Gender-specific Developmental Trajectories of Anxiety during Adolescence: Determinants and Outcomes. The TRAILS Study

SUPPLEMENTARY ONLINE MATERIALS

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Methods

Study design and sample description

This study was part of Tracking Adolescents' Individual Lives Survey (TRAILS), a prospective cohort study of Dutch young adolescents initially aged 10–12 years, who are followed bi- or triennially, until the age of 25. TRAILS aims to chart and explain the development of mental health from preadolescence into adulthood (for a detailed description of the TRAILS cohort see de Winter et al., 2005; Huisman et al., 2008). Participants came from five municipalities, including both urban and rural areas, in three Northern provinces of the Netherlands. So far, four data collection waves have been completed: T1 (March 2001-July 2002), T2 (September 2003-December 2004), T3 (September 2005-December 2007), and T4 (September 2009 to October 2010). Informed consent was obtained from all participants at each assessment wave. The Central Dutch Medical Ethics Committee has approved the study.

At T1 (N=2,230; response rate 76.0%; mean age=11.1 years, SD=0.6 years), the sample consisted of 1,132 girls and 1,098 boys, of whom 2 girls and 3 boys did not report on anxiety symptoms. At T2 (N=2,149; response rate 96.4% of baseline participants; mean age=13.6 years, SD=0.5 years), the sample consisted of 1,096 girls and 1,053 boys. At T3 (N=1,816; response rate 81.4% of baseline participants; mean age=16.3 years, SD=0.7 years), the sample consisted of 950 girls and 860 boys. At T4 (N=1,584 completed CIDI; response rate 71% of baseline participants; mean age=19.2 years, SD=0.6 years), the sample consisted of 856 girls and 728 boys (Nederhof, et al., in press).

Attrition analyses (see supplementary Table A1) showed that T3-responders scored approximately 10% higher on anxiety and depression at T1 than non-responders. Adolescents without anxiety scores at T2 or T3 had lower T1 ratings for parental emotional warmth, parental education, family income, and intelligence, and for T3 also lower sociometric status and more likely lived in single parent families. All differences were small, indicated by an R^2 of .01 at T2 and .05 at T3.

Male gender, low socio-economic status, ethnic minority background, one-parent family, and a total score of the Child Behaviour Checklist (Achenbach & Rescorla, 2001) in the clinical range at baseline were related to non-response on the CIDI at T4.

Measures

At the first three waves, the total anxiety scale of the Revised Child Anxiety and Depression Scale (RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) was used to measure current anxiety symptoms. Internal consistencies of the RCADS total anxiety scale were 0.91 (T1), 0.93 (T2) and 0.92 (T3). The RCADS consists of 37 anxiety items, 7 measure separation anxiety, 9 social phobia, 6 generalized anxiety, 9 panic, and 6 obsessive compulsive symptoms. The items were rated on a 4-point Likert scale ranging from 0 (never) to 3 (always). The total anxiety score is the sum of all items divided by the number of items.

At T1 (10-12 years), child, family and peer factors were measured. Child, family and peer factors were included, which in a previous study (van Oort, et al., 2011) in the

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	T1	T2			T3		
		Response[a] N = 146	Non-response N = 2084	P (R2)	Response N = 589	Non-response N = 1641	P (R2)
Characteristics							
Anxiety score		0.57 (0.007)[b]	0.57 (0.03)		0.58 (0.008)	0.53 (0.01)	** (0.005)
Depression score		0.29 (0.005)	0.27 (0.02)		0.30 (0.006)	0.27 (0.01)	* (0.003)
Shyness		2.5 (0.02)	2.7 (0.08)	** (0.003)	2.5 (0.02)	2.5 (0.04)	
Frustration		2.8 (0.02)	2.8 (0.06)		2.8 (0.02)	2.8 (0.03)	
Effortful control		3.2 (0.02)	3.1 (0.06)		3.3 (0.02)	3.1 (0.03)	** (0.005)
Self-competence		3.3 (0.01)	3.3 (0.05)		3.3 (0.01)	3.3 (0.02)	
Parenting							
Rejection		1.5 (0.007)	1.5 (0.03)		1.5 (0.008)	1.5 (0.01)	
Protection		1.9 (0.008)	1.9 (0.03)		1.9 (0.009)	1.9 (0.02)	
Emotional warmth		3.2 (0.01)	3.1 (0.04)	*** (0.005)	3.2 (0.01)	3.1 (0.02)	*** (0.006)
Parental internalizing problems- lifetime		0.55 (0.02)	0.58 (0.07)		0.55 (0.02)	0.57 (0.03)	
Parental education		3.3 (0.02)	2.8 (0.09)	*** (0.01)	3.4 (0.02)	2.9 (0.04)	*** (0.04)
Parental income		4.5 (0.04)	3.7 (0.17)	*** (0.01)	4.6 (0.05)	3.8 (0.08)	*** (0.04)
Single parent family		15%	25%	**	10%	5%	***
IQ		97.6 (0.33)	91.3 (1.25)	*** (0.01)	99.2 (0.36)	91.4 (0.60)	*** (0.05)
Sociometric status		2.6 (0.02)	2.7 (0.07)		2.6 (0.02)	2.7 (0.03)	*** (0.007)
Peer victimization							
Victim		20%	16%		20%	19%	
Bully-victim		14%	17%		13%	15%	
Bully		16%	20%		15%	17%	

