

Trajectories of Marijuana Use in Youth Ages 15–25: Implications for Postsecondary Education Experiences

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Abstract

Objective—This study examined associations between longitudinal trajectories of marijuana use from adolescence to young adulthood and postsecondary education (PSE) experiences. Outcomes examined included the type of PSE undertaken, the timing of enrollment, and the likelihood of dropping out.

Method—Participants ($N = 632$; 332 females) were from the Victoria Healthy Youth Survey, a five-wave multicohort study of young people interviewed biennially between 2003 and 2011. Latent class growth analysis was used to identify distinct trajectories of the frequency of marijuana use from ages 15 to 25. Logistic regression analyses evaluated class membership as a predictor of the three PSE outcomes, with sex, maternal education, family structure, high school grades, and conduct problems controlled for.

Results—Three trajectory groups of marijuana use were identified: abstainers (31%), occasional users (44%), and frequent users (25%). Compared with abstainers, frequent users had the lowest high school grades and the most conduct problems and were least likely to enroll in PSE, especially in a university. Occasional users did not differ from abstainers on high school grades or conduct problems and were no less likely than abstainers to enroll in PSE. However, they delayed enrollment longer and were more likely to drop out of PSE.

Conclusions—Frequent marijuana use from adolescence to young adulthood may close off opportunities for entering PSE, whereas occasional use may create delays in starting and finishing PSE among less at-risk young people. The mechanisms underlying associations between marijuana use and educational difficulties during emerging adulthood as well as adolescence need to be better understood.

The negative effects of adolescent marijuana use on educational attainment, especially high school non-completion, are well recognized (Fergusson and Horwood, 1997; Lynne-Landsmen et al., 2010; Lynskey et al., 2003). However, fewer studies have examined associations between marijuana use and postsecondary education (PSE) experiences. This is

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an important issue because postsecondary qualifications are increasingly required for entry into career-track jobs, and research shows that youth with disrupted and incomplete PSE have a low probability of career acquisition by their early 30s (Vuolo et al., 2014). Given the widespread use of marijuana among adolescents and young adults, the focus of the present research was to examine how differences in trajectories of marijuana use from adolescence to young adulthood were associated with PSE outcomes.

The majority of existing research has operationalized postsecondary attainment as either college attendance or achievement of a college degree. However, these outcomes reflect success or failure at different stages of the postsecondary career. Some high school graduates do not achieve the grades to enroll in degree programs and instead enroll in non-degree-granting institutions, some delay enrollment after high school graduation, and others drop out of postsecondary programs. Past research shows that failure to enroll in college is related to marijuana use (Horwood et al., 2010), but the role of marijuana use in enrollment in noncollege programs, the timing of enrollment, and dropping out has not received as much attention. We contribute to the preceding research on marijuana use and PSE by focusing on these three outcomes.

Longitudinal research shows that, on average, marijuana use increases up to about age 19, stabilizes to about age 24, and then decreases steadily (Schulenberg et al., 2005). However, there is substantial variation around this average pattern. Research examining distinct developmental trajectories of marijuana use generally shows at least three different longitudinal patterns of onset and frequency of use between adolescence and young adulthood. These include a group of abstainers who rarely report using; a group who start using early in adolescence, increase their frequency of use throughout adolescence, and continue to use heavily during young adulthood; and a group of occasional users who start later in adolescence, use occasionally during adolescence and young adulthood, and decrease to very infrequent use after their early 20s. Some studies also report additional trajectory classes—including a group who use frequently during early adolescence then desist rapidly—and further low-level user classes (Brook et al., 2011a, 2011b; Flory et al., 2004; Jackson et al., 2008; Lynne-Landsmen et al., 2010; Schulenberg et al., 2005; Tucker et al., 2005; Windle and Wiesner, 2004).

Youth who exhibit a pattern of early onset and stable frequent use of marijuana into early adulthood are more likely to drop out of high school (Fleming et al., 2012) and are less likely to enroll in PSE or complete a degree (Fergusson and Boden, 2008; Horwood et al., 2010; Tucker et al., 2005). It is likely that cascades from early onset of marijuana use to other problem behaviors and academic failure are implicated in this association.

However, it is less clear whether occasional adolescent use also predicts poor long-term educational outcomes. Some longitudinal studies suggest that occasional adolescent users are less likely than abstainers to obtain postsecondary qualifications (Degenhardt et al., 2010; Ryan, 2010; Tucker et al., 2005), but other studies find that experimental or occasional users do not differ from abstainers in their educational outcomes (Englund et al., 2013; Schulenberg et al., 2005; Windle and Wiesner, 2004). Thus, although early adolescent use

impedes success in high school and entry into PSE, increasing use later in adolescence or early adulthood may interfere with the ability to perform well in college.

