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Effects of Early Adolescent Drug Use on Cognitive Efficacy in Early-Late Adolescence: A Developmental Structural Model

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Despite an accumulated body of research evidence that documents the negative physical consequences of chronic alcohol and drug use, it is less clear whether the use of these same substances produces impaired cognitive abilities during the early stages of use. Early drug use may impede acquisition of critical thinking skills and hinder the learning of important cognitive strategies required for successful transition to adulthood. To better understand these relations, longitudinal latent-variable analyses were used to examine the effects of early adolescent drug use on early-late adolescent cognitive efficacy. Latent factors of polydrug use, behavioral control, and cognitive efficacy were hypothesized in early adolescence, the latter two controlling for potential spurious relations. At outcome, six constructs were hypothesized tapping polydrug use, cognitive mastery, self-reinforcement, problem-solving confidence, decision-making skills, and cognitive and affective self-management strategies. Models were psychometrically sound and accounted for large portions of variance. Early adolescent drug use had a small but significant negative effect on cognitive and affective self-management strategies. By the 12th grade, linkages between drug use and cognitive functioning were of larger magnitude than long-term influences, perhaps reinforcing the argument that deficits in cognitive skills are developmentally delayed and surface only with exacerbated or persistent drug use. Overall, specific effects of drug use adversely influenced important cognitive skills that may be critically related to functioning in both interpersonal and intrapersonal domains.

Alcohol and drug use have been hypothesized to negatively influence a wide array of social, psychological, and physical facets of functioning. Perhaps the most prominently researched outcomes of drug use by adolescents have been the adverse effects on mental health (i.e., depression), various aspects of intrapersonal status (i.e., self-esteem), and interpersonal relationships (Friedman, Utada, Glickman, & Morrissey, 1987; Huba, Newcomb, & Bentler, 1986; Johnson & Kaplan, 1990; Kandel, Davies, Karus, & Yamaguchi, 1986; Newcomb & Bentler, 1988; Shedler & Block, 1990; Weller & Halikas, 1985). Both theoretical formulations and empirical findings have suggested that drug use is motivated, in part, by self-deprecation and the need

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to assuage painful emotional feelings (e.g., Kaplan, Martin, & Robbins, 1982; Labouvie, 1986). If psychological distress is a primary cause of drug use, mental health outcomes represent an important and objective standard to ascertain the consequences of drug abuse.

As part of their efforts to reduce early onset to alcohol and other drug use, many current prevention programs have integrated this rich body of information detailing the negative effects of drug use into current school-based intervention strategies (e.g., Botvin & Botvin, 1992). Although varied in their theoretical orientation regarding the causes of drug use, most programs are based on the assumption that illicit drug use (i.e., alcohol, tobacco, marijuana) can compromise psychological and physical health (Botvin, Baker, Dusenbury, Tortu, & Botvin, 1990; Ellickson & Bell, 1990). In keeping with this tradition, longitudinal studies of community samples have substantiated most, if not all, of these negative effects (e.g., Kandel, 1984; Kandel et al., 1986; Newcomb & Bentler, 1988). However, the scientific accuracy of claims concerning the specific consequences of drug use on cognitive functioning warrant further empirical confirmation (Johnson & Kaplan, 1990).

In this study, we examine the effects of long-term drug use on later cognitive functioning using a cohort of students comprising the nonintervention control group from a school-based drug prevention study. Students were assessed annually from Grades 7 through 12 and responded to a battery of questions pertaining to self-reported alcohol and drug use and various measures of psychosocial functioning linked empirically to the etiology of drug use. Measures of cognitive functioning assessed a wide range of skills primarily tapping cognitive self-regulation (e.g., self-reinforcement, problem-solving confidence, decision-making skills). These mostly formal operational cognitive and metacognitive skills are key ingredients to the construction of self-esteem (e.g., Flavell, 1985; Harter, 1985) and are the requisite building blocks for psychological identity that emerges during adolescence (Keating, 1990; Marcia, 1980). Moreover, individual differences in learning, aptitude, and academic performance often have been linked to ease of implementation of cognitive and metacognitive strategies (Borkowski, Carr, Rellinger, & Pressley, 1990; Garner & Alexander, 1989; Snow, 1989). Thus, damage or disruption to these mechanisms at a critical juncture in their development can have serious long-term effects.

EVIDENCE FOR DRUG USE AND COGNITIVE IMPAIRMENT

A large body of clinical and neuropsychological studies has examined the consequences of alcohol and drug use. Broadly defined, these studies have been primarily experimental in nature, conducted in controlled laboratory settings (mostly hospitals or treatment settings), and measured performance criteria under dose-regulated conditions with extremely small samples (e.g., Hindmarch, Kerr, & Sherwood, 1991; Mendelson & Mello, 1991). Studies of drug-abusing adults in treatment also have provided a broad base of empirical knowledge on neuropsychological functioning (Grant et al., 1978; Miller, 1990). In general, these studies collectively show marked decreases in cognitive skills from acute alcohol or drug intoxication (Grant et al., 1978; Miller, 1985; Tarter, 1976).

Among the many potential harmful substances, alcohol in particular has received a large share of the research attention on cognitive deficits (Miller, 1990). Extensive laboratory trials with adults have shown that compared to nonalcoholic controls, alcoholics are generally slower, less accurate, and perform more poorly in solving a wide variety of neuropsychological and sensorimotor tasks (Glenn & Parsons, 1991; Nixon & Parsons, 1991; Parsons & Leber, 1981). Clinical studies of adult alcoholics suggest that deficits in problem-solving tasks may result from inefficient strategies that influence performance by reducing alternatives and inhibiting concept formulation and nonverbal abstract problem solving (Beatty, Katzung, Nixon, & Moreland, 1993; see Miller, 1990, for a review).

Consistent with the findings from studies of alcoholics, studies of the consequences of marijuana use also document similar patterns of neuropsychological deficits. Acute effects of marijuana intoxication include poor psychomotor coordination and performance (i.e., attentional processes), slowed reaction time, short-term memory deficits, and disrupted information processing (Ferraro, 1980; Glantz, 1984). Notwithstanding the importance of these findings, much of the current fund of knowledge documenting cognitive deficits from chronic alcohol and drug use has been based on clinical studies of drug-abusing adults in treatment.

CONSEQUENCE STUDIES UTILIZING ADOLESCENT POPULATIONS

Studies of adolescent substance abusers in treatment also have revealed similar findings to those reported from adult populations. In one study, for example, alcohol abusers showed greater deficits in attentional processes compared to non-abusers and substance abusers. Likewise, other drug abusers had deficits in problem-solving flexibility compared to alcohol and nonsubstance-abusing youth (Pogge, Stokes, & Harvey, 1992). Also in this study, both alcohol- and other drug-abusing groups performed more poorly on intelligence subtests measuring freedom from distractibility compared to the nonsubstance-using group. In effect, the literature is replete with examples of problem-solving deficits in adolescent and young adult alcohol and drug abusers (Brannock, Schandler, & Oncley, 1990; Frank, Green, & McNeil, 1993; Slavkin, Heimberg, Winning, & McCaffrey, 1992).

EPIDEMIOLOGICAL AND GENERAL POPULATION STUDIES

Epidemiological studies also have contributed much to our understanding of drug-use consequences (e.g., Brook, Gordon, Brook, & Brook, 1989; Kandel, 1984; Kandel et al., 1986; Lamanna, 1981; Newcomb & Bentler, 1988). These correlationally based general community studies have examined associations between self-reported drug use and school performance (usually grade point average), educational pursuits, and academic aspirations (i.e., motivation), all of which may be proxies for underlying cognitive processes and abilities. In general, alcohol- and drug-using youth report lower academic achievement, less academic motivation, poorer grades, and they do not plan on pursuing their educational goals as much as nonsubstance-using youth.

