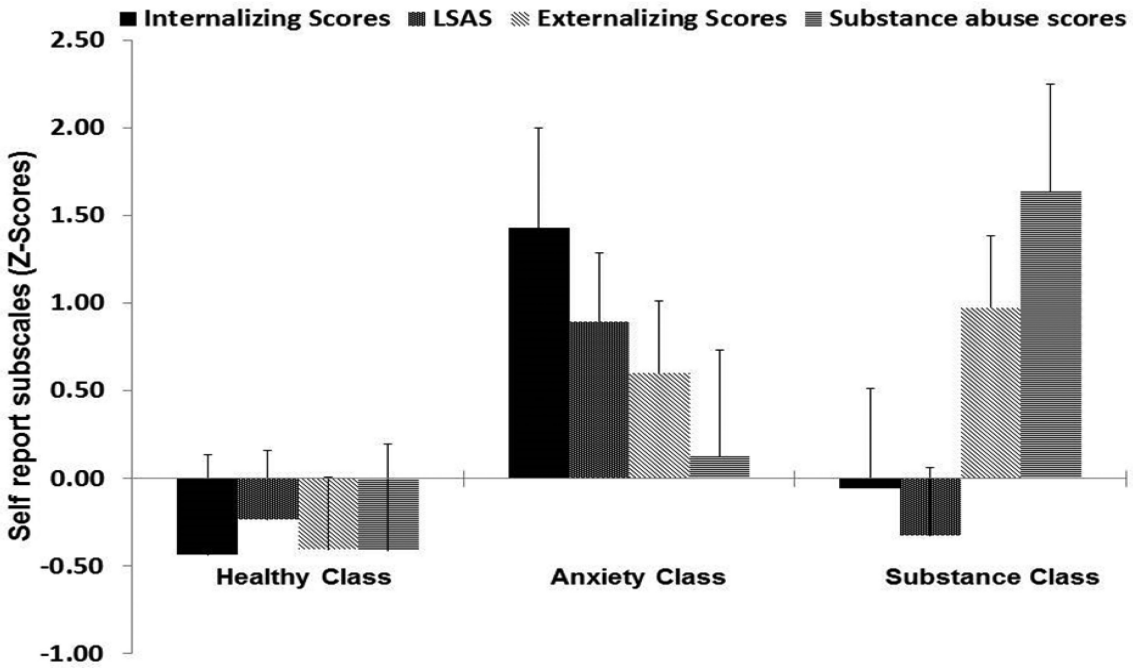

Figure 1A.
Self-report on the ASR and LSAS by Adult Psychopathology Classes.

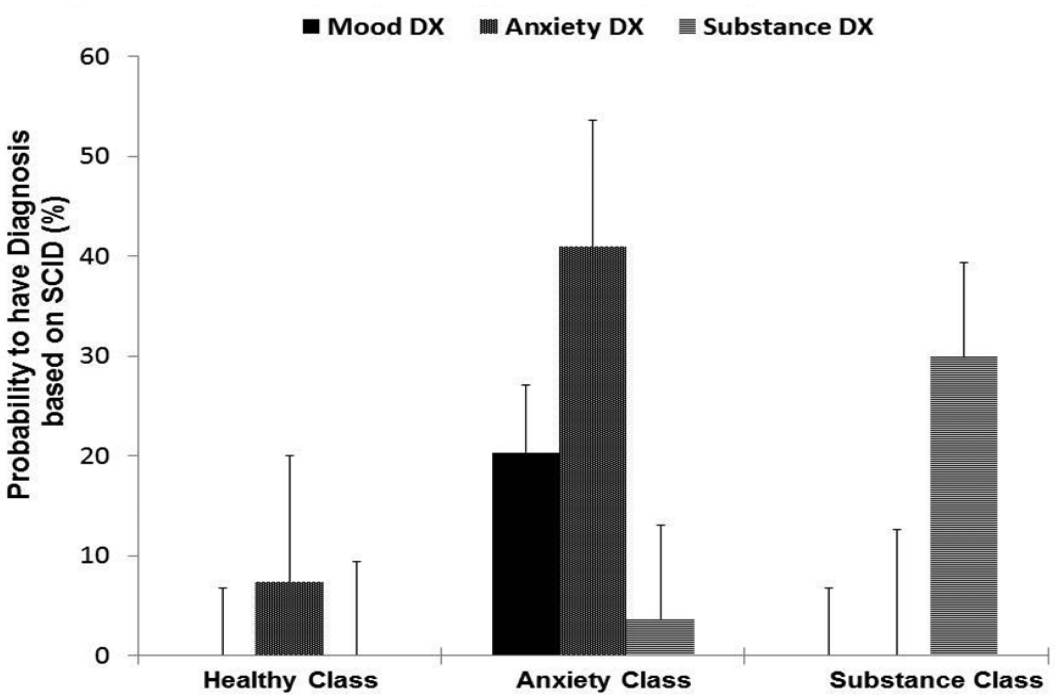

Figure 1B.
Psychiatric Diagnosis on the SCID by Adult Psychopathology Classes.

