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The role of school engagement in preventing adolescent delinquency and substance use: A survival analysis☆

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A B S T R A C T

The present study was designed to examine the effects of school engagement on risky behavior in adolescence. Using data from the 4-H Study of Positive Youth Development (PYD), a longitudinal study of U.S. adolescents, discrete-time survival analyses were conducted to assess the effect of behavioral and emotional school engagement on the initiation of drug use and delinquency. The current analyses used seven years of longitudinal data collected from youth and their parents. Results of discrete-time survival analysis indicated that, controlling for demographic variables, higher degrees of behavioral and emotional school engagement predicted a significantly lower risk of substance use and involvement in delinquency. Substance use prevention programs and other health-risk reduction programs should include components (i.e., adolescents' participation in and emotional attachment to school) to capitalize on the protective role of the school context against youth risk behavior.

Adolescence is a time of experimentation, risk, and opportunity (Schwartz et al., 2010). Many risky behaviors, such as delinquency, drug and alcohol use, and unprotected sex, are initiated during this developmental period. Although many youth navigate adolescence successfully without encountering significant problems, others go through the second decade of life facing an increased risk of delinquency and health-compromising behavior. Engagement in delinquency and health-compromising behavior could potentially prevent youth from undertaking a positive and prosperous journey across adolescence, and instead place them on a developmental path marked by negative trajectories, pathways that could lead to less-than-optimal functioning. Thus, identifying factors that prevent problematic behaviors may have important implications for enhancing positive youth development.

Delinquency, measured either using official records of arrests or using self-reports of offending, is prevalent in American youth. According to the U.S. National Youth Survey, the annual prevalence of violence reaches a peak of 28% of males at age 17 and 12% of females at ages 15–17 (Elliott, 1994). For example, the annual prevalence for carrying a weapon among boys increased from 12% at age 10 to 23% at age 13. In addition, large-scale longitudinal studies conducted in high risk and disadvantaged

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neighborhoods in U.S. cities including Denver, Rochester, and Pittsburgh found a similar trend in street crimes – fewer than 15% at age 11 to almost 50% at age 17 (Huizinga, Loeber, & Thornberry, 1993). In other words, various forms of delinquency occur between the beginning of the second decade and before youth graduate (or fail to graduate) from high school. Research has found that an early onset of delinquency in the teenage years predicts a long and serious antisocial path (Loeber & Le Blanc, 1990). The continuity of offending behavior in adolescence and more serious problems at a later age signifies the importance of protecting against delinquent behavior initiation, and against early initiation in particular, during the adolescent years.

A number of health-compromising behaviors such as smoking, drinking, and substance use may become prominent among many adolescents (Cooper, Wood, Orcutt, & Albino, 2003). The *Monitoring the Future Study* (Johnston, O'Malley, Bachman, & Schulenberg, 2011) reveals that 36% of students have consumed alcohol by 8th grade, and 71% of them have consumed alcohol by 12th grade. In addition, while 20% of 8th grade students have tried cigarettes, twice as many (42%) have tried smoking by 12th grade. About 7% of students were current smokers in Grade 8, and this figure almost tripled in 12th grade (19%). In terms of marijuana use, 1.2% and 6.1% of students are daily users in 8th and 12th grades respectively (Johnston et al., 2011). These figures all seem to suggest that many common health-compromising behaviors begin to occur during or before children reach their mid-teens. The literature suggests that alcohol use and illicit drug use before the mid-teenage years is associated with elevated risk for the development of long term alcohol and drug disorders (Grant & Dawson, 1997; Windle, Mun, & Windle, 2005).

A substantial body of literature has suggested that delinquency and health-compromising behaviors are closely linked (Farrington, 2004; Jessor, Costa, Krueger, & Turbin, 2006). In particular, the observation that delinquency and substance use tend to coexist and are correlated has led researchers to speculate that these behaviors may share a common cause (e.g., Farrington, 2004; Hawkins, Catalano, Jones, & Fine, 1987; Jessor 1991) and that interventions effective in reducing one set of behaviors may apply to the others as well. For instance, the Good Behavior Game intervention delivered in first and second grade classrooms was shown to exert powerful protective effects on violent or criminal behaviors as well as drug-related problems 20 years later (Ialongo et al., 1999; Poduska et al., 2008). Several temperamental, relational, and contextual factors have been suggested as being involved in promoting or preventing delinquency and substance use. For instance, temperamental factors such as hyperactivity, lack of self-regulation, and restlessness have been frequently cited as causes of these risk behaviors (e.g., Sher, Trull, Bartholow, & Vieth, 1999). In addition to personality variables, variations in demographic factors such as gender, family socioeconomic background, and race/ethnicity have also been found to be associated with these problem behaviors. However, contextual and other malleable factors have not received as much attention.

Several theoretical frameworks, such as social control theory (Elliott, Huizinga, & Ageton, 1985; Hirschi, 1969; Payne & Salotti, 2007) and the social development model (Catalano & Hawkins, 1996; Hawkins et al., 2007), point to more modifiable or changeable contexts as reasons for the onset and exacerbation of behavior problems. Both models emphasize the role of weakened bonds or attachments to conventional institutions and to the prosocial values that they represent (Chassin, Flora, & King, 2004). As one of the most important social institutions in the lives of children and adolescents, school may have an effect on the occurrence of positive as well as delinquent and health-compromising behaviors. Theoretically speaking, adolescents who are connected or emotionally attached to school may be less likely to engage in problematic behavior because they strive to meet schools' expectations and are willing to endorse the norms established within the school context (Hirschi, 1969; Resnick et al., 1997). In other words, it may be that, when appropriate prosocial socialization is provided in school, young people are motivated to conform to the norms of the school community. Such conformity may be internalized, which then promotes positive development; as a result, their involvement in risky behaviors is attenuated (Henry, Swaim, & Slater, 2005). Weak attachment and connectedness to school may decrease the likelihood that youth will adhere to prosocial school norms that discourage violence and substance use. In addition, when students become less constrained by prosocial bonds, they may be more likely to seek support from delinquent peers inside and outside of school settings. The confluence of low emotional connectedness with school coupled with association with delinquent peers is likely to result in initiation of and continued involvement in delinquency and substance use (Henry, Phornberry, & Huizinga, 2009).