Table A1. Attrition analyses

[a] response is defined as having data on anxiety symptoms (RCADS).

[b] mean (standard error).

* p<.05; **p<.01; ***p<.001. Given the large number of tests, without a prioti hypotheses, p-values between .05 and .001 should be interpreted with caution.

More detailed analyses of attrition have been published in: Nederhof, E., Jorg, F., Raven, D., Veenstra, R., Verhulst, F. C., Ormel, J., & Oldehinkel, A. J. (2012). Benefits of extensive recruitment effort persist during follow-ups and are consistent across age group and survey method. The TRAILS study. BMC Medical Research Methodology, 12(1), 93.

same population study were predictive of unfavourable deviations from normal anxiety development throughout adolescence. Included risk factors were: self-competence, temperament (i.e., shyness, frustration and effortful control), parenting (i.e., rejection and overprotection), parental internalizing problems (i.e., lifetime and current), life events (i.e., illness and death in the family), and peer victimization (i.e., bully and victim).

Self-competence was measured with the global self-worth scale of the Self-Perception Profile for Children (Harter, 1982). Temperament was assessed with the short form of the Early Adolescent Temperament Questionnaire-Revised (Oldehinkel, Hartman, De Winter, Veenstra, & Ormel, 2004). Perceived parenting was assessed with the Egna Minnen Beträffende for Children (Markus, Lindhout, Boer, Hoogendijk, & Arrindell, 2003). An average score of adolescents' ratings about both parents was calculated. Parental current internalizing problems were assessed with the

Depression Anxiety Stress Scales (Henry & Crawford, 2005), and lifetime internalizing problems with the TRAILS Family History Interview (Ormel, et al., 2005). Paternal and maternal internalizing problems were combined. Included life events were severe illness of mother, father or a sibling, and death of a family member lifetime before T1. Three groups related to peer victimization were identified based on two items of the Youth Self-Report (Achenbach & Rescorla, 2001; item 16 "I am mean to others" and item 39 "I get teased a lot"): victims (children who are bullied), bullies (children who bully others), and bully-victims (children who are both victimized and bully others).

At T4, the Composite International Diagnostic Interview 3.0 (CIDI; Kessler & Ustun, 2004) was used to assess anxiety disorders (i.e., specific phobia, social phobia, generalized anxiety disorder, panic disorders and agoraphobia) and major depressive disorder according to the criteria of the DSM-IV retrospectively between the ages of 10 and 17

Table A2. Model fit statistics of anxiety trajectories, stratified by gender					
Gender	Anxiety trajectories	BIC	LMR-LRT 2LL	Entropy	Range of posterior probabilities
Girls	1	1,352.22			
	2	1,232.58	147.76*	0.85	0.86–0.97
	3	1,153.27	107.43**	0.91	0.84–0.97
	4	1,105.85	75.53	0.86	0.78–0.95
Boys	1	402.28			
	2	246.87	183.41***	0.84	0.85–0.97
	3	178.72	96.14*	0.81	0.80–0.94
	4	128.75	77.96	0.83	0.77–0.94

Note. BIC: Bayesian Information Criterion; LMR-LRT: Lo-Mendell-Rubin Likelihood Ratio Test; 2LL: 2 times the Loglikelihood Difference.

In the models for girls and boys the variance of the quadratic slope factor was fixed at zero. In the models for boys, but not for girls, the variance of the linear slope factor was fixed at zero.