A variety of cognitive deficits may contribute to lowered academic goals in these substance-using youth. Newcomb and Bentler (1988), for example, reported that early drug use decreased deliberateness (i.e., planning) in a sample of adolescents followed into young adulthood. More recently, in an extended set of analyses, Newcomb, Scheier, and Bentler (1993) reported that, in addition to decreasing deliberateness, exacerbated (increased) drug use increased disorganized and disruptive thinking.

Several other studies also have documented decreased educational attainment and lowered academic potential from early drug use (Johnston, O'Malley, & Bachman, 1992; Kandel et al., 1986; Newcomb & Bentler, 1986). In sum, both clinical and community-based studies have made important contributions toward our understanding of the consequences of alcohol and drug use on cognitive functioning. In fact, these studies have provided a more detailed understanding of how alcohol and drug use adversely influence learning opportunities (i.e., reduced cognitive skills), which may presage lowered academic competencies (i.e., grades) and educational pursuits.

METHODOLOGICAL AND CONCEPTUAL PROBLEMS ASSOCIATED WITH PREVIOUS STUDIES

Notwithstanding the consistency and importance of these findings, several confounds prevent drawing direct causal inferences from studies that rely on treatment populations. First, as with any study that seeks to untangle developmental processes, confusion between correlates, causes, and consequences may obscure important research findings. In most cases, a brief interlude exists between initial and follow-up assessments raising the possibility that acute effects may carry over for short periods of time. In some cases, initial psychomotor and cognitive deficits diminished with time, leading the researchers to conclude that significant between-group differences were solely attributable to acute toxicity with minimal duration (Murphy & DeWolfe, 1989; Parsons & Leber, 1981).

Second, clinical studies have primarily examined adults with long histories of alcohol and drug abuse and it is difficult to disentangle the acute effects of drug abuse from chronic use and the effects of cumulative impairment. Examination of adolescents in the early stages of their drug use (i.e., initiation) and before any cumulative deficits become manifest provides a unique opportunity to assess the "pure" and uncontaminated consequences of their drug-use behaviors.

Third, in most instances, participants in these studies are primarily seeking psychological treatment. Convenience samples such as these are characterized by high levels of distress and other psychiatric illnesses that may spuriously cause impaired cognitive functioning (Meyer, 1986). Thus, an important research goal is to disentangle cognitive impairments that result from alcohol or drug abuse from those associated with concurrent or premorbid psychopathology. Finally, sample sizes in most of these studies were relatively small and the experimental protocols largely relied on controlled dose-regulated conditions. It remains unresolved whether the acute effects observed with alcohol and marijuana persist over long periods of time and whether they are evident consistent with the type of recreational use observed more often in the general community.

IMPORTANCE OF THIS STUDY

Despite the empirical convergences between clinical and general-population studies, very few community studies have examined precisely the effects of early drug use on later cognitive skills and abilities. To address these concerns, this study expands on earlier research in several ways. First, a larger and more conceptually diverse set of outcome measures assessing cognitive strategies and skills were included. Previous studies have either relied on too few items or, as in the case of clinical studies, utilized neuropsychological assessments that are time consuming and costly to implement in community settings. In this study, the criterion assess a host of complex cognitive self-regulatory strategies and skills including cognitive mastery, self-reinforcement, decision-making skills (i.e., skills for evaluating potential solutions to problems), problem-solving confidence, and self-management skills. These measures obstensibly reflect learner characteristics closely allied to the motivational and attributional systems essential for the construction of self-efficacy and self-esteem (Harter, 1985; Pintrich, Cross, Kozma, & McKeachie, 1986; Weiner, 1986).

Second, certain dispositional or learner characteristics including behavioral self-control (impulsivity) and diligence (i.e., task persistence) also have been implicated as precursors to poor school achievement (Trembly, et al., 1992), academic competence (Talwar, Schwab, & Lerner, 1989), and cognitive performance (Schonfeld, Shaffer, O'Connor, & Portnoy, 1988). Among poorly performing and low-competence youth, the inability to focus and attend to relevant informational cues may divert important cognitive resources and lead to distraction, negative self-referencing, and low self-esteem, all of which may independently contribute to alcohol and drug use. To avoid model misspecification, these constructs are represented in the model and their effects on cognitive functioning estimated.

Third, the study spanned 4 years from early adolescence corresponding to Grade 8 through early-late adolescence corresponding to Grade 12. The time span provides a unique opportunity to examine cognitive deficits that extend beyond short-term and immediate consequences. The length of the study also provides a means of distinguishing developmental change (i.e., effects that are related to short-term performance changes attributed to school-based learning) from a more enduring type of change to cognitive skills that can be attributed to chronic alcohol or drug use.

Fourth, confirmatory factor analysis was used to empirically establish the psychometric properties of the hypothesized ("latent") constructs as well as examine their interrelations. Latent-variable structural equation models (SEMs) were then used to test causal theoretical formulations (Bentler, 1989). SEMs are statistically appropriate for assessing the fit of sample covariances against a hypothetical model and are especially useful for testing simultaneous multivariate relations.

Finally, with increasing prevalence, drug users are typically engaging in multiple drug use. Early experimental drug use mainly includes cigarettes, alcohol, and marijuana used in some combination (Bailey, 1992; Newcomb & Bentler, 1988). Prior studies have examined at most one or two drugs or created a single index of drug use, which may gloss over the different neuropharmacological properties of these drugs (i.e., stimulation vs. depressant effects). In our study, frequency of use measures for alcohol, cigarettes, and marijuana were used to reflect a latent factor of general drug use. Using statistical conventions available in the EQS structural equation modeling program (Bentler, 1989), both general and drug-specific effects were estimated simultaneously.

METHODS

Sample Description

Data for this study were obtained as part of a longitudinal investigation conducted between the fall of 1985 and the spring of 1991, which was designed to study the etiology and prevention of tobacco, alcohol, and marijuana abuse. The study was conducted at three suburban sites including central and eastern upstate New York and Long Island. These areas present a mixture of rural and urban locations, are predominantly (91%) White and middle class. Students in the seventh grade (Time 1 pretest) and annually thereafter were randomly administered three forms of a closed-ended, self-administered questionnaire. Items included in the survey assessed a variety of attitudes, intentions, and behaviors related to alcohol, cigarette, and marijuana use.

These analyses are based on one of the three forms that included the requisite measures of alcohol and drug use, psychosocial, and cognitive functioning. Two waves of data constitute the panel sample corresponding to Grades 8 (Time 3) and 12 (Time 6). The selection of the Time 3 cohort as the initial baseline measure for the analyses reported in this article was made primarily for two reasons: (a) Distributions for alcohol- and drug-use items in earlier waves were extremely nonnormal (i.e., the numbers of youth reporting sufficiently high levels of drug use was small) and may strain the robustness of the maximum likelihood estimation techniques (Bentler, 1989) and (b) this age represents a period of developmental consolidation when academic concerns become more essential and salient characteristics in the lives of these youth, thus this age period is ideal for identification of the deleterious effects of alcohol and drug use.