Such emotional attachment and connectedness to the school community is an important component of school engagement, or the extent to which students participate in academic and social activities of school, feel connected at school, and value educational goals (Glanville & Wildhagen, 2007). Emotional engagement involves students' emotional reaction to the school, teachers, and classmates (Stipek, 2002). In addition to the emotional aspect of school engagement, behavioral engagement is another commonly measured component of school engagement (Fredricks, Blumenfeld, & Paris, 2004; Li, Bebiroglu, Phelps, & Lerner, 2008). Behavioral engagement entails involvement in academic activities, participation in school-based social activities, and positive conduct (Fredricks et al., 2004). Both components can potentially affect the extent to which youth enjoy healthy, successful development or, in turn, the likelihood that they will initiate and develop various problematic behaviors. When failing to develop personal connection with peers and teachers or when social competence is lacking, adolescents may develop antisocial attitudes and behavior. Similarly, when students are not actively involved in academic activities, they are likely not to take full advantage of these opportunities to develop academic competence, which in turn may lead to feelings of inadequacy. Feelings of inadequacy may then further detach students from the school community (Harter, 1999). Thus, the effects of the behavioral and emotional dimensions of school engagement may be interrelated.

Investigations into the associations between school engagement and delinquency or substance use have been limited to emotional engagement or to terms that resemble emotional engagement, such as connectedness, bonding, and attachment (e.g., Catalano, Haggerty, Oesterle, Fleming, & Hawkins, 2004; Loukas, Ripperger-Suhler, & Horton, 2009; Resnick et al., 1997; Shochet, Dadds, Ham, & Montague, 2006). Empirically, emotional engagement has been found to reduce adolescents' risk of

involvement in health-compromising behaviors (Shochet et al., 2006). Most extant research has focused primarily on how the lack of behavioral engagement leads to academic failure (e.g., You & Sharkey, 2009) but has not yet explored extensively how participation in school activities may play a role in the etiology of delinquency and health-compromising behaviors, e.g., by attenuating such problem behaviors. The potential for behavioral engagement to serve as a protective factor in reducing risky behaviors has received scant empirical attention. Therefore, in the present study we sought to determine whether and how behavioral and emotional engagement is each associated with the risk for and occurrence of delinquency and substance use.

Another limitation of prior literature is that most of the existing research employs correlational or regression-based techniques, based on cross-sectional data, which are not fully equipped to address developmental questions such as how changes in school engagement across portions of childhood or adolescence predict the timing of substance use and delinquency initiation. Even though there has been some research on the over-time associations between school engagement (and other terms researchers have granted similar meanings to) and risk behavior, few studies are available that have focused on the prediction of initiation of such behavior. For instance, Li and Lerner (2011) found that youth who experienced more favorable trajectories of emotional and behavioral engagement tended to be less delinquent and tended not to use substances as much as youth who had more problematic engagement trajectories from Grade 5 to Grade 8 but were not able to confirm whether different trajectories of school engagement are associated with timing of the initiation of such behavior.

Longitudinal research documenting a relationship between school engagement and the *onset* of substance use and delinquency during adolescence has been especially scarce. Indeed, given the importance of predicting and preventing initiation of problematic behavior, analyses examining the role of school attachment and involvement in preventing or delaying initiation of risky and health-compromising behavior are critical to conduct. Innovative techniques such as discrete-time hazard models enable us to model the probability of initiation at any given point in time and the shape of the "hazard" function, insofar as it is conditional on theoretically legitimate covariates (Singer & Willet, 1993). Taking advantage of the flexibility of discrete-time survival analysis, the present study was designed to explore the developmental implications of school engagement for the timing and occurrence of adolescent delinquency and substance use while accounting for possible effects of gender and other demographic variables. Specifically, we examined the extent to which, during early and mid-adolescence (between 5th and 11th grades), different levels of behavioral and emotional engagement would be associated with a varying hazard of initiating substance use and engaging in delinquent acts.

Method

Participants

The present study was part of a larger, multi-wave investigation of youth in the United States, the 4-H Study of Positive Youth Development (PYD) (e.g., Bowers, Li, Kiely, Brittian, & Lerner, 2010; Lerner et al., 2005). The larger study was first launched in 2002 and covers various domains of social, cognitive, behavioral, and emotional development during adolescence. However, the current study only included data on variables pertaining to school engagement and adolescent risk behaviors, in addition to key demographic information. The sample for the 4-H Study was recruited from schools and after school programs to reflect the racial/ethnic and socioeconomic diversity of the United States. School districts were contacted across a number of cities and towns from 41 states. Youth were also recruited from out-of-school programs (e.g., Boys and Girls Clubs and 4-H affiliated clubs and programs). Once agreement from a school or youth organization was obtained, recruitment information was sent to youth and their parents through school and site staff. A flyer describing the study and inviting participation, along with parental consent and youth assent forms, was also sent home with adolescents.