There is substantial variation in the types of PSE and training that can be pursued. Around 80% of Canadian youth undertake some form of PSE, with 38% of these attending a university, 27% college, and 45% another type of institution (Shaienks and Gluszynski, 2007; Shaienks et al., 2008). However, few North American longitudinal studies distinguish between 2- and 4-year college attendance when examining outcomes of or changes in substance use (Carter et al., 2010). Dichotomizing “college” and “noncollege” status can conflate educational attainment with correlates of cannabis use, such as socioeconomic background and academic ability. As a result, little is known about patterns of cannabis use in adolescence and early adulthood in relation to different types of PSE and training. For example, does heavy adolescent cannabis use decrease the likelihood that young adults will undertake vocational training as well as academic degrees?

Many students delay enrollment in PSE. In Canada, 50% of youth who enrolled in PSE did so within 3 months of high school graduation, 73% within 15 months, and 81% within 28 months (Hango, 2011). Similar rates are reported in studies using recent cohorts in the United Kingdom (Crawford and Cribb, 2012), the United States (Bozick and DeLuca, 2005), and Australia (Curtis et al., 2012). Delayed enrollment may create substantial challenges for young people. For instance, family and work commitments may compete with study for youth who enroll at an older age (Bozick and DeLuca, 2005; Jacobs and King, 2002). Research also shows that delayers have lower earnings in their early 30s than those who enroll on time (Crawford and Cribb, 2012; Lamb, 2001). This can be partially accounted for by pre-existing characteristics that are associated with both delaying and eventual attainment, such as lower grades in high school and lower parental education.

However, the effects of substance use on the timing of enrollment have not been well studied. When academic ability and sociodemographic factors were controlled for, U.K. students who had ever smoked marijuana by grade 11 were significantly more likely to delay university enrollment by at least 1 year (Crawford and Cribb, 2012). As marijuana was assessed at only one point in time, however, it is not clear how patterns of use may affect timing of enrollment. Moreover, previous studies have not examined how predictors of delayed enrollment may differ for youth who enter different types of postsecondary institutions.

Around one third of Canadian college students drop out in their first year after enrollment (Shaienks et al., 2008). A few studies have examined how marijuana use is associated with dropping out after taking into account the fact that adolescent marijuana users are less likely to enroll in the first place. For example, Fleming and colleagues (2012) found that students who dropped out of 2- and 4-year colleges were more likely to have used marijuana during high school and in the few years following high school than were students who did not drop out. Arria et al. (2013) examined trajectories of marijuana use among students from a single U.S. university and found that all trajectories of use, even infrequent use, increased the risk of not completing a degree. These findings suggest that it is necessary to examine patterns of

marijuana use both before and after high school to determine how use in different developmental periods may be related to dropping out of PSE.

In summary, the type of PSE undertaken, the timing of enrollment, and the likelihood of dropping out are three aspects of the PSE transition that may be disrupted by marijuana use. The aim of the present study was to examine how patterns of marijuana use from adolescence to early adulthood are related to each of these three postsecondary experiences. Using data from a prospective, longitudinal, community-based study of Canadian youth, we used group-based trajectory modeling to identify distinct classes of individuals characterized by their frequency of marijuana use from adolescence to early adulthood. Based on previous research, we expected at least three classes of marijuana use, including an abstaining class, a chronic class (characterized by frequent use at all ages), and at least one class characterized by lighter or occasional use over time. Consistent with past research, we expected that the class using most frequently would exhibit the poorest outcomes compared with the abstainer class. Specifically, we expected that members of the frequent-user class would be least likely to undertake PSE, would delay enrollment, and would be most likely to drop out if they did enroll. Given the mixed previous findings for occasional developmental patterns of marijuana use in relation to PSE outcomes, we did not make predictions for associations between lighter use and these outcomes.

Finally, a range of earlier risk factors confound the relationship between marijuana use and PSE outcomes (McCaffrey et al., 2010). Prominent among these are low socioeconomic status, male sex, low high school grades, and early externalizing problems (Fergusson et al., 2002; Horwood et al., 2010). Therefore, all analyses controlled for sex, maternal education, family structure, high school grades, and baseline conduct problems.

Method

Participants

The Victoria Healthy Youth Survey is a five-wave multi-cohort study of young people assessed biennially between 2003 and 2011. Participants were recruited in 2003 from a medium-sized Canadian city using random digit dialing of 9,500 private telephone listings. Of the 1,036 eligible households, 662 adolescents ages 12–18 years ($M = 15.52$, $SD = 1.93$), 51% female, agreed to participate (64%). Response rates were 87% at Time 2, 81% at Time 3, 70% at Time 4, and 70% at Time 5. The sample was 85% White, 4% Asian, 4% mixed/biracial, 3% Aboriginal, and 4% other (e.g., Black, Hispanic, or other). Informed consent was obtained from parents or guardians and from youth. Surveys were administered by trained interviewers, and respondents received an honorarium. The living situation, parental education, and ethnicity reported by participating youth were almost identical to those of the population from which the sample was drawn (Albrecht et al., 2007).

