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One factor or two parallel processes? Comorbidity and development of adolescent anxiety and depressive disorder symptoms

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Background: This study investigates whether anxiety and depressive disorder symptoms of adolescents from the general community are best described by a model that assumes they are indicative of one general factor or by a model that assumes they are two distinct disorders with parallel growth processes. Additional analyses were conducted to explore the comorbidity of adolescent anxiety and depressive disorder symptoms and the effects that adolescent anxiety and depressive disorder symptoms have on each other's symptom severity growth. **Methods:** Two cohorts of early (N = 923; Age range 10–15 years; Mean age = 12.4, SD = .59; Girls = 49%) and middle adolescent (N = 390; Age range 16–20 years; Mean age = 16.7, SD = .80; Girls = 57%) boys and girls from the general community were prospectively studied annually for five years. These two adolescent cohorts were divided into five groups: one group at-risk for developing a specific anxiety disorder and four additional groups of healthy adolescents that differed in age and sex. Self-reported anxiety and depressive disorder symptoms were analyzed with latent growth modeling. **Results:** Comparison of the fit statistics of the two models clearly demonstrates the superiority of the distinct disorders with parallel growth processes model above the one factor model. It was also demonstrated that the initial symptom severity of either anxiety or depression is predictive of the development of the other, though in different ways for the at-risk and healthy adolescent groups. **Conclusions:** The results of this study established that the development of anxiety and depressive disorder symptoms of adolescents from the general community occurs as two distinct disorders with parallel growth processes, each with their own unique growth characteristics. **Keywords:** Adolescents, anxiety, depression, development, latent growth modeling, parallel growth.

Consensus is gradually being reached as to the relationship that adolescent anxiety and depression have with one another. More specifically, three interrelated issues have been addressed in previous studies. First, it has been found that 25–50% of the adolescents with a depressive disorder also have a comorbid anxiety disorder and that 10–15% of adolescents with an anxiety disorder have a comorbid depressive disorder (Axelson & Birmaher, 2001; Brady & Kendall, 1992; Cole, Truglio & Peeke, 1997). Second, it has been shown that comorbid anxiety and depressive disorders have strong effects on one another; the presence of anxiety disorder symptoms predicts an increase in depressive symptoms and vice versa (Bittner et al., 2007; Goodwin, Fergusson, & Horwood, 2004). Owing to these findings, it has further been explored whether the symptoms of one disorder play a role in the etiology of the other. Most studies have found evidence indicating that adolescent anxiety disorder symptoms seem to precede adolescent depressive disorder development (Cole, Peeke, Martin, Truglio, & Seroczynski, 1998; Reinherz et al., 1993), while the results of the converse relationship have been less conclusive (Axelson & Birmaher, 2001). The third issue is directly related to the previous two. Given that adolescent anxiety and depression are frequently comorbid, as well as predictive of one another, it has been questioned whether adolescent anxiety and depression are two distinct syndromes or are simply the same disorder but can be viewed on a severity continuum (Brady & Kendall, 1992; Lee & Rebok, 2002).

Hence, while there is agreement in the literature on the comorbidity and the prediction issues, the consensus begins to fray as to whether adolescent anxiety and depressive disorders symptoms represent either one general factor or two parallel processes. It is this third issue, of the phenomenology of adolescent anxiety and depression being either two separate syndromes or representing one underlying disorder, that has been disputed in the recent literature (e.g., Angold & Costello, 2008; Cole et al., 1997; Laurent & Ettelson, 2001; Turner & Barrett, 2003).

On the one hand, the *general factor approach*, as represented by the negative affectivity theory of Watson and Clark (1984), suggests that adolescent anxiety and depression are different expressions of the same underlying disorder. However, this theory was later expanded into the tripartite model that additionally includes a specific anxiety component

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(physiological hyperarousal) and a specific depression component (low positive affect) (Clark & Watson, 1991). Empirical support has been mixed; while some adolescent studies have found support for the tripartite model (Joiner, Catanzaro, & Laurent, 1996), others have found that both the general factor model and the tripartite model have equally good fits for the data (Cole et al., 1997; Turner & Barrett, 2003). Conversely, findings also suggest that only when adolescent anxiety and depressive symptoms reach diagnostic thresholds (*category approach*) can they can be differentiated as distinct disorders (Gurley, Cohen, Pine, & Brook, 1996). Nevertheless, both the *general factor approach* and the *category approach* seemingly agree that it is difficult to conceptually differentiate the sub-syndrome symptoms of adolescent anxiety and depression from one another.

