The power of the proposition: frequency of marijuana offers, parental knowledge, and adolescent marijuana use

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Abstract

Background—The frequency with which adolescents are offered marijuana has been investigated as a predictor of marijuana use. The current study was designed to test whether the number of marijuana offers received provides an indirect path between parental knowledge and adolescents' marijuana use.

Methods—Data from the nationally representative National Survey of Parents and Youth were examined. Analysis 1 tested the association between frequency of being offered marijuana and adolescents' ($N = 4264$) marijuana usage in the subsequent year. Analysis 2, spanning a three-year time frame, tested whether the frequency of marijuana offers at the second year of the panel study bridged the relationship between parental knowledge in Year 1 and marijuana use in Year 3.

Results—Analysis 1 indicated that the frequency with which adolescents were offered marijuana predicted usage one year later, after controlling for previous usage and nine other common predictors of marijuana use. Analysis 2 revealed an indirect relationship between parental knowledge and use through the number of marijuana offers the adolescent received.

Conclusion—There was a strong link between the number of offers received and adolescents' future marijuana use. Higher parental knowledge predicted reductions in offer frequency, which was associated with lower levels of marijuana use. Reducing the number of marijuana offers an adolescent receives could serve as a useful focus for intervention programs targeting parents.

Keywords

offering; marijuana; parental monitoring; parental knowledge; adolescent drug use

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1. INTRODUCTION

Marijuana use is associated with many undesirable outcomes, including inferior academic achievement (Bryant et al., 2003), risky sexual behavior (Bryan et al., 2012), increased tobacco and alcohol use (Siegel et al., 2013), and greater vulnerability to addictive behaviors (Hurd et al., 2014). Adolescent usage is particularly detrimental as it affects neurocognitive development, with younger users at proportionally greater risk of harm (Gruber et al., 2012). Predictors of marijuana use that traditionally garner attention include parental knowledge (Lac and Crano, 2009), sensation seeking (Eisenman et al., 1980), and peer norms (Elliot and Carey, 2012; Pedersen et al., 2013). The frequency with which an adolescent is offered marijuana has received less attention, and is the focus of the current research.

1.1. Being Offered Marijuana as a Predictor of Use

Wagner and Anthony (2002) credit Frost (1927) with introducing the concept of exposure opportunity. Opportunity is crucial, because "Being presented with an opportunity to use drugs is the first step of drug involvement…drug use is only possible given exposure to drug use opportunities" (Benjet et al., 2007, p. 128). Beyond opportunity (i.e., being around others who are using a drug), being *offered* marijuana amplifies drug use cues (Wertz and Sayette, 2001). Thus, adolescents predisposed to risky behavior may be more likely to act on their predilection when an offer is made (Voelkl and Frone, 2000), and even those who may never have considered marijuana use might otherwise accede, if offered.

In support of the importance of whether adolescents receive offers to use marijuana in relation to future use, Ellickson and colleagues' (2004) 30 school study indicated that merely being offered marijuana predicted current use, and use one year later. In research on secondary school students, Manning and colleagues (2001) reported that 65.9% of users reported using marijuana as a result of an offer. Grady and colleagues (1986) found that 58% of 8th graders from two New England towns reported being offered marijuana, and approximately 65% accepted the offer.

1.2. Parental Knowledge, Offering, and Marijuana use

Greater parental knowledge (i.e., awareness of the child's activities; Stattin and Kerr, 2000) is a commonly noted protective factor in research on adolescent marijuana use (Lac and Crano, 2013). Even though peers are highly influential in adolescence, parents still hold major sway over their children's decisions, even those involving drug use (Blake et al., 2001; Fletcher et al., 1998; Krosnick and Judd, 1982; Lamb and Crano, 2014; Li et al., 2002). In addition to highlighting the utility of investigating number of received marijuana offers, the current study assesses whether being offered marijuana provides an indirect path between parental knowledge and later marijuana use. If the number of times an adolescent is offered marijuana provides an indirect path between parental knowledge and marijuana use, the utility of the construct of marijuana offers will not only be highlighted, it also will offer a potential approach for future prevention efforts. Working with parents to minimize the likelihood that their children will be in situations in which marijuana is likely to be offered, for example, may prove an effective prevention strategy.

Previous studies offer reason to suspect that frequency of marijuana offers indeed provides an indirect path from parental knowledge to marijuana use. An association between parental knowledge and substance use has been identified (Lac and Crano, 2009). Not every longitudinal study supports a direct relationship between parental knowledge and use (Tebes et al., 2011), but such a relationship has been indicated (Abar et al., 2014) and indirect effects have been reported in a study such that there was an effect of parental knowledge and reduced substance use through reduced susceptibility (Cleveland et al., 2005). Further, although focused on parental monitoring (i.e., parental tracking and surveillance) rather than the more global construct of knowledge (i.e., awareness of the child's activities; e.g., Crouter and Head, 2002; Stattin and Kerr, 2000), Pinchevsky and colleagues (2012) reported a negative relationship between parental monitoring in high school and marijuana offers when students attended university (also see Chen et al., 2005). Further, as noted, a relationship between offers received and marijuana use was reported by Ellickson and colleagues (2004). However, whether the number of offers an adolescent receives provides an indirect path from knowledge to use is relatively untested. If being offered marijuana is a mediator of the relationship between parental knowledge and marijuana use, it will highlight the "power of the proposition" (i.e., the importance of being offered marijuana as a predictive variable), and provide insight into future prevention programs.