The design of the 4-H Study uses a cohort sequential longitudinal design (Baltes, Reese, & Nesselroade, 1977; Collins, 2006), that is, the sample size increases across successive waves of assessments. More specifically, data from fifth graders were gathered in Wave 1 of the study (the 2002–2003 school year). These fifth graders consisted of the initial cohort in the study. To control for attrition and for effects of repeated testing, we added "retest control" cohorts of youth (and a sample of their parents) in subsequent data collections. Participants in the added "retest control" cohorts were then followed longitudinally. Both the original cohort of fifth graders and the added cohort of sixth graders were followed into Grade 7, where in addition to retesting initial Grade 5 and initial Grade 6 participants, a new cohort of seventh graders was added to the sample (along with a sample of their parents). This same process was followed throughout the course of the study.

Data for the current analyses were derived from seven waves (Grades 5 through 11) of the larger study. Analyses were conducted on a sample 6864 adolescents (mean age at Grade 5 = 10.97 years, $SD = 0.53$ years), 60.2% of whom were girls. The current sample varied in race/ethnicity, socioeconomic status, rural-urban location, and geographic regions. Students were 66.3% European American, 9.6% Latino/a, 7.0% African American, 1.7% Asian American, 2.3% Multiracial, and 1.5% Native American. 11.5% of participants did not report their race/ethnicity or reported inconsistently over time. The average household income was \$62,225 (SD = \$37,808). The mean maternal education in the current sample was 14.06 years ($SD = 2.42$ years).

Procedure

At each data collection, teachers or program staff distributed packets for students to take home to their parents. The packets included a letter outlining the purpose of the study, consent forms for the child and parent, a parent questionnaire (PQ), and a self-addressed envelope with which to return the completed forms. Students receiving parental consent took part

in data collection, in which trained staff administered a student questionnaire (SQ) to the youth within the school or program. At the beginning of the assessment session, staff read instructions to the participants regarding the SQ. The session, which included one or two short breaks, took approximately two hours. Students who were unable to attend the data collection received a survey by mail or were given instructions for completing the survey online. In Grades 5 to 7, all youth completed surveys on-site using paper and pencil. In the Grade 8 and later waves of data collection, small proportions of students completed the survey off site and sent it back in mail or participated in the study online. Comparisons were made among students who completed the survey by paper-and-pencil on site, those who returned it by mail, and those who filled out the questionnaire online, with regard to key demographic variables such as sex, race/ethnicity, and family SES (mother's education) as well as school engagement variables. No significant differences were found among these three respondent groups on any of the study variables.

Measures

We used several standard demographic questions relating to date of birth, sex, race/ethnicity, and family background to assess participants and their families. In addition, we used measures assessing several aspects of delinquency and substance use, as well as behavioral and emotional components of school engagement.

Behavioral school engagement

Behavioral school engagement was assessed using items derived from the Profiles of Student Life: Attitudes and Behaviors (PSL-AB), created by the Search Institute (Leffert et al., 1998). From this scale, four items were used to assess students' behaviors regarding involvement in school. For example, students were asked how frequently they went to school without their homework completed, without books, and without bringing paper or something to write with. Students rated their answers on a scale ranging from 1 = usually to 5 = never. Responses were coded such that higher scores indicated higher levels of behavioral school engagement. The Cronbach's alphas for Grades 5 to 11 were ranged from .63 to .79.

Emotional school engagement

Measures of emotional school engagement were also derived from the PSL-AB (Leffert et al., 1998) and assessed students' affects toward school. Three items were used for this measure, such as "I care about the school I go to," "Students care about me," and "Teachers in this school care about me." The response options ranged from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating higher levels of emotional school engagement. The Cronbach's alphas for Grades 5 to 11 ranged from .63 to .73.

The correlations of behavioral and emotional engagement were moderate across grades (all lower than .50), suggesting that these two constructs were correlated yet distinct from each other.

Delinquency

Indicators of delinquency were measured using a set of questions derived from items included in the Monitoring the Future survey (Bachman, Johnston, & O'Malley, 2000). In grades 5 and 6, four items assessed the frequency of delinquent behaviors during the last 12 months, such as stealing, hitting, or beating up someone, and getting in trouble with police. Starting from grade 7, an item was added to assess vandalism. The response format ranged from 1 (never) to 5 (5 or more times). A sample item is: "During the last 12 months, how many times have you hit or beat up someone?" We used participants' responses to these delinquent behaviors to create a set of dichotomous indicators reflecting whether a person had not been involved in (0) or had been involved in at least one delinquent behavior by the date of each assessment.

Substance abuse

Five items, derived from items in the Monitoring the Future (Bachman et al., 2000) questionnaire, were used in each wave assessed the frequency of substance use (e.g., smoked cigarettes, drank alcohol, used marijuana or hashish, or chewed tobacco) in the past year. The response format ranged from 1 = *never* to 4 = *regularly*. A sample item is: "During the last 12 months, how many times have you used marijuana?" Responses to these five items were recoded to create a set of dichotomous indicators that reflected substance use (1) and non-use (0) by each wave of assessments.

