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Rosalie Liccardo Pacula and Beau Kilmer
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ABSTRACT

We examine the relationship between marijuana use and non-drug related crime using data on arrests from the Arrestee Drug Abuse Monitoring (ADAM) Program and Uniform Crime Reports. There is a positive association between self-reported use at the time of the offence and non-drug related violent, property and income-producing crime even after accounting for other substance use in the ADAM data. Reduced form equations using both data sets only provide evidence supporting a causal mechanism for property and income-producing crime. In the case of violent crime, we find a statistically significant association with arrests but not reported crime, suggesting that marijuana use may just influence the likelihood of getting caught committing these crimes.

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I. Introduction

An extensive literature exists examining the relationship between substance abuse and crime, the focus of which has typically centered on cocaine, heroin, and alcohol. Few studies specifically examine the relationship between marijuana and crime despite consistent findings that marijuana is the most commonly identified drug among arrestees. Reports from the United States, England, and Australia, for example, all show that approximately 60% of arrestees test positive for marijuana use and that marijuana is the drug whose metabolites are most frequently found in arrestees' urine (Taylor and Bennett, 1999; Makkai et al., 2000).

There are two good reasons why inferences should not be made about the relationship between marijuana and crime on the basis of urine tests of arrestees. First, very few arrestees who test positive for marijuana have only used marijuana. Most of those who test positive for marijuana also use other illicit drugs or alcohol (NIJ, 2000)[1]. The use of these other substances may be what motivated the criminal behavior rather than marijuana. Second, unlike other illegal substances, a positive urine sample for THC only indicates use in the past month; it does not indicate that marijuana was used immediately prior to the offence taking place. Hence, a positive urine test in the case of marijuana cannot be interpreted as evidence that the crime was committed under the influence of marijuana.

Despite its frequent use among arrestee populations, marijuana has generally been shown to inhibit aggressive behavior and violence in humans and thus it is believed not to be a major contributor to crime (Miczek et al., 1994; White and Gorman, 2000). However, in their review of the literature on the topic, the National Research Council concluded that the long-term use of marijuana may alter the nervous system in ways that do promote violence (National Research

[1] Data from the 1999 ADAM sample suggests this figure could exceed 70%. Of the 16,684 arrestees who tested positive for marijuana, 7,748 (46.4%) tested also tested positive for another illicit drug and another 4,436 (26.6%) reported use of alcohol in the previous 72 hours.

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I. Introduction

An extensive literature exists examining the relationship between substance abuse and crime, the focus of which has typically centered on cocaine, heroin, and alcohol. Few studies specifically examine the relationship between marijuana and crime despite consistent findings that marijuana is the most commonly identified drug among arrestees. Reports from the United States, England, and Australia, for example, all show that approximately 60% of arrestees test positive for marijuana use and that marijuana is the drug whose metabolites are most frequently found in arrestees' urine (Taylor and Bennett, 1999; Makkai et al., 2000).

There are two good reasons why inferences should not be made about the relationship between marijuana and crime on the basis of urine tests of arrestees. First, very few arrestees who test positive for marijuana have only used marijuana. Most of those who test positive for marijuana also use other illicit drugs or alcohol (NIJ, 2000)[1]. The use of these other substances may be what motivated the criminal behavior rather than marijuana. Second, unlike other illegal substances, a positive urine sample for THC only indicates use in the past month; it does not indicate that marijuana was used immediately prior to the offence taking place. Hence, a positive urine test in the case of marijuana cannot be interpreted as evidence that the crime was committed under the influence of marijuana.

Despite its frequent use among arrestee populations, marijuana has generally been shown to inhibit aggressive behavior and violence in humans and thus it is believed not to be a major contributor to crime (Miczek et al., 1994; White and Gorman, 2000). However, in their review of the literature on the topic, the National Research Council concluded that the long-term use of marijuana may alter the nervous system in ways that do promote violence (National Research

[1] Data from the 1999 ADAM sample suggests this figure could exceed 70%. Of the 16,684 arrestees who tested positive for marijuana, 7,748 (46.4%) tested also tested positive for another illicit drug and another 4,436 (26.6%) reported use of alcohol in the previous 72 hours.

Council, 1993). Further, a consistent link between frequent cannabis use and violent crime and property damage has been identified among juveniles (Dembo et al., 1991; Salmelainen, 1995; Baker, 1998). Thus the issue of whether marijuana use *causes* crime, even if limited to a small segment of the population, remains in question.

The assumption that drugs and crime are causally related is a major reason for prohibiting the use of illicit drugs in many developed countries. If marijuana use is not the *cause* of crime, but merely *defined* as a crime, then one must consider all the criminal justice resources dedicated to arresting, processing, and adjudicating marijuana offenders as a cost of prohibition when weighing the cost and benefits of our current marijuana policy.

In this paper, we begin to investigate the causal association between marijuana use and crime. Using individual-level data from the Arrestee Drug Abuse Monitoring (ADAM) Program, we examine the relationship between marijuana use and the probability of getting arrested for a violent, property and income-producing and crime while controlling for concurrent use of alcohol and cocaine. Models consider the sensitivity of results when marijuana use is measured by a positive urine test, self-reported use in the past 3 days, and self-reported use at time of the offence. We find that marijuana use is positively associated with the likelihood of being arrested for a property and income-producing crime, with reduced form models supporting the conclusion that at least some of the association is causal in nature. This finding is further supported by additional analyses of the number of property and income-producing offence arrests measured in the Uniform Crime Reports (UCR). Models estimating the likelihood of being arrested for a violent crime using reduced form models are mixed, with no statistical association found in the ADAM sample and a positive association between marijuana use and violent crime arrests in the UCR sample.

The rest of the paper is organized as follows. In the next section we provide some background on the hypothesized relationship between marijuana and crime and the findings to date. In section III we present the theoretical framework. In Section IV, we discuss the empirical model and the primary data sets used to estimate our models. In Section V we present our results and in Section VI we offer some discussion and conclusions.

II. Background and Significance

Surprisingly few studies have explicitly examined the relationship between cannabis use and crime. Those studies that have been done generally examine the association within the context of four alternative hypotheses based on Goldstein's (1985) tripartite framework, where the association between marijuana use and crime is explained by either psychopharmacological factors, economic-compulsive behavior, systemic violence or common factors.

The psychopharmacological model hypothesizes that drug users engage in violent and/or non-violent crime because of the acute psychoactive effects of the substance (Goldstein, 1985). There is very little support for this model in the case of marijuana, except for adolescents. Laboratory studies generally show that marijuana, unlike alcohol, temporarily inhibits aggression and violence (Mizcek et al, 1994; White and Gorman, 2000), raising doubt that any association identified in the data is causal in nature. Still, there is some evidence showing a correlation between chronic marijuana use and increased risk of violent behavior (White and Hansell, 1998; Kaplan and Damphousse, 1995).

Although cannabis use may temporarily inhibit aggression in the general population, it is possible that cannabis use increases aggression in some individuals. In controlled laboratory studies, for example, the relationship between alcohol use and aggression is influenced by

subject characteristics, such as gender, aggressive tendencies and cognitive abilities, as well as experimental conditions, such as whether the subject was provoked (Bushman, 1997). Indeed, Bushman's (1990) meta-analysis found more aggression among marijuana smokers than placebo controls in laboratory experiments, although he notes that the placebo controls showed significantly less aggression than nondrug controls highlighting the importance of individual heterogeneity in general tendencies toward aggression. Nonetheless, it may be the case, as suggested by the US National Research Council (1993), that prolonged use of cannabis promotes violent or aggressive behavior because of changes in the nervous system.