1.3. The Current Study

Using a nationally representative sample of adolescents, the first goal of the present research is to examine the lagged associations between the number of marijuana offers received and adolescent marijuana use, and to compare this relation with those involving more common predictors (e.g., tobacco and alcohol use, refusal skills, and delinquency). Although frequency of offers has been associated with current and future marijuana use, study samples have been relatively small or constrained geographically. Further, the predictive association of offers with marijuana use has only occasionally been inspected over and above other common predictors of use, such as alcohol and tobacco use, family communication, and academic achievement (e.g., Ellickson et al., 2004). As a second assessment of the importance of the frequency with which an adolescent is offered marijuana, and to explore a potential path for parent-based prevention efforts, we also assess whether being offered marijuana provides an indirect path between parental knowledge and marijuana use.

2. METHODS

2.1. Respondents and Sampling Procedure

Data from a nationally representative sample of 9 to 18 year olds in the United States ($N = 8117$) were used. The survey was conducted in conjunction with the National Youth Anti-Drug Media Campaign, a social intervention that used nearly all known mass-media to persuade adolescents to avoid illicit substances (Hornik et al., 2003). Respondents were randomly selected from 81,000 households within 90 geographic areas (90 of 100 Primary Sampling Units; see National Institute on Drug Abuse, 2006, for a detailed description of the sample, instrument, and the data collection procedures). The overall cross-sectional response rate for all youth (ages 9–18) at each round, defined as the product of (a) the percent of sampled households that were eligible, (b) the eligible households that completed the

screening roster, (c) eligible households selected for follow-up, and (d) completion rate of youth in the round, was 64 % in round 1. Follow-up response rates for eligible participants were 86.3, 92.3, and 93% in rounds 2, 3, and 4, respectively.

2.2. Respondents and Interview Procedure

At respondents' households, interviewers obtained non-sensitive data (e.g., demographic information) via a computer-assisted personal interview; audio-computer-assisted self-interviewing was used for sensitive data such as drug-relevant perceptions and behaviors. From November 1999 to June 2003, four interviews were administered in respondents' homes at approximately yearly intervals. For present purposes, to minimize respondent loss only the first three rounds of data are used (respondents aged-out of the study at 19 years of age). Children between the ages of 9 to 11 answered abbreviated surveys and were excluded from the analyses.

For Analysis 1, 4264 respondents who participated in the Year 1 (Y1) and Year 2 (Y2) interviews were used. Analysis 2 used individuals who participated in Years 1–3 ($N = 3540$). The sample drops from 8117 to 4264 primarily due to the removal of the 9–11 year old participants. In Year 1, 36.8% (n = 2985) were 9–11. Using a maximum likelihood estimator that accounts for missing data, attrition rates were 16.96% (n = 871) from Year 1 to Year 2, and 16.98% (n = 724) from Year 2 to Year 3. A large portion of these dropouts were due to aging out ($n = 333$ in Year 2, $n = 359$ in Year 3), as only those 18 or younger were eligible to participate. Of the base sample from Y1, approximately half was male (51.4%). The mean age at the first measurement point was 14.83 ($SD = 1.91$) years, and grew by approximately one year as the survey progressed. Racial/ethnic makeup of the sample was as follows: 66.6% White, 14.8% African-American; 14.6% Latino; and 4.0% other. All participants were exposed to the media campaign either through mass media channels, or through during data collection that included exposing adolescents to anti-drug advertisements and asking for an evaluation of the messages.

2.3. Measures

In developing predictive models, many variables commonly associated with marijuana use were included in addition to offers. These include gender (Voelkl and Frone, 2000), age and delinquency (Treno et al., 2008), tobacco use (Smart, 1977), alcohol use (Siegel et al., 2013), parental knowledge (Abar et al., 2004), academic performance (Bergen et al., 2005; Cox et al., 2007), sensation seeking (Eisenman et al., 1980; Palmgreen et al., 2001), and refusal strength (e.g., Botvin, 2000).

2.3.1. Offers—Being offered marijuana was measured by a single item: "How many times in the last 30 days have you been offered marijuana?" Responses could range from 1 (*never*) to 5 (*5 or more times)*.

2.3.2. Demographics—Age and gender were recorded for use as covariates.

2.3.3. Marijuana Use—A single score of marijuana use was compiled from three items. All respondents were asked, "Have you ever, even once, smoked marijuana?" Those

responding "*no*" were given a score of 0; those responding "*yes*" were asked, "How long has it been since you last used marijuana?" Those responding "*More than 12 months ago*" were given a score of 0; those responding "*during the last 30 days*" or "*More than 30 days ago but within the last 12 months*" were asked, "During the last 12 months, how many times have you used marijuana?" Answers were scored as follows: 1 (*1 to 2 times*), 2 (*3 to 5 times*), 3 (*6 to 9 times*), 4 (*10 to 19 times*), 5 (*20 to 39 times*), or 6 (*40 or more times*).