*: p≤.05; **: p≤.01; ***: p≤.001.

Table A3. Parameter estimates of developmental trajectories of anxiety symptoms, stratified by gender									
		Intercept			Linear slope			Quadratic slope		
Gender	Classes	M	(SE)	p	M	(SE)	p	M	(SE)	p
Girls	Low	0.62	(0.01)	***	-0.09	(0.01)	***	0.01	(0.01)	***
	MAI	0.78	(0.11)	***	-0.17	(0.05)	**	0.05	(0.01)	***
	MAL	0.93	(0.14)	***	0.24	(0.11)	*	-0.04	(0.02)	**
Boys	Low	0.49	(0.02)	***	-0.11	(0.01)	***	0.01	(0.01)	***
	EAD	1.37	(0.13)	***	-0.45	(0.08)	***	0.05	(0.01)	***
	MAL	0.70	(0.05)	***	0.11	(0.04)	**	-0.02	(0.01)	**

Note. M: Mean; SE: Standard Error; MAI: Mid-adolescence-increase; MAL: Mid-adolescence-limited; EAD: Early-adolescence-decrease

*: p≤.05; **: p≤.01; ***: p≤.001.

years, and over the past year. The reliability of the CIDI 3.0 has been demonstrated to be excellent, and the validity has been demonstrated to be adequate (Andrews & Peters, 1998).

Statistical analyses

Growth mixture modelling (GMM) was used to identify distinct developmental trajectories of anxiety symptoms. GMM was conducted in Mplus version 5.1 (Muthén & Muthén, 2007). Multigroup comparisons indicated that the analyses needed to be stratified by gender (details available on request from corresponding author). Trajectories were determined by latent growth factors, which model the intercepts and slopes (linear and quadratic) of the individual growth trajectories. Following van Oort et al (2009) and Morin et al (2011) we included both a linear and a quadratic slope, which fitted the data better than a linear slope only. We fitted the GMM models with increasing numbers of classes. Trajectories were estimated based on maximum

likelihood with robust standard errors (MLR), which is robust regarding non-normality of the scores. Missing data are not imputed in MLR, but parameters and standard errors are estimated directly using all the observed data. Adolescents were included in the GMM analyses who participated in at least one assessment wave. The data were rearranged as a function of chronological age instead of clustered by wave of data collection.

Rules to determine the number of trajectory classes were formulated a priori, and included a significant Lo-Mendell-Rubin likelihood ratio test (LMR-LRT; Lo, Mendell, & Rubin, 2001), which indicates that a model with k classes is preferred over k-1 classes. Further, the Bayesian Information Criterion (BIC; Schwartz, 1978) had to be lower than the BIC of the model with k-1 classes. Average posterior probabilities had to be 0.80 or larger and entropy had to be above 0.80 for adequate class distinction. Posterior probability reflects the probability to be a member of a specific

class. Entropy summarizes the posterior probabilities for all classes and varies between 0 and 1. An entropy value of 1 indicates a perfect distinction between classes (Celeux & Soromenho, 1996).

Estimating class specific variances for the intercept and linear slope resulted in convergence problems, which is often an indication of over-fitting. Therefore, the intercept factor and linear slope factor variances were constrained to be equal between the classes in all models. Additionally, variances of the linear slope factor were fixed to zero for boys, but not for girls. In the models for girls and boys the variance of the quadratic slope factor was fixed at zero. All adolescents were allocated to one of the anxiety trajectories based on their highest posterior probability. Outcomes of the restricted models were reported on in the Results section.

Multinomial logistic regression analyses were performed to examine whether child, family and peer factors predicted membership of specific anxiety trajectories. To minimize the loss of statistical power and risk for bias, we used multiple imputation (Donders, van der Heijden, Stijnen, & Moons, 2006). Twenty datasets were generated using Imputations and Variance Estimation Software (IVEware; Ragnunathan, Solenberger, & van Hoewyk, 2002). Regression coefficients and SEs were pooled using Rubins method for multiple imputation inference (Barnard & Rubin, 1999). All continuous variables wee dichotomized at the 80th percentile (shyness, frustration, parental rejection and overprotection, parental internalizing problems) or the 20th percentile (self-competence, effortful control). Binary logistic regression analyses were performed to examine the relation between anxiety trajectories and anxiety disorders and major depressive disorders during adolescence (10-17 years) and in early adulthood (T4, 17-20 years).

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