Published in final edited form as:
J Youth Adolesc. 2009 March ; 38(3): 440–453. doi:10.1007/s10964-008-9324-5.

Juvenile Offenders' Alcohol and Marijuana Trajectories: Risk and Protective Factor Effects in the Context of Time in a Supervised Facility

Anne M. Mauricio,
Department of Psychology, Arizona State University, P.O. Box 876005, Tempe, AZ 85287-6005, USA anne.mauricio@asu.edu

Michelle Little,
Department of Psychology, Arizona State University, P.O. Box 876005, Tempe, AZ 85287-6005, USA michelle.little@asu.edu

Laurie Chassin,
Department of Psychology, Arizona State University, P.O. Box 876005, Tempe, AZ 85287-6005, USA laurie.chassin@asu.edu

George P. Knight,
Department of Psychology, Arizona State University, P.O. Box 876005, Tempe, AZ 85287-6005, USA george.knight@asu.edu

Alex R. Piquero,
Department of Criminology and Criminal Justice, University of Maryland, College Park, Maryland 20742-8235, USA apiquero@crim.umd.edu

Sandra H. Losoya, and
Department of Psychology, Arizona State University, P.O. Box 876005, Tempe, AZ 85287-6005, USA sandl@asu.edu

Delfino Vargas-Chanes
Department of Psychology, Arizona State University, P.O. Box 876005, Tempe, AZ 85287-6005, USA dvchanes@gmail.com

Abstract

The current study modeled trajectories of substance use from ages 15 to 20 among 1,095 male serious juvenile offenders (*M* age = 16.54; 42% African-American, 34% Latino, 20% European-American, and 4% other ethnic/racial backgrounds) and prospectively predicted trajectories from risk and protective factors before and after controlling for time spent in a supervised setting. Results indicated that supervised time suppressed age-related growth in substance use. Trajectories of offenders with no supervised time and low levels of supervised time increased in substance use across age, whereas offenders with high levels of supervised time showed no growth. Almost all risk and protective factors had effects on initial substance use but only adolescent history of substance use, impulse control, and psychosocial maturity had an effect on change in substance use over time. Findings highlight the importance of formal sanctions and interventions superimposed on normal developmental processes in understanding trajectories of substance use among serious juvenile offenders.

Correspondence to: Anne M. Mauricio.

Keywords

Risk and protective factors; Substance use; Juvenile offenders; Supervised time

Substance use/abuse is a significant problem among juvenile offenders (Abrantes et al. 2005) who have approximately five times higher rates of drug use and three times higher rates of substance abuse disorders than do non-offending juveniles (Grisso 2004). Additionally, drug use and delinquent behavior are closely linked (White et al. 1999), with some data suggesting that drug use facilitates youth aggression and violence (Welte et al. 2005) and hinders desistance from offending (Hussong et al. 2004). Thus, examining patterns and predictors of substance use among juvenile offenders is important in understanding and ameliorating adjustment problems and recidivism in young offenders. Accordingly, the purpose of the current study was to model age-related changes in alcohol and marijuana use among a sample of serious juvenile offenders and to examine whether risk and protective factors that predict substance use trajectories among the general adolescent population prospectively predict substance use among serious juvenile offenders. To our knowledge, no study has examined age-related change and predictors of alcohol and marijuana use among serious juvenile offenders.

Examining patterns and predictors of substance use among offenders poses the unique challenge of accounting for the impact of time in a supervised facility on offender trajectories. Residence in a supervised setting may alter juvenile offender trajectories considerably, by exhibiting deterrent or criminogenic effects (Bhati and Piquero 2008; Piquero and Blumstein 2007). Additionally, because time in a supervised facility alters exposure to risk and protective factors as well as opportunities for these factors to affect substance use behavior, expectations about how risk and protective factors function to predict substance use in non-offender populations may not translate to an offender population. Accordingly, the purpose of the current study was also to examine how time in a supervised facility affected substance use trajectories of serious juvenile offenders and how supervised time interacted with psychosocial risk and protective factors to predict substance use trajectories.

Ecological Influence of Supervised Settings on Age-related Growth in Substance Use

Longitudinal studies of adolescents in community samples have found that substance use is typically initiated in early to middle adolescence, and then increases to a peak at ages 18–25, with declines beginning in the mid-20s (Chen and Kandel 1995), often with entry into adult roles (Bachman et al. 2002). In contrast, serious juvenile offenders experience a variety of sanctions and interventions and are likely to start their substance use at an early age. Thus, their progressions in alcohol and marijuana use may not resemble those of their non-offending age peers. Most importantly, serious juvenile offenders may spend a substantial proportion of time in a locked facility (OJJDP 2001). Residence in a supervised setting likely restricts youths' access to alcohol and illicit drugs due to the incapacitation effect of formal placement, and therefore, may alter their trajectories considerably. Thus, it is important to account for time in a supervised facility when examining offender substance use trajectories.

The issue of youths' differential drug access and drug use during formal care is significant in developmental criminology. Current theory in developmental criminology emphasizes the importance of youths' social context in constraining or promoting their anti-social opportunities in the course of development (Catalano and Hawkins 1996; Steinberg et al. 2004). When delinquent youth are presented with many anti-social influences in the context of disadvantaged, high crime neighborhoods, they are more likely to use drugs and participate

in antisocial activities (Crane 1991; Sampson 1997). Removing adolescents from contextual risk that promotes substance use in addition to the formal monitoring, structured time, and physical security of supervised settings constrains adolescents' access to and use of substances. In addition, the interventions and substance use treatment that may be available in supervised settings (Chassin et al. in press) may reduce substance use above and beyond the incapacitation effect created by confinement.

In addition to developmental criminology theory, our expectation that supervised settings would alter substance use trajectories was based on research by Piquero et al. (2001) demonstrating that time spent in a supervised facility suppressed trajectories of criminal behavior. These authors found that adjusting for supervised time resulted in an increase in estimates of the arrest rate. Moreover, before adjusting for supervised time, results showed a peak in criminal activity during the late teens and early 20s followed by a rapid decline for almost the entire sample. However, after controlling for supervised time, results continued to support a peak in criminal activity during the late teens and early 20s but showed that almost 30% of sample no longer initiated a decline in criminal activity upon reaching their early 20s. In accord with Piquero et al.'s findings, we expected that youths' residence in supervised settings would directly suppress their trajectories of alcohol and marijuana use.

In addition to removing offenders from contextual risk factors that promote substance use and introducing formal control mechanisms that suppress substance use, time in a supervised facility may also alter exposure to other risk and protective factors predictive of substance use. For example, time in a supervised facility would theoretically weaken the operation of protective factors that are specific to the adolescent's social environment, such as family and positive neighborhood influences (e.g. Stewart et al. 2002). Additionally, the restrictive nature of formal supervision impedes the development of autonomy and maturity (Gold and Osgood 1992), which has been associated with reduced substance use (Ievers-Landis et al. 2006). Further, the social segregation inherent to incarceration increases their exposure to antisocial peers and may undermine their bonding to conventional norms as well as expectation for success in these activities, which are also protective of substance use (Adams et al. 2003; Buehler et al. 1966; Gold and Osgood 1992). Finally, formal supervision may introduce new interventions and adult relationships (i.e. staff) in youths' lives which may have a protective, although time-limited, impact on offender substance use (Gold and Osgood 1992). Because time in a supervised facility alters the adolescent's exposure to risk and protective factors as well as opportunities for these factors to affect substance use, expectations about how risk and protective factors function to predict substance use in non-offender populations may not translate to an offender population.