Baseline Measures (Time 3)

Eleven indicators were used to reflect three latent constructs at Time 3 (corresponding to the autumn assessment in Grade 8). A latent factor[1] of polydrug

[1]A latent factor (construct) refers to an hypothesized statistical dimension that reflects the common covariation among several measured or observed variables. Based on classical test and psychometric theory, an observed variable is disaggregated into the true score and an error component (specific or unique item variance). The overlap between true scores of several manifest indicators (items or scale scores) is hypothesized to be statistically "caused" by the latent factor. The residual, or unique (error) variance, is comprised of both unreliable measurement or random error and item or test-specific features that are not common to the remaining items. Thus, for example, in these analyses, a latent factor of polydrug use reflects the proclivity toward multiple substance use behaviors, that is, students whose behavioral profile for all three substances (tobacco, alcohol, and marijuana) is consistently in the same part of the distribution. More technical considerations appropriate for latent-variable CFAs and path regression techniques in general are provided by Bollen and Long (1993) and direct applications in drug-abuse research by Newcomb and Bentler (1988).

use was reflected by three variables tapping frequency of alcohol, cigarette, and marijuana use. These measures captured general use with responses on a 7-point scale ranging from 1 (*never*) to 7 (*more than a pack a day*) for cigarettes, a 9-point scale ranging from 1 (*never tried them*) to 9 (*more than once a day*) for alcohol, and a 9-point scale ranging from 1 (*never tried it*) to 9 (*more than once a day*) for marijuana use. All three frequency-of-drug-use items at Time 3 were averaged with the corresponding item at Time 2. This helped smooth the markedly skewed distributions and provided a more precise assessment of frequency of early drug use.

In addition to measuring a proclivity toward polydrug use as part of the measurement and path analyses, we also examined drug-specific effects captured in the residuals of each measured variable (reflecting unique variance that is not part of the common polydrug use variance). This statistical technique has been described extensively elsewhere (Newcomb, 1990; Newcomb & Bentler, 1988). Although many youth use drugs in some combination, some youth consume only one substance necessitating that we examine drug-specific effects on the hypothesized cognitive outcomes. In effect, latent-variable SEMs enabled us to capture the severity of multiple drug use in the first-order construct of polydrug use as well as the specific effects of a drug class (e.g., alcohol) reflected in the variances of the residual term corresponding to each measured variable.

Two other constructs were included at baseline to control for spurious influences and potential confounds on later cognitive functioning. Three composite scales were used to reflect a construct of behavioral control: (a) a seven-item scale measuring risk-taking and sensation seeking (Eysenck & Eysenck, 1975), (b) a seven-item scale measuring diligence and task persistence (Self-Control Rating Scale [SCRS], Kendall & Wilcox, 1979), and (c) a three-item scale measuring impulse control and conventionality modified from the SCRS (Kendall & Wilcox, 1979). Sources, sample items, and internal consistency estimates (coefficient alpha) for the complete set of baseline and outcome measured scales and items corresponding to the Time 2 screening (Grade 7) sample, Time 3 (Grade 8), and Times 3 through 6 panel samples are contained in Table 1.

A construct of cognitive efficacy was reflected by five composite indicators, each linear observed scale corresponding to one of the Time 6 primary factors. To imply statistical causation, it is necessary to have a temporally precedent measure of the consequent. Thus, any observed changes in variation for the criterion is additional to stability or autocorrelation effects over time. The five measured indicators included a five-item scale measuring cognitive mastery, an eight-item scale measuring self-reinforcement and internal reward mechanisms, a seven-item scale measuring decision-making skills, a six-item scale measuring confidence in applied problem-solving strategies, and a seven-item scale measuring cognitive and affective self-management strategies.

Outcome Measures (Time 6)

Thirty-six measured variables were used to reflect six latent constructs at Time 6. Polydrug use at Time 6 was comprised of the same three frequency-of-use measures as Time 3 (alcohol, cigarettes, and marijuana), although the Time 6 measures were

Table 1. Reliabilities and Sources for Measures Used in Longitudinal Analyses: Seventh Grade (Time 2), Eighth Grade (Time 3), and Panel Sample (Eighth Grade–12th Grade: Times 3–6)

Composite Name	Sample Item	Time 2	Time 3	Panel Sample	Principal Source
Diligence (7)	I stick to what I am doing until I am finished with it.	.71	.75	.76	Kendall and Wilcox (1979)
Behavioral Control (3)	I bother other students when they are trying to work.	.75	.79	.81	Kendall and Wilcox (1979)
Risk Taking (7)	I get bored more easily than most people.	.70	.77	.78	Eysenck and Eysenck (1975)
Cognitive Mastery (5)	When I make plans, I am almost certain to make them work.	.74	.75	.76	Paulhus (1983)
Self-Reinforcement (8)	I silently praise myself even for small achievements.	.83	.84	.85	Heiby (1983)
Decision-Making Skills (7)	I get the information needed to make the best choice.	.87	.89	.88	Wills (1985)
Problem-solving Confidence (6)	I trust my ability to handle new and difficult problems.	.79	.81	.82	Heppner and Petersen (1982)
Cognitive and Affective Strategies (7)	If I am feeling sad, I try to think about pleasant things.	.81	.82	.81	Rosenbaum (1980)

Note: Numbers in parentheses reflect the number of items in the scale. Reliabilities were computed using Cronbach's alpha. Five-point scales ranged from 1 (*never*) to 5 (*always*), 1 (*strongly disagree*) to 5 (*strongly agree*), and 1 (*definitely would*) to 5 (*definitely would not*).

not averaged over multiple assessment points (the distributions for these measures were less influenced by skewness). The Time 6 measure of polydrug use was included in these analyses to control for potential contemporaneous (acute) effects of alcohol and drug use on the cognitive outcomes.

A latent construct of cognitive efficacy was reflected by five items taken from the Spheres of Control (SOC) battery (Paulhus, 1983). These five items were modified from the 30-item SOC and measured personal efficacy and cognitive mastery. Eight items from Heiby's (1983) 30-item Frequency of Self-Reinforcement Attitudes Questionnaire were used to reflect a latent construct of self-reinforcement. Heiby defined self-reinforcement as "the process of establishing and controlling overt and covert positive consequences of one's own behavior" (p. 1304). Accordingly, individuals with low frequency of self-reinforcement will be characteristically low in self-confidence and self-esteem as part of their response set due primarily to the unpredictable nature of external sources of reinforcement.

Seven items were used to reflect a latent construct of decision-making skills (Wills, 1985). Six of the seven items tap direct-action cognitive strategies (e.g., planning, evaluation, weighing options) individuals use when confronted with a problem. The seventh item is a more global strategy implemented to ensure a positive outcome when faced with problems (e.g., compromise to get something positive from the situation).

Six items from Heppner and Petersen's (1982) 35-item Personal Problem Solving Inventory (1982) assessing self-perceived confidence in applied problem-solving activities were used to reflect a latent construct of problem-solving confidence. Seven items from Rosenbaum's (1980) 36-item Self-Control Schedule (SCS) were used to reflect a latent construct of cognitive and affective self-management strategies. The SCS assesses both self-control and self-management procedures that are prompted by cognitive and affective internally cued events. Such strategies are aimed toward reducing interference caused by these events (i.e., minimizing anxiety) and usually include behaviorally oriented self-statements.

RESULTS

Summary descriptive statistics are given in Table 2 for all the Grade 8 and 12 scales used in the longitudinal analyses. In order to maximize sample retention, scale means for the psychosocial and cognitive outcome measures are prorated for the number of items (scales with more than 30% constituent items missing were set to missing) and then the panel sample data were subject to imputation using maximum-likelihood regression estimation procedures available in BMDP (Dixon, 1992). As part of this two-stage procedure, individual cases with more than 50% missing data were excluded from further analyses.

Point-biserial correlations between gender and the composite scale scores are contained in the right-hand most column of Table 2. Overall, the largest significant mean difference based on gender was for behavioral self-control, which accounted for 6.7% of the variance. At both Times 3 and 6, male students reported greater alcohol use ($r = .12, p < .05$) and there was a marginal trend for greater alcohol use by male students at Time 6 ($r = .11, p = .06$). Averaging across all of the psychosocial scales, gender accounted for 1.5% of the variation and only .6% of variance for the alcohol- and drug-use measures.

