

Derivation of the irritability dimension

The irritability dimension analyzed here, identified previously by Stringaris et al. (1), was derived from the CBCL oppositionality items using exploratory factor analysis. Exploratory, rather than confirmatory, methods were preferred because there is only one previous study of the CBCL irritability factor structure. These analyses yielded two factors: Headstrong/Hurtful and Irritability, with Eigen values ≥ 1 . The irritability items identified previously include: 1) stubborn, sullen or irritable, 2) Sudden changes in mood, and 3) temper tantrums or hot temper. “Argues a lot” also loaded highly on both the headstrong/hurtful and irritability factors.

First, we determined whether we could replicate this factor structure for each wave and each informant. To do this, we conducted seven separate exploratory factor analyses using the CBCL Oppositionality items (see Table S1A). These analyses indicated that all three irritability items loaded strongly on the Irritability factor for parent (range .61-.91) and child self-report (range .52-.88) on the Irritability factor. The item “argues a lot” did not load highly on the irritability dimension and, therefore, was not included as part of the Irritability dimension. Next, we created an Irritability score by summing the three irritability items to create an Irritability score at each wave for each informant. This repeated measure, multi-informant Irritability score served as the primary variable in biometric twin models. Irritability scores were standardized (i.e., converted to z scores), which is the preferred approach for complex models. EFA analyses were performed in Mplus (2), using the weighted least squares mean variance estimator, while biometric twin models were conducted in Mx (3).

A limited examination of construct validity was conducted by examining correlations between irritability scores and the anxious/depressed subscale of the Child Behavior Checklist. Correlations occurring at the same wave were all positive, moderate in strength, and statistically significant ($p < .01$; $r_s = .36-.51$), providing preliminary construct validity and suggesting an association with internalizing symptoms.

References

1. Stringaris A, Zavos H, Leibenluft E, et al: Adolescent irritability: phenotypic associations and genetic links with depressed mood. *Am J Psychiatry* 2012; 169:47–54.
2. Muthén, L. K., & Muthén, B. O. (2007). *Mplus user's guide*. Los Angeles: Muthén & Muthén.
3. Neale MC, Boker SM, Xie G, et al: *Mx: Statistical Modeling*, 6th ed. Richmond, Virginia Commonwealth University School of Medicine, 2003

TABLE S1. Loadings of the Exploratory Factor Analysis of CBCL Oppositionality Items Yielding the Irritability and Headstrong/Hurtful Factors. Items Were Assessed Across Waves 1–4 by Parent and Child Report.

CBCL Content Item	Wave1-Parent		Wave2-Parent		Wave3-Parent		Wave4-Parent	
	Headstrong /hurtful	Irritability	Headstrong /hurtful	Irritability	Headstrong /hurtful	Irritability	Headstrong /hurtful	Irritability
	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2
Argues a lot	0.48	0.30	0.52	0.31	0.32	0.52	0.72	-0.05
Cruelty, bullying, or meanness to others	0.71	0.14	0.50	0.33	0.24	0.58	0.57	0.59
Destroys things belonging to his/her family or others	0.68	0.14	0.68	0.06	0.48	0.33	0.59	0.06
Disobedient at home	0.87	-0.01	0.92	-0.02	0.96	0.03	----	----
Disobedient at school	0.83	-0.09	0.71	0.00	0.88	-0.05	----	----
Teases a lot	0.51	0.19	0.41	0.23	0.22	0.41	0.05	0.34
Stubborn, sullen or irritable	0.26	0.61	0.27	0.61	0.16	0.71	0.14	0.73
Sudden changes in mood	-0.01	0.87	-0.03	0.90	-0.13	0.95	-0.11	0.90
Temper tantrums or hot temper	0.21	0.68	0.03	0.84	0.00	0.87	-0.11	0.91

CBCL Content Item	Wave2-Child		Wave3-Child		Wav4-Child	
	Headstrong /hurtful	Irritability	Headstrong/hurtful	Irritability	Headstrong/hurtful	Irritability
	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2
Argues a lot	0.03	0.18	0.12	0.14	0.31	-0.05
Cruelty, bullying, or meanness to others	0.43	0.32	0.41	0.29	0.70	0.02
Destroys things belonging to his/her family or others	0.45	0.11	0.61	0.03	0.64	-0.03
Disobedient at home	0.72	0.05	0.79	-0.01	----	----
Disobedient at school	0.90	-0.04	0.84	0.00	----	----
Teases a lot	0.31	0.33	0.28	0.26	0.66	0.03
Stubborn, sullen or irritable	0.00	0.52	0.15	0.42	0.22	0.61
Sudden changes in mood	0.07	0.81	0.009	0.76	-0.02	0.84
Temper tantrums or hot temper	0.01	0.79	-0.01	0.88	0.26	0.65

TABLE S2. Pearson Correlations Between and Within Parent Report and Self-Report of Irritability Across Waves 1–4

	W1 (8-9) Parent	W2 (12-13) Parent	W3 (16-17) Parent	W4 (19-20) Parent	W2 (12-13) Self-report	W3 (16-17) Self-report	W4 (19-20) Self-report
W1, Parent	-----	.49	.46	.32	.20	.19	.19
W2, Parent		-----	.59	.46	.32	.31	.23
W3, Parent			-----	.48	.25	.36	.23
W4, Parent				-----	.13	.28	.23
W2, Self-report					-----	.44	.31
W3, Self-report						-----	.45

All correlations are significant at $p < 0.01$.