2.3.4. Academic Performance—Academic performance was measured by a single item: "Which of the following best describes your average grade in school?" This single item measure was on a scale from 1 (*D {69 or below}*) to 9 (*A {93–100}*).

2.3.5. Parental Knowledge (α = .75, r = .60)—Parental knowledge was measured by the following two items: "In general, how often does at least one of your {parents/caregivers}:" "Know what you are doing when you are away from home?" and "Have a pretty good feeling of your plans for the upcoming day?" For both questions, the response options ranged from 1 (*never or almost never*) to 5 (*always or almost always)*.

2.3.6. Refusal Strength (α = .92)—A 5-item scale measured refusal strength. Items included: "How sure are you that you can say no to marijuana, if you really wanted to, if: You are at a party where people are using it." "A very close friend suggests you use it." "You are home alone and feeling sad or bored." "You are on school property and someone offers it." And, "You are hanging out at a friend's house whose parents aren't home." Responses ranged from 1 (*not at all sure I can say no*) to 5 (*completely sure I can say no*).

2.3.7. Delinquency (α = .53)—Delinquency was measured with the following 3-item scale: "During the last 12 months, how often have you:" "Gotten into a serious fight in school or at work?" "Taken something not belonging to you worth under $50?" And, "Damaged school property on purpose?" Responses could range from 1 (*not at all*) to 5 (*5 or more times*). Due to a lack of gender invariance, "Gotten into a serious fight in school or at work?" was removed, resulting in a slight reduction of internal consistency from α = .56 to α = .53.

2.3.8. Sensation Seeking (α = .81)—Sensation seeking was measured by a 4-item scale: "Do you disagree or agree with the following statements:" "I would like to explore strange places." "I like to do frightening things." "I like new and exciting experiences, even if I have to break the rules." And, "I prefer friends who are exciting and unpredictable." Responses could range from 1 (*strongly disagree*) to 5 (*strongly agree*).

2.3.9. Marijuana Approval (α = .84, r = .72)—A 2-item scale was used to measure marijuana approval. These items were: "Do you disapprove or approve of people doing each of the following:" "Trying marijuana once or twice," and, "Using marijuana nearly every month for 12 months." Responses could range from 1 (*strongly disapprove*) to 5 (*strongly approve*).

2.3.10. Cigarette Use—A single item measured was used to measure cigarette use: "Have you ever smoked part or all of a cigarette?" Responses could range from 1 (*never*) to 5 (*I have smoked in the last 30 days*).

2.3.11. Alcohol Use—Alcohol use was measured by two items. "Have you ever, even once, had a drink of any alcohol beverage, that is, more than a few sips?" Those responding "yes" were asked "How long has it been since you last drank an alcoholic beverage, more than a few sips?" Responses on the derived scale could range from 1 (*no*) to 4 (*during the last 30 days*).

2.4. Analytic Plan

Two sets of analyses were conducted. The first set of analyses tested whether number of marijuana offers was predictive of subsequent marijuana use after controlling for a host of other variables previously shown to predict marijuana use. The second set of analyses tested whether there was an indirect effect on marijuana use of parental knowledge through number of marijuana offers. Structural equation modeling (SEM) was used for both sets of analyses so that constructs with multiple items could be modeled latently, and so that the indirect effect in the second set of analyses could be tested directly. Due to high levels of skew, sensitivity tests were conducted using non-transformed, natural log transformed, and dichotomized (using median split) measures of marijuana use and number of offers received.

All analyses were conducted with mPlus version 7.2 using jackknife replicate weights, which retained the nationally representative feature of the results. Maximum likelihood estimation was used, as other forms of estimation were not possible when using replicate weights. Chi-square fit values produced by mPlus when using jackknife replicate weights are not valid; however, Stapleton (2008) has suggested a method of adjusting these values to be more accurate. The chi-square values reported below have been adjusted using her method. Assumptions of measurement invariance and normality were tested, and adjustments were made if necessary. Before examining fit indices, the baseline model (i.e., all structural paths fixed at 0.00) was examined. When the RMSEA of the baseline model is less than .158 it is computationally impossible for incremental measures of fit such as the CFI and TLI to exceed .90 (Kenny, 2014). In such cases, CFI and TLI values may not be as informative in indicating the model's goodness of fit to the data. Finally, modification indices were inspected for theoretically relevant changes to the model, which were tested using adjusted chi-square values.

3. RESULTS

All constructs measured with more than one item were tested for measurement invariance with respect to gender. The factor structure was not significantly different between male and female participants for all scales except delinquency. To address this issue, the item "Gotten into a serious fight in school or at work" was removed. Being offered marijuana and marijuana use were positively skewed such that the majority of participants had received fewer offers (69.1% [Y2] to 76.0% [Y1] reported receiving no offers in the past 30 days) and were not marijuana users (72.3% [Y3] to 77.9% [Y2] reported not using marijuana in the past year). Due to these high levels of skew, sensitivity tests were conducted using non-

transformed, natural log transformed, and dichotomized (using median split) measures of marijuana use and number of offers received. As the pattern of results was maintained with transformed and non-transformed variables, only the results using the non-transformed variables are reported.