Although mean gender differences across a majority of the psychosocial scales and drug use items were small, it is still worth noting that in addition to greater frequency of alcohol use, male students reported more marijuana use, whereas female students reported greater frequency of cigarette use (at both Times 3 and 6). Among the Time 3 psychosocial measures, female students reported greater conventionality and diligence, greater cognitive efficacy, greater utilization of cognitive and affective strategies ($r = -.19, p < .01$), more problem-solving skills, and self-reinforcement, whereas male students reported greater risk taking ($r = .11, p = .06$). At Time 6, female students had higher scores on cognitive efficacy, decision-making skills, problem-solving confidence, and cognitive and affective strategies, whereas male students scored higher on self-reinforcement. The small sample size and large number of hypothesized factors precluded testing models separately by gender (Tanaka, 1987).

Panel Attrition Analyses

Panel attrition rates for this study are consistent with other "real-world" school-based prevention studies (Snow, Tebes, & Arthur, 1992). A total of 567 control

Table 2. Summary Descriptive Statistics for Items and Composite Scales Used in Longitudinal Analyses

Latent Construct and Measured Variable	*M*	No. of Items	Range[a]	*SD*	Skew	Kurtosis	Mean Gender Difference (r_{pbi})[b]
	Early Adolescence (Eighth Grade)						
Polydrug Use[c]							
Alcohol Frequency	2.23	2	1–6.5	1.18	1.14	0.91	.12*
Cigarette Frequency	1.20	2	1–4.0	0.60	3.31	10.46	−.02
Marijuana Frequency	1.19	2	1–5.5	0.68	4.44	20.31	.10[m]
Behavioral Control							
Diligence (Persistence)	22.31	7	7–35	4.78	0.03	0.29	−.06
Impulsivity	11.02	3	3–15	2.96	−0.53	−0.26	−.27***
Sensation-Seeking	22.54	7	8–35	5.08	−0.22	0.02	.11[m]
Cognitive Efficacy							
Cognitive Mastery	19.37	5	5–25	2.97	−0.73	2.82	−.04
Self-Reinforcement	27.96	8	8–40	4.96	−0.37	2.01	−.09
Decision-Making Skills	24.91	7	7–35	5.14	−0.15	0.40	−.08
Problem-Solving Confidence	21.20	6	7–30	3.68	−0.30	1.57	.01
Cognitive and Affective Strategies	23.45	7	7–35	4.89	−0.20	1.16	−.19**
	Early-Late Adolescence (12th Grade)						
Polydrug Use							
Alcohol Frequency	4.39	1	1–9	1.86	0.05	−0.72	.11[m]
Cigarette Frequency	1.96	1	0.9–7	1.77	1.57	0.83	−.01
Marijuana Frequency	2.09	1	1–9	1.87	2.13	3.69	.04
Cognitive Efficacy							
Cognitive Mastery	19.74	5	9–25	2.83	−0.49	1.09	−.02
Self-Reinforcement	28.29	9	8–40	4.83	−0.05	1.24	−.05
Decision-Making Skills	26.24	7	7–35	5.24	−0.14	−0.03	−.04
Problem-Solving Confidence	21.85	6	6–30	3.71	−0.48	1.62	−.02
Cognitive and Affective Strategies	23.00	7	7–35	4.65	−0.19	1.17	−.05

[a]Maximum likelihood estimation was used for missing data imputation, thus some scale ranges may not correspond to interval point estimates. [b]A positive correlation indicates that male students had the larger value. [c]Scores were averaged over seventh and eighth grade.
*$p \leq .05$. **$p \leq .01$. ***$p \leq .001$. [m]$p < .10$.

students were available for cross-sectional analyses at Time 2 (Time 1 was a pretest), 478 control students at Time 3, and 301 students comprised the Time 3 through 6 panel sample (one student was subsequently eliminated because of insufficient data). The Time 3 sample had 51.5% male students and the Time 3 through 6 panel sample had 51% male students, indicating that the slight differential representation by gender was preserved in the longitudinal sample. Overall, and based on a use versus nonuse distinction, students retained in the panel sample were less likely to smoke cigarettes, χ^2 (1, N = 472) = 5.6, $p < .05$, and marijuana, χ^2(1, N = 476) =

9.8, $p < .01$. Although there were small but significant differences in mean level of consumption between dropouts and the panel sample for all three substances, and it is likely that the estimates of drug use in the panel sample are conservative at best, it is unlikely that attrition patterns disturbed the patterns of covariation between the baseline and outcome assessments.

Analyses also were conducted to determine if any Time 3 baseline differences existed in the cognitive, psychosocial, and drug-use measures between dropouts and the panel sample. Dropouts had significantly lower grades at Time 3, $t(473) = -2.53$, $p < .05$ (dropouts $M = 4.75$ vs. panel $M = 5.15$ on a 7-point scale). Other than grades ($b = .13$, $p < .001$, $R^2 = 26.4\%$), there were no systematic differences on any of the psychosocial measures between panel and dropout participants. Finally, although the sample was fairly homogeneous with respect to race (91% White), this composition was statistically independent of attrition status overtime.

Drug-Use Patterns

In the eighth grade, 15% of the students reported some use of cigarettes, 71.2% reported some use of alcohol, and 15% reported some use of marijuana. By the time these same youths were seniors in high school, 27% reported cigarette use, 95% reported use of alcohol, and 43.3% reported some use of marijuana. The transitions in use patterns (nonuse to use) between the two time points were significant for all three substances: cigarettes, $\chi^2(1, N = 298) = 31.85$, $p < .001$, alcohol, $\chi^2(1, N = 300) = 16.80$, $p < .001$, and marijuana, $\chi^2(1, N = 300) = 43.19$, $p < .001$, again underscoring the increased prevalence of drug use by these youth in the 12th grade.

Confirmatory Factor Analyses (CFAs)

Prior to conducting the longitudinal structural or path regression (SEM), we conducted a CFA to assess how well the observed measures reflected the hypothesized latent constructs. In addition, this analysis enabled us to examine the "error-free" intercorrelations among the latent factors. The fit of this model was adequate, $\chi^2(998, N = 300) = 1960.53$, $p < .001$, Comparative Fit Index (CFI, Bentler, 1990a) = .849, $\chi^2/df = 1.96$. Standardized factor loadings corresponding to the CFA model are contained in Figure 1.

As expected, all of the hypothesized factor loadings were significant ($p < .001$) and large in magnitude. The size of the loading attests to the strength of the indicator (reflecting the latent construct) and psychometric soundness of the hypothesized construct. Grade 8 polydrug use was most strongly reflected by cigarette use and least so by alcohol use. Behavioral control was most strongly indicated by task diligence and persistence and least so by sensation seeking. The three behavioral control measures were intended to capture trait characteristics (e.g., temperamental style) that could faciliate or impede learning and cognitive performance.