However, these three related issues (i.e., comorbidity, prediction and the exact affiliation between adolescent anxiety and depressive disorder symptoms) have not been addressed in one and the same research design. In this study, these three related issues will be addressed within the framework of structural equation modeling. First, this study investigates whether anxiety and depressive disorder symptoms of adolescents from the general community are best described by a model that assumes they are indicative of one underlying psychopathological process, or by a model that assumes they are two distinct disorders, each with their own unique developmental growth parameters. Second, additional analyses will be conducted as to the comorbidity of adolescent anxiety and depressive disorder symptoms and, third, the effect that adolescents' anxiety and depressive symptoms have one each other's symptom severity growth. These last two analyses will be conducted using a multigroup analysis of healthy early and middle adolescent boys and girls as compared to adolescents who are at-risk for developing an anxiety disorder, in line with the findings that adolescent anxiety disorder symptoms seem to precede adolescent depressive development (Cole et al., 1998; Reinherz et al., 1993). Furthermore, as a result of findings that there are specific differences between these groups (e.g., Hale, Raaijmakers, Muris, Van Hoof, & Meeus, 2008), multigroup analyses of adolescent age and sex groups will be conducted. While the adolescents for this study come from the general community and cannot be compared to adolescents with an actual psychiatric diagnosis, analysis of at-risk adolescents may give insight into the role of initial anxiety symptom severity in the development of depressive symptoms in the general population.

Method

Sample

Data for this study were collected as part of a prospective five-wave longitudinal research with one-year intervals between each wave. The participating students consisted of two cohorts of early (N = 923; Age range 10–15 years; Mean age = 12.4, SD = .59; Girls = 49%) and middle adolescent (N = 390; Age range 16–20 years; Mean age = 16.7, SD = .80; Girls = 57%) boys and girls from 12 different Dutch junior high and high schools in the Utrecht province of the Netherlands (Centraal Bureau voor de Statistiek, 2003). Sample attrition was 1.2% across waves.

Instruments

Adolescent anxiety symptoms. The SCARED is a self-report questionnaire for measuring symptoms of five anxiety disorders in children and adolescents, namely generalized anxiety disorder (GAD), panic disorder (PD), school anxiety (or: school refusal) (SA), separation anxiety disorder (SAD), and social phobia (SP). Apart from school anxiety, these symptom dimensions are clearly related to DSM-IV-TR anxiety disorders. In addition to the initial studies in clinical populations (Birmaher et al., 1997, 1999), SCARED symptom dimensions have shown satisfactory sensitivity and specificity when compared to DSM-IV-TR anxiety disorder diagnoses as measured by the Diagnostic Interview Schedule for Children (DISC) (Muris, Merckelbach, Mayer, & Prins, 2000). Confirmatory factor analyses demonstrated that the SCARED possesses the same five-factor structure in healthy youth as originally observed in clinically referred children and adolescents (Hale, Raaijmakers, Muris, & Meeus, 2005).

Participants rated each symptom item on a 3-point scale: 1 (almost never), 2 (sometimes), and 3 (often). The range of the internal consistency coefficients (Cronbach's alphas) of the SCARED factors for each wave of the study was GAD .82–.86, PD .81–.90, SA .64–.74, SAD .68–.77, and SP .85–.88.

Adolescent depressive symptoms. The Children's Depression Inventory (CDI) is a widely utilized self-report questionnaire of depressive symptomology in children and adolescents (Kovacs, 1981; Timbremont & Braet, 2002). The questionnaire is composed of 27 items referring to various depressive symptom categories such as mood, vegetative, cognitive and psychomotor disturbances. The questionnaire is scored on a three-point scale ranging from 'not true', 'somewhat true' to 'very true'. The CDI has strong internal consistency and validity in non-clinical populations (Saylor, Finch, Spirito, & Bennett, 1984). In this study, the range of the internal consistency coefficients of the CDI was .89–.93.

Data collection procedures

Students filled in the SCARED and the CDI during the adolescents' homeroom study period at school. Before the study, the student and his/her parents received written information and, if the student agreed to participate, provided written informed consent. Less than 1% elected not to participate. Consent was also obtained from all the participating schools. This study and its assent and consent documents were approved by the

Research Review Board (Utrecht division) of the Dutch Institute for the Study of Education and Human Development (ISED).

