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Developmental Trajectories of Marijuana Use from Adolescence to Adulthood: Relationship with Using Weapons including Guns

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Abstract

This is the first study to assess the associations between the trajectories of marijuana use and other predictors of violent behavior with the use of guns or other weapons as well as stealing without the use of weapons among inner-city African Americans and Puerto Ricans (N=838). Logistic regression analyses examined whether the longitudinal trajectories of marijuana use compared with the trajectory of no/low marijuana use predicted violent behavior. A higher Bayesian posterior probability (BPP) for the increasing marijuana use trajectory group (AOR=3.37, $p<.001$), the moderate use of marijuana trajectory group (AOR=1.98, $p<.01$), and the quitter trajectory group (AOR=1.70, $p<.05$) predicted an increased likelihood of engaging in violence (i.e., shooting or hitting someone with a weapon) compared with the BPP of the no use of marijuana trajectory group. Our results address a number of important public health and clinical issues. Public health funds might be spent on prevention programs focused on decreasing the use of marijuana, increasing educational retention, and decreasing contact with deviant associates. Understanding the psychosocial conditions related to the use of weapons is critical for individuals involved in the criminal justice system, physicians, and other health care providers in managing individuals who engage in violent behavior.

Keywords

marijuana; violence; longitudinal studies

INTRODUCTION

Adolescents and adults who engage in violent acts, particularly the use of guns, are of great concern among policy makers (National Conference of State Legislatures [NCSL], 2005), health care professionals, educators, and the public (Hemenway, 2004; Palfrey & Palfrey, 2013). Although the rate of non-fatal firearm crimes has decreased (Planty & Truman, 2013), assault-injured youth who were admitted to an emergency service had high rates of firearm possession, most of which were not obtained from legal sources in the United States (Carter et al., 2013).

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Currently, there is a relative dearth of longitudinal research focusing on the specific risk factors for violent behavior, more specifically, the use of guns or other weapons. The present research examines one such risk factor; namely marijuana use. This investigation focuses on the association between the trajectories of marijuana use from adolescence into young adulthood and violent behavior with the use of guns or other weapons in young adulthood during an important part of the life cycle. In addition, we examine the relationship of adolescent delinquency and peer deviance and external (e.g., level of education) factors with violent behavior with the use of guns or other weapons and stealing without using a weapon.

Our study is unique in three ways. First, we assess the predictors of violent behavior with the use of guns or other weapons among relatively understudied ethnic groups – namely, inner-city African Americans and Puerto Ricans. Second, we follow our adolescent sample up to the mean age of 29, in contrast to the majority of prior research, which has been conducted upon samples either of adolescents or young adults. Third, we identify the trajectories of marijuana use during several developmental stages spanning a 15 year period as a predictor of violent behavior with the use of guns or other weapons as well as stealing without the use of weapons.

The use of marijuana has increased in many developed societies, with the occasional use of marijuana now being a common experience. For example, in studies of New Zealand birth cohorts, Fergusson and Horwood (2000) found that nearly 70% of cohort members had used marijuana by the age of 21. Studies from other regions including the United Kingdom and the United States have reported that experimentation with or more frequent use of marijuana is common among young people (Ashton, 2001; Hall & Degenhardt, 2007).

Several investigators have identified the trajectories of marijuana use and examined risk and protective factors as related to the trajectories of marijuana use (Mauricio et al., 2009; Windle & Wiesner, 2004). Windle and Wiesner (2004) found that the high chronic marijuana use trajectory group, relative to the other trajectory groups, had higher levels of delinquency. Mauricio et al. (2009) found that the trajectories of individuals convicted of a crime who received little or no supervision post discharge or release had increased substance use with age. In contrast, offenders who received high levels of supervised time (e.g., detention centers, residential treatment) showed no increase in substance use over time.

A statistical association between substance use and violent behavior has been well documented in studies of populations of criminals and addicts as well as in community samples (Friedman et al., 2001; Loh et al., 2010; Steinman and Zimmerman, 2003). Marijuana use seems to play a role in violent behavior. Loh et al. (2010) reported that marijuana use predicted handgun access in a cross-sectional study. Friedman et al. (2001) found that those who used marijuana at a higher frequency were more likely to commit a crime using weapons. Steinman and Zimmerman (2003) documented that marijuana use predicted episodic gun-carrying. Similar results were also reported in the few longitudinal studies using community samples (Kaplan & Damphouse, 1995).

Prior research suggests that sociodemographic factors including gender, ethnicity, and educational level are associated with violent behavior involving the use of guns (Brown, 2004; Harlow, 2003; Sampson, Morenoff, & Raudenbush, 2005). Increasing evidence shows that low educational level correlates with greater prevalence of inmates in prison (Harlow, 2003). Farrington (2012) has highlighted the importance of several factors related to violent behavior including delinquency and peer deviance. Therefore, we included measures of these dimensions in the present study.