TABLE S3. Pearson Correlations Between Parent Report of Twin Irritability and the Child Behavior Checklist Anxious/Depressed Subscale Symptoms (Top) and Between Child Self-Report of Irritability and the Child Behavior Checklist Anxious/Depressed Subscale Symptoms (Bottom) Across Waves 1–4

		Irritability			
		W1 (8-9)	W2 (12-13)	W3 (16-17)	W4 (19-20)
Anxious/Depressed	Parent				
	W1	.44	.32	.30	.29
	W2	.33	.50	.35	.38
	W3	.27	.33	.44	.35
	W4	.23	.32	.33	.51
	Child Self-report				
	W2	---	.37	.26	.24
	W3	---	.24	.36	.28
	W4	---	.23	.26	.47

All correlations are significant at $p < 0.01$. Bolded values represent the irritability and Child Behavior Checklist Anxious/Depressed subscale correlations for the same data collection wave.

FIGURE S1A. Parameter Estimates for the Best-Fit Model for Irritability (Males)

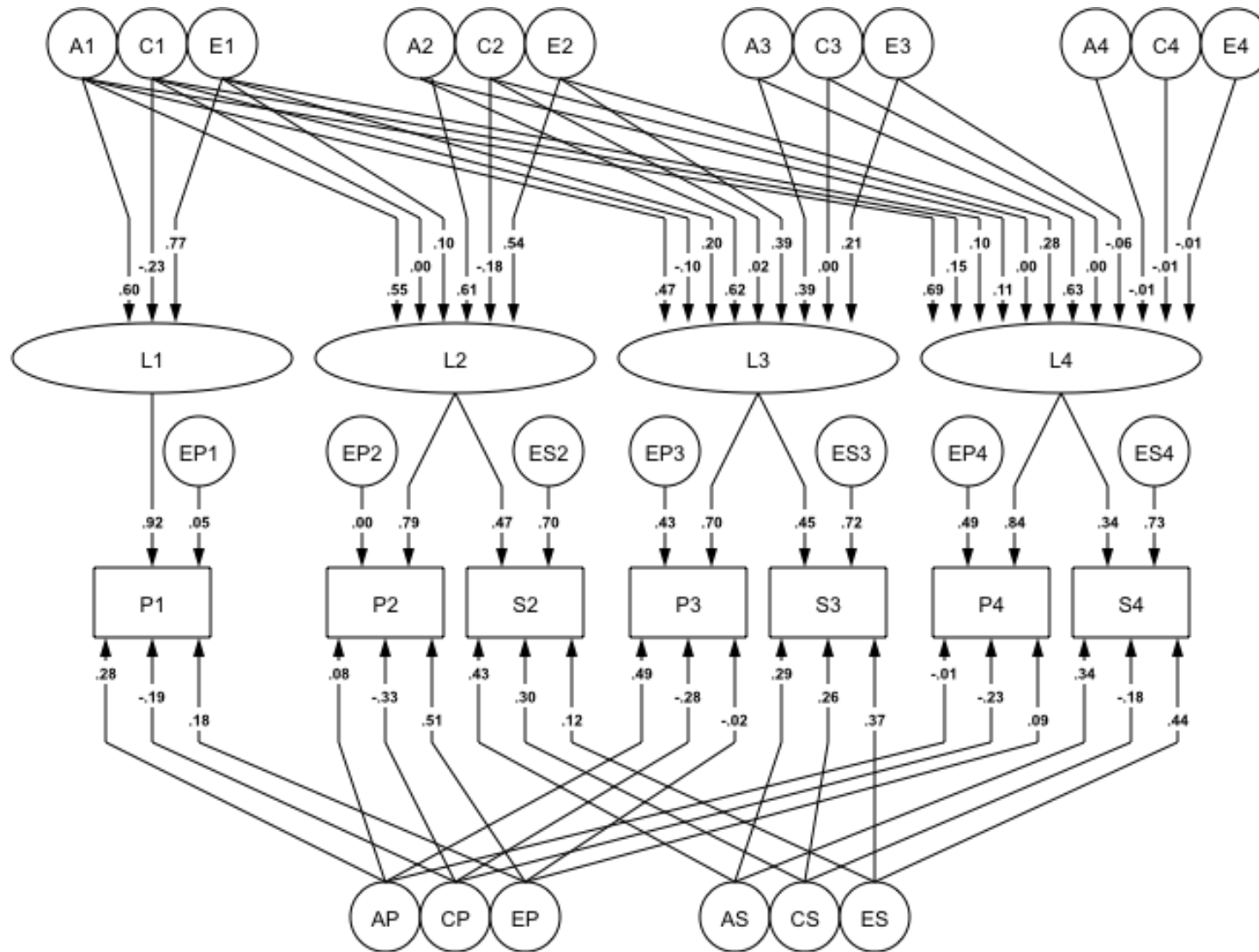


FIGURE S1B. Parameter Estimates for the Best-Fit Model for Irritability (Females)

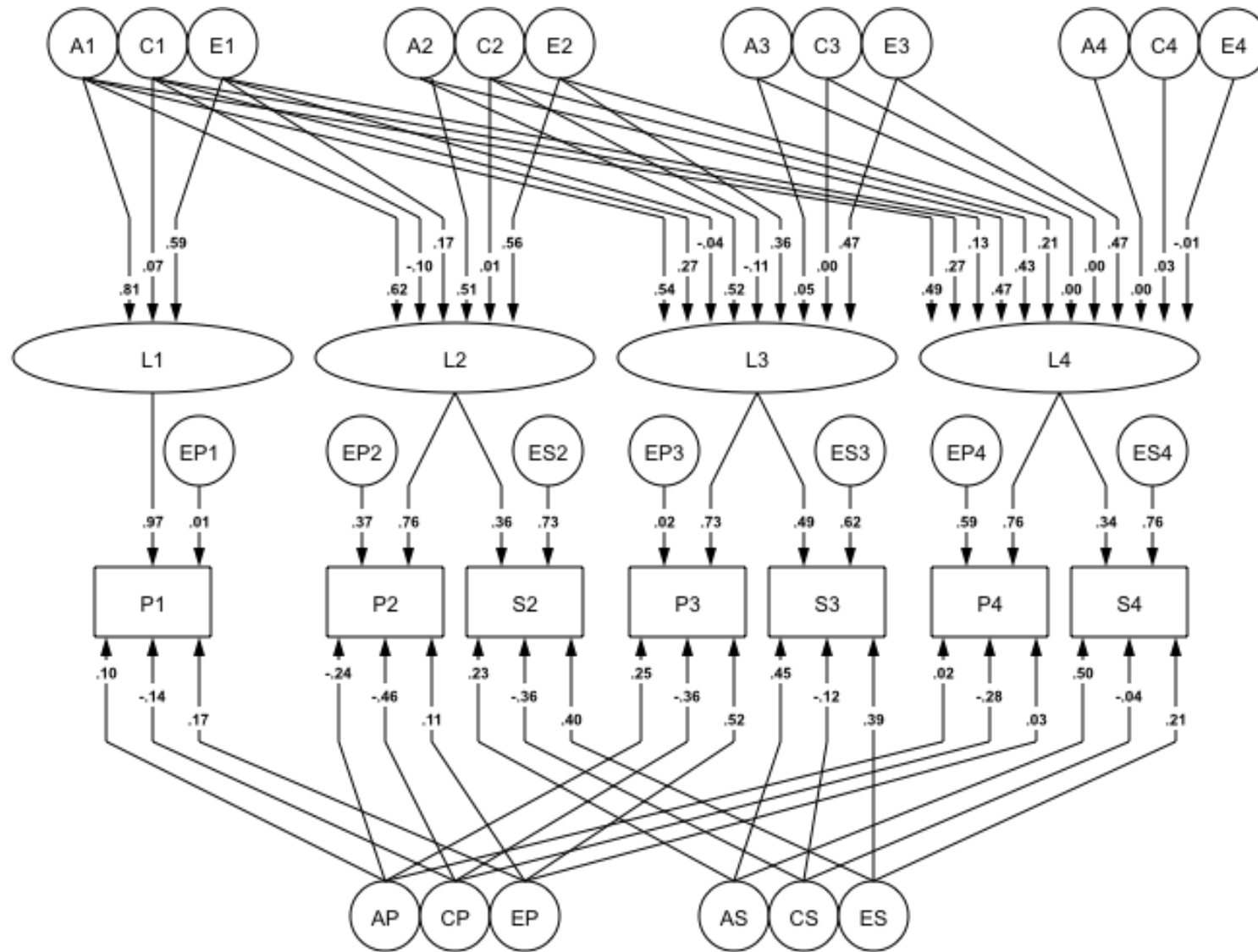


FIGURE S2. Longitudinal Cholesky Decomposition With Parameter Estimates for Irritability, Females and Males Combined