Risk Factors Influencing Substance Use Escalation

Mental health problems have been linked with the early initiation as well as the relative frequency and persistence of substance use. For example, diagnosis of a substance use disorder is a strong and well-established predictor of an adolescent's future alcohol and drug use, and adolescent substance use problems are generally prognostic of adult substance use problems (Chassin et al. 1996; Kandel et al. 1986). Pre-existing psychological problems are also predictive of both the onset and escalation of adolescent substance use (Shedler and Block 1990). Although associations between substance use and externalizing problems have been more consistent and robust than associations between substance use and internalizing symptoms, psychological distress (and particularly depression) has been linked to adolescent substance use (Deykin et al. 1987). Accordingly, we tested adolescents' history of substance use disorder diagnosis and psychological distress as predictors of substance use.

Associations with antisocial peers is another well-established predictor of juvenile substance use (Dishion et al. 1995). Multiple mechanisms have been identified as underlying this relation including selection (Engels et al. 1999), social influence (Kandel 1985) and reciprocal effects (Krohn et al. 1996). Thus, we tested effects of antisocial peer association on offender substance use. Moreover, gang involvement is a marker of affiliation with antisocial peers and has been linked to drug use (Thornberry et al. 1993, 2003). Therefore, we also tested gang membership as a predictor of substance use. Given that peers and social networks, such as gangs, play a particularly critical role during the adolescent developmental period, juvenile offenders' substance use may be especially influenced by their association with antisocial peers and their gang involvement (for a review see Lipsey and Derzon 1998; Keenan et al. 1995).

Protective Factors Influencing Substance Use Escalation

Developmentalists have highlighted the role of social control factors in adolescent trajectories of problem behaviors and substance use (Sampson and Laub 1993). One important source of social control is bonding to conventional norms and activities and prior research suggests that adolescents with high aspirations for conventional success are less likely to use substances (Hawkins and Weis 1985). For offenders, aspirations for lawful behavior may be a particularly important social control mechanism. Accordingly we tested offenders' aspirations to stay out of trouble with the law as protective against growth in substance use.

We also examined effects of adolescents' capacity to control behavioral impulses, which is an established protective influence for the development of drug and alcohol problems (Wong et al. 2006). Impulse control, as a key source of self-regulation, enables youth to resist peer and social influences to use alcohol and drugs (Gottfredson and Hirschi 1990). The positive impact of impulse control on trajectories of adolescent substance use is also suggested by findings that low self-control predicts higher levels of and greater growth in substance use among both high risk youth and juvenile delinquents (Chassin et al. 2004; Wills et al. 1998). Problems with impulse control are especially common behavioral precursors of antisocial behaviors for serious juvenile offenders (e.g., Loeber and Farrington 1998; Otto et al. 1992). Thus, we tested offenders' impulse control as a protective mechanism against their increased use of substance uses.

Finally, we examined effects of adolescents' psychosocial maturity on substance use. Psychosocial maturity protects individuals from vulnerability to antisocial and problem behaviors (Cauffman and Steinberg 2000). Adolescents that achieve psychosocial maturity are able to make socially responsible decisions and desist from substance use and other delinquent behaviors (Steinberg et al. 2004). It is also noteworthy that higher levels of maturity have been linked with lower substance use even after taking into account the effects of parental and peer drinking (Jones et al. 1989). Associations between offender substance use and psychosocial maturity are of particular interest given that psychologists have questioned whether time in supervised facilities may impede the healthy development of psychosocial maturity (Chung et al. 2005). Thus, we tested effects of offenders' psychosocial maturity as protective against increased substance use.

Study Purposes and Hypotheses

The first purpose of the current study was to model trajectories of substance use among a sample of serious juvenile offenders between ages 15 and 20 to examine whether escalations in substance use typically found in the age period 15–20 in the general adolescent population extend to serious juvenile offenders. The second purpose of the study was to examine how time in a supervised setting would impact offender substance use trajectories. Guided by developmental criminology literature and in accord with Piquero et al. (2001), we hypothesized that supervised time would suppress age-related growth trajectories of offender substance use.

Another study purpose was to test whether risk and protective factors that predict substance use among the general adolescent population prospectively predicted substance use among serious juvenile offenders. Finally, we examined how time in a supervised facility interacted with psychosocial risk and protective factors to predict substance use trajectories. We hypothesized that supervised time would weaken risk and protective factor effects on these trajectories.

Method

Participants

The current sample consisted of 1,095 male serious juvenile offenders participating in a longitudinal study of desistance from juvenile crime, the Pathways to Desistance Study (see Mulvey et al. 2004; total N = 1,170 males). Participants were between the ages of 14 and 19 at baseline interview (M age 16.54; 42% African-American, 34% Latino, 20% European-American, and 4% from other ethnic/racial backgrounds). Seventy-five of the original male Pathways study participants were not assessed between the ages of 15 and 20 during follow-up interviews in the first 36 months of the study and thus were not considered for the current study.

Recruitment of Full Sample

Participants were recruited in Phoenix and Philadelphia after a review of court files indicated that they had been adjudicated of a serious offense (almost entirely felonies). Because drug violations represent such a large proportion of the offenses committed by this age group, the proportion of juvenile males recruited with a drug offense was capped at 15% so that the heterogeneity of the sample would not be compromised.

Participating juvenile courts provided names of eligible individuals and cases were assigned to interviewers who contacted juveniles and their families. Upon obtaining juvenile and parent/guardian informed consent, participants were interviewed within 75 days of adjudication in the juvenile system (or within 90 days of a decertification hearing if in the Pennsylvania adult system or an adult arraignment if in the Arizona adult system) and then interviewed every six months for 3 years. Our participation rate, defined as the number of participants enrolled divided by the number attempted for enrollment, was 67% (see Schubert et al. 2004). The informed consent of the juvenile's parent or guardian, as well as his or her own informed assent, was obtained for all participants. To assess participation bias, enrolled and non-enrolled eligible participants were compared. Enrolled participants were somewhat younger at adjudication (15.9 vs. 16.1 for non-participants), had more prior court petitions (2.1 versus 1.5 for non-participants), were younger at first petition (13.9 years versus 14.2 for non-participants) and were somewhat more likely to be non-Hispanic Caucasian (25% versus 20% for non-participants). Although statistically significant, these differences are modest in magnitude. Sample retention ranged from 90 to 93% over the six follow-up periods, with 3% of participants having died. For more information on sample recruitment see Schubert et al. (2004).

Procedures

Data were collected with computer-assisted interviews at the participants' homes, in libraries (or other public places), or in facilities. All measures and skip patterns were programmed onto laptop computers. Trained interviewers read items aloud and, to maximize privacy, respondents could choose to enter their responses on a key pad. Honest reporting was encouraged and confidentiality was assured by confidentiality protections provided by statute to the Department of Justice. Baseline interviews were generally completed over two consecutive days and took approximately 3–4 h. Follow-up interviews took about 2 h to complete. Participant payments ranged from $50 to $150 over the interviews.

Measures

In order to ensure temporal precedence, all risk and protective factor scores were taken from the baseline interview, but substance use outcomes were taken from the subsequent follow-ups. Results for all psychometric analyses including results for confirmatory factor analyses are available upon request.

Substance Use Outcomes—Two self-reported substance use outcomes were used in this study: frequency of past six-month alcohol use and frequency of past six-month marijuana use. At each wave, participants self-reported their frequency of alcohol and marijuana use (Chassin et al. 1991; i.e., "How often have you had alcohol to drink/used marijuana?"). Because of the non-normal distribution, responses were collapsed from eight categories into five: 0 (*Not all*), 1 (*1–2× & 3–5× over the six months*), 2 (*1× and 2–3× per month*), 3 (*1× and 2–3× per week*) and 4 (*4–5× per week and everyday*).

As expected for an offender sample, rates of lifetime abstinence at baseline were lower than national data, especially for marijuana use. Compared to 10th graders in the Monitoring the Future Study (MTF; Johnston et al. 2005), our rates of abstinence for alcohol were 20% (vs. 30% in MTF) and 15% for marijuana (vs. 56% in MTF).

