Teasing Apart the Developmental Associations Between Alcohol and Marijuana Use and Violence

EVELYN H. WEI
ROLF LOEBER
University of Pittsburgh

HELENE RASKIN WHITE
Rutgers, the State University of New Jersey

This study explored the longitudinal associations of alcohol and marijuana use and violence over ages 11-20 in the youngest sample of males from the Pittsburgh Youth Study (N = 503). We examined trends in alcohol and marijuana use and violence, how they covaried both concurrently and over time, and whether frequent substance use predicted violence and vice versa in multivariate models controlling for common risk factors. The analyses focused on frequent alcohol or marijuana users, those who scored in the highest 25% of frequency. Throughout adolescence, substance use was more prevalent than violence. Most substance users did not engage in violence, and the proportion of substance users who engaged in violence was smaller than the proportion of violent offenders who were also substance users. Concurrently, frequent use of alcohol and marijuana were both significantly associated with violence. Longitudinal associations between frequent drinking and violence were weak, whereas longitudinal associations between frequent marijuana use and violence were more consistent. However, the relationship between frequent marijuana use and violence (and vice versa) was spurious; it was no longer significant when common risk factors such as race/ethnicity and hard drug use were controlled for. We conclude that the marijuana-violence relationship is due to selection effects whereby these behaviors tend to co-occur in certain individuals, not because one behavior causes the other; rather, both are influenced by shared risk factors and/or an underlying tendency toward deviance.

Keywords: *alcohol; marijuana; violence; developmental associations*

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A substantial body of literature has addressed the link between substance use and violence. The substance use–violence relationship has been addressed by two angles of research: Acute or pharmacological effects have been examined in survey and laboratory studies, and longer term, developmental effects have been addressed by longitudinal survey studies. These studies have shown differences in the effects of alcohol and marijuana on violent behavior. Several key issues remain, such as developmental trends between substance use and violence throughout the adolescent period, and concurrent and predictive associations, especially when appropriate statistical controls are introduced.

Numerous studies have shown an association between alcohol use and violence (see reviews by Boles & Miotto, 2003; Chermack & Giancola, 1997; Miczek et al., 1994; White, 1997a). However, the evidence concerning the association between marijuana use and violence is much more ambiguous and controversial. Federal documentation on the Internet (Center for Substance Abuse and Prevention, 2003) cites as one of "ten good reasons to focus on marijuana use" that "violence and other crime have been attributed directly to marijuana use." In the year 2000, marijuana was the most popular drug used by juvenile male detainees; across nine sites nationwide, 42% to 55% of detainees tested positive for marijuana (U.S. Department of Justice, 2003).

Acute and Concurrent Associations

There is a consensus that most users of alcohol do not commit violence but that heavy or frequent alcohol use lowers the threshold for the manifestation of violence, especially among aggressive individuals. This consensus is supported by experimental laboratory studies, longitudinal survey studies, and reviews of the literature (Chermack & Giancola, 1997; Ito, Miller, & Pollock, 1996; Parker & Auerhahn, 1998; White, 1997a).

On the other hand, most studies do not support an acute or direct association between marijuana use and violence (Boles & Miotto, 2003; Dembo et al., 1991; Friedman, 1998; Miczek et al., 1994; Reiss & Roth, 1993; White, 1997a). Laboratory research has demonstrated that alcohol and marijuana have opposite psychopharmacological associations vis-à-vis aggression (Miczek et al., 1994). Survey data also fail to find that marijuana use psychopharmacologically induces violence (Boles & Miotto, 2003; Goldstein, 1985). According to Reiss and Roth (1993), "In general, scientific reviews have concluded that violent behavior is either decreased or unaffected by marijuana use" (pp. 1165-1167).

Most studies have examined the acute effects of substance use on violence among adults. In one survey study of adolescent males from the Pittsburgh

Youth Study (PYS), White, Tice, Loeber, and Stouthamer-Loeber (2002) found that offenses against persons were committed more often than general theft while under the influence of alcohol. In addition, aggressive acts were more often related to self-reported acute alcohol use than to marijuana use. Offenses committed under the influence were more prevalent among heavier alcohol and drug users, more serious offenders, more impulsive youth, and youth with more deviant peers. White and Hansell (1998) also found that acute use of alcohol compared to marijuana was more strongly associated with fighting, especially in late adolescence and early adulthood.

