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Differentiation of Early Adolescent Predictors of Drug Use Versus Abuse: A Developmental Risk-Factor Model

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Many psychosocial factors are associated with adolescent drug use, though most have not been tested as true predictors of drug use in prospective studies. Studies to date have also not differentiated predictors of drug use from abuse and have not addressed differential effects for specific substances. To address these concerns, we expanded the multiple risk-factor approach using 2-year longitudinal data from a sample of seventh graders. Frequencies of use for alcohol, cigarettes, marijuana, cocaine, and hard drugs were assessed at Time 1 and Time 2 and used to reflect latent constructs of polydrug use. From a set of 29 risk factors, unique predictors of any substance were separated conceptually according to whether they most related to initiation/experimental or problem/heavy drug use and were then summed into two-unit weighted indexes at each time. Distribution-free structural equation models were used to accommodate the nonnormal distributions of the illicit drug use measures. The problem risk index was strongly correlated with polydrug use at Time 1 and increased polydrug use at Time 2. Several specific relationships between risk and drug use across time also were noted.

Numerous etiological theories have been proposed to account for adolescent drug use (for reviews, see Lettieri, 1985; Newcomb & Bentler, 1988a; Sadava, 1987). Many of these conceptualizations are concerned with explaining initiation of drug use (Braucht, Brakarsh, Follingstad, & Berry, 1973; Gorsuch & Butler, 1976; Kandel, Kessler, & Margulies, 1978; McBride & Clayton, 1985; Wingard, Huba, & Bentler, 1980). Unfortunately, linkages between

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developmental theory and empirical studies of drug use have only recently been constructed, refined, and elaborated (e.g., Chassin, 1984). Additionally, many studies of teenage drug use in community populations focus only on whether drugs have been used, and often fail to differentiate patterns or extent of drug involvement, such as initiation, experimentation, regular use, or abuse (e.g., Hawkins, Lishner, & Catalano, 1985; Kandel et al., 1978). Discrimination of predictors into those which predict initiation to use drugs from those which predict more problematic drug use has evaded researchers (e.g., Chassin, 1984). Confounding these issues, some researchers have identified distinct etiological patterns associated with specific drugs (Brook, Whiteman, Gordon, Nomura, & Brook, 1986; Fleming, Kellam, & Brown, 1982; Spotts & Shontz, 1985; Weber, Graham, Hansen, Flay, & Johnson, 1989), whereas other investigators have found that similar variables contribute to use of all types of substances (e.g., Mills & Noyes, 1984).

RISK-FACTOR RESEARCH

Several researchers have tried to reconcile the different etiological theories and findings using a risk-factor approach. This approach is adapted from epidemiological disease paradigms (Dawber et al., 1959; Jenkins, 1976; Walker & Duncan, 1967; Zukel, Oglesby, & Schnaper, 1981) and suggests that susceptibility to drug involvement is based on the number of risk factors present, rather than the relative importance of any one factor. From this perspective, greater drug abuse would be associated with exposure to more risk factors. Some preliminary support of this approach in predicting drug use has been demonstrated using single indexes, composed of multiple risk factors, both in cross-sectional (Bry, McKeon, & Pandina, 1982; Newcomb, Maddahian, Skager, & Bentler, 1987) and longitudinal data (Bry, Pedraza, & Pandina, 1988; Newcomb, Maddahian, & Bentler, 1986).

However, a single risk index may be overly reductionistic and poorly predict different drug use patterns (e.g., Newcomb et al., 1987). Many drug users ingest numerous substances whereas others restrict their involvement to one drug (Clayton & Ritter, 1985; Johnston, O'Malley, & Bachman, 1988). Delineation of risk profiles along more than one dimension may be necessary to account for these important variations. An initial, basic, and essential distinction seems to be needed between risk factors most predictive of early initiation and those most related to continuation or escalation of drug use to abuse. Moreover, risk profiles may need to be established separately for users of different substances as well as those who use drugs in some combination (e.g., Clayton & Ritter, 1985).

Empirical Foundations

Bry et al. (1982) empirically demonstrated that the number of risk factors, derived as a unit-weighted risk index, was linearly related to severity of drug use. Their model was originally developed with cross-sectional data and later

tested using longitudinal data with similar results (Bry et al., 1988). They hypothesized that drug use is a general coping mechanism activated by stress (Bry, 1983). Reinforcing this view is the work of Labouvie (1986, 1987) and Wills and Shiffman (1985), which elaborated a palliative coping model of adolescent drug use.

Newcomb, Maddahian, and Bentler (1986) cross-validated the Bry et al. (1982) risk-factor methodology using prospective data. Their research expanded upon Bry et al.'s original work by: (1) expanding the set of risk factors (10 factors as opposed to 6) thus gaining in explanatory model specification; (2) deriving cut-off points based on combined conceptual and empirical criteria; (3) using separate measures for five types of drugs; and (4) demonstrating that the risk-factor index actually generated a change in drug use over time (unlike the longitudinal analyses of Bry et al., 1988, which did not control for prior drug use, and thus only established an across-time association with no predictive utility; see Newcomb, 1989).

Critique

Even though these early risk-factor trials have been encouraging as a methodology for studying teenage drug use, several important questions remain unanswered. First, Newcomb et al. (1987) reported that a single unit-weighted risk index may not be sufficient to account for all forms of drug use. Specifically, they found that cocaine and hard drug use were minimally related to the risk-factor index, though restricted ranges may have attenuated these correlations. These empirical findings underscore the problem of whether risk is best conceptualized as a unitary phenomenon (i.e., one general risk process), or as two or more conceptual pathways (i.e., one type of risk predicting drug use initiation and another type predicting more problematic drug use syndromes). Second, only a very few studies have attempted to evaluate empirically the developmental generality of risk (Labouvie, Pandina, White, & Johnson, 1990). More specifically, little attention has been paid to the developmental trajectory of risk over time (Baumrind & Moselle, 1985; Jessor, 1983).

Third, much research has been cross-sectional, which cannot address developmental concerns (Newcomb & Bentler, 1986). Even in many longitudinal studies, relatively short time spans are captured (Kandel & Faust, 1975), which may be insufficient to study developmental processes (Pandina, Labouvie, & White, 1984).