There is far more convincing evidence of a link between frequent cannabis use and violent crime and nonviolent delinquency among juveniles (Salmelainen, 1995; Fergusson and Horwood, 1997; Baker, 1998). In a study of 10,441 secondary students in New South Wales, Australia, students who were frequent cannabis users were two times more likely to participate in assault and malicious damage of property than students who did not use cannabis. The relationship persisted after adjusting for differences in developmental characteristics, demographics and other substance use (Baker, 1998).[2] In a longitudinal analysis of a New Zealand birth cohort, Fergusson and Horwood (1997) considered four measures of delinquency in their analysis of the consequences of adolescent marijuana use: three or more violent offences, three or more property offences, arrested by police, and convicted of an offence in court. There was a dose-response relationship between each of these outcomes and frequency of marijuana use by age 16. This persisted after adjustment for covariates, suggesting that it was not wholly explained by the characteristics of adolescents who become regular marijuana users by age 16. It

[2] The developmental factors controlled for in the model included parental supervision, family structure, school performance and truancy. The demographic factors accounted for were gender and Aboriginality. Other substance use indicators accounted for were infrequent and frequent use of alcohol and any use of opiates, stimulants, and steroids.

also persisted after adjustment for drug use and criminal behaviour in the user's peer group, indicating that it was not explained by affiliating with delinquent and drug using peers.

Economic crime is that which is motivated by the need to generate income to fund one's own drug use (Goldstein, 1985). By comparison with other illicit drugs, marijuana consumption does not typically produce compulsive patterns of criminal behavior among users and it is not as expensive as other illicit drugs. However, studies suggest that there may be some economically motivated crime at least among youth. In studies of juvenile offenders in the United States and Australia, young offenders who reported frequent use of marijuana reported greater involvement in theft than non-users (Dembo, et al. 1991; Salmelainen 1995; Stevenson and Forsythe 1998). In addition, among juvenile offenders higher marijuana involvement was significantly correlated with higher rates of offending for specific property crimes (Salmelainen, 1995; Stevenson and Forsythe, 1998). The relationship was supported by B. .er's (1998) study of secondary students from New South Wales, in which he found that frequent marijuana users were almost five times more likely to report participation in acquisitive property crime than non-users, even after controlling for individual characteristics, family background, and other substance use (Baker, 1998).[3] What is perhaps most surprising about this study is the fact that frequent marijuana use was found to have a larger effect on participation in property crime than frequent alcohol use or any other illicit drug use.

Systemic violence is that which arises when violence is used to enforce contracts or to resolve "turf wars" in illicit drug markets. Such violence is motivated by the enormous profits that are generated by illicit drug sales and by the absence of legitimate law enforcement to resolve disputes. For a number of reasons it is doubtful that the experience of violence in heroin

[3] The author of the report defines acquisitive property crime as motor vehicle theft, breaking and entering, receiving or selling stolen goods, and shoplifting goods worth $20 or more.

and cocaine markets is applicable to marijuana markets. There is some evidence that violence has been generated by marijuana markets in a few places in the United States, but this has been extremely rare and very localized (Goldstein et al., 1989; ONDCP, 2001). For example, Goldstein et al (1989) found in their assessment of 414 drug-related homicides in New York City that only 6 were related to marijuana. Ethnographic work examining the drug market in New York City showed that although marijuana dealers dominated outdoor parks and streets during the early 1980s, the marijuana market was not associated with the violence seen in the crack market. In the United States today, the majority of marijuana sales are done in private so dealers do not see even see their competitors (ONDCP 2001, Taylor et al. 2001). Even the majority of arrestees report purchasing marijuana indoors (median was 71%). The proportion of arrestees who made outdoor purchases of marijuana exceeded 50 percent in only 4 sites (Taylor et al., 2001).

Marijuana use and criminal behavior may also be associated because both behaviors are driven by a common cause, such as personal characteristics of individuals that motivate them to become involved in both behaviors (Hirschi and Gottfredson, 1988; Fagan, 1990; White 1990). Among the third factors that have been hypothesized to generate the association are: gang involvement (Fagan, 1990), peer effects (Gorman and White, 1995), general problem behavior during adolescence (Jessor and Jessor, 1977), and common environments or situational causes. (Skogan, 1990; Fagan, 1993). There is evidence that substance use and delinquent behavior share many common causes or predictors. For example, many of the childhood risk factors for violence, such as hyperactivity, impulsiveness, risk taking, early school failure, peer rejection, and inability to delay gratification, have been identified as risk factors for teenage drug use and adult drug problems (Hawkins, Catalano, and Miller, 1992. Brook, Whiteman and Cohen, 1995).

Although the common factor model is the model most commonly believed for marijuana there is evidence supporting a causal mechanism and thus the question regarding a causal link even if limited to specific populations remains unanswered. In this paper we explore the relationship between marijuana use and criminal activity using data from two different data sources on crime, the Arrestee Drug Abuse Monitoring program (ADAM) and Uniform Crime Reports (UCR). Reduced form models are used to test the appropriateness of conclusions regarding the association between an individual's marijuana use and the likelihood of getting arrested for a violent, property, and income-producing crime.

III. The Theoretical Framework

Following the theoretical work of Ehrlich (1973), we assume that criminals are risk-neutral expected utility maximizers and make decisions about whether to commit specific crimes based on whether the expected reward (benefit) is greater than the expected cost. The use of mind-altering substances, including marijuana, may influence one's perceptions of the expected payoff or expected cost of engaging in specific crimes or it may reduce one's natural inhibitions for engaging in criminal activity. The direct mechanism through which marijuana and other substances influences the individual's decision to commit an offense is not of immediate interest in this paper because the data are not sufficient to empirically test alternative causal mechanisms. We therefore focus on a reduced-form equation of the number of offences that individual i living in jurisdiction j chooses to become involved in at time t (O_{ijt}), which can be specified as follows:

(1) $O_{ijt} = O(E_{jt}, Y_{it}, Z_{jt}, A_{it}, MJ_{it}, OD_{it})$.

Here E_{jt} is a vector of variables representing the enforcement risk (expected cost) of committing those offences in jurisdiction j at time t, Y_{it} represents a vector of individual-level variables

influencing the marginal benefit of committing the offence at time t, and Z_{jt} represents other community economic factors that may influence either the marginal benefit or marginal cost of committing an offence in jurisdiction j at time t. The variables A_{it}, M_{it}, and OD_{it}, represent the amount of alcohol, marijuana and other drugs, respectively, consumed by individual i during time t. Reduced form demand functions for each of these substances are derived from constrained maximization of the individual's expected utility function, and can be represented as follows:

(2) $A_{it} = A\ (P_{Ajt}, P_{Mjt}, P_{ODjt}, Y_{it})$

(3) $MJ_{it} = MJ\ (P_{Ajt}, P_{Mjt}, P_{ODjt}, Y_{it})$

(4) $OD_{it} = OD\ (P_{Ajt}, P_{Mjt}, P_{ODjt}, Y_{it})$

where P_A, P_M, and P_{OD} represent the price of alcohol, marijuana and other illicit drugs, respectively. Substituting equations (2) – (4) into equation (1) yields the following reduced-form equation:

(5) $O_{ijt} = O(E_{jt}, Y_{it}, Z_{jt}, P_{Ajt}, P_{Mjt}, P_{ODjt})$

If marijuana use does influence one's willingness to engage in crime, either by reducing one's natural inhibitions or by changing one's perceptions of the expected costs or benefits, then we would expect that an increase in the price of marijuana, which reduces the consumption of marijuana, would be negatively associated with the number of offences committed, or $\partial O_{ijt}/\partial P_{Mjt} < 0$.[4] It is quite plausible in light of physiological properties of marijuana, however, that marijuana use only influences one's willingness to engage in certain types of crimes. Thus, in our empirical specification of the model, we separately examine the relationship between this substance and violent, property and income-producing crimes.