Adolescent groups. The 1,313 participants were divided into a group at-risk for anxiety disorder and a healthy adolescent group that was divided into four subgroups of early and middle adolescent boys and girls. The at-risk adolescent group was determined for each of the anxiety disorder symptom scales of the SCARED using the at-risk anxiety disorder symptom cutoff scores of the Dutch manual of the SCARED (Muris, Bodden, Hale, Birmaher, & Mayer, 2007). The specific sample sizes for each anxiety at-risk group as compared to the healthy adolescent groups are reported in Table 2. We were unable to make a similar group – for depressive disorder since the most commonly used cutoff scores (Timbremont, Braet & Dreessen, 2004) for the CDI resulted in a group size too small ($N < 20$) for structural equation modeling. While cutoff scores are commonly used in studies of child and adolescent anxiety and depression, these cutoff score should not be confused with a psychiatric diagnosis since previous studies have shown their diagnostic accuracy to be quite modest (e.g., Dierker et al., 2001).

Data analyses

In this study, the repeated measurement of adolescent anxiety and depressive disorder symptoms were examined using structural equation modeling (SEM). SEM is capable of combining the traditional statistical techniques for the analysis of means (ANOVA), relationships (regression), and latent structures (factor analysis) (Byrne, 2001; Kline, 2005). Both observed and latent variables can be simultaneously modeled in SEM as being a predictor or independent variable in one relationship as well as an outcome or dependent variable in another relationship (Duncan, Duncan, Strycker, Li, & Alpert, 1999).

Additionally, SEM is specifically designed for the comparison and testing of qualitatively distinct models of approximately equal complexity (i.e., absolute fit indexes) (MacCallum & Austin, 2000). SEM allows for the comparative analysis of the model fit in multiple samples ('multigroup analysis'), which makes it possible to simultaneously examine and test the similarities and differences between samples (e.g., differing in age and sex) in both the means and the relationships of the model variables.

A particular variant of SEM is latent growth modeling (LGM). In LGM, latent growth factors are identified, which are indicated by repeated observed or repeated latent variables. The factor loadings of these repeated indicators can be parameterized in such a way that separate growth factors represent intercept (i.e., initial symptom score severity) and slope (i.e., growth in symptom score), respectively. The separation of intercept and slope factors also distinguishes LGM from the traditional repeated measures ANOVA approach, in which it is impossible to analyze these factors separately (Duncan et al., 1999). Additionally, LGM allows for the study of factors that differentially influence these growth factors, as well as the study of the possible effects these growth factors themselves might have on other variables in the model.[1]

For the evaluation of the models, several fit indices are reported. The discrepancy between observed and model implied data is indicated and tested by the value of χ^2. As the value of χ^2 is highly sensitive to sample size, additional indices are advocated for the evaluation of the model fit with large samples (Kline, 2005). The Comparative Fit Index (*CFI*) indicates the improvement of the model compared to a model in which the observed variables are assumed to be uncorrelated. Values of *CFI* above .90 and .95 represent an acceptable and good fit, respectively (Byrne, 2001). The Root Mean Square Error of Approximation (*RMSEA*) index represents the value of the discrepancy after fitting the model to the population covariance matrix instead of the sample covariance matrix. It reflects the degree to which the model is considered to be incorrect in the population. Values of *RMSEA* less than .05 are indicative of a good fit, and values less than .10 are considered to be acceptable (Byrne, 2001). Finally, the Akaike Information Criterion (*AIC*) is specifically designed for comparing the fit of different, non-nested models, with lower values indicating a better fit.

The two growth models

In order to analyze the relationship between adolescent anxiety and depressive disorder symptoms, two models were made. The first model, One Factor Growth Model (OFGM), assumes that anxiety and depressive disorder symptoms are indicative of one general factor. The second model, Parallel Growth Model (PGM), assumes that they are two parallel processes, each with their own unique developmental growth parameters.

In the OFGM (depicted in Figure 1), both the depression disorder scale of the CDI and one of the anxiety disorder scales of the SCARED at each specific measurement occasion represent different indicators of the same latent factor (*F*). Hence, five models (one model for each specific anxiety disorder scale together with the depressive disorder scale) were examined. The development of this latent process is modeled by two second-order factors that define the linear growth parameters of intercept and slope. Finally, these intercept and slope factors are allowed to covary.