Finally, most studies examine older teenagers (Clayton & Ritter, 1985; Kandel, 1975; O'Donnell, Voss, Clayton, Slatin, & Room, 1976), which partly reflects the fact that drug use increases with age during adolescence (e.g., Kandel & Logan, 1984) and that younger samples engage in insufficient drug use and related behaviors for reliable analyses. Nevertheless, most of the developmental preparation for later drug involvement probably occurs at a younger age, emphasizing the importance of studying children and young teenagers (e.g., Newcomb & Bentler, 1986, 1989).

This Study

We tested the utility of a multivariate risk-factors model to explain the developmental progression of early teenage drug use. A two-wave prospective design was used to analyze data from students in seventh grade and later in ninth grade. Both confirmatory measurement and structural path methods were used to test the theoretical premise that factors predicting problematic/heavy drug use are conceptually and empirically different from those that predict initiation/experimentation to drug use.

Separation of predictor variables into conceptually distinct indexes was based on a careful examination of relevant literature (Scheier, 1989). Although this literature has certainly improved our understanding of drug abuse etiologies and consequences, it may not be possible to represent a concerted and unified theoretical approach toward identifying the correlates and concomitants of adolescent substance use (e.g., Braucht, Kirby, & Berry, 1978; Kandel, 1980; Lettieri, 1985). Notwithstanding, the social learning literature suggests that youth initiate and experiment with drugs as a direct result of modeling and peer influences (e.g., Kandel, 1986; Pentz, 1985). As youth become more enmeshed in drug use they develop important attitudes and perceptions regarding the effects of drugs (Christiansen & Goldman, 1983). These attitudes become closely intertwined with actual use behaviors and form specific cognitive expectations for future drug-related experiences (e.g., Adesso, 1985). On the other hand, research has shown that negative intrapersonal experiences (e.g., depression) are important predictors of more problematic drug use (e.g., Paton, Kessler, & Kandel, 1977). In the latter example, drug use is functionally aimed toward tension reduction and alleviating distress. Along the lines of these conceptual distinctions, we created three domains: attitudinal (involving perceptions of the positive and negative consequences of drug use), behavioral (involving actual experiences related to drugs including deviance), and psychosocial (involving inter- and intrapersonal experiences related to drugs including locus of control, academic and personal motivations, bonding to normed institutions, and perceptions of peer use of drugs). Following this basic and essential distinction, each factor was conceptually distinguished according to whether it was more often associated with initiation or problem/heavy drug use.

METHODS

Data utilized were obtained for secondary analysis from a school-based drug prevention program conducted in Napa, California (Moskowitz, Malvin, Schaeffer, & Schaps, 1983; Moskowitz, Schaps, Schaeffer, & Malvin, 1984; Schaps, Moskowitz, Malvin, & Schaeffer, 1986). Annual self-report assessments included measures of drug use, psychosocial, attitudinal, and behavioral variables. All students in the seventh grade ($N = 717$) with complete data who also were present for the ninth-grade assessment were used for these analyses. The resulting panel sample ($N = 311$) was 52% female. There were no

statistically significant differences in sex composition for the baseline and panel sample. No data were available on ethnicity and social class, although local census information indicated a relatively homogeneous white, middle-class population.

Risk Measures

Twenty-nine psychosocial, attitudinal, and behavioral risk-factor scales were created at Time 1 from a variety of multiitem inventories. Factor analysis of the Self-Observation Scales (SOS; Stenner & Katzenmeyer, 1975) produced eight scales assessing student's perception of school as a positive climate, perception of their academic performance, orientation to success, affiliation with children, worry and anxiety, happiness, bonding toward peers, and bonding toward the classroom. Five scales were derived from the Instructional Objectives Exchange (1972) Student Sentiment Index assessing student's perception of peer affect toward school, academic performance, level of competition in school activities, perceived freedom in the school environment, and bonding to teachers. The Crandall Intellectual Achievement Responsibility Questionnaire (CIAR; Crandall, Katkovsky, & Crandall, 1965) contains two scales assessing external and internal locus of control in achievement or academic situations. The Drug and Alcohol Survey (DAS; Moskowitz, Schaeffer, Condon, Schaps, & Malvin, 1981) contains 14 scales assessing perceptions of the positive and negative benefits of drug use, attitudes toward drug use, perceptions of peer attitudes toward drug use, and peer use of drugs.

Internal consistency estimates for all scales ranged from a low of .76 for Orientation to Success to .98 for Perceived Peer Use of Hard Drugs. At Time 2, 25 of the 29 scales were repeated. The smaller number of scales at Time 2 resulted from changes in some of the item scaling (from dichotomous to 4-point Likert) and deletion of certain items between the two assessment points. Scales not present at Time 2 included: Worry and Anxiety, Affiliation with Children, Orientation to Success, and Perceived Competition in School Activities.

Drug Use Measures

The DAS also included self-report assessments of lifetime, and past-month use of alcohol, cigarettes, marijuana, cocaine, and hard drugs (a composite of barbiturates, amphetamines, inhalants, psychedelics, and heroin). Analyses for Time 1 relied on lifetime frequencies of use, ranging from *never* (1) to *100 or more occasions* (6). At Time 2, past-month frequency of drug use was used and ranged from *none* (1) to *20 or more occasions* (5). The different time frames for the Time 1 and Time 2 drug measures may reduce their stabilities, and Time 2 drug use measures may be less sensitive because they can be more easily influenced by random fluctuations in drug use behaviors. Nevertheless, previous literature attests to the reliability and validity of measures with these time frames for this age cohort (e.g., Single, Kandel, & Johnson,

1975) and to drug use measures in general (e.g., Stacy, Widaman, Hays, & DiMatteo, 1985).

Selection of Risk Factors

Selection of risk factors should be based on parsimony and maximizing predictive variance (Newcomb, Maddahian, & Bentler, 1986). Five multiple regression analyses were conducted with the 29 risk factors as independent variables and each of the five drug use measures as dependent variables (alcohol, cigarettes, marijuana, cocaine, and hard drugs). Risk factors were retained if they significantly predicted any one of the five drug use measures. All equations were significant and the portions of variance accounted for ranged from 19% for cocaine to 49% for marijuana.

Twenty-one risk factors were retained at Time 1 and 19 of those were available at Time 2. The two scales not available at Time 2 were Affiliation with Children and Orientation to Success. Table 1 presents these final sets of risk factors along with cut-off points for the extreme quartiles of risk and percent at risk for each factor.