[4] As the literature review above shows, there is basically no evidence that marijuana markets themselves generate violence or crime, unlike the market for cocaine. Hence, we are implicitly assuming here that higher marijuana prices do not have a direct association with criminal behavior due to the need to protect territory or market share.

IV. The Data and Empirical Models

Two different data sets are used to explore the relationship between marijuana use and crime. The first source of data is the Arrestee Drug Abuse Monitoring (ADAM) Program (formerly Drug Use Forecasting System). Since 1987, the U.S. Department of Justice has interviewed arrestees in urban booking facilities about their drug use patterns as well as tested them for drug use. The purpose of the study is to provide local law enforcement and other local officials with reliable estimates of the prevalence of drug abuse and related problems in the population of arrestees in their jurisdiction. Sites were originally selected through applications from those jurisdictions interested in participating, but the number of sites increased substantially during the 1990s from 23 in 1996 to 35 in 1998 (See Appendix for complete list of sites).

Prior to 1998 the data generally reflect convenience samples, as they were collected from recent arrestees in the largest booking facility in the county. Since 1998, the sampling methodology has been modified so that the sampling frame now represents all arrestees within a county, not just those booked at the central booking facility. Data collection takes place four times a year (once each calendar quarter) at each site. Arrestees are approached within 48 hours of their arrest and asked to participate in the study. Although participation in ADAM is strictly voluntary, response rates hover around 80 to 90 percent (U.S. Department of Justice, 2000).

Although the data are non-representative of the overall arrestee population, they are the only data source where information on the offender's substance use near the time of the arrest is available. Self-reported use of various legal and illicit substances in the past year, past month and past 72 hours are obtained and validated through analysis of urine specimen. The urinanalyses can identify any of ten substances (including the NIDA-5: cocaine, opiates, marijuana, methamphetamine and PCP), but the results should be interpreted with caution since

some drugs are detectable in the body for up to a month after consumption. Between 1995 and 1999, the survey also included questions pertaining to whether the offender was "under the influence" of specific drugs at the time of the offence. Given that marijuana is one of the drugs that remains detectable in the body for longer periods of time, knowledge of use of marijuana at the time of the offence is extremely important for validating a causal connection. Hence, we use information from the 1996 through 1999 ADAM data for our current analysis. Data from 1995 were not included because of a change in the method for evaluating a positive urine test during that year that resulted in an increase in the number of marijuana detections (NIJ, 1999).

ADAM reports up to three charges for each arrestee and classifies these into more than fifty offenses, ranging from murder to unlicensed vending. We aggregate the most serious offence into three broad categories: violent crime, property crime, and income producing crime.[5] Violent crime includes murder, forcible rape, robbery and aggravated assault. Property crimes include burglary, larceny-theft, motor vehicle theft and arson. Income-producing crimes are defined as robbery, burglary, motor vehicle theft, forgery, embezzlement, stolen goods, and prostitution. For each type of crime in the ADAM data, we estimate the following regression model:

(6) $\Pr(O_{cijt} = 1) =$

$$\Phi(\alpha_0 + \alpha_1 P_{Aji} + \alpha_2 P_{Mji} + \alpha_3 P_{ODji} + \alpha_4 E_{ji} + \alpha_5 Y_{it} + \alpha_6 Z_{jt} + \alpha_7 W_j + \alpha_8 Year + \varepsilon_{it}).$$

where c = violent crime, property crime and income producing crime, Φ is the cumulative distribution function of the univariate normal distribution, W_j is a series of dummy variable for each ADAM site that pick up time invariant unobservable factors that are unique to each

[5] We group people by their most serious arrest charge for two main reasons. First, most arrestees are only charged with one offense. Second, the crime data from the FBI only report the arrest for the most serious charge (the hierarchy rule) and since this analysis utilizes both of these data sets it is useful to make them as consistent as possible.

location, ε_{it} is an individual random error term which is assumed to be normally distributed, and the other variables are as specified previously.[6] Our measure of local enforcement (E_{jt}) is the number of full time sworn officers per capita, which was obtained from estimates reported in the Justice Expenditure and Employment Abstracts. These data are extracted from the Census Bureau's Annual Government Finance Survey and Annual Survey of Public Employment and includes the same jurisdictions covered by ADAM sites.[7]

Individual-level characteristics (Y_{it}) that are collected in the ADAM survey include age, gender, race, ethnicity, marital status, educational attainment, and income. In the case of income, two separate questions are included about legal and illegal income earned in the previous month.[8] Other community factors (Z_{jt}) also controlled for in these models include real per capita income and the local unemployment rate, obtained from the Census Bureau and Bureau of Labor Statistics, respectively.

Information on the monetary price of marijuana comes from various publications of the Illegal Drug Price/Purity Report, (IDPPR) published by the DEA Office of Intelligence or Intelligence Division of the U.S. Department of Justice. Although other sources of marijuana price data are available, the IDPPR published data represents the only source we are aware of in which it is possible to distinguish high and low quality marijuana consistently over time for the same locations. The IDPPR report the minimum and maximum retail (ounce) and wholesale (pound) price of commercial-grade and sinsemilla marijuana in 19 cities located in 16 states. These 19 cities represent main branch offices for the DEA. The price and quality information

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[6] Year dummy variables were also explored but the dummies indicated a linear trend. Hence the linear trend was employed in all of the models.

[7] We also considered a measure of the relative crime per officers by constructing a measure of the total crime per number of full-time sworn officers. Results are qualitatively similar to those presented here.

[8] Individuals with missing information for either of these income measures, approximately 20% of our ADAM sample, were dropped from the current analysis.

are obtained for purchases made by undercover police officers and DEA agents that are sent to a laboratory for analysis. For the purposes of this analysis, we focus on the quarterly prices for commercial marijuana sold at the retail level. Predicted quarterly prices are obtained using data from 1982 through 2001 to predict the natural logarithm of real price using indicators for the location of the DEA field office, year, interaction terms of the DEA field office and the year of purchase, and year squared.[9] We match the predicted price to the ADAM data set based on quarter and to the UCR data based on year. Each ADAM site is assigned the predicted price of the closest within-state branch office that reported to one of the 19 main field offices.

Cocaine and alcohol prices are included to ensure that the estimated marijuana price effects do not reflect indirect effects through alcohol and cocaine consumption. Similar to previous studies, we use information about the price of cocaine from the DEA's STRIDE data. STRIDE contains records on acquisitions of cocaine (and other illicit drugs) made by undercover agents and informants of the DEA. For each cocaine acquisition, information is recorded about the type of cocaine (e.g. cocaine base (crack), cocaine hydrochloride (powder cocaine), and others), the quantity acquired, its purity (in percent), the cost (if the cocaine was purchase rather than seized), along with the DEA field office responsible for the acquisition and the date that it took place. In addition to cost differences arising from the form of cocaine, the cost of purchases may vary due to the weight and/or purity of the purchase. One method to account for differences in the weight purchased is to divide the (CPI deflated) cost of purchase by its weight to obtain a price per gram. However, this method ignores the quantity discounting evident in these data as well as differences due to actual purity. To overcome these issues, we follow the economics literature and form a predicted price of a pure gram of cocaine for each year and

[9] It is necessary to use predicted prices instead of actual prices because of missing data for particular cities and quarters.

city.[10] City-specific predicted quarterly and annual prices for one pure gram of cocaine were matched to the ADAM site on the basis of the closest city for which we had price data.

