Prevention Science, Vol. 1, No. 2, 2000

Understanding the Links Among School Misbehavior, Academic Achievement, and Cigarette Use: A National Panel Study of Adolescents

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Relations among academic achievement, school bonding, school misbehavior, and cigarette use from 8th to 12th grade were examined in two national panel samples of youth (n = 3056). A series of competing conceptual models developed a priori was tested using structural equation modeling (SEM). The findings suggest that during middle adolescence the predominant direction of influence is from school experiences to cigarette use. School misbehavior and low academic achievement contribute to increased cigarette use over time both directly and indirectly. Two-group SEM analyses involving two cohorts—gender and ethnicity—revealed that our findings are robust. In addition, comparisons between high school dropouts and nondropouts and between eighth-grade cigarette use initiators and nonusers revealed few differences in direction or magnitude of effects. Results suggest that prevention programs that attempt to reduce school misbehavior and academic failure, as well as to help students who misbehave and have difficulty in school constructively avoid negative school- and health-related outcomes, are likely to be effective in reducing adolescent cigarette use.

KEY WORDS: cigarette use; academic achievement; school misbehavior; adolescence.

Researchers have established significant links between adolescent substance use and negative school behaviors—school failure, alienation from school, and school misbehavior (Hawkins, Catalano, & Miller, 1992; Petraitis, Flay, & Miller, 1995). The direction of causality, however, between school factors and substance use is unclear (Newcomb & Bentler, 1988). Students who use cigarettes and other substances like school less, skip school more often, have lower grade point averages, and are more likely to drop out of school than nonusers (Bachman, O'Malley, & Johnston, 1978; Galambos & Silbereisen, 1987; Mensch & Kandel, 1988; Paulson, Coombs, & Richardson, 1990; Smith & Fogg, 1978). Conversely, students who are truant, have lower grades, and have fewer aspirations for college are more likely to engage in substance use (Schulenberg, Bachman, O'Malley, & Johnston, 1994; Swaim, 1991). In all likelihood, substance use and negative school outcomes are reciprocally related over time. By adopting a developmental perspective, we may achieve a better understanding of how adolescents' school experiences relate to substance use.

Adolescents move through a variety of school and social contexts. As they make school transitions and progress through adolescence, they may experience increased academic stress and school misbehavior, and decreased school bonding and achievement (Eccles & Midgley, 1989; Simmons & Blyth, 1987;

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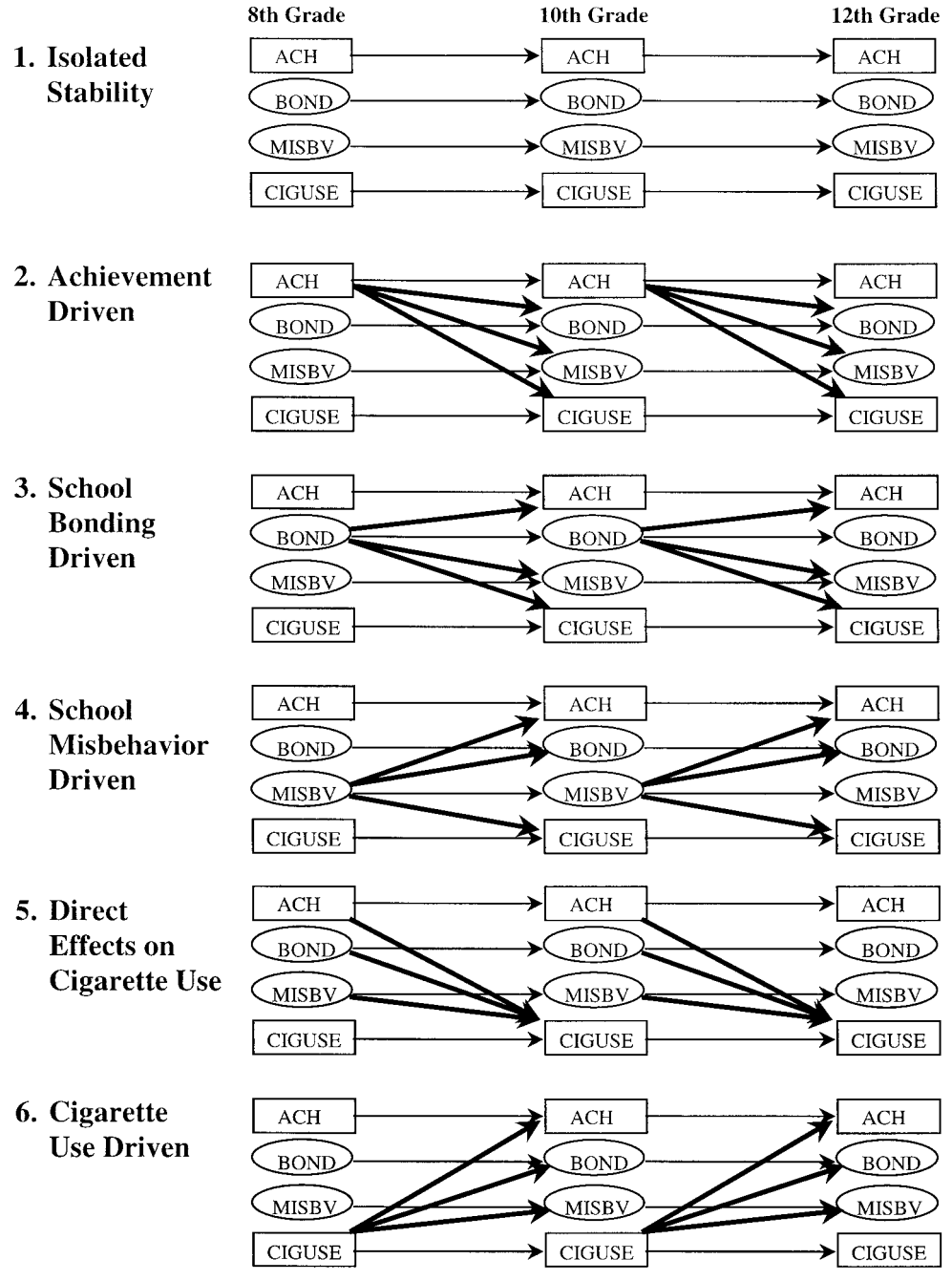

Fig. 1. Conceptual models. ACH = academic achievement; BOND = school bonding; MISBV = school misbehavior; CIGUSE = cigarette use.

Wagner & Compas, 1990). At the same time, some youth are exposed to, and begin to experiment with, cigarettes and other substances. Adolescents' ability to negotiate these various transitions successfully and to make informed and responsible decisions will contribute to their successful transition to adult roles (Schulenberg, Maggs, & Hurrelmann, 1997). Longitudinal research on adolescent competence suggests that dependable, intellectually invested and self-confident (i.e., "planful competent") youth are more likely to have positive educational, occupational, and family outcomes during adulthood compared to less competent youth (Clausen, 1991; Masten & Coatsworth, 1998). Thus, difficulties during school

may contribute to risky behaviors during adolescence that in turn have negative implications for the course of health and well-being.