To examine trajectories of marijuana use from adolescence to young adulthood, the five waves of data were rearranged based on the participants' age at each interview. Data for ages 12, 13, 14, 26, and 27 were dropped because of low covariance coverage and low variance in marijuana use at the younger and oldest ages. Thus, analyses of marijuana use trajectories from age 15 to age 25 included 632 participants (53% female). Thirty participants were

excluded because they were 12–14 years old at Time 1 (T1) and did not return to the study. There were no significant differences in sociodemographic characteristics or T1 marijuana use between these youth and the other 12- to 14-year-olds who remained in the study beyond T1.

Information about educational outcomes was available for 518 participants who participated in either Wave 4 or Wave 5 of the study, when detailed information about PSE was collected. Compared with the 144 who did not participate in either Wave 4 or Wave 5, this subsample reported significantly higher grades, $t(657) = -4.13, p < .001$, and higher levels of mother's education at T1, $t(654) = -3.3, p = .001$, but did not differ on other measures.

Measures

Marijuana use—At each wave, participants were asked, “How often have you used marijuana in the past 12 months?” Response options were *never* (0), *a few times a year* (1), *a few times a month* (2), *once a week* (3), and *more than once a week* (4).

Postsecondary experiences in young adulthood—During the Wave 4 and Wave 5 interviews, participants provided a history of their PSE enrollments since leaving high school. Three education outcomes were developed: postsecondary enrollment type, timing of enrollment, and dropping out.

(A) Postsecondary enrollment type: This five-category variable captured information about high school completion and enrollment in different types of PSE. Forty participants (7.7%) left high school early or did not have a high school diploma, and 87 (16.8%) completed a high school diploma but had not enrolled in PSE by their most recent interview. The remaining 391 (75.5%) enrolled in some type of PSE after completing high school.

Participants were grouped into three categories. The university group included those who enrolled in a 4-year degree program at a university. The college group included those who enrolled in a subbaccalaureate program (e.g., diploma, associate's degree) at a community college. The transfer group included those who started in a subbaccalaureate program with the intention of transferring to a university or who started in a subbaccalaureate program and changed within 3 months to a university. Note that group membership was based on first enrollment rather than program completion, as 27% of participants who undertook PSE were still enrolled in this first program at the time of their last interview.

(B) Timing of enrollment: Timing of enrollment was a three-category variable. Based on previous studies (Bozick and DeLuca, 2005; Hango, 2011), participants were classified as enrolling on time if they started PSE within 3 months of finishing high school, as taking a gap year if they started PSE within 15 months of finishing high school, and as delayed if they enrolled after 15 months.

(C) Dropping out: Participants were classified as having dropped out of their first postsecondary program if they reported an end date for the enrollment but did not report having obtained the relevant qualification.

Covariates

Sex, maternal education, high school grades at T1, conduct problems at T1, and family structure at age 15 (1 = living in a two-parent family) were included as covariates in all analyses. Mother's education was a five-point scale that ranged from *less than a high school diploma* to *finished college/university*. To assess high school grades, participants were asked, "In general, what are your grades right now?" with response options ranging from 1 (*mostly F's*) to 5 (*mostly A's*). Conduct problems were assessed as an index of behaviors with eight items that reflect symptoms based on conduct-disorder criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (American Psychiatric Association, 1994). Participants were asked, "How often do you [... item]?" with responses on a three-point scale (1 = *never*, 2 = *sometimes*, or 3 = *often*). Examples of items included (a) "steal things at home?" (b) "run away from home?" and (c) "damage school or other property?" Responses were coded as 0 (has not happened) and 1 (has happened) and summed to yield an index from 0 to 8. Information about family structure at age 15 was taken from either the T1 or the T2 interview, depending on the participant's T1 age.

Analytic plan

We followed a two-stage process for examining the research questions. We first used latent class growth analysis (Muthén, 2004) to identify distinct subgroups of individuals who showed similar developmental patterns of marijuana use from age 15 to 25. Based on the best-fitting latent class growth model, each participant was assigned to a trajectory class using posterior probabilities—that is, the class to which he or she was most likely to belong. Next, we examined the association between membership in these latent classes and the three PSE outcomes.

Latent class growth analysis of marijuana use—As longitudinal research shows that marijuana use increases throughout adolescence and then decreases in young adulthood (Fleming et al., 2012; Schulenberg et al., 2005), the trajectory of marijuana use was estimated with a quadratic growth curve for all classes, with the intercept set at age 15. Frequency of marijuana use variables was treated as ordered categorical outcomes with thresholds constrained to equality across latent classes and ages (Feldman et al., 2009; Mehta et al., 2004). The parameters were estimated using a full-information maximum likelihood estimator with robust standard errors, MLR in MPlus 6.1 (Muthén and Muthén, 1998–2010). This approach uses data from all available time points for a given case under the assumption that data are missing at random, which allows for missingness to be related to variables included in the analyses (Little and Rubin, 2002).