Information on the monetary cost of alcohol is represented by the CPI deflated sum of federal and state taxes on a twelve-ounce can of beer. These data are published annually in the Beer Institute's Brewers' Almanac. Information on state and local taxes is used for these analyses instead of city-level alcohol prices because city-specific prices are not consistently available through ACCRA for the ADAM locations in our sample. However, supplemental regressions using this alternative measure for alcohol price resulted in similar findings.

The ADAM data obviously represent a selective population in that we only observe individuals in these data if they committed an offence, were caught, and were sent to a booking facility that participates in the ADAM survey. Probabilistic samples were not drawn from most jurisdictions until 1998. Hence, there are numerous reasons to be concerned about the generalizability of findings obtained from these data. Therefore, we also examine reduced form models using data from the Federal Bureau of Investigation's Uniform Crime Reports (UCR) to test the robustness of our findings. The UCR system collects information on the number of crimes reported to the police in specific crime categories each year for every city in the country. Arrests are also reported for each jurisdiction by criminal offence. While the shortcomings of these data are well documented (e.g. O'Brien, 1985), they remain the only source of geographically disaggregated crime and arrest data in the United States.

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[10] The model used to predict price is based on regressing the log of the real cost of purchase on the log of the weight of the purchase, the log of the purity of the purchase, indicators for the city of purchase, interactions between the city and year of purchase, the square of the year of purchase, and a set of indicators for the quarter of purchase. In order to address the issue of uncertainty of purity at the time of purchase, we replace actual purity with the predicted purity based on a model containing the regressors included in the model for the predicted price (except the year squared term and quarter dummies). The effect of (the log of) purity is identified in the cost model by constraining its coefficient to be equal to the coefficient on the (log of) weight of the purchase. We then predict the log of the price of a pure gram of cocaine for each city and year, and exponentiate this quantity to get the real price of a gram of cocaine. City-specific prices were estimated for those cities where at least 40 observations were observed over the period 1985-2000 to reduce the noise in the series.

Because we are primarily concerned about ADAM's reliance on convenience sampling during the 1996-1999 time period, we restrict our UCR data to reflect the same 35 counties included in our ADAM sample. Further, we restrict the UCR time period to 1994 through 2000 so that it overlaps with our ADAM sample; thus we can reduce the number of plausible explanations for differences in results that might emerge across these two data sets.[11]

Publicly available data from the UCR provide information on crime and arrest rates, but no information is available on individual characteristics or whether crimes were committed under the influence of alcohol or illicit drugs. At best we can infer an association between crime and marijuana use from the UCR by using a reduced form model to determine if decreases in marijuana prices are associated with increases in particular types of crime. Using data from ADAM, we are able to confirm that use of marijuana among the arrestee population is price responsive (see Table A1 in the Appendix).[12] Preliminary examination and statistical testing of the UCR data suggests that the appropriate empirical specification of equation (5) using these data varied by type of offence.[13] In the case of violent crimes, we model the data using a general linear model with log-link function and nonconstant variance, or:

(7) E [(violent crime arrests/10,000 population)$_{jt}$] =

$$\exp(\beta_0 + \beta_1 P_{Ajt} + \beta_2 P_{Mjt} + \beta_3 P_{OOjt} + \beta_4 E_{jt} + \beta_5 Z_{jt} + \beta_6 W_j + \beta_7 Year_t + v_{jt}).$$

(8) V[(violent crime arrests/10,000 population)$_{jt}$]=

$$E^2[(\text{violent crime arrests/10,000 population})_{jt}].$$

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[11] It was necessary to expand the time horizon in the UCR data because our unit of observation in the UCR is a county-year. Thus a sample from 1996-1999 would have little statistical power. We chose the years 1994-2000 because trends in crime rates in these locations during that time period were consistent with what occurred during 1996-1999.

[12] The probability of using marijuana, as measured by all three indicators of use in our ADAM sample, is negatively associated with changes in price.

[13] The specific functional form was determined by empirically testing alternative functional forms suggested by box-cox transformations. The variance structure was determined through a modified Park Test (Deb, Manning, and Norton, 2003).

In the case of property and income-producing crimes, we model these outcomes using general linear models with log-link functions and constant coefficient of variation, or:

(9) E [(property crime arrests/10,000 population)$_{it}$] =

$$exp\,(\delta_0 + \delta_1 P_{Nit} + \delta_2 P_{Mit} + \delta_3 P_{ODit} + \delta_4 E_{jt} + \delta_5 Z_{it} + \delta_6 W_j + \delta_7 Year_t + \mu_{it}).$$

(10) V [(property crime arrests/10,000 population)$_{it}$] = 1.

Because individual-level demographic information is not available in the public use UCR data we exclude Y_{it} from the equations above. County-level demographics, income and unemployment rates are included as components of the Z_{it} matrix, however. In addition, we account for county-level income and unemployment rates, obtained from the Bureau of Economic Analysis and Bureau of Labor Statistics, respectively.[14]

In our UCR analyses, we include an additional measure of local enforcement (E_{jt}) so that we can account for the prominence of drug crime and drug enforcement activity in the area. In addition to a measure of the local crime per number of officers, we construct the ratio of local drug arrests to total reported crime from UCR data. Both our measures of enforcement are likely to be endogeneous in the UCR analyses. However, we are unable to identify variables that allow us to uniquely identify variation in law enforcement independent of arrests. Thus, to test the sensitivity of our main marijuana findings to the inclusion of these endogenous variables, we run two sets of models for each outcome. One set of models excludes these enforcement measures and one set includes them.

Descriptive statistics for the ADAM and UCR samples employed for all regression analyses are included in Table 1. Looking only at violent, property, and income-producing

[14] Unemployment figures were not available for the Anchorage FIPS so unemployment data for the Anchorage MSA are substituted (http://www.economagic.com/em-cgi/data.exe/blsla/lausm0380000003).

crimes, there is a larger share of income-producing crimes in the ADAM sample than in the UCR. And for both samples, violent crimes are the least common of the three categories. The predicted prices for cocaine and marijuana, on average, are slightly higher in the UCR sample, in part because the UCR data include data on all 35 locations going back to 1994. The ADAM data only have information for 23 of the 35 cities until 1998. The difference in county characteristics between the two samples therefore, can partially be explained by the inclusion of all cities for more years in the UCR and the fact that the ADAM sample draws a different number of observations from each jurisdiction. To adjust for the unequal weight attributed to various jurisdictions within the ADAM sample, all models are run using a Huber/White correction of the standard errors using the "robust" option in STATA 7.0.

V. Results

Table 2 provides a preliminary look at the association between marijuana use and specific types of crime for the full ADAM sample. When individuals charged with a drug offence are included in the sample, then marijuana users—identified through urine tests or self-reported use—are generally found to be less likely to be charged of a violent, property or income-producing crime than non-users. The notable exception are those individuals who reported use in the past three days who are statistically more likely to be arrested for property and income producing crime, but the finding of a positive association contradicts the result of a negative association for those self-reporting that they were under the influence at the time of the arrest.

Individuals who report being under the influence of alcohol at the time of the offence are more likely to be charged with a violent crime and less likely to be charged with a property or income-producing crime. Not surprisingly, the data show that marijuana users, regardless of

how it is measured, are statistically more likely to be charged with a drug crime. Those under the influence of alcohol, however, are less likely to be charged of a drug-involved crime.