The present research was designed to address the role of school factors in the development of health risks by following two nationally representative samples of adolescents, and considering their cigarette use and school-related attitudes and behaviors over multiple time points (8th, 10th, and 12th grades). We examine a number of conceptual models of different school factors and cigarette use to consider the possible causal relations among academic achievement, school bonding, school misbehavior, and cigarette use during adolescence (Fig. 1). Cigarette use is an important starting point for understanding how school factors and substance use are related for at least two reasons: first, among a variety of substances that are illegal for them to use, youth tend to experiment first with cigarettes (e.g., Kandel, Kessler, & Margulies, 1978; Kandel, Yamaguchi, & Chen, 1992); second, among these substances cigarette use shows the strongest relation with school difficulties (Bachman *et al.,* 1978; Schulenberg *et al.,* 1994).

Many studies have explored alternate causal perspectives relating adolescents' cigarette use and their school experiences. Some researchers have argued that cigarette smoking and other substance use is a direct response to school problems and low achievement. Smoking may be a compensatory or coping behavior for students who have not succeeded in the school context. These interpretations have largely been grouped as psychogenic explanations of the link between substance use and school outcomes (Brunswick & Messeri, 1984). Others have proposed the alternate causal direction, the impaired ability interpretation (Newcomb & Bentler, 1986). Students experience academic failure as a result of their drug use, which interferes with the learning and motivational process. This explanation may be applicable to substance use in general, but seems less suited to cigarette use in particular. The third interpretation posits that both drug use and poor academic achievement are caused by the same underlying set of social and psychological processes. This view that some youth have a general tendency toward deviance or problem behavior has been labeled the general deviance or problem behavior theory (Jessor & Jessor, 1977; Newcomb & Bentler, 1986). Adolescents' involvement in substance use may actually be in place before high school, suggesting much stability in these behaviors. A conceptual model that represents such stability is presented in the first model in Fig. 1, the Isolated Stability model, where there is little (rank-ordered) change in, or influence among, these different school and cigarette use factors. Below, we summarize the relevant empirical literature that supports various perspectives regarding the relations among school attitudes and behaviors and substance use over the course of adolescence.

THE LINK BETWEEN SUBSTANCE USE AND SCHOOL DIFFICULTIES

Cigarette Use and School Problems Are Driven by Poor Academic Achievement

The negative relation between academic achievement and substance use is well established in the research literature (Hundleby, Carpenter, Ross & Mercer, 1982; Schulenberg *et al.,* 1994; Smith & Fogg, 1978). Students with low grade point averages initiate and maintain cigarette use more than students with high grade point averages (Brunswick & Messeri, 1984; Schulenberg *et al.,* 1994). According to the psychogenic interpretation, these low-achieving students may use cigarettes or other substances to cope with their failure in school (Brunswick & Messeri, 1984; Newcomb & Bentler, 1986). In a longitudinal sample of African-American youth, Brunswick and Messeri (1984) find some support for the psychogenic theory, particularly among female students. School failure, indicated by low grade point average, is one of the most consistent risk factors for substance use (Dryfoos, 1990; White *et al.,* 1987). What is less clear is when, in the developmental process, academic achievement has its strongest impact on substance use, and whether the effects are primarily direct or indirect. Students' school failure and frustration with academics may lead to increased school misbehavior and weakened bonds to school (Hawkins & Weis, 1985; Simmons & Blyth, 1987; Sommer, 1985), which are associated with increased substance use. The conceptual model that represents adolescents' academic achievement as the primary causal factor is presented in the second model in Fig. 1, the Achievement Driven model.

Poor School Bonds Are the Source of Increases in Substance Use and Misbehavior

Some theories of adolescent substance use posit that the link between academic failure and substance

use operates through a process of decreased bonding and commitment to school. Hawkins and Weis (1985), in their social development model, propose that students who experience academic failure feel less commitment to school and are likely to form attachments to delinquent peers who encourage substance use. Empirical studies indicate that students who do not like school are more likely than those who like school to engage in substance use (Smith & Fogg, 1978), school misbehavior (Berndt & Mekos, 1995; Jenkins, 1995), and delinquent acts (Free, 1993; Hirschi, 1969). These findings show support for the third model in Fig. 1, the School Bonding Driven model. Other findings, which focus on marijuana and alcohol use, suggest that measures of attachment, commitment, and bonding to school contribute very little to an explanation of initiation of and involvement in substance use (Bailey & Hubbard, 1990; Free, 1993). Little research has linked school bonding with cigarette use in particular, so it will be of interest to examine this link in the present research.

School Misbehavior Is an Early Indicator of School Problems and Substance Use

The relation between adolescent substance use and misbehavior in school (e.g., truancy, suspensions, being sent to the principal) has received little attention as well. Although some researchers have used multiple indicators of school misbehavior and found positive correlations with cigarette use (i.e., Hundleby *et al.,* 1982); more frequently researchers have only considered truancy. Truant students use cigarettes more often and are less likely to believe that smoking can cause health problems, compared with students who do not skip school (Bachman, Johnston, & O'Malley, 1981; Pritchard, Cotton, & Cox, 1992). In a sample of Canadian female adolescents, Diem, McKay, and Jamieson (1994) found that truancy was the strongest predictor of cigarette use among a number of demographic, school-related, and psychosocial variables. In addition to skipping school, students who use cigarettes and other substances have a higher number of suspensions, school expulsions, and other school disciplinary problems than students who abstain from use (Shannon, James, & Gansneder, 1993; Welte & Barnes, 1987). Not surprisingly, truancy, disruptive classroom behavior, and disciplinary problems are also commonly associated with underachievement and low school bonding (Gold & Mann, 1982; McCall, Evahn, & Kratzer, 1992; Simmons & Blyth, 1987). These findings, as a whole, support the fourth model in Fig. 1, the School Misbehavior Driven model, in which high school misbehavior is associated with increased negative school and substance use outcomes. Little research has looked at school misbehavior from a developmental perspective, however, addressing whether school misbehavior is more likely a cause or consequence of substance use and other school-related factors.

Cigarette Use Is the Cause of Multiple School Problems

Cigarette use and other associated behaviors may also be the cause of increases in school misbehavior and decreases in academic achievement and school bonding during the high school years (see the last model in Fig. 1). Cigarette use by itself may not directly contribute to decrements in school achievement and bonding; however, it may be part of a constellation of risky health behaviors that set the stage for ongoing school-related problems. Although research tends to support the psychogenic and problem behavior interpretations, some research supports the causal link from drug use to school outcomes (Galambos & Silbereisen, 1987; Newcomb & Bentler, 1986). Using a cross-lagged design, Newcomb and Bentler (1986) found that drug use during high school was related to a lack of college involvement during young adulthood. Students who use cigarettes, marijuana, and other drugs are also more likely to drop out of high school, particularly if they initiate drug use during early adolescence (Friedman, Glickman, & Utada, 1985; Garnier, Stein, & Jacobs, 1997; Mensch & Kandel, 1988). In general, compared to nonusers, substance-using students have lower grade point averages, are bored in school, and skip school more often (Paulson *et al.,* 1990).

