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Marijuana Exposure Opportunity and Initiation during College: Parent and Peer Influences

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Abstract

Marijuana is the most prevalent illicit drug used by adolescents and young adults, yet marijuana initiation is rarely studied past adolescence. The present study sought to advance our understanding of parent and peer influences on marijuana exposure opportunity and incident use during college. A sample of 1,253 students was assessed annually for four years starting with the summer prior to college entry. More than one-third (38%_{wt}) of students had already used marijuana at least once prior to college entry; another 25%_{wt} initiated use after starting college. Of the 360 students who did not use marijuana prior to college, 74% were offered marijuana during college; of these individuals, 54% initiated marijuana use. Both low levels of parental monitoring during the last year of high school and a high percentage of marijuana-using peers independently predicted marijuana exposure opportunity during college, holding constant demographics and other factors ($AOR=0.92$, 95% $CI=0.88-0.96$, $p<.001$ and $AOR=1.11$, 95% $CI=1.08-1.14$, $p<.001$, respectively). Among individuals with exposure opportunity, peer marijuana use ($AOR=1.04$, 95% $CI=1.03-1.05$, $p<.001$), but not parental monitoring, was associated with marijuana initiation. Results underscore that peer influences operate well into late adolescence and young adulthood and thus suggest the need for innovative peer-focused prevention strategies. Parental monitoring during high school appears to influence exposure opportunity in college; thus parents should be encouraged to sustain rule-setting and communication about adolescent activities and friend selection throughout high school.

Keywords

Cannabis; College students; Family influences; Peer Influences; Prevention

Marijuana has been the most commonly used illicit drug on college campuses for decades and remains so today (Arria et al. 2008a; Johnston et al. 2009). Epidemiological studies estimate that more than 45% of college students have used marijuana at least once in their lifetime, and recent past-year prevalence estimates hover around 30% (Johnston et al. 2009; Mohler-Kuo et al. 2003). While many studies have documented that marijuana use typically begins in adolescence (Gfroerer et al. 2002), little is known about individuals who initiate

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use in college. In a large national sample of college students, Gledhill-Hoyt et al. (2000) observed that 29% of past-30 day marijuana users had initiated marijuana use at or after the age of 18. Understanding the processes that are involved in initiating marijuana use after entering college has important implications for the timing of intervention strategies and the targeting of developmentally-appropriate interventions to reduce the likelihood of new initiates.

Opportunities to use marijuana are prevalent in adolescence and continue throughout college and adulthood. In the general US population, approximately two-thirds of individuals with exposure opportunity initiate marijuana use, with 45% progressing from opportunity to use within one year (Van Etten et al. 1997).

Among the various consequences of marijuana use, short-term memory deficits and difficulties with concentration (Ashton 2001) have particular relevance to college students. Compared to non-users, adolescent and college marijuana users report poorer academic performance, less time spent studying, and increased absence from class (Bell et al. 1997; Caldeira et al. 2008; Lynskey & Hall 2000; Mustaine & Tewksbury 2004). It has been estimated that 24.6% of marijuana-using students in their first year of college meet criteria for cannabis use disorder (Caldeira et al. 2008).

A large body of literature exists on risk factors for marijuana use among adolescents; however, fewer studies have been conducted to explain marijuana initiation after high school. In selecting a set of possible explanatory variables, we were guided by social development theory (Hawkins & Weis 1985) and ecological systems theory (Bronfenbrenner 1979), both of which describe multiple spheres of influence on behavior. The more an individual is exposed to activities and values that discourage underage drinking and drug use, and receives reinforcement for non-use, the more likely that individual is to internalize these norms, which will drive future behavior. For example, greater religiosity can provide both contact with prosocial influences and a mechanism for shaping prosocial beliefs, although it is difficult to generalize across denominations. Many empirical studies have demonstrated a protective influence of religiosity on adolescent drug use (Bahr et al. 1998; Wallace et al. 2007).

Peer influences have long been recognized as critical risk factors for substance use involvement at different stages of development (Brook et al. 2001; Hawkins et al. 1992; Reifman et al. 1998; Windle 2000). Several studies of adolescents have found that individuals who use drugs are more likely to have friends who also engage in substance use (Bahr et al. 1998; Barnes et al. 2006; Steinberg et al. 1994). Dinges and Oetting (1993) reported that 41.6% of non-marijuana-using youth had friends who used marijuana, while 97.5% of marijuana-using youth had friends also using marijuana. In an effort to understand the impact of peer influences on marijuana use beyond the teenage years, White et al. (2006) studied 319 twelfth graders prospectively and found that those with fewer marijuana-using friends in high school were less likely than their counterparts to increase their marijuana use frequency six months later. This study also demonstrated a similarly protective effect of high levels of religiosity.