Given that we are only looking at those arrested, it is not surprising that marijuana users are more likely to be charged with a drug-related crime and less likely to be charged with other crimes simply because many marijuana users are picked up on drug charges. Once we take individuals arrested on drug charges out of the sample, however, we should not expect to see any sort of systematic relationship between marijuana use and specific arrest charges unless there is some sort of association (spurious or real) between marijuana use and these specific offences.

When we remove those arrested on drug charges from the sample, we see some interesting changes. In the case of violent crime, we find that those who report use of marijuana in the past three days or being under the influence at the time of the crime are no longer less likely to be charged with a violent crime than non-marijuana users. In fact, those with a positive urine test for marijuana are statistically more likely to be charged with a violent crime than those testing negative. Given that marijuana can be identified in urine for up to 30 days past the time of consumption, this suggests that individuals who engage in violent crimes are also likely to engage in marijuana use but the marijuana use is not necessarily related to their decision to engage in crime.

In the case of property and income-producing crime we find a more consistent story across different measures of marijuana use. Here we see that marijuana users, regardless of how it is measured, are more likely to be arrested for property and income-producing crime. Interestingly, this is the opposite of what we find for those who report being under the influence of alcohol. Those who report being under the influence of alcohol at the time of the offence are less likely to be in either property or income producing crimes than non-alcohol users.

None of the previous findings control for observable factors that may be driving these associations. In Table 3 we present the marginal effects from a probit specification of the likelihood of being charged with a violent crime controlling for individual demographics, sources of income, county demographics, unemployment rates, and county law enforcement.[15] Given the previous table demonstrated differences in findings based on the measure of marijuana that was employed, we decide to estimate each of the models using the three different measures of marijuana use as well as the price of marijuana so we could have a better understanding of how to interpret results from the models including price. Results from the first two models (M1 and M2) suggest that marijuana users are less likely to be charged with a violent arrest than non-users. However, this finding does not hold in model 3 (M3), where use is measured at the time of the offence suggesting that the association identified in the first two models may not be causal in nature. Indeed, our reduced form specification of the model (M4) shows a positive but statistically insignificant relationship between marijuana price and the probability of a violent crime offence, reinforcing the conclusion that marijuana use is not causally related to violent criminal behavior.

Neither the beer tax nor the price of cocaine is statistically significant in these models, contrary to findings from previous studies (DeSimone, 2001; Lott and Mustard, 1997; Cook and Moore, 1993). Although this might appear to be somewhat surprising, it is easily explained by the limited longitudinal variation in these variables during the time period being evaluated and the inclusion of county fixed effects. Cross-sectional variation in the beer tax is captured by county-specific dummies that are included in the regression; the only independent variation that can be identified from the beer tax is the within state variation in real taxes over time. During

[15] Note that all individuals arrested on drug charges are removed from the sample used in this and all subsequent analyses.

In Table 4 we present findings from similar models of the probability of getting arrested for a property crime. Here our different measures of marijuana use generate some conflicting findings. When marijuana use is measured in terms of a positive urine sample (indicating use at some point in the previous thirty days), we find no statistical association between marijuana use and the likelihood of getting arrested for a property crime. If we instead use a more proximal measure of use (M2 and M3), we find that marijuana use is positively associated with the probability of getting arrested for a property crime although the finding with respect to use at the time of offence is only statistically significant at the 10% level. This positive association between marijuana use and property crime is confirmed in the reduced form version of the model (M4), where marijuana prices are found to have a negative and statistically significant association with the probability of arrest for a property crime, suggesting the association may be causal in nature. The positive association between recent marijuana use and property crime is invariant to the inclusion of self-reported alcohol use at the time of the offence (Models M6 through M8).

Contrary to what is found by DeSimone (2001), these models suggest that there is a negative association between powder cocaine use and property crime as higher powder cocaine prices (associated with lower cocaine use) are positively associated with property crime. The finding is fairly robust to variation in the measure of marijuana use and alcohol use. There are at least two plausible explanations for the difference in findings across studies. First, as was already stated, our model has limited variation in the price of cocaine because of our relatively short time period being evaluated and the inclusion of county-fixed effects. Thus, findings obtained from this relatively short panel may not be robust if evaluated over longer periods. Second, our method for predicting the price of cocaine differs substantially from that employed

by DeSimone (2001).[17] For example, we do not include measures of crime and drug arrests when predicting cocaine prices and we exclude crack observations from our price regression so that our price series only reflects changes in the price of powder cocaine.[18] Thus, we are cautious not to place too much importance on this finding.

In Table 5 we present results from models estimating the probability of being arrested for an income-producing crime. The results presented in these models again suggest that marijuana use is causally linked to crime as self-reported measures of marijuana use near the time of the arrest (Models M2 and M3) are positively and significantly associated with property crime and the price of marijuana is inversely related to income-producing crime at conventional levels of significance. The fact that the results from models M2 through M4 are substantially different than those implied by model M1, which relies on urinalysis for identification of use, suggests that we should be cautious drawing conclusions from associations identified off this measure of use.

As was the case in Table 4, we again see in Table 5 a positive association between cocaine prices and income-producing crime, but the same interpretation applies. An intriguing puzzle is presented in Table 5 by the different implied relationship between alcohol and income-producing crimes based on our two different measures of alcohol use. When the beer tax is used to capture the influence of alcohol consumption, we find that higher beer taxes, indicating less alcohol use, is associated with a lower likelihood of being arrested for an income-producing crime, consistent with results obtained elsewhere in the literature (DeSimone 2001, Gyimah-

[17] As indicated in the prior section, we use a much more restricted subset of the STRIDE data and do not include measures of arrest or crime in our estimation of the price of cocaine.

[18] There is a significant literature demonstrating an association between crack cocaine use and crime (Grogger and Willis, 2000; Inciardi, 1990; Fagan and Chin, 1990). It may be the case that by narrowing our focus to powder cocaine in the 1990s, we identify a different relationship between cocaine and crime. Future research will explore this hypothesis.

Brempong, 2001). This contradicts findings obtained from models M5 through M8, however, where alcohol intoxication is shown to be negatively associated with getting arrested for income-producing crimes. The contradiction may simply be caused by an endogencity bias that is generated from the inclusion of self-reported alcohol measures, but it is difficult to know for sure given the limited variability in the beer tax measure.

Overall the findings from the reduced form models would suggest that marijuana use is positively associated with property and income-producing crimes and that no causal association exists between marijuana use and violent crime. However, one must be careful drawing these conclusions based on analysis that only considers the likelihood of getting arrested for a specific criminal offence among a nonrandom sample of arrestees. Results from these models may not hold in the general population because this sample is not representative of the general arrestee population, the criminally involved population, or the general population.

To test the generalizability of these findings to the arrestee population, we estimated models of the number of arrests for violent, property and income producing crimes in the same geographic locations over a similar time period using county-level data from Uniform Crime Reports. Results from these models are presented in Table 6. In the case of the number of property crimes and income-producing crimes we obtain results that are consistent with those presented in Tables 4 and 5. Higher marijuana prices, indicative of lower marijuana use, are negatively and statistically associated with the number of property and income producing criminal arrests per capita, suggesting that marijuana use is positively associated with these measures of arrest. This finding is not sensitive to the inclusion of the endogenous enforcement measures (Column M2).

We find a new result when the dependent variable is the number of violent arrests per capita. In the ADAM analysis (Table 2) we saw no statistical relationship between marijuana prices and the probability of an arrest for a violent offence. Here in Table 6 we see that marijuana prices are negatively and statistically associated with violent crime arrest rates, suggesting that marijuana use may be positively associated with violent crime as well. The result is robust to the inclusion of the endogenous enforcement measures.