The main focus of the present paper is to consider the patterns of relation among cigarette use and academic behaviors and attitudes such as those described in the previous sections and to examine the temporal, if not causal, connections between school experiences and cigarette use during adolescence. In addition, this study includes comparisons between those who initiated cigarette use prior to 8th grade and those who did not, and between those who dropped out of high school before 12th grade and those who did not, to consider whether this link varies as a function of young people's psychosocial risk trajectories (e.g., Dryfoos, 1990).

COMPETING CONCEPTUAL MODELS

In this investigation, we include alternate conceptualizations of the causal relations among academic achievement, school bonding, school misbehavior, and cigarette use in a set of six *a priori* models (see Fig. 1) that we test using national panel data spanning 8th, 10th, and 12th grades. These six conceptual models are utilized as prototypes and allow us to test the various theoretical and empirical perspectives that have been described above. In summary, the Isolated Stability model, model 1, indicates that school factors and cigarette use are highly stable over time (no cross-lagged relations are included). Building from model 1, the Achievement Driven model (2) suggests support for the psychogenic interpretation such that cigarette use and school problems originate in adolescents' early experiences of academic difficulties. The School Bonding Driven (3) and the School Misbehavior Driven (4) models suggest that these factors contribute causally to changes in others over time. The Direct Effects on Cigarette Use model (5) indicates that these school-related constructs drive changes in cigarette use only over time. In contrast, the Cigarette Use Driven model (6) suggests the alternate causal direction such that any decrements in school-related factors are due to the negative effects of adolescent cigarette use (the impaired ability interpretation).

Based on these model tests in our original cohort, we will accept the best fitting parsimonious model. We will then examine the robust nature of our findings by testing whether the same model applies across an additional cohort, gender, and ethnicity. We will also test whether a similar model applies to students who have tried cigarettes in eighth grade (vs. those who have not) and to students who have dropped out of school.

METHOD

Three waves of national panel data were obtained from the Monitoring the Future project, an ongoing study of adolescents and young adults. The project has surveyed nationally representative samples of 12th grade students (from the United Status) each year since 1975, using questionnaires administered in classrooms. In 1991, the project was expanded to include 8th and 10th grade students. Of the approximately 13,000 8th graders surveyed in 1991, 2000 individuals were selected for follow-up surveys by mail. The biennial follow-up surveys began when most respondents were in 10th grade. Study procedures are described in detail elsewhere (Bachman, Johnston, & O'Malley, 1996; Johnston, O'Malley, Schulenberg, & Bachman, 1996).

Sample

The panel sample included respondents from the 1991 and 1992 8th grade cohorts who did not drop out of school between 8th and 12th grade and who participated in the study during at least one of the two biennial follow-ups (when most respondents had reached 10th and 12th grades). The sample (weighted $n = 3056$)[5] was restricted to those participants who provided valid data for at least one of the observed measures at two of the three time points. At baseline, 1537 students in the 1991 cohort and 1451 in the 1992 cohort had sufficient data to be included, 1485 (1991 cohort) and 1432 (1992 cohort) students were included at 10th grade, and 1225 (1991 cohort) and 1151 (1992 cohort) students were included at 12th grade (weighted cases). To account for the clustering of our data by school, we adjusted for design effects in all of our analyses.[6]

In the total sample, 65.8% of the sample were Caucasian, 10.3% African American, 6.9% Hispanic, 5.4% Native American, and 1.8% Asian American (7.2% reported "Other" and 2.6% had missing data). The sample was split nearly evenly by gender (54% female). Most youth came from two-parent house-

[5]Individuals estimated to be at high risk for dropping out of school were oversampled for the panel samples; accordingly, corrective weighting was needed so that the panel samples best represent the original national samples.

[6]The complex sample design (with students clustered by school) used in this study means that the actual sampling variance may be larger than the variance expected from a simple random sample. Design effects have been estimated to allow for correcting the estimated variances (see Johnston, O'Malley, & Bachman, 1998, Appendix C.) The estimated design effects for 8th grade measures of prevalence of cigarette smoking among all cross-sectional respondents vary between 3.0 and 4.0 (depending on the specific prevalence, for example, daily versus monthly). However, those measures are based on all respondents (about 120 students per school), whereas the longitudinal analyses used in the present manuscript are based on only about 10 students per school per cohort. Because the design effect is strongly (positively) related to average number of students per school, we estimate the design effect for the present analyses to be much lower, on the order of 1.25 for analyses involving the entire sample, and 1.13 when we are considering subgroup effects, where the average number of students per school will be smaller.

holds (80%); 14% of the youth lived with their mothers only; 3% lived with their fathers only; and 2% lived with grandparents or other relatives.

Attrition Analyses

To examine differential attrition effects, we compared the eighth grade data of those who were successfully retained in the panel sample for at least one follow-up and those who were not. There were no mean differences in level of school bonding (on all three indicators); however, in comparison to those in the panel sample, those lost to the sample were significantly more likely to be male, to have lower GPAs, to have higher levels of school misbehavior (on all four indicators), and to smoke cigarettes. A two-group confirmatory factor analysis revealed that, compared to those who remained in the panel sample, those lost to the panel sample had significantly higher variances for, and covariances between, cigarette use and school misbehavior indicators; they also had a significantly higher covariance between GPA and "hate school," and significantly higher variances for GPA and "school interest." The largest differences in covariances were between reports of skipping classes and cigarette use (correlations were .22 for the panel sample and .30 for the attrition sample) and GPA and "hate school reports" (correlations were −.19 for the panel sample and −.10 for the attrition sample). These relatively small differences would likely have had little effect on our results had the attrition sample been included in our analyses.

Measures

Four constructs were measured at 8th, 10th, and 12th grades: achievement, school bonding, school misbehavior, and cigarette use. Constructs and items are summarized in Table 1, along with means and standard deviations.

Academic Achievement

This was measured by the single item, youths' self-report of their grade point average during the current school year. Self-reported grades tend to correlate very highly with school-reported grades (e.g., Crockett, Schulenberg, & Petersen, 1987; Zimilies & Lee, 1991).

School Bonding

School bonding was measured with three items regarding youths' attitudes toward school during the past year. Although there is little consensus in literature regarding the measurement of school bonding, our indicator of youths' attachment and bonding to school was based on liking school, disliking school, and being interested in schoolwork (Finn, 1989; Hawkins *et al.,* 1997; Hirschi, 1969).

School Misbehavior

School misbehavior was indicated by four items regarding the frequency of truancy, suspensions, and misbehavior (Sommer, 1985).

