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Predicting Substance Use Initiation from Multiple Informant Washington Ratings of Behavioral and Emotional Problems

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Introduction

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Results – Aim 1

Substance use and misuse present major public health problems worldwide. Early substance use initiation (SUI) is a significant risk factor for continued, heavier use, and the subsequent development of dependence (1). Accordingly, identifying significant predictors of early SUI is an important step in developing effective prevention and intervention programs. Problematic behavior in childhood and early adolescence has been related to substance use. However, it is not clear what informant provides the most useful information about children's behavior, and many studies have found poor agreement between different informants (e.g., 2). In the FinnTwin12 (FT12) project, we find low to moderate correlations (.24 - .62) between ratings of behavioral (BP) and emotional (EP) problems made by different informants (3).

This study examined the relationship between BP and EP at age 12, as rated by different types of informants, and subsequent SUI at age 14. We were interested in whether reports by different informants were differentially related to early SUI (Aim 1). Do parents, teachers, and peers differ in how well they predict adolescents at risk for early SUI? A second aim that can be addressed with FT12 twin data is whether or not estimates of genetic and environmental influences on problematic behavior differ across informants. Do heritability estimates of BP and EP vary substantially when using ratings from different informants (Aim 2)?

Method

 Participants: FT12 is a population-based longitudinal twin study of health risk factors beginning at the age of 12. It consists of five consecutive birth cohorts of twins who were identified through Finland's Central Population Registry. Analyses reported here are from an intensive sub-sample of 791 MZ, DZ, and OSDZ twins pairs.

• **Measures and Procedure:** At age 12, we collected ratings of BP and EP problems using a multidimensional inventory of children's behavior from parents, teachers, and peers (Multidimensional Peer Nomination Inventory, MPNI; 3).

- Parent and Teacher Ratings: Questionnaires based on the Parental and Teacher Rating Forms of the MPNI that solicit ratings for BP, EP, and adjustment.
- Peer nominations: The same MPNI items were read aloud in the classroom and children were told to choose 3 female and 3 male classmates from a list who best fit the behavior described. Each child received a certain number of nominations for each item, expressed as a percentage of the maximum possible number of nominations.
- Follow-up: At age 14, we collected questionnaire-based information from each twin
 on health habits, including whether they had ever smoked cigarettes or drank alcohol.
 Retention from age 12 to age 14 exceeded 90%.

Statistical Analyses:

- Aim 1: We selected one twin randomly from each pair (391 boys, 400 girls) and used structural equation modeling (SEM) to test the relationship between informant ratings of BP and EP at age 12 and smoking initiation and drinking initiation at age 14. The statistical package Mx was used for all analyses (4). The significance of constraining pathways to be equal across gender, and of dropping pathways from the model, was tested by evaluating the change in chi square for the degrees of freedom gained.
- Aim 2: Univariate modeling procedures in Mx (4) were used to estimate the additive genetic (A), shared environmental (C), and unique environmental (E) influences on ratings of both BP and EP across the three different informants. For these analyses, we used 172 MZ female pairs, 140 DZ female pairs, 173 MZ male pairs, and 165 DZ male pairs.

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Structural Equation Modeling (Aim 1): Complete SEM results predicting SUI from ratings of BP and EP are presented in Table 1 with the basic SEM model shown in Figure 1. We found low to moderate correlations (.23 - .65; red correlations in Figures 1) among informant ratings of BP and EP for boys and girls. Across all models, path estimates could be constrained equal across gender without a significant decrease in fit (model 2). Accordingly, all subsequent submodels were compared to model 2. For smoking initiation, parent and teacher ratings could be dropped from the BP and EP models without a significant decrease in fit. Thus, *only* peer ratings of both BP and EP were significant predictors of smoking initiation by age 14. The pattern of results for drinking initiation was similar to that for smoking initiation, except that we were unable to differentiate teacher and peer ratings: either pathway could be dropped without causing a significant decrease in fit of the model, but not both pathways. Higher ratings of BP at age 12 inferred a *greater* risk of SUI by age 14.