In both sets of analyses, the latent variable covariance matrix was not positive definite. This problem likely was caused by the latent variables measured with only two-items. This can result in instability of the model because the variable cannot be identified without borrowing information from other parts of the model. Therefore, variables with only two indicators (i.e., parental knowledge, delinquency, and marijuana approval) were aggregated by taking the mean of the two items. When the models were run with these new aggregated variables, the latent covariance matrix was positive definite, allowing for accurate maximum likelihood estimation.

3.1. Analysis 1

A structural equation model was tested using jackknife replicate weights with marijuana use in the past 12 months at Y2 regressed on variables taken from Y1 of the NSPY dataset, including: marijuana use, number of marijuana offers in the past 30 days, age, gender, academic success, refusal strength, delinquency, sensation seeking, marijuana approval, cigarette use, and alcohol use. Latent factors were used to measure refusal strength and sensation seeking (see Table 1 for factor loadings). Fit indices suggest an adequate fit of the model to the data ($\chi^2[113] = 818.28$, RMSEA = .04, CFI = .98, TLI = .98). As none of the modification indices were theoretically acceptable, no changes were made to the model. Being offered marijuana was a significant predictor of marijuana use at Y2, $z = 3.76$, $p < .001$, even after controlling for marijuana use reported at Y1, age, gender, academic success, refusal strength, delinquency, sensation seeking, marijuana approval, cigarette use, and alcohol use. Holding other variables in the model constant, for every additional time a person was offered marijuana, predicted marijuana use increased by .16 ($SE = .04$) on average. Other variables that significantly predicted marijuana use included past marijuana use, marijuana approval, cigarette use, alcohol use, academic success, and delinquency (see Table 2).

3.2 Analysis 2

Assessments of the proposed relationships were conducted using structural equation modeling with jackknife replicate weights. It was predicted that parental knowledge at Y1 would indirectly influence frequency of marijuana use at Y3, through the number of offers received at Y2. Frequency of marijuana use, number of marijuana offers in the past 30 days, age, gender, academic success, refusal strength, delinquency, sensation seeking, marijuana approval, cigarette use, and alcohol use at Y1 were used as covariates of marijuana use at Y3. Latent factors were used to measure refusal strength and sensation seeking (see Table 1 for factor loadings). The baseline model had a RMSEA value of .108; as this value was less than .158, values for incremental measures of fit such as the CFI and TLI could not exceed .90 (Kenny, 2014). Fit indices suggest an adequate fit of the model to the data ($\chi^2[130] = 1049.76$, RMSEA = .045, CFI = .85, TLI = .82). As illustrated in Figure 1, the direct path was not statistically significant, $z = 0.746$, $p = .456$, but a test of the indirect effect indicated

that being offered marijuana provides an indirect path between parental monitoring and marijuana use, $z = -5.52$, $p < .001$. Those who reported higher levels of parental monitoring were less likely to report being offered marijuana, and those offered marijuana more frequently were more likely subsequently to use marijuana. Modification indices suggested adding marijuana use at Y1 as a covariate of being offered marijuana at Y2. While this significantly improved the fit of the model ($\chi^2_{change}[1] = 157.47$, $p < .0001$, RMSEA = .04, CFI = .88, TLI = .85), the pattern of effects remained the same. The direct path remained non-significant, $z = .726$, $p = .468$, while the indirect effect remained statistically significant, $z = -3.459$, $p = .001$. Those who reported higher levels of parental monitoring were less likely to report being offered marijuana, and those who were offered marijuana more frequently were more likely to use marijuana subsequently (see Figure 1).

4. DISCUSSION

Prevention specialists have focused on many variables to understand and reduce adolescent drug use, but the direct association of being offered marijuana has received relatively limited attention (e.g., Pinchevsky et al. 2012; Wagner and Anthony, 2002). The results of the current study indicate that a greater focus on the number of marijuana offers an adolescent receives could be an important determinant of marijuana use.

The first analysis was concerned with whether the number of times an adolescent was offered marijuana predicted marijuana use one year later. To offer a staunch assessment of the association between number of offers and marijuana use, we assessed the predictive strength of the offers received over and above the variance accounted for by several typically explored predictors of marijuana use. These include academic success (Englund and Siebenbruner, 2012; Vaughan et al., 2011), delinquency (Becker et al., 2012; Doherty et al., 2008), tobacco use (Fielder et al., 2013; Goncy and Mrug, 2013), alcohol use (Leonard et al., 2013; Pacek et al., 2012), marijuana approval (e.g., Malmberg et al., 2012), past marijuana use (e.g., Siegel et al. 2013), refusal strength (e.g., Hansen, 1992), and sensation seeking (Eisenman et al.1980; Palmgreen et al, 2001). The current results indicate that when all of these variables are entered simultaneously, prior marijuana use, marijuana approval, cigarette use, alcohol use, academic success, and delinquency remained significant predictors of future marijuana use. Over and above the influence of these significant predictors, the number of marijuana offers received was predictive of use one year later. The current finding is in accord with the results of Ellickson and colleagues (2004) which indicated that being offered marijuana in 7th and 8th grade was predictive of use in 9th grade and 10th grade, over and above a host of covariates (e.g., cigarette use, marijuana approval, academic achievement). As Ellickson and colleagues' investigation was limited to schools in California and Oregon, the nationally representative nature of the data in the current research complements their findings.

