Predicting substance use initiation from multiple informant ratings of behavioral and emotional problems

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Introduction

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%.
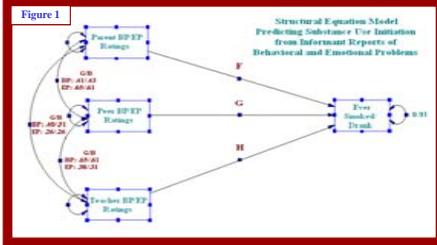
- **Statistical Analyses:**

  - 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.

Results – Aim 1

- **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 at age 14, but higher ratings of EP inferred a *decreased* risk of SUI by age 14.

Table 1. Parameter Estimates and Fit Statistics

Figure 1. Structural Equation Model Predicting Substance Use Initiation from Informant Reports of Behavioral and Emotional Problems
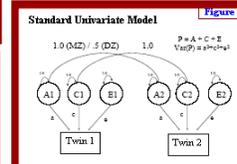
Conclusions – Aim 1

- 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%.

Figure 2. Standard Univariate Model

Table 2. Ratings of Behavior Problems — Parameter Estimates and Fit Statistics

- Table 3 presents results for EP ratings. For parent, peer, and teacher ratings, pathways could be constrained to be equal across genders. C could be dropped for parent ratings without a significant fit reduction, but dropping either A or C for peer or teacher ratings resulted in a significant decrease in fit of the models. In the best fitting models, A accounted for 46 to 63% of the variance, C accounted for 17 to 31% of the variance, and E explained a moderate 20 to 38% of the variance in EP ratings.

Table 3. Ratings of Emotional Problems — Parameter Estimates and Fit Statistics

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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