Most research on substance use and violence among adolescents has focused on the developmental associations rather than acute associations. Whereas studies of acute effects clarify the association between doses of substance use and immediate aggressive behavior, developmental studies help to clarify the temporal associations and to delineate longer term effects (Huang, White, Kosterman, Catalano, & Hawkins, 2000, p. 80). Rather than assuming a pharmacological association, much of the developmental research is based on the assumption that substance use and aggression are problem behaviors that co-occur during adolescence and that both types of problem behaviors are dependent on a similar set of common risk factors (White & Labouvie, 1994).

There are several plausible ways by which alcohol, and possibly marijuana use, can be developmentally implicated in violence. For example, (a) substance use may lead to violence; (b) violence may lead to substance use; (c) causation may be reciprocal (i.e., one causes the other and vice versa); (d) violence and substance use may be seen as aspects of general dispositions to deviance (i.e., they may be alternative manifestations of the same concept); and (e) substance use and violence may be seen as independent forms of deviance that share common precursors, resulting in a spurious relationship (Kaplan & Damphousse, 1995, pp. 189-191; see also White, 1997a, 1997b).

Developmental Associations and Direction of Effects

Studies examining developmental relationships in adolescence have generally found that early aggressive behavior predicts later substance use and that increases in substance use are related to increases in violent offending (Elliott, Huizinga, & Menard, 1989; White, 1997a, 1997b). The linkage between frequent alcohol use and violence has also been confirmed in longitudinal studies (e.g., Elliott et al., 1989; White, Loeber, Stouthamer-Loeber, & Farrington, 1999). Frequent alcohol use has been shown to predict violence, even when controlling for marijuana use and for other shared risk factors (White et al., 1999).

Using a sample of predominantly White, middle- and working-class adolescent males, White, Brick, and Hansell (1993) found that while controlling for concurrent associations and stability of behaviors over time, aggression in early adolescence (age 12) predicted increases in later alcohol use (age 15), but alcohol use did not predict increases in aggression. White and Hansell (1998) repeated these analyses after following their sample into young adulthood (ages 25-31) and did not find an association between early aggression and later substance use nor between early alcohol use and later aggression. They did find that marijuana use in adolescence (ages 12-18) was negatively related to later aggressive behavior (ages 15-21) and that marijuana use in later adolescence (ages 18-24) was positively related to aggression in young adulthood (ages 25-31). Cross-sectional correlations were much stronger between alcohol and aggression than between marijuana and aggression. In this latter study, aggression was measured by a single indicator of minor aggressive behavior.

In a study of a high-risk Seattle sample, Huang and colleagues (2000) found that the concurrent associations between alcohol use and aggression decreased with age from midadolescence (age 14) into late adolescence (age 18). In terms of cross-lagged associations, aggressive behavior at age 15 predicted increases in alcohol use at age 16, and alcohol use at age 16 predicted increases in aggressive behavior at age 18. However, when common risk factors were controlled for, only the association between alcohol use and later aggressive behavior remained significant. This study focused on aggression as measured by throwing objects, picking fights, and hitting to hurt, as opposed to more serious criminal acts of violence.

Similarly, White et al. (1999) also examined the cross-lagged associations between substance use and violence using data from the oldest cohort in the PYS from ages 13 to 18. The authors found reciprocal associations between alcohol and violence. These associations held even after risk factors that have been associated with both sets of behaviors were controlled for, thus ruling out a purely spurious relationship. White and colleagues found that the concurrent associations were stronger for marijuana and violence than for alcohol and violence, but the longitudinal associations were opposite. Nevertheless, marijuana use in early adolescence (at age 13) was a strong predictor of later violent behavior. However, although changes in marijuana use predicted changes in violence, the association was no longer significant once the effects of prior alcohol use and violence were partialled out. This finding is important, because frequent marijuana users also consume alcohol, and the pure effect of each substance on violence can best be investigated by means of partial correlations in which the effect of one substance on violence is examined while holding constant the effect of the other substance.

In summary, the relationship between substance use and violence appears to be a complicated one. Findings have not been consistent across studies and tend to differ depending on the substance that is examined and the sample that is used. Use of different age ranges and outcome measures (minor aggression versus violence) also contributes to the inconsistency in findings. In addition, previous studies have pointed to the importance of investigating developmental associations between substance and violence while partialling out the effects of co-occurring substance use.