The family context, especially during early adolescence, establishes boundaries for acceptable behavior. While several aspects of parenting behavior have been found to be associated with adolescent drug involvement, a high level of parental monitoring appears to be one of the most consistent protective factors across developmental stages (Chassin et al. 1993; Chilcoat & Anthony 1996; Kosterman et al. 2000). The effect of parental monitoring, as reflected by rule-setting and vigilance regarding child activities, whereabouts, and friends, can serve to limit drug exposure during high school (Barnes et al. 2006; Beck et al.

1999; Steinberg et al. 1994). According to Chilcoat and Anthony (1996), youth who were monitored least during middle childhood had a higher risk of marijuana, cocaine, and inhalant initiation than youth who were highly monitored. A later follow-up study of this cohort observed that parental monitoring measured in early childhood did not predict marijuana exposure opportunity over and above the effects of coercive discipline and involvement/reinforcement (Chen et al. 2005). However, other research has suggested that parental monitoring in later adolescence might have a protective effect on later opportunities to use drugs. This notion was partially supported by White et al. (2006), who found that higher levels of parental monitoring in twelfth grade predicted fewer increases in marijuana use six months later, but only among college-bound students. Similarly, in prior analyses of the longitudinal dataset used in the current study, Arria et al. (2008b) observed that higher levels of parental monitoring in high school were indirectly associated with lower levels of alcohol consumption in college via lower levels of alcohol consumption in high school.

Because it is clear that both parent and peer factors are influential with respect to adolescent drug use, many investigators have found it useful to examine the interplay between these two broad domains of influence rather than engage in debates about their relative importance. To this end, research studies have concluded that a possible mechanism underlying the protective effect of parental monitoring is through reducing the risk of deviant peer affiliation. Studies have demonstrated that rule-setting and monitoring have a negative relationship with deviant peer involvement (Flannery et al. 1999; Oxford et al. 2000; Steinberg et al. 1994). As students approach the transition from high school into college, high levels of parental monitoring might help them internalize parental values relating to friend selection, such that students who were highly monitored as adolescents are accustomed to associating with non-delinquent peers, which in turn might influence prosocial friend selection during college. In support of that hypothesis, one prospective study of 392 college freshmen (Abar & Turrisi 2008) demonstrated that peers' alcohol use mediated the relationship between pre-college parental monitoring and students' own alcohol consumption in their second semester of college. It remains to be seen if this association also holds true for marijuana use in college. Other studies have suggested that parental monitoring and parental disapproval moderate the adverse effects of peer factors on alcohol consumption during the transition to college (Martino et al. 2009; Wood et al. 2004).

Finally, although influences in the social and family environment are critically important factors with respect to the likelihood of drug involvement, individual-level characteristics are also highly predictive of risk. Multiple studies have consistently found that behavioral undercontrol—defined as a decreased capacity to plan and regulate behavior appropriately—is a cardinal feature of risk for early onset substance use and development of substance use problems (Iacono et al. 2008; Tarter et al. 2004). Related to this construct is sensation-seeking, which has also been observed to have strong relationships with adolescent and young adult drug involvement (Arria et al. 2008c; Martins et al. 2008; Newcomb & McGee 1991). With respect to demographic correlates, marijuana use is generally more prevalent in males than females and in Whites than non-Whites (Johnston et al. 2009). The gender difference, however, appears to be explained by differences in marijuana exposure opportunity. Once opportunity occurs, males and females are equally likely to use marijuana (Van Etten & Anthony 2001).

Purpose of the Present Study

The current study focused on identifying correlates of marijuana exposure opportunity and initiation of use during college. In particular, we evaluated whether or not high levels of parental monitoring during the last year of high school and lower affiliation with drug-using peers in college had direct statistical effects on lowering the risk of marijuana exposure

opportunity and use during college among those with no prior involvement with marijuana. Accordingly, the study aimed to: 1) estimate the risk for marijuana initiation during college among students who never used marijuana prior to college; 2) compare students who did and did not have marijuana exposure opportunity during college on several suspected risk factors, including race, sex, religiosity, sensation-seeking, affiliation with marijuana-using peers, and parental monitoring during the last year of high school; and 3) compare initiators with non-users during college on these same suspected risk factors. To gain a thorough understanding of the interplay between parent and peer factors, we tested the possible mediating and moderating influences of peer drug use on the relationships between parental monitoring and the risk of marijuana exposure opportunity and use, controlling for demographic characteristics, religiosity, and sensation-seeking.