In a previous study of African Americans and Puerto Ricans based on this sample, we identified four trajectory groups of marijuana use (Brook, Lee, Finch, Seltzer, & Brook,

2013). Membership in the chronic marijuana user group as compared to the none, increaser, and moderate user groups was related to low work commitment, financial instability, and aspects of the social environment, such as peer drug use. In addition, Brook and colleagues (Brook, Zhang, & Brook, 2011) studied marijuana use from age 14–32 in a predominantly White sample and identified five trajectory groups. Both chronic and increasing marijuana use groups were predictors of adult antisocial behavior. Finally, a study of joint trajectories of victimization and marijuana use among African American and Puerto Rican males showed that males who experienced both high levels of violent victimization and marijuana use reported the most adverse psychological and health problems (Pahl, Brook, & Lee, 2013).

Based on the literature, we hypothesize that 1) there will be at least 4 trajectory groups of marijuana use such as the chronic marijuana use trajectory group, the moderate marijuana use trajectory group, the quitter trajectory group, and the no/low marijuana use trajectory group, 2) the higher level of marijuana use trajectory groups (e.g., the chronic marijuana use trajectory group and the moderate marijuana use trajectory group) compared to the no/low marijuana use trajectory group will be associated with an increased likelihood of engaging in violent behavior with the use of guns or other weapons as well as stealing without the use of weapons, and 3) male gender, adolescent delinquency, adolescent alcohol use, young adult peer deviance, and lower educational level will be associated with an increased likelihood of engaging in violent behavior with the use of guns or other weapons.

METHOD

Participants

Data on the participants in grades 7–10 (N=1,332) were initially collected in 1990 at Time 1 (T1) when the participants were attending schools in the East Harlem area of New York City (The Harlem Longitudinal Development Study). The questionnaires were completed by the participants in their classrooms with teachers not present. Each participant could choose to have a questionnaire in either English or Spanish. At T1, the mean age was 14.1 years with a standard deviation (SD) of 1.3 years.

At Time 2 (T2; 1994–1996, N=1,190), the participants were interviewed in person. The mean age of the participants was 19.2 years with a SD of 1.5 years. Interviewers of the same gender and ethnicity as the participants were used to the greatest extent possible. Participants could choose either an English or Spanish questionnaire. At Time 3 (T3; 2000–2001, N=660), the mean age of the participants was 24.5 years with a SD of 1.4 years. The mean age of participants at Time 4 (T4) was 29.2 years with a S.D of 1.7 years. As before, interviewers were matched to the participants' gender and ethnicity as much as possible.

There were 838 participants at T4 (2004–2006). The T4 sample was 41% male and 59% female and composed of 54% African American and 46% Puerto Rican respondents. At T4, the median educational level was having completed at least one year of business or technical school after high school; 25% were employed in semi-skilled jobs (e.g., factory worker), 11% in skilled jobs (e.g., mechanic), 45% in clerical positions, 17% had professional level jobs, and 2% were unemployed at the time of the interview. In addition, 22% of the sample was married and living together with a spouse at the time of the interview. Another 22% of the sample was cohabiting with a partner.

Our participation rate, defined as the number of participants enrolled divided by the number attempted for enrollment was 63% (838/1332). Among 838 participants, 79% of the sample participated at all four time points, and 100% of the sample participated at least three times. We compared the demographic variables for the participants who were interviewed at T1 but

not at T4 (N=494) and those who participated at T1 and T4, using the chi-square test of independence. Males (56% at T1 but not at T4; 41% at T1 and T4; $\chi^2(1) = 29.50, p < 0.001$) and Puerto Ricans (53% at T1 but not at T4; 45% at T1 and T4; $\chi^2(1) = 7.17, p < 0.01$) were more likely to drop out of the study. Based on a *t* test, participants who were interviewed at T1 but not at T4 drank more alcohol on average than those who participated at both T1 and T4 ($t = 3.79, p < .001$). There were no statistically significant differences between the two groups on the measures of delinquency at T1.

The Institutional Review Boards of the Mount Sinai School of Medicine and New York University School of Medicine approved the study's procedures for data collections. A Certificate of Confidentiality was obtained from the National Institute on Drug Abuse. Written informed assent was obtained from all minors. Passive consent procedures were used for the parents of minors. For participants older than age 18, informed consent was obtained. Additional information regarding the study methodology is available from previous reports (Brook, Brook, Gordon, Whiteman, & Cohen, 1990).

Measures

Table I presents the measures used in this study including the Cronbach's alpha, the numbers of items, a sample item, and the answer options.

We then defined indicator variables for the outcome behavior: a) shooting (or hitting) someone with a weapon, b) holding a weapon to someone, and c) stealing without a weapon. Each indicator variable was assigned the value of 1 if the participant's item response was greater than or equal to one time.

Analytic Procedure

We used Mplus to obtain the trajectories of marijuana use. Marijuana use at each point in time was treated as a censored normal variable. We applied the full information maximum likelihood approach (FIML) for missing marijuana use data (Muthén & Muthén, 2007). We used the optimal Bayesian Information Criterion (BIC) to determine the number of trajectory groups. For Figure 1 and Table 2, each participant was assigned to the trajectory group with the largest Bayesian posterior probability (BPP). The observed trajectories for a group were the averages of marijuana use at each point in time.