These issues are addressed in this study, which is a replication and extension of prior developmental research in the Pittsburgh Youth Study on substance use and violence in the oldest sample from ages 13 to 18 (White et al., 1999). In this article, we use the youngest sample of the PYS to examine the concurrent and longitudinal associations between alcohol and marijuana use and violence over a 10-year period from ages 11 to 20 years. This study addresses the following questions:

1. What are the developmental trends of substance use and violence throughout adolescence in terms of the prevalence and frequency of each behavior?
2. What are the concurrent and longitudinal associations between frequent substance use and violence?
3. What is the direction of effect between substance use and violence when controlling for shared risk factors?

It is important to replicate findings across different samples. This study extends the earlier study with the older sample (White et al., 1999) in several ways. First, the earlier study was based on a shorter window of time (from ages 13 to 18 compared with 11 to 20). Second, those findings were for a sample that reached adolescence during the peak of the violence epidemic in Pittsburgh (Fabio, Loeber, & Farrington, 2003), whereas this sample is less violent but more involved in illegal drug use (White, Stouthamer-Loeber, Loeber, & Farrington, 2001). Finally, in this study we control for two important demographic factors that are related to violence and substance use (i.e., neighborhood context and race/ethnicity), which were not included in the earlier study.

Nevertheless, we anticipate replicating earlier associations between alcohol and violence. Second, we hypothesize that frequent marijuana use will predict violence and that violence will predict frequent marijuana use. However, we also predict that once statistical controls for confounding factors are taken into account, the association between frequent marijuana use and violence will appear to be spurious, whereas the association between frequent alcohol use and violence will remain.

METHOD

Data were collected as part of the PYS, a longitudinal study of the development of delinquency, substance use, and mental health problems among inner-city adolescent males (Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998). In 1987, three samples of boys were randomly drawn from the first, fourth, and seventh grades of public schools. Of the 3,436 randomly selected, 85% of the boys and their caretakers (93% of whom were biological mothers) consented to participate in a screening assessment. From each sample, the top 30% (about 250 from each grade) of boys with the highest rates of antisocial behavior were selected, along with an equal number randomly selected from the remaining 70%. This resulted in three samples of about 500 boys each. The present analyses focus on the youngest cohort (N = 503), those who were in the first grade when the study began.

At the first assessment, participants in the youngest sample were an average of 7 years old. Slightly more than half (56.3%) of the sample was African American, and almost half (41.4%) was Caucasian, reflecting the racial composition of Pittsburgh public schools when the study began. The population of other ethnic/racial minority groups in Pittsburgh is very low. About 40% of the boys lived with a single parent, and about 40% of the caretakers received public assistance. Further details about the study design and participants can be found in Loeber et al. (1998).

The first 8 assessments were conducted semiannually, and the next 10 were conducted annually. Information was collected from the boys and their caretakers and teachers until age 17 and then from interviews with the boys only. These analyses use data from ages 11 to 20. Data from the semiannual assessments were combined to reflect behaviors occurring in the past year. Data from ages 7 through 10 were not used, because few boys were using substances at these ages, and measures at the younger ages (ages 7-10) used categorical rather than continuous scales. At the last data collection phase (age 20), the participation rate was 82%, and the overall average follow-up rate was 92%, reflecting very low attrition.

Violence Measures

Violence was measured annually by the Self-Reported Delinquency scale (Loeber et al., 1998) and included the past year frequency (number of times) of gang fighting, strong-arming, attacking someone with a weapon or intent to seriously hurt or kill, and rape or forced sex.

Substance Use Measures

Self-reported frequency (number of times in the past year) of alcohol, marijuana, and hard drug use was assessed annually by the Substance Use Scale (Loeber et al., 1998). Hard drugs included hallucinogens, cocaine, crack, heroin, PCP, and nonmedical use of tranquilizers, barbiturates, codeine, amphetamines, and other prescription medications. The lifetime prevalence of hard drug use from ages 11 to 20 was too low ($n = 73$) to include hard drug use as an outcome measure. Therefore, the analysis focuses on the relationship of alcohol and marijuana use with violence. Hard drug use is controlled for in some of the analyses.

The frequency of alcohol consumption was the sum of the number of times participants drank beer, wine, or hard liquor and did not count trying a few sips or drinking with the permission of adults during special occasions/religious services.