To further investigate importance of the number of offers received, frequency of offers received was proposed as a mediator between the established relationship between parental knowledge and marijuana use. To offer a staunch test of the importance of offer frequency, this set of analyses also controlled for the same range of variables as Study 1 (e.g., prior use, cigarette use, sensation seeking). As expected, parental knowledge (Y1) was associated with

being offered marijuana in Y2. Pinchevsky and colleagues' (2012) investigation indicated a relationship between parental monitoring (i.e., parental tracking and surveillance) and being offered marijuana, by focusing on parental knowledge (awareness of the child's whereabouts; e.g., Crouter and Head, 2002; Stattin and Kerr, 2000). The results of current study complement their findings. Furthermore, as indicated in the first analysis, being offered marijuana at Y2 was predictive of increased marijuana use at Y3 (see Ellickson et al., 2004, for a similar result). Adding to the literature, the analysis revealed an indirect effect from parental knowledge to substance use through frequency of offers received. This finding highlights the critical association between offers received and future marijuana use, and indicates that improving parental knowledge could attenuate the offers adolescents receive.

4.1. Limitations

The findings are based on a set of secondary analyses of a large, nationally representative, longitudinal data set. There are advantages with such an approach (e.g., high generalizability, rich data, large samples, longitudinal design), but there also are limitations. Even though the measures used offered insight into adolescent marijuana use, internal consistency in one case (i.e., delinquency) was lower than desired, and variables that may have been useful additions (e.g., marijuana availability) were not available. Further, physiological measures of use would have strengthened certainty of interpretations, even though steps were taken to minimize the influence of social desirability of responses, and self-report of drug use has been recognized as a valid means of assessing use (Katz et al., 1997; Wilcox et al., 2013). An additional limitation is that design of the study was non-experimental, and thus, causal claims based on the analyses are ambiguous. A final limitation is that we examined the relationship between parental knowledge and offers received as well as between parental knowledge and substance use as unidirectional. Recent scholarship has suggested a bi-directional relationship between parental knowledge and adolescent delinquency (Kerr et al., 2010; Siegel et al., 2013). While we did not have the statistical power to perform the cross-lagged analysis necessary to assess the bi-directional relationship, future studies could offer a more nuanced understanding of the relationships presented by modeling the bidirectional, as well as the unidirectional relationships.

4.2. Implications

The current study highlights the extent to which marijuana use is associated with an important contextual feature – the number of marijuana offers an adolescent receives. Offer frequency was predictive of future use over and above variables long associated with usage, including prior use, age, gender, academic success, refusal strength, cigarette use, and alcohol use. Moreover, the number of marijuana offers received partially explains the relationship between parental knowledge and frequency of marijuana use. Even though there have been prior investigations into the number of offers received (Wertz and Sayette, 2001) and the broader construct of exposure opportunity (Wagner and Anthony, 2002), the current results indicate that greater attention to the offer measure is warranted. Follow-up studies can investigate why some adolescents are more likely to be affected by offers than others, the extent to which the source of the offer wields influence, and whether the current results are generalizable to other substances.

Further, as the results indicate that intervention and prevention programs could possibly benefit by focusing attention on teaching parents to minimize the contexts in which adolescents are offered marijuana, intervention and prevention programs that educate parents as to the best ways to increase their knowledge of their adolescents' whereabouts could indirectly reduce marijuana use by reducing the number of marijuana offer received. Given that parents sometimes feel incapable of influencing the behavior of their adolescents (e.g., Hockenberry-Eaton et al., 1996; Lamb and Crano, 2014; Reinisch, 1990), interventions that emphasize the means of increasing parental knowledge and provide parents with information regarding the importance of reducing the number of times their offspring are offered marijuana could be both welcome and effective.

Acknowledgements

REFERENCES

Abar CC, Jackson KM, Wood M. Reciprocal relations between perceived parental knowledge and adolescent substance use and delinquency: the moderating role of parent–teen relationship quality. Dev. Psychol. 2014; 50:2176–2187. [PubMed: 25046124]

Becker SJ, Nargiso JE, Wolff JC, Uhl KM, Simon VA, Spirito A, Prinstein MJ. Temporal relationship between substance use and delinquent behavior among young psychiatrically hospitalized adolescents. J. Subst. Abuse Treat. 2012; 43:251–259. [PubMed: 22197300]

Benjet C, Borges G, Medina-Mora ME, Blanco J, Zambrano J, Orozco R, Feliz C, Rojas E. Drug use opportunities and the transition to drug use among adolescents from the Mexico City Metropolitan Area. Drug Alcohol Depend. 2007; 90:128–134. [PubMed: 17382489]

Bergen HA, Martin G, Roeger L, Allison S. Perceived academic performance and alcohol, tobacco and marijuana use: longitudinal relationships in young community adolescents. Addict. Behav. 2005; 30:1563–1573. [PubMed: 16122617]

Blake SM, Simkin L, Ledsky R, Perkins C, Calabrese JM. Effects of a parent-child communications intervention on young adolescents' risk for early onset of sexual intercourse. Fam. Plann. Perspect. 2001; 33:52–61. [PubMed: 11330851]

Botvin GJ. Preventing drug abuse in schools: social and competence enhancement approaches targeting individual-level etiologic factors. Addict. Behav. 2000; 25:887–897. [PubMed: 11125777]

Bryan AD, Schmiege SJ, Magnan RE. Marijuana use and risky sexual behavior among high-risk adolescents: trajectories, risk factors, and event-level relationships. Dev. Psychol. 2012; 48:1429–1442. [PubMed: 22390666]

Bryant AL, Schulenberg JE, O'Malley PM, Bachman JG, Johnston LD. How academic achievement, attitudes, and behaviors relate to the course of substance use during adolescence: a 6-year, multiwave national longitudinal study. J. Res. Adolesc. 2003; 13:361–397.