As depicted by the factor loadings in Figure 1, cognitive efficacy is a broad-band construct comprised of a psychometrically sound set of indicators tapping multiple facets of cognitive functioning and metacognition. The equivalent magnitude of

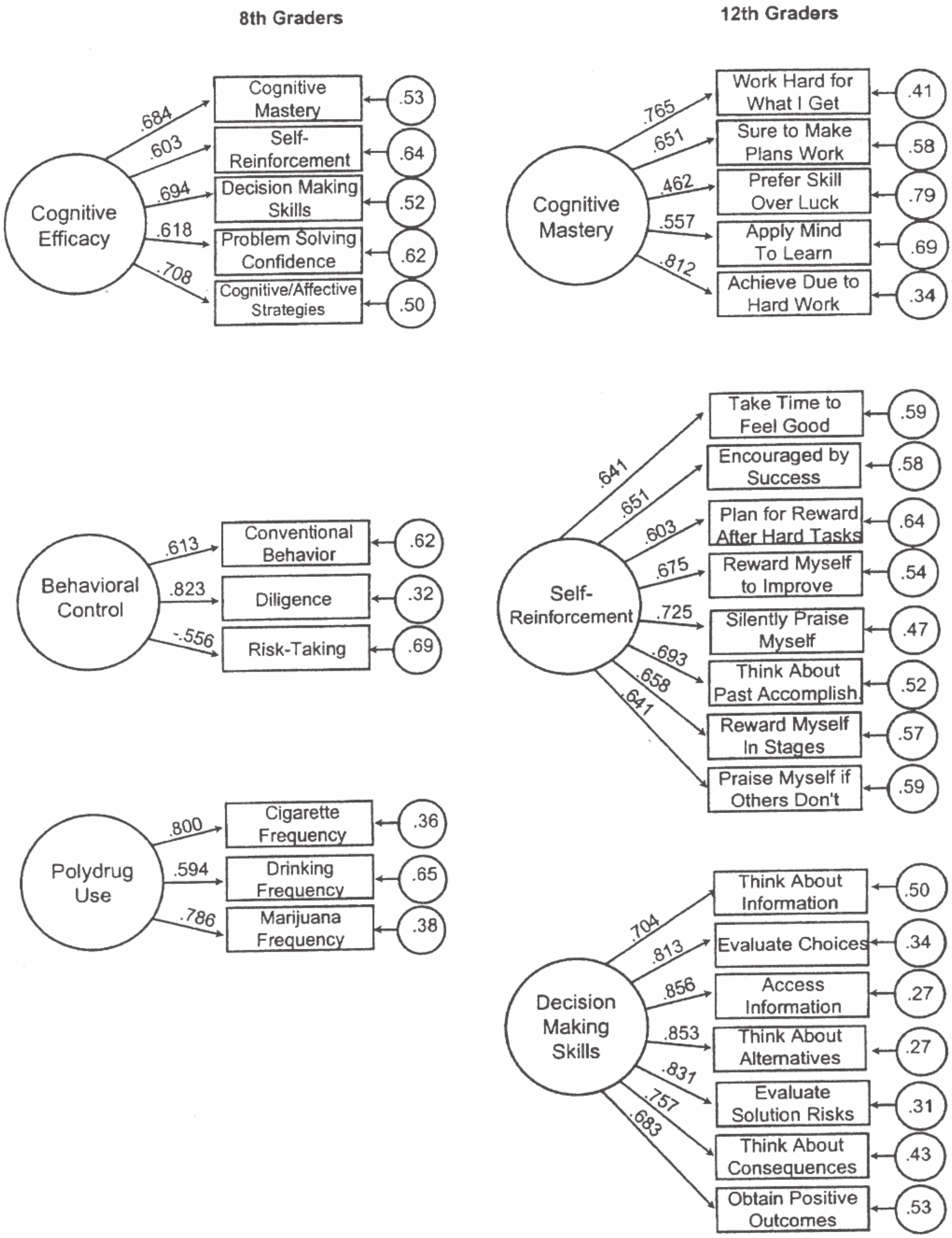
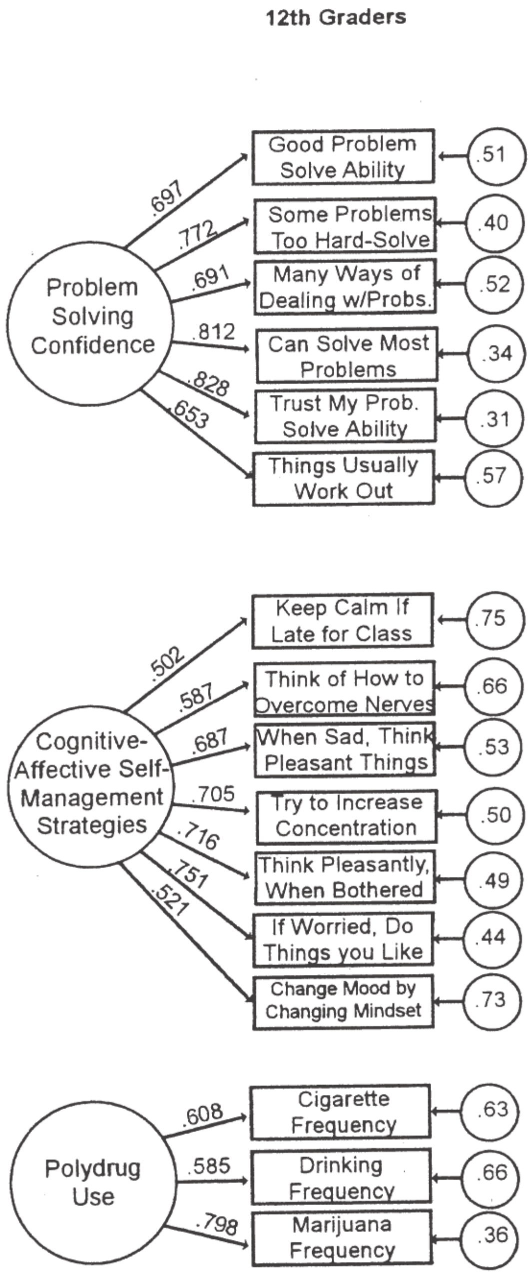


Figure 1. CFA model. Large circles represent latent constructs, rectangles are measured variables, and small circles with numbers are residual variances. Factor loadings are standardized and significance levels were determined by critical ratios on unstandardized



coefficients (*$p<.05$, **$p<.01$, ***$p<.001$). Not depicted in the figure are two-headed arrows, representing correlations, joining each possible pair of factors. Estimates for these correlations are given in Table 3.

factor loadings reinforces that although each indicator taps a conceptually unique set of cognitive strategies and skills, their overlapping variances reflects a higher level "executive" cognitive functioning.

At outcome, polydrug use was most strongly reflected by marijuana frequency, perhaps attesting to the stabilization and increased prevalence of this behavior. A minimum of five measured variables were used to reflect any of the five outcome measures of cognitive efficacy (the largest was eight) and across all five constructs the loadings were equivalent, significant, and large in magnitude, underscoring the statistical reliability of the hypothesized constructs.

Table 3 contains factor intercorrelations corresponding to the CFA (refer to Figure 1). Polydrug use at Time 3 was moderately and negatively associated with behavioral control ($r = -.43$, reflecting increased diligence, conventionality, and low risk-taking) and likewise negatively with cognitive efficacy ($r = .49$, reflecting greater cognitive skills and strategies and less contemporaneous drug use).

Cognitive efficacy and behavioral control had the largest association both within and across time ($r = .66$), underscoring the conceptual and developmental overlap and the close interplay between behavioral facets of learning (e.g., impulsivity and task orientation) and cognitive strategies (e.g., self-reinforcement and decision-making skills).

As an indirect measure of validity (convergent and divergent), the autocorrelations (among similar measures) were of larger magnitude than conceptually divergent measures. For instance, Time 3 and 6 polydrug use was moderately associated ($r = .41$), and likewise Time 3 cognitive efficacy was moderately associated with most of the Time 6 cognitive outcomes. The association between Time 3 behavioral control (tapping persistence) and drug use, on the other hand, was larger ($r = -.35$) than the association between Time 3 cognitive efficacy and drug use ($r = -.24$), possibly reflecting the strength of behavior-specific measures overtime. Behavioral control was significantly associated with all of the cognitive outcomes, although these relations were more modest than the same correlations between cognitive efficacy and the cognitive outcomes.