Attrition Effects

The panel sample represents 43% of the original seventh-grade sample. We report elsewhere results of extensive regression analyses to predict retention (Scheier & Newcomb, 1991). In summary, students not present at Time 2 of the study reported greater levels of marijuana use, felt that using marijuana would not get them into trouble in school, with the law, or have any damaging effects on friendships or their own health. Moreover, these youth perceived fewer legal, physical, and social consequences from alcohol and drug use in general and had more deviant problems at Time 1. Interestingly, these same youth reported more negative perceptions of the gateway drugs. This equation accounted for 10% of the variance between groups. There were no systematic attrition effects based on gender. Clearly, subjects lost to attrition were more prone to engage in deviant and drug-related behaviors. However, the remaining panel sample still engaged in a wide variety of drug-using behaviors as typified by the distributions for the five drug use items. Overall, we believe that the loss of subjects may be moderately systematic, but should not severely bias the results.

Formation of Risk Indexes

Using the dichotomized risk factors (score: 1 for *risk* and 0 for *no risk*), two separate, summed, unit-weighted index scores were formed based on conceptual distinctions: One from risk factors expected to predict initiation to drug use, and one from risk factors hypothesized to generate problem or escalated drug use. These conceptual categories were based on an extensive

Table 1. Summary Statistics and Cut-Off Points for Risk-Factor Composites

Risk-Factor Composite[a]		T1 (N = 717)			T2 (N = 481)		
	[b]	M	% at risk	Cut point	M	% at risk	Cut point
Initiation/Experimental Risk Factors							
Peer/Friendship Bonding (14)	.91	1.7	23 5	< 1 57	3.1	33.4	< 2 88
Affiliation with Children (3)	.82	1.7	38 6	< 1.67	—[c]	—	—
Academic Performance (12)	.91	1.7	17 4	< 1 60	2 9	12.5	< 2.50
Positive School Climate (9)	.85	1.7	16.4	< 1.44	2 6	24.1	< 2.25
Perceived Freedom in School (5)	83	2 4	17.0	> 2.75	2.4	24 1	> 2.50
Peers Affect Toward School (11)	.91	2 6	22.2	< 2.33	2.4	22 8	< 2.25
Problem/Heavy Risk Factors							
Happy/Dysphoria (10)	.84	1.8	24.4	< 1.78	3.1	12 2	< 3 00
Bonding to Teacher (17)	.95	2.6	21.0	< 2.40	2.6	17.4	< 2.42
Orientation to Success (3)	.76	1.8	41.8	< 1.67	—	—	—
Locus of Control Failure (9)	.89	1.7	40.0	> 1.88	1.8	23 8	> 1.90
Risky Attitudes Toward Drugs (17)	.92	2.1	26.4	> 2 53	2.4	24.4	> 3.06
Negative Util. for Alcohol (5)	.82	1.9	21.2	> 2 40	2.2	24.1	> 2.71
Negative Util. for Pills (5)	.88	1.6	24.4	> 2.00	1.7	20.0	> 2.20
Negative Util. for Pills (8)	.97	1.5	21.0	> 1.87	1.6	21.5	> 1.87
Negative Util. for Marijuana (5)	.90	1.8	18.0	> 2.40	2 1	22.2	> 2.60
Negative Util. for Marijuana (8)	.96	1.7	18 3	> 2.25	1.9	19.6	> 2.50
Perceived Peer Attitude Toward Soft Drugs (3)	.92	2.7	18.0	> 3.67	3.2	11.0	> 4.00
Perceived Peer Attitude Toward Hard Drugs (3)	.95	1.9	25.7	> 2.78	2.1	25 4	> 2.71
Perceived Peer Use Soft Drugs (3)	.93	3.3	28 0	> 4.33	4.2	21.5	> 5.00
Perceived Peer Use Hard Drugs (7)	.98	1.9	21.2	> 2.28	1.9	21.0	> 2.28
Number of Deviant Problems (7)	—[d]	2.4	3.2	> 3.00	2.3	6.1	> 3.00

[a] Number in parentheses represents number of items in the factor. [b] Internal consistency coefficients were computed using the complete T1 sample. [c] Some items are present at T1 only. [d] This scale is a unit-weighted summed index of problems.

review of the existing literature and prior empirical evidence relating various psychosocial and behavioral domains to drug use (e.g., Braucht et al., 1978; Brook, Whiteman, & Gordon, 1982; Kandel, 1978; Scheier, 1989).

The initiation index both at Time 1 (RFINIT1) and Time 2 (RFINIT2) included: Peer/Friendship Bonding, Academic Performance, Positive School Climate, Perceived Freedom in School, and Peer Affect Toward School. The problem/heavy index both at Time 1 (RFPROB1) and Time 2 (RFPROB2) included: Happy/Dysphoria, Bonding to Teachers, Internality for Failure, Risky Attitudes Toward Drugs, Number of Deviant Problems, Negative Utilities (consequences) for alcohol, pills, and marijuana, Positive Utilities (benefits) for pills and marijuana, Perceived Peer Attitudes Toward Soft, and separately, Toward Hard Drugs, and Perceived Peer Use of Soft, and separately, of Hard Drugs.

Distribution of Risk Indexes

As expected (Newcomb, Maddahian, & Bentler, 1986; Newcomb et al., 1987), prevalence rates for the four risk indexes were positively skewed so that fewer students had higher numbers of risk factors. Distributions for the four risk indices are graphically portrayed in Figure 1. Modal number for each risk index was 1.0 except for RFINIT2 which was 0. Boys had significantly higher means for both initiation risk indexes than girls: RFINIT1, (M_m = 1.5 and M_f = 1.2), $t(309) = 2.32$, $p < .05$, and RFINIT2, (M_m = 1.4 and M_f = 1.0), $t(309) = 2.33$, $p < .05$, respectively, whereas girls had a higher mean for the problem risk index at Time 1 (M_f = 3.8 and M_m = 3.2), $t(309) = -2.22$, $p < .05$. No significant differences based on gender were found for the problem risk index at Time 2.