Common Risk Factors

Based on findings of previous studies examining substance use and violence (Huang et al., 2000; White et al., 1999), several risk factors common to both substance use and violence were selected as covariates. Because many distributions were skewed, and to ease interpretability, risk factors were dichotomized at the top 25%. These risk factors included the *lifetime frequency of hard drug use*, assessed annually by self-report, and the *frequency of self-reported property crime* (theft, fraud, and vandalism), assessed at age 11. Other child factors were *low academic achievement*, assessed by the primary caretaker and teacher when the boy was age 7, and *depressed mood* and *hyperactivity/impulsivity/inattention problems* (from the Child Behavior Checklist; Achenbach & Edelbrock, 1979, 1983; Edelbrock & Achenbach, 1984), assessed by caretaker and teacher when the boy was age 7. Family risk factors were based on reports by caretakers and participants and included *poor communication with caretaker*, measured at age 11, and *poor supervision*, measured at age 7. In addition, we controlled for *caretaker perception of bad neighborhood*, assessed by the primary caretaker at the first interview (when the boy was age 7). This variable measured caretakers' perceptions of factors such as crime, unemployment, racial conflict, vandalism, and so on in their neighborhood. We also controlled for African American ethnicity because the prevalence of violence is much higher among African Americans (Reiss & Roth, 1993). However, we do not assert that race or ethnicity per se is a risk factor. Rather, we treat African American race/ethnicity as a *marker*

of environmental, socioeconomic, or psychosocial risk, for which we wish to control in investigating the substance use–violence relationship.

Analyses

Prevalence and frequency of substance use and violence over time were used to examine trends in the behaviors. For all analyses, frequent substance use was a dichotomous variable defined as being in the highest 25% of frequency. Concurrent associations between substance use and violence were tested with 2×2 contingency tables, and odds ratios are reported.

In examining longitudinal associations of frequent alcohol use and later violence, prior violence and frequent marijuana use were controlled for. Similarly, analysis of the relationship between frequent marijuana use and later violence controlled for prior violence as well as prior frequent alcohol use. Reverse associations were also tested (i.e., the relationship between violence in one year and frequent alcohol or marijuana use in the next, controlling for prior frequent alcohol and marijuana use). Logistic regression analyses were conducted and adjusted odds ratios are reported.

Longitudinal associations were examined first by cross-lagged (year-to-year) associations from ages 11 to 20. Then, several waves of data were aggregated into two time periods covering ages 11 to 14 and 15 to 20. Based on a cutoff point of the top 25% of alcohol use frequency, frequent users during the first time period drank a total of four or more times between ages 11 and 14, and frequent users during the second time period drank a total of 181 or more times between ages 15 and 20. Any use of marijuana between ages 11 and 14 classified participants as frequent users in the first time period, and for the second time period, the cutoff point was using a total of 300 or more times over ages 15 to 20. In terms of violence, participants who ever engaged in *any* violence were considered, and this applied to both time periods. To reduce false negative classification, participants who were not classified in the top 25% in terms of frequency *and* who missed three or more of the 10 assessments were excluded. Logistic regression analyses were repeated as described above.

Finally, to determine whether longitudinal associations between substance use and violence are spurious, common risk factors were added to the logistic regression models. First, univariate associations between the selected risk factors with frequent alcohol use, frequent marijuana use, and violence were tested, and tests for multicollinearity were conducted. Risk factors that were associated at the $p < .10$ level with both frequent alcohol use and violence, or with both frequent marijuana use and violence (or all three outcomes), and

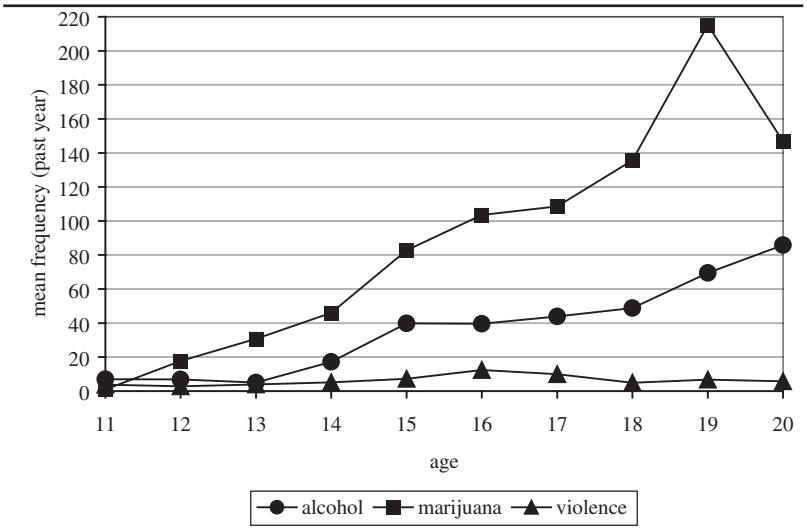

Figure 1 Mean Frequencies of Substance Use and Violence by Age Among Active Users/Offenders

were not highly collinear were selected as covariates. Predictors were entered simultaneously into logistic regression models.