Method

Study Design

Figure 1 portrays a conceptual schematic for the stages of marijuana initiation, beginning with non-use before college, leading to opportunity to use marijuana, and finally marijuana initiation during college. This conceptual schematic helps clarify the two main outcomes that are the focus of this analysis, namely, marijuana exposure opportunity and marijuana initiation during college. Accordingly, two sets of hypotheses guided our analyses and are depicted as arrows in Figure 1. First, with respect to marijuana exposure opportunity during college, we hypothesized that higher levels of parental monitoring during high school would have both a direct protective effect on marijuana exposure opportunity and an indirect effect via reduced likelihood of social contact with marijuana-using peers. Similarly, we tested the significance of these same interrelationships with respect to our second outcome variable, marijuana initiation during college among those who had exposure opportunity.

Data were derived from the College Life Study, an ongoing prospective longitudinal study of college students at a large, public, mid-Atlantic university (Arria et al. 2008a; Vincent et al. under second review). At new-student orientation in 2004, the entire cohort of first-time, first-year students ages 17 to 19 were invited to complete a brief screening survey ($N=3,401$; response rate 88.7%). Next, a sample of screener participants was selected for participation in a longitudinal study. Individuals who used an illicit drug (or used a prescription drug nonmedically) at least once prior to college were purposively oversampled to optimize statistical power for analyses of drug use. The sampling frame was stratified by race and sex to ensure demographic diversity in the sample. Sampling weights were computed later to adjust for the purposive sampling design, in order to produce prevalence estimates (denoted as %_{wt}) that generalize back to the original target population of incoming first-year students. The resulting sample of 1,253 students (86.5% response rate) completed a two-hour, in-person “baseline” assessment (consisting of both interviewer-administered and self-administered modules) at some point during their first year of college (Year 1), and were eligible for annual follow-up assessments, regardless of continued college enrollment. Assessments were conducted by trained interviewers, informed consent was obtained, and a Federal Certificate of Confidentiality was acquired. Participants received \$5 for participating in the screener and \$50 for each interview assessment, plus an additional \$20 bonus for on-time completion of each follow-up assessment (i.e., within four weeks of the anniversary of their baseline assessment). Follow-up rates (of the original 1,253 baseline participants) were 91.1% ($n=1,142$) in Year 2, 87.9% ($n=1,101$) in Year 3, and 87.6% ($n=1,097$) in Year 4.

Participants

Figure 2 depicts the derivation of the two analytic samples. First, for the analyses focused on marijuana exposure opportunity, Sample A was restricted to the 360 individuals who did not

use marijuana prior to college and who completed all four assessments with non-missing data on hypothesized predictors (i.e., parental monitoring scale score, peer marijuana use). Participants not meeting inclusion criteria were 632 individuals who used marijuana prior to college (based on their screener data), plus 235 individuals missing one or more annual assessments, and 26 individuals missing data on predictor variables. Individuals excluded from analyses were significantly more likely to be male, White, and have a higher estimated family income (all at $p \leq .01$) than those individuals included in the sample; more specifically, males were disproportionately more likely to be excluded due to incomplete data, whereas Whites and individuals with higher family income were disproportionately more likely to be excluded due to pre-college marijuana use. The second analysis sample (Sample B) consisted of the subset of individuals from the first analytic sample who had marijuana exposure opportunity during college ($n=265$). It is important to note that, although most participants were continuously enrolled at the same university all four years (72.2%), a portion of them studied abroad, graduated early, attended school sporadically, or transferred to a different school during the four years of study (data not shown).

To place these two analytic sub-samples in a broader context, we computed weighted lifetime prevalence of marijuana use based on the entire sample studied ($N=1,253$), after statistically adjusting for our purposive sampling design. An estimated 37.8%_{wt} of incoming first-year students tried marijuana at least once prior to coming to college, and another 24.6%_{wt} used marijuana for the first time after starting college. The remaining 37.6%_{wt} never used marijuana in their lifetime, even by Year 4 of the study. Thus, lifetime prevalence of marijuana use by Year 4 was 62.4%_{wt}.

Measures

Marijuana exposure opportunity—At Year 1 participants were asked the age at which they were first offered marijuana. In each subsequent assessment, participants were asked “in the past 12 months, on how many days have you been offered any type of marijuana?” Responses from all four years were collapsed to form a single, binary variable indicating marijuana exposure opportunity at least once since starting college, based on age at college entry.