Analysis

To address the two research questions, we estimated a discrete-time proportional odds survival model (Allison, 2002) for three reasons. First, the model allows for a discrete specification of time (Henry et al., 2009). In the current study, participants were surveyed annually; thus, there is no way to know the exact time when initiation occurred. Instead, we only know that it occurred sometime within the roughly 12 month interval between assessment occasions. Second, discrete-time survival analysis considers the timing as well as the initial occurrence (i.e., whether or not an event occurs) of delinquency and substance use. Another advantage of discrete-time survival analysis is that it allows modeling of time-varying covariates. As a result, we were able to model not only how Grade 5 behavioral and emotional engagement influenced the timing of occurrence of the outcome variables, but also how changes in students' engagement levels over time affect the onset of delinquency and substance use.

An essential concept in survival analysis is *censoring* (Hosmer, Lemeshow, & May, 2008). Simply put, a case that is censored is one where the event of interest is not reported during the course of the study. *Left-censored* cases are those whose behavior was already initiated prior to the person's entry into the study, whereas *right-censored* cases are those whose behavior has not been initiated by the time the person exits the study. Right-censoring can occur for two general reasons: (a) the person drops out of the study before initiating the behavior in question, or (2) the person completes the study but still has not initiated the behavior. Left-censored cases do not contribute to the analysis, because initiation occurred prior to measurement of the predictors (and because the time when initiation occurred is unknown). Right-censored cases contribute to the risk pool, and to predicting the *likelihood* of initiation, at each time point where they provide data – but information about the association between the predictors and the *timing* of initiation is provided only by uncensored cases.

The problem of missing data is inevitable in longitudinal research (Hofer & Hoffman, 2007), particularly in studies that incorporate participant responses from multiple assessment occasions and across multiple school transitions. It is important to minimize missing data using careful research design and through strong retention efforts. However, after missing data occur, the priority is to understand the mechanisms that lead to missing values and to choose an appropriate method to handle missing data. For the present study, it was assumed that data were missing at random (MAR, Little & Rubin, 1987). In other words, we assumed that the possibility that the variables of interest are missing does not depend on the value of the variables themselves, but may have been caused by other variables (such as sex, race/ethnicity, family income, mothers' education) that were measured in the current study (Jeličić, Phelps, & Lerner, 2009). Based on the MAR assumption, we performed multiple imputation using the imputation procedure in SAS 9.2 (SAS Institute, Inc.). Guided by Allison's (2002) observation that conventional imputation software is not suited for missing data on event timing and censoring in survival analysis, multiple imputation was performed only for missing values on predictor variables and not on the dependent variables. Variables indicating right or left censoring were included to model the relations between these variables and the predictors. Ten data sets were created. Subsequent analyses were conducted based on the multiple-imputed data sets, and the parameter estimates were combined following the procedure introduced by Rubin (1987) using SAS PROC MIANALYZE.

Results

Despite the theoretical burden placed on school engagement in influencing youth development, little is known about whether school engagement protects youth against involvement in risk behaviors. Accordingly, the goal of this research was to ascertain if levels of behavioral and emotional involvement in school were associated with hazards of initiating substance use and engaging in delinquent acts among youth in Grades 5 through 11.

Results are presented in three general steps. First, we described the prevalence rates for substance use and delinquency among these youth. Second, we present unconditional survival models (i.e., no predictor variables entered) for each risk behavior; and third, we add demographic variables and school engagement to the survival model for the behavior in question.

Prevalence and risk of substance use and delinquency initiation

Table 1 displays the percentages of boys and girls reporting substance use (i.e., cigarettes, tobacco/snuff, alcohol, marijuana, and other illicit drugs) and involvement in delinquent acts (i.e., stealing, hitting, beating up someone, getting trouble with police and vandalism) prior to each assessment. Consistent with developmental expectations and findings of other studies (e.g., Costello, Dierker, Jones, & Rose, 2008; Schwartz et al., 2010), rates of substance use and delinquency generally increased across grades for each substance and for every type of delinquent behavior through the early high school years and

Table 1
Prevalence of substance use (cigarette, alcohol, marijuana, and other illicit drugs) and delinquency (Stealing, hitting, beating up, getting in trouble with police and vandalism) by gender and grade level.

	Grade 5		Grade 6		Grade 7		Grade 8		Grade 9		Grade 10		Grade 11	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Substance use	20.36%	9.77%	31.82%	28.10%	29.26%	25.92%	38.15%	36.00%	49.86%	39.07%	43.37%	37.27%	42.46%	35.60%
Cigarette use	4.32%	1.72%	6.19%	5.89%	9.36%	9.22%	13.27%	12.40%	19.72%	15.02%	19.13%	13.02%	17.38%	9.66%
Chewing tobacco	1.76%	0.49%	3.10%	1.22%	5.64%	3.22%	12.78%	3.59%	15.58%	3.39%	17.09%	2.48%	15.33%	2.89%
Alcohol use	19.16%	8.98%	21.27%	18.63%	22.28%	20.06%	32.20%	31.87%	43.91%	35.88%	36.23%	32.98%	37.24%	32.52%
Marijuana use	1.37%	0.49%	2.60%	2.15%	5.12%	3.87%	7.42%	6.75%	17.23%	12.01%	13.72%	9.80%	14.50%	8.08%
Other drugs	1.23%	0.62%	0.91%	1.13%	2.98%	2.25%	4.15%	2.71%	5.65%	4.57%	5.70%	2.55%	3.53%	2.43%
Delinquency	48.27%	24.22%	48.23%	23.85%	46.48%	25.81%	55.62%	30.34%	51.65%	27.09%	54.15%	27.24%	42.71%	20.64%
Stealing	14.97%	7.55%	11.27%	8.73%	13.95%	9.88%	17.38%	9.07%	18.33%	11.54%	17.41%	10.08%	12.81%	6.63%
Hitting	14.42%	3.47%	12.07%	5.54%	13.18%	6.84%	17.56%	8.12%	19.06%	10.07%	18.12%	7.95%	12.63%	6.04%
Beating up someone	39.39%	18.20%	40.97%	18.57%	33.45%	16.52%	31.06%	19.21%	30.77%	18.49%	31.66%	14.50%	19.34%	8.03%
Getting in trouble with police	11.46%	3.49%	12.22%	5.07%	12.48%	6.52%	31.06%	6.82%	16.62%	7.38%	18.63%	6.84%	11.11%	3.55%
Vandalism					23.36%	5.98%	35.73%	9.75%	26.26%	7.55%	35.46%	9.51%	25.63%	6.65%