In the PGM (depicted in Figure 2) the repeated depression and anxiety scores are modeled as two distinct processes that elapse over time in a parallel fashion. In the PGM analyses, five models (one model for each specific anxiety disorder scale together with the depressive disorder scale) were also examined. In the PGM analyses, two distinct processes may occur simultaneously but their development is characterized by scale-specific linear growth parameters of intercept and slope. Within each scale, these intercept and slope factors also are allowed to covary. In this model, the comorbidity of depressive and anxiety symptoms is portrayed at two different levels: 1) by assuming a

[1] The reader can request a full description of the preliminary analyses (which demonstrates that a linear model is the best model to use) and the examination and evaluation of distributional properties (which demonstrates our assumption of the normality of our data distribution) from the first author.

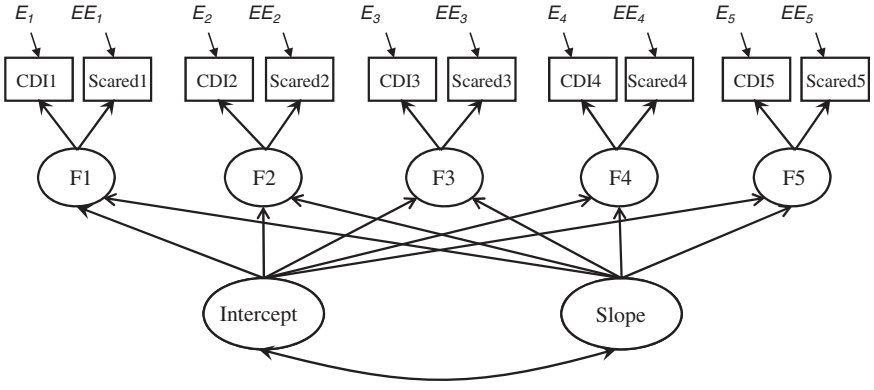

Figure 1 One factor growth model of the relationships between adolescent anxiety and depressive disorder symptoms. *Note.* Intercept weights are fixed at 1; Slope weights are linearly fixed at 0, 1, 2, 3 and 4 (for time1 to time 5, respectively). Five models (for each specific anxiety disorder symptoms and the depressive disorder symptoms) were examined separately

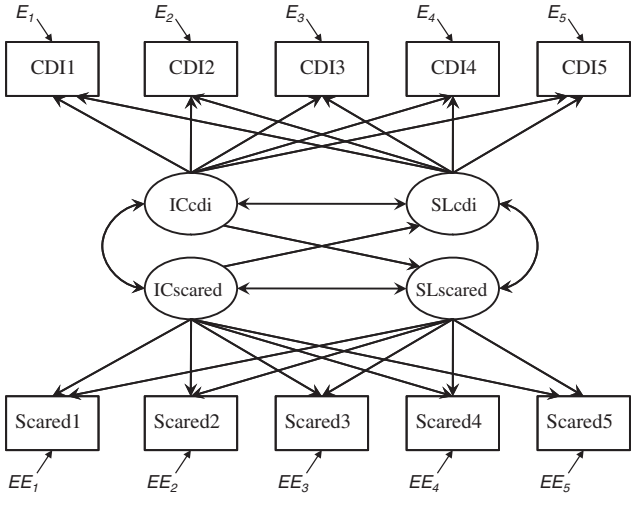

Figure 2 Parallel growth model of the relationships between adolescent anxiety and depressive disorder symptoms. *Note*. IC = Intercept; SL = Slope. Intercept weights are fixed at 1; Slope weights are linearly fixed at 0, 1, 2, 3 and 4 (for time1 to time5, respectively). Error covariances within measurement occasions ($E_x \leftrightarrow EE_x$) have been omitted in this depiction for reasons of clarity. Five models (for each specific anxiety disorder symptoms and the depressive disorder symptoms) were examined separately

correlation between the intercept of the depression scores and the intercept of the anxiety scores, and 2) by assuming a correlation between the separate slopes of the repeated depression and anxiety scores. Finally, the possible mutual influence of anxiety and depression symptoms is modeled by the regression path of the intercept factor of one scale to the slope factor of the other scale.