RESULTS

In the youngest sample of the PYS, the lifetime prevalence of alcohol use by age 20 was 84.8%. The percentage of participants who had ever used marijuana by age 20 was 61.8%. Slightly more than a third (35.4%) had ever engaged in violence by age 20.

Figure 1 shows the mean frequency of alcohol consumption, marijuana use, and violence among active users/offenders by age. Among those who used alcohol, the frequency of consumption increased sharply between ages 13 and 15 and again after age 18. From age 12 on, marijuana use was more frequent among marijuana smokers than the frequency of alcohol use among drinkers, and the difference increased with age through age 19. Starting at age 15, marijuana users reported an average frequency reflecting use as often as once per week or more (i.e., frequencies > 52 times in past year), peaking at age 19. The frequency of violent behavior followed a typical age-crime curve, peaking at around age 16 (at about one time per month) and then declining (Farrington, 1986). Frequencies of substance use were substantially higher than frequencies of violence at all age levels.

TABLE 1
Associations Between Use and Frequent Use of Alcohol and Marijuana and Violence (ages 11-20)

	N	%
Ever used alcohol:	417	84.8
Also engaged in violence	162	38.8
Ever used alcohol frequently:	329	37.1
Also engaged in violence	154	46.8
Ever used marijuana:	417	61.8
Also engaged in violence	162	48.7
Ever used marijuana frequently:	329	51.4
Also engaged in violence	154	54.0
Ever engaged in violence:	174	35.4
Also ever used alcohol	162	93.1
Also ever used alcohol frequently	154	88.5
Also ever used marijuana	162	85.1
Also ever used marijuana frequently	154	78.2

Next, we examined the overall associations between the prevalence of substance use and violence. Table 1 shows the overall associations between *any* substance use and violence and between *frequent* substance use and violence. Of the 84.8% of participants who had ever used alcohol between ages 11 and 20, 38.8% had engaged in violence. Turning to frequent users, of the 67.1% of participants who had ever consumed alcohol frequently (had ever been in the top 25% frequency), 46.8% had engaged in violence.

Of the 61.8% of participants who had ever used marijuana, less than half (48.7%) had engaged in violence. Of the 51.4% of participants who had ever used marijuana frequently (had ever been in the top 25% frequency), slightly more than half (54.0%) had engaged in violence between ages 11 and 20. In contrast, of the 35.4% of participants who had ever engaged in violence, 93.1% had ever used alcohol, 88.5% had ever used alcohol frequently, 85.1% had ever smoked marijuana, and 78.2% had ever smoked marijuana frequently. Thus, throughout the adolescent period, the proportion of substance users who engaged in violence was lower than the proportion of violent individuals who used substances.

Table 2 shows the percentages and odds ratios of the concurrent associations of frequent alcohol and marijuana use with any violence for each age from 11 to 20. At every age, the percentage of violent individuals who used alcohol frequently was greater than the percentage of frequent drinkers who engaged in violence. This was also true for marijuana use starting at age 14; the percentage of violent individuals who used marijuana frequently exceeded the percentage of frequent marijuana smokers who engaged in violence. All associations were in the positive direction (i.e., all odds ratios were

TABLE 2
Concurrent Associations Between Frequent Alcohol and Marijuana Use and Violence by Age

		Frequent Alcohol Use & Violence				*Frequent Marijuana Use & Violence*			
Age	*Total* N	n	*% Violence With Alcohol*	*% Alcohol With Violence*	*Odds Ratio*	n	*% Violence With Marijuana*	*% Marijuana With Violence*	*Odds Ratio*
11	464	11	26.19	18.97	2.83**	0	.00	.00	—
12	475	22	45.83	29.33	5.97***	5	10.42	83.33	—
13	469	17	44.74	16.50	3.25***	10	26.32	34.48	7.74***
14	464	37	71.15	27.41	7.93***	26	50.00	39.39	9.30***
15	452	34	62.96	27.42	5.84***	31	57.41	31.00	6.43***
16	445	26	61.90	22.03	5.49***	26	61.90	22.61	5.73***
17	436	18	54.55	16.07	3.95***	21	63.64	19.27	6.26***
18	434	12	57.14	11.01	4.34**	16	76.19	14.68	11.01***
19	419	10	58.82	9.52	4.62**	11	64.71	10.48	6.01***
20	414	6	50.00	5.50	2.90	9	75.00	8.65	9.70***

