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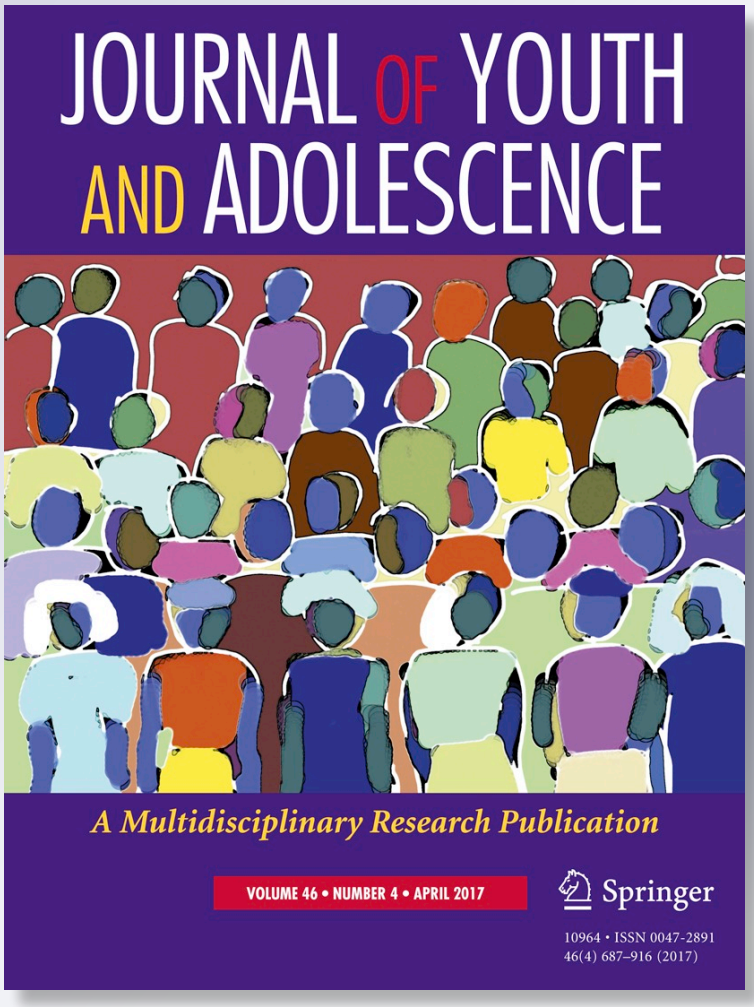

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EMPIRICAL RESEARCH

Gender Differences in Anxiety Trajectories from Middle to Late Adolescence

Christine McCauley Ohannessian[1,2] · Stephanie Milan[3] · Anna Vannucci[1]

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Abstract Although developmental trajectories of anxiety symptomatology have begun to be explored, most research has focused on total anxiety symptom scores during childhood and early adolescence, using racially/ethnically homogenous samples. Understanding the heterogeneous courses of anxiety disorder symptoms during middle to late adolescence has the potential to clarify developmental risk models of anxiety and to inform prevention programs. Therefore, this study specifically examined gender differences in developmental trajectories of anxiety disorder symptoms (generalized anxiety disorder, panic disorder, and social anxiety disorder) from middle to late adolescence in a diverse community sample ($N = 1000$; 57 % female; 65 % White), assessed annually over 2 years. Latent growth curve modeling revealed that girls exhibited a slight linear decrease in generalized anxiety disorder, panic disorder, and social anxiety disorder symptoms, whereas boys exhibited a stable course. These models suggested that one trajectory was appropriate for panic disorder symptoms in both girls and boys. Growth mixture models indicated the presence of four latent generalized anxiety disorder symptom trajectory classes: low increasing, moderate decreasing slightly, high decreasing, and very high decreasing rapidly. Growth mixture models also suggested the presence of five latent social anxiety disorder symptom trajectory classes: a low stable trajectory class and four classes that were qualitatively similar to the latent generalized anxiety disorder trajectories. For both generalized anxiety disorder and social anxiety disorder symptoms, girls were significantly more likely than boys to be in trajectory classes characterized by moderate or high initial symptoms that subsequently decreased over time. These findings provide novel information regarding the developmental course of anxiety disorder symptoms in adolescents.

Keywords anxiety · adolescence · development · gender differences · trajectories

Introduction

During adolescence, numerous changes occur within the individual, including pubertal development, increases in cognitive abilities, alterations in emotion processing, and the development of autonomy and identity (Forbes and Dahl 2010; Smetana et al. 2006; Yurgelun-Todd 2007). Multiple changes occur in adolescents' contexts as well. As adolescence progresses, adolescents begin to spend less time with their family and more time with their peers (Forbes and Dahl 2010; Smetana et al. 2006). In addition, the beginning of adolescence is marked by the transition to a larger, more complex school (middle school), quickly followed by a transition to an even larger, more complex school (high school) (Eccles and Roeser 2011; Waters et al. 2014). It is important to note that many of the individual and contextual changes during adolescence occur simultaneously, which

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may make this developmental period especially challenging for some youth.

Given the considerable number of changes that take place during adolescence, within such a small window of time, it is not surprising that the prevalence of psychological problems, including anxiety problems, increases dramatically during adolescence (Davey et al. 2008; McLaughlin and King 2015; Negriff and Susman 2011; Telzer and Fuligni 2013). In the United States, approximately one-third of adolescents meet the criteria for at least one anxiety disorder (Maldonado et al. 2013; Merikangas et al. 2010). Many more adolescents experience mild to moderate levels of anxiety—levels that are significant enough to negatively influence daily life (Ohannessian et al. 1999). Anxiety at threshold and subthreshold levels during adolescence is a robust predictor of the emergence and/or persistence of anxiety disorders (Copeland et al. 2009; Ferdinand et al. 2007) and is associated with greater psychiatric comorbidity, poor academic performance, significant role impairment, and increased health service utilization (Burstein et al. 2012; Kendall et al. 2010; Langley et al. 2014; Merikangas et al. 2010). The profound impact of anxiety on adolescents' adjustment underscores the need to improve understanding of the developmental course of anxiety symptoms.