Results

Total sample analyses

Anxiety and depression: one factor or two parallel processes? The model fit statistics of the OFGM and the PGM models representing the developmental relationship between adolescent anxiety and depressive disorder symptoms are reported in Table 1. Comparison of the fit statistics of the OFGM and the PGM models clearly demonstrates the superiority of the PGM over the OFGM. According to the *AIC* index (with lower values indicating a better fit), the PGM unmistakably outperforms the OFGM. While all of the PGMs exhibit a good fit to the data (i.e., *CFI*s > .95 and *RMSEA*s < .05), none of the OFGMs reaches an acceptable fit according to these criteria (i.e., *CFI*s < .90 and *RMSEA*s > .10). These same *CFI* and *RMSEA* results for the OFGM and the PGM models were also obtained when the boys and girls were analyzed separately. We therefore selected the PGM for the examination of specific parameter estimates.

For testing the possible differences between the adolescent boys and girls, the differences in the boys' and girl's *CFI* (Δ*CFI*) and *RMSEA* (Δ*RMSEA*) values were analyzed. According to Chen (2007), Δ*CFI* values > .01 and Δ*RMSEA* values > .015 indicate differences in model fit. Using these criteria, the PGM model fit did not differ between the adolescent boys

Table 1 Summary of model fit statistics

Model	χ^2	*df*	*p*	CFI	RMSEA	90% CI of RMSEA	AIC
Model 1: One Factor Growth Model (OFGM)							
GAD	1779.09	40	<.001	.776	.182	.175–.189	1829.09
Panic	1259.57	40	<.001	.786	.152	.145–.160	1309.57
School	826.48	40	<.001	.847	.122	.115–.130	876.48
Separation	1364.29	40	<.001	.714	.159	.152–.166	1414.29
Social phobia	2158.43	40	<.001	.630	.201	.194–.208	2208.43
Model 2: Parallel Growth Model (PGM)							
GAD	93.92	36	<.001	.993	.035	.026–.044	151.92
Panic	94.26	36	<.001	.990	.035	.027–.044	152.26
School	104.08	36	<.001	.987	.038	.030–.047	162.08
Separation	105.64	36	<.001	.985	.038	.030–.047	163.64
Social phobia	105.21	36	<.001	.988	.038	.030–.047	163.21
Model 3a: Multigroup Parallel Growth Model (PGM): Fixed Growth Parameters							
GAD	855.34	236	<.001	.913	.045	.042–.048	1033.34
Panic	1352.03	236	<.001	.770	.060	.057–.063	1530.03
School	1190.77	236	<.001	.788	.056	.052–.059	1368.77
Separation	1135.64	236	<.001	.796	.054	.051–.057	1313.64
Social phobia	1043.97	236	<.001	.837	.051	.048–.054	1221.97
Model 3b: Multigroup Parallel Growth Model (PGM): Free Growth Parameters							
GAD	480.41	212	<.001	.977	.031	.027–.035	706.41
Panic	694.19	212	<.001	.901	.042	.038–.045	920.19
School	595.16	212	<.001	.935	.037	.034–.041	821.16
Separation	637.45	212	<.001	.904	.039	.036–.043	863.45
Social phobia	573.93	212	<.001	.927	.036	.033–.040	799.93

Note. CFI = Comparative Fit Index; *RMSEA* = Root Mean Square of Error; 90% *CI* = 90% Confidence Interval; *AIC* = Akaike Information Criterion.

and girls (i.e., Δ*CFI* varied from .000 to .006 and Δ*RMSEA* varied from .004 to .013).

Comorbidity of anxiety and depressive disorder symptoms. In the PGM model, comorbidity is expressed in the positive and significant values of various model parameters. First, strong correlations are observed between the values of the intercept of depressive symptoms with the values of the intercepts of the five separate anxiety scales (values ranging from .45 to .76; *p*s < .001). And additionally, the same applied to the corresponding correlations of the slope values (ranging from .32 to .71; *p*s < .001). Generally, these results demonstrate that depression scores are strongly associated with anxiety scores, both momentarily and longitudinally.

Multigroup analyses

Multigroup differences in parallel growth models. At the multivariate level we tested whether significant differences in growth parameters between the adolescent groups could be observed by comparing the model fit of two kinds of nested multigroup parallel growth models. In the first kind (denoted as 'Model 3a: Fixed Growth Parameters' in Table 1), all of the model parameters were constrained to be equal across groups, with the exception of the error (co)variances of the observed variables. In the second kind ('Model 3b: Free Growth Parameters'), growth parameters (i.e., the mean of intercept and slope factors, and the effects of the intercepts on the slopes of the concurrent measure) were allowed to vary across groups. By following this procedure, we were able to focus exclusively on the possible differences between groups in those parameters that define increase or decrease in anxiety and depressive disorder symptoms. The comparison of the fit statistics of these multigroup analyses (Model 3a versus Model 3b) clearly indicates that allowing for differences in these growth parameters between the groups leads to substantial improvements of the model fit.