We then conducted logistic regression analyses using SAS (Cody & Smith, 2005) to examine whether the trajectories of marijuana use from T1 to T4 compared with the reference trajectory group (i.e., no/low marijuana use) were associated with shooting (or hitting) someone with a weapon, holding a weapon to someone, and stealing from someone without a weapon at T4. We used the BPPs of the marijuana trajectories as independent variables. In these analyses, we also examined the relationships of the following variables with our dependent variables: gender, ethnicity, delinquency at T1, alcohol use at T1, peer deviance at T4, and educational level at T4.

RESULTS

The mean and SD scores of marijuana use at each point in time were 0.2 (0.6), 0.9 (1.4), 1.2 (1.6) and 1.0 (1.5) for T1–T4, respectively. We computed solutions for 2 through 5 trajectory groups. The BICs and entropy measures for each number of groups were: 2 (6379, 0.80), 3 (6229, 0.85), 4 (6105, 0.86), and 5 (6120, 0.82). We chose the 4 trajectory group model because it had the smallest BIC (See Figure 1). The mean BPP of the participants who were assigned to the groups ranged from 85% to 99%, which indicated a good classification.

As shown in Figure 1, we labeled the four marijuana use trajectory groups as follows. The no marijuana use trajectory group had an estimated prevalence of 45% and included participants who reported no use of marijuana at each wave. The quitter trajectory group included participants who reported using marijuana less than a few times a year at age 14 to more than a few times a year at age 19, using a few times a year or less at age 24, and using no marijuana at age 29. This group had an estimated prevalence of 17%. The moderate marijuana use group included participants who reported using marijuana less than a few times a year at age 14, and using marijuana more than a few times a year at age 19, 24, and 29. This group had an estimated prevalence of 18%. The increasing chronic marijuana use group included participants who reported using marijuana less than a few times a year at age 14, about once a month at age 19, around several times a month at age 24, and around once a week at age 29. This group had an estimated prevalence of 20%.

Table II contains the means with standard deviations or the percentages in each trajectory group of the variables in this study.

Table IIIA shows the odds ratios (ORs) from the bi-variate logistic regression analyses for each variable in this study. Most variables were related to shooting or hitting someone with a weapon and holding a weapon (gun or club) to someone.

Table IIIB presents the adjusted odds ratios (AORs) of each marijuana use trajectory group compared to the non marijuana use trajectory group for each T4 outcome indicator variable, controlling for gender, ethnicity, delinquency at T1, alcohol use at T1, peer deviance at T4, and educational level at T4.

Shooting (or hitting) someone with a weapon (gun or club)

Having greater delinquency at T1 (AOR=1.47, $p<.05$) and having greater peer deviance at T4 (AOR=1.79, $p<.001$) were associated with an increase in the likelihood of shooting (or hitting) someone with a weapon. Higher BPP for the increasing chronic marijuana use trajectory group (AOR=3.37, $p<.001$), the moderate use of marijuana trajectory group (AOR=1.98, $p<.01$), and the quitter trajectory group (AOR=1.70, $p<.05$) were associated with an increased likelihood of shooting (or hitting) someone with a weapon compared with the BPP of the no use of marijuana trajectory group. Gender, ethnicity, alcohol use at T1, and educational level at T4 were not significantly associated with the likelihood of using a weapon in the multivariate logistic regression analysis.

Holding a weapon (gun or club) to someone

Being male (AOR=1.59, $p<.05$), African American (AOR=0.57, $p<.01$), having greater peer deviance at T4 (AOR=1.98, $p<.001$), and having a lower level of education at T4 (AOR=0.84, $p<.01$) were associated with an increase in the likelihood of holding a weapon (gun or club) to someone at T4. Higher BPP for the increasing chronic marijuana use trajectory group (AOR=3.49, $p<.001$) and the quitter trajectory group (AOR=2.88, $p<.01$) were associated with an increased likelihood of holding a weapon to someone compared with the BPP of the no use of marijuana trajectory group.

Stealing without weapons

Being African American (AOR=0.59, $p<.05$), having greater peer deviance at T4 (AOR=2.69, $p<.001$), and having a higher level of education at T4 (AOR=1.17, $p<.05$) were associated with an increase in the likelihood of stealing from someone (or some place) without using a weapon at T4. Higher BPP for the increasing chronic marijuana use trajectory group (AOR=2.13, $p<.05$) was associated with an increased likelihood of stealing

from someone (or some place) without using weapons compared with the BPP of the no use of marijuana trajectory group.

DISCUSSION

To our knowledge, this is the first research study to investigate the several risk factors for violent behavior with the use of guns or other weapons and stealing without the use of weapons in a prospective, longitudinal study in an urban community sample of African American and Puerto Ricans beginning in adolescence and extending into the late 20's. Our study extends the literature by examining the trajectories of marijuana use related to violent behavior in both male and female adolescents and following them into the late 20's.