Sequence of Analyses

Prior to implementing the structural model, a measurement model was tested to confirm the psychometric fit and hypothesized relationships among the measured and latent constructs. Both in the structural and measurement models, a polydrug use latent factor represented a general tendency toward multiple drug use (Clayton & Ritter, 1985; Hansen et al., 1987; Newcomb & Bentler, 1988a). This polydrug use latent construct is a measure of increasing involvement with many drugs, which at the high end reflects heavy drug use or abuse. Furthermore, we tested paths from residual portions of the measured drug use variables, which enabled us to study the specific impact

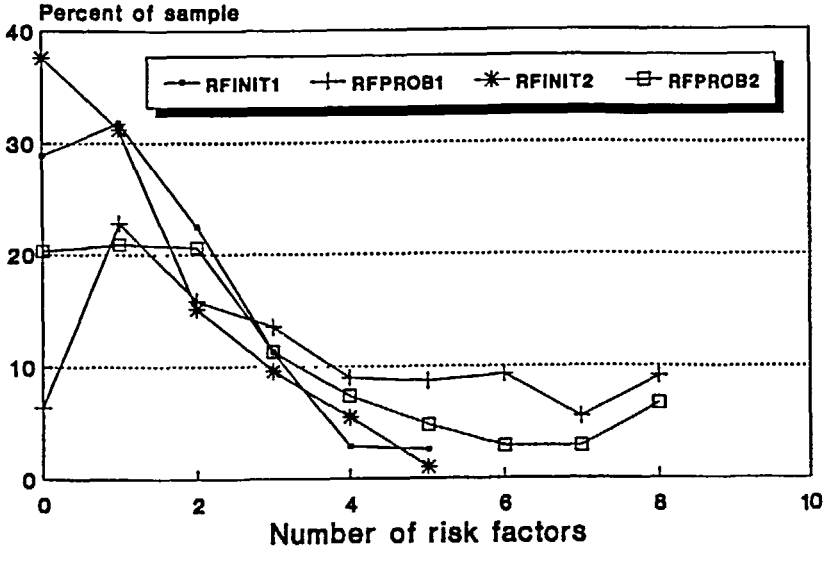

Figure 1. Graph portraying distribution of risk indexes. (RFINIT1 = initiation risk index [T1]; RFPROB1 = problem/heavy risk index [T1]; RFINIT2 = initiation risk index [T2]; RFPROB2 = problem/heavy risk index [T2]).

of each of the five drug measures above and beyond the tendency toward multiple drug use (see Newcomb & Bentler, 1988a, 1988b).

Several theoretical concerns guided the analyses. Primarily, we were interested in the effects of risk on drug use over the 2-year period. However, we also tested the effects of both risk indexes in the seventh grade on subsequent risk in the ninth grade, while controlling for early drug use. The latter analysis addressed both stability and change in risk over time. We also tested the effects of drug use on subsequent risk while controlling both for early risk and each of the five drug use measures. For example, we posed the empirical question, what is the effect of alcohol on risk, while controlling for earlier risk and the four remaining baseline measures of drug use? Finally, we tested the effects of early drug use on later drug use while controlling for both early risk indexes. The latter analysis enabled us to test empirically the developmental progression model of drug use.

RESULTS

Drug Use Patterns for the Baseline and Panel Samples

Changes in reported drug use between time periods were statistically evaluated using a use/nonuse dichotomy. Overall, 75% of the sample reported using alcohol at Time 1 and this percent decreased to 62% at Time 2, $\chi^2(1, N = 311) = 11.3$, $p < .001$. Cigarette use also significantly declined from 59% at Time 1 to 30% at Time 2, $\chi^2(1, N = 311) = 51.7$, $p < .001$. Slightly under 25% of the sample reported using marijuana at both times, 6% reported using cocaine at both times, and 16% reported using hard drugs at Time 1 and 12% at Time 2. None of these latter changes in reported drug usage were significant, however, we caution that the different time frames for the drug use items at Time 1 and Time 2 for all five types of drug use make the interpretation of these results difficult.

Four significant mean sex differences on frequency of drug use were evident. At Time 1, girls reported more frequent cigarette use than boys ($r = .15$, $p < .05$). No other sex differences between drug use behaviors were observed at Time 1. For the panel sample at Time 2, boys reported more alcohol use ($r = -.13$, $p < .05$) and more marijuana use ($r - .12$, $p < .05$), whereas girls reported more frequent consumption of cigarettes ($r = .19$, $p < .001$). Given the slight differences in drug use by gender, and the fact that these differences were not consistent between the two time periods, we conducted the multivariate analyses using combined data (e.g., Mills & Noyes, 1984).

Confirmatory Factor Analysis Model

Distributions for cocaine and hard drug use were extremely skewed and kurtotic. Maximum likelihood estimation assumes multivariate normality, and though these techniques have been shown to be robust over normality violations, the small size of our theoretical model and sufficient sample size

allowed us to use the asymptotic distribution-free (ADF) structural equation model (SEM) method for estimating parameters (Browne, 1984). The EQS program was used for all of our SEM analyses (Bentler, 1989).

A confirmatory factor analysis (CFA) was conducted to test the adequacy of the measurement portion of our SEM. Results from this analysis allowed us to evaluate whether the observed drug use variables reflect the polydrug use latent contructs in a statistically reliable manner, and to examine the associations among the two polydrug latent constructs and the four risk-factor indexes. A priori, we included across-time, drug-specific correlations (i.e., between residuals of alcohol at Time 1 and alcohol at Time 2). We also included within-time correlated residuals between cocaine and hard drug use and between cigarettes and marijuana at both times.

An initial CFA model did not fit well $\chi^2(57, N = 311) = 116.5$, $p < .001$. The Comparative Fit Index (CFI) was .89 (Bentler, 1990). This latter statistic indicates the amount of covariation in the data captured by the hypothesized model. The ratio of chi square to degrees of freedom was greater than 2 indicating that some adjustments should be made to the model (Bentler, 1980). We modified the model by including several within and across-time correlated residuals guided by substantive interpretation of the Lagrangian Multiplier (LM) modification indexes (Chou & Bentler, 1990). For example, we added correlations between the problem risk index and the residual for cigarettes at Time 1. Also at Time 1, we correlated residuals between alcohol and cigarette use. Additional across-time correlations were included between: the residual for hard drug use at Time 1 and the initiation risk index at Time 2; the initiation risk index at Time 1 and the residual for alcohol at Time 2; the problem risk index at Time 1 and residual for cigarettes at Time 2; and residuals between cigarettes at Time 1 and alcohol at Time 2. With these modifications, the final CFA model fit well, $\chi^2(55, N = 311) = 57$, $p = .41$, CFI = .99. Figure 2 presents the standardized confirmatory factor loadings, residuals, and intercorrelations from the final CFA model.