Developmental Trajectories

Although anxiety disorders become more prevalent during adolescence, the natural course of anxiety symptoms throughout adolescence remains unclear. Several studies have examined the course of overall anxiety symptoms throughout adolescence (Allan et al. 2014; Crocetti et al. 2009; Leadbeater et al. 2012; Stapinski et al. 2015; Van Oort et al. 2011). However, focusing on overall anxiety symptomatology may obscure trends in specific types of anxiety disorder symptoms. Indeed, there is a high degree of heterotypic continuity in anxiety symptoms, such that their presentation often changes in an individual throughout development (Copeland et al. 2009). Developmental theories of anxiety suggest that age differences in the predominant expression of anxiety symptoms are linked to normative developmental periods and tasks that youth experience (Weems 2008; Westenberg et al. 2004). Specifically, these theories hypothesize that the predominant anxiety symptoms across development include: separation anxiety and animal-related fears during early-to-middle childhood, generalized anxiety and death/danger-related fears during late childhood and early adolescence, and social anxiety and performance-related fears during middle-to-late adolescence. Cross-sectional epidemiological data supports these hypotheses. Separation anxiety disorder and specific phobias tend to emerge and predominate during childhood, whereas the initial onset of generalized anxiety disorder (GAD), panic disorder (PD), and social anxiety disorder (SAD) most often occurs during adolescence (Beesdo-Baum and Knappe 2012; Burstein et al. 2012). As such, focusing on GAD, SAD, and PD symptom trajectories during adolescence is developmentally appropriate and may yield particularly salient clinical implications.

Several prospective studies have used latent growth curve modeling to examine trajectories of specific anxiety symptoms during adolescence. In a 5-year study of Dutch youth aged between 10 to 12 years at baseline, GAD, PD, and SAD symptoms slightly decreased and then leveled off from early to middle adolescence, followed by a slight increase in GAD and SAD symptoms during middle adolescence and in PD symptoms during late adolescence (Van Oort et al. 2009). In another 5-year study of Dutch adolescents (spanning 11–17 years of age), GAD and PD symptoms decreased over time while social anxiety disorder symptoms were stable (Hale et al. 2008). A small subset of this sample who were 11–14 years of age at baseline were followed for 8 years (Nelemans et al. 2014). Similar to the initial study (Hale et al. 2008), social anxiety disorder symptoms remained stable over time, whereas GAD and PD symptoms demonstrated initial decreases from early to middle adolescence. However, GAD symptoms subsequently increased in middle adolescence and then leveled off during late adolescence. In contrast, the decreases in PD symptoms leveled off in middle adolescence and subsequently were followed by a slight increase during late adolescence (Nelemans et al. 2014). While these initial studies provide important knowledge about the nature of adolescent anxiety symptom trajectories, the homogeneous racial/ethnic composition of these samples (>80 % non-Hispanic White, ethnic Dutch) significantly limits the generalizability of these findings to more diverse populations. In a more racially/ethnically diverse U.S. sample of 10–15 year-olds, decreases in GAD, PD, and SAD symptoms were observed over the course of one year (McLaughlin and King 2015). However, the McLaughlin and King sample was comprised of primarily Hispanic/Latino adolescents from low socioeconomic status neighborhoods. Moreover, the limited follow-up interval only provided information about anxiety trajectories during early-to-middle adolescence.

Heterogeneity in Anxiety Symptom Trajectories

Developmental theories of anxiety also propose that youth fall into discrete subgroups distinguished by their unique course of anxiety symptoms (Weems 2008). Indeed, studies investigating the developmental course of GAD, PD, and SAD symptoms throughout adolescence have revealed significant variance in growth parameters (Hale et al. 2008; McLaughlin and King 2015; Nelemans et al. 2014; Van Oort et al. 2009), suggesting that specific anxiety symptoms

may follow several heterogeneous trajectories not identified by population-level trends. However, the vast majority of prior work examining such latent heterogeneous trajectories using latent class growth modeling or growth mixture modeling has focused on overall anxiety symptoms during adolescence (Allan et al. 2014; Crocetti et al. 2009; Legerstree et al. 2013; Letcher et al. 2012; Morin et al. 2011) or parent-reported GAD and SAD symptoms during childhood (Broeren et al. 2013; Duchesne et al. 2008; Marmorstein et al. 2010). Despite major methodological differences across studies, identified anxiety trajectories consistently have included: (1) *low* initial symptoms that remain stable or decrease slightly over time; (2) *high* initial symptoms that remain stable or increase slightly over time; and (3) moderate-to-high initial symptoms that *decrease* markedly over time.

Findings from these prior studies indicate that there is heterogeneity in the developmental trajectories of anxiety symptoms. However, only one study has examined latent trajectories of GAD, PD, and SAD symptoms using latent class growth analysis in an adolescent sample. In a study conducted by Nelemans and colleagues (2014), a cohort of 11–14 year-olds were followed over an 8-year period. Two GAD symptom trajectories were found. These trajectories were characterized by: (1) low initial symptoms that decreased slightly over time ("Low Decreasing"); and (2) high initial symptoms that remained stable ("High Stable"). Only one PD symptom trajectory was identified, which was characterized by an initial decrease and leveling off of symptoms followed by a slight increase. By contrast, the following three SAD symptom trajectories emerged: (1) low initial symptoms that remained stable ("Low Stable"); (2) "High Stable" symptoms; and (3) moderate initial symptoms the remained stable ("Moderate Stable"). While the Nelemans et al. (2014) study provided important initial information about the nature of specific anxiety symptom trajectories during adolescence, the study was limited in several respects. The vast majority (>80 %) of adolescents identified as White, ethnic Dutch. In addition, the study was somewhat underpowered for latent class growth analyses ($N = 239$). The relatively small sample size required the specification that every latent trajectory class be comprised of at least 5 % of the sample. This approach holds utility for ensuring the identification of replicable classes, but it may obscure less prevalent, yet clinically meaningful developmental trajectories. Finally, the application of latent class growth analysis (Nagin 1999), which constrained the variance in growth parameters across trajectory classes to zero, may bias model specifications (Morin et al. 2011). Growth mixture modeling, by contrast, allows growth parameter invariance assumptions to be tested and modified to fit the nature of the data.

Gender Differences

The developmental course of anxiety symptoms may differ between girls and boys. Adolescent girls consistently have been found to have a higher risk of experiencing anxiety disorders (Kessler et al. 2012; Merikangas et al. 2010) and report higher anxiety symptom levels cross-sectionally (Hale et al. 2008; McLaughlin and King 2015; Olatunji and Cole 2009; Stapinski et al. 2015; Van Oort et al. 2009) in comparison to adolescent boys. Although most prospective studies have found no gender differences in the trajectory of overall anxiety symptoms (Crocetti et al. 2009; Leadbeater et al. 2012; Stapinski et al. 2015), the nature of gender differences in specific anxiety symptom trajectories remains unclear. Some studies have found that girls experience increases in GAD and SAD symptoms, whereas boys report a decline in GAD, PD, and SAD symptoms from early to late adolescence (Hale et al. 2008; Nelemans et al. 2014). However, no gender differences in GAD, PD, and SAD symptom trajectories during adolescence have been reported (Hale et al. 2008; McLaughlin and King 2015; Nelemans et al. 2014; Van Oort et al. 2009). Of note, these studies focused on anxiety trajectories beginning in early adolescence. It is possible that gender differences in anxiety symptom trajectories emerge more consistently later in middle-to-late adolescence. Discrepancies in findings regarding gender differences in specific anxiety symptom trajectories during adolescence may stem from examining one overall symptom course rather than distinct heterogeneous trajectories. To date, no study has evaluated whether latent GAD, PD, and SAD symptom trajectories are gender-specific using the technique of growth mixture modeling in a diverse sample of middle-to-late adolescents.