Marijuana initiation during college—Annually, participants were asked “in the past 12 months, on how many days have you used any type of marijuana?” Responses from all four years were collapsed to form a single, binary variable indicating use during college.

Peer marijuana use—With the exception of Year 1, participants were asked annually about marijuana use among their peers via self-administered questionnaire. For each year, the percentage of marijuana-using peers was computed as the number of close friends the participant believed were using marijuana, divided by their total number of close friends, multiplied by 100. Next, a summary variable was derived as the average of the three annual percentages. The annual percentage variables correlated strongly ($r=.57$ to $.65$), and the overall sample means and standard deviations of these percentages were very similar across the three years ($M=28.6\%$, $SD=29.6\%$ for Year 2; $M=28.9\%$, $SD=30.5\%$ for Year 3; and $M=27.4\%$, $SD=29.8\%$ for Year 4).

Parental monitoring in high school—The screener survey included a version of Capaldi and Patterson's (1989) nine-item parental monitoring scale that was adapted to be more developmentally appropriate for older adolescents, which has been published previously (Arria et al. 2008b). This scale assessed the individual's perception of the level of monitoring and supervision they received during their senior year of high school. Respondents were asked to think back over their last year in high school and answer

questions such as, “When you got home from school, how often was an adult there within an hour of you getting home?”, “When you went to parties, how often was a supervising adult present at the party?”, and “How often before you went out would you tell your parents when you would be back?” Each item was scored on a 5-point scale with higher scores signifying a higher level of parental monitoring. The scale showed good internal consistency in the study sample (Cronbach's $\alpha=.75$).

Impulsive sensation-seeking—Sensation-seeking was assessed in Year 1 using the impulsive sensation-seeking subscale of the Zuckerman-Kuhlman Personality Questionnaire-Short Form (Zuckerman 2002). This 7-item self-administered scale measured facets of sensation-seeking such as impulsivity, unpredictability, and the need for excitement. Participants indicated their agreement with each statement by responding “true” or “false”, with one point assigned for each “true” item. Higher scores indicate higher levels of sensation-seeking. The scale demonstrated good internal consistency in the study sample (Cronbach's $\alpha=.72$).

Religiosity—The screener questionnaire contained one self-administered item: “How important is religion in your life?” This item was strongly correlated ($r=.7$ to $.8$) with the eight other religiosity items assessed in Years 1 through 4 of the study on religious activity attendance, frequency of prayer, strength of beliefs, and other aspects of religiosity. Thus the single-item measure was used in the analyses. The four response options were later dichotomized into “low” (i.e., not/slightly important) versus “high” (i.e., moderately/extremely important).

Demographic characteristics—Sex was coded as observed by the interviewer in Year 1. Race was obtained via self-report in Year 3 and confirmed using university administrative data. Because almost three-quarters of the sample were White, race was dichotomized as White versus non-White. The mean adjusted gross income for each participant's home ZIP code was used as a proxy for family income (MelissaDATA 2003).

Statistical Analyses

Descriptive statistics were computed using unweighted data for the two analytic samples defined in Figure 2. For Sample A (360 individuals who never used marijuana prior to college), differences in control variables and hypothesized predictors of exposure opportunity were examined between those who were and were not offered marijuana during college ($n=265$ and 95 , respectively). For Sample B (265 individuals who had exposure opportunity in college), differences in control variables and hypothesized predictors of marijuana initiation were examined between those who did and did not initiate marijuana use during college ($n=144$ and 121 , respectively). Significant differences were evaluated using t -tests and chi-square tests ($p\leq.05$).

Next, a series of multiple regression models were developed to test the interrelationships between parental monitoring, peer marijuana use, and the two dependent variables: marijuana exposure opportunity and initiation during college among those with opportunity. As noted earlier, we hypothesized that parental monitoring would be associated with a decreased likelihood of both exposure opportunity and initiation, both directly and indirectly via peer marijuana use. Thus, in Sample A, we evaluated: 1) the main effect of parental monitoring on opportunity; 2) the main effect of peer marijuana use on opportunity; 3) the possibility that peer marijuana use mediated any observed association between parental monitoring and marijuana exposure opportunity; and 4) the possibility that the effect of parental monitoring on exposure opportunity might differ at varying levels of peer marijuana

use (i.e., moderation), evaluated as the first-order interaction of parental monitoring with peer marijuana use.

Finally, in Sample B, the above regression modeling process was repeated to evaluate the interrelationships between parent and peer influences and marijuana initiation among individuals with exposure opportunity. The effects of sex, race, religiosity, family income, and sensation-seeking were held constant in all regression models.