Proportion of Supervised Time (PST)—At each wave, the proportion of time spent in a supervised setting (e.g., prison, detention, residential treatment) was equal to the number of days in a supervised setting divided by total number of days from one interview to the next. PST was modeled as a cumulative proportion and was equal to the total time spent in a supervised setting during the 36 months of the study, ranging from 0 days through 3 years (M = 12 months; SD = .90). Across 36 months of this study, 19% of males were never in a supervised setting.

Baseline Risk and Protective Factors

Adolescents' History of Substance Use Diagnosis—Adolescents' lifetime history of substance use disorder (abuse/dependence versus none) was measured using a DSM-IV based structured interview, the Composite International Diagnostic Interview (CIDI; World Health Organization 1994). Those with missing CIDI scores (n = 52) were categorized based on self-reported consequences and dependence symptoms (items modeled after DSM criteria, see Chassin et al. 1991). In these cases, youth endorsing 3 or more consequences received a score of "1." Forty-six percent of the youth in the sample endorsed a history of substance use diagnosis at baseline.

Psychological Distress—Psychological distress was measured by the Global Severity Index (GSI) of the Brief Symptom Inventory (BSI; Derogatis and Melisara 1983). The GSI score, based on 53 items, provides a continuous measure of distress associated with several dimensions of psychological symptoms, including depression, anxiety, interpersonal sensitivity, and psychoticism. Responses are scaled on a five-point scale from 0 (*Not at all*) to 4 (*Extremely*) and showed high internal consistency (M = .53; SD = .51; α = .95).

Gang Involvement—Past and present gang membership was coded from two items (e.g., "Have you ever been involved in a gang?" and "Have you been involved in a gang in the past 6 months?") on the baseline interview (Thornberry et al. 2003). Participants who endorsed either question were coded as "1" for gang membership and all others were coded "0". Twenty-four percent of the youth in the sample at baseline reported gang-involvement.

Association with Antisocial Peers—Association with antisocial peers was measured using 10 items from the Antisocial Behavior Scale of the Peer Delinquent Behavior measure

(Menard and Elliot 1996). This scale assesses the number of friends in a youth's peer group (e.g., "How many of your friends have purposely damaged or destroyed property that did not belong to them?") who have participated in different antisocial acts using a 5-point scale from 1 (*None of them*) to 5 (*All of them*) and provided reliable measurement (M = 2.35; SD = .93; α = .92).

Aspirations for Lawful Behavior—Youths' aspirations to stay out of trouble with the law were assessed with an item from the Perceptions of Opportunity inventory (e.g., "How important is it to you to stay out of trouble with the law?" (M = 3.55; SD = 1.25; Menard and Elliot 1996). Participants responded on a 5-point Likert scale ranging from 1 (*Not at all important*) to 5 (*Very important*), with higher scores indicating greater aspirations.

Impulse Control—The 8-item Impulse Control scale measured with the the Weinberger Adjustment Inventory (Weinberger and Schwartz 1990). Participants rated the frequency with which their behavior in the past six months matched a series of statements (e.g.," I stop and think things through before I act") on a scale from 1 (*Almost Never*) to 5 (*Almost Always*). High scores indicate greater impulse control, and reliability was adequate (M = 2.95; SD = .95; α = .76).

Psychosocial Maturity—Psychosocial Maturity Inventory (PSMI Form D; Greenberger et al. 1974) measured psychosocial maturity. The 30 items assess identity (i.e., self-esteem, clarity of the self, and consideration of life goals), self-reliance, and work orientation. Responses are on a 4-point scale from 1 (*Strongly Agree*) to 4 (*Strongly Disagree*). Higher scores indicate more maturity, and reliability was good (M = 3.00; SD = .46; α = .90).

Data Analytic Strategy

Latent growth curve modeling with individually varying times of observation for substance use was used to model change in alcohol and marijuana use trajectories and to prospectively predict these trajectories from risk and protective factors. Change in substance use was measured as a function of youths' age at each of six follow-up intervals that were completed in six month intervals. Individually varying times of observation for substance use were used because age varied across youth at the follow-up intervals. Initial level of substance use (i.e. intercept factor) and rate of change in substance use (i.e. slope factor) were modeled as random effects to capture differences in initial level and rate of change in substance use (Muthén and Muthén 2006). Age was centered at age 15. Thus, the intercept factor of the model corresponded to an estimate of the level of substance use at age 15. Linear slopes were modeled because preliminary analyses showed that quadratic slope factors did not improve model fit. Robust full information maximum likelihood (MLR) facilitates the most accurate estimation of standard errors in the presence of non-normally distributed data and was the method of estimation for all analyses (Yuan and Bentler 1998). Full information maximum likelihood estimation provides unbiased parameter estimates in the presence of missing data under missing at random conditions (Schafer and Graham 2002). Rates of missing observations ranged from <1 to 9% across interviews.

Analyses—Our first set of analyses modeled unconditional substance use trajectories (e.g., trajectories not influenced by any covariates) to examine age-related change in alcohol and marijuana use trajectories.[1] Next, to test the impact of PST on substance use trajectories, we modeled substance use with PST added as a covariate. When PST had a significant effect on substance use intercept or slope, we used multiple group models to probe how the effect of

[1]Moderating effects of race/ethnicity on PST effects on substance trajectories were explored, and results indicated that PST effects on substance use trajectories did not vary across race and ethnic groups. Thus, race/ethnicity was dropped from all models as a covariate.

PST differed across No PST (PST = 0, $N = 209$), Low PST (PST > 0 and ≤16 months, $N = 447$), and High PST (PST above the median = 17 months–3 years, $N = 439$) youth. Specifically, models that did not allow intercept and slope values to vary across No, Low, and High PST youth were compared to models that did allow these parameters to vary across the three PST groups.[2] The log likelihood value, an index of model adequacy, of the model that did not allow intercept and slope to vary was compared to the log likelihood value of the model that did. Differences between log likelihoods are distributed as a Chi Square (χ^2) statistic. The difference in degrees of freedom between the constrained and unconstrained model was used to determine if the difference in log likelihoods was significant (e.g., $p < .05$). This likelihood ratio test (–2 * log likelihood difference/differences in degrees of freedom) was the basis of model comparisons. CFI and fit indices were not available because we used robust full information maximum likelihood (MLR) to estimate growth in substance use and because substance use was modeled as a function of youths' age at each of six follow-up intervals, with age varying across youth at each of the follow-up intervals (e.g., individually-varying time scores).

Next, longitudinal growth models with risk and protective factors as predictors of substance use trajectories tested the effects of risk and protective factors on these trajectories. For each outcome, risk factor effects and protective factor effects were tested in two separate models. To address the third study purpose, risk and protective factor effects were first tested without controlling for PST. To address the final study purpose, final models tested risk and protective factor main effects and interactions with PST as predictors of substance use trajectories, controlling for PST main effects. For each outcome, effect of each risk and protective factor interaction with PST was tested independently of other interaction effects. All continuous risk and protective factors were centered to compute risk and protective factor interactions with PST (Aiken and West 1991). When PST interactions with risk and protective factors were significant, multiple group models probed differences in risk or protective factor effects across No, Low, and High PST groups. Specifically, models with risk and protective factor effects on intercept and/or slope constrained to be equal across No, Low, and High PST youth were compared to models that allowed risk and protective factor effects on intercept and/or slope to vary across the groups. Marginally significant interaction effects were not probed. Alcohol and marijuana use outcomes were modeled separately.

Results

Study Purpose 1: Modeling Offender Substance Use Trajectories

Results of latent growth substance use models that did not control for PST showed that initial alcohol and marijuana use at age 15 was greater than zero and varied across individuals (alcohol: $b = .50$, $p < .001$, s^2 intercept = .62, $p < .001$; marijuana: $b = .65$, $p < .001$, s^2 intercept = .71, $p < .001$). Participants' substance use rose significantly between ages 15 and 20 with variation in rate of change across individuals (alcohol: $b = .12$, $p < .001$, s^2 slope = .05, $p < .001$; marijuana: $b = .08$, $p < .001$, s^2 slope = .07, $p < .001$). Higher levels of initial (age 15) substance use were associated with a slower rate of growth in substance use (alcohol: $b = –.09$, $p < .05$; marijuana: $b = –.11$, $p < .05$).