The findings partially support our hypotheses. There are 4 trajectory groups of marijuana use: a) the increasing chronic use of marijuana trajectory group, b) the quitter trajectory group, c) the moderate use of marijuana trajectory group, and d) the no use of marijuana trajectory group. The increasing chronic use of marijuana trajectory group is an interesting group because their use of marijuana is similar to the other marijuana using groups in adolescence, but their use increases during emerging adulthood and young adulthood. It would be important to determine whether there are any environmental or psychosocial factors early in life for identifying the increasing chronic marijuana use group. Some of the contributing factors might include impulsivity and antisocial behavior. While the moderate marijuana use trajectory group shows a somewhat lower level of marijuana use in adolescence as compared with the increasing chronic marijuana use trajectory and the quitting marijuana trajectory groups, the moderate use group continues its marijuana use into the twenties. Although the trajectory of the quitting marijuana group shows a similar pattern to the increasing chronic marijuana use trajectory group in adolescence, the participants in the quitting marijuana trajectory group decrease their marijuana use thereafter and finally quit by the age of 29. Life events such as parenthood which lead to a conventional life style in emerging and young adulthood may play a role in the cessation of marijuana use for the quitter marijuana trajectory group. Indeed, participants who are parents compared to those who do not have children are more likely to stop using marijuana (Data not shown). It should be noted that males in the quitter marijuana trajectory group possibly engage in as much violent behavior as males in the increasing chronic use of marijuana trajectory group.

Membership in the increasing chronic marijuana use trajectory group, the moderate marijuana use trajectory group, and the quitter trajectory group compared to the no marijuana use trajectory group is associated with an increased likelihood of engaging in violent behavior using weapons including guns. Of interest, these results are maintained despite control on gender, ethnicity, early delinquency, early alcohol use, current peer deviance, and current educational level. Thus, a diversity of developmental progressions of marijuana use may result in violent behavior before adulthood. It may be that early involvement in deviant behaviors such as substance use (e.g., marijuana use) places an individual into a pattern of more deviant behavior over time (McCaffrey et al., 2010). These individuals, particularly in the increasing chronic marijuana use trajectory group, may become part of a deviant peer sub-culture in which their continued frequent drug use and violent behavior reinforce one another. However, when we controlled for peer deviance, the findings are still maintained.

Our findings are also consistent with cross-sectional and short-term longitudinal studies in the literature indicating the existence of the association between the use of marijuana and violent behavior involving the use of guns (Loh et al., 2010; Steinman & Zimmerman, 2003; Swahn, Hammig, & Ikeda, 2002). The present study extends the research of Friedman et al. (2001) who found that higher frequency of marijuana use was associated with a greater

likelihood to commit a crime using weapons. In contrast to our hypotheses, as regards stealing from someone or some place without the use of weapons, only the increasing chronic marijuana users differed from the non-users. Comparison of the three columns of AORs in Table 3 shows that the AOR for stealing without a weapon is lower than the AORs for the other two outcomes for each marijuana trajectory group.

Consistent with the literature, males as compared with females were more likely to hold or shoot a weapon at someone (Brown, 2004). From an environmental perspective, it has been suggested that boys as compared with girls are more susceptible and exposed to certain risk factors as they are given more freedom than girls (Moffit, Caspi, Rutter, & Silva, 2001; Rutter, 2003). Therefore, they are more likely to hold, shoot, or hit someone with a weapon. Furthermore, males as compared with females are more likely to steal without the use of weapon (Gonzalez-Muél et al., 2013).

Consistent with Sampson and his colleagues (Sampson et al., 2005), our findings indicated that African Americans are more likely to hold a weapon to someone and steal without a weapon (but not to shoot or hit someone) than Puerto Ricans. Identification of the ethnic factors leading to this increased use of weapons would be a valuable contribution to the epidemiological study of weapon-related violence.

Prior research on behavioral risk factors suggests that delinquency is a predictor of violent behavior (Farrington, 2012; Herrenkohl, Lee, & Hawkins, 2012). Our bi-variate findings are in accord with earlier investigators who reported that delinquency is related to both interpersonal violence and general offending across important stages of the life cycle (Farrington, 2007; Fergusson, Horwood, & Ridder, 2005; Nagin, Pogarsky, & Farrington, 1997; Piquero, MacDonald, Dobrin, Daigle, & Cullen, 2005). Our empirical result that T1 delinquency (i.e., inter-personal aggression, theft and vandalism) is not associated with T4 weapon holding after controlling for the trajectories of marijuana use suggests that marijuana use is an important mediator to holding a weapon to someone before adulthood.

With regard to level of education, we confirm the positive bi-variate association between higher educational attainment and the lower likelihood of violent behavior. With greater education and training, individuals are more likely to obtain work and are more likely to exhibit self-control (Harlow, 2003). However, increased educational attainment was associated with an increased likelihood of stealing from someone without the use of a weapon in our multivariate finding. This finding may be a false positive due to multiple comparisons.