Chen CY, Storr CL, Anthony JC. Influences of parenting practices on the risk of having a chance to try cannabis. Pediatrics. 2005; 115:1631–1639. [PubMed: 15930226]

Cleveland MJ, Gibbons FX, Gerrard M, Pomery EA, Brody GH. The impact of parenting on risk cognitions and risk behavior: a study of mediation and moderation in a panel of African American adolescents. Child Dev. 2005; 76:900–916. [PubMed: 16026504]

Cox RG, Zhang L, Johnson WD, Bender DR. Academic performance and substance use: findings from a state survey of public high school students. J. School Health. 2007; 77:109–115. [PubMed: 17302852]

Crouter, AC.; Head, MR. Parental monitoring and knowledge of children. In: Bornstein, MH., editor. Handbook of Parenting. New York: Psychology Press; 2002. p. 461-483.

Doherty E, Green KM, Ensminger ME. Investigating the long-term influence of adolescent delinquency on drug use initiation. Drug Alcohol Depend. 2008; 93:72–84. [PubMed: 17980514]

Eisenman R, Grossman JC, Goldstein R. Undergraduate marijuana use as related to internal sensation novelty seeking and openness to experience. J. Clin. Psychol. 1980; 36:1013–1019. [PubMed: 7440728]

Ellickson PL, Tucker JS, Klein DJ, Saner H. Antecedents and outcomes of marijuana use initiation during adolescence. Prev. Med. 2004; 39:976–984. [PubMed: 15475032]

Elliott JC, Carey KB. Correcting exaggerated marijuana use norms among college abstainers: a preliminary test of a preventive intervention. J. Stud. Alcohol Drugs. 2012; 73:976–980. [PubMed: 23036216]

Englund MM, Siebenbruner J. Developmental pathways linking externalizing symptoms, internalizing symptoms, and academic competence to adolescent substance use. J. Adolesc. 2012; 35:1123–1140. [PubMed: 22465287]

Fielder RL, Carey KB, Carey MP. Hookah, cigarette, and marijuana use: a prospective study of smoking behaviors among first-year college women. Addict. Behav. 2013; 38:2729–2735. [PubMed: 23934004]

Fletcher, AC.; Darling, N.; Steinberg, L. 16 Parental monitoring and peer influences on adolescent substance use. In: McCord, J., editor. Coercion and Punishment in Long-term Perspectives. Cambridge: Cambridge University Press; 1998. p. 259-271.

Frost, WH. Public Health and Preventive Medicine. Vol. 2. London: Nelson; 1927.

Goncy EA, Mrug S. Where and when adolescents use tobacco, alcohol, and marijuana: comparisons by age, gender, and race. J. Stud. Alcohol Drugs. 2013; 74:288–300. [PubMed: 23384377]

Grady K, Gersick KE, Snow DL, Kessen M. The emergence of adolescent substance use. J. Drug Educ. 1986; 16:203–220. [PubMed: 3772678]

Gruber SA, Sagar KA, Dahlgren MK, Racine M, Lukas SE. Age of onset of marijuana use and executive function. Psychol. Addict. Behav. 2012; 26:496–306. [PubMed: 22103843]

Hansen WB. School-based substance abuse prevention: a review of the state of the art in curriculum, 1980–1990. Health Educ. Res. 1992; 7:403–430. [PubMed: 10171672]

Hockenberry-Eaton M, Richman MJ, DiIorio C, Rivero T, Maibach E. Mother and adolescent knowledge of sexual development: the effects of gender, age, sexual experience. Adolescence. 1996; 31:35–47. [PubMed: 9173791]

Hornik, R.; Maklan, D.; Cadell, D.; Prado, A.; Barmada, C.; Jacobsohn, L.; Orwin, R.; Sanjeev, S.; Zador, P.; Southwell, B.; Zanutto, E.; Baskin, R.; Chu, A.; Morin, C.; Taylor, K.; Steele, D. Executive Summary. Rockville: NIDA/NIH; 2003. Evaluation of the National Youth Anti-Drug Campaign: Fourth Semi-Annual Report of Findings.

Hurd YL, Michaelides M, Miller ML, Jutras-Aswad D. Trajectory of adolescent cannabis use on addiction vulnerability. Neuropharmacology. 2014; 76:416–424. [PubMed: 23954491]

Katz CM, Webb VJ, Gartin PR, Marshall CE. The validity of self-reported marijuana and cocaine use. J. Crim. Just. 1997; 25:31–41.

Kenny DA. Measuring model fit. 2014 [http://davidakenny.net/cm/fit.htm].

Kerr M, Stattin H, Burk WJ. A reinterpretation of parental monitoring in longitudinal perspective. J. Res. Adolesc. 2010; 20:39–64.