The Present Study

Although developmental trajectories of anxiety symptomatology have begun to be explored, most research has focused on total anxiety symptom scores, early adolescents, and racially/ethnically homogenous samples. Neglecting to examine the different anxiety symptoms or potential gender differences may mask important developmental differences. Moreover, when anxiety trajectories have been examined, the vast majority of studies have focused on childhood and early adolescence. Understanding the heterogeneous courses of GAD, PD, and SAD symptoms during middle-to-late adolescence may clarify developmental risk models of anxiety and inform prevention programs. As such, the following research questions were examined in a large, diverse sample of 15–17 year-old adolescents over time: (1) Do anxiety symptom trajectories differ between girls and boys (i.e., gender differences in growth parameters from latent

growth curve models)? and (2) Are there different types of anxiety symptom trajectories in girls vs. boys (i.e., gender differences in the number and nature of symptom trajectories as revealed by growth mixture modeling)? Although we expected to observe gender differences, no specific hypotheses could be made based on the equivocal nature of prior findings.

Method

Participants

During the spring of 2007 (Time 1), all 10th and 11th grade students attending seven public high schools in the Mid-Atlantic region of the United States were eligible and invited to participate in the study. Participants were followed up during the spring of 2008 (Time 2) and the spring of 2009 (Time 3). The sample included 1000 15–17 year-old girls (57 %) and boys (43 %). The mean age of the adolescents at Time 1 was 16.10 (SD = .71). The majority of the adolescents (65 %) were Caucasian; 19 % were African American; 11 % were Hispanic; and 2 % were Asian (the remainder described themselves as "other"). The race/ethnicity composition was fairly reflective of the area from which the sample was drawn ("U.S. Census Bureau" 2008). Most of the adolescents (60 %) lived with their biological mother and their biological father. Ninety-one percent of the adolescents lived with their biological mother, 65 % lived with their biological father, 4 % lived with a stepmother, 13 % lived with a stepfather, 1 % lived with an adoptive mother, and 1 % lived with an adoptive father. The majority of mothers (96 %) and fathers (97 %) had graduated from high school. In addition, 35 % of mothers and 32 % of fathers had completed 4 years of college, and 9 % of mothers and 8 % of fathers had attended graduate or medical school, respectively.

Measures

All participants completed a self-report survey that included demographic questions (e.g., age, gender) and a measure of anxiety. The 41-item Screen for Child Anxiety Related Disorders (SCARED; Birmaher et al. 1995) was administered to assess anxiety symptoms over the last three months. Prior research has shown that the SCARED possesses good psychometric properties in adolescent samples (Birmaher et al. 1997; Muris et al. 2002). The response scale for the SCARED ranges from 0 = *not true or hardly ever true* to 2 = *very true or often true*. Responses were summed to generate the SCARED subscales described below.

GAD

The GAD subscale includes 9 items. A sample item is "I worry about things working out for me." The Cronbach alpha coefficient for the GAD subscale ranged from 0.87–0.88 across Time 1–Time 3.

PD

The PD subscale consists of 13 items. A representative item is "When I get frightened, I feel like I am choking." The Cronbach alpha coefficient for the PD subscale ranged from 0.87–0.88 across Time 1–Time 3.

SAD

The SAD subscale includes 7 items. A sample item is "I feel nervous with people I don't know well." The Cronbach alpha coefficient for the SAD subscale ranged from 0.84–0.88 across Time 1–Time 3.

Procedures

The protocol for this study was approved by the Institutional Review Board at the University of Delaware. Public high schools in Delaware, Maryland, and Pennsylvania that were within approximately 60 miles of the study site were invited to participate in a prospective study of adolescent adjustment (Ohannessian 2009). Seven high schools participated. During the spring of 2007, 10th and 11th grade students from these high schools, who provided assent and had passive parental consent, were given a self-report survey in school by trained research staff. Seventy-one percent of the eligible students attending the participating schools completed the survey. Most of the students that did not participate did not do so because they were absent on the day of data collection. Only 3 % of eligible students present declined participation. On the day of data collection, participants were assured that all data collected were confidential, participation was voluntary, and they could withdraw from the study at any time. In addition, they were told that an active Certificate of Confidentiality from the U.S. government was in place to further protect their privacy. The survey took approximately 40 min to complete. After turning in the completed survey, participants were given a free movie pass. All participants were invited to participate again in spring of 2008 (Time 2) and 2009 (Time 3).

Analytic Plan

Bivariate correlations were examined among the study variables. Gender differences in anxiety symptom trajectories were tested using structural equation modeling

approaches to growth curve modeling and nested model comparisons with AMOS 19 (Byrne 2013). Potential gender differences in trajectories parameters were tested using nested model comparisons. In this approach, the same model is generated for different groups (girls vs. boys) with parameters of interest estimated simultaneously under increasingly restrictive sets of conditions. If a model in which parameters are constrained to be equal provides a significantly worse fit to the data then the unconstrained model, the parameter of interest is not equivalent across groups. In the first model tested, factor loadings were constrained to be equal in a linear pattern, but trajectory estimates (intercept means and variance, slope mean and variance, intercept and slope covariance) were freely estimated. In the second model, factor loadings and trajectory estimates were all constrained to be equal. Models used full-information maximum likelihood (FIML) approaches to estimation, which allows individuals with missing data to be retained and provides the least biased estimates in simulation studies on the effects of missing data (Buhi et al. 2008).

When the slope variance was significant in latent growth curve models, growth mixture modeling was performed to identify latent anxiety symptom trajectories with the full sample using Mplus 7.4 software (Muthen and Muthen 1998–2015). Models with between one to six trajectories classes were estimated. Growth parameter invariance was tested across classes by estimating a series of growth mixture models with increasingly lenient constraints. For all models, the slope factor variances did not significantly differ from zero and did not markedly differ across classes. As such, the slope factor variances were constrained to zero to achieve model convergence as recommended by Jung and Wickrama (2008). The intercept factor variances, by contrast, were significantly different from zero in all models. The intercept factor variances were held equal across classes in models examining SAD symptom trajectories. Intercept factor variances were freely estimated across classes in models examining GAD symptom trajectories because they were shown to differ markedly across classes in preliminary models. All models were estimated with 1000 random initial start values and 50 optimizations to avoid solutions that represented local rather than global maxima.