It is important to consider the differences in the samples employed for these two analyses before interpreting these findings. The UCR and ADAM samples employed in Tables 2 and 6 differ in the following ways: the representativeness of the data samples; the inclusion of three extra years of data in the UCR analysis; the exclusion of individual demographics in the UCR analysis; and the presence of data for all thirty-five cities for all years in the UCR sample.[19] We ran additional analyses exploring the influence of omitted demographics, the extra years, and the presence of cities in additional years and none of these factors led to a change in the statistical significance of the marijuana price variable, suggesting that the cause for the differential findings across the UCR and ADAM analysis is who is represented in the data.

Findings with respect to the beer tax and cocaine price also differ across the ADAM and UCR analysis. For example, beer taxes are shown in Table 6 to be positively associated with higher levels of all three arrests, which is inconsistent with the previous tables. Our supplemental analyses reveal that this finding is driven by the inclusion of all thirty-five counties in all years. When we restrict the UCR sample to just those counties that are in the sample ADAM sample in each year, we again see that there is no statistical association between the beer tax and any of the arrest rates. The sensitivity of the finding to the inclusion of additional counties in some years reinforces our concern regarding how to properly interpret any findings

[19] The ADAM sample grew from 23 cities in 1996 and 1997 to 35 cities in 1998 and 1999.

from this variable. The findings with respect to the price of cocaine in Table 6 are much more consistent with the existing literature and are robust to changes in the county and years of data included. Thus, we believe that this difference in results pertaining to the cocaine price measure on crime rates identified across the different studies is largely being driven by a difference in the representativeness of the two alternative samples.

VI. Discussion

Results from reduced form specifications of models of the number (UCR) and type (ADAM) of arrest suggest that marijuana use may actually be causally associated with specific types of crime, even for the general population of arrestees. Evidence from both sets of analyses suggest that higher marijuana use, as indicated by lower marijuana prices, is positively associated with property arrests and income-producing criminal arrests. There is also evidence from the UCR analysis that marijuana use might be positively associated with the number of violent arrests.

A significant limitation of the results so far is that we do not know the extent to which those arrested for crimes are behaviorally similar to those who commit crimes. It may be the case that substance use reduces an individual's ability to get away with a crime rather than influencing the likelihood of committing a crime. To consider this possibility, we re-ran our basic reduced form model using crime rates instead of arrest rates for the same locations in our ADAM sample. Although we recognize that crimes reported may not accurate reflect actual crimes committed, these are the only source of crime for all the locations in our ADAM sample. Results from these additional specifications are included in Table 7. Note that we are unable to estimate a model for the number of income-producing arrests per 10,000 residents because the data were not available at a disaggregated level.

Results from our reduced form models predicting violent crime per 10,000 residents in the ADAM locations reinforce the original findings presented in Table 2 that marijuana use is not causally linked to violent criminal behavior. The marijuana price variable, although negative, is statistically insignificant at conventional levels and this null finding is invariant to the inclusion of general enforcement measures. The results from our models predicting property crime are more mixed, as the marijuana price variable is only negative and statistically significant when endogenous measures of enforcement are included in the model. Future work will need to carefully consider the proper treatment of these endogenous variables to fully understand the nature of the relationship between marijuana use and known property crimes.

The results from reduced form models tell a fairly consistent story across all of the tables. The positive association between marijuana use and arrests for property and income-producing crimes is not driven by a spurious correlation; these findings suggest a causal interpretation. These results are consistent with models using more proximate measures of use, including use of marijuana at the time of the offence. However, the proper interpretation of the result is still unclear. It may be the case that marijuana use causes individuals to participate in these crimes or it may be the case that marijuana use increases the likelihood that offenders get arrested for these crimes. Further investigation of this important distinction with other data sets will be necessary.

The results pertaining to the relationship between marijuana use and violent crime are a bit more complex to interpret. Evidence from the ADAM sample of arrestees suggests that the positive association identified between marijuana use and violent crime is not causal in nature. This result is not confirmed in analyses using all known arrests from the ADAM cities, however. When UCR arrest data are employed a causal interpretation is supported. But the finding disappears again when crime is measured in terms of known offences as opposed to arrests.

suggesting that the positive association identified in the UCR analysis may be driven by the fact that marijuana users who participate in crime are more likely to get arrested. Future work will need to consider the extent to which these current findings hold in a nationally representative sample of arrests and crime in order for us to clearly understand whether the criminal justice costs of marijuana prohibition are partially reimbursed through a reduction in crime.

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Table 1

Means of Primary Data Sets

ADAM Analysis N = 101,990					UCR Analysis N = 188				
Variable	Mean	Std. Dev	Min	Max	Variable	Mean	Std. Dev	Min	Max
Positive Urine Test	0.349	0.477	0	1	Violent arrests per capita	33.030	20.773	7.071	113.250
Use in past 3 days	0.268	0.442	0	1	Log(violent arrests per capita)	3.327	0.576	1.956	4.730
Under the inf: MJ	0.051	0.220	0	1	Property arrests per capita	94.870	29.607	27.546	188.901
Under the inf: Alc	0.211	0.408	0	1	Log(property arrests per capita)	4.500	0.333	3.316	5.241
Arrested for violent crime	0.183	0.387	0	1	Income arrests per capita	52.937	27.000	13.153	186.691
Arrested for property crime	0.246	0.431	0	1	Log(income arrests per capita)	3.861	0.460	2.577	5.229
Arrested for income crime	0.320	0.467	0	1					
Real predicted price of MJ	55.21	18.940	20.37	101.02	Real predicted price of MJ	58.539	19.024	23.839	98.268
Real beer tax	2.32	1.972	0.59	10.76	Real beer tax	2.462	1.863	0.577	11.454
Real predicted price of cocaine	85.76	14.730	34.34	105.85	Real predicted price of cocaine	68.699	14.558	34.944	103.710
Male	0.753	0.431	0	1	Match dummy	0.938	0.243	0	1
Black	0.465	0.499	0	1					
Hispanic	0.214	0.410	0	1	% male	0.484	0.012	0.463	0.514
Other race	0.031	0.173	0	1	% pop less than 18	0.257	0.032	0.180	0.366
Education >= 12	0.420	0.494	0	1	% pop 18-24	0.099	0.011	0.071	0.128
Age 18-24	0.264	0.441	0	1	% white	0.762	0.160	0.320	0.991
Age 25-34	0.295	0.456	0	1	% black	0.182	0.170	0.002	0.649
Age > 34	0.299	0.458	0	1	% other	0.056	0.046	0.007	0.228
Real income - illegal sources	180.80	1185.47	0	63734	% hispanic	0.175	0.200	0.005	0.953
Real income - legal sources	573.64	1423.63	0	63734	unemployment rate	4.911	1.932	1.900	15.400
Year	1997.60	1.145	1996	1999	Real per capita income (in $1000	18.294	5.533	7.959	49.019
Unemployment rate	4.700	1.580	1.9	9.2	Log(county pop)	13.852	0.826	12.000	16.049
FTE police per capita	0.004	0.006	0.001	0.030	Year	1997	1.712	1994	1999
Real per capita income (in $1000)	19483	7213	8471	49019	Index Crime	94384.5	89798.9	9447	591795
% male	0.484	0.01	0.463	0.513	FTE sworn officers	4178.9	7576.1	250	46158
% pop < 18	0.252	0.029	0.182	0.366	total drug arrests/index crime	0.117	0.068	0.020	0.430
% pop 18-24	0.098	0.011	0.074	0.126	index crime/ FTE sworn officers	0.569	0.542	0.009	2.725
% black	0.216	0.173	0.002	0.642					
% other	0.060	0.050	0.007	0.228					
% hisp	0.199	0.176	0.006	0.953					