Cigarette Use

Cigarette use was measured with a single item concerning the frequency of smoking cigarettes during the past 30 days. Cigarette use initiation in 8th grade was measured by adolescents' reports of whether they had ever smoked cigarettes (1 = never; 2 = once or twice; 3 = occasionally but not regularly; 4 = regularly in the past; 5 = regularly now). Students reporting 2 or higher were coded as initiators (42%); 57% of the total weighted sample reported they have never smoked cigarettes. The reliability and validity of self-reported cigarette use measures have been reported and discussed extensively (e.g., Johnston, O'Malley, & Bachman, 1998; O'Malley, Bachman, & Johnston, 1983).

High School Dropout Status

School dropout status was indicated by youth reporting that they "left school without graduating (dropped out, been permanently expelled, etc.)." Between the second and third survey, 5.9% of the unweighted sample (n = 172) shifted from in school to school dropout status, and only these dropouts are included in the final phase of the analyses.

Missing Data

Because of the restrictions regarding sample selection (described above), there was very little miss-

Table 1. Constructs and Items: Item Means, Standard Deviations, and Factor Loadings at Each Grade for the 1991–1992 Cohorts (Weighted $n = 3056$)

Constructs/Item	Means (SD)			Standardized factors loadings		
	8th Grade	10th Grade	12th Grade	8th Grade	10th Grade	12th Grade
Achievement						
Which of the following best describes your average grade in this school year?[a]	6.07 (2.16)	5.67 (2.15)	6.20 (2.00)	0.95	0.95	0.95
School bonding						
Now thinking back over the past year in school, how often did you						
. . . enjoy being in school?[b]	3.30 (1.04)	3.37 (1.01)	3.32 (1.04)	0.75	0.79	0.80
. . . hate being in school?[b]	3.02 (1.08)	2.94 (1.03)	3.00 (1.05)	−0.69	−0.70	−0.70
. . . find your course work interesting?[b]	3.10 (0.98)	2.98 (0.95)	3.05 (0.97)	0.55	0.67	0.68
School Misbehavior						
Now thinking back over the past year in school, how often did you get sent to the office, or have to stay after school, because you misbehaved?[b]	1.66 (0.99)*	1.53 (0.87)*	1.42 (0.80)*	0.69	0.67	0.67
During the last four weeks, how often have you gone to school, but skipped a class when you weren't supposed to?[c]	1.20 (0.68)*	1.39 (0.81)*	1.65 (1.06)*	0.38	0.43	0.38
During the last four weeks, how many whole days of school have you missed because you skipped or cut?[d]	1.20 (0.75)*	1.41 (1.08)*	1.79 (1.39)*	0.42	0.41	0.40
Have you ever been suspended or expelled from school?[e]	1.22 (0.54)*	1.29 (0.61)*	1.31 (0.63)*	0.53	0.57	0.66
Cigarette Use						
How frequently have you smoked cigarettes during the past 30 days?[f]	1.22 (.67)*	1.43 (0.96)*	1.75 (1.30)	0.95	0.95	0.95

[a]Possible responses were 1 = D, 2 = C−, 3 = C, 4 = C+, 5 = B−, 6 = B, 7 = B+, 8 = A−, 9 = A.
[b]Possible responses were 1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = almost always.
[c]Possible responses were 1 = not at all, 2 = 1 or 2 times, 3 = 3–5 times, 4 = 6–10 times, 5 = 11–20 times, 6 = >20 times.
[d]For 8th grade, possible responses were 1 = none, 2 = 1 day, 3 = 2 days, 4 = 3 days, 5 = 4–5 days, 6 = 6–10 days, 7 = 11 or more days. For 10th and 12th grades, possible responses were 1 = none, 2 = 1 day, 3 = 2 days, 4 = 3 days, 5 = 4–5 days, 6 = 6–10 days, 7 = 11–19 days, 8 = 20 or more days.
[e]Possible responses were 1 = no, 2 = yes one time, 3 = yes two or more times.
[f]Possible responses were 1 = not at all, 2 = less than 1 cigarette per day, 3 = 1–5 cigarettes per day, 4 = about one half pack per day, 5 = about one pack per day, 6 = about one and one-half packs per day, 7 = two packs or more per day.
*Kurtosis of these variables was greater than 2.0.

ing data within waves among participants who were included at the wave. Only four variables had more than 3% missing data: 8th and 10th grade reports of the number of days youth skipped school (5.9% and 5.4%, respectively) and 12th grade reports of classes skipped (7.9%) and suspensions (9.7%).

Plan of Analysis

Structural equation modeling (SEM) analyses with latent variables were conducted to test the models and to provide a simultaneous estimation of the parameters while accounting for attenuation in the structural coefficients due to measurement error. The SEM analyses were conducted using LISREL 8 (Jöreskog & Sörbom, 1996) with maximum likelihood estimation. Covariance matrices served as the data base for all SEM analyses (pairwise deletion of missing data); results are presented in the standardized metric to facilitate interpretation. Analyses were based on the total weighted sample size adjusted for design effects.[7] The adopted analytic strategy was to first compare the six *a priori* models discussed previously using the 1991 cohort and to select a final model. Then, two-group SEM analyses using the final model were conducted to test for invariance across cohort,

[7]Conclusions regarding the final model do not change when the smallest weighted n ($n = 2142$) of the covariance matrix was used (and adjusted for design effects).

gender, and ethnicity. In the last phase of the analyses, the final model was adapted first to examine differences between participants who have initiated cigarette use in 8th grade and those who have not, and second, to examine the invariance of the model across high school dropouts and non-dropouts.

To determine the suitability of the models, several fit indices were used: the LISREL Goodness-of-Fit Index (GFI), Bentler and Bonett's Comparative Fit Index (CFI), and the Relative Normed Fit Index (RNFI) (Mulaik *et al.,* 1989). For each of these indices, a value between .9 and 1.0 indicates that the model provides a good fit to the data.[8] Hu and Bentler (1999) suggested that a cutoff value close to .95 for the CFI and RNFI was needed to conclude that the fit is relatively good. To compare models, difference in chi-square tests were conducted, in which the chi-squares of nested models are compared to determine which one provides a significantly better fit. In two-group analyses, constraining parameters to be equal between the two groups and observing the resulting change in chi-squares allows us to consider the extent of invariance across the two groups (Jaccard & Wan, 1996; Jöreskog & Sörbom, 1996).

RESULTS

Model Testing on the 1991 Cohort

Measurement Model

Before the full structural equation model tests were conducted, the measurement portion of the model was developed and tested to establish relations between the observed and latent constructs. Single indicators were used to measure academic achievement (indicated by grade point average) and cigarette use (indicated by monthly cigarette use) at each time point. The six additional items loaded on the two latent constructs (school bonding and school misbehavior) in the specified pattern at each of the three measurement occasions. The standardized lambda estimates (i.e., factor loadings) from the accepted measurement model are presented in Table 1 (for the 1991 to 1992 cohorts combined). (The 1991 and 1992 cohorts are combined in Table 1 because, as we show below, measurement equivalence across the two cohorts was established.) The loadings for the same items were consistent across the three waves. As suggested by Hayduk (1987), for items that served as single indicators of constructs (academic achievement and cigarette use), unique variances were fixed at a standard proportion[9] (.10) at each measurement occasion, generating a factor loading of .95.