Note: Vandalism was not measured in Grades 5 and 6.

then decreased from 9th or 10th grades to 11th grade. This pattern was demonstrated both for boys and girls. The slight drop during the high school grades may be due to participant attrition; it may be that youth with the most problematic behavior dropped out of the study (e.g., see Schaie & Strother, 1968, for a similar conjecture about the influence of selective attrition on the nature of longitudinal trajectories in mental abilities). It is also possible that youth who belonged to the later cohorts were lower in delinquency and drug use compared to students who entered the study earlier (see Schwartz et al., 2010).

According to participants' self-reports, alcohol was the most frequently used substance, whereas beating up someone else was the most frequently exhibited delinquent act among the adolescents in the current sample. In addition, as shown in Table 1, girls consistently reported lower rates of substance use and of involvement in delinquency compared to boys. When combining rates of use of different types of substances and delinquent behavior, we found that approximately half of the boys and almost 40% of the girls used at least one substance at some point in time prior to the 11th grade assessment. About 55% of the boys and almost one third of the girls were involved in at least one type of delinquent behavior during the course of the study. In other words, with some gender differences, adolescent boys and girls both were exposed to substantial risks to their health or to the health of others, either in the form of substance use or delinquency.

Behavioral and emotional school engagement as predictors of substance use initiation

Discrete-time survival analysis was used to assess the role of behavioral and emotional school engagement in predicting substance use initiation. Because of sex differences in the prevalence of substance use, we included sex and family SES variables (indexed by mother's education and per capita family income) as covariates in addition to school engagement variables. To estimate the discrete hazard model, we used PROC LOGISTIC in SAS 9.2 to regress the event indicator on the school engagement and demographic predictors in the reconstructed person-period data set (Singer & Willet, 1993). Youth who had initiated substance use or had been involved in delinquency prior to their participation in the study were excluded from all models for which they were left-censored on the variable of interest (if a student initiated substance use but not delinquency, he or she was still included in the delinquency analyses). Given that some participants joined the study in middle or later adolescence (in high school, for example), the numbers of left-censored cases for delinquency and substance use both were somewhat large (1681 initiated substance use and 2054 initiated delinquency prior to study participation).

In testing these discrete-time hazard models, a taxonomy of models were fitted to assess the effects of grade levels (i.e., time), sex, family SES, and school engagement predictors. Fitted models of increasing complexity were built and then compared as a way of assessing the different influences of these predictors. The parameter estimates and corresponding hazard ratios are presented in Table 2.

Unconditional survival model

We started by fitting an unconditional survival model for substance use, that is, a survival model that included only the time indicators (one time indicator for each grade). The unconditional hazard function for first use of substances (i.e., tobacco, alcohol, marijuana, and other illicit drugs) is presented in Fig. 1. The survival function takes into account the risk of initiation at each grade to estimate the probability (i.e., the survival function) that a given adolescent will survive (i.e., not initiate use of any substances) through grade 11. Fig. 2, on the other hand, demonstrates the unique risk of initiation at each grade level by presenting the probability that an adolescent initiated use of at least one type of substance, given that he or she had never engaged in substance use at or prior to the time of the Grade 5 assessment. As shown in Fig. 2, a slower increase in the hazard of initiation was observed from Grade 5 to Grade 10 and then a more rapid increase between Grades 10 and 11.

Table 2
Hazard models of the effect of behavioral and emotional engagement on substance use initiation.

Variable	Model 1		Model 2		Model 3		Model 4	
	Combined B	Average hazard ratios	Combined B	Average hazard ratios	Combined B	Average hazard ratios	Combined B	Average hazard ratios
Grade 5	−19.20	0.00	−18.98	0.00	−18.08***	0.00	−15.72***	0.00
Grade 6	−4.52***	0.01	−4.30***	0.01	−3.40***	0.03	−1.10**	0.33
Grade 7	−3.66***	0.03	−3.43***	0.03	−2.53***	0.08	−0.24	0.80
Grade 8	−3.01***	0.05	−2.78***	0.06	−1.88***	0.16	0.57	1.78
Grade 9	−2.76***	0.06	−2.53***	0.08	−1.61***	0.20	0.63	1.89
Grade 10	−2.27***	0.10	−2.03***	0.13	−1.11***	0.33	1.41***	4.11
Grade 11	−0.97***	0.38	−0.71***	0.49	0.23	1.28	2.86***	17.67
Sex			−0.38***	0.68	−0.38***	0.69	−0.18*	0.83
Mother education					−0.05*	0.95	−0.02	0.98
Per capita family income					0.00	1.00	0.00	1.00
Behavioral engagement							−0.39***	0.68
Emotional engagement							−0.52***	0.60
AIC	5796.70		5773.85		5748.16		5543.85	
SC	5852.01		5837.04		5827.17		5638.67	
−2LL	5782.70		5757.85		5728.16		5519.85	

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

Multivariate survival model

After testing an unconditional discrete-time survival model for substance use, we added sex, mother education, and average per capita family income as time-invariant covariates, and behavioral and emotional school engagement as time-varying covariates. First, we tested the univariate effect of sex without any other covariates being involved in the analysis. The results indicated that boys were more likely than girls to initiate substance use. The estimated odds of substance use initiation for girls were about one-third lower than the odds of initiation for boys (hazard ratio = 0.68, see Model 2 in Table 2). Fig. 3 presents the fitted hazard functions for boys and girls, computed from the parameter estimates for Model 2 in Table 2.