We first examined models without the covariates to establish the optimal number of latent classes (Tofiqhi and Enders, 2007). The number of classes that best fit the data was selected based on the Bayesian information criterion (BIC), the adjusted Lo–Mendell–Rubin (LMR) test, the bootstrapped likelihood ratio test (BLRT), inspection of standardized residuals from the univariate margins, entropy (classification accuracy), and class size and interpretability (Feldman et al., 2009; Nylund et al., 2007).

Predicting young adult education outcomes—Logistic regression analyses were used to evaluate class membership in relation to the three young adult education outcomes. All pairwise comparisons between marijuana use trajectory classes were examined. However, to maximize clarity in analyses involving education path, we describe results for models in which the university group served as the reference category. All analyses controlled for sex, mother's education, age-15 family structure, age in years, T1 grades, and T1 conduct problems. In models predicting enrollment timing and dropping out, we also controlled for PSE type (i.e., university, transfer, or college) and examined the interaction of PSE type with marijuana user class.

Results

Latent class growth analysis of marijuana use

A series of unconditional latent class growth models was estimated to determine the optimal number of marijuana use classes. The three-class model was selected as the best-fitting model (BIC = 5403.72; LMR = 178.72, $p < .001$; BLRT = 184.03, $p < .001$). Although the four-class model was also a good fit to the data (BIC = 5380.72; LMR = 46.98, $p = .01$; BLRT = 48.51, $p < .001$), inspection of the standardized residuals suggested that the model did not fit as well as the three-class model, and classification accuracy was not as good as the three-class model.

Next, sex, mother's education, family structure, and T1 grades and conduct problems were added to the three-class model as covariate predictors of marijuana use class membership. Figure 1 shows fitted growth curves from the final model of marijuana use from ages 15 to 25, with covariate predictors included. The "abstainers" class ($n = 197$; 31.2%) never used marijuana. The "occasional" class ($n = 275$; 43.5%) started with using a few times a year, with their probability of use increasing to peak at a few times a month around age 20. Finally, the "frequent" class ($n = 160$; 25.3%) had a probability of using marijuana a few times a month at age 15 and increased rapidly to more than once a week by age 18. Frequency of use began to decline after age 21, but by age 25 it was still likely to be more than once a week.

The average posterior class membership probabilities were .88 (abstainers), .91 (frequent), and .87 (occasional), which were above the minimum threshold for class assignment of .70 recommended by Nagin (2005). Overall entropy was .74. Assignment uncertainty was therefore not considered to be a problem for subsequent analyses of educational outcomes.

Table 1 shows results of multinomial logistic regression predicting class membership from the covariates. Compared with the abstainer class, members of the frequent class were more likely to be male, were less likely to have lived in a two-parent household at age 15, reported more conduct problems at T1, and had significantly lower T1 grades. Members of the frequent class also had significantly lower grades than the occasional class at T1. The only significant difference between occasional users and abstainers was more T1 conduct problems among occasional users.

Description of young adult postsecondary experiences

Table 2 shows descriptive statistics for the three education outcomes across marijuana user classes. Three quarters of participants enrolled in PSE, of which about half enrolled in a university. Of those who enrolled, a little over half enrolled on time, 25% enrolled after a 1-year gap, and 20% delayed enrollment longer than a year. Finally, a little over a third of participants who enrolled dropped out of their first program. The abstainer class contained the highest percentage of university students (47%) and the lowest percentages of participants with a high school diploma only or participants who did not complete high school. Most abstainers who enrolled did so on time (70%), and they were least likely to drop out (27%). The proportion of occasional users in each enrollment type was similar to abstainers, but only half of those who enrolled went on time, and they contained a higher percentage of students who dropped out (39%). The frequent user class was least likely to enroll in PSE, especially in a university or transfer programs. They were also least likely to enroll on time (37%).

Enrollment timing and rates of dropping out differed substantially among PSE types (Table 3). Almost 80% of university students enrolled on time compared with 28% of college students and 46% of transfer students. Only 5% of university students delayed enrollment longer than a year compared with 39% in the college path. Dropout rates also were lowest for students who enrolled in a university (26%) and highest for those in a transfer program (50%), reflecting the fact that many students who started at a college and intended to transfer to a university failed to do so.