Results

Marijuana Exposure Opportunity and Initiation during College

As can be seen in Figure 2, of the 360 individuals who entered college never having tried marijuana, 265 (73.6%) were offered marijuana sometime during the four years of college. Of those given the opportunity, 144 (54.3%) used marijuana at least once sometime during the four years of college.

Correlates of Marijuana Exposure Opportunity

Among the 360 individuals who did not use marijuana prior to college entry, exposure opportunity was associated with being male and White, and having low religiosity, low parental monitoring, high sensation-seeking, and a high percentage of marijuana-using peers (see Table 1, Sample A). Family income was the only variable tested that was not associated with marijuana exposure opportunity.

Correlates of Marijuana Use Initiation in College, given Exposure Opportunity

Among the 265 individuals with exposure opportunity, those who initiated marijuana use during college had a higher percentage of marijuana-using peers and higher levels of sensation-seeking than non-initiators, but were similar with respect to race, sex, religiosity, family income, and parental monitoring (see Table 1, Sample B). In most cases, initiation occurred during the first two years of college (74.3% of initiators, data not shown in a table).

Models Predicting Marijuana Exposure Opportunity among Non-users Prior to College

As shown in the first two columns of Table 2 (Models 1 and 2), both parental monitoring and peer marijuana use were significantly related to exposure opportunity, independent of demographics, religiosity, and sensation-seeking. As hypothesized, higher levels of parental monitoring were associated with a lower risk of marijuana exposure opportunity ($AOR=0.92$, $95\% CI=0.88-0.96$, $p<.001$), while higher levels of peer marijuana use conferred greater risk ($AOR=1.11$, $95\% CI=1.08-1.14$, $p<.001$). Although sex, race, religiosity, and sensation-seeking all had significant bivariate associations with opportunity, only the effects of race and sensation-seeking were robust to the inclusion of parental monitoring. No control variables were robust to the inclusion of peer marijuana use.

As shown in the third column of Table 2 (Model 3), the effect of parental monitoring on marijuana exposure opportunity remained significant ($AOR=0.94$, $95\% CI=0.89-1.00$, $p=.041$) independent of peer marijuana use. Also nested within that column are results from the separate model showing a significant negative association between parental monitoring and peer marijuana use ($b=-0.78$, $95\% CI=-1.19- -0.37$, $p<.001$), a necessary condition for demonstrating mediation. However, given that both parental monitoring and peer marijuana use were significantly and independently associated with opportunity, results fail to provide clear support for the hypothesis that peer marijuana use mediated the effect of parental monitoring on marijuana exposure opportunity. Moreover, although parental monitoring remained significantly associated with opportunity regardless of peer marijuana use, its contribution was insubstantial in the context of peer marijuana use ($R^2=.36$ versus $.35$).

Lastly, shown in Model 4 is the significant first-order interaction between parental monitoring and peer marijuana use ($AOR=0.99$, $95\% CI=0.99-1.00$, $p=.044$), such that the protective effect of parental monitoring on marijuana exposure opportunity was strongest at high levels of peer marijuana use.

Models Predicting Marijuana Initiation, given Marijuana Exposure Opportunity

From the first two columns of Table 3 (Models 1 and 2), peer marijuana use was associated with marijuana initiation ($AOR=1.04$, $95\% CI=1.03-1.05$, $p<.001$), independent of demographics, religiosity, and sensation-seeking, but parental monitoring was not ($AOR=0.98$, $95\% CI=0.94-1.02$, $p=.327$). Sensation-seeking was significantly associated with marijuana initiation, regardless of the inclusion of parental monitoring and/or peer marijuana use. Race, which was non-significant in the bivariate analyses (see Table 1), became significant when peer marijuana use was entered in the model. Given opportunity, Whites were significantly less likely than non-Whites to initiate marijuana use ($AOR=.49$, $95\% CI=.26-.93$, $p=.030$). As in the bivariate analyses, the remaining control variables were not significantly related to marijuana initiation in the multivariate models.

In the third column of Table 3 (Model 3), the association between peer marijuana use and marijuana initiation was essentially unchanged with the inclusion of parental monitoring, which itself remained non-significant. Although the absence of a significant association with parental monitoring precludes the possibility of a mediation effect, for the sake of completeness we tested the effect of parental monitoring on peer marijuana use, the results of which are depicted as a separate column nested under Model 3. Similar to the previous analyses for opportunity, results remained supportive of a strong association between parental monitoring and peer marijuana use ($b=-0.58$, $95\% CI= -1.08- -0.07$, $p=.025$). Finally, we found no evidence of an interaction between parental monitoring and peer marijuana use on marijuana initiation (see Table 3, Model 4), suggesting the absence of moderation.