	Parameter Estimates					Fit Statistics			Table 1
Model: BP Ratings and Ever Smoked	BP Parent (B/G)	BP Peer (B/G)	BP Teach (B/G)	x2	df	P	AIC	Δχ2	p-valu
1. Full model with males/females different	.04/.11	24*/.15	01/.20*	0.907	13	1	-25.093	14	
2. Full model constraining gender	0.07	0.19	0.12	4.579	16	0.997	-27.421	3.672	0.2991
a Dropping only Parents		.21*	.14*	6.024	17	0.993	-27.976	1.445	0.2293
b. Dropping only Teachers	0.1	.26*		7.08	17	0.982	-26.92	2.501	0.1137
c. Dropping only Peers	0.1	**	.23*	11.731	17	0.816	-22.269	7.152	0.0074
d. Dropping Smallest 2 Paths (par & teach)		31*	-	9.998	18	0.932	-26.002	5.419	0.0665
e. Dropping all three pathways		**	**	42.924	19	0.001	4.924	38.345	2.4E-0
Model BP Ratings and Ever Drank	BP Parent (B/G)	BP Peer (B/G)	BP Teach (B/G)	¥2	df	p	AIC	Δx2	p-valu
1 Full model with maleofemales different	08/- 01	19*/.02	02/20*	0.076	13	1	-25.924		
2. Full model constraining gender	0.02	0.1	0.1	3.154	16	1	-28.846	3.078	0.3797
a. Dropping only Parents		0.1	0.11	3.3	17	1	-30.7	0.146	0.7023
b. Dropping only Teachers	0.05	.154*	**	5.198	17	0.997	-28.802	2.044	0.1528
c. Dropping only Peers	0.04	**	158*	5.43	17	0.996	-28.57	2.276	0.1313
d. Dropping two Paths (par & teach)		.172 *	-	5.888	18	0.997	-30.112	2.734	0.2548
e. Dropping two Paths (par & peer)		-	0.1741	5.813	18	0.997	-30.187	2.659	0.2646
f. Dropping two Paths (peer & teacher)	.11*		**.	12.987	18	0.792	-23.013	9.833	0.0073
g Dropping all three pathways		**		17.454	19	0.559	-20.546	14.3	0.0025
Model EP Ratings and Ever Smoked	BP Parent (B/G)	BP Peer (B/G)	BP Teach (B/G)	χ2	df	P	AIC	Δχ2	p-vilu
 Full model with males/females different 	- 04/- 03	24*/07	.05/11	0.184	13	1	-25.816		
2. Full model constraining gender	-0.03	- 15*	-0.03	3.384	16	1	-28.616	3.2	0.3618
a Dropping only Parents		- 15*	-0.04	3.709	17	1	-30.291	0.325	0.5686
b. Dropping only Teachers	-0.04	- 16*	**	3.706	17	1	-30.294	0.322	0.5704
c. Dropping only Peers	-0.05	**	-0.08	10.053	17	0.901	-23.947	6.669	0.0098
d. Dropping Smallest 2 Paths (par & teach)	-	-17*		4.189	18	1	-31.811	0.805	0.3696
e. Dropping all three pathways	. 44	**		14.52	19	0.753	-23.48	11.136	0.0008
Model EP Ratings and Ever Drank	BP Parent (B/G)	BP Peer (B/G)	BP Teach (B/G)	x2	df	p	AIC	Δχ2	p-value
1. Full model with males/females different	.04/- 02	.00/24*	- 1/.05	0.239	13	1	-25.761		
2 Full model constraining gender	-0.01	- 11*	-0.03	6.106	16	0.987	-25.894	5.867	0.1182
a. Dropping only Parents		11*	-0.03	6.156	17	0.992	-27.844	0.05	0.8230
b. Dropping only Teachers	0.01	- 12*	**	6.435	17	0.99	-27.565	0.329	0.5662
c. Dropping only Peers	-0.01		-0.07	10.154	17	0.897	-23.846	4.048	0.0442
d. Dropping Smallest 2 Paths (par & teach)		121	-	6.449	18	0.994	-29.551	0.343	0.8424
e. Dropping all three pathways				12 399	19	0.868	-25.601	6.293	0.0981



Conclusions – Aim 1

SEM results suggest that, whenever possible, researchers should gather informant data from peers when attempting to predict problem behavior, particular adolescent substance use. The parameter estimates in Table 1 for models in which path estimates were not constrained equal across gender show some potential gender differences between informant ratings. We are currently doing further exploration of gender differences.

Results – Aim 2

• Heritability Estimates (Aim 2): Informant ratings of BP and EP were fit to a standard univariate twin model (see Figure 2) to estimate the variance explained by A, C, and E. Table 2 presents parameter estimates and model fit statistics for BP ratings across informants. Path estimates could be constrained equal across gender for parent and peer ratings of BP; dropping either A or C resulted in a significant reduction in fit. Path estimates could not be constrained equal across gender for teacher ratings, and dropping A or C for boys, girls, or both resulted in a significant decrease in fit. In the best fitting models, additive genetic (A) influences account for a substantial amount of the variance for BP ratings across informants (45-67%), while shared environmental (C) influences accounted for 17 to 37% of the variance. Unique environmental (E) influences varied little across informant ratings ranging from 11 to 21%.