Krosnick JA, Judd CM. Transitions in social influence at adolescence: who induces cigarette smoking? Dev. Psychol. 1982; 18:359–368.

Lac A, Crano WD. Monitoring matters meta-analytic review reveals the reliable linkage of parental monitoring with adolescent marijuana use. Perspect. Psychol. Sci. 2009; 4:578–586.

Lamb CS, Crano WD. Parents' beliefs and children's marijuana use: evidence for a self-fulfilling prophecy effect. Addict. Behav. 2014; 39:127–132. [PubMed: 24144589]

Leonard KE, Smith PH, Homish GG. Concordant and discordant alcohol, tobacco, and marijuana use as predictors of marital dissolution. Psychol. Addict. Behav. 2013; 28:780–789. [PubMed: 24128287]

Li X, Stanton B, Galbraith J, Burns J, Cottrell L, Pack R. Parental monitoring intervention: practice makes perfect. J. Nat. Med. Assoc. 2002; 94:364–370.

Malmberg M, Overbeek G, Vermulst AA, Monshouwer K, Vollebergh WM, Engels RE. The theory of planned behavior: precursors of marijuana use in early adolescence? Drug Alcohol Depend. 2012; 123:22–28. [PubMed: 22056217]

Manning V, Best D, Rawaf S, Rowley J, Floyd K, Strang J. Drug use in adolescence: the relationship between opportunity, initial use and continuation of use of four illicit drugs in a cohort of 14–16-year-olds in South London. Drug Educ. Prev. Policy. 2001; 8:397–405.

National Institute on Drug Abuse. Rockville, MD: Westat; 2006. User's Guide For The Evaluation Of The National Youth Anti-Drug Media Campaign: Restricted Use Files For The National Survey Of Parents And Youth (NSPY), Rounds 1, 2, 3, 4.

Pacek LR, Malcolm RJ, Martins SS. Race/ethnicity differences between alcohol, marijuana, and co-occurring alcohol and marijuana use disorders and their association with public health and social problems using a national sample. Am. J. Addict. 2012; 21:435–444. [PubMed: 22882394]

Palmgreen P, Donohew L, Lorch EP, Hoyle RH, Stephenson MT. Television campaigns and adolescent marijuana use: tests of sensation seeking targeting. Am. J. Public Health. 2001; 91:292–296. [PubMed: 11211642]

Pedersen ER, Miles JN, Hunter SB, Osilla KC, Ewing BA, D'Amico EJ. Perceived norms moderate the association between mental health symptoms and drinking outcomes among at-risk adolescents. J. Stud. Alcohol Drugs. 2013; 74:736–745. [PubMed: 23948533]

Pinchevsky GM, Arria AM, Caldeira KM, Garnier-Dykstra LM, Vincent KB, O'Grady KE. Marijuana exposure opportunity and initiation during college: parent and peer influences. Prev. Sci. 2012; 13:43–54. [PubMed: 21870157]

Reinisch, JM. The Kinsey Institute New Report On Sex. London: Macmillan; 1990.

Siegel JT, Crano WD, Alvaro EA, Lac A, Hackett JD, Hohman Z. Differentiating common predictors and outcomes of marijuana initiation: a retrospective longitudinal analysis. Subst. Use Misuse. 2013; 49:30–40.

Smart RG. Perceived availability and the use of drugs. Bull. Narc. 1977; 29:59–63. [PubMed: 246375]

Stapleton LM. Variance estimation using replication methods in structural equation modeling with complex sample data. Struct. Equat. Model. 2008; 15:183–210.

Stattin H, Kerr M. Parental monitoring: a reinterpretation. Child Dev. 2000; 71:1072–1085. [PubMed: 11016567]

Tebes J, Cook E, Vanderploeg J, Feinn R, Chinman M, Shepard J, Brabham T, Connell C. Parental knowledge and substance use among African American adolescents: influence of gender and grade level. J. Child Fam. Stud. 2011; 20:406–413. [PubMed: 24683304]

Treno AJ, Ponicki WR, Remer LG, Gruenewald PJ. Alcohol outlets, youth drinking, and self-reported ease of access to alcohol: a constraints and opportunities approach. Alcohol. Clin. Exp. Res. 2008; 32:1372–1379. [PubMed: 18540922]

Vaughan EL, Kratz L, d'Argent J. Academics and substance use among Latino adolescents: results from a national study. J. Ethnic Subst. Abuse. 2011; 10:147–161.

Voelkl KE, Frone MR. Predictors of substance use at school among high school students. J. Educ. Psychol. 2000; 92:583–592.

Wagner FA, Anthony JC. Into the world of illegal drug use: exposure opportunity and other mechanisms linking the use of alcohol, tobacco, marijuana, and cocaine. Am. J. Epidemiol. 2002; 155:918–925. [PubMed: 11994231]

Wertz JM, Sayette MA. A review of the effects of perceived drug use opportunity on self-reported urge. Exp. Clin. Psychopharmacol. 2001; 9:3–13. [PubMed: 11519632]

Wilcox CE, Bogenschutz MP, Nakazawa M, Woody G. Concordance between self-report and urine drug screen data in adolescent opioid dependent clinical trial participants. Addict. Behav. 2013; 38:2568–2574. [PubMed: 23811060]

Highlights

- We examine the relationship between the number of marijuana (MJ) offers received and future MJ use.