In the accepted measurement model, the unique variances for the same item over time were permitted to correlate (between 8th and 10th grade, 10th and 12th grade, and 8th and 12th grade). As indicated in Table 2, this ''measurement with correlated errors'' model provided a better fit to the data and a significant improvement over the measurement model without correlated errors (i.e., the chi-square was significantly reduced), and thus was the accepted measurement model.[10] The factor correlations from the accepted measurement model for the 1991–92 cohort sample are shown in Table 3. The substantial within-time correlations among the constructs at eighth grade reveals that much of the interrelations among the constructs is in place at (and likely prior to) 8th grade. Across grade levels, the within-time correlations between cigarette use and the other constructs tended to increase.

Structural Models

The six conceptual models were constructed based on the accepted measurement model, with the

[8]The GFI represents the extent to which the observed variances and covariances are accounted for by the model. The CFI represents the extent of improvement in fit of the given model over the ''independence model'' in which no covariances are permitted among variables. Both the GFI and the CFI are influenced by the fit of the measurement portion of the model because this portion constitutes the bulk of the estimated covariances in most models (Mulaik *et al.,* 1989). The RNFI is unique because it represents the improvement of the given structural null model (i.e., the accepted model with uncorrelated factors) while controlling for the fit of the measurement model, which permits a more meaningful consideration of alternative structural models.

[9]These unique variance parameters were fixed to .10 based on previous reliability estimates (Schulenberg, Bachman, O'Malley & Johnston, 1994). In making decisions about error variances for single indicators, we wanted the estimates to be conservative because larger error variances yield larger causal parameters, and we did not want to inflate these coefficients artificially. In further analyses, not reported here, we found that neither increasing the error in reported monthly cigarette use to .20 nor decreasing the error to .05, changed our conclusions.

[10]The ''structural null model'' included in Table 2 incorporates the accepted measurement model except that all correlations among factors were constrained to zero. This model, which is used to calculate the RNFI, provides a very poor fit to the data attesting to the strength of the interrelationships among the factors.

Table 2. Summary of Model Fit Indices for the 1991 Cohort

Model	χ^2 test			GFI	CFI	RNFI	Model compared	Change in χ^2 test		
	χ^2	df	$p<$					$\Delta\chi^2$	Δdf	$p<$
A. Measurement without correlated errors	1145.78	258	.001	.932	.920	—	—	—	—	—
B. Measurement with correlated errors	447.83	237	.001	.975	.981	—	A	697.95	21	.001
C. Structural null model	4435.69	303	.001	.715	.628	—	B	3987.86	66	.001
D. Isolated Stability	626.53	277	.001	.966	.969	.965	B	178.70	40	.001
E. Academic Achievement Driven	577.49	271	.001	.968	.972	.976	D	49.04	6	.001
F. School Bonding Driven	596.69	271	.001	.967	.971	.971	D	29.84	6	.001
G. School Misbehavior Driven	564.44	271	.001	.969	.974	.979	D	62.09	6	.001
H. Direct Effects on Cigarette Use	572.65	271	.001	.969	.973	.977	D	53.88	6	.001
I. Cigarette Use Driven	619.73	271	.001	.966	.969	.965	D	6.80	6	NS
J. School Misbehavior with 2 Paths Added	552.82	269	.001	.969	.974	.982	G	11.62	2	.005
K. Trimmed Final Model*	553.38	271	.001	.969	.975	.982	J	0.56	2	NS

Note: GFI = Goodness of Fit Index; CFI = Comparative Fit Index; RNFI = Relative Normed Fit Index; see text for description of models and fit indices. Design effects n = 1261 (weighted n = 1576).
*Accepted model.

structural portion constrained for each as illustrated earlier in Fig. 1. In addition, 8th grade factors were correlated, and at 10th and 12th grades, factor unique variances and unique covariances were included. The fit indices for the six structural models are presented in Table 2 (models D–I). As is evident, each of the six models provided a good fit to the data (i.e., GFIs ranged from .966 to .969 and CFIs ranged from .969 to .974). The RNFIs ranged from .965 for the Isolated Stability and the Cigarette Use Driven models to .979 for the School Misbehavior Driven model. According to the change in chi-square tests for nested models, compared to the most restrictive Isolated Stability model, five of the six models provided a significantly better fit (i.e., change in chi-square test was significant in each case, indicating that comparatively, the less restrictive model provided a significantly better fit). The Cigarette Use Driven model provided no improvement over the Isolated Stability model. The School Misbehavior Driven model provided the largest improvement in fit. Thus, although it was not possible to compare directly the fit of models E–I, the School Misbehavior model was selected as the preferred a priori model, a decision further justified by consideration of the modification indices and residuals in models E–I.

The final model was developed by modifying the School Misbehavior model. According to the modification indices provided in the LISREL output, adding cross-lags from 8th grade academic achievement to 10th grade school misbehavior and from 10th grade academic achievement to 12th grade cigarette use would provide a better fit to the data. Model J, the ''School Misbehavior with 2 Paths Added,'' provided

Table 3. Factor Correlations for Accepted Measurement Models (1991 and 1992 Cohorts)

Factor	8th Grade				10th Grade				12th Grade			
	AA	SB	SM	CU	AA	SB	SM	CU	AA	SB	SM	CU
Academic achievement—8th												
School bonding—8th	.29											
School misbehavior—8th	−.44	−.38										
Cigarette use—8th	−.20	−.20	.46									
Academic achievement—10th	.68	.23	−.40	−.18								
School bonding—10th	.17	.58	−.22	−.11	.31							
School misbehavior—10th	−.43	−.30	.75	.35	−.55	−.38						
Cigarette use—10th	−.21	−.15	.34	.47	−.26	−.25	.47					
Academic achievement—12th	.45	.15	−.26	−.12	.66	.21	−.36	−.17				
School bonding—12th	.12	.35	−.17	−.08	.21	.59	−.27	−.17	.33			
School misbehavior—12th	−.32	−.23	.56	.26	−.41	−.28	.75	.35	−.51	−.40		
Cigarette use—12th	−.19	−.11	.25	.27	−.24	−.18	.35	.55	−.29	−.28	.50	

Design effects n = 2445 (weighted n = 3056).

a significant improvement over the School Misbehavior Driven model (see Table 2). Nonsignificant paths (the school misbehavior–school bonding link between 8th and 10th grade and the school misbehavior–academic achievement link between 10th and 12th grade) were eliminated from model J, and the Trimmed Final model (model K) was accepted as the most parsimonious best-fitting model for the 1991 cohort. The parameters associated with the final model were similar when an alternate estimation method and covariance matrix were used because of the kurtotic nature of some of the data.[11]

Cohort Comparisons

The second phase of the analysis was to examine whether the final model from the 1991 cohort fit equally well to the data of the 1992 cohort using two-group SEM analyses. Model invariance across the two cohorts would indicate replication of the underlying structural relationships, a necessary and often neglected component of model development and testing. The first step in this two-group model test was to fit the model to the data of the two cohorts without constraining any parameters to be equal across cohort (model C1, Table 4).