Multivariate regression analyses predicting young adult education outcomes from marijuana user classes

Postsecondary enrollment type—We used multinomial logistic regression to estimate the odds of being in any other education path relative to enrolling in a university, based on marijuana user class and covariates. Table 4 shows relative risk ratios from these analyses. Compared with both abstainers and occasional users, frequent users were less likely to enroll in a university; instead, frequent users were more likely to enroll in a college (as opposed to a university), complete a high school diploma only, or leave high school early. Differences were strongest for frequent users compared with abstainers and became stronger as educational attainment decreased. For instance, frequent users had a risk of college (relative to university) enrollment that was almost five times greater than abstainers. The risk of early high school leaving was more than 15 times greater for frequent users than for abstainers. In contrast, the occasional user class was no more likely than abstainers to follow nonuniversity paths.

Timing of enrollment—Table 5 shows the results of a multinomial logistic regression predicting the odds of taking a gap year or delaying enrollment longer than a year, relative to enrolling on time. These analyses were restricted to participants who enrolled in a university, college, or transfer program. Although the descriptive results (Table 2) showed that the frequent user class had the lowest percentage of on-time enrollment, in this multivariate model, only occasional users were significantly more likely than abstainers to take a gap

year or delay enrollment for 15 months or more. The interaction between marijuana user class and PSE enrollment type was not significant.

Dropping out of first postsecondary program—Table 6 shows results from a binary logistic regression examining marijuana trajectory class as a predictor of dropping out of the first postsecondary program undertaken. Occasional users were significantly more likely to drop out than were abstainers, but frequent users who enrolled were not significantly more likely to drop out than abstainers or occasional users. Once again, the interaction between marijuana user class and PSE path was not significant.

Discussion

The results of this study confirm previous research demonstrating the overall negative association between adolescent marijuana use and educational attainment. The findings add to previous research in two ways. First, we focus on a range of postsecondary outcomes beyond college enrollment, providing a more nuanced examination of specific ways and time periods in which marijuana use and educational failure are linked. Specifically, marijuana use limits educational attainment not just because many frequent users do not enroll in PSE but also because marijuana use is associated with delayed enrollment and a higher likelihood of dropping out. This shows that marijuana use is associated with educational difficulties during young adulthood as well as adolescence.

Second, frequent and occasional patterns of marijuana use from adolescence to emerging adulthood are associated with difficulties at different stages of the PSE pathway. Consistent with previous research (Fleming et al., 2012; Tucker et al., 2005), frequent users were significantly less likely than both occasional users and abstainers to finish high school or enroll in PSE. When they did enroll, they were less likely than occasional users and abstainers to enroll in programs leading to a bachelor's degree.

In contrast, occasional users experienced difficulties later in the educational pathway. They were as likely as abstainers to finish high school and enroll in PSE, and they were equally likely to enroll in a university (compared with other PSE types). However, occasional users delayed enrollment significantly longer than did abstainers and were more likely than abstainers to drop out.

For frequent users, the findings may reflect cascading effects of multiple problems reported in the substance use literature (Lynne-Landsmen et al., 2010). Frequent users had the lowest high school grades and greatest number of conduct problems at T1. These earlier risk factors may have led to deviant peer involvement and adjustment problems at school, relating to increasing substance use across adolescence and a closing-off of educational opportunities before emerging adulthood (King et al., 2006; Lynne-Landsmen et al., 2010). Although frequent users delayed enrollment and dropped out at higher rates than did abstainers, these differences were no longer significant when baseline covariates and postsecondary program type were controlled for. This suggests that delayed enrollment and dropping out among frequent users were explained by earlier risk.

Moreover, frequent users had the lowest rates of enrollment in any postsecondary program and were most likely to enroll in college programs, which had the longest average enrollment delay. Thus, cell sizes for frequent users in different types of PSE were quite small, restricting variance in analyses of enrollment timing and dropping out across marijuana user classes. It is also possible, however, that the few frequent users who did enroll in postsecondary programs represented a resilient subgroup who were able to succeed despite earlier difficulties. Given the potential importance of this group for prevention planning, more research is needed to explore protective factors such as school engagement in high school (Finn and Rock, 1997).

Occasional users were less disadvantaged than frequent users by earlier risk factors. Compared with abstainers, they reported significantly more T1 conduct problems but did not differ from abstainers on high school grades or indicators of socioeconomic status. These may be among the reasons they were not disadvantaged in terms of enrolling in PSE. However, the present findings are consistent with longitudinal studies suggesting that occasional or experimental use during adolescence may interfere with later performance during college (Degenhardt et al., 2010; Horwood et al., 2010; King et al., 2006).

There is increasing evidence that even occasional marijuana use has acute effects on attention, decision making, impulsivity, and working memory (Crean et al., 2011). Caldeira et al. (2008) reported high rates of marijuana-related problems such as oversleeping or missing class among users in a cohort of first-year college students, even for those who were not using heavily or reporting dependence symptoms. It is unclear whether the acute cognitive effects of marijuana use have direct impacts on academic performance. Nonetheless, the increase in marijuana use after students enroll in college (Arria et al., 2013; Fleming et al., 2012) may also indicate an increase in the problematic acute effects of marijuana.