Several indicators of model fit were considered when selecting the best fitting number of latent classes of anxiety symptom trajectories from growth mixture modeling. The Bayesian information criterion (BIC; Schwarz 1978) and the consistent Akaike information criterion (cAIC; Bozdogan 1987) were examined to evaluate relative model fit, with lower values indicating a better fitting model. In addition, the Lo-Mendell-Rubin likelihood ratio-based test (LMR-LRT; Lo et al. 2001) and the bootstrapped parametric likelihood ratio test (BLRT; Nylund et al. 2007) compared the absolute fit between a *k*-class model and a *k*-1 class model. Classification accuracy was examined using the entropy value and the average of the posterior probabilities for each participant's most likely trajectory class membership, with higher values closer to 1.0 indicating better classification accuracy (Jung and Wickrama 2008). The FIML estimation approach was used in growth mixture modeling to handle missing data to preserve the sample size and minimize potential missingness biases (Buhi et al. 2008).

Multinomial logistic regression analyses were conducted within the context of the best-fitting growth mixture model to examine whether gender predicted latent class membership in anxiety symptom trajectories. The MPlus auxiliary option was used to automate the three-step approach to protect the formation of latent trajectory classes from the influence of predictors when conducting the multinomial logistic regression models (Wickrama et al. 2016). The dependent variable was latent trajectory class membership, with the largest trajectory class serving as the reference class as recommended by Muthen and Muthen (1998–2015). Of note, p values $< .05$ were considered to be statistically significant.

Results

Table 1 provides correlations, means, and standard deviations for the three anxiety scales across the three time points. As expected, all of the correlations were positive and the majority of correlations were significant. Independent samples *t*-tests were conducted to examine whether any of the anxiety scales differed by gender. As shown in Table 1, girls reported significantly higher levels of GAD symptoms than boys at all three times of measurement [t (953) = −7.96, $p < .001$ at Time 1, t (650) = −5.39, $p < .001$ at Time 2, and t (365) = −3.72, $p < .001$ at Time 3]. Similarly, girls reported significantly higher levels of PD symptoms in comparison to boys at all times of measurement [t (930) = −6.46, $p < .001$ at Time 1, t (640) = −3.89, $p < .001$ at Time 2, and t (433) = −2.51, $p < .05$ at Time 3]. The same pattern was found for SAD; however, the gender difference only was significant at Time 1 [t (965) = −6.12, $p < .001$ at Time 1, t (656) = −1.91, $p = .06$ at Time 2, and t (433) = −1.59, $p = .11$ at Time 3].

Latent Growth Curve Models

To first ensure a linear model was appropriate across gender, growth models were estimated separately for girls and boys for each of the three anxiety scales with factor loadings from the slope factor to Time 1 − Time 3 observed anxiety measures set at 0, .5, and 1 (a linear model). This step was done because although polynomial growth models cannot be tested with only three time points, it is possible to

Table 1 Correlations, means, and standard deviations among study variables

Variables	1	2	3	4	5	6	7	8	9
GAD									
1. Time 1	–	.63***	.50***	.59***	.36***	.20*	.64***	.38***	.24**
2. Time 2	.59***	–	.48***	.43***	.65***	.19*	.39***	.65***	.23*
3. Time 3	.50***	.54***	–	.23**	.08	.51***	.27**	.28**	.61***
PD									
4. Time 1	.59***	.38***	.26***	–	.44***	.32***	.43***	.32***	.17*
5. Time 2	.38***	.54***	.28***	.57***	–	.25**	.23***	.57***	.07
6. Time 3	.23***	.29***	.51***	.56***	.50***	–	.01	.10	.51***
SAD									
7. Time 1	.52***	.32***	.24***	.32***	.19***	.09	–	.58***	.42***
8. Time 2	.36***	.52***	.26***	.27***	.38***	.17**	.61***	–	.42***
9. Time 3	.26***	.22**	.54***	.17**	.11	.33***	.50***	.58***	–
Girl Mean/SD	6.15/4.29	5.61/4.14	6.08/4.62	4.37/4.70	3.96/4.40	3.85/4.55	4.89/3.38	4.24/3.46	4.04/3.55
Boy Mean/SD	4.06/3.82	3.87/3.97	4.50/4.06	2.61/3.67	2.64/4.01	2.75/4.12	3.58/3.28	3.72/3.39	3.50/3.30

Note Correlations for boys and girls are presented above and below the diagonal, respectively

GAD generalized anxiety disorder, *PD* panic disorder, *SAD* social anxiety disorder

*$p < .05$; **$p < .01$; ***$p < .001$.

model non-uniform growth specific to a given sample (i.e., nonequivalent rate of change from Time 1 - Time 2 vs. Time 2 - Time 3). Fit indices in all cases indicated that a linear function was appropriate for modeling fit in both genders across the three symptom measures (all CFI > .96, all RMSEA < .05).

Table 2 provides fit statistics for linear models with and without gender equality constraints on symptom trajectory parameters (intercept and slope means, variances, and covariance). As shown, nested model comparisons using chi-square differential tests indicated that forcing gender equality constraints led to a worse fit to the data in all of the anxiety symptom domains.

Table 3 provides intercept and slope parameter estimates by gender. Trajectories based on these estimates are presented in Fig. 1. Across the three symptom domains, there were some expected similarities in the pattern of results. First, adolescent girls reported higher initial symptom levels than adolescent boys regardless of the type of anxiety assessed. Second, for both girls and boys, there was significant variance in intercept estimates in all domains, indicating significant, between-person variability in baseline symptom scores. Overall, the magnitude and statistical significance of parameters for boys vs. girls suggested some gender specificity in trajectories, as described below.

Girls

For adolescent girls, slope parameter estimates suggested that average GAD, SAD, and PD symptom scores all decreased over the 2-year period, although the magnitude of the decline was small. In other words, there was a slight decline in anxiety symptoms for girls across different types of symptoms. The variance estimate for PD slope estimates was nonsignificant, indicating that the very small decline in PD symptomatology for girls overall (−.62) was characteristic of the sample; there was not significant variability in how much girls PD symptoms changed during the study period. In contrast, for GAD and SAD symptoms, there was significant variability in slope estimates. In other words, there was between-person variability in how much girls changed in these symptom domains over the 2-year period. Thus, while the average decline in GAD and SAD symptoms for girls was small (less than one point), there were some adolescent girls who showed a much greater decrease or increase in symptoms during late adolescence.