At both times, the polydrug use latent factor had significant and positive loadings for all five drug use measures ($p < .001$). Marijuana had the largest loading at Time 1, and at Time 2 hard drug use perfectly loaded on the polydrug use latent construct. Stability correlations were moderate for polydrug use ($r = .46$), the initiation risk index ($r = .39$), and problem risk index ($r = .37$). At both Times 1 and 2, the problem risk indexes were strongly associated with polydrug use within-time, and the problem risk index at Time 1 was moderately correlated with polydrug use at Time 2. Within-time correlations between the initiation risk indexes and polydrug use were modest compared to the problem risk indexes' similar correlations.

Structural Model

Based on the final CFA model, a series of structural path models were run. Across-time covariances among the risk indexes and polydrug use constructs in the CFA model were replaced with unidirectional paths indicating

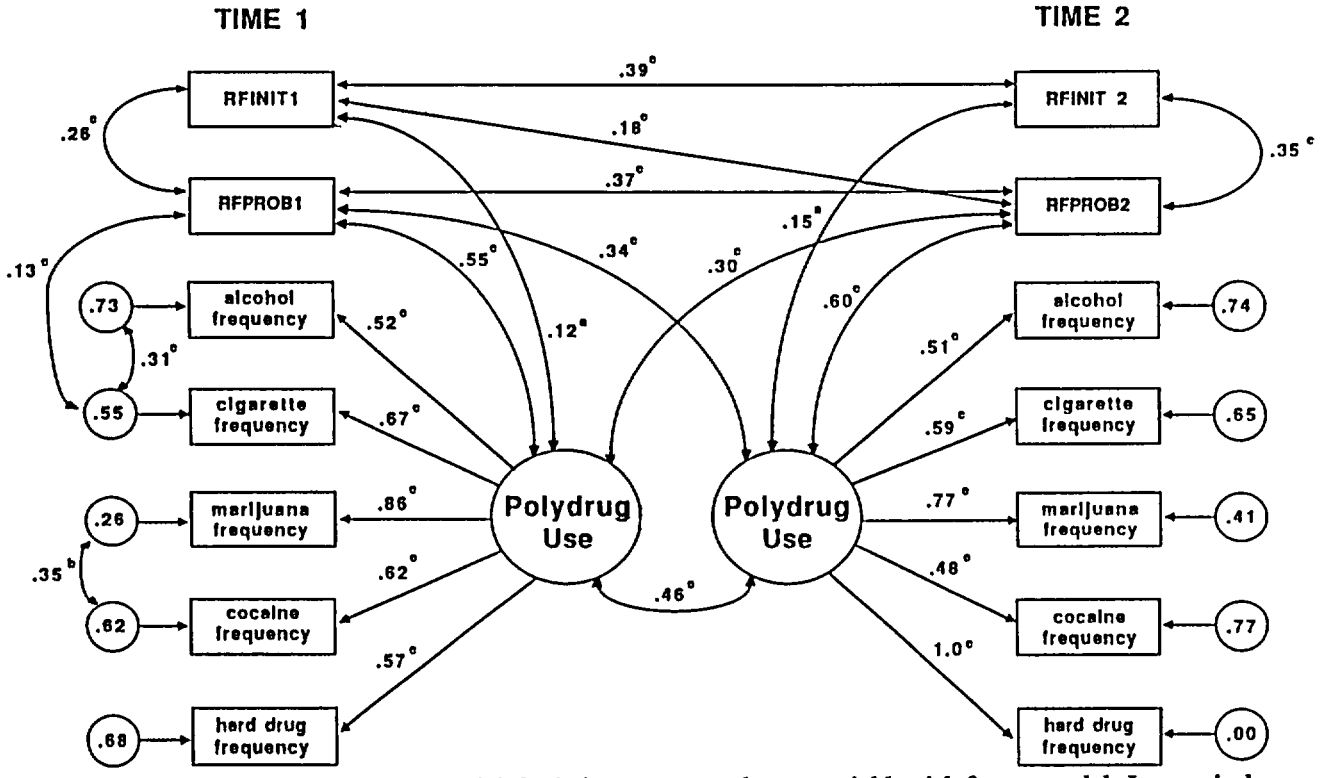

Figure 2. Confirmatory measurement model depicting two-wave latent-variable risk-factor model. Large circles are latent factors; rectangles are measured variables. Double-headed arrows are covariances; small circles with unidirectional arrows are residual variances. Parameter estimates are standardized and significances are determined by critical ratios (*$p < .05$; **$p < .01$; ***$p < .001$). Across-time associations not shown where R designates residual variance include: RFINIT1, Alcohol (R) = .14**; RFPROB1, Cigarettes (R) = .17***; Hard Drugs (R), RFINIT2 = .20***; Alcohol (R), Alcohol (R) = .39***; Cigarettes (R), Alcohol (R) = .11*; Cigarettes (R), Cigarettes (R) = .49***; Marijuana (R), Marijuana (R) = .35.**

possible causal influences. In addition, polydrug use and the two risk indexes at Time 2 had disturbance terms representing residuals from prediction. These residuals were allowed to correlate freely. Across-time correlated residuals for specific drug use measures were left intact in the structural model. As well, within-time correlated residuals from the CFA model were retained because within-time regression paths are difficult to justify and interpret (Newcomb & Bentler, 1988a).

The initial structural model had identical fit indexes as the final CFA as expected. Several further modifications were made to achieve a tighter fit. A direct path was included from RFINIT1 to alcohol use at Time 2. Several paths were added from Time 1 residual terms to Time 2 measures including: Time 1 alcohol (residual) to RFPROB2, Time 1 cigarettes (residual) to Time 2 alcohol, Time 1 hard drug use (residual) to RFINIT2, and from both Time 1 alcohol (residual) and marijuana (residual) to RFPROB2. We also included a path from polydrug use at Time 1 to cigarette use at Time 2. When no additional paths or within-time associations would improve the model fit, the Wald test was used to remove nonsignificant parameters. These modifications considerably improved the model fit, $\chi^2(61, N = 311) = 61.6$, $p = .45$, CFI $= .99$. Figure 3 portrays the final structural model and includes only significant paths and associations.