Group differences in mean intercepts and slopes. The at-risk group consistently showed substantially higher mean initial depression scores (IC) compared to the healthy adolescent groups (Table 2). This result was to be expected since the at-risk group is defined by higher anxiety scores; scores strongly correlated with the depression scores. Additionally, the at-risk group consistently demonstrated strong, negative values for the slopes (SL) of both depression and anxiety (with the exception of SP), indicating the return to more average depression and anxiety scores at the group level.

In contrast, the healthy adolescent groups generally showed mean slope values (SL) that were not statistically different from zero, indicating stability. However, some significant differences between early adolescent boys and girls were observed in the value of the mean slopes of GAD and SA (see Table 2). Early adolescent boys showed a significant increase in these scores (mean slope values of .12 and .08, *p*s <.01), whereas girls of the same age remained stable (mean slope values of –.01, $p = .698$ and .00, $p = .928$). These differences in the growth of GAD

Table 2 Growth parameter estimates for the total sample, and the at-risk and healthy adolescent groups

	(Standardized) parameter estimates					
	Total sample	At-risk	Early boys	Early girls	Middle boys	Middle girls
GAD (*N*)	(*1313*)	(*33*)	(*454*)	(*448*)	(*165*)	(*213*)
Mean IC CDI	1.19*	1.70_a*	1.15_b*	1.17_b*	1.18_{bc}*	1.21_c*
Mean IC GAD	1.38*	2.34_a*	1.28_b*	1.37_c*	1.31_b*	1.51_d*
Mean SL CDI	.03*	$-.84_a$*	$.04_b$*	$.01_b$	$.03_b$	$.02_b$
Mean SL GAD	0.06	-1.71_a*	$.12_b$*	$-.01_c$	$.02_{bc}$	$-.03_c$
Regression coefficients						
IC CDI → SL GAD	−.15*	$.94_a$*	$-.33_b$*	$.09_c$	$-.09_{bc}$	$.09_c$
IC GAD → SL CD	−.17*	$.92_a$*	$-.21_b$*	$.02_c$	$-.27_b$*	$-.11_{bc}$
Panic (*N*)	(*1313*)	(*135*)	(*403*)	(*420*)	(*146*)	(*209*)
Mean IC CDI	1.19*	1.41_a*	1.12_b*	1.15_c*	1.18_{cd}*	1.20_d*
Mean IC PD	1.24*	1.84_a*	1.13_b*	1.20_c*	1.10_d*	1.18_c*
Mean SL CDI	.05*	$-.63_a$*	$.01_b$	$.05_b$	$-.00_b$	$.00_b$
Mean SL PD	.08*	$-.69_a$*	$.02_b$	$.00_b$	$.01_b$	$.06_b$
Regression coefficients						
IC CDI → SL PD	−.36*	$.87_a$*	$-.10_b$	$-.04_b$	$-.05_b$	$-.22_b$
IC PD → SL CDI	−.22*	$.73_a$*	$-.01_b$	$-.10_b$	$-.05_b$	$-.03_b$
School (*N*)	(*1313*)	(*124*)	(*423*)	(*414*)	(*151*)	(*201*)
Mean IC CDI	1.19*	1.41_a*	1.14_b*	1.15_{bc}*	1.18_{cd}*	1.20_d*
Mean IC SA	1.28*	2.02_a*	1.20_b*	1.19_b*	1.19_b*	1.20_b*
Mean SL CDI	.03*	$-.49_a$*	$.07_b$*	$.04_b$	$.03_b$	$-.04_c$
Mean SL SA	.11*	$-.70_a$*	$.08_b$*	$.00_c$	$.06_{bc}$	$.14_b$*
Regression coefficients						
IC CDI → SL SA	−.38*	$.83_a$*	$-.29_b$*	$.01_c$	$-.29_b$*	$-.48_b$*
IC SA → SL CDI	−.18*	$.78_a$*	$-.28_b$*	$-.12_b$	$-.21_b$	$.15_c$
Separation (*N*)	(*1313*)	(*120*)	(*413*)	(*414*)	(*154*)	(*212*)
Mean IC CDI	1.19*	1.35_a*	1.13_b*	1.16_b*	1.20_c*	1.22_c*
Mean IC SAD	1.32*	1.94_a*	1.25_b*	1.31_c*	1.18_d*	1.27_b*
Mean SL CDI	0.03	$-.44_a$*	$.03_{bc}$	$.07_b$	$-.01_{bc}$	$-.03_c$
Mean SL SAD	0.03	$-.38_a$*	$-.04_b$	$-.03_b$	$-.01_{bc}$	$.05_c$
Regression coefficients						
IC CDI → SL SAD	−.23*	$.68_a$*	$.07_b$	$.00_b$	$-.05_{bc}$	$-.31_c$*
IC SAD → SL CDI	−.12	$.63_a$*	$-.09_b$	$-.15_b$	$-.05_b$	$.05_b$
Social phobia (*N*)	(*1313*)	(*83*)	(*456*)	(*417*)	(*161*)	(*196*)
Mean IC CDI	1.19*	1.36_a*	1.16_b*	1.16_b*	1.18_{bc}*	1.20_c*
Mean IC SP	1.53*	2.66_a*	1.41_b*	1.50_c*	1.38_b*	1.55_c*
Mean SL CDI	.00	$-.26_a$*	$.02_b$	$.01_b$	$.01_b$	$-.01_b$
Mean SL SP	0.03	.06	−.02	−.02	−.07	−.00
Regression coefficients						
IC CDI → SL SP	−.07	$-.33_a$	$.05_b$	$.08_b$	$.13_b$	$-.01_b$
IC SP → SL CDI	−.04	$.57_a$*	$-.12_b$	$-.00_b$	$-.18_b$	$-.01_b$