Boys

For boys, GAD and PD symptoms did not change over time at the group level as indicated by slope mean estimates that were not significantly different from 0. The slope variance estimates also were largely nonsignificant, indicating minimal change over time across the sample of boys. Thus, for the majority of boys, the level of GAD and PD symptoms they reported at baseline did not change over the subsequent two-year period. The one exception to this pattern was in SAD symptoms. Again, the estimate of the slope mean was nonsignificant, meaning the average change for boys in SAD symptoms was zero. However, the slope variance estimate was significant, indicating between-person differences in how much boys' SAD symptoms

Table 2 Results from nested model comparisons testing for gender differences in anxiety symptom trajectory parameter estimates

Model	χ^2	df	χ^2_{diff}	CFI	RMSEA
Generalized anxiety disorder symptoms					
Model 1: Unconstrained	23.34	7		.96	.048
Model 2: Gender equality constraints	97.80	12	74.46 df = 5, $p = .001$	.80	.083
Panic disorder symptoms					
Model 1: Unconstrained	17.07	7		.97	.037
Model 2: Gender equality constraints	87.64	12	70.57 df = 5, $p = .001$	.76	.078
Social anxiety disorder symptoms					
Model 1: Unconstrained	8.91	7		.99	.016
Model 2: Gender equality constraints	45.24	12	36.33 df = 5, $p < .001$	.92	.052

Note CFI comparative fit index, *RMSEA* root mean square error approximation

Table 3 Coefficients and variances for growth curve parameters for anxiety symptom trajectories for adolescent girls and boys

	Generalized anxiety disorder symptoms		Panic disorder symptoms		Social anxiety disorder symptoms	
Parameter	Coefficient	Variance	Coefficient	Variance	Coefficient	Variance
Intercept						
Girls	6.05**	11.43**	4.35**	12.22**	4.83**	7.04**
Boys	3.98**	8.21**	2.59**	4.64**	3.59**	6.35**
Slope						
Girls	−0.47*	6.37**	−0.62*	0.12, ns	−0.98**	2.50*
Boys	0.23, ns	1.26, ns	0.28, ns	0.28, ns	−0.09, ns	3.03*

Note Critical ratio *t*-tests were used to determine whether parameter estimates differed significantly from zero
*$p < .05$; **$p < .01$

changed over the two-year period. While the average change in SAD symptoms was zero, boys displayed more variability in SAD symptom trajectories than in other symptom domains.

Unconditional Growth Mixture Models

Table 4 provides the fit indices of unconditional growth mixture models examining latent trajectories of GAD and SAD symptoms. Growth mixture modeling was not performed for PD symptoms because the non-significant slope parameter variance for both boys' and girls' trajectories in latent growth curve models suggested that the vast majority of adolescents exhibited a similar change in symptomatology over time.

GAD symptoms

Examination of the fit indices suggested the presence of a four-class solution. The BIC and cAIC were lowest for a four-class solution. In addition, the LMR-LRT and BLRT indicated that a four-class solution provided a superior fit than did a three-class solution (*ps* = .001–.02). The average posterior probabilities for most likely class membership ranged between 0.79–0.88, suggesting good classification accuracy.

As shown in Fig. 2, the GAD symptom trajectories identified were: (1) a "Low Increasing" trajectory with low initial GAD symptoms that increased significantly over time (45.5 %, $n = 456$); (2) a "Moderate Decreasing Slightly" trajectory with moderate initial GAD symptoms that decreased slightly, yet significantly over time (34.1 %, $n = 342$); (3) a "High Decreasing" trajectory with high initial symptoms that decreased significantly over time (10.6 %, $n = 107$); and (4) a "Very High Decreasing Rapidly" trajectory with very high initial symptoms that decreased markedly over time (9.8 %; $n = 98$). Table 5 presents the mean growth factors for the latent GAD symptom trajectories.

SAD symptoms

Examination of the fit indices suggested the presence of a five-class solution for SAD symptoms. The BIC and cAIC were lowest for a five-class solution. The LMR-LRT and BLRT indicated that a five-class solution provided a superior fit in comparison to a four-class solution (*ps*

= .001–.01). The average posterior probabilities for most likely class membership ranged between 0.80–0.90, suggesting excellent classification accuracy.

As shown in Fig. 3, the SAD symptom trajectories identified were: (1) a "Low Increasing" trajectory (39.6 %, $n = 397$); (2) a "Low Stable" trajectory distinguish by low initial symptoms that did not significantly change over time (21.3 %; $n = 214$); (3) a "Moderate Decreasing" trajectory (25.9 %; $n = 260$); (4) a "High Decreasing Rapidly" trajectory (10.0 %, $n = 100$); and (5) a "Very High Decreasing Rapidly" trajectory (3.1 %; $n = 30$). Table 5 presents the mean growth factors for the latent SAD symptom trajectories.

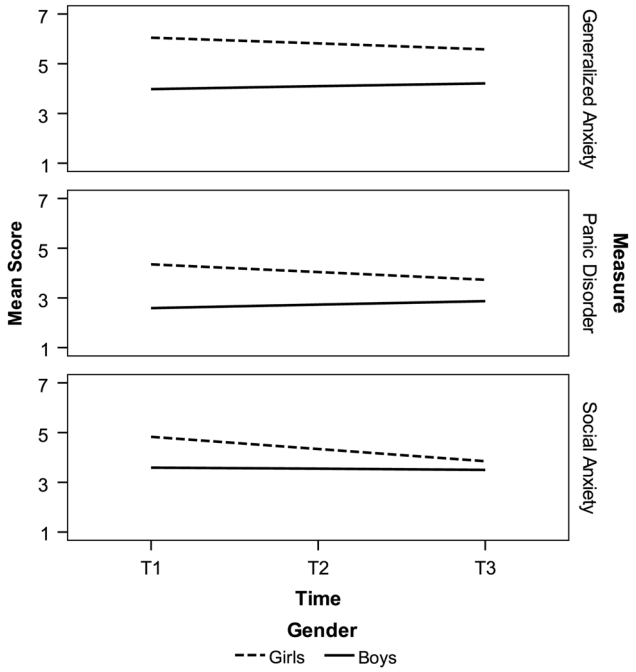

Fig. 1 Anxiety symptom trajectories in adolescent girls and boys as revealed by latent growth curve models

Gender as a Predictor of Latent Anxiety Trajectory Class Membership

Figure 4 depicts the breakdown of adolescent girls and boys in each latent trajectory class for GAD symptoms and SAD symptoms. Multinomial logistic regression analyses revealed that gender was a significant predictor of membership in latent anxiety symptom trajectory classes.