NOTE: — = 1+ cell with $n < 5$.
** $p < .01$. *** $p < .001$.

greater than one). For example, at age 18, frequent marijuana users were 11 times more likely than nonfrequent users to also engage in violence (OR = 11.01), whereas frequent drinkers were 4 times as likely as nonfrequent drinkers to also engage in violence (OR = 4.34).

Table 3 summarizes the longitudinal associations between frequent alcohol and marijuana use and violence. Cross-lagged associations are presented first to address whether substance use in one year was associated with violence in the next year. For example, at age 11, frequent alcohol use was associated with violence at age 12, while controlling for violence and marijuana use at age 11 ($OR_{adj} = 2.68$). However, after age 11, there was no significant association between frequent alcohol use in one year and violence in the following year. Frequent use of marijuana was associated with violence in the following year (controlling for prior year violence and alcohol use) for five of the eight annual comparisons ($OR_{adj} = 2.67\text{-}3.83$).

We also addressed whether violence increased substance use in the following year. In terms of violence predicting frequent drinking in the following year, those who were violent at age 14 were more than twice as likely as those who were not violent to be frequent drinkers at age 15 ($OR_{adj} = 2.38$). However, violence during late adolescence, at age 19, was significantly associated with a *lower* likelihood of frequent drinking at age 20 ($OR_{adj} = .22$). Violence was significantly associated with frequent marijuana use in two of the nine comparisons ($OR_{adj} = 4.96$ from ages 13 to 14 and $OR_{adj} = 5.50$ from ages 17

TABLE 3
Longitudinal Associations Between Frequent Alcohol and Marijuana Use and Violence

Prediction From Age to Age	*Adjusted Odds Ratios*			
	Alcohol → Violence[a]	*Marijuana → Violence*[b]	*Violence → Alcohol*[c]	*Violence → Marijuana*[d]
11 → 12 (*N* = 461)	2.68*	n/a	1.36	2.23
12 → 13 (*N* = 465)	1.07	.00	1.69	2.22
13 → 14 (*N* = 456)	1.31	3.11*	1.83	4.96***
14 → 15 (*N* = 443)	1.79	3.07**	2.38*	1.71
15 → 16 (*N* = 432)	.79	3.36**	1.56	1.03
16 → 17 (*N* = 426)	.93	2.67*	1.67	1.31
17 → 18 (*N* = 413)	1.41	2.58	1.35	5.50***
18 → 19 (*N* = 407)	1.44	3.83*	.42	.65
19 → 20 (*N* = 394)	.61	1.31	.22*	.89
Ages 11-14 → 15-20 (*N* = 417)				
No risk factors	1.79	2.34*	1.36	1.90*
Risk factors included[e]	1.97*	1.91	1.70	1.67

a. Controlling for prior year violence and marijuana.
b. Controlling for prior year violence and alcohol.
c. Controlling for prior year alcohol and marijuana.
d. Controlling for prior year marijuana and alcohol.
e. Common risk factors = hard drug use, property crime (theft, fraud, and vandalism), low academic achievement, poor communication with caretaker, caretaker perception of bad neighborhood, and African American ethnicity.
* $p < .05$. ** $p < .01$. *** $p < .001$.

to 18). Thus, frequent marijuana use appears to predict violent behavior over time, especially during midadolescence, whereas frequent alcohol use only predicts later violence at the youngest age. In addition, violence does not appear to be a consistent predictor of frequent alcohol or marijuana use.