Study Purpose 2: Examining PST-Effects on Offender Substance Use Trajectories

After controlling for PST, initial substance use at age 15 was still greater than zero (alcohol: $b = .53$, $p < .001$; marijuana: $b = .60$; $p < .001$). As illustrated in Fig. 1, rise in substance use

[2]Model comparisons in this study were limited to predictor effects on intercept and slope. When an omnibus multiple group test showed that predictor effects on intercept and/or slope differed significantly between PST groups, intercept and/or slope mean and variances were released simultaneously. Residual covariances and predictor means were modeled as unconstrained parameters when comparing predictor effects on intercept and/or slope.

was steeper when models controlled for PST compared to models that did not control for PST (alcohol: $b = .23$, $p < .001$; marijuana: $b = .15$, $p < .001$). Both initial substance use and rate of change in use varied significantly across individuals (alcohol: s^2 intercept = .60, $p < .001$, s^2 slope = .03, $p < .001$; marijuana: s^2 intercept = .71, $p < .001$, s^2 slope = .06, $p < .001$). When controlling for PST, initial marijuana use (e.g., intercept) and change in marijuana use (e.g., slope) were unrelated but alcohol use at age 15 was associated with a slower rise in alcohol use ($b = –.08$, $p < .05$).

In terms of main effects of PST on intercept and slope, PST had no effect on initial substance use but was associated with a slower rise in substance use (alcohol: $b = –.05$, $p < .001$; marijuana: $b = –.03$, $p < .001$). That is, adolescents who spent a higher proportion of the study residing in supervised settings showed the least age-related growth in alcohol and marijuana use. As presented in Table 1 and as illustrated in Fig. 1, follow-up multiple group growth models showed that the rate of change in substance use varied across PST groups. For alcohol use, No PST and Low PST youth had a significant rise in alcohol use between ages 15 and 20 whereas High PST youth had no change. Moreover, Low PST youth had a slower rise in alcohol use than did No PST youth. For marijuana use, both Low PST and No PST youth showed a significant rise in marijuana use, and did not differ from each other. However, High PST youth had a slower rise in marijuana use than did Low PST youth but did not differ from No PST youth.

Study Purposes 3 and 4: Risk and Protective Factor Effects on Substance Use Trajectories

To test whether risk and protective factors prospectively predicted substance use among serious juvenile offenders, risk and protective factor effects on substance use were first tested without controlling for PST. These results are presented in Table 2 and are described below in the sections *Risk Factors* and *Protective Factors*. For the final study purpose of examining how time in a supervised facility interacted with psychosocial risk and protective factors to predict substance use trajectories, risk and protective factor main effects and interactions with PST were tested as predictors of substance use trajectories, controlling for PST main effects. These results are presented in Table 3 and are described below in the sections *Risk Factors* and *Protective Factors*.

Risk Factors—As shown in Table 2, without controlling for PST, youth who had a substance use disorder at baseline, compared to those with no disorder, reported marginally greater alcohol and marijuana use at age 15. Additionally, substance use disorder at baseline was associated with a faster rise in marijuana use but was not related to rate of change in alcohol use. After controlling for PST, youth who reported a substance use disorder at baseline did not differ from youth who reported no disorder on age 15 substance use and effect of youth substance use disorder at baseline on alcohol and marijuana use slopes did not change (see Table 3). PST did not interact with adolescent history of substance use disorder to predict substance use trajectories.

Without controlling for PST, psychological distress had no effect on alcohol or marijuana use (see Table 2). After controlling for PST, psychological distress was marginally associated with a faster rise in alcohol use (see Table 3). PST interacted with psychological distress to predict alcohol use (marginally) and marijuana use at age 15. Follow-up analyses showed that the effect of psychological distress on marijuana use at age 15 only differed significantly between No PST and High PST groups, with psychological distress associated with more marijuana use at age 15 for No PST youth but not for High PST youth [$\Delta\chi^2$ (1, $N = 648$) = 6.35, $p < .05$].

Without controlling for PST, gang-involved youth used more alcohol and marijuana at age 15, and gang-involved youth had a marginally slower rise in alcohol use than did youth who were not gang-involved (see Table 2). After controlling for PST, effects of gang-involvement on

age 15 use did not change but gang-involvement no longer predicted rise in alcohol use (see Table 3). PST did not interact with gang-involvement to predict substance use.

Without controlling for PST, youth with more antisocial peer associations reported more alcohol and marijuana use at age 15 than did youth with fewer antisocial peer associations, but antisocial peer associations were not associated with changes in alcohol or marijuana use (see Table 2). These results did not change after controlling for PST, and PST did not interact with antisocial peer association to predict alcohol or marijuana use (see Table 3).

Protective Factors—As shown in Table 2, without controlling for PST, higher aspirations to stay out of legal trouble were associated with less alcohol and marijuana use at age 15 but had no effect on rate of change in substance use. After controlling for PST (see Table 3), effects of aspirations to stay out of legal trouble on substance did not change. Adolescent aspirations for lawful behavior did not interact with PST to predict substance use.

Without controlling for PST, higher levels of impulse control were associated with less alcohol and marijuana use at age 15 (see Table 2) and with a slower rise in alcohol use. Impulse control had no effect on change in marijuana use. After controlling for PST, (see Table 3), these effects did not change and impulse control interacted with PST to predict change in alcohol use. Follow-up analyses showed that the effect of impulse control on change in alcohol use only differed significantly between No PST and High PST groups, with impulse control marginally associated with a slower rise in alcohol use for No PST youth but not for High PST youth [$\Delta\chi^2$ (1, N = 648) = 5.58, $p < .05$].

Without controlling for PST, psychosocial maturity had no effect on alcohol or marijuana use at age 15 but did predict change in alcohol use. However, youth with greater psychosocial maturity showed a faster rise in alcohol use (see Table 2). After controlling for PST, effects of psychosocial maturity on adolescent alcohol or marijuana use did not change and PST did not moderate the effects of psychosocial maturity on substance use trajectories (see Table 3).

Discussion

The current study modeled growth in alcohol and marijuana use from ages 15 to 20 among a sample of serious juvenile offenders. Previous studies of the general population have established age-related patterns in which alcohol and marijuana use are typically initiated in early adolescence, with escalations that peak between ages 18 and 25, and subsequent declines (Kandel et al. 1995; Chassin and Ritter 2002). Because serious juvenile offenders often spend a proportion of their adolescence in a supervised setting, this study tested whether similar age-related patterns would be found among serious juvenile offenders, who are an under-studied group (Laub and Sampson 2001). We also tested whether risk and protective factors that predict substance use in the general adolescent population would predict substance use for serious juvenile offenders and tested how time in a supervised setting would influence these effects on substance use trajectories.

Consistent with findings from the general population, we found that alcohol and marijuana use had (on average) already been initiated by age 15, and that there was significant growth in these trajectories between ages 15 and 20 (Kandel et al. 1995). Moreover, after considering total time spent in a supervised facility, estimates for rate of change in substance use increased. Thus, consistent with previous research, results from the current study demonstrated that omitting the effects of supervised time can produce distorted estimates of substance use frequency and underestimate the increases in substance use over time among serious juvenile offenders (Piquero et al. 2001).

We also found that substance use was less likely to increase with age for those offenders that spent greater amounts of time in a supervised setting, which suggests that supervised time may suppress the trajectories of substance use for adolescent offenders. This suppression may be due to simple incapacitation effects (i.e., more monitoring by adults, less opportunity for use) or to changes in the youths' social context that may promote opportunities for pro-social development (e.g., decreased use due to interventions and interactions with role models while in a supervised setting; Catalano and Hawkins 1996). Either way, our findings suggest that supervised time must be considered in predicting substance use outcomes among serious juvenile offenders. Surprisingly, few drug treatment outcome studies with adolescent offenders have examined effects of supervised time, perhaps producing over-estimates of treatment effects (McCaffrey et al. 2007).