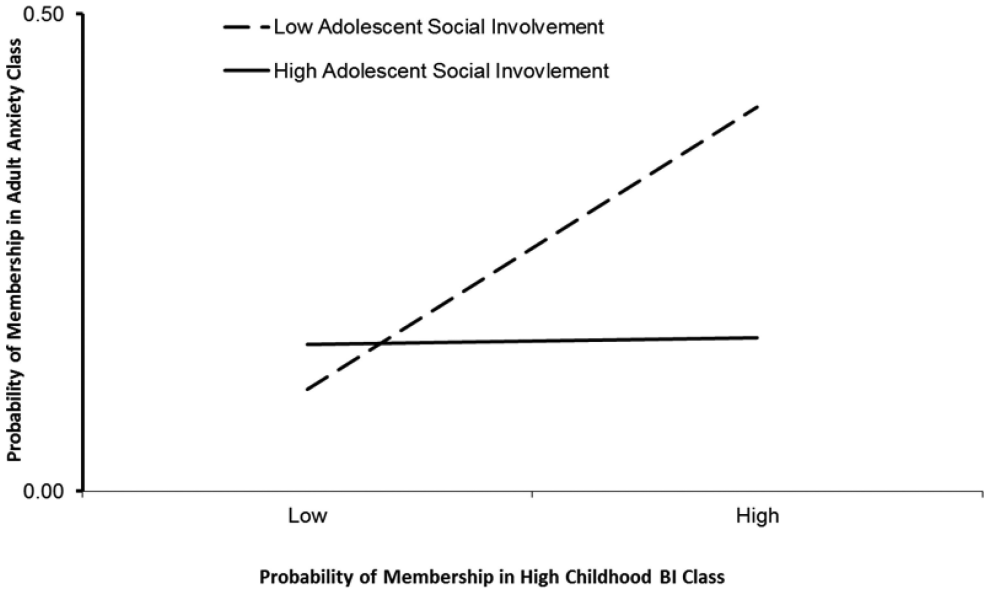

Figure 2.

Interaction between high childhood BI and adolescent peer group social involvement predicting risk for adult anxiety.

Table 1

Descriptive statistics of all psychopathology measures collected in adulthood

	N	Min - Max	*M*	*SD*	Skewness	%N above borderline clinical cutoff
Internalizing Problems (T score ASR)	103	30-73	45.81	10.87	0.64	11.65%
Externalizing Problems (T score ASR)	103	30-72	47.02	9.77	0.11	7.77%
Substance Problems (T score ASR)	100	50-74	55.74	6.65	1.04	13%
Social Anxiety (LSAS)	110	0-90	26.89	17.16	1.06	35.45%[a]
Any current Anxiety Disorder (SCID)	126	-	-	-	-	14.29%
Any current Mood Disorder (SCID)	126	-	-	-	-	4.76%[b]
Any current Substance Disorder (SCID)	126	-	-	-	-	4.76%

[a] Clinical cutoff point specifically for Social Anxiety Disorder

[b] 66.67% of cases with mood disorder diagnoses had comorbid anxiety disorders.

Table 2

Bivariate correlations between all variables included in the moderation model.

	2.	3.	4.	5.
1. Childhood BI	−0.018	0.075	−0.047	0.237*
2. Adolescent Social Involvement	-	−0.283**	−0.094	−0.155
3. Adolescent Anxiety composite	-	-	0.304**	0.272**
4. History of Previous Intervention	-	-	-	0.254*
5. Adult Anxiety Class	-	-	-	-

* **p<0.05**

** **p<0.01**

Table 3

Effects of High BI on inclusion in the three adult psychopathology classes (N=116)

	B	SE B	β	*t*
High BI Predicting Inclusion in Healthy Class	−0.31	0.11	−0.26	−2.84**
High BI Predicting Inclusion in Anxiety Class	0.20	0.10	0.19	2.11*
High BI Predicting Inclusion in Substance Class	0.11	0.08	0.13	1.43

*p<0.05

**p<0.01

Table 4

Moderation analyses - the effect of the interaction between high BI and adolescent social involvement on inclusion in the adult anxiety class.

	B	SE B	β	*T*
Moderation Analysis Predicting inclusion in Adult Anxiety Class (N=94)				
High BI	0.24	0.11	0.22	2.24*
Social Involvement	−0.11	0.08	−0.14	−1.45
High BI X Social Involvement	−0.51	0.23	−0.22	−2.24*
Moderation Analysis predicting inclusion in Adult Anxiety Class - Controlling for Previous Intervention (N=85)				
High BI	0.29	0.11	0.26	2.58*
Social Involvement	−0.08	0.08	−0.10	−0.98
Previous Intervention	0.21	0.07	0.28	2.77**
High BI X Social Involvement	−0.52	0.23	−0.23	−2.24*
Moderation Analysis predicting inclusion in Adult Anxiety Class - Controlling for Adolescent Anxiety (N=94)				
High BI	0.23	0.11	0.21	2.14*
Social Involvement	−0.06	0.08	−0.09	−0.84
Adolescent Anxiety	0.08	0.04	0.21	2.05*
High BI X Social Involvement	−0.46	0.23	−0.20	−2.04*
Moderation Analysis predicting inclusion in Adult Anxiety Class - Controlling for both Previous Intervention and Adolescent Anxiety (N=85)				
High BI	0.27	0.11	0.24	2.40*
Social Involvement	−0.03	0.08	−0.04	−0.35
Previous Intervention	0.16	0.08	0.22	2.04*
Adolescent Anxiety	0.07	0.04	0.18	1.56
High BI X Social Involvement	−0.49	0.23	−0.21	−2.12*

* **p<0.05**

** **p<0.01**