Next, data were aggregated into two time periods (ages 11-14 and 15-20) and the total frequency of each behavior was dichotomized to isolate the top 25%. The results are shown on the second to last line of Table 3. For these analyses, we only included boys for whom we also had complete data on risk factors so we could compare, for the same individuals, this model to the final model that includes the risk factors ($N = 417$). If we had not restricted the sample to participants for whom we had complete data on risk factors, the sample on the first model would have been 431. The results for this model ($N = 417$) were the same as for the sample of 431. Males who drank frequently were not significantly more likely to be violent later. However, those who used marijuana frequently between ages 11 and 14 were significantly more likely than nonusers and nonfrequent users to engage in violence later

(OR_{adj} = 2.34, p = .012), and this was independent of prior violence or frequent use of alcohol. As frequent drinking did not increase the likelihood of violence, early violent behavior was not associated with later frequent drinking, when controlling for prior frequent alcohol or marijuana use. In terms of marijuana–violence relationships, a reciprocal association was found; early violence was significantly associated with later frequent use of marijuana, when controlling for prior frequent marijuana or alcohol use (OR_{adj} = 1.90, p = .028).

To determine whether the above relationships were spurious, common risk factors were added to the model. Following a univariate screening, the following risk factors were controlled for: lifetime hard drug use, frequency of self-reported property crime (theft, fraud, and vandalism), low academic achievement, poor communication with caretaker, caretaker perception of bad neighborhood, and African American race/ethnicity. The last line of Table 3 shows the results of the logistic regression analyses while controlling for common risk factors (N = 417). The prediction of alcohol to violence was not statistically significant until common risk factors were taken into account, indicating a suppressor effect (OR_{adj} = 1.97, p = .033; without the risk factors, it was OR_{adj} = 1.79, p = .052). Post-hoc analyses indicated that a disproportionate lower prevalence of frequent drinking and higher prevalence of violence among African Americans suppressed the effect of alcohol on violence. In converse, when common risk factors were considered, the prediction of marijuana use to violence was no longer statistically significant (OR_{adj} = 1.91, p = .068); this finding suggests that the association was spurious. Turning to the reverse associations, violence was still not associated with later frequent alcohol use. The prediction from early violence to later marijuana use was no longer statistically significant when common risk factors were included (OR_{adj} = 1.67, p = .107), again suggesting that the association was spurious. Common risk factors that predicted both violence and frequent marijuana use in the multivariate models were African American ethnicity (OR_{adj} = 1.98, p = .043 for violence; OR_{adj} = 2.04, p = .029 for marijuana) and lifetime hard drug use (OR_{adj} = 2.28, p = .034 for violence; OR_{adj} = 5.25, p < .001 for marijuana).

DISCUSSION

From ages 11 to 20, substance use was more prevalent and frequent than violence. Substance use continued to increase throughout late adolescence, whereas violence followed a typical age-crime curve, increasing to around age 16 and then decreasing. Frequent alcohol and marijuana use were both concurrently associated with violence. Overall, odds ratios showed that the longitudinal relationship with violence was stronger for marijuana use than

alcohol use, and the relationship between marijuana use and violence was bidirectional; earlier violence was also related to later marijuana use but not alcohol use. However, the association between marijuana use and later violence was spurious; it was mediated by common risk factors. Participants who were African American or hard drug users were more likely to engage in violence and also were more likely to become frequent marijuana users.

With regard to the associations between early frequent marijuana use and later violence, our conclusions are similar to those of White et al. (1999), in that what we are seeing is a selection effect. In other words, marijuana use is more atypical during early adolescence and becomes more normative with age, and the subset of males who begin marijuana use at younger ages are at elevated risk for several serious outcomes, including poly drug use, violence, and property offending. It is likely that this subgroup of males is inherently more deviant, engaging in multiple problem behaviors at earlier ages, choosing deviant peers, and being more likely to manifest their individual propensity for aggression and antisocial behavior later on. Our findings reinforce the benefits of primary prevention efforts that address multiple risk factors early on, as well as early intervention with high risk or aggressive males.

Because the proportion of violent individuals who used marijuana frequently was larger than the proportion of frequent marijuana users engaging in violence, and because the prediction of violence from earlier frequent marijuana use was mediated by common risk factors, our results do not indicate that early frequent marijuana use causes later violence. Rather, we conclude that frequent marijuana use and violence co-occur because they share common risk factors (e.g., race/ethnicity, hard drug use). It is important to keep in mind that marijuana has been used for centuries and is the most widely used illicit drug today and that the majority of marijuana users do not engage in violence (Boles & Miotto, 2003). Our findings indicate that intervention with young violent offenders to prevent or treat substance use problems may be more practical than targeting marijuana users for violence prevention.