Interestingly, the suppressing effects of supervised time varied somewhat for alcohol and marijuana. For alcohol, the steepest age-related increases were seen in those with no supervised time, followed by low supervised time, with the least growth among those with high supervised time. This suggests a simple suppressing effect of supervised time, with more time spent in a restricted setting equal to less opportunity for growth in substance use. However, for marijuana, the magnitude of rise in marijuana use did not differ between youth with no supervised time and youth with low levels of supervised time. In fact, although not significant, the rise in marijuana use among youth with low levels of supervised time was slightly higher than youth with no supervised time (see Fig. 1). This more complex pattern of findings is not consistent with a simple suppressing effect of supervised time on marijuana use and might reflect a combination of selection and incapacitation effects. That is, incapacitation effects explain why youth with high levels of supervised time have the least growth in marijuana use, but selection effects explain why boys with low levels of supervised time show more growth in marijuana use than youth with no supervised time (who are likely to be the least severe offenders).

The possibility that our data reflect both incapacitation and selection effects suggests that that caution is warranted in interpreting the effects of supervised time on substance use trajectories. First, because offenders are not randomly assigned to supervised settings, the relations between substance use and supervised time are correlational and do not allow for causal inference. Second, modeling supervised time as having a cumulative effect on substance use trajectories does not consider that vulnerability to effects of supervised time may vary across age (Bhati and Piquero 2008). Future studies should explore whether there is developmental variation in adjusting for the effects of supervised time on substance use trajectories among juvenile and young adult offenders. Finally, although our findings suggest that supervised time has suppressing effects on offender substance use, the long-term effects are unknown, and offenders may experience "rebound" increases in substance use later in life (Bhati and Piquero 2008). Analyses that would allow us to definitively conclude that offenders experience rebound effects upon release into the community are beyond the scope of this paper. However, comparing the average substance use patterns of youth who were continuously in the community during the course of this study with a small subset of youth (n = 27) who were supervised at ages 15 through 18 but then resided in the community at ages 19 through 20 suggested that rebound effects are possible. Specifically, age 15–18 substance use was lower among those who were incarcerated than among those who were continuously in the community. However, at age 19, upon release into the community, substance use for these previously incarcerated youth rebounded to the same level of use as those youth who were continuously in the community. An important direction for future research is to provide a rigorous test of such possible rebound effects.

After considering the effects of supervised time, significant variation in individual substance use trajectories allowed us to test risk and protective factor effects on these trajectories. In general, risk and protective factors had the same effects on initial (age 15) substance use as

they do in general adolescent samples (Hawkins et al. 1993). Adolescents who were gang-involved, had antisocial peers, and had histories of substance disorder, generally showed higher levels of use at age 15 than did their lower-risk peers. Similarly, adolescents who had aspirations for lawful behavior and higher levels of impulse control had lower levels of substance use at age 15 than did their peers without these protective factors. Moreover, these effects were maintained after controlling for PST, further supporting the generalizability of these risk and protective factors from the general adolescent population to serious adolescent offenders when predicting initial substance use.

Interestingly, risk and protective factors effects on age-related growth over time were more complex. Whereas the protective factors impulse control and psychosocial maturity predicted change in alcohol use, only adolescent history of substance use predicted change in marijuana use. Moreover, the effect of psychosocial maturity on change in alcohol use was in the opposite of the predicted direction. This paradoxical effect may be because youth with lower levels of psychosocial maturity, and thus at greater risk for use early on, had correspondingly higher levels of alcohol use at age 15 but showed less of an increase in use between ages 15 and 20. Low-risk adolescents started at lower levels of use but showed a greater rise in their levels of use. Consistent with expectations, impulse control was protective of increases in alcohol use, and high-risk youth with a history of substance showed increases in their marijuana use. Thus, the effects of impulse control and substance abuse diagnosis on offender substance use trajectories mirrored the effects expected in non-offender samples (Chassin et al. 1996; Chassin et al. 2004; Kandel et al. 1986; Wills et al. 1998).

After controlling for effects of supervised time, risk and protective factor effects on initial (age 15) substance use and on change in substance use over time were the same as those before controlling for supervised time, with some exceptions. First, before controlling for supervised time, gang involvement was marginally associated with decreases in alcohol use over time, but gang involvement had no effect on change in alcohol use after controlling for supervised time. Alternatively, psychological distress had no relation to change in alcohol use before controlling for supervised time, but marginally predicted an increase in alcohol use after controlling for supervised time. Moreover, supervised time had little influence on the operation of risk and protective factors on substance use (i.e., there were few significant interactions between PST and risk and protective factors). Further, when supervised time did influence the operation of risk and protective factor effects, these effects only differed between youth who were never in a supervised setting and youth who had high levels of time in a supervised setting. Thus, although supervised time did reduce the operation of risk and protective factors, this evidence was not consistent across all risk and protective factors and the effects were not as robust as expected.

Although the current study contributes to the literature as the first to track age-related substance use trajectories among serious juvenile offenders while considering the effects of supervised time in interaction with psychosocial risk and protective factors, it is important to consider its limitations. Most notably, our sample is limited to serious male juvenile offenders. Thus, the conclusion about the suppressive effects of supervised time and risk and protective effects on substance use cannot be generalized to female juvenile offenders. Next, our analyses were limited to alcohol and marijuana use. Thus, study findings cannot be generalized to other drugs (i.e., cocaine, heroin). Examining patterns of drug use other than alcohol and marijuana among offenders is a potential area for future research. In addition, our data are limited to adolescent self-reports, and we modeled only the static effects of predictors assessed at baseline, which could explain why risk and protective factors were not predictive of change in offender substance use. To the extent that these factors change over time, their effects may be revealed only by methods that model these changes and test their effects on outcomes that are assessed more proximally in time. Finally, because adolescents were not randomly assigned to

supervised time, we cannot draw causal inferences about the effects of supervised time on substance use trajectories.

In sum, the current study showed that increases in substance use were suppressed by time spent in controlled environments, highlighting that the failure to consider supervised time may result in misleading estimates of substance use. Additionally, study findings suggest that caution is warranted in concluding that the influence of risk and protective processes on substance use for serious juvenile offenders is similar to the influence of risk and protective processes on non-offenders. Whereas some risk and protective processes may affect non-offenders and serious juvenile offenders similarly, others may not. These findings can help inform efforts to reduce substance use and abuse among juvenile offenders and identify targets of substance use interventions for serious juvenile offenders. For example, our study findings that a history of substance use diagnosis and impulse control predicted escalation in substance use suggest that early prevention of and treatment for substance use as well as interventions aiming to improve offender impulse control may be especially important in preventing escalation in substance use among serious juvenile offenders. Taken together, the current study's findings contribute to our understanding of how formal sanctions superimposed on normal developmental processes affect juvenile offenders' growth in substance use and mental health problems during adolescence.

Acknowledgments

Preparation of this manuscript was supported by an NIMH Training Grant (T32 MH 018387). The project described was supported by funds from the following: Office of Juvenile Justice and Delinquency Prevention, National Institute of Justice, John D. and Catherine T. MacArthur Foundation, William T. Grant Foundation, Robert Wood Johnson Foundation, William Penn Foundation, Center for Disease Control, National Institute on Drug Abuse (R01DA019697), Pennsylvania Commission on Crime and Delinquency, and the Arizona Governor's Justice Commission. We are grateful for their support. The content of this paper, however, is solely the responsibility of the authors and does not necessarily represent the official views of these agencies.