Occasional marijuana use may also be a marker or mediator of other factors that are associated with delayed enrollment or dropping out. Several mechanisms can be proposed. Marijuana use may be related to general involvement in a “party” lifestyle in which spending time with friends and substance use are prioritized over study plans. For instance, heavy drinking increases after college enrollment (White et al., 2005), and some studies suggest that drinking predicts dropping out (Martinez et al., 2008). Moreover, students who increase their marijuana use during college also report higher rates of alcohol problems (Arria et al., 2013). It is possible that some occasional users increased their drinking more than abstainers after they enrolled in PSE, and for these participants, this may have increased the likelihood of dropout.

Several important limitations of this study should be noted. First, several past studies of latent marijuana use trajectories report more than three classes (e.g., Jackson et al., 2008; Windle and Wiesner, 2004). Theorists caution that the number of classes identified is highly contingent on factors such as the number of assessment points and the measure used (Jackson and Sher, 2008). However, the shape of the trajectories we describe in this study is supported by previous findings. Moreover, differences in covariates and outcomes across the classes are interpretable, supporting the distinctiveness of the classes. Second, limiting the

generalizability of findings, our participants included Canadian, primarily White youth. Third, although we were able to examine heterogeneity in developmental trajectories of marijuana use in relation to postsecondary outcomes that have not received much attention in past research, the sample size and upper age (25 years old) limited the extent to which we could focus on variation in postsecondary paths (e.g., returning to school after dropping out) and later outcomes like degree attainment. Fourth, many of the students in our sample were attending the same local community college and university. Although both the college and university are typical examples of these types of institutions within Canada, observed differences in outcomes between marijuana user groups may be specific to these institutions. Use of nationally representative data on substance use and PSE would enhance the generalizability of our findings. Finally, given the complexity of the analyses as well as the need to enhance interpretability, we chose not to control for other predictors of PSE outcomes such as alcohol use (Fleming et al., 2012) and mental health problems (Needham, 2009). Future research should examine the role of these factors in understanding the association between marijuana use and PSE outcomes.

The association between frequent use and failure to complete high school or enroll in PSE supports the use of interventions targeting adolescents at high risk for both educational failure and substance use early in high school. The findings also suggest that more normative developmental patterns of occasional marijuana use are related to problems during PSE. This highlights the need for continued interventions that target increases in marijuana use during late high school and after college enrollment, even for young people without a history of heavy use.

For instance, counseling services for youth who are not performing well at college should include motivational interviewing (Arria et al., 2013; White et al., 2007) and screening for substance use. The further development of effective interventions requires improved understanding of the mechanisms underlying success and difficulties in PSE for different subgroups of marijuana users.

Acknowledgments

This research was supported by Canadian Institutes for Health Research Grants #838-20000-075 (to Tim Stockwell), #79917, and #93533 (to Bonnie Leadbeater).

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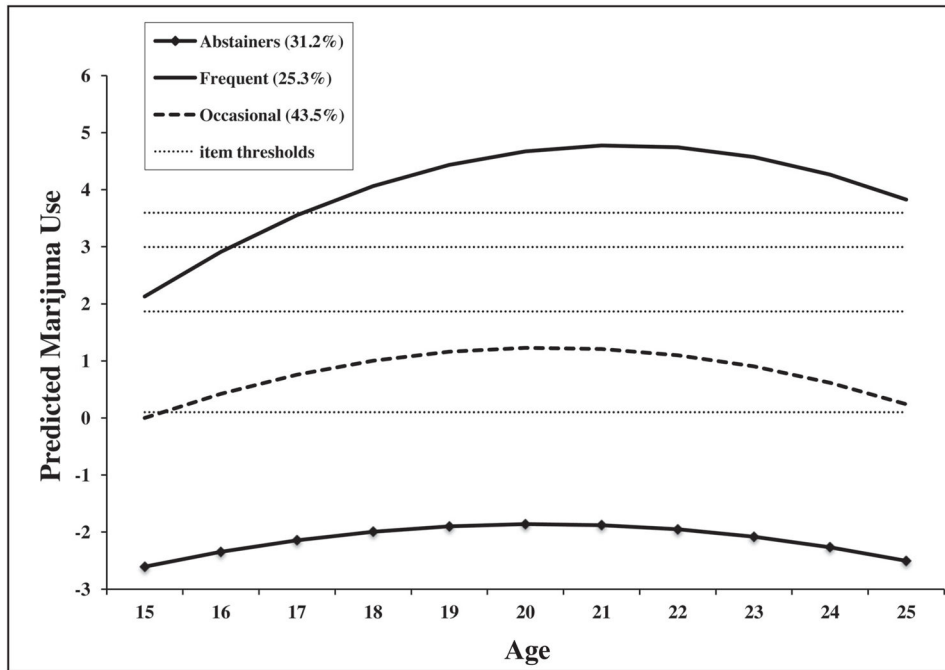


Figure 1. Predicted marijuana use trajectories from ages 15 to 25 for abstainers, occasional users, and frequent users. Because the log-odds trajectories are on arbitrary scales, the estimated thresholds that divide the categories of observed data are shown as dashed lines to facilitate interpretation. The first (lowest) line represents using marijuana a few times a year, the second a few times a month, the third a few times a week, and the fourth more than once a week.