Post-Hoc Analysis of Marijuana Use Frequency

It is important to note that not all marijuana users in the sample used marijuana frequently. A post-hoc analysis was conducted to determine how many marijuana users used twelve or more times in the past year (roughly corresponding to monthly). Based on the original sample ($N=1,253$), 32.8%_{wt} of all students met this criterion at least once over four years. Interestingly, monthly marijuana use was significantly more prevalent among the pre-college initiators as compared to those who initiated use after college entry (64.6% vs. 34.9%, $p<.001$). Weekly or more than weekly use (i.e., 52 or more times in the past year) was also more common for pre-college initiators than college initiators (35.9% vs. 15.6%, $p<.001$).

Discussion

The current study provides strong evidence of the continuity of marijuana use from high school to college and shows that the risk for exposure and use of marijuana remains high during college, even among students who never used marijuana during high school. Fortunately, frequent use was uncommon among individuals who initiated marijuana use in college: two-thirds never attained a monthly pattern of use. This finding is consistent with prior literature showing that early onset of various forms of substance use is associated with a greater degree of subsequent problems (Winters & Lee 2008). Notably, the proportion initiating marijuana use during college—54% of those who had opportunity—was only slightly less than in the general US population 12 and over, previously estimated at approximately 66% (Van Etten et al. 1997).

The current study also sheds light on how parent and peer influences combine to play a role in marijuana exposure opportunity and initiation among college students. Both peer influences in college and earlier parental monitoring during high school had additive effects on risk for exposure opportunity. Once exposure occurred, however, the decision to use or not use was related to proximal peer influences more so than to earlier parental influences. One possible explanation for this finding is that the percentage of marijuana-using peers might be positively correlated with the number of offers to use. Being offered marijuana more frequently might make use more likely, regardless of earlier parental monitoring. The present finding that peer marijuana use moderated the effect of parental monitoring on marijuana exposure opportunity echoes and extends prior evidence that peer and parent influences on heavy drinking interact during late adolescence (Martino et al. 2009; Wood et al. 2004), and supports the notion that, far from being superseded by peer influences, parents' protective influences become increasingly important as peer risk factors increase.

The findings have implications for the design and timing of peer-based interventions. Some investigators have suggested that increasing the availability of prosocial peer-related activities during high school might be a promising strategy for reducing the risk for drug involvement. It might also be prudent for colleges to consider peer-focused interventions, which have shown promise in reducing the quantity and frequency of heavy drinking among college students (Wood et al. 2007). Because new initiation was very unlikely past the second year in college, these sorts of prevention efforts should be targeted to students in the first two years of college, as a continuation of sustained prevention activities beginning before high school.

This study supports strategies to empower parents to recognize and exert their role in drug prevention. Parents should recognize that even if their child did not become involved with marijuana in high school, there is still a very high likelihood of exposure opportunity in college and a moderate likelihood of becoming a new user. One critical message for parents emanating from this study, which is consistent with the findings of others (Abar & Turrisi 2008; Wood et al. 2004) is that parents should not "let up" in high school with respect to the degree of vigilance concerning their adolescent's whereabouts, activities, and friends. Given the continued strength of peer influences on behavior observed in this study, and the significant inverse association between the level of parental monitoring and drug-using peers, parent-focused prevention strategies that include teaching parents of older adolescents about the importance of parent-child communication regarding friend selection and drug use opportunities should be encouraged and evaluated. These types of parenting interventions might be particularly useful for parents of college-bound adolescents, where multiple opportunities for social interactions exist and group living situations allow for easy sharing of drugs. Prior research has shown some parent-based interventions to be effective in reducing the number of alcoholic drinks consumed per week (Ichiyama et al. 2009).

One plausible explanation for our findings is that students who experienced high levels of parental monitoring during high school might have had little opportunity to associate with drug-using friends in high school, and thus developed and internalized prosocial peer preferences that they maintained during college. Strong support for this mechanism of influence was demonstrated by Abar and Turrisi (2008) in their study of college freshmen, whereby peer alcohol use mediated the association between pre-college parenting practices and college drinking. Other evidence suggests that high levels of parental monitoring can cushion the effect of peer deviance on substance use (Barnes et al. 2006; Oxford et al. 2000; Wood et al. 2004). Unlike Abar and Turrisi (2008), we did not observe a mediation effect from drug-using peers, perhaps due to our narrow focus on marijuana initiation rather than frequency of marijuana use or another more inclusive measure. Nevertheless, our results confirm the protective influence of parental monitoring on subsequent peer marijuana use

and exposure opportunity in college. Further confirmation of the mediation hypothesis will require future studies which include assessment of the peer selection process starting from an earlier developmental stage.