Note. IC = Intercept; SL = Slope. Values in rows with different subscripts differ significantly at $p < .05$. *$p < .01$.

and SA anxiety symptoms were highly significant (*p*s < *.01*).

Finally, within the healthy adolescent groups, girls scored higher in mean initial anxiety symptom levels (IC) of GAD, PD and SP, as was expected on the basis of previous research (Hale et al., 2005).

Group differences in mean intercepts of one disorder affecting the slope of the parallel disorder. For the at-risk group (IC → SL findings in Table 2), the relatively high initial levels of anxiety and depression symptoms (IC) strongly affected the slopes (SL) of the parallel disorder symptoms, in a consistently positive way (with the exception of SP). This result indicates that the return to more regular levels of anxiety and depression was least pronounced for those adolescents within the at-risk group who displayed the highest levels of depressive and anxiety disorder symptoms.

However, the initial levels generally exerted no influence on the parallel symptoms of the healthy adolescent groups, indicative of general stability, with the exception of GAD and SA. Here, again, some significant differences between early adolescent boys and girls were observed. The initial GAD and SA scores (IC) of the early adolescent boys were negatively associated with growth (SL) in depression scores (–.21 and –.28, *p*s < .01), while such a relationship was absent in early adolescent girls (.02, $p = .790$ and –.12, $p = .133$). The same applied to the relationship between initial depression scores (IC) and the growth in anxiety symptoms (SL) of GAD and SA (for early adolescent boys: –.33 and –.29, *p*s < .01; and for early adolescent girls: .09, $p = .343$ and .01, $p = .898$, respectively). All of the differences between early adolescent boys and girls in the relationships of IC and SL were significant (*p*s < .01), with the exception of the difference between the initial school

anxiety score (IC) and the growth in the depression score (SL) (p = .070).

Discussion

The results of this study established that the development of adolescent anxiety and depressive disorder symptoms are best represented in a parallel growth model that assumes two distinct disorders, each with their own unique (albeit related) growth characteristics (Table 1). The strong comorbidity for both disorders, as consistently observed in previous studies, is indicated by strong correlations both at the initial symptom severity (intercept) level (ranging from .45 to .76) and at the developmental growth (slope) level (ranging from .32 to .71). Finally, the results also suggest that the development of one disorder may be affected by the initial symptom severity of the other disorder (IC → SL findings in Table 2).

These findings may have important implications for the nosology of adolescent anxiety and depressive symptoms. Briefly put, it is demonstrated that these symptoms are best described by the parallel growth model; the model which assumes two distinct disorders (category approach). These findings are supportive of a position held by Angold and Costello (2008), who state that while there is overwhelming evidence that adolescent anxiety and depression are related, additionally state 'But linkage is not the same as identity' (p. 2). Based on the findings of this study we would also suggest that the present-day DSM-IV-TR nosology of adolescent anxiety and depressive symptoms also applies to adolescents from the general population.