There were a total of 10 correlations among the five cognitive outcomes, all of which were significant ($ps < .001$) and moderate in magnitude. The largest association was between self-reinforcement and cognitive mastery ($r = .54$), whereas the smallest was observed between self-reinforcement and problem-solving confidence ($r = .19$). In effect, the pattern that emerges from inspection of these associations is that each factor taps a somewhat distinct facet of cognitive functioning, representing the variegated set of skills utilized to attend to and solve a diverse set of real-world problems. The moderately large association among several of the cognitive outcome constructs suggests that at a more abstract level these constructs may tap into a generalized set of "high-level" metacognitive strategies, expectations, and internal mental beliefs that govern or regulate applications involving cognitive skills and reasoning.

Finally, among the contemporaneous associations between Time 6 polydrug use and the criterion factors, the largest association was observed for cognitive mastery ($r = -.28$) and decision-making skills, ($r = -.27$), whereas the smallest association was observed for self-reinforcement ($r = -.08$, $p > .05$).

Table 3. Factor Intercorrelations for the CFA Model

Factor	1	2	3	4	5	6	7	8	9
Grade 8									
Polydrug Use	—								
Cognitive Efficacy	−.49***	—							
Behavioral Control	−.43***	.66***	—						
Grade 12									
Cognitive Mastery	−.15*	.46***	.33***	—					
Self-Reinforcement	−.11	.28***	.20***	.54***	—				
Decision-Making Skills	−.08	.33***	.16*	.36***	.24***	—			
Problem-Solving Confidence	−.15*	.40***	.29***	.53***	.19**	.33***	—		
Cognitive and Affective Strategies	−.18**	.37***	.16	.37***	.46***	.52***	.23***	—	
Polydrug Use	.41***	−.24***	−.35***	−.28***	−.08	−.27***	−.14*	−.19**	—

Note. CFA = Confirmatory factor analysis. Significance level is determined by a critical ratio of the unstandardized parameter estimate divided by its standard error.

*$p < .05$. **$p < .01$. ***$p < .001$.

Structural Model Analyses

In the SEM portion of the analyses, the longitudinal associations between the Time 3 baseline measures and Time 6 outcomes were replaced with unidirectional "causal" regression paths. The covariances among the three baseline constructs were estimated freely as were the associations among the residual disturbance terms corresponding to the six outcome factors (these residuals capture unique variances after prediction from exogenous Time 3 constructs). As recommended by MacCallum (1986), an initial saturated model (with all possible cross-sectional associations and longitudinal paths specified) was tested. This initial structural model had the identical fit to the CFA model.

We then conducted a specification search to identify additional (and perhaps more subtle and elaborate) across-time effects. These nonstandard paths reflect unique or specific effects between any of the Time 3 measures and Time 6 outcomes not specified at the latent construct level. The pattern of empirical search included both measured variables and residual terms at Time 3 that may influence either constructs or measured variables at Time 6 and latent constructs at Time 3 that may influence measured variables at Time 6 (the latter paths reflect generalized behaviors in early adolescence that influence specific forms of cognitive efficacy or drug use in early-late adolescence).

MacCallum, Roznowski, and Necowitz (1992) confirmed empirically that post hoc modifications of this nature can be unstable and difficult to cross-replicate. However, failure to include these specific and often subtle risk mechanisms can undermine the veracity of model testing (Bentler, 1990b). Thus, we included only those nonstandard effects representing sizable longitudinal effects and that were guided by substantive theory (Newcomb, 1990). Following the addition of 32 nonstandard effects and the removal of any nonsignificant paths using the Wald test, a final structural model was obtained that fit well, $\chi^2(966, N = 300) = 1620.46, p < .001$, CFI = .90, $\chi^2/df = 1.68$.

Figure 2 contains the results of the final SEM model. As depicted, cross-sectional associations among the Time 3 constructs in the final SEM were patterned consistently with the results of the CFA analysis (although the Time 3 associations dropped somewhat because some variance was apportioned to the across-time regression component). Among the hypothesized longitudinal effects, polydrug use remained moderately stable over the 4-year time span ($b = .24$). Among the specific drug-to-cognitive functioning effects, only Time 3 polydrug use significantly decreased cognitive and affective self-management strategies ($b = -.11$). Cognitive efficacy had two effects on the outcome factors, increasing both decision-making skills ($b = .18$) and cognitive and affective strategies ($b = .21$). Behavioral control had by far the largest number (and greatest magnitude) of effects on Time 6 outcomes. Behavioral control (i.e., impulsivity, diligence and persistence, low risk taking) increased cognitive mastery ($b = .27$), self-reinforcement ($b = .25$), problem-solving confidence ($b = .24$), and decreased polydrug use ($b = -.19$).

Nonstandard effects that were added to the model are contained in Table 4. Cross-sectional associations among Time 6 disturbance terms are contained in Table 5 (both tables should be interpreted in connection with Figure 2). As in-

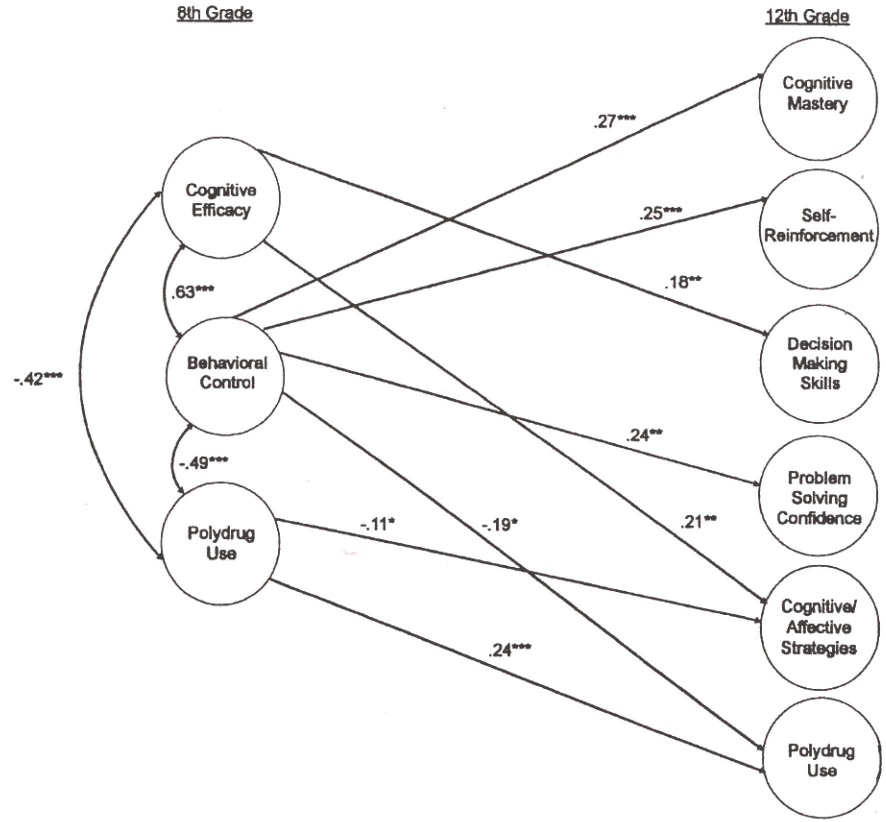


Figure 2. Final structural model of the across time effects between latent constructs. Large circles represent latent factors and small circles with numbers reflect residual variances. Path coefficients are standardized and significance levels were determined by critical ratios on unstandardized coefficients (*$p < .05$, **$p < .01$, ***$p < .001$). Other nonstandard regression effects from this same final model that do not relate latent constructs to one another are given in Table 4. Correlations among the results of early-late adolescent cognitive outcomes latent factors are given in Table 5.