The remaining steps in the two-group analyses involved constraining specific parameter values in the measurement and structural portions of the model to be equal across the two cohorts. Constraining the factor loadings (but not the unique variance in the observed variables for school bonding and misbehavior), structural parameters, and the factor variances and covariances (constrained in separate steps) provided no significant change in the chi-square (see final model, C2, in Table 4). This indicates that the measurement of and structural relations among the constructs were invariant across the cohorts and suggests that the final model developed on the 1991 cohort also represents the relations between these variables for the 1992 cohort. Thus, we combined the 1991 and the 1992 cohorts in subsequent analyses. In combining the two cohorts, an additional cross-lag from 8th grade academic achievement to 10th grade cigarette use was suggested by the modification indices. Freeing this path reduced the chi-square significantly.

The Final Model for the 1991 and 1992 Cohorts

Figure 2 presents the final model for the combined 1991 to 1992 cohort. Across the two time intervals (8th to 10th grade, 10th to 12th grade), school misbehavior was the most stable of the four constructs, while cigarette use was the least stable. Regarding cross-lagged effects, between 8th and 10th grade, school misbehavior contributed significantly to a decrease in academic achievement and an increase in cigarette use, with the latter cross-lag also present between 10th and 12th grades. In addition, lower academic achievement in 8th grade contributed significantly to increased school misbehavior and cigarette use between 8th and 10th grades, with the latter cross-lag also present between 10th and 12th grades. School misbehavior in 10th grade contributed significantly to decreased school bonding between 10th and 12th grades. Two mediated paths link academic achievement, school misbehavior, and 12th grade cigarette use: the indirect effect of 8th grade school misbehavior on cigarette use via 10th grade academic achievement was significant ($p < .01$), with a standardized coefficient of .12; the indirect effect of academic achievement on cigarette use via 10th grade school misbehavior was also significant ($p < .01$), with a standardized coefficient of $-.09$. Overall, 25% and 32% of the variance in cigarette use was accounted for at 10th and 12th grades, respectively.

These findings suggest that during middle adolescence the dominant direction of influence is from school experiences to cigarette use. School misbehavior and low academic achievement contribute to increased cigarette use over time both directly and indirectly. These findings are robust, as they are supported by two independent national samples (i.e., the 1991 and the 1992 cohort).

Comparisons Across Gender and Ethnicity

The third phase of the analysis involved examining whether the final model fit equally well across gender and ethnicity for the combined 1991 and 1992 cohort sample, using the same two-group SEM approach used in the cohort comparisons (see Table 4). Additional analyses not reported here also show

[11]Bollen (1989) suggests using a distribution-free estimator such as weighed least squares (WLS) when data are not normally distributed (the school misbehavior and cigarette use variables were highly kurtotic). When we test the model using WLS and an asymptotic covariance matrix, the model was very similar and our conclusions did not change.

Table 4. Summary of Model Fit Indices: Cohort, Gender, and Ethnicity Comparisons

Model (see text for details)	χ^2 test χ^2	df	$p<$	Model compared	Change in χ^2 test $\Delta\chi^2$	Δdf	p
Cohort comparisons							
(C1) Unconstrained	1220.18	542	.001	—	—	—	—
(C2) Constrained factor variances and covariances, structural paths, and factor loadings[a]	1302.46	601	.001	C1	82.28	59	.02
Gender comparisons							
(G1) Unconstrained	1370.73	540	.001	—	—	—	—
(G2) Constrained factor variances and covariances, structural paths, and factor loadings with additional parameters free	1439.06	588	.001	G1	68.33	48	.03
Ethnicity comparisons							
(E1) Unconstrained	1329.52	540	.001	—	—	—	—
(E2) Constrained factor variances and covariances, structural paths and factor loadings with additional parameters free[b]	1409.81	595	.001	E1	80.29	55	.02

[a]No factor (co)variances, structural or measurement differences.
[b]No structural differences.
Note: Errors in observed variable were not equal between comparison groups.

that the final model was largely invariant with respect to levels of parental education, parental monitoring, and peer cigarette use (see Bryant, Schulenberg, Bachman, O'Malley, & Johnston [2000] for details).

Gender Comparisons

The factor loadings, structural paths, and factor variances and covariances of the final model were constrained equal between males and females in separate steps and compared to the unconstrained model (G1, Table 4). Constraints were released at each stage such that there was no decrement in fit at the $p <$ .01 level. The final model (G2, Table 4) includes three free measurement parameters, seven free factor (co)variances, and two structural parameters. The stabilities of cigarette use between 8th and 10th grades (.46 for females; .34 for males) and school

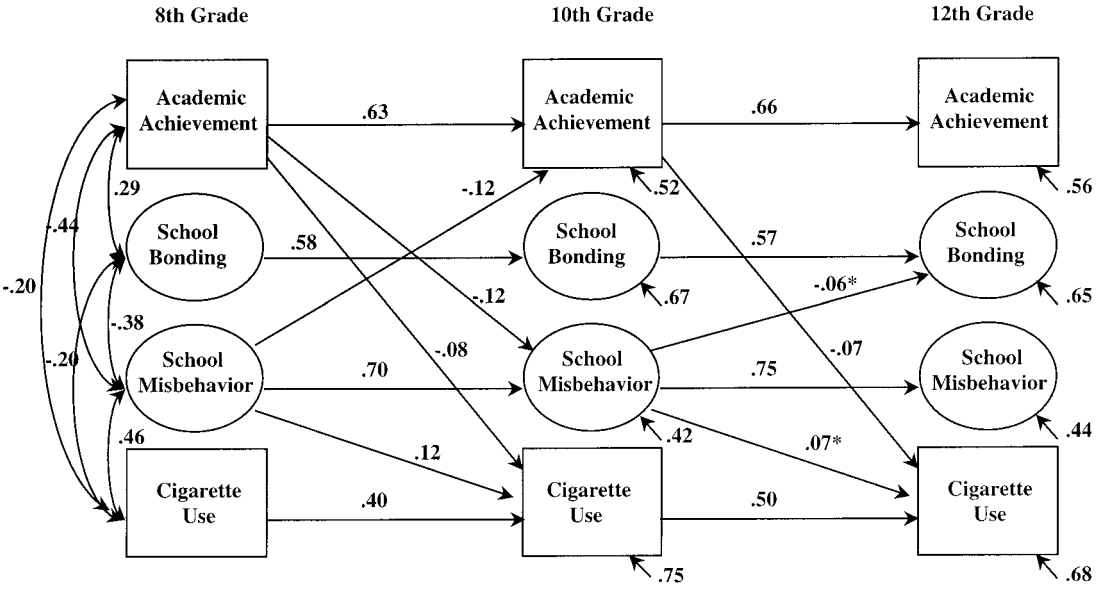

Fig. 2. Final model, 1991 and 1992 cohorts combined. *Note.* Only the structural portion of the model is shown; standardized coefficients are present; all coefficients are significant at the $p < .001$ level (two-tailed t test), except as otherwise indicated; design effects $n = 2445$ (weighted $n = 3056$); c^2 (270) = 901.33; GFI = .974; CFI = .971. * $p <$ .05, ** $p < .01$.

misbehavior between 10th and 12th grades (.65 for females; .81 for males) were freed in this model. These results suggest that, for the most part, the final model was the same for males and females, although females tend to have somewhat more stable cigarette use from 8th to 10th grade and males have more stable school misbehavior from 10th grade to 12th grade.