Limitations

Our data are also based on self-reports rather than on external measurements from official records such as police records. However, studies have shown that use of this type of self-report data yields reliable results (Mennes, Abdallah, & Cottler, 2009). The estimation of the individual trajectories is sensitive to the sample analyzed. For example, in this paper, the analyses of marijuana use with 838 participants found four trajectory groups, including a quitter group that was 17% of the sample. In an earlier paper, Brook et al. (2013) analyzed data from a fifth wave with a sample of 816 participants, 22 fewer than at T4. They found four groups with the quitter group replaced by an increasing user group (estimated prevalence 10%). Thus, the interpretation of the results on groups that are not large should be made with caution. We also did not have information on probation status or participation in treatment programs. Being on probation/parole and going into treatment may serve as protective factors offsetting the effect of trajectories of marijuana use and violent behaviors with or without weapons. Future studies should include these measures.

Despite these limitations, the study supports and adds to the literature in a number of ways. First, unlike most research that focuses on one point in time, we assess marijuana use over a span of up to 15 years. The prospective nature of the data allows us to go beyond a cross-sectional analysis and to consider the temporal sequencing of variables. Second, the sample is unique as it consisted of African American and Puerto Rican inner city adolescents studied until the late 20's. Moreover, it is a community sample that was selected from schools in East Harlem varying in socioeconomic status. Third, the use of trajectory methodology enables us to identify the increasing chronic marijuana use group which would not have been possible with cross-sectional data. Fourth, a contribution of the paper is a set of findings relating to different trajectories of marijuana use beginning in adolescence related to the occurrence of adult violent behavior using guns or other weapons.

CONCLUSIONS

The findings of this study have implications for public policy, prevention, and treatment. As noted earlier, our results indicate that young ethnic minority men who are on a trajectory of increasing chronic marijuana use over adolescence and young adulthood are more likely to engage in physical violence involving the use of weapons. Therefore, it is important for public policy including education to focus on this very vulnerable and problematic group.

The findings also provide information for prevention and treatment. Interventions in emerging adulthood and adulthood should focus on decreasing the increasing chronic marijuana use trajectory group, the quitting marijuana trajectory group, and the moderate marijuana trajectory group. This may lower the rates of violent behavior with the use of guns. As regards public policy, eased regulation regarding marijuana use could conceivably result in an increase in violent behavior.

Future research is necessary to examine the association of the trajectories of marijuana use with the use of guns and other weapons within larger and more diverse samples of individuals at different developmental stages. Only then can useful interventions to reduce violent behavior with weapons tailored to the individual's stage of development be designed and implemented.

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References

- Ashton CH. Pharmacology and effects of cannabis: A brief review. *British Journal of Psychiatry*. 2001; 178(2):101–106.10.1192/bjp.178.2.101 [PubMed: 11157422]
- Brook JS, Brook DW, Gordon AS, Whiteman M, Cohen P. The psychosocial etiology of adolescent drug use: A family interactional approach. *Genetic, Social, and General Psychology Monographs*. 1990; 116(2):111–267.
- Brook JS, Lee JY, Finch SJ, Seltzer N, Brook DW. Adult work commitment, financial stability, and social environment as related to trajectories of marijuana use beginning in adolescence. *Substance Abuse*. 2013; 34(3):298–305.10.1080/08897077.2013.775092 [PubMed: 23844962]
- Brook JS, Zhang C, Brook DW. Antisocial behavior at age 37: Developmental trajectories of marijuana use extending from adolescence to adulthood. *The American Journal on Addictions*. 2011; 20(6):509–515.10.1111/j.1521-0391.2011.00179.x [PubMed: 21999495]