With regard to GAD symptoms, girls had significantly greater odds than boys of being in the "Very High Decreasing Rapidly" trajectory class (OR = 6.36, 95 % CI = 2.97, 13.60), the "High Decreasing" trajectory class (OR = 4.62, 95 % CI = 2.31, 9.30), and the "Moderate Decreasing Slightly" trajectory class (OR = 2.34, 95 % CI = 1.49, 3.67) in comparison to the "Low Increasing" trajectory class ($ps < .001$). With regard to SAD symptoms, girls had significantly greater odds than boys of being in the "Very High Decreasing Rapidly" trajectory class (OR = 4.81, 95 % CI = 1.56, 14.73), the "High Decreasing Rapidly" trajectory class (OR = 2.72,

Table 4 Fit indices for unconditional growth mixture models identifying latent anxiety symptom trajectories in adolescent girls and boys

Latent classes	Parameters	LL	BIC	cAIC	LMR-LRT (*p* value)	Entropy
Generalized anxiety disorder symptoms						
1	5	−5361.27	10756.13	10761.13	–	1.00
2	8	−5206.97	10467.67	10475.67	<.001	0.79
3	11	−5150.41	10374.71	10385.71	<.001	0.74
4	14	−5134.75	**10363.55**	**10377.55**	.02	0.73
5	17	−5127.05	10368.30	10385.30	.34	0.74
6	20	−5117.04	10368.44	10388.44	.17	0.74
Social anxiety disorder symptoms						
1	5	−4987.45	10008.48	10013.48	–	1.00
2	8	−4855.88	9765.50	9773.50	<.001	0.70
3	11	−4795.90	9665.69	9676.69	<.001	0.76
4	14	−4775.22	9644.49	9658.49	.002	0.79
5	17	−4758.65	**9631.49**	**9648.49**	.01	0.76
6	20	−4749.47	9633.29	9653.29	.19	0.77

Note Lower BIC and cAIC values indicated better model fit

LMR-LRT *p* values ≤.05 indicated that the *k*-class solution was a superior fit compared to a *k*-1 class solution

Entropy provided a measure of classification accuracy, with higher values indicating better accuracy. The bolded numbers represent the lowest values of each information-based fit index

BIC Bayesian Information Criterion, *cAIC* Consistent Akaike Information Criterion, *LL* Log-likelihood, *LMR-LRT* Lo-Mendell-Rubin Likelihood Ratio Test

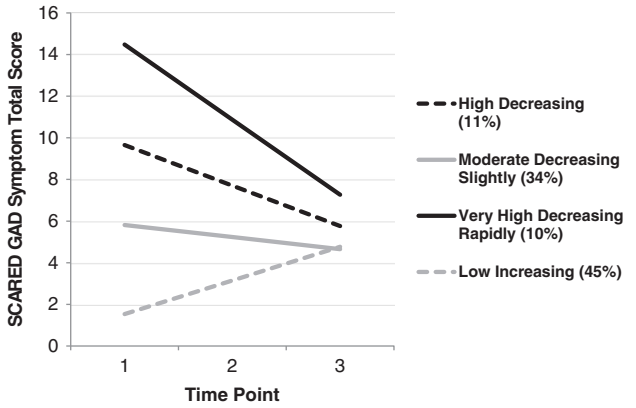

Fig. 2 Mean generalized anxiety disorder (GAD) symptom trajectories of the best fitting, four-class solution from unconditional growth mixture models. *Note* SCARED = Screen for Child Anxiety Related Disorders. A total score of 9 or above is indicative of probable generalized anxiety disorder (GAD)

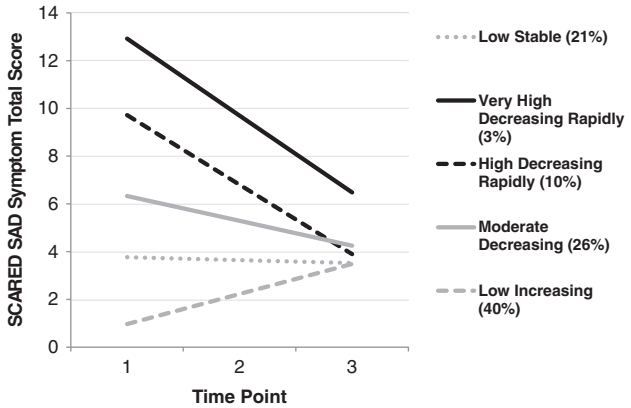

Fig. 3 Mean social anxiety disorder (SAD) symptom trajectories of the best fitting, five-class solution from unconditional growth mixture models. *Note* SCARED = Screen for child anxiety related disorders. A total score of 8 or above is indicative of probable social anxiety disorder (SAD)

Table 5 Mean growth factors for latent anxiety symptom trajectory classes from best-fitting unconditional growth mixture models

	Intercept factor		Linear slope factor	
Latent trajectory classes	M (SE)	*p* value	M (SE)	*p* value
Generalized anxiety disorder symptom trajectory classes				
Very high decreasing rapidly	14.48 (0.43)	<.001	−3.61 (0.43)	<.001
High decreasing	9.65 (0.71)	<.001	−1.94 (0.35)	<.001
Moderate decreasing slightly	5.81 (0.37)	<.001	−0.58 (0.24)	.02
Low increasing	1.54 (0.15)	<.001	1.62 (0.16)	<.001
Social anxiety disorder symptom trajectory classes				
Very high decreasing rapidly	12.92 (0.24)	<.001	−3.22 (0.57)	<.001
High decreasing rapidly	9.72 (0.22)	<.001	−2.91 (0.31)	<.001
Moderate decreasing	6.33 (0.21)	<.001	−1.04 (0.15)	<.001
Low stable	3.77 (0.28)	<.001	−0.12 (0.22)	.58
Low increasing	0.97 (1.26)	<.001	1.26 (0.12)	<.001

95 % CI = 1.51, 4.90), the "Moderate Decreasing" trajectory class (OR = 2.51, 95 % CI = 1.60, 3.94), and the "Low Stable" trajectory class (OR = 2.18, 95 % CI = 1.28, 3.71) in comparison to the "Low Increasing" trajectory class (*p*s = .001–.006).