Table 1

Marijuana class differences on early covariates

Covariates predicting marijuana class membership	Abstainers	Occasional	Frequent	Total
Female, <i>n</i> (% of class)	120 (60.9) _a	149 (54.2)	63 (39.4) _a	332 (52.5)
Two-parent family, age 15, <i>n</i> (% of class)	138 (70.1) _a	181 (65.8)	77 (48.1) _a	396 (62.7)
Mother's education, [†] <i>M</i> (<i>SD</i>)	3.99 (1.35)	3.88 (1.38)	3.83 (1.37)	3.90 (1.37)
Grades at Time 1, [‡] <i>M</i> (<i>SD</i>)	4.28 (0.73) _a	4.14 (0.76) _b	3.63 (0.75) _{a,b}	4.05 (0.79)
Conduct problems at Time 1, [§] <i>M</i> (<i>SD</i>)	0.32 (0.54) _{a,b}	0.97 (1.37) _a	1.47 (1.43) _b	0.89 (1.27)
Total, <i>n</i> (%)	197 (31.2)	275 (43.5)	160 (25.3)	632 (100.00)

Notes: Entries that share a lettered subscript are significantly different from each other at $p < .05$.

[†] Mother's education—range: 1–5 (1 = *did not finish high school*; 2 = *finished high school*; 3 = *vocational training*; 4 = *some college/university courses*; 5 = *finished college/university*).

[‡] Grades at Time 1—range: 1–5 (1 = *mostly F's*; 2 = *mostly D's*; 3 = *mostly C's*; 4 = *mostly B's*; 5 = *mostly A's*).

[§] Conduct problems—an index of eight behaviors that reflect conduct-disorder symptoms based on criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (see the Method section); range: 0–8, where each 1-unit increase represents one more behavior.

Table 2

Descriptive statistics for postsecondary experiences by marijuana trajectory group

Variable	Marijuana class			Total <i>n</i> (% of total)
	Abstainers <i>n</i> (% of class)	Occasional <i>n</i> (% of class)	Frequent <i>n</i> (% of class)	
Enrollment type				
University	74 (46.5)	91 (39.6)	15 (11.6)	180 (34.7)
College	32 (20.1)	49 (21.3)	43 (33.3)	124 (23.9)
Transfer	31 (19.5)	40 (17.4)	16 (12.4)	87 (16.8)
High school diploma	18 (11.3)	34 (14.8)	35 (27.1)	87 (16.8)
High school noncompletion	4 (2.5)	16 (6.7)	20 (15.5)	40 (7.7)
Total	159 (100.0)	230 (100.0)	129 (100.0)	518 (100.0)
Timing of enrollment in PSE ^a				
On-time enrollment	96 (70.1)	92 (51.1)	27 (36.5)	215 (55.0)
Gap year	24 (17.2)	52 (28.9)	20 (27.0)	96 (24.6)
Delayed enrollment	17 (12.4)	36 (20.0)	27 (36.5)	80 (20.1)
Total	137 (100.0)	180 (100.0)	74 (100.0)	391 (100.0)
Drops out of first PSE program ^b				
Drops out of first PSE program ^b	26 (26.8)	53 (39.3)	22 (36.7)	101 (34.6)
Total	97 (100.0)	135 (100.0)	60 (100.0)	292 (100.0)

Notes: Entries are within-marijuana-class *n* (percentages). PSE = postsecondary education.

^aFor those who enrolled only (i.e., university, college, and transfer groups);

^bexcluding participants still enrolled in their first program at the last interview.

Table 3

Descriptive statistics for enrollment timing and dropping out by PSE enrollment type

Variable	PSE enrollment type			Total <i>n</i> (% of total)
	University <i>n</i> (% of path)	College <i>n</i> (% of path)	Transfer <i>n</i> (% of path)	
Timing of enrollment in PSE ^a				
On-time enrollment	140 (77.8)	35 (28.2)	40 (46.0)	215 (55.0)
Gap year	31 (17.2)	41 (33.1)	24 (27.6)	96 (24.6)
Delayed enrollment	9 (5.0)	48 (38.7)	23 (26.4)	80 (20.1)
Total	180 (100.0)	124 (100.0)	87 (100.0)	391 (100.0)
Drops out of first PSE program ^b				
Total	33 (26.0)	36 (35.6)	32 (50.0)	101 (34.6)
Total	127 (100.0)	101 (100.0)	32 (50.0)	292 (100.0)

Notes: Entries are within-education-path *n* (percentages). PSE = postsecondary education.