- Brown B. Juveniles and weapons: Recent research, conceptual considerations, and programmatic interventions. *Youth Violence and Juvenile Justice*. 2004; 2(2):161–184.10.1177/1541204003262226
- Carter PM, Walton MA, Newton MF, Clery M, Whiteside LK, Zimmerman MA, Cunningham RM. Firearm possession among adolescents presenting to an urban emergency department for assault. *Pediatrics*. 2013; 132(2):213–221. Advance online publication. 10.1542/peds.2013-0163 [PubMed: 23837181]
- Cody, RP.; Smith, JK. *Applied Statistics and the SAS Programming Language*. 5. Upper Saddle River, NJ: Prentice-Hall, Inc; 2005.
- Farrington, D. Origins of violent behavior over the life span. In: Flannery, DJ.; Vaszonyi, AJ.; Waldman, ID., editors. *The Cambridge handbook of violent behavior and aggression*. Cambridge, UK: Cambridge University Press; 2007. p. 19-48.
- Farrington, D. Childhood risk factors for young adult offending: Onset and persistence. In: Losel, F.; Bottoms, A.; Farrington, DP., editors. *Young adult offenders: Lost in transition?*. London, UK: Routledge; 2012. p. 48-64.
- Fergusson DM, Horwood LJ. Cannabis use and dependence in a New Zealand birth cohort. *New Zealand Medical Journal*. 2000; 113(1109):156–158. [PubMed: 10894340]
- Fergusson DM, Horwood LJ, Ridder EM. Show me the child at seven: The consequences of conduct problems in childhood for psychosocial functioning in adulthood. *Journal of Child Psychology & Psychiatry*. 2005; 46(8):837–849.10.1111/j.1469-7610.2004.00387.x [PubMed: 16033632]
- Friedman AS, Glassman K, Terras A. Violent behavior as related to use of marijuana and other drugs. *Journal of Addictive Diseases*. 2001; 20(1):49–72.10.1300/J069v20n01_06 [PubMed: 11286431]
- Gonzalez-Muél E, DeGeest DS, Kiersch CE, Mount MK. Gender differences in personality predictors of counterproductive behavior. *Journal of Managerial Psychology*. 2013; 28(4):333–353.10.1108/JMP-12-2012-0397
- Hall WD, Degenhardt L. Prevalence and correlates of cannabis use in developed and developing countries. *Current Opinion in Psychiatry*. 2007; 20(4):393–397.10.1097/YCO.0b013e32812144cc [PubMed: 17551355]
- Harlow, CW. *Education and Correctional Populations*. Washington, DC: U.S. Bureau of Justice Statistics; 2003.
- Hemenway, D. *Private guns, public health*. Ann Arbor, MI: University of Michigan Press; 2004.
- Herrenkohl TI, Lee J, Hawkins JD. Risk versus direct protective factors and youth violence: Seattle Social Development Project. *American Journal of Preventive Medicine*. 2012; 43(2 Suppl 1):S41–S56.10.1016/j.amepre.2012.04.030 [PubMed: 22789957]
- Kaplan, HB.; Damphouse, KR. Self-attitudes and antisocial personality and moderators of the drug use-violence relationship. In: Kaplan, HB., editor. *Drugs, crime, and other deviant adaptations: Longitudinal studies*. New York, NY: Plenum; 1995. p. 187-210.
- Loh K, Walton MA, Harrison SR, Zimmerman M, Stanley R, Chermack ST, Cunningham RM. Prevalence and correlates of handgun access among adolescents seeking care in an urban emergency department. *Accident Analysis & Prevention*. 2010; 42(2):347–353.10.1016/j.aap.2009.11.012 [PubMed: 20159053]
- Mauricio AM, Little M, Chassin L, Knight GP, Piquero AR, Losoya SH, Vargas-Chanes D. Juvenile offenders' alcohol and marijuana trajectories: Risk and protective factor effects in the context of time in a supervised facility. *Journal of Youth and Adolescence*. 2009; 38(3):440–453.10.1007/s10964-008-9324-5 [PubMed: 19636756]
- McCaffrey DF, Pacula RL, Han B, Ellickson P. Marijuana use and high school dropout: The influence of unobservables. *Health Economics*. 2010; 19(11):1281–1299.10.1002/hec.1561 [PubMed: 19937639]
- Mennes CE, Abdallah AB, Cottler LB. The reliability of self-reported cannabis abuse, dependence and withdrawal symptoms: A multisite study of differences between general population and treatment groups. *Addictive Behaviors*. 2009; 34(2):223–226.10.1016/j.addbeh.2008.10.003 [PubMed: 19004561]

- Moffit, TE.; Caspi, A.; Rutter, M.; Silva, PA. Sex differences in antisocial behavior: Conduct disorder, delinquency, and violence in the Dunedin longitudinal study. Cambridge, UK: Cambridge University Press; 2001.
- Muthén, LK.; Muthén, BO. Mplus User's Guide. 4. Los Angeles, CA: Muthén & Muthén; 2007.
- Nagin DS, Pogarsky G, Farrington DP. Adolescent mothers and the criminal behavior of their children. *Law & Society Review*. 1997; 31(1):137–162.10.2307/3054097
- National Conference of State Legislatures (NCSL). Law and criminal justice committee report - Addressing gun violence: Guiding principles for policymakers. 2005. Retrieved from <http://www.ncsl.org/issues-research/justice/addressing-gun-violence-guiding-principles.aspx>
- Pahl K, Brook JS, Lee JY. Joint trajectories of victimization and marijuana use and their health consequences among urban African American and Puerto Rican young men. *Journal of Behavioral Medicine*. 2013; 36(3):305–314.10.1007/s10865-012-9425-1 [PubMed: 22532191]
- Palfrey JS, Palfrey S. Preventing gun deaths in children. *New England Journal of Medicine*. 2013; 368(5):401–403.10.1056/NEJMp1215606 [PubMed: 23272974]
- Piquero AR, MacDonald J, Dobrin A, Daigle LE, Cullen F. Self-control, violent offending, and homicide victimization: Assessing the general theory of crime. *Journal of Quantitative Criminology*. 2005; 21(1):55–71.10.1007/s10940-004-1787-2
- Planty, M.; Truman, JL. Bureau of Justice Statistics. Firearm Violence, 1993–2011. 2013. Retrieved from <http://www.bjs.gov/index.cfm?ty=pbdetail&iid=4616>
- Rutter, M. Crucial paths from risk indicator to causal mechanism. In: Lahey, B.; Moffit, TE.; Caspi, A., editors. *Causes of Conduct Disorder and Juvenile Delinquency*. New York, NY: Guilford Press; 2003. p. 3-24.
- Sampson RJ, Morenoff JD, Raudenbush S. Social anatomy of racial and ethnic disparities in violence. *American Journal of Public Health*. 2005; 95(2):224–232.10.2105/AJPH.2004.037705 [PubMed: 15671454]
- Steinman KJ, Zimmerman MA. Episodic and persistent gun-carrying among urban African-American adolescents. *Journal of Adolescent Health*. 2003; 32(5):356–364.10.1016/S1054-139X(03)00022-3 [PubMed: 12729985]
- Swahn MH, Hammig BJ, Ikeda RM. Prevalence of youth access to alcohol or a gun in the home. *Injury Prevention*. 2002; 8(3):227–230.10.1136/ip.8.3.227 [PubMed: 12226121]
- Windle M, Wiesner M. Trajectories of marijuana use from adolescence to young adulthood: Predictors and outcomes. *Developmental Psychopathology*. 2004; 16(4):1007–1027.10.1017/S0954579404040118