In the second step, we tested another model that included sex, mother's education, and family income as covariates (Model 3). Girls and youth whose mothers received higher levels of education tended to have lower hazards of substance initiation than boys (hazard ratio = 0.69) and than youth whose mothers had completed fewer years of education (hazard ratio = 0.95). However, per capita family income did not have a significant effect on initiation. Next, we added behavioral and emotional school engagement as time-varying covariates to the model (Model 4). A comparison of goodness-of-fit statistics for this model and Model 3 confirmed that adding the school engagement variables in the model significantly improved prediction of the risk profile. The contribution of mothers' education and per capita income became nonsignificant with the addition of behavioral and emotional school engagement. Behavioral and emotional school engagement were both significantly associated with decreased odds of initiation of substance use (hazard ratios are 0.68 and 0.60 respectively). After controlling for sex and family SES, the odds of initiating substance use for a given student were about one-third lower than the odds for a student whose behavioral engagement was one point lower. Similarly, the odds of initiating substance use for a given student were 40% lower than the odds for someone whose emotional engagement was one point lower.

Behavioral and emotional school engagement as predictors of onset of delinquency

Unconditional survival model for delinquency

A similar set of models were tested for delinquency, following the same steps used in the analysis for substance use. First, we fitted an unconditional survival model including only the time term. As described earlier, Fig. 1 presents the survival probabilities cumulated for the risk of initiation at each grade, to assess the probability that an adolescent would "survive," or not become involved in delinquent acts, through Grade 11. As the students grew older, the probability of survival (or not becoming engaged in delinquent acts) declined. In other words, increasingly more students became involved in delinquent behaviors. A similar finding is also illustrated in Fig. 2: as students progressed through adolescence, they faced greater and greater hazards of delinquency onset.

Multivariate survival model

The unconditional survival model for delinquency was then extended by adding sex as a time-invariant covariate (Model 2). A comparison of goodness-of-fit statistics for this model and the unconditional model confirmed that adding sex in the model significantly improved prediction of the risk profile. Boys were more likely than girls to have been involved in delinquent behaviors from Grade 5 to Grade 11. The hazards for boys to be involved in delinquency were more than twice as

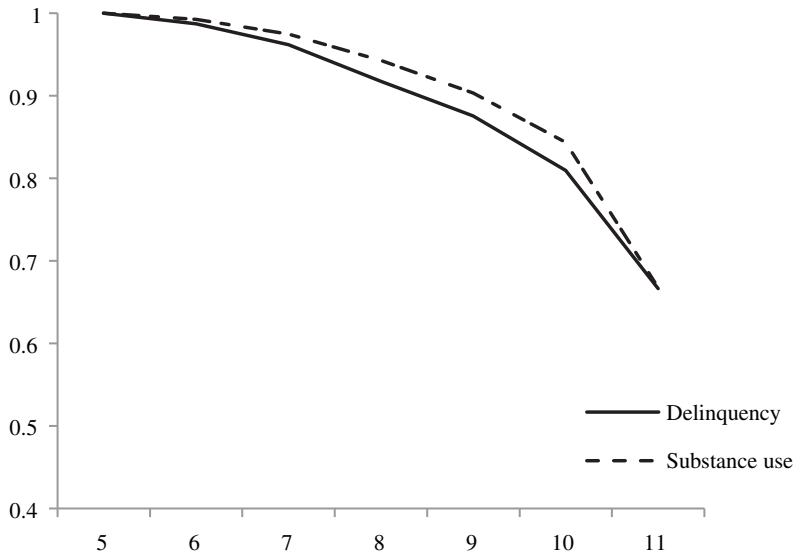

Fig. 1. Fitted survival functions for onset of substance use and delinquency among adolescents between grade 5 to grade 11.

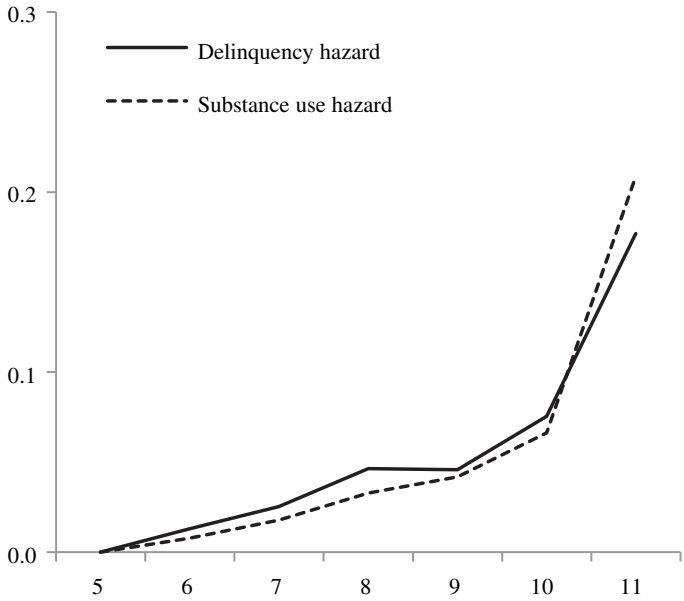

Fig. 2. Hazard functions for onset of substance use and delinquency among youth from Grade 5 to Grade 11.

high as those for girls (see Table 3). Fig. 4 presents the fitted hazard functions for boys and girls computed from the parameter estimates for Model 2 in Table 3.