	Ratings of Behavior Problems	Parameter Estmates		nates	Fit Statistics			\$	Table	
Figure 2	Contraction of the state of the state of the state	A	С	E	χ2	df	AIC	Δχ2	p-valu	
Standard Univariate Model	Parent	(B/G)	(B/G)	(B/G)						
P=A+C+E	1. Full Model-No constraints	0.67/0.67	0.16/0.17	0.17/0.15	-484 944	1292	0.0			
$1.0 (MLZ) / .5 (DZ) 1.0 Var(P) = a^{5+c^{5+a^{2}}}$	2. Full Model w/ Gender Constrained	0.67	0.17	0.16	-484.752	1295	0.0	0.192	0.978	
	a Dropping A		0.68	0.32	-379.948	1296	103	104.8	1E-24	
	b. Dropping C	0.84		0.16	-480.809	1296	1.94	3.943	0.047	
(A1)(C1)(E1) (A2)(C2)(E2)	Peer	(B/G)	(B/G)	(B/G)						
$\langle \langle \varphi \rangle \rangle \langle \varphi \rangle \rangle$	1. Full Model-No constraints	0.58/0.40	0.18/0.41	0.23/0.19	3538.92	1292	0.0	**		
	2. Full Model w' Gender Constrained	0.49	0.29	0.21	3542.62	1295	0.0	3.703	0.295	
Twin 1 Turin 2	a Dropping A		0.67	0.33	3591.67	1296	47.1	49.05	2E-1.	
	b. Dropping C	0,79	**	0.21	3554.32	1296	9.7	11.7	0.000	
	Teacher	(B/G)	(B/G)	(B/G)						
	I. Full Model-No constraints	0.45 0.64	0.37.0.25	0.180.11	100 400	1292	0.0	06.00	100 0	
Table 2 presents regults for ED	a Dropping A (boys & gris)	164	0.70/0.74	20/11	199.422	1294	0.0	93.82	25-2	
 Table 5 presents results for EF 	 Dropping A (objy only) Dropping A (objy only) 	140	22/24	19/ 26	172 267	1293	0.0	60 66	112.14	
ratings. For parent, peer, and	d Decement C (hours & ords)	0.8200.89	.30.14	0.18/0.11	119.018	1294	0.0	15.41	0.000	
teacher ratings nathways could	* Dropping C (boys only)	82/64	125	18/11	114 623	1293	0.0	11.02	0.000	
teacher ratings, pathways could	f Dropping C (girls only)	45/89	37/	18/11	107 998	1293	0.0	4.394	0.036	
be constrained to be equal across	2. Full Model w/ Gender Constrained	0.55	0.31	0.15	111 906	1295	0.0	8.302	0.040	
genders. C could be dropped for	Nos- 10 + Talarice Packless, A + Additive Genetic	C + Shared Ex	er; E = Usigue	Law issuer, Dar	Otting model	presented	in bold	Alban .		
parent ratings without a	Ratings of Emotional Problems	Parameter Estimates			Fit Statistics			5	Table	
significant fit reduction but	and the statement of th	A	C	E	×2	df	AIC	$\Delta \chi^2$	p-vak	
significant in reduction, out	Parent	(B/G)	(B/G)	(B/G)					-	
dropping either A or C for peer or	1 Full Model-No constraints	0.52/0.63	0.09/0.0	0.39/0.37	-195.78	1207	0.0			
teacher ratings resulted in a	2. Full Model w/ Gender Constrained	0.62	0.0	0.38	-195.275	1210	0.0	0.505	0.917	
	a Dropping A	++	0.45	0.55	-164.241	1211	0.0	31.03	3E-0	
significant decrease in fit of the	b. Dropping C	0.62		0.38	-195.275	1211	0,0	0	1	
models. In the best fitting	Peer	(B/G)	(B/G)	(B/G)	1.000					
models. A accounted for 46 to	1 Full Model-No constraints	0.69/0.57	0.10/0.24	0.21/0.19	2871.5	1291	0.0	- 4.4		
models, A accounted for 46 to	2. Full Model w/ Gender Constrained	0.63	0.17	0.20	2872.6	1294	0.0	1.145	0.766	
63% of the variance, C accounted	a Dropping A		0.66	0.34	2948.37	1295	0.0	75.77	3E-1	
for 17 to 31% of the variance	b. Dropping C	0.80	3.0	0.20	2876.32	1295	0.0	3.718	0.053	
101 17 to 51% of the variance,	Teacher	(B/G)	(B/G)	(B/G)						
and E explained a moderate 20 to	I. Full Model-No constraints	0 51/0 38	0.23/0.42	0.27/0.20	217.292	1284	0.0	1000	-	
38% of the variance in FP	2. Pun Alodes w. Gender Constramed	0.46	0.31	0.23	222.334	128	0.0	20.34	0.168	
	a Liopping A	0.72	0.00	0.54	225 041	1200	0.0	12.61	0.000	
ratings.	10. LPTOPPER C.	C = Shared E	w.E + Unique	East James Tax	1 fitting model	1200	U.U.	13.01	0.000	

Conclusions – Aim 2

- With only one exception (teacher ratings of BP), path estimates could be constrained to be equal
 across gender when estimating the variance explained by A, C, and E in BP and EP models.
 Parameter estimates suggest that genes are the most important influence on ratings of BP and EP
 from parents, peers, and teachers. Estimates of the shared and unique environment suggest low to
 moderate influences on BP and EP.
- In the future, we plan to integrate information from multiple informants into multiple rater models.
- Although cumbersome, gathering data from multiple informants permits researchers to use more sophisticated modeling procedures and get a more complete picture of the phenotype of interest.

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