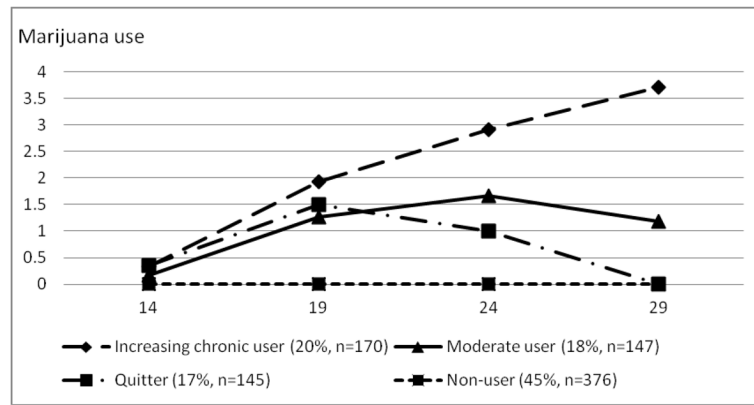


Fig. 1. Trajectories of marijuana use from adolescence to young adulthood (T1–T4)
 Note. The answer options ranged from never (0) to once a week or more (4).

TABLE I

Measures

Measures	Number of items	Sample item	Answer options
<i>Demographic variables</i>			
Gender	1	Gender	Female (1), Male (2)
Ethnicity	1	Ethnicity	African American (1), Puerto Rican (2)
<i>Control variables</i>			
Delinquency at T1 ($\alpha = .78$)	10	During the past 5 years, how often have you broken into a house or building that you were not supposed to be in?	Never (1) to 5 or more times (5)
Alcohol use at T1	1	How often do you drink beer, wine, or hard liquor?	Never (1) to 3 or more drinks every day
Peer deviance at T4 ($\alpha = .83$)	3	How many of your friends have stolen something worth more than \$5?	None (1) to most (4)
Educational level at T4	1	What year of school are you in? If not in school, what was last grade you completed?	11 th grade or below (0) to post graduate degree (6)
<i>Independent variable</i>			
Marijuana use at T1–T4	1 at T1–T4	How often have you ever used marijuana? at T1 How often have you used marijuana in the past 5 years? at T2–T4	Never (0) to once a week or more (4)
<i>Dependent variables</i>			
Shooting or hitting someone with a weapon (gun or club) at T4	1	How often have you shot or hit someone with a weapon (gun or club)?	Never (0) to 5 or more times (4)
Holding a weapon (gun or club) to someone at T4	1	How often have you held a weapon (gun or club) to someone?	Never (0) to 5 or more times (4)
Stealing from someone (some place) without a weapon at T4	1	How often have you stolen from someone or some place without using a weapon?	Never (0) to 5 or more times (4)

Note. α = Cronbach's alpha

TABLE II

Summary statistics by trajectory groups (percentages or means with standard deviations). Classification into trajectory with highest Bayesian posterior probability