Table 2
Descriptive Statistics
1996 - 1999 ADAM data

	# of Obs	Full Sample	Non User	User	P-value for diff ~=0
PANEL A : Includes those charged of a drug offence					
Violent Crime					
MJ: Positive urine test	137409	0.148	0.148	0.147	0.544
MJ: Use in past 3 days	137091	0.148			
MJ: under influence	136496	0.148			
ALC: under influence	136497	0.148			
Property Crime					
MJ: Positive urine test	137409	0.197			
MJ: Use in past 3 days	137091	0.197			
MJ: under influence	136496	0.196			
ALC: under influence	136497	0.196			
Income Crime					
MJ: Positive urine test	137409	0.255			
MJ: Use in past 3 days	137091	0.255			
MJ: under influence	136496	0.255			
ALC: under influence	136497	0.255			
Drug-involved Crime					
MJ: Positive urine test	137409	0.187			
MJ: Use in past 3 days	137091	0.187			
MJ: under influence	136496	0.187			
ALC: under influence	136497	0.187			
PANEL B: Excludes those charged with a drug offence					
Violent Crime					
MJ: Positive urine test	111721	0.182			
MJ: Use in past 3 days	111459	0.182	0.181	0.183	0.382
MJ: under influence	110969	0.182	0.181	0.189	0.156
ALC: under influence	110970	0.182			
Property Crime					
MJ: Positive urine test	111721	0.242			
MJ: Use in past 3 days	111459	0.242			
MJ: under influence	110969	0.242			
ALC: under influence	110970	0.242			
Income Crime					
MJ: Positive urine test	111721	0.314			
MJ: Use in past 3 days	111459	0.314			
MJ: under influence	110969	0.314			
ALC: under influence	110970	0.314			

Table 3

Marginal Effects and Robust Standard Errors from Probit Estimation of Prob(Arrested for a Violent Crime)[a]
ADAM 1998 - 1999, Non-drug offenders

	M1		M2		M3		M4	
MJ: positive urine	-0.0054	**						
	(0.003)							
MJ in past 3 days			-0.0111	***				
			(0.003)					
MJ: under influence					-0.0084			
					(0.005)			
Real price of MJ							0.0002	
							(0.001)	
Real beer tax	-0.0112		-0.0122		-0.0113		-0.0136	
	(0.041)		(0.041)		(0.041)		(0.042)	
Real price of cocaine	-0.0002		-0.0002		-0.0002		-0.0002	
	(0.001)		(0.001)		(0.001)		(0.001)	
County Fixed Effects	Yes		Yes		Yes		Yes	
# of Observations	101,960		101,960		101,960		101,960	
Pseudo-R2	0.051		0.051		0.051		0.051	
	M5		**M6**		**M7**		**M8**	
MJ: positive urine	-0.0066	**						
	(0.003)							
MJ in past 3 days			-0.0144	***				
			(0.003)					
MJ: under influence					-0.0191	***		
					(0.005)			
Real price of MJ							0.0002	
							(0.001)	
ALC: under influence	0.0493	***	0.0503	***	0.0506	***	0.0490	***
	(0.003)		(0.003)		(0.003)		(0.003)	
Real price of cocaine	-0.0002		-0.0001		-0.0002		-0.0001	
	(0.001)		(0.001)		(0.001)		(0.001)	
County Fixed Effects	Yes		Yes		Yes		Yes	
# of Observations	101,960		101,960		101,960		101,960	
Pseudo-R2	0.053		0.054		0.053		0.053	

[a] Models include as additional regressors gender, ethnicity, race, education, age categories, legal and illegal income, quarter dummies, time trend, county unemployment rate, the number of police per capita, real county income, % county population that male, black and other race, and age demographics of the county. Statistical significance is designated as follows: *** indicates significance at the 1% level (2-tailed test), ** indicates significance at the 5% level , and * indicates significance at the 10% level.

Table 4

Marginal Effects and Robust Standard Errors from Probit Estimation of Prob(Arrested for a Property Crime)[a]
ADAM 1996 - 1999, Non-drug offenders

	M1		M2		M3		M4	
MJ: positive urine	-0.0036							
	(0.003)							
MJ in past 3 days			0.0211	***				
			(0.003)					
MJ: under influence					0.0109	*		
					(0.006)			
Real price of MJ							-0.0034	**
							(0.001)	
Real beer tax	-0.0369		-0.0357		-0.0378		-0.0065	
	(0.047)		(0.047)		(0.047)		(0.049)	
Real price of cocaine	0.0051	***	0.0051	***	0.0051	***	0.0053	***
	(0.001)		(0.001)		(0.001)		(0.001)	
County Fixed Effects	Yes		Yes		Yes		Yes	
# of Observations	101,960		101,960		101,960		101,960	
Pseudo-R2	0.032		0.032		0.032		0.032	
	M5		**M6**		**M7**		**M8**	
MJ: positive urine	-0.0017							
	(0.003)							
MJ in past 3 days			0.0267	***				
			(0.003)					
MJ: under influence					0.0300	***		
					(0.006)			
Real price of MJ							-0.0036	***
							(0.001)	
ALC: under influence	-0.0772	***	-0.0792	***	-0.0792	***	-0.0773	***
	(0.003)		(0.003)		(0.003)		(0.003)	
Real price of cocaine	0.0053	***	0.0053	***	0.0053	***	0.0053	***
	(0.001)		(0.001)		(0.001)		(0.001)	
County Fixed Effects	Yes		Yes		Yes		Yes	
# of Observations	101,960		101,960		101,960		101,960	
Pseudo-R2	0.036		0.037		0.036		0.036	

[a] Models include as additional regressors gender, ethnicity, race, education, age categories, legal and illegal income, quarter dummies, time trend, county unemployment rate, the number of police per capita, real county income, % county population that male, black and other race, and age demographics of the county. Statistical significance is designated as follows: *** indicates significance at the 1% level (2-tailed test), ** indicates significance at the 5% level , and * indicates significance at the 10% level.

Table 5

Marginal Effects and Robust Standard Errors from Probit Estimation of Prob(Arrested for an Income-Producing Crime)[a]

ADAM 1996 - 1999, Non-drug offenders

	M1		M2		M3		M4	
MJ: positive urine	0.0023							
	(0.003)							
MJ in past 3 days			0.0361	***				
			(0.004)					
MJ: under influence					0.0236	***		
					(0.007)			
Real price of MJ							-0.0047	***
							(0.001)	
Real beer tax	-0.1007	*	-0.0983	*	-0.1018	**	-0.0574	
	(0.052)		(0.052)		(0.052)		(0.054)	
Real price of cocaine	0.0045	***	0.0045	***	0.0045	***	0.0047	***
	(0.001)		(0.001)		(0.001)		(0.001)	
County Fixed Effects	Yes		Yes		Yes		Yes	
# of Observations	101,960		101,960		101,960		101,960	
Pseudo-R2	0.049		0.050		0.049		0.049	
	M5		**M6**		**M7**		**M8**	
MJ: positive urine	0.0046							
	(0.003)							
MJ in past 3 days			0.0432	***				
			(0.004)					
MJ: under influence					0.0479	***		
					(0.007)			
Real price of MJ							-0.0053	***
							(0.001)	
ALC: under influence	0.0961	***	0.0993	***	0.0992	***	0.0960	***
	(0.004)		(0.004)		(0.004)		(0.004)	
Real price of cocaine	0.0052	***	0.0051	***	0.0052	***	0.0051	***
	(0.001)		(0.001)		(0.001)		(0.001)	
County Fixed Effects	Yes		Yes		Yes		Yes	
# of Observations	101,960		101,960		101,960		101,960	
Pseudo-R2	0.054		0.055		0.054		0.054	

[a] Models include as additional regressors gender, ethnicity, race, education, age categories, legal and illegal income, quarter dummies, time trend, county unemployment rate, the number of police per capita, real county income, % county population that male, black and other race, and age demographics of the county. Statistical significance is designated as follows: *** indicates significance at the 1% level (2-tailed test), ** indicates significance at the 5% level , and * indicates significance at the 10% level.