Additionally, our study found that parallel growth analyses of the two distinct processes model also allow for the detection of subtle differences between the healthy adolescent groups from the general population and the at-risk adolescent group. For the early and middle adolescent boys and girls of the healthy groups, anxiety and depression symptom growth generally remained stable compared to their initial symptom scores (Mean SL findings in Table 2). Likewise, the symptoms of one disorder do not produce much growth in the symptoms of the other disorder (IC → SL findings in Table 2). In other words, the early and middle adolescent boys and girls do not have many anxiety and depressive symptoms to start with and this continues to stay the same over time.

However, as noted in Table 2, this general trend for the healthy adolescent groups can be further specified. For example, for early boys negative bidirectional relationships were found between the intercepts and slopes of depression and school anxiety (IC → SL), whereas for both middle adolescent boys and girls this was a specific negative relationship from initial depression severity to school anxiety growth (IC → SL). In another example, significant differences were observed between the early adolescent boys and girls, with boys demonstrating significant negative bidirectional relationships between the intercepts and slopes of depression and school anxiety and GAD scores (IC → SL), whereas no such significant relationships for the early girls were found. Since these reciprocal effects of intercept and slope (IC → SL) have not been widely studied for adolescent age and sex groups, our findings of these relationships could lead to further study of mediation and moderation effects of third variables to help explain these specific differences.

Conversely, for adolescents at-risk for anxiety disorder development, their high levels of initial symptom severity (IC) decline (SL) rapidly over time. For most of these adolescents, decline in anxiety and depressive symptoms is generally the norm. Hence, although these adolescents start with elevated at-risk levels of anxiety symptom severity, most return to levels similar to the healthy adolescent groups, and further symptom development of the other disorder may not occur.

However, it is those at-risk adolescents who have the highest symptom severities of one disorder that are most vulnerable to increase in the symptoms of the other disorder. This was demonstrated in the intercept (of one disorder) to the slope (of the other disorder) findings for the at-risk adolescents presented in Table 2 (IC → SL). While these findings are in agreement with previous studies that have found adolescent anxiety and depressive symptoms increasing each other's severity (Bittner et al., 2007; Goodwin et al., 2004), the findings of this study help to specify those adolescents that might be most affected by this occurrence. Furthermore, these adolescents could potentially be best targeted for and possibly most benefit from early prevention and/or treatment programs that focus on both anxiety and depressive symptoms; this in light of the strong comorbidity findings of this study. While most research into prevention and treatment programs for adolescent anxiety or depression focuses on classic RCT (randomized controlled trials) designs with stringent exclusion criteria of comorbid disorders, it is conceivable that future research into adolescent anxiety and depression prevention and treatment programs may profit by having patient inclusion criteria that allow for symptoms of both anxiety and depressive disorders.

Limitations

With respect to limitations, it should be stated that this study focused on the adolescents' self-report of anxiety and depressive symptoms. Although it is generally accepted that adolescents should be the main informant in the case of anxiety disorders (Stallings & March, 1995) a multi-informant diagnostic interview, such as the Anxiety Disorders

Interview Schedule for Children and Parents (ADIS-C/P) (Silverman & Albano, 1996), could have been used to study differences to determine the relationship between the self-report symptoms and an actual diagnosis (Comer & Kendall, 2004). A similar approach could also be applied to the adolescents' depressive symptoms.

Additionally, since this study focused only on self-reports of anxiety and depressive symptoms of adolescents from the general population, the results cannot be readily extrapolated to adolescents from clinical populations or to other age-group populations. However, with respect to adolescents, several researchers have suggested that the referral bias in adolescent clinical populations may limit generalizability and argue that prospective, community studies of adolescents may better characterize the course of adolescent disorders (Pine, Cohen, Gurley, Brook, & Ma, 1998; Woodruff-Borden & Leyfer, 2006).

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Key points

- It is known that adolescent anxiety and depression symptoms are frequently comorbid and are predictive of one another.
- It is debated whether the development of adolescent anxiety and depressive symptoms are best explained by one general growth factor or by two distinct disorders.
- This study demonstrated that development of anxiety and depressive disorder symptoms of adolescents from the general community occurs as two distinct disorders with parallel growth processes.
- The findings suggest that the present-day DSM-IV-TR nosology of adolescent anxiety and depressive symptoms also applies to adolescents from the general population.
- It is also suggested that future research into adolescent prevention and treatment programs should have patient inclusion criteria for symptoms of both anxiety and depressive disorders.

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