Table 4. Nonstandard Longitudinal Effects not Depicted in Figure 2

Early Adolescent Predictor	Early-late Adolescent Consequence		
Observed Variable	Observed Variable	Latent Variable	Standardized Estimate[a]
	Early Adolescent Drug Effects		
Cigarette Frequency	Cigarette Frequency		.33***
Cigarette Frequency	Trust ability to handle most problems		−.10*
Drinking Frequency	Drinking frequency		.23***
Marijuana Frequency	Encouraged by successes at small things		−.16**
Drinking Frequency	Encourage myself with special rewards		.16**
Drinking Frequency	Silently praise myself for achievements		.12**
Drinking Frequency		Polydrug Use	.16*
	Non-drug Effects		
Cognitive Mastery		Cognitive Mastery	.35***
Cog/affective Strategies		Cognitive Mastery	.30***
Self-reinforcement		Self-Reinforcement	.20**
Cog/affective Strategies		Decision Skills	.17**
Prob. solv. Confidence		Decision Skills	.26***
Decision making skills		Decision Skills	.17**
Cognitive mastery		Prob Solv Confd	.24***
Cog/affective strategies		Prob Solv Confd	.24***
Prob. solv. confidence		Prob Solv Confd	.48***
Self-reinforcement		Prob Solv Confd	.20***
Cog/affective strategies		Cog/Affective	.31***
Prob. solv. confidence	Sure to make plans work		.25***
Self-reinforcement	Sure to make plans work		.22***
Sensation-seeking	Sure to make plans work		.12*
Cognitive mastery	Prefer games skill than luck		.22***
Prob. solv. confidence	Prefer games skill than luck		.20***
Cognitive mastery	Learn anything setting mind to it		.33***
Cog/affective strategies	Learn anything setting mind to it		.24***
Prob. solv. confidence	Learn anything setting mind to it		.27***
Decision making skills	Learn anything setting mind to it		.31***
Self-reinforcement	Learn anything setting mind to it		.18**
Sensation-seeking	Learn anything setting mind to it		−.13*
Cog/affective strategies	Take time to enjoy good feeling		.15**
Cog/affective strategies	If I succeed I become encouraged		.24***
Prob. solv. confidence	If I succeed I become encouraged		.15**
Cog/affective strategies	Get through tough tasks by planning enjoyment		.23***
Cog/affective strategies	Encourage improvement by special rewards		.12*
Cog/affective strategies	Motivate myself by past accomplishments		.13**
Cognitive mastery	Think about information to solve problem		.13**
Self-reinforcement	Think about information to solve problem		.10*
Decision-making skills	Evaluate solution risks to deal with problem		−.09*[b]
Cognitive mastery	Have ability to solve most difficult problems		.15**
Prob. solv. confidence	Have ability to solve most difficult problems		.12*
Decision making skills	Have ability to solve most difficult problems		.20***
Self-reinforcement	Handling problems things usually work out		.10*
Diligence/persistence	Handling problems things usually work out		.17**

(continued)

Table 4.

Early Adolescent Predictor	Early-late Adolescent Consequence		
Observed Variable	Observed Variable	Latent Variable	Standardized Estimate[a]
	Non-drug Effects		
prob. solv. confidence	think about being calm in stressful situations		.15**
prob. solv. confidence	when sad, think about pleasant things		.18***
prob. solv. confidence	with difficult homework, increase concentration		.11*
prob. solv. confidence	change way I feel by changing thinking		−.13*

Note: [a]Significance level determined by a critical ratio of the unstandardized parameter estimate divided by its standard error. [b]Effect is counterintuitive, however, excess model tension and removal of this effect at this point would seriously disrupt the multivariate configuration. [*$p < .05$; **$p < .01$; ***$p < .001$].

dicated, nonstandard effects capture more subtle mechanisms by which drugs can influence cognitive strategies and skill implementation. Among the across-time drug-specific effects, Time 3 cigarette use predicted Time 6 cigarette use (b = .33). Likewise, Time 3 alcohol predicted Time 6 alcohol use (b = .23). Drinking frequency had a specific effect on polydrug use (b = .16), perhaps reinforcing the notion that early alcohol use precipitates later multiple drug use. Use of alcohol had two additional longitudinal effects, both of which increased self-reinforcement strategies. Cigarette and marijuana use each had one long-term effect, decreasing indicators of problem-solving confidence (b = −.10) and self-reinforcement (b = −.16), respectively.

The remaining effects captured nondrug-specific relations. For ease of interpretation, these effects are grouped in order according to the presentation of the outcome factors. By far, the most numerous effects were to indicators of cognitive mastery (a total of 13 effects involved residual paths to the factor or measured variables). The largest of these effects was domain specific and captured the autocorrelation between the baseline indicator of cognitive mastery (loading on cogni-

Table 5. Correlations Among the Factor Residuals in Grade 12

Factor	1	2	3	4	5	6
Polydrug Use	—					
Cognitive Mastery	−.23[a]	—				
Self-Reinforcement	.00[a]	.40***	—			
Decision-Making Skills	−.21**	.15*	.18**	—		
Problem-Solving Confidence	.00[a]	.20*	.00[a]	.10	—	
Cognitive and Affective Strategies	−.11[m]	.34	.33***	.49***	.00[a]	—

[a]Parameter was nonsignificant and constrained at zero in the final structural model.
*$p < .05$. **$p < .01$. ***$p < .001$. [m]$p < .10$.

tive efficacy) and the Time 6 outcome factor cognitive mastery (b = .35). Similar domain-specific patterns emerged for the indicators of self-reinforcement skills predicting its consequent factor (b = .20), decision-making skills predicting its consequent factor (b = .17), problem-solving confidence predicting its consequent factor (b = .48), and cognitive and affective strategies predicting its consequent factor (b = .31). All told, these effects capture developmental stability of skills and demonstrate empirically the predictive strength of early cognitive functioning on later performance.

At outcome, problem-solving confidence had a total of nine cross-time effects. Both mastery and confidence reflect an underlying cognitive motivational enterprise that captures an inclination to engage in difficult problem situations and likewise a positive self-evaluation of problem-solving potential. Both the motivational and evaluative component are internal cogitations that represent a cornerstone of self-esteem.

Finally, there were several associations among the factor disturbances corresponding to the Time 6 latent constructs (net variation remaining after prediction from all other elements specified in the model). Polydrug use was associated with decreased cognitive mastery ($r = -.23$), decision-making skills ($r = -.21$) and there was a marginal trend for decreased cognitive and affective strategies ($r = -.11$).

DISCUSSION

Among the various facets of psychosocial functioning linked to early stage drug use, determination of the effects of drug use on cognitive skills and strategies have received the least attention, both theoretically and empirically. This may be a critical oversight, because impairment of cognitive functioning as a result of early and persistent (stable) drug use can have untoward negative effects that extend to important aspects of social, emotional, and psychological growth. The inability to master these important developmental milestones can lead to self-derogation, disenfranchisement, and extreme levels of distress that retard opportunities for growth and achievement.

In this study, we used 4-year longitudinal data from a cohort of adolescents to examine both general and specific effects of drug use on subsequent cognitive functioning. To control for potential spurious longitudinal relations, dimensions of behavioral control and cognitive efficacy were specified. Given the presence of cognitive deficits in clinical treatment samples of drug-abusing youth and young adults, perhaps the most compelling finding overall is that adverse influences of drug use on cognitive functioning is observed also in community samples. Although we hypothesized that drugs would longitudinally influence five distinct facets of cognitive functioning, only one significant long-term effect was obtained between early drug use and later cognitive and affective self-management strategies.