Biographies

Anne Marie Mauricio, Ph.D., is a research faculty member at the Prevention Research Center at Arizona State University. She received her Ph.D. in Counseling Psychology from Michigan State University. Her major research interests include interpersonal violence and preventative interventions for substance use, academic disengagement, and mental health disorders.

Michelle Little, Ph.D., is an Assistant Professor at the University of Texas at San Antonio. She received her Ph.D. in Developmental Psychology from Temple University. Her major research interests include prevention of externalizing disorders.

Laurie Chassin, Ph.D., is a Regents Professor of Psychology at Arizona State University. She received her Ph.D. in Clinical Psychology from Teachers College, Columbia University. Her major research interests include the development and intergenerational transmission of alcohol, tobacco, and other drug use and substance use disorders.

George P. Knight, Ph.D., is a Professor in the Department of Psychology at Arizona State University. He received his Ph.D. in 1980 from the University of California at Riverside. His research interests include cultural adaptation in immigrant and minority youth and adults as well as methodological issues associated with research on ethnic minority families.

Alex R. Piquero, Ph.D., is presidential scholar and professor in the Department of Criminology & Criminal Justice at the University of Maryland College Park. He received his Ph.D. in

Criminology from the University of Maryland College Park in 1996. His major research interests include criminal careers, criminological theory, and quantitative research methods.

Sandra H. Losoya, Ph.D., is a research assistant professor of psychology at Arizona State University. She received her Ph.D. in developmental psychology, specializing in socio-emotional development, from the University of Oregon. Her research interests include individual differences in emotional responding and coping, and sources of resilience in high-risk children.

Delfino Vargas-Chanes, Ph.D., is research faculty member in the Department of Psychology at Arizona State University. He received his Ph.D. in Sociology from Iowa State University. His major research interests include development of measurement instruments, structural equation modeling, multilevel modeling and advanced statistical analyses applied to social and behavioral sciences.

References

Aiken, L.; West, S. Multiple regression: testing and interpreting interactions. Sage Publications, Inc; Thousand Oaks, CA, US: 1991.

Abrantes AM, Hoffmann NG, Anton R. Prevalence of co-occurring disorders among juveniles committed to detention centers. International Journal of Offender Therapy and Comparative Criminology 2005;49 (2):179–193. [PubMed: 15746269]doi:10.1177/0306624X04269673

Adams MS, Robertson CT, Gray-Ray P, Ray MC. Labeling and delinquency. Adolescence 2003;38:171–186. [PubMed: 12803461]

Bachman, G.; O'Malley, P.; Johnston, L.; Schulenberg, J. The decline of substance use young adulthood: Changes in social activities, roles, and beliefs. Erlbaum; NY: 2002.

Bhati SB, Piquero AR. Estimating the impact of incarceration on subsequent offending trajectories: deterrent, criminogenic, or null effect? Journal of Criminal Law and Criminology 2008;98(1):207–253.

Buehler RE, Patterson GR, Furniss JM. The reinforcement of behavior in institutional settings. Behaviour Research and Therapy 1966;4:157–167. [PubMed: 5946536]

Cauffman E, Steinberg L. (Im)maturity of judgment in adolescence: Why adolescents may be less culpable than adults. Behavioral Sciences & the Law 2000;18:740–760.doi:10.1002/bsl.416

Chassin L, Curran PJ, Hussong AM, Colder CR. The relation of parent alcoholism to adolescent substance use: A longitudinal follow-up study. Journal of Abnormal Psychology 1996;105(1):70–80. [PubMed: 8666713]doi:10.1037/0021-843X.105.1.70

Chassin L, Flora D, King KM. Trajectories of alcohol and drug use and dependence from adolescence to adulthood: the effects of familial alcoholism and personality. Journal of Abnormal Psychology 2004;113(4):483–498. [PubMed: 15535782]doi:10.1037/0021-843X.113.4.483

Chassin L, Knight G, Vargas-Chanes D, Losoya SH, Naranjo D. Substance use treatment outcomes in a sample of male serious juvenile offenders. Journal of Substance Abuse Treatment. forthcoming

Chassin L, Presson CC, Pitts SC, Sherman SJ. The natural history of cigarette smoking from adolescence to adulthood in a Midwestern community sample: Multiple trajectories and their psychosocial correlates. Health Psychology 2000;19(3):223–231. [PubMed: 10868766]doi: 10.1037/0278-6133.19.3.223

Chassin, L.; Ritter, J. Vulnerability to substance use disorders in childhood and adolescence.. In: Ingram, R.; Price, J., editors. Vulnerability to psychopathology: Risk across the lifespan. Guilford; NY: 2002. p. 107-134.

Chen K, Kandel DB. The natural history of drug use from adolescence to the mid thirties in a general population sample. American Journal of Public Health 1995;85(1):41–47. [PubMed: 7832260]

Crane J. The epidemic theory of ghetto and neighborhood effects on dropping out and teenage childbearing. American Journal of Sociology 1991;96:1226–1259.doi:10.1086/229654

Deykin E, Levy J, Wells V. Adolescent depression, alcohol, and drug abuse. American Journal of Public Health 1987;77:178–182. [PubMed: 3492151]

Dishion TJ, Capaldi D, Spracklen KM, Li F. Peer ecology of male adolescent drug use. Development and Psychopathology. Special Issue: Developmental Processes in Peer Relations and Psychopathology 1995;7(4):803–824.

Engels RCME, Knibbe RA, de Vries H, Drop MJ, van Breukelen GJP. Influences of parental and best friends' smoking and drinking on adolescent use: A longitudinal study. Journal of Applied Social Psychology 1999;29(2):337–361.doi:10.1111/j.1559-1816.1999.tb01390.x

Gold, M.; Osgood, DW. Personality and peer influence in juvenile corrections. Vol. 38. Greenwood Press; Westport, Connecticut: 1992.

Greenberger, E.; Knerr, C.; Knerr, B.; Brown, JB. The measurement and structure of psychological maturity.. Center for Social Organization of Schools Report, Johns Hopkins U, No. 170. 1974.

Grisso, T. Double jeopardy: Adolescent offenders with mental disorders. University of Chicago Press; Chicago, IL, US: 2004.

Gottfredson, MR.; Hirschi, T. A general theory of crime. Stanford University Press; Stanford, CA: 1990.

Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. Psychological Bulletin 1993;112(1):64–105. [PubMed: 1529040]doi:10.1037/0033-2909.112.1.64

Hawkins JD, Weis JG. The social development model: An integrated approach to delinquency prevention. The Journal of Primary Prevention 1985;6(2):73–97.doi:10.1007/BF01325432

Hussong A, Curran P, Moffit T, Caspi A, Carrig M. Substance abuse hinders desistance in young adults' antisocial behavior. Development and Psychopathology 2004;16:1029–1046. [PubMed: 15704826]

Ievers-Landis CE, Greenley RN, Burant C, Borawski E. Cognitive social maturity, life change events, and health risk behaviors among adolescents: Development of a structural equation model. Journal of Clinical Psychology in Medical Settings 2006;13:111–120.doi:10.1007/s10880-006-9016-9

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the future national results on adolescent drug use: Overview of key findings, 2004. (NIH Publication No. 05-5726). National Institute on Drug Abuse; Bethesda, MD: 2005.

Jones RM, Hartmann BR, Grochowski CO, Glider P. Ego identity and substance abuse: A comparison of adolescents in residential treatment with adolescents in school. Personality and Individual Differences 1989;10(6):625–631.

Kandel DB. On processes of peer influences in adolescent drug use: A developmental perspective. Advances in Alcohol & Substance Abuse 1985;4:139–163. [PubMed: 3874527]

Kandel D, Chen K, Gill A. The impact of drug use on earnings: A life-span perspective. Social Forces 1995;74(1):243–270.doi:10.2307/2580631

Kandel DB, Davies M, Karus D, Yamaguchi K. The consequences in young adulthood of adolescent drug involvement: An overview. Archives of General Psychiatry 1986;43(8):746–754. [PubMed: 3729669]

Keenan K, Loeber R, Zhang Q, Stouthamer-Loeber M, Van Kammen W. The influence of deviant peers on the development of boys' disruptive and delinquent behavior: A temporal analysis. Development and Psychopathology 1995;7(4):715–726.