The next model, which assessed the effect of demographic variables, indicated that sex, mother's education, and family income were all significant predictors of delinquency initiation. Girls, youth whose mothers had higher levels of education, and youth from wealthier families tended to face lower risk of delinquency initiation than boys and youth from lower-SES families. We then added school engagement variables into the model. Sex and per capita income remained significant as predictors, but mother's education became nonsignificant. After adjusting for the covariates, the protective effect of behavioral and emotional engagement remained significant.

In sum, the addition of school engagement variables significantly improved the precision of risk prediction (see Table 3). With other predictors held constant, the odds for a given student were slightly above two-thirds of the odds for a student whose behavioral engagement was one unit lower. Similarly, the odds for a given student to begin use of one or more substances were a bit over half of the odds for someone whose emotional engagement was one unit lower.

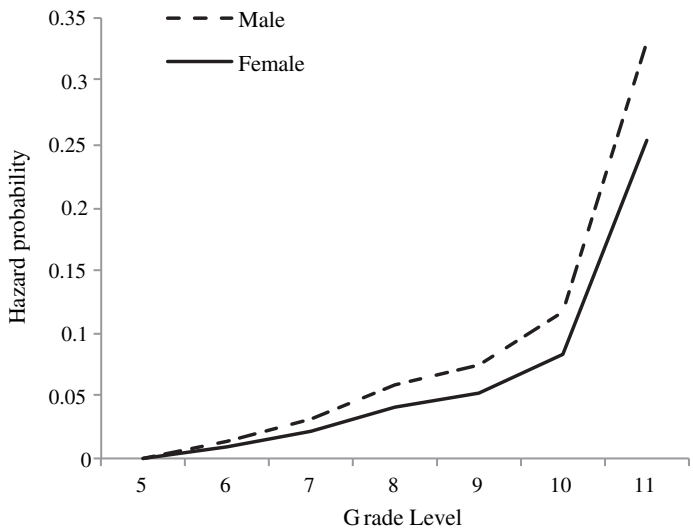

Fig. 3. Fitted hazard functions describing the risks of substance use initiation by sex, from a hazard model containing the main effect of the grade level indicators and the main effect of sex as predictors.

Discussion

The current study examined the extent to which behavioral and emotional engagement influences the initiation of substance use and delinquency during adolescence. Consistent with our hypotheses, the results suggested that both behavioral and emotional engagement in school were inversely associated with the timing of the initiation of substance use and delinquency among adolescents. Poor attachment to school and chronic disengagement from school activities were associated with higher risks of both delinquent and health-compromising behaviors. Generally, our results attested to the usefulness of the behavioral and emotional components of school engagement in predicting the initiation of substance use and delinquency in adolescence.

Overall, the present research extends what is known about the predictive contributions of school engagement to adolescent development outcomes in several ways. In particular, behavioral and emotional engagement both forecast risk of substance use and involvement in delinquency. Relative to peers, students who entered adolescence with higher levels of behavioral and emotional engagement tended to be less likely to initiate substance use and delinquency, or more likely to initiate such behavior later, compared with youth characterized by lower school engagement. The negative association between school engagement and risk of substance use and delinquency initiation supports the hypothesis that adolescents stayed away from problematic behaviors when they attended classes regularly, came prepared with necessary materials, cared about school, and felt attached to school personnel. The findings also were consistent with the social development model (Hawkins et al., 2007), which posits that negative feelings about school may expose young people to a greater risk for multiple problem behaviors (Sankey & Huon, 1999). Future research should, however, understand the mechanisms through which low attachment to school is linked to risk behaviors. For instance, the nature of peer groups may play an important role in providing an environment where various problematic behaviors can propagate. Another point of entry is teachers. At this point, however, we can conclude that the current findings support the idea that a young person's behavioral adjustment is closely tied to the extent to which he or she is able to capitalize on knowledge and skill development opportunities provided by educational institutions (Eccles, 2004; Elmore, 2009; Fredricks et al., 2004).

The consistent association between improved school engagement and decreased incidence (or risk) of problem behavior is encouraging. Interventions designed to prevent substance use or delinquency should include components to promote active participation in and foster emotional attachment to school (Henry et al., 2005). Efforts to improve teacher-student relationships in middle and high school, efforts to build caring school communities, efforts to increase parental involvement and monitor problematic peer influences, and efforts in promoting positive behaviors have emerged. For instance, the aforementioned classroom management program, Good Behavior Game, has been adopted in early grade classrooms to help children learn how to work together to create a positive learning environment (Poduska et al., 2008). These programs, although they do not necessarily aim specifically to prevent substance use or delinquency, may play a role in preventing (or at least delaying) these problematic behaviors. Gender differences identified in the current study also suggest that interventions should not be "one-size-fits-all" and may need to be modified separately for boys and for girls (and perhaps for high-SES and low-SES families, as well).

Limitations

The present results should be interpreted in light of the study's limitations. First, the current sample was predominantly European American and consists of relatively small percentages of African American and Latino youth. In addition, the average

Table 3
Hazard models of the effect of behavioral and emotional engagement on onset of delinquency.