- We assess an indirect relationship between parental knowledge and MJ use through MJ offers.

- Frequency of MJ offers received (Year 1) predicted MJ use in adolescents (Year 2).

- Parental knowledge (Year 1) indirectly influenced use (Year 3) through offers received (Year 2).
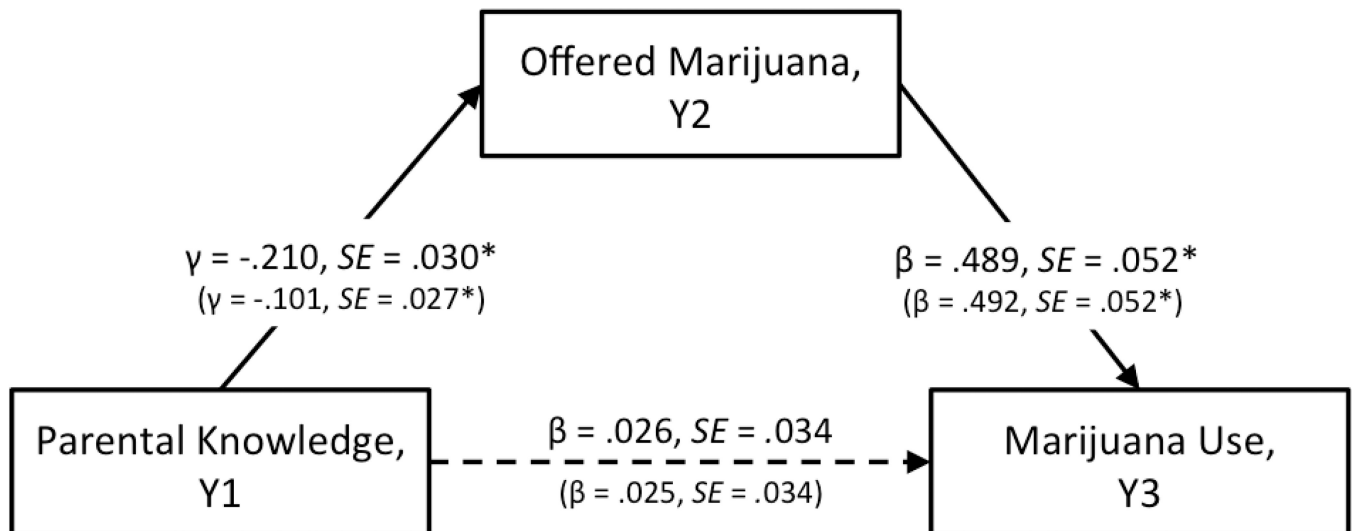
Figure 1.
Unstandardized coefficients and standard errors for the indirect effect of parental knowledge through number of times offered marijuana on marijuana use. Past marijuana use, age, gender, academic success, refusal strength, delinquency, sensation seeking, marijuana approval, cigarette use, and alcohol use at Year 1 (Y1) were used as covariates of marijuana use at Year 3 (Y3). Coefficients and standard errors in parentheses reflect the addition of marijuana use at Y1 as a covariate of being offered marijuana at Year 2 (Y2). *$p < .001$.

Table 1

Factor loadings for refusal strength and sensation seeking for Study 1 and Study 2.

	Study 1		Study 2	
	λ(*SE*)	*p*-value	λ (*SE*)	*p*-value
Refusal Strength				
At a party… people are using	1.00(.00)		1.00(.00)	
Very close friend suggests	1.03(.03)	<.001	1.02(.03)	<.001
Home alone… feeling sad or bored	0.96(.04)	<.001	0.95(.04)	<.001
School property… someone offers	0.75(.04)	<.001	0.77(.04)	<.001
Friend's… parents aren't home	1.14(.04)	<.001	1.12(.04)	<.001
Sensation Seeking				
Explore strange places	1.00(.00)		1.00(.00)	
Do frightening things	1.22(.03)	<.001	1.14(.04)	<.001
New and exciting experiences	1.24(.05)	<.001	1.26(.05)	<.001
Friends… exciting/unpredictable	1.00(.04)	<.001	1.00(.04)	<.001

Note: λ = unstandardized factor loading estimate. *SE* = standard error of the λ estimate. For full items, see section 2.3 Measures.

Table 2

Coefficients for variables at Year 1 predicting marijuana use at Year 2

	Standardized Coefficient	Unstandardized Coefficient	SE	p-value
Offered Marijuana	.117	0.158	0.042	<.001
Past Marijuana Use	.468	0.581	0.047	<.001
Age	−.013	−0.011	0.016	.475
Gender	.013	0.043	0.043	.312
Academic Success	−.034	−0.027	0.011	.013
Refusal Strength	.002	0.005	0.037	.896
Delinquency	.062	0.172	0.060	.004
Sensation Seeking	.011	0.024	0.048	.621
Marijuana				.014
Approval	.049	0.090	0.037	
Cigarette Use	.197	0.255	0.056	<.001
Alcohol Use	.060	0.085	0.029	.003

Note: SE = standard error of the unstandardized coefficient estimate.