Krohn MD, Lizotte AJ, Thornberry TP, Smith C. Reciprocal causal relationships among drug use, peers, and beliefs: A five-wave panel model. Journal of Drug Issues 1996;26(2):405–428.

Laub, JH.; Sampson, RJ. Understanding desistance from crime.. In: Tonry, Michael., editor. Crime and justice: An annual review of research. University of Chicago Press; Chicago: 2001. p. 1-69.

Lipsey, MW.; Derzon, JH. Predictors of violent or serious delinquency in adolescence and early adulthood: A synthesis of longitudinal research.. In: Loeber, R.; Farrington, DP., editors. Serious & violent juvenile offenders: Risk factors and successful interventions. Sage; Thousand Oaks, CA: 1998. p. 86-105.

Loeber, R.; Farrington, DP. Serious & violent juvenile offenders: Risk factors and successful interventions. Sage Publications, Inc; Thousand Oaks, CA: 1998.

McCaffrey D, Moral A, Ridgeway G, Griffin B. Interpreting treatment effects when cases are institutionalized after treatment. Drug and Alcohol Dependence 2007;89:126–138. [PubMed: 17275215]doi:10.1016/j.drugalcdep.2006.12.032

Menard, S.; Elliot, DS. Prediction of adult success using stepwise logistic regression analysis: Report submitted to the John D. & Catherine T. MacArthur Foundation; 1996.

OJJDP. Anticipating space needs in juvenile detention. Juvenile Justice Bulletin. 2001

Orlando M, Tucker JS, Ellickson PL, Klein DJ. Concurrent use of alcohol and cigarettes from adolescence to young adulthood: An examination of developmental trajectories and outcomes. Substance Use & Misuse 2005;40(8):1051–1069. [PubMed: 16040368]doi:10.1081/JA-200030789

Otto, RK.; Greenstein, JJ.; Johnson, MK.; Friedman, RM. Prevalence of mental disorders among youth in the juvenile justice system.. In: Cocozza, JJ., editor. Responding to the mental health needs of youths in the juvenile justice system. National Coalition for the Mentally Ill in the Criminal Justice System; Seattle, WA: 1992.

Piquero AR, Blumstein A. Does incapacitation reduce crime? Journal of Quantitative Criminology 2007;23:267–285.

Piquero AR, Blumstein A, Brame R, Haapanen R, Mulvey EP, Nagin DS. Assessing the impact of exposure time and incapacitation on longitudinal trajectories of criminal offending. Journal of Adolescent Research 2001;16(1):54–74.doi:10.1177/0743558401161005

Sampson RJ. Collective regulation of adolescent misbehavior: Validation results from eighty Chicago neighborhoods. Journal of Adolescent Research 1997;12:227–244.doi:10.1177/0743554897122005

Sampson, RJ.; Laub, JH. Crime in the making: Pathways and turning points through life. Harvard University Press; Cambridge, MA: 1993.

Schubert CA, Mulvey EP, Steinberg L, Cauffman E, Losoya S, Hecker T, et al. Operational lessons from the pathways to desistance project. Youth Violence and Juvenile Justice 2004;2:237–255.doi: 10.1177/1541204004265875

Shedler J, Block J. Adolescent drug use and psychological health: A longitudinal inquiry. The American Psychologist 1990;45(5):612–630. [PubMed: 2350080]doi:10.1037/0003-066X.45.5.612

Steinberg L, Chung HL, Little M. Reentry of young offenders from the justice system: A developmental perspective. Youth Violence and Juvenile Justice 2004;2:21–38.doi:10.1177/1541204003260045

Stewart EA, Simons RL, Conger RD, Scaramella LV. Beyond the interactional relationship between delinquency and parenting practices: The contribution of legal sanctions. Journal of Research in Crime and Delinquency 2002;39(1):36–59.

Thornberry TP, Krohn MD, Lizotte AJ, Chard-Wierschem D. The role of juvenile gangs in facilitating delinquent behavior. Journal of Research in Crime and Delinquency 1993;30(1):55–87.doi: 10.1177/0022427893030001005

Thornberry, TP.; Krohn, MD.; Lizotte, AJ.; Smith, CA.; Tobin, K. Gangs and delinquency in developmental perspective. Cambridge University Press; New York: 2003.

Wei E, Loeber R, White HR. Teasing apart the developmental associations between alcohol and marijuana use and violence. Journal of Contemporary Criminal Justice 2004;20(2):166–183.doi: 10.1177/1043986204263777

Weinberger DA, Schwartz GE. Distress and restraint as superordinate dimensions of self-reported adjustment: A typo-logical perspective. Journal of Personality 1990;58(2):381–417. [PubMed: 2213473]doi:10.1111/j.1467-6494.1990.tb00235.x

Welte JW, Barnes GM, Hoffman JH, Wieczorek WF, Zhang L. Substance involvement and the trajectory of criminal offending in young males. The American Journal of Drug and Alcohol Abuse 2005;31 (2):267–284. [PubMed: 15912716]doi:10.1081/ADA-200047934

White HR, Loeber R, Stouthamer–Loeber MB, Farrington DP. Developmental associations between substance use and violence. Development and Psychopathology 1999;11:785–803. [PubMed: 10624726]doi:10.1017/S0954579499002321

Wills TA, Windle M, Cleary SD. Temperament and novelty seeking in adolescent substance use: Convergence of dimensions of temperament with constructs from Cloninger's theory. Journal of Personality and Social Psychology 1998;74(2):387–406. [PubMed: 9491584]doi: 10.1037/0022-3514.74.2.387

Winters RD, Stinchfield E, Opland C, Weller, Latimer WW. The effectiveness of the Minnesota Model approach in the treatment of adolescent drug abusers. Addiction (Abingdon, England) 2000;95:601–612.doi:10.1046/j.1360-0443.2000.95460111.x

World Health Organization. Composite International Diagnostic Interview (CIDI) researcher's manual. American Psychiatric Press; Washington, DC: 1994.

Wong MN, Nigg JT, Zucker RA, Puttler L, Fitzgerald H, Jester JM, et al. Behavioral control and resiliency in the onset of alcohol and illicit drug use: A prospective study from preschool to adolescence. Child Development 2006;77(4):1016–1033. [PubMed: 16942503]doi:10.1111/j.1467-8624.2006.00916.x