Several limitations of the study are important to consider. First, because the data were derived from a single university, the findings have limited generalizability to students on other campuses, such as small private colleges and populations with more racial/ethnic diversity than in our predominantly White sample. In light of prior evidence of racial/ethnic differences in parenting influences on substance use (Broman et al. 2006), future studies should investigate whether the observed associations hold true for college students with different racial/ethnic or socioeconomic backgrounds. Second, as with all self-report studies of drug use, our results are subject to recall bias and socially desirable responding. Given the confidentiality measures in place, the likelihood of under-reporting was minimized. Thirdly, because initiation was dichotomized into use or non-use, individuals who only tried marijuana once or twice were counted in the same way as frequent or persistent users. Future studies should focus on developing explanatory models for different marijuana use patterns. In addition, parental monitoring was only assessed for the pre-college period, and thus we cannot comment on whether or not the observed effects resulted from some form of continued parental contact in college. Lastly, because our measure of parental monitoring was based on child and not parent reports, it might reflect child-driven behaviors and perceived parental monitoring rather than actual parental behavior.

The findings of this study have implications for future research that is needed to understand the developmental processes involved in substance use initiation during the older adolescent and young adult years. For example, this study only measured parental monitoring during the last year of high school. Future studies should clarify whether other aspects of parental behavior in the older adolescent years can either adversely impact or reduce drug use risk or the escalation of drug problems, or even perhaps facilitate treatment when problems occur. Given the strong association between sensation-seeking and both exposure opportunity and initiation observed in this study, future research with larger and more diverse samples is needed to clarify how various parenting styles interact with child temperament and personality characteristics to lead to different child outcomes.

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Figure 1.
Conceptual schematic depicting hypothesized relationships

Figure 2.
Derivation of two analytic samples (depicted in boxes with bold outline)

Table 1

Sample characteristics, by marijuana exposure opportunity; and by marijuana initiation, given opportunity

	Sample A: Students with no prior marijuana use		Sample B: Students with no prior use and with marijuana exposure opportunity during college		
	No opportunity to use marijuana (n=95)	Opportunity to use marijuana (n=265)	Total (n=360)	No initiation (n=121)	Initiators (n=144)
Dependent Variable					
Initiated marijuana use during college					
Yes: N (%)	0 (.00)	144 (54.34)**	144 (40.00)	--	144 (54.3)
No: N (%)	95 (100.00)	121 (45.66)	216 (60.00)	--	121 (45.7)
Hypothesized Predictors					
Parental monitoring score: Mean (SD)	34.13 (6.14)	31.00 (6.01)**	31.83 (6.19)	31.73 (6.44)	31.00 (6.01)
Peer marijuana use: Mean % (SD)	6.32 (10.96)	35.95 (24.92)**	28.04 (25.67)	24.94 (20.68)	35.95 (24.92)
Control Variables					
Sex					
Male: N (%)	31 (32.63)	121 (45.66)*	152 (42.22)	49 (40.50)	121 (45.66)
Female: N (%)	64 (67.37)	144 (54.34)	208 (57.78)	72 (59.50)	144 (54.34)
Race					
White: N (%)	47 (49.47)	186 (70.19)**	233 (64.72)	87 (71.90)	186 (70.19)
Non-white: N (%)	48 (50.53)	79 (29.81)	127 (35.28)	34 (28.10)	79 (29.81)
Religiosity					
Low: N (%)	29 (30.53)	114 (43.02)*	143 (39.72)	46 (38.02)	114 (43.02)
High: N (%)	66 (69.47)	151 (56.98)	217 (60.28)	75 (61.98)	151 (56.98)
Family Income: Mean (SD)	6.57 (2.52)	6.98 (3.27)	6.87 (3.09)	6.61 (3.26)	6.98 (3.27)
Sensation-seeking score: Mean (SD)	2.23 (1.84)	2.98 (2.09)**	2.78 (2.05)	2.53 (1.99)	2.98 (2.09)

^aThe mean adjusted gross income reported by the Internal Revenue Service for each participant's home ZIP code during their last year in high school, measured in ten thousands.