In addition to this long-term effect, early drug use was moderately and contemporaneously associated with decreased cognitive efficacy and behavioral control (reflecting impulsivity, sensation seeking, and task persistence). Likewise, drug use remained associated with multiple facets of cognitive functioning in the 12th grade, reinforcing the developmental linkages between cognitive skills and drug behaviors.

The strength of the association (both cross-sectional and longitudinal) between drugs and cognitive skills is particularly alarming because the panel sample in this study is comprised of youth who remain in school (as opposed to dropping out), who are likely to be more conventional, persistent, and diligent, and who are likely to benefit from their exposure to important educational skills during this lengthy socialization period.

Drug-use levels in this study were entirely characteristic of this age period. Use of alcohol, cigarettes, and marijuana was consonant with findings from regional (Barnes & Welte, 1986) and national surveys (Oetting & Beauvais, 1990). Alcohol was the most prevalently used drug at both Time 3 and 6 followed by marijuana at Time 6. Frequency of drug use significantly increased between Grades 8 and 12 (both mean level of use and the proportion of users), although this increase may underestimate actual usage patterns because attrition was selective for higher drug-using youth.

Psychosocial Mechanisms of Action

The precise mechanisms that underlie how drug use influences cognitive functioning and implementation of cognitive and metacognitive strategies are poorly understood. One possible explanation is that drug-abusing youth experience a hiatus from learning important developmental skills during their drug-using years (e.g., Baumrind & Moselle, 1985). Given their closely specified linkages, the moratorium on psychosocial identity development promulgated by drug use also retards acquisition and refinement of important cognitive skills. The absence of these skills can have a dramatic and negative impact on the future development of these youth, influencing a wide arena of psychosocial functioning. Contrary to this position, Newcomb (1987) suggested that rather than a hiatus, alcohol and drug-abusing youth experience developmental acceleration and "pseudomaturity," the latter which impedes the acquisition of normative role functions. Regardless, for drug-abusing youth, the recurrent emphasis on utilizing inefficient and inappropriate cognitive resources and strategies fosters continued problems in living.

Despite controlling for early temperamental differences in behavioral control (impulsivity) and cognitive efficacy, we still found a few, small, negative effects of drug use on later cognitive skills and abilities. Consistent with findings reported by Windle (1991) regarding difficult temperament and drug use, this study reinforces that conventional, diligent, and low sensation-seeking youth develop more cognitive resources and skills from their scholastic experiences than their impulsive, distractible, risk-taking counterparts. This is also consistent with the findings by Brook, Nomura, and Cohen (1989) and Brook, Whiteman, Gordon, Nomura, and Brook (1986) who reported that low conflict in school, conventionality, and a positive learning environment were all protective factors that mitigated alcohol and drug use.

Difficult youth who lack persistence with school tasks and are prone to "acting out" may miss important learning opportunities that would enhance their academic competence and self-esteem. According to self-derogation theory, the lack of socially valued educational pursuits and feelings of peer rejection collectively instill a sense of devaluation and self-deprecation (Kaplan, 1980; Kaplan et al., 1982). For highly derogating youth, alcohol and drugs are part of a complex social-cognitive response mechanism motivated almost entirely by the need to dampen or mitigate painful emotional experiences.

For the most part, the data support the contention that alcohol and drugs decrease cognitive efficacy skills. In two specific examples, drinking had two small but significant positive effects on self-reinforcement and reward processes. It is important to note, however, that these positive effects in combination with the overall negative longitudinal effect of drug use on cognitive and affective self-management strategies as well as the negative contemporaneous effects between drug use and cognitive skills, dovetail quite nicely with the basic postulates of self-derogation theory and reinforce the importance of positive self-regard as a basis for self-esteem (Harter, 1985). Thus, drinking should not be interpreted to increase reward mechanisms per se, but rather as a vehicle for positive self-expression in derogating youth who obtain peer status and affectively regulate negative emotions by drinking.

Other studies of similar risk processes, conducted over shorter time spans, also have shown some beneficial effects from alcohol on cognitive functioning (e.g., Baum-Baicker, 1985; Kandel et al., 1986; Newcomb, Bentler, & Collins, 1986). In a shortened time frame, the functions of drug use may have been directly associated with relieving emotional distress and a by-product of this may have been improved cognitions. Thus, alcohol serves to block or negate the effects of stress and provides some immediate rewards and a boost to self-esteem.

In addition, the moderate stability of drug use over the 4-year period in concert with the poor problem-solving strategies may contribute to an "amotivational syndrome" characterized by low academic motivation, minimal educational goals, and poor bonding to normative institutions (i.e., school; Baumrind & Moselle, 1985; Mellinger, Somers, Davidson, & Manheimer, 1976). Findings from our study suggest a mechanism that may be responsible for catalyzing or initiating the sequence of events that lead youth to "turn on" and "tune out" from psychoeducational experiences available in school and related learning settings.

For instance, the lack of reinforcing learning opportunities in school and related environments (e.g., extracurricular activities) may lead to a sense of personal disappointment coupled with social and emotional despair. Perhaps the initial catalyst for their poor performance was not related to drugs, but rather was prompted by deficient or maladaptive academic skills or abilities tied to any one of many undetected learning problems. For these youth, early detection (i.e., screening) and remediation (i.e., counseling) of learning difficulties may serve to buffer or inoculate against further amplification of these problems by drug use. To help combat these often imperceptible skill deficiencies, future prevention programs may want to augment or develop specific instructional methods that emphasize cognitive competencies through self-reinforcement, decision-making skills, and developed confidence in applied strategies and cognitive mastery. These skills will go well to complement the emphasis placed by schools on domain-specific knowledge and will likely lead to a superior integration with social skills that come into play in these developmental years.

Limitations

Several important limitations to this research are worth noting. The study focused on measures of cognitive efficacy and did not explore the consequences of drug use on other key developmental processes. Impairment of cognitive abilities can have untoward effects by spilling over into closely related areas of psychological functioning including vocational aspirations, interpersonal relationships, and emotional functioning, just to name a few. Any number of studies, for example, have shown direct effects of drug use on academic motivation, dropout status, and achievement goals (Mensch & Kandel, 1988; Newcomb & Bentler, 1986; Weng, Newcomb, & Bentler, 1988). Perhaps the lack of cognitive skills resulting from early drug use was a precondition to the abandonment of educational goals, rather than a direct influence of drug use on educational goals. Tests of direct-effects models are important to determine major risk influences; however, more fine-grained analyses are required to test models that posit specific risk mechanisms that may include moderator and mediational processes.

Clearly, the developmental and functional linkages among the measures of cognitive efficacy used in this study and other facets of intrapersonal functioning (i.e., self-esteem) need to be explored as part of a drug-abuse consequence framework. In this regard, consequence studies are noted for their difficulty for several reasons, perhaps the most salient of which is that many putative risk factors can contribute to changes in the outcomes and models can easily be misspecified. It is quite possible that ineffective problem-solving strategies are a by-product of the loss of self-esteem, the latter which predisposes youth to avoid cognitive engagement (i.e., problem-solving activities) as a part of learned expectancy or reinforcement contingency (i.e., operant or aversive conditioning has reduced motivation to engage in problem-solving activities). A more comprehensive theoretical approach would include blending elements of several key theories of drug use (i.e., self-derogation, social strain, developmental competence, and problem behavior), all of which should bring researchers closer to understanding the richness and complexity of developing youth.

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