^aFor those who enrolled only (i.e., university, college and transfer groups);

^bexcluding participants still enrolled in their first program at the last interview.

Table 4

Multinomial logistic regression models predicting PSE enrollment type

Variable	University compared with:			
	Transfer Relative risk (SE)	College Relative risk (SE)	High school diploma, no PSE Relative risk (SE)	Early high school leaving, no PSE Relative risk (SE)
Abstainers vs.				
Occasionals	1.08 (0.34)	1.33 (0.41)	1.75 (0.66)	3.75 (2.38)
Frequent	2.30 (1.06)	5.18 (2.18)***	8.32 (4.02)***	18.22 (12.74)***
Occasionals vs.				
Abstainers	0.92 (0.28)	0.75 (0.23)	0.57 (0.22)	0.27 (0.17)
Frequent	2.13 (0.91)	3.91 (1.50)***	4.76 (2.02)***	4.86 (2.49)**
Female	1.56 (0.46)	0.82 (0.22)	2.11 (0.69)*	1.49 (0.64)
Age in years	1.11 (0.08)	0.98 (0.07)	0.95 (0.08)	0.88 (0.10)
Mother's education	0.81 (0.09)	0.80 (0.08)*	0.65 (0.08)***	0.62 (0.09)**
Two-parent family, age 15	0.67 (0.20)	0.58 (0.16)*	0.51 (0.17)*	0.27 (0.12)**
Grades at Time 1	0.33 (0.08)***	0.21 (0.05)***	0.11 (0.03)***	0.06 (0.02)***
Conduct problems at Time 1	0.81 (0.25)	0.61 (0.18)	0.51 (0.18)*	0.40 (0.18)*
<i>n</i>	518			
Log likelihood	-649.84			
BIC	1,524.68			
Pseudo <i>R</i> ²	.17			

Notes: PSE = postsecondary education; BIC = Bayesian information criterion.

* $p < .05$;

** $p < .01$;

*** $p < .001$.

Table 5

Multinomial logistic regression model predicting timing of postsecondary enrollment

Variable	On-time enrollment compared with:	
	Gap year Relative risk (SE)	Delayed enrollment Relative risk (SE)
Abstainers vs.		
Occasionals	2.23 (0.71) [*]	2.38 (0.96) [*]
Frequent	1.50 (0.64)	2.25 (1.06)
Occasionals vs.		
Abstainers	0.45 (0.14) [*]	0.48 (0.18) [*]
Frequent	0.94 (0.35)	1.49 (0.57)
Female	1.56 (0.44)	1.22 (0.41)
Age in years	0.93 (0.07)	1.45 (0.16)
Mother's education	0.93 (0.10)	0.90 (0.11)
Two-parent family, age 15	0.77 (0.22)	0.90 (0.31)
Grades at Time 1	0.53 (0.12) ^{***}	0.33 (0.08) ^{***}
Conduct problems at Time 1	1.45 (0.43)	1.89 (0.66)
PSE type (reference category is university)		
Transfer	2.24 (0.78) [*]	5.97 (2.78) ^{***}
College	4.20 (1.43) ^{***}	12.57 (5.76) ^{***}
<i>n</i>	391	
Log likelihood	-315.89	
BIC	763.08	
Pseudo <i>R</i> ²	.19	

Notes: For conciseness, we do not report coefficients for the nonsignificant interaction between marijuana user group and PSE type. PSE = postsecondary enrollment; BIC = Bayesian information criterion.

^{*} $p < .05$;

^{***} $p < .001$.

Table 6

Binary logistic regression model predicting dropping out of a postsecondary program

Variable	Odds ratio (SE)
Abstainers vs.	
Occasionals	1.96 (0.64) *
Frequent	1.29 (0.52)
Occasionals vs.	
Abstainers	0.51 (0.17) *
Frequent	0.66 (0.23)
Female	1.15 (0.31)
Age in years	0.79 (0.06) **
Mother's education	1.02 (0.11)
Two-parent family, age 15	0.49 (0.14) *
Grades at T1	0.59 (0.13) *
Conduct problems at T1	1.03 (0.31)
Postsecondary program type (reference category is university)	
Transfer	2.36 (0.84) *
College	0.91 (0.32)
<i>n</i>	292
Log likelihood	-171.05
BIC	404.54
Pseudo R^2	.10

Notes: For conciseness, we do not report coefficients for the nonsignificant interaction between marijuana user group and postsecondary enrollment type. BIC = Bayesian information criterion.

* $p < .05$;

** $p < .01$.