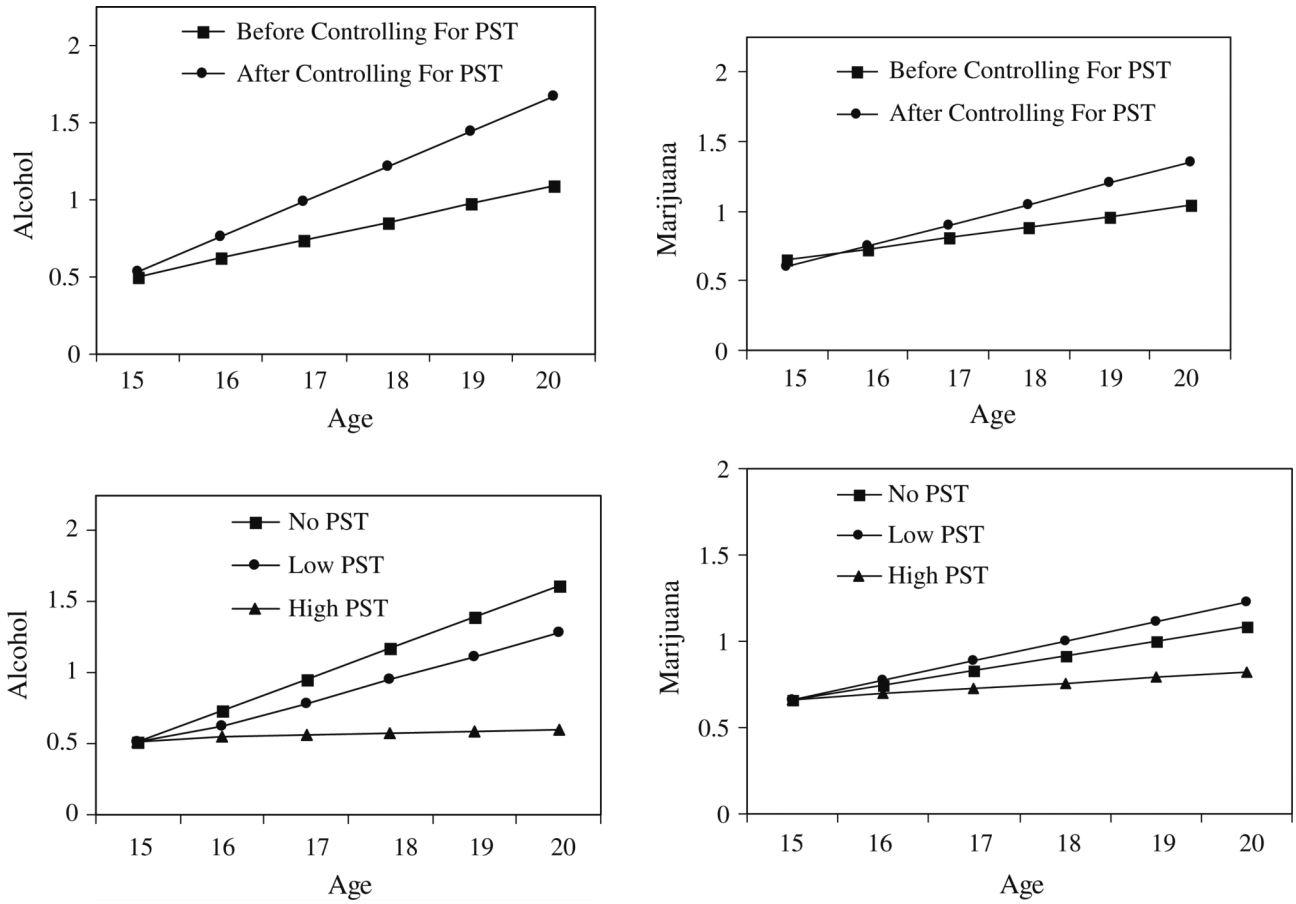

Fig. 1.

Substance use trajectories before and after controlling for PST and substance use trajectories by no, low, and high PST groups. *Note*: Values on *Y* axes equal frequency of alcohol or marijuana use. 0 = no use; 1 = 1 – 5*x* in the past 6 months; 2 = 1 – 3*x* per month

Table 1

Multiple group log likelihood ratio difference tests for no (n = 209), low (n = 447), and high (n = 439) PST groups comparing unconditional growth models with constrained versus unconstrained slopes

Group comparisons	*N*	Alcohol					Marijuana				
		$\Delta(df)\chi^2$	Intercept	Unconstrained slopes			$\Delta(df)\chi^2$	Intercept	Unconstrained slopes		
				No	Low	High			No	Low	High
All group comparison	1095	138.17(4)***	.51***	.22***	.16***	.01	19.72(4)**	.66***	.09***	.11***	.03
High PST vs. no PST	648	79.83(2)***	.54***	.21***	–	.01	3.27(2)	.62***	.10***	–	.04*
High PST vs. low PST	886	84.19(2)***	.51***	–	.17***	.02	17.07(2)**	.73***	–	.09***	.01
No PST vs. low PST	656	18.01(2)**	.48***	.23***	.17***	–	3.01(2)	.62***	.10***	.12***	–

Note: $\Delta(df)\chi^2$ is the difference in the log likelihood ratio and the corresponding difference in degrees of freedom between the constrained and unconstrained models

* $p \leq .05$.

** $p \leq .01$.

*** $p \leq .001$

J Youth Adolesc. Author manuscript; available in PMC 2009 November 18.

Table 2

Risk and protective factor effects on substance use at age 15 and on change in substance use before controlling for PST, ages 15–20 (N = 1095)

Predictors	Alcohol		Marijuana	
	Intercept *b* (*SE*)	Slope *b* (*SE*)	Intercept *b* (*SE*)	Slope *b* (*SE*)
Risk factors				
1. Youth substance use diagnosis	.14(.08)†	.01(.03)	.16(.09)†	.06(.03)*
2. BSI scores	–.10(.08)	.01(.03)	–.02(.09)	–.02(.03)
3. Gang involvement	.27(.10)**	–.06(.03)†	.22(.11)*	–.04(.03)
4. Antisocial peer associations	.09(.05)*	.01(.02)	.22(.11)*	–.04(.01)
Protective factors				
1. Aspirations for lawful behavior	–.08(.03)**	.01(.01)	–.09(.03)**	–.01(.01)
2. Impulse control	–.09(.04)*	–.03(.01)**	–.11(.04)**	–.01(.02)
3. Psychosocial maturity	–.04(.08)	.07(.02)**	.04(.10)	.03(.03)

*** $p \leq .001$.

Note: For alcohol and marijuana, risk factor effects and protective factor effects on substance use were tested in two separate models. Intercept equals initial level of substance use (e.g., age 15 substance use). Slope equals rate of change in substance between ages 15 and 20

* $p \leq .05$.

** $p \leq .01$.

† $p \leq .10$

Table 3

Effects of risk and protective factors and PST × Risk and protective factor interactions on age 15 substance use and on change in substance use controlling for PST, ages 15–20 (N = 1,095)

Predictors	Alcohol		Marijuana	
	Intercept *b* (*SE*)	Slope *b* (*SE*)	Intercept *b* (*SE*)	Slope *b* (*SE*)
Risk factors				
1. Youth substance use diagnosis	.11(.07)	.03(.02)	.14(.09)	.07(.03)*
PST × youth substance use diagnosis	–.02(.04)	–.01(.01)	–.01(.05)	–.01(.01)
2. BSI scores	–.12(.07)	.04(.02)†	–.03(.09)	.01(.03)
PST × BSI scores	–.07(.04)†	.01(.01)	–.13(.05)**	.01(.01)
3. Gang involvement	.26(.09)**	–.04(.03)	.20(.10)*	–.03(.03)
PST × Gang involvement	–.05(.05)	–.01(.01)	–.05(.06)	–.01(.02)
4. Antisocial peer associations	.13(.04)**	.01(.01)	.10(.05)*	.01(.01)
PST × antisocial peer associations	–.03(.02)	–.01(.01)	–.03(.03)	–.01(.01)
Protective factors				
1. Aspirations for lawful behavior	–.09(.03)**	.01(.01)	–.09(.03)*	–.01(.01)
PST × aspirations for lawful behavior	.01(.02)	–.01(.01)	–.01(.02)	.01(.01)
2. Impulse control	–.10(.04)**	–.03(.01)**	–.11(.04)**	–.02(.02)
PST × impulse control	–.01(.02)	.02(.01)*	.01(.02)	.01(.01)
3. Psychosocial maturity	–.04(.07)	.05(.02)*	.04(.10)	–.02(.03)
PST × psychosocial maturity	.04(.04)	–.01(.01)	.08(.05)	–.01(.02)

*** $p \leq .001$.

Note: For alcohol and marijuana, risk factor and protective factor effects on substance use were tested in two separate models. Effect of each risk and protective factor interaction with PST was tested independently of other interaction effects. Intercept equals initial level of substance use (e.g., age 15 substance use). Slope equals rate of change in substance between ages 15 and 20

* $p \leq .05$.

** $p \leq .01$.

† $p \leq .10$