	Trajectories of marijuana use				Whole sample (N=838)
	Non user (n=376)	Quitter (n=145)	Moderate user (n=147)	Increasing chronic (n=170)	
Females	72.9% (n=274)	66.2% (n=96)	45.0% (n=67)	35.9% (n=61)	59.4% (n=498)
African American	58.0% (n=218)	53.1% (n=77)	47.6% (n=70)	55.9% (n=95)	54.9% (n=460)
Delinquency at T1	1.4 (0.4)	1.6 (0.6)	1.6 (0.6)	1.7 (0.7)	1.5 (0.6)
Alcohol use at T1	1.1 (0.3)	1.3 (0.5)	1.3 (0.5)	1.3 (0.4)	1.2 (0.4)
Peer deviance at T4	1.4 (0.6)	1.6 (0.7)	1.7 (0.7)	1.9 (0.8)	1.6 (0.7)
Educational level at T4	2.8 (1.9)	2.3 (1.8)	2.5 (2.0)	1.8 (1.8)	2.4 (1.9)
Shooting or hitting someone with a weapon (gun or club) at T4	3.7% (n=14) Males=2.9% Females=4.0%	9.7% (n=14) Males=20.4% Females=4.2%	8.8% (n=13) Males=10.0% Females=7.5%	18.2% (n=31) Males=22.0% Females=11.5%	8.6% (n=72) Males=13.2% Females=5.4%
Holding a weapon (gun or club) to someone at T4	7.4% (n=28) Males=9.8% Females=6.6%	21.1% (n=31) Males=40.8% Females=11.5%	17.0% (n=25) Males=21.3% Females=11.9%	32.9% (n=56) Males=37.6% Females=24.6%	16.7% (n=140) Males=25.9% Females=10.4%
Stealing from someone (some place) without a weapon at T4	7.7% (n=29) Males=12.6% Females=5.8%	4.8% (n=7) Males=8.2% Females=3.1%	13.6% (n=20) Males=15.0% Females=11.9%	25.9% (n=44) Males=30.3% Females=18.0%	11.9% (n=100) Males=18.2% Females=7.6%

Notes. The answer options for delinquency at T1 ranged from never (1) to 5 or more times (5). The answer options for alcohol use at T1 ranged from never (1) to three or more drinks every day (5). The answer options for peer deviance at T4 ranged from none (1) to most (4). The answer options for educational level at T4 ranged from 11th grade or below (0) to post graduate degree (6)

TABLE III

Odds ratios with confidence intervals (CI) of bi-variate logistic regression analyses and adjusted odds ratios (CI) of multi-variate logistic regression analysis

	Shooting or hitting someone with a weapon (gun or club)	Holding a weapon (gun or club) to someone	Stealing from someone or some place without using a weapon
A. Bi-variate logistic analyses			
Gender	2.66 *** (1.62, 4.38)	3.00 *** (2.06, 4.36)	2.70 *** (1.76, 4.15)
Ethnicity	0.91 (0.56, 1.49)	0.81 (0.56, 1.17)	0.68 (0.44, 1.05)
Delinquency at T1	1.05 * (1.01, 1.09)	1.08 *** (1.05, 1.11)	1.06 *** (1.03, 1.10)
Alcohol use at T1	1.40 (0.86, 2.28)	1.76 ** (1.21, 2.57)	1.67 * (1.11, 2.51)
Peer deviance at T4	2.27 *** (1.83, 2.81)	2.61 ** (2.04, 3.33)	2.80 *** (2.14, 3.66)
Educational level at T4	0.83 ** (0.73, 0.96)	0.77 *** (0.69, 0.85)	1.00 (0.89, 1.11)
Increasing chronic user vs. non user	6.80 *** (3.23, 14.32)	7.46 *** (4.27, 13.03)	3.82 *** (2.46, 5.93)
Moderate user vs. non user	2.86 * (1.26, 6.93)	3.11 *** (1.66, 5.83)	1.20 (0.71, 2.03)
Quitter vs. non user	3.21 * (1.30, 7.95)	4.07 *** (2.12, 7.81)	0.18 *** (0.07, 0.47)
B. Multi-variate logistic regression analysis			
Gender	1.20 (0.86, 1.69)	1.59 * (1.03, 2.47)	1.46 (0.88, 2.44)
Ethnicity	0.88 (0.64, 1.20)	0.57 ** (0.38, 0.87)	0.59 * (0.36, 0.95)
Delinquency at T1	1.47 * (1.05, 2.06)	1.25 (0.86, 1.82)	1.24 (0.80, 1.92)
Alcohol use at T1	0.79 (0.51, 1.23)	1.21 (0.74, 1.96)	1.27 (0.72, 2.26)
Peer deviance at T4	1.79 *** (1.41, 2.27)	1.98 *** (1.50, 2.61)	2.68 *** (1.95, 3.68)
Educational level at T4	1.01 (0.93, 1.10)	0.84 ** (0.74, 0.94)	1.17 * (1.02, 1.33)
Increasing chronic user vs. non user	3.37 *** (2.13, 5.33)	3.49 *** (1.90, 6.39)	2.13 * (1.11, 4.08)
Moderate user vs. non user	1.98 ** (1.24, 3.18)	1.91 † (0.97, 3.75)	0.97 (0.46, 2.01)
Quitter vs. non user	1.70 * (1.01, 2.86)	2.88 ** (1.45, 5.73)	0.39 † (0.14, 1.08)

Notes.

¹† $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$

²The estimated probability of each outcome indicator for the non-use group is: a) for shooting or hitting someone with a weapon 0.04; b) for holding a weapon 0.07; and c) for stealing without using a weapon 0.08.

³The sex coding is female=1, male=2. The ethnicity coding is African American=1, Puerto Rican=2