Ethnicity Comparisons

Using the same analytic approach as above, the final model was compared for minority versus white students. The factor loadings, structural paths, and factor variances and covariances were constrained to be equal in separate steps and compared to the unconstrained model (E1, Table 4). Constraints were released for one factor loading and three factor variances and covariances. The variances of 8th grade school misbehavior, 10th grade academic achievement, and 12th grade school bonding were freed in the final model as well as the covariance between school bonding and cigarette use in 10th grade (E2, Table 4). These results suggest that the final model was the same for minorities and nonminorities, although there were some differences in variability of the factors.

Initiation and School Dropout Analyses

In the final phase of the analyses, the final model was modified to allow comparisons using initiators and nonusers of cigarettes in 8th grade and the 12th grade school dropout sample from the 1991 and 1992 cohorts.

Initiation Comparisons

To consider whether the final model applies both to students who have initiated cigarette use in 8th grade and to students who have not tried cigarettes in 8th grade, the model was adapted by removing 8th grade cigarette use. Using the modified model, the factor loadings and structural paths were constrained to be equal between these two groups in separate steps and compared to the unconstrained model (I1, Table 5). In the last step, the factor variances and covariances could not be constrained to be equal without a large decrement in fit. Therefore, the final model (I2, Table 5) includes only measurement and structural constraints with four measurement and two structural parameters freed. The stability of cigarette use from 10th to 12th grade was different (.52 for initiators, .38 for noninitiators) and the modification indices suggested a link between 8th grade school bonding to 10th grade cigarette use, which was significant for initiators (−.11) and not significant for noninitiators. These results suggest that the final model was the same for youth who have tried cigarettes in 8th grade and for those who have not with some differences in variability and stability of the factors. In addition, school bonding may be more of a risk factor for increased cigarette use for early initiators than for students who have not tried cigarettes in 8th grade.

School Dropout Comparisons

Because the dropouts had left school by the 12th grade, only cigarette use was included in the model at the third wave (i.e., 12th-grade academic achievement, school bonding, and school misbehavior were removed from the model). The modified model was tested on the school dropouts (n = 172) and nondropouts (n = 2761) (Table 5), using unweighted data. The factor loadings, structural paths, and factor variances and covariances were constrained to be equal in separate steps and compared to the unconstrained model (D1, Table 5). The final model (D2, Table 5) included one free structural parameter and one free factor variance. The stability of academic achievement between 8th and 10th grades was .61 for nondropouts and .21 for students who drop out of school by the 12th grade. The factor variance of academic achievement in 10th grade, therefore, was less for nondropouts (.57) than for dropouts (.83). These results indicate that except for these differences, the final model was the same for dropouts as for youth who stay in school.

DISCUSSION

Our findings offer strong support for the view that early school misbehavior and low academic achievement are key risk factors for increased cigarette use during adolescence. In two independent

Table 5. Summary of Model Fit Indices: Initiator/Noninitiators and Dropout/Nondropout Comparisons

Model (see text for details)	χ^2 test			Model compared	Change in χ^2 test		
	χ^2	df	$p<$		$\Delta\chi^2$	Δdf	p
Initiation comparisons							
(I1) Unconstrained	1103.20	494	.001	—	—	—	—
(I2) Constrained structural paths and factor loadings with additional parameters free	1140.72	516	.001	I1	37.52	22	.02
Dropout comparisons							
(D1) Unconstrained	664.37	246	.001	—	—	—	—
(D2) Constrained factor variances and covariances, structural paths and factor loadings with additional parameters free[a]	709.48	286	.001	D1	45.11	40	.27

[a]No measurement differences.

Note: Errors in observed variables were not equal between comparison groups.

nationally representative panel samples of adolescents, we found that school misbehavior contributed to increased cigarette use and decreased academic achievement between 8th and 10th grades, and increased cigarette use and decreased school bonding between 10th and 12th grades. In addition, lower levels of academic achievement contributed to increased school misbehavior between 8th and 10th grades, and increased cigarette use between 8th and 10th grades and 10th and 12th grades. These findings also indicate that the influence of early school misbehavior and low academic achievement on cigarette use is indirect via reciprocal pathways. Although other researchers have associated school misbehavior (e.g., truancy, suspensions, misbehavior) and academic failure with adolescent cigarette use, the longitudinal design of the present research has allowed us to extend this research by assigning temporal, if not causal, precedence to early school misbehavior and school failure. Furthermore, our findings are robust, indicating that the direction and magnitude of the effects do not vary as a function of gender, ethnicity, early initiation of cigarette use, or high school dropout status. This suggests a general phenomenon in which early school failure and misbehavior are indicators of potentially negative developmental trajectories throughout adolescence involving school problems and multiple health risks.

For many students, school difficulties are not unique to adolescence. Histories of antisocial behavior, school problems, and school failure during childhood are common among high school dropouts and youth with academic or truancy problems during high school (Cairns, Cairns, & Neckerman, 1989; Hinshaw, 1992; Lambert, 1988). Students whose early school experiences include misbehavior or failure are likely to miss out on formative academic experiences in the classroom and to affiliate with other alienated or delinquent peers. In this study, we have tapped into one segment of a trajectory of negative school experiences that may have started during childhood. Our results indicate that school misbehavior and failure early in adolescence may be key indicators that youth are on this negative school trajectory.

Why do students fail academically, skip school, and misbehave in school during adolescence? The present research indicates that academic achievement and school misbehavior are associated in a reciprocal relationship such that low levels of one are associated with increases in the other over time, particularly during early adolescence. Similarly, Simmons and Blyth (1987) found that a low 6th grade grade point average was associated with increased 7th grade school problem behavior (i.e., problem behavior in school, suspensions, truancy), and Berndt and Mekos (1995) found that 7th graders who perceived junior high school less positively in the fall increased their misconduct during the year. It is likely that adolescents' attitudes regarding school influence their engagement in substance use as well as their academic achievement and school misbehavior (Bryant, 1999).

A review of the research on the etiology of school difficulties suggests that adolescents' school attitudes and behaviors, family backgrounds, and school and community environments all are likely to contribute to both school misbehavior and academic failure. Poor social and emotional functioning, school failure, conduct disorders, and frustration with negative school experiences are among the personal factors associated with misbehavior and truancy in adolescence (Pestello, 1989). Attitudes toward edu-

cation, socioeconomic background, and climate distinguish families of truant students from nontruants (Bell, Rosén, & Dynlacht, 1994). Family and peer environments in concert with adolescents' accumulated experiences and beliefs related to school contribute to youths' involvement in school misbehavior and their achievement in school.