Selection effects may also explain why we did not find a longitudinal association between frequent drinking and violence. Alcohol is a legal drug, and drinking is more commonly accepted by society than marijuana use, which is illicit. Thus, alcohol is seen as normative, whereas marijuana use and violence are not normative and are more likely to cluster in individuals with more deviant tendencies. Obviously, these findings apply to an inner-city adolescent sample and do not necessarily apply to frequent or heavy drinking and violence among adults.

Our findings differed somewhat from those for the older sample in terms of alcohol and violence relationships (White et al., 1999). In that study, White and colleagues found that the longitudinal associations between alcohol and

violence were slightly stronger than those between marijuana use and violence except in very early adolescence. The longitudinal associations between alcohol and violence remained significant when marijuana use as well as other risk factors were controlled. One reason that the findings from this study differed from the previous study may relate to cohort or period effects. The older sample experienced more violence and was in middle to late adolescence in 1993 during the peak of the violence epidemic in Pittsburgh, whereas the youngest sample was just entering adolescence (Fabio et al., 2003). The oldest sample came of age during the lowest rates of drug use in the early 1990s. In contrast to the oldest sample, the youngest sample is more involved in substance use and less involved in violence (White et al., 2001).

Differing results may also be due to the different age ranges used in the longitudinal analyses. The previous study examined behaviors at age 13 predicting behaviors at ages 14 to 18. This study examined behaviors at ages 11 to 14 predicting behaviors at ages 15 to 20. It is likely that developmental processes and temporal windows that fluctuate throughout adolescence shape the substance use–violence nexus. In the earlier study, race/ethnicity and hard drug use were not controlled for. In this study, both these factors were strongly related to violence and frequent marijuana use. Being African American was significantly related to engaging in violence as well as frequent marijuana use. We surmise that contextual effects may drive cultural differences in the associations between substance use and violence. We know that inner-city neighborhoods with a high minority concentration are plagued by violence. At the same time, a subculture of young African American males is using marijuana as their "drug of choice" instead of alcohol (Golub & Johnson, 2001). Thus, at the individual level, it may be hard drug rather than marijuana use that is the important predictor of violence.

Some limitations of the study should be considered. This study focused on a group of adolescents from one city. Therefore, the findings may not be generalizable to other areas of the country. Furthermore, we only included males in the study. Future research should also examine females. Our measure of violence can also be seen as a limitation. Because we focused on those who ever engaged in violence, those who may have committed violence only once are included with those who committed multiple acts of violence. It may be that associations between substance use and violence differ according to the degree or frequency of violent behavior, possibly in a dose-response fashion.

The strengths of this study stem from it being a community-based, longitudinal study with high follow-up rates and regular assessments with no gaps. Substance use and violence were measured prospectively, minimizing recall bias. The data are highly complete and collected at multiple waves, and infor-

mation about risk factors was gathered from multiple informants. Recent analyses of this dataset do not indicate selective attrition: Follow-up rates did not significantly differ according to initial high-risk status, race/ethnicity, socioeconomic status (SES), or baseline levels of alcohol, marijuana, or hard drug use. Further, substance use was based on frequency counts (rather than use/no use) and focused on the most frequent users.

The developmental relationships between substance use and violence are quite complex and are moderated by a host of individual (biological and psychosocial) and environmental factors. The nature of the substance use–violence relationship changes over the life course, and it is likely that the range and influence of risk factors also vary over time. It is also important to consider differences between bingeing, or acute episodic substance use, as opposed to patterns of chronic use. The developmental relationships between substance use and violence are further complicated by the fact that the prevalence and influence of risk factors also vary throughout development. In this study and the previous study, risk factors were measured at one point in time. It is possible that studies using time-varying covariates (e.g., changing levels of parental supervision or neighborhood quality) or more proximal risk factors (e.g., weapon carrying) would offer different findings as well.

Future research should explore the notion of alcohol consumption being more normative among Caucasian participants, in comparison to marijuana use being more normative among African American participants. Differential expectancies of the effects of alcohol or marijuana on violent behavior should also be considered. It is likely that different subcultures may adopt varying expectancies of the effects of substance use intoxication on aggressive behavior. Research on criminal careers can benefit from research about the persistence of violence, in terms of how substance use patterns are associated with chronic offending, desistance, and recidivism. Separate analysis by race/ethnicity can aid the development of culturally specific prevention and intervention programs for multiproblem youth. Finally, research should continue to identify factors that mediate or moderate the associations between substance use and violence.

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