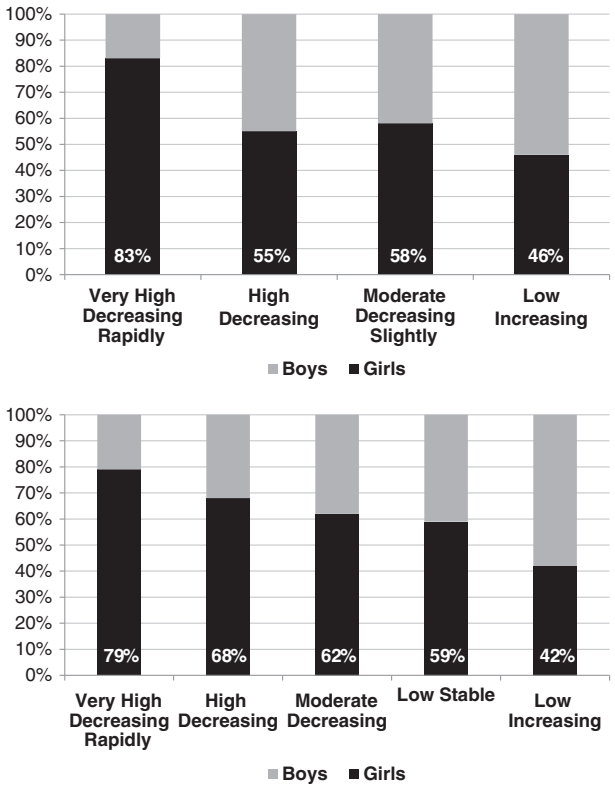

Fig. 4 Breakdown of adolescent girls and boys across latent anxiety symptom trajectory classes. **a** Generalized anxiety disorder symptom trajectories **b** Social anxiety disorder symptom trajectories

Discussion

Adolescence represents a period of substantial vulnerability for internalizing problems, particularly for girls. As such, the current prospective study sought to examine gender differences in anxiety symptom trajectories during middle-to-late adolescence. With regard to developmental

trajectories of overall anxiety symptom levels, girls reported higher initial symptoms and exhibited a slight linear decrease in GAD, PD, and SAD symptoms, whereas boys exhibited a stable course across all symptom types. Findings from latent growth curve models suggested that one trajectory is appropriate for describing the developmental course of PD symptoms in both girls and boys. Results from growth mixture models revealed four GAD symptom trajectories and five SAD symptom trajectories, and that girls were more likely than boys to be in trajectory classes distinguished by higher initial anxiety symptoms that subsequently decreased over time. These findings provide novel information regarding the developmental course of GAD, PD, and SAD symptoms in a diverse community sample of middle-to-late adolescent girls and boys, and highlight the utility of applying growth mixture modeling to clarify individual differences in anxiety trajectories.

Adolescent girls reported higher initial GAD, PD, and SAD symptoms than boys in the current study, which is consistent with gender differences found in numerous prior cross-sectional studies (Hale et al. 2005; Hale et al. 2008; McLaughlin and King 2015; Muris et al. 2002; Nelemans et al. 2014; Van Oort et al. 2009). Differential genetic predispositions toward anxiety or related biological vulnerability factors (e.g., gonadal hormones, neurophysiological stress reactivity) may make adolescent girls more susceptible to GAD, PD, and SAD symptoms in comparison to boys (McLean and Anderson 2009). In addition, adolescent girls report more exposure and sensitivity to interpersonal stressors in comparison to boys, perhaps in part due to the heightened importance that girls place on their social status and peer relationships (Rose and Rudolph 2006). This increased social stress, as well as girls' greater use of emotion-focused coping strategies, such as rumination (Rood et al. 2009) and co-rumination with friends or parents (Rose 2002; Tompkins et al. 2011), may account for gender differences in anxiety symptoms during adolescence. Of note, despite girls and boys differing on mean levels of GAD, PD, and SAD symptoms, there also was substantial individual variability in initial anxiety symptom levels among both girls and boys. Future work is needed to evaluate the hypothesized biopsychosocial mechanisms accounting for gender differences in overall levels of anxiety during adolescence, as well as factors that promote elevated symptoms among girls and boys.

At the population-level, latent growth curve models found that GAD, PD, and SAD symptoms decreased from middle to late adolescence among adolescent girls, whereas these anxiety symptoms were stable among boys. These findings are consistent with the majority of prior studies, which have observed either decreasing or stable GAD, PD, and SAD symptom trajectories throughout adolescence (Hale et al. 2008; McLaughlin and King 2015; Nelemans et al. 2014; Van Oort et al. 2009). Findings from the current study contribute to a small, but equivocal body of literature on gender differences in anxiety symptom trajectories during adolescence (Hale et al. 2008; Nelemans et al. 2014; Van Oort et al. 2009). Of note, this earlier work focused primarily on samples that were racially/ethnically homogenous and that followed youth beginning in early-to-middle adolescence. Findings from the current study provide novel information regarding gender differences in GAD, PD, and SAD symptom trajectories during the middle-to-late adolescent period in a diverse sample.

Of note, the vast majority of adolescents were characterized by low initial PD symptoms that remained stable or changed slightly over time, as there was very little individual variability in the course of PD symptoms in both girls and boys. These findings are consistent with prior work examining latent PD symptom trajectories in adolescents, which identified only one PD symptom trajectory (Nelemans et al. 2014). It is possible that greater inter-individual variability in PD symptoms may not emerge until later in adolescence and emerging adulthood. Indeed, cross-sectional epidemiologic data suggest that full-syndrome PD is relatively rare in adolescence, but its prevalence increases further in adulthood (Beesdo-Baum and Knappe 2012), which may account for the lack of subgroups characterized by high stable or increasing PD symptom trajectories.

At a population level, latent growth curve models revealed significant variability in the GAD symptom trajectory slope factor among adolescent girls, but not boys. Consistent with these latent growth curve model findings, growth mixture modeling also found that girls were significantly more likely than boys to be in numerous latent GAD symptom trajectory classes, including those distinguished by very high initial symptoms that decrease rapidly, high initial symptoms that decrease less markedly over time, and moderate initial symptoms that decrease slightly over time. Although prior research has identified only two latent GAD symptom trajectory classes (vs. four in the current study), findings generally are consistent with this earlier work such that the trajectory class characterized by higher initial GAD symptoms was predominantly comprised of adolescent girls (69 %) (Nelemans et al. 2014). Given that adolescent girls are more prone to elevated GAD symptoms than boys (Beesdo-Baum and Knappe 2012), it may be expected that the full spectrum of GAD symptom severity and subsequent symptom changes would be present among girls. By contrast, most boys in the current study were in a GAD symptom trajectory class characterized by low initial symptoms that increased slightly over time. Taken together, findings suggest that the majority of individual variance in GAD symptom trajectories in boys may already present by middle adolescence, with relatively few adolescent boys entering middle adolescence with high

initial symptoms or experiencing decreases in GAD symptoms after this time.