School misbehavior and school failure share sequelae as well as etiology. They are often identified as risk factors for school dropout, delinquency, and substance use and included as part of a general tendency toward problem behavior. This research supports these previous findings and also lends support for findings that truancy, school misbehavior, and low academic achievement are among the strongest predictors of cigarette use (Diem *et al.,* 1994) and negative school outcomes (Ianni & Orr, 1996; Rumberger, 1995). Being absent from school may be one of the earliest indicators of future school problems. In a study comparing high school dropouts to graduates using data from first grade through high school, Barrington and Hendricks (1989) found that compared with high school graduates, dropouts had been absent twice as often by the fifth grade, and three times as often by ninth grade.

In addition to school misbehavior and failure, research has indicated that dropping out of school and experimenting with cigarettes at an early age are risk factors for increased cigarette use during adolescence (Hawkins *et al.,* 1992). Yet, the present model holds true for adolescents in these ''at risk'' groups. School misbehavior and poor academic performance are associated directly and indirectly with increased cigarette use among ''at risk'' youth and also among youth from backgrounds of less risk. Although these groups may differ in the variation and stability of cigarette use, the implications for reducing use among adolescents from various backgrounds of risk are essentially the same. Curbing school misbehavior and truancy and assisting students with academic problems are likely to deter school dropout and to promote increased academic achievement and engagement and decreased cigarette use and health risks.

How can schools reduce school misbehavior and promote achievement among students? Classroom environments that are competitive and high in control, and schools with open attendance policies, are likely to have the highest rates of truancy (Bell *et al.,* 1994). Positive school climates where all students have the opportunity to succeed are likely to enhance student motivation, achievement, and other positive school outcomes (Masten, 1994; Pintrich & Schunk, 1996). Research on school dropout by Rumberger (1995) indicates that academically rigorous schools with more fair discipline policies as perceived by students significantly reduced the odds of students dropping out of school compared to less rigorous schools with unfair discipline practices. Rumberger suggests that discipline policies are often neglected in school reform because they are associated with behavioral issues rather than academic learning. Yet, he finds, as we find here, that school behavioral issues are a critical aspect of the educational experience, particularly for those students who may be most at risk for negative school- and health-related outcomes. Intervention efforts on the part of preventionists are likely to be most effective when they take into account existing school culture and practices (Gottfredson, Gottfredson, & Skroban, 1996; Meyers, 1989).

Strengths and Limitations

The present study includes panel data from two national samples of young people tracked from 8th through 12th grade, including youth who have dropped out of school by 12th grade. The analyses revealed that our findings were robust across two cohort samples, gender, ethnicity, cigarette use initiation, and dropout status. Some limitations of the study, however, merit consideration. First, by 8th grade, many experiences in classrooms, at home, and among peers may have already shaped youths' attitudes and beliefs related to cigarette use and to school. The relatively high stability coefficients of the constructs in the present study indicate that many relevant behaviors and attitudes are in place prior to 8th grade. Expanding similar research to include elementary students may help us to extend our understanding of the role that school misbehavior plays in the context of school failure and cigarette use during early adolescence. Second, we are limited by single indicator measurement of academic achievement and cigarette use. Additional information from students (e.g., cigarette use in school, grades in different classes) and schools (e.g., achievement test scores) would improve our measurement of these constructs. Third, during the time period considered in the present study, many youth experience school transitions. Collecting information once a year rather than biennially would provide information that is more sensitive to these school environmental changes. Fourth, consistent with other panel studies of adolescents, we

had some differential attrition. The 2-year interval and differential attrition in the present study are also likely to contribute to an underestimation of effects. Last, this study makes use of correlational data, and strictly speaking, while we were able to establish strong relationships and temporal precedence among the constructs, we were not able to establish causal influences.

Implications

This research has important implications for intervention and prevention efforts. Contrary to previous findings (e.g., Free, 1993; Hirschi, 1969; Smith & Fogg, 1978), our results suggest that adolescents' feelings of school bonding contribute very little independent information to our understanding of the link between school difficulties and cigarette use once these factors are taken into account. Students' early involvement in school misbehavior, however, is likely to be linked to decreases in school bonding, academic achievement, and cigarette use over time. Early experiences of school failure may set the stage for decreased school engagement and increased school misbehavior as well as increased cigarette use during high school. The reciprocal effects of skipping classes, acting out in school, and academic failure may put youth on a negative school trajectory that is also associated with increased cigarette use. Helping students who misbehave and experience school failure to constructively avoid negative school- and health-related outcomes should be a priority among teachers and schools.

Prevention scientists would also benefit from extending the present research to consider school misbehavior, academic achievement, and substance use among a younger sample of students, and employing a variety of methodologic approaches. Multilevel methods such as latent growth modeling and hierarchical linear modeling would enable us to examine trajectories of substance use and school factors from early adolescence to young adulthood and to consider how changes in one (perhaps via intervention) influence changes in the other over time (Bryk & Raudenbush, 1992; Duncan *et al.,* 1997). Mixture modeling (Muthén, in press) and pattern-centered approaches (Magnusson, 1998; Schulenberg, O'Malley, Bachman, Wadsworth, & Johnston, 1996) may also reveal diverse patterns of change and continuity among adolescents and shed light on the mechanisms behind the relation between school difficulties and substance use.

Clearly, school misbehavior and low academic achievement are problems that have not gone unrecognized by teachers, schools, and researchers. According to the National Center for Education Statistics (1996), in a 1993 to 1994 survey, 59% of teachers considered absenteeism and 40% considered cutting class to be serious problems. In another survey, 43% of secondary teachers reported that student misbehavior limits to a great or moderate extent their ability to maintain order and discipline in their school, and 25% felt their schools were not effective in preventing school misbehavior (National Center for Education Statistics, 1991). Many existing substance use preventative programs have components that focus on promoting positive learning environments and improving adolescents' academic skills and achievement (e.g., Allred, 1995; Gottfredson *et al.,* 1996; Hawkins *et al.,* 1992; Kellam & Anthony, 1998). Future research would do well to identify school practices, policies, and prevention programs that are associated with reduced school misbehavior, failure, and dropout, as well as lower substance use.

There is evidence that the negative effects of school misbehavior and truancy extend beyond adolescence. Hibbett and Fogelman (1990) find that controlling for social and educational background, truants were more likely to be heavy smokers, to show signs of depression, and to experience marital and family problems during adulthood compared to their nontruant peers. Schools and intervention programs that deter school misbehavior and aim to keep youth in school and active in the classroom are likely to have an important impact on future educational attainment, health status, and family outcomes.

ACKNOWLEDGMENTS

Earlier versions of components of this article were presented at the biennial meeting of the Society for Research on Adolescence, San Diego, CA (February 1998) and the annual meeting of the Society for Prevention Research, Park City, UT (June 1998). This research was supported by a grant from the National Institute on Drug Abuse (DA01411).

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