* $p \leq .05$

** $p \leq .01$

Table 2

Multiple regression results predicting marijuana exposure opportunity on the basis of parental monitoring, peer marijuana use, and control variables, among individuals who had not used marijuana prior to college ($n=360$)

	Model 1: Primary Independent Variable: Parental Monitoring ^a	Model 2: Primary Independent Variable: Peer Marijuana Use ^b	Model 3: Peer marijuana use mediating the association between parental monitoring and exposure opportunity ^b	Model 4: Peer marijuana use moderating the association between parental monitoring and exposure opportunity ^b
	AOR(95% CI)	AOR(95% CI)	AOR(95% CI)	AOR(95% CI)
Hypothesized Predictors				
Parental monitoring	0.92 (0.88-0.96)**		0.94 (0.89-1.00)*	-0.78 (-1.19, -0.37)**
Peer marijuana use		1.11 (1.08-1.14)**	1.10 (1.07-1.13)**	1.34 (1.10-1.63)**
Interaction: Parental monitoring × peer marijuana use				0.99 (0.99-1.00)*
Control Variables				
Sex=Male	1.28 (0.75-2.17)	1.33 (0.71-2.47)	1.26 (0.67-2.37)	1.21 (0.64-2.28)
Race=White	2.57 (1.52-4.34)**	1.50 (0.82-2.76)	1.63 (0.88-3.04)	1.58 (0.84-2.94)
Religiosity=High	0.75 (0.43-1.28)	1.10 (0.57-2.11)	1.17 (0.61-2.26)	1.17 (0.60-2.28)
Family Income ^c	1.01 (0.93-1.11)	1.02 (0.92-1.12)	1.01 (0.92-1.12)	1.02 (0.92-1.12)
Sensation-seeking score	1.23 (1.08-1.41)**	1.10 (0.94-1.29)	1.12 (0.95-1.32)	1.10 (0.93-1.30)
R^2	.11	.35	.36	.37

^aRegression run with $n=357$; three cases were excluded due to missing data on family income.

^bRegression run with $n=353$; four cases were excluded due to missing data on peer marijuana use; three cases were excluded due to missing data on family income.

^cThe mean adjusted gross income reported by the Internal Revenue Service for each participant's home ZIP code during their last year in high school, measured in ten thousands.

* $p \leq .05$

** $p \leq .01$

Table 3

Multiple regression results predicting marijuana initiation on the basis of parental monitoring, peer marijuana use, and control variables, among individuals with marijuana exposure opportunity during college ($n=265$)

	Model 1: Primary Independent Variable: Parental Monitoring ^a	Model 2: Primary Independent Variable: Peer Marijuana Use ^b	Model 3: Peer marijuana use mediating the association between parental monitoring and marijuana initiation ^b	Model 4: Peer marijuana use moderating the association between parental monitoring and marijuana initiation ^b
	AOR(95% CI)	AOR(95% CI)	AOR(95% CI)	AOR(95% CI)
Hypothesized Predictors				
Parental monitoring	0.98 (0.94-1.02)			0.94 (0.85-1.03)
Peer marijuana use		1.04 (1.03-1.05)**	0.99 (0.95-1.04)	0.99 (0.92-1.06)
Interaction: Parental monitoring × peer marijuana use			1.04 (1.03-1.05)**	1.00 (1.00-1.00)
Control Variables				
Sex=Male	1.29 (0.76-2.17)	1.19 (0.68-2.09)	1.18 (0.67-2.08)	1.20 (0.68-2.11)
Race=White	0.74 (0.42-1.31)	0.49 (0.26-0.93)*	0.49 (0.26-0.93)*	0.50 (0.26-0.95)*
Religiosity=High	0.69 (0.40-1.18)	0.87 (0.49-1.57)	0.88 (0.49-1.60)	0.89 (0.49-1.62)
Family Income ^c	1.08 (0.99-1.18)	1.08 (0.99-1.18)	1.08 (0.99-1.18)	1.08 (0.99-1.18)
Sensation-seeking score	1.22 (1.08-1.39)**	1.16 (1.01-1.33)*	1.16 (1.01-1.33)*	1.16 (1.01-1.34)*
R^2	.06	.16	.16	.17

^aRegression run with $n=262$; three cases were excluded due to missing data on family income.

^bRegression run with $n=258$; four cases were excluded due to missing data on peer marijuana use; three cases were excluded due to missing data on family income.

^cThe mean adjusted gross income reported by the Internal Revenue Service for each participant's home ZIP code during their last year in high school, measured in ten thousands.

* $p \leq .05$

** $p \leq .01$