Moderate stability paths were evident for polydrug use and the initiation and problem risk indexes. No path was required between the problem risk index at Time 1 and the initiation risk index at Time 2. Risk for initiation at Time 1 did predict risk for problem use at Time 1, although this path was relatively small. At both times, within-time correlations between the risk indexes were relatively moderate. These associations serve as a validity check and reinforce our differential conceptualization of the risk indexes.

Polydrug use at Time 1 was highly correlated with the problem risk index at Time 1, whereas no such association was found for the initiation risk index and polydrug use at Time 1. The problem risk index at Time 1 predicted polydrug use at Time 2, although no such path was necessary for the Time 1 initiation risk index to Time 2 Polydrug Use. Time 1 Polydrug Use also predicted increased frequency of cigarette use over the 2-year time span.

Higher risk for initiation at Time 1 increased alcohol frequency of use at Time 2, although this effect was relatively small. In addition, both risk indexes at Time 2 were related to the disturbance term on the polydrug use latent construct at Time 2, although the stronger magnitude was between the problem risk index and polydrug use. In the final model, several across-time nonstandard effects were also apparent and provide a picture of the specific effects of drug use on risk and the developmental progression of drug use. Alcohol increased risk for problem/heavy use. Marijuana use increased risk for problem/heavy drug use and hard drug use increased risk for initiation. Cigarette use increased alcohol use over the 2-year period. Finally, as we hypothesized in the earlier CFA model, drug-specific associations for alcohol,

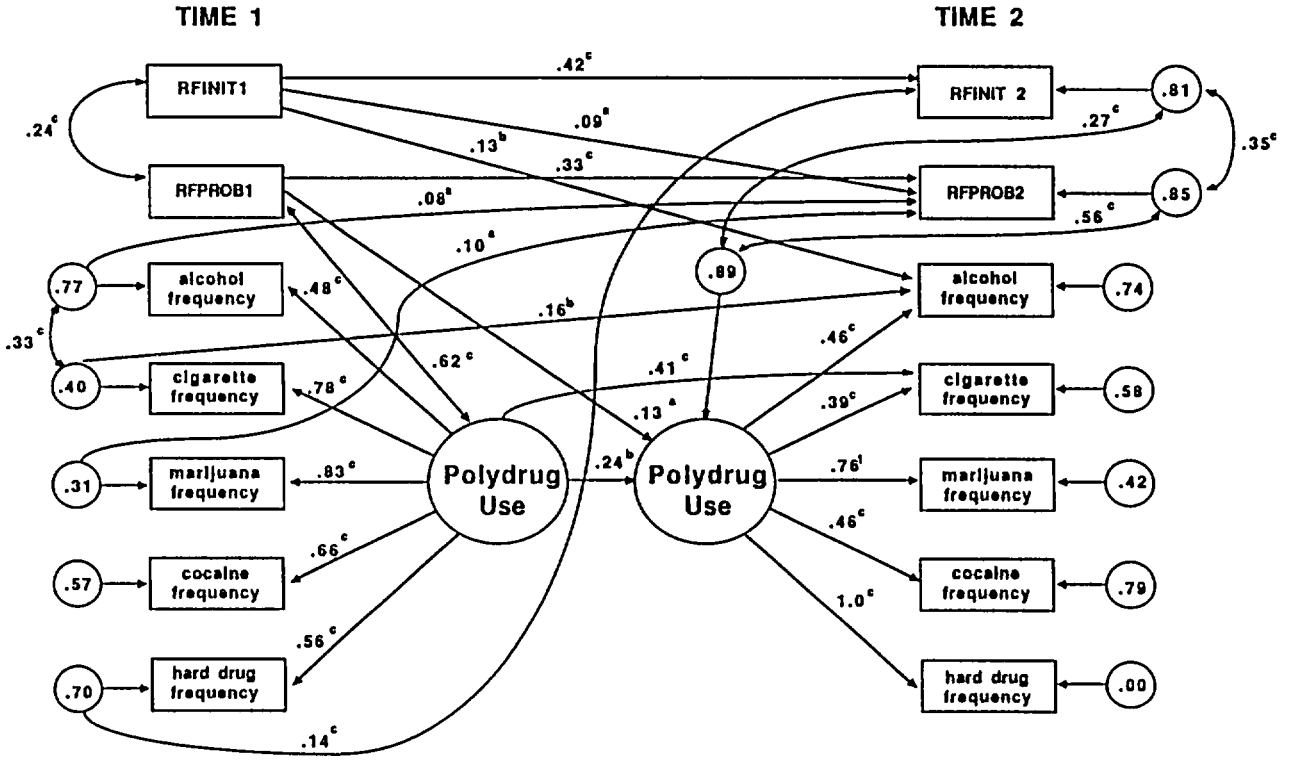

Figure 3. Structural model depicting relationship of four major risk indexes and five types of drug use at two time points. Unidirectional arrows represent direct causal paths. Double-headed arrows within-time are correlations. Parameter estimates are standardized, residuals are variances, and significances are determined by critical ratios (*$p < .05$; **$p < .01$; ***$p < .001$). Only significant paths are shown. Across-time associations between same drug-type residuals not depicted in Figure 3 include: Alcohol (R) = .38***; Cigarettes (R) = .37***; Marijuana (R) = .50.***

This factor loading was fixed at 1 in the unstandardized solution in order to identify the factor.

cigarettes, and marijuana remained relatively stable across the 2-year period (refer to Figure 3).

DISCUSSION

Multiple Dimensions of Risk

Several researchers have suggested the need to distinguish conceptually and empirically between predictors of use and abuse of drugs (Chassin, 1984; Donovan & Jessor, 1983; Long & Scherl, 1984). We created two psychosocial and attitudinal risk indexes designed to predict differentially early initiation to drug use from exacerbating problem/heavy polydrug involvement. Analyses of two-wave panel data from middle-school students supported this distinction.

Several aspects of these findings argue for differentiating predictors of drug use from drug abuse. First, within-time correlations between risk indexes provided evidence of divergent validity. Only one cross-lagged effect was apparent from the data: Risk for initiation increased later risk for problem/heavy drug use, and this effect was small. Developmental stabilities for the risk indexes were moderate, providing further support that differential patterns of risk emerge at this young age and remain part of the psychological repertoire of these youth over time.

Based on the results of the structural model, there were more numerous associations within-time and paths across-time between the problem risk index and polydrug use than the initiation risk index. At Time 2, where both initiation and problem risk indexes were associated with polydrug use, the stronger relationship was between the problem/heavy risk index and polydrug use. Moreover, the problem/heavy risk index at Time 1 predicted polydrug use at Time 2, whereas no support for such an effect existed for the initiation risk index.