Variable	Model 1		Model 2		Model 3		Model 4	
	Combined B	Average hazard ratios	Combined B	Average hazard ratios	Combined B	Average hazard ratios	Combined B	Average hazard ratios
Grade 5	−19.2	0.00	−18.65	0.00	−17.35***	0.00	−14.86***	0.00
Grade 6	−4.33***	0.01	−3.78***	0.02	−2.49***	0.08	−0.12	0.89
Grade 7	−3.65***	0.03	−3.10***	0.04	−1.80***	0.17	0.58	1.80
Grade 8	−3.03***	0.05	−2.46***	0.09	−1.15***	0.32	1.39***	4.06
Grade 9	−3.04***	0.05	−2.47***	0.08	−1.15***	0.32	1.18***	3.29
Grade 10	−2.51***	0.08	−1.92***	0.15	−0.58	0.57	1.99***	7.40
Grade 11	−1.54***	0.21	−0.91***	0.40	0.45	1.58	3.11***	22.67
Sex			−0.89***	0.41	−0.92***	0.40	−0.76***	0.47
Mother education					−0.07**	0.93	−0.04	0.96
Per capita family income					−0.00***	1.00	−0.00**	1.00
Behavioral engagement							−0.37***	0.69
Emotional engagement							−0.51***	0.60
AIC	5175.08		5060.51		5004.92		4841.08	
SC	5230.07		5123.36		5083.48		4935.35	
−2LL	5161.08		5044.51		4984.92		4817.08	

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

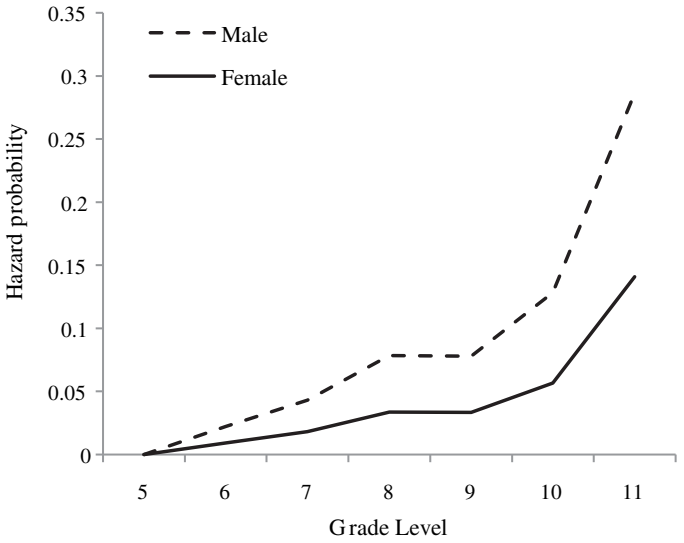

Fig. 4. Fitted hazard functions describing the risks of delinquency onset by sex, from a hazard model containing the main effect of the grade level indicators and the main effect of sex as predictors.

family income in the sample is much higher than the national average. Generalizations should not be made to the entire population of American high school students or to a more diverse or a less advantaged sample of youth. In addition, the study design may be another limitation of this research. In addition to the original 5th grade cohort, later cohorts of students were added in each subsequent wave, which means that due to late entry, some youth may have tried some substances or engaged in delinquent acts before being assessed for the first time but they had such experience after the study began. However, they had to be excluded from the study due to left-censoring. Thus, the timing of these students' substance use or delinquency onset could not be modeled in the present study. The extent to which this problem would bias the results is unknown. In addition, the sample was derived via online as well as onsite data collection procedures. Although every effort was made to provide detailed administrative protocols, there is no way to fully ensure fidelity with the desired survey procedures.

An additional limitation of the study is that we only sought to model a hazard model for substance use and delinquency. Combining cigarettes, alcohol, marijuana and other substances or different types of delinquent acts could be potentially problematic, given that different substances may be different in terms of ease of obtaining and severity of harm and different delinquent acts also have different severity levels. Furthermore, solely relying on students' self-reports may create problems involving socially desirable responding, inaccurate recall of past behaviors, and common method variance that inflates the correlation between constructs assessed from a single source (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Other methods of data collection are needed to control for these potential problems. We modeled mother's education and family income as time-invariant variables given that these two variables at Grade 5 were both highly correlated with the same variables at later grades. However, family income (and even mothers' education) may not be as static over time for many reasons. Another limitation is related to lack of information about the school contexts; delinquency and substance use may be influenced by the characteristics of the schools that the youth attend. It is possible that both low school engagement and high rates of problem behaviors resulted from the different features of schools serving different populations of youth. The potential influences of school and family contextual variables should be addressed to a fuller extent in future research on predictors of problem behavior initiation. In addition, this study included only a small subset of possible predictors and demographic covariates of problem behaviors. Future studies should, then, explore how different individual characteristics of youth (such as self-regulation, or the timing of puberty) and contextual variables (such as social supports within schools, families, and peer groups) interact in predicting the occurrence and initiation of problem behavior.

Despite these limitations, the present study strongly suggests that school engagement serves as a protective mechanism against the initiation of substance use and delinquent behavior. These results extend prior theoretical ideas that the prevention of youth problem behaviors may be enhanced by promoting engagement in learning and school (e.g., Catalano et al., 2004; Schwartz, Pantin, Coatsworth, & Szapocznik, 2007). The present study therefore adds to the growing body of literature on positive developmental processes as protective against delinquent and health-compromising behaviors.

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