When examining SAD symptoms, significant variability in trajectory slopes within latent growth curve models was observed in both girls and boys, suggesting potentially important individual differences in rates of anxiety symptom change over the 2-year follow-up period across both genders. Indeed, growth mixture modeling yielded five latent SAD symptom trajectory classes: four that were qualitatively similar to the latent GAD symptom trajectory classes (i.e., low increasing, moderate decreasing, high decreasing, very high decreasing) and another unique class distinguished by low initial symptoms that remained stable over time. These findings diverged from the only prior study examining latent SAD symptom trajectories in adolescents (Nelemans et al. 2014), which identified three trajectory classes (low stable, moderate stable, high stable). However, gender differences were somewhat consistent with this initial study because girls were more likely than boys to be in the very high decreasing, high decreasing, moderate decreasing, and low stable trajectories relative to the low increasing trajectory. Gender disparities were greatest in trajectory classes characterized by moderate or high initial SAD symptoms (ranging from 62–79 % girls), whereas the vast majority of boys were in both trajectories characterized by low initial symptoms.

In contrast to developmental theories of anxiety (Weems 2008; Westenberg et al. 2004) and previous empirical studies (Broeren et al. 2013; Duchesne et al. 2008; Marmorstein et al. 2010; Nelemans et al. 2014), there were no latent trajectories characterized by high initial symptoms that remained stable over time for any anxiety symptom dimension. For both GAD and SAD symptoms, girls were more likely to exhibit higher symptoms that decreased from middle to late adolescence and anxiety symptomatology settling at a lower level. However, most boys entered middle adolescence with low initial GAD and SAD symptoms that increased slightly or remained stable over time. It is possible that the developmental period captured in the current study accounts for this pattern of findings, as adolescents either experienced no major psychosocial transitions (e.g., starting high school) or entered into emerging adulthood. Although emerging adulthood certainly possesses a number of novel stressors, this developmental period also is accompanied by positive changes that may ameliorate GAD and SAD symptoms and account for their decreases in severity, such as increasing autonomy, establishing stable friendships, and solidifying identity development (Adkins et al. 2009; Arnett 2015). Given that the influence of environmental (vs. genetic) factors on anxiety has been shown to be greater among girls (Boomsma et al. 2005; Kendler et al. 2008), it is conceivable that girls may be more sensitive to the beneficial effects of progressing from middle adolescence to late adolescence and emerging adulthood and therefore be more likely to be in higher initial, yet decreasing GAD and SAD symptom trajectories.

Nevertheless, it is notable that one potential "high risk" trajectory was identified for both GAD and SAD symptoms. This "very high decreasing" trajectory was characterized by very high initial symptoms that decreased over time but remained close to the clinical cut-off scores for GAD and SAD, respectively (Birmaher et al. 1995). The vast majority of this trajectory class was comprised of girls for GAD symptoms (83 %) and SAD symptoms (79 %), whereas the majority of boys exhibited trajectories characterized by low initial symptoms that increased slightly or remained stable. It is possible that these "high risk" subgroups may account for gender differences in the prevalence of GAD and SAD in the general adolescent population (Beesdo-Baum and Knappe 2012; Burstein et al. 2012). Thus, girls who enter middle adolescence with very high GAD or SAD symptoms may be at higher risk for a more severe and protracted developmental course, despite some normative decreases in severity. Established risk factors common to both GAD and SAD that may distinguish these vulnerable groups include low socioeconomic status, familial aggregation of anxiety and depression, high behavioral inhibition, emotional hyper-reactivity, biased attentional processing of emotional stimuli, perceived parental rejection, and poor ability to cope with negative emotions such as worry (Beesdo et al. 2009; Newman et al. 2013). It would be important for prevention programs to target these risk factors during early adolescence to keep GAD and SAD symptoms at bay as girls progress through middle and late adolescence.

Importantly, the current study provides novel information regarding the developmental course of GAD, PD, and SAD symptoms during a critical developmental period. Additional study strengths include the large, ethnically diverse community sample of adolescent girls and boys, the longitudinal design, and the application of growth mixture modeling to better understand heterogeneity in the developmental course of anxiety symptoms. Indeed, growth mixture modeling allows for evaluating growth parameter invariance across trajectory classes and setting parameters to reflect variance in the data accurately, which may enhance model identification (Morin et al. 2011). The use of the SCARED, which is a self-report questionnaire with excellent psychometric properties (Birmaher et al. 1997; Muris et al. 2002), to assess specific anxiety symptoms improves upon prior work that has focused on overall anxiety scores (Allan et al. 2014; Crocetti et al. 2009; Legerstree et al. 2013; Letcher et al. 2012; Morin et al. 2011) or has utilized parent-reports of GAD and SAD symptoms (Broeren et al. 2013; Duchesne et al. 2008; Marmorstein et al. 2010).

Although the study contributes to the literature, several caveats should be considered. For instance, the reliance on the SCARED, rather than a clinical interview, to assess anxiety symptomatology precludes inferences that may be made about anxiety disorders or clinical populations. In addition, the sample was derived from the Mid-Atlantic region of the United States, and therefore may have limited generalizability to other geographic locations. Finally, only linear anxiety symptom trajectories could be examined because data only were collected at three time points. Importantly, linear models appeared to fit the data very well, but it is possible that quadratic or cubic growth trajectories may have provided further improvements upon model fit. Future studies would benefit from including four or more data collection periods, as well as longer follow up intervals to examine long-term anxiety symptom trajectories.

Conclusion

The findings from this study extend previous work on the developmental course of anxiety disorder symptoms in girls and boys throughout adolescence. Distinct latent developmental trajectories were observed for different anxiety disorder symptoms, emphasizing the importance of examining separate dimensions of anxiety rather than considering anxiety as a general construct. For most adolescents, GAD, PD, and SAD symptoms at low levels represent normal developmental phenomena. Future research is required to examine predictors of increases in overall anxiety disorder symptoms, as well as membership in high-risk latent anxiety symptom trajectories. Such research is crucial for informing developmental risk models of anxiety and novel prevention approaches.

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Author Contributions CO conceived the study, designed the study, and took the lead in drafting the manuscript; SM performed statistical analysis, drafted portions of the manuscript, and participated in the interpretation of data; AV performed statistical analysis and participated in the interpretation of data and drafting the manuscript. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interests.

Ethical Approval (1) Statement of human rights: The study was approved by the appropriate institutional and/or national research ethics committee and has been conducted in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. (2) Statement on the welfare of animals: This article does not contain any studies with animals performed by any of the authors.

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

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