Several important points arise from these findings. First, we have significantly elaborated the conceptualization and implementation of the risk-factors approach used in previous empirical work. We used two distinct risk indexes (rather than one), that were separated conceptually for their ability to predict initiation versus more problematic drug use. Unlike Bry et al. (1982, 1988) and Newcomb, Maddahian, and Bentler (1986) and Newcomb et al. (1987), our use of structural modeling techniques allowed us to examine our panel data in one, simultaneous analysis and draw causal inferences. Thus, we were able to examine simultaneously differential patterns of associations within-time as well as using the longitudinal component of these data to isolate the partial regression effects of: (a) risk on drug use, (b) risk on risk, (c) drug use on risk, and (d) drug use on drug use.

Bry et al. (1982, 1988) used a single composite substance use index to reflect involvement with drugs. A single composite drug use score does not permit examination of the specific influences of various types of drug use on risk and the converse of risk on drug use. For these analyses, we obtained frequency of use measures for five types of drugs including alcohol, cigarettes,

marijuana, cocaine, and an index of hard drugs, which allowed us to examine relationships between risk and different types of drug use separately.

Third, these findings confirm the moderate developmental stabilities of the risk indexes, as well as that of polydrug use, for young adolescents. Early adolescence is a period of initiation into problem behaviors (e.g., Jessor & Jessor, 1977). Likewise, early drug use is also a considerably strong predictor of later involvement with drugs (e.g., Newcomb, 1989) and related behaviors (e.g., crime). For youth involved in multiple drug use, a consistent pattern of involvement with drugs and a heightened level of risk for problem/heavy drug use was established as part of their intrapersonal and interpersonal environments as early as the seventh grade.

Reciprocal Influences of Risk and Drug Use

Alcohol

A couple of interesting reciprocal patterns can be inferred from the structural model. Youth at risk for drug use initiation in the seventh grade increased their alcohol use in the ninth grade. These youth reported lower peer/friendship bonding, low-affiliation with children, and lower academic performance. These same youth did not perceive school as a positive environment, did not perceive many freedoms in school, and did not perceive their friends as having strong positive affect toward school. On the other hand, increased alcohol use in the seventh grade increased risk for problem/heavy use in the ninth grade, although this effect was small. The latter results confirm those of Donovan and Jessor (1983) and Barnes (1984), who reported that problem drinking was a good predictor of the tendency to engage in other problem behaviors. One possible mechanism for these relationships is that some youth are at risk for initiating to alcohol use, and that over time, persistent use of alcohol as a means of coping catalyzes increased risk for other problem behaviors.

The involvement of alcohol as a gateway substance predicting onset of subsequent drug use has long been noted in the drug literature (e.g., Kandel et al., 1978; Welte & Barnes, 1985). Early involvement with alcohol and marijuana has been thought to accelerate involvement with other illicit substances (e.g., Kandel & Faust, 1975; Newcomb & Bentler, 1986; Single, Kandel, & Faust, 1974; Yamaguchi & Kandel, 1984) and to portend greater involvement with problem behavior (e.g., Jessor, 1986; Jessor & Jessor, 1977; Jessor, Jessor, & Finney, 1973). Donovan and Jessor (1983) used cross-sectional data from two national student surveys and reported that problem drinking occupied an important hierarchical step between marijuana use and use of pills and illicit substances other than marijuana. They distinguished problem drinking as "accompanied by frequent drunkenness and/or the experience of personal and social problems as a result of the use of alcohol" (Donovan & Jessor, 1983, p. 544).

Our data also establish a more indirect relationship of alcohol to other problem behaviors (e.g., Barnes, 1984; Barnes & Welte, 1986). Besides the

direct across-time relationships between (a) alcohol use at Time 1 and problem behavior at Time 2, and (b) risk for initiation at Time 1 and alcohol use at Time 2, risk for initiation to drug use increased risk for problem/heavy use across the 2-year time span. In this complex nexus of relationships, alcohol use may catalyze risk that persists unabatedly, deepening both exposure to risk and problem use of alcohol. That is, early, continued, and problematic alcohol use can interfere with the development and refinement of life skills important to this critical developmental period (e.g., Newcomb & Bentler, 1988a; 1989). Along these lines, we also found that risk for problem/heavy use increased polydrug use across-time and was strongly associated with polydrug use within-time both at Times 1 and 2. Because alcohol had a small but significant effect on risk for problem/heavy use from Time 1 to Time 2 and risk for initiation had a small but significant effect on alcohol use from Time 1 to Time 2, a possible mechanism may be created whereby alcohol use creates a heightened risk syndrome and leads to further illicit drug use. A third wave of data would be helpful toward furthering our understanding of these relationships.

Marijuana

Besides the relationships between alcohol and risk, we also found that marijuana consumption in the seventh grade increased risk for problem/heavy-drug use in the ninth grade. Contrary to some of the earlier findings from studies of the developmental progression of drug use (e.g., Kandel & Faust, 1975; Kandel et al., 1978), our data suggest that use of alcohol or marijuana at this early age presents an alternate and more direct pathway for greater involvement with illicit drugs. Risk for problem/heavy drug use forms a functional linkage between early alcohol and/or marijuana use and later polydrug use, which in our data mainly reflects involvement with hard drugs. Youth who consumed alcohol or smoked marijuana in the seventh grade reported greater attributions for failure, greater perceived benefits, and fewer perceived consequences from drug use, riskier attitudes toward drug use, greater number of deviant problems, greater perceived peer use, and stronger perceptions of peer approval for use of drugs. These findings confirm many of the findings from studies on consequences of drug use, especially for alcohol (e.g., Newcomb, Bentler, & Collins, 1986).

Hard Drugs

Interestingly, hard drug use at Time 1 increased the initiation risk index at Time 2. We expect that hard drug use should adversely affect later behaviors (both drug and nondrug). Newcomb and Bentler (1988b) hypothesized and demonstrated that social support relationships can attenuate the negative consequences of drug use. They further argue that spurious statistical associations may be found among such constructs as early drug use, deviance, and later employment problems, and statistical controls are required to determine the true statistical association. We controlled for early deviance as one component of the problem-risk index, and we controlled for each of the

five types of drug use and still found that early hard drug use increased later risk for initiation.

Cigarettes

Finally, we also found that polydrug use at Time 1 predicted increased cigarette use at Time 2. Various conflicting findings have been reported in the literature regarding the role of smoking. For example, Welte and Barnes (1985) reported that cigarettes did not fit as well in their scalogram analyses as had been expected based on the "stepping-stone" hypothesis. They reported a progression in drug use from alcohol to marijuana to pills to hard drugs. On the other hand, Fleming, Leventhal, Glynn, and Ershler (1989) reported that early cigarette use was the entry-level substance for predicting subsequent illicit drug use over a 2-year period. It is especially worth noting that Fleming et al. (1989) suggested that further research attempt to understand the functions of drug use as opposed to detailing the temporal order or scalability of drug use.

Nonetheless, there is not a substantial literature on the association between polydrug use and cigarette use. Welte and Barnes (1985) suggested that for extremely youthful samples, cigarette use represents a deviant act and can occur in concert with other deviant acts, for which polydrug use is one example. Quite possibly, involvement with a deviant subculture presents opportunities for exposure to a wide range of drugs and drug-related behaviors. Adolescents who engage in multiple-drug use also may seek out peers who use similar substances and who also smoke cigarettes. Increasing their use of illicit drugs may thus inadvertently escalate their use of cigarettes resulting from the experience of various social influences (see e.g., Chassin, Presson, & Sherman, 1990).

Relatedly, Newcomb and Bentler (1986) reported several "mini-sequences" of drug involvement using 8-year longitudinal data. They reported frequency of cigarette use in early adolescence significantly increased frequency of hard drug use in late adolescence. Early marijuana use also increased frequency of cigarette use and cigarette use increase frequency of marijuana use between early and late adolescence. Using a third wave of data providing additional drug use measures during young adulthood, they found that marijuana use increased frequency of hard drug use and cigarette use.

One means of furthering our understanding of the specific role of cigarette use on subsequent drug use and risk proneness would be to obtain another wave of data following the ninth grade. This would permit more extensive examination of the developmental effects of early cigarette use on later risk and drug use.

Theoretical Implications

Several researchers have suggested that greater involvement in drugs parallels a widening of problem behaviors associated with drug use (e.g., Thompson, Smith-DiJulio, & Matthews, 1982). Greater support for and modeling of

drug use is available to youth who initiate drug use early (Kandel, 1986). Support for this hypothesis stems from strain theories (Hirshi, 1969), social-learning (Bandura, 1977), and deviant subgroup peer-bonding theories (Kaplan, Martin, & Robbins, 1985). Kaplan (1975, 1980) described the disenfranchised youth as using drugs to mitigate low self-worth or high self-derogation. Rather than continually facing a disapproving social environment that fosters their self-derogation, these individuals are motivated to disengage from normative structures. Such disengagement consists of rejection of traditional peer groups, associated institutions such as school, and norms promulgated by traditional society. Alternative social environments for these youths include joining deviant peer groups that provide opportunities for achieving self-accepting attitudes and exposure to behaviors associated with drug use. Strong social-learning influences may catalyze increased drug use and lead some youth to denounce negative sanctions and social controls regarding use of drugs. Affiliation with the deviant peer subculture provides a reinforcing social setting with access to drugs and instruction as to their use (e.g., Elliott, Huizinga, & Ageton, 1985). As indicated by these data, much of the framework for these social relations can be formulated as early as seventh grade, corresponding to early adolescence. In addition, many of the risk factors comprising the problem/heavy risk index included measures of attitudes that are affected by some direct firsthand experience with drugs. The strong associations both within and across-time between the problem/heavy risk indexes and polydrug use may reflect strong social-learning influences that have begun operating at this youthful age (e.g., Pentz, 1985).

Studies of such youthful samples as in these data are critical for many reasons. Some have suggested that precocious drug use during this critical life stage may impede psychosocial maturation and interfere with the stage-sequential process of development (e.g., Baumrind & Moselle, 1985; Newcomb & Bentler, 1988a). Adolescence has long been recognized as an important developmental period for the individual to test and refine cognitive and social skills (Erikson, 1968; Pentz, 1985). Some youth may develop vulnerabilities to problem behaviors that may compromise their social competencies. Likewise, early drug use may adversely affect major cognitive and emotional growth during adolescence. These health-compromising and dysfunctional patterns may continue unless offset by some risk-buffering, inoculatory experience, or remediation.

Limitations

Certain limitations to this study exist. For the most part, data collection relied on self-report methods. The only objective measure was the number of deviant acts, obtained from school archival records. Reliance on self-reports may introduce certain methodological biases attributed to error in measurement. Others (Single et al., 1975; Stacy et al., 1985) have empirically confirmed self-report drug use measures to be reliable indicators of actual use patterns. For this sample, percentages of youth reporting any use for the five types

of drugs are consistent with drug use rates for young adolescents both from national samples studied during the same historical period (e.g., Miller & Cisin, 1983) and local regional samples (e.g., Huba, Wingard, & Bentler, 1981; Skager, Fisher, & Maddahian, 1986). Nonetheless, improved methods of data collection for estimating drug use patterns would enhance both theoretical and methodological arguments. In addition, prevalences for cocaine and the individual hard drugs were low, and distributions for these substances were extremely skewed. To correct for possible biases in our modeling efforts attributed to multivariate nonnormality, we applied ADF methods. Others (e.g., Huba & Harlow, 1983) have shown these methods to be robust for deviations from normality required under the more restrictive assumptions of maximum likelihood methods. Also, by combining the individual hard drugs into a single composite index, we were unable to differentiate separate drug influences for those illicit substances included in the hard drug use composite. These drug categories represent a wide range of pharmacological effects and may have diverse etiologies. However, the extreme skewness for their distributions makes it necessary to form a summary index.

In addition, the 2-year panel design we used may provide insufficient time to study the behaviors and attitudes investigated in this study. A longer time span may permit a fuller differentiation of the complex of risk factors underlying the risk indexes and enhance their ability to predict different types of drug use during adolescence and into young adulthood.

Finally, the findings of this study may add some more fuel to the ongoing scientific debate regarding the need to distinguish between predictors of use versus abuse of drugs. It is hoped that the results of this research can lend some credence to the position that teenage drug abuse is conceptually different from the more normative experimental drug use consistent with the values and expectations of today's youth. Further scientific understanding of these important social relationships is certainly worth pursuing.

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