Table 6
GLM Estimates of Log Arrest Rates from UCR: 1994 -1999

	M1		M2	
	OLS Coefficient	Robust Std. Err	OLS Coefficient	Robust Std. Err
Log (# of violent crime arrests/ 10K pop)				
Real price of MJ	-0.017 ***	0.006	-0.022 ***	0.004
Real price of Cocaine	0.002	0.003	-0.001	0.003
Real beer tax	0.215 ***	0.079	0.256 ***	0.087
log(county pop)	-1.853 ***	0.452	-0.447	0.627
% of county pop < 18	11.059 ***	3.809	4.536	4.182
% of county pop black	1.390	5.636	-0.318	4.289
% of county pop other race	34.256 ***	10.077	42.310 ***	8.264
% of county pop Hispanic	-8.914 *	5.122	-13.333 ***	3.971
Real per capita income	-3.59E-05 ***	1.21E-05	-8.51E-05 ***	1.51E-05
Unemployment rate	0.013	0.014	0.007	0.012
Year	-0.037 *	0.019	-0.059 ***	0.015
Crime per officer			0.440 ***	0.128
Drug arrests/total crime			3.342 ***	0.888
Constant	97.940 ***	38.451	126.071 ***	29.710
Log (# of property crime arrests / 10 K pop)				
Real price of MJ	-0.010 **	0.005	-0.013 ***	0.005
Real price of Cocaine	-0.002	0.002	-0.004 **	0.002
Real beer tax	0.177 ***	0.066	0.151 **	0.066
log(county pop)	-0.482	0.336	0.023	0.398
% of county pop < 18	15.342 ***	3.704	15.407 ***	3.751
% of county pop black	1.032	4.223	0.472	4.023
% of county pop other race	8.091	8.343	16.737 **	8.068
% of county pop Hispanic	-5.199	4.505	-8.291 *	4.371
Real per capita income	-1.18E-05	1.35E-05	-3.36E-05 ***	1.19E-05
Unemployment rate	0.013	0.009	0.007	0.009
Year	-0.049 ***	0.015	-0.063 ***	0.017
Crime per officer			0.341 ***	0.083
Drug arrests/total crime			1.562 ***	0.420
Constant	106.099 ***	33.664	125.901 ***	32.365
Log(# of income arrests/ 10K pop)				
Real price of MJ	-0.011 **	0.005	-0.017 ***	0.004
Real price of Cocaine	-0.004	0.003	-0.005 **	0.003
Real beer tax	0.154 *	0.084	0.238 ***	0.072
log(county pop)	-1.008 ***	0.378	0.303	0.490
% of county pop < 18	20.707 ***	3.867	17.411 ***	3.946
% of county pop black	7.775	4.904	6.447 *	3.743
% of county pop other race	13.805	9.064	19.349 **	8.662
% of county pop Hispanic	-3.963	4.033	-10.916 ***	3.708
Real per capita income	-1.43E-05	1.45E-05	-5.63E-05 ***	1.78E-05
Unemployment rate	0.017	0.018	0.011	0.015
Year	-0.057 ***	0.017	-0.063 ***	0.018
Crime per officer			0.328 ***	0.127
Drug arrests/total crime			2.722 ***	0.656
Constant	122.440 ***	35.204	118.105 ***	37.157

All models include as additional regressors city fixed effects.
*** Indicates significance at 1% level (two-tailed test), ** indicates significance at 5% level (two-tailed test) and * indicates significance at the 10% level (two-tailed test)

Table 7
GLM Estimates of Log Crime Rates from UCR: 1994 -1999

	M1		M2	
	OLS Coefficient	Robust Std. Err	OLS Coefficient	Robust Std. Err
Log (# of violent crimes/ 10K pop)				
Real price of MJ	-0.009	0.006	-0.005	0.003
Real price of Cocaine	0.004	0.003	0.000	0.003
Real beer tax	0.286 ***	0.069	0.172 **	0.070
log(county pop)	-1.123 **	0.497	-1.831 ***	0.443
% of county pop < 18	7.929 **	3.796	4.942	3.190
% of county pop black	4.621	3.537	12.023 ***	2.995
% of county pop other race	20.524 *	12.237	9.770	8.906
% of county pop Hispanic	-3.279	6.029	2.631	3.432
Real per capita income	-2.72E-02 ***	1.03E-02	-2.00E-02 *	1.14E-02
Unemployment rate	0.013	0.016	0.008	0.016
Year	-0.047 ***	0.013	-0.054 ***	0.015
Crime per officer			0.518 ***	0.101
Drug arrests/total crime			-0.578 *	0.326
Constant	108.014 ***	30.087	129.284 ***	34.111
Log (# of property crimes / 10 K pop)				
Real price of MJ	-0.003	0.003	-0.005 *	0.003
Real price of Cocaine	0.003	0.002	0.003	0.002
Real beer tax	0.186 ***	0.045	0.026	0.053
log(county pop)	0.718 *	0.418	0.057	0.299
% of county pop < 18	0.092	3.026	9.524 ***	2.537
% of county pop black	0.151	3.146	-2.015	2.840
% of county pop other race	-6.555	5.029	-5.729	3.816
% of county pop Hispanic	-6.965 **	3.139	-9.127 ***	2.355
Real per capita income	-1.44E-02 **	7.16E-03	4.33E-03	7.54E-03
Unemployment rate	0.013	0.013	0.006	0.009
Year	0.002	0.015	0.026 **	0.013
Crime per officer			0.467 ***	0.064
Drug arrests/total crime			-1.704 ***	0.324
Constant	-8.122	30.964	-48.733	26.608

All models include as additional regressors city fixed effects.
*** Indicates significance at 1% level (two-tailed test), ** indicates significance at 5% level (two-tailed test) and * indicates significance at the 10% level (two-tailed test).

Table 7
GLM Estimates of Log Crime Rates from UCR: 1994 -1999

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Real price of Cocaine	0.004	0.003	0.000	0.003
Real beer tax	0.286 ***	0.069	0.172 **	0.070
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% of county pop < 18	7.929 **	3.796	4.942	3.190
% of county pop black	4.621	3.537	12.023 ***	2.995
% of county pop other race	20.524 *	12.237	9.770	8.906
% of county pop Hispanic	-3.279	6.029	2.631	3.432
Real per capita income	-2.72E-02 ***	1.03E-02	-2.00E-02 *	1.14E-02
Unemployment rate	0.013	0.016	0.008	0.016
Year	-0.047 ***	0.013	-0.054 ***	0.015
Crime per officer			0.518 ***	0.101
Drug arrests/total crime			-0.578 *	0.326
Constant	108.014 ***	30.087	129.284 ***	34.111
Log (# of property crimes / 10 K pop)				
Real price of MJ	-0.003	0.003	-0.005 *	0.003
Real price of Cocaine	0.003	0.002	0.003	0.002
Real beer tax	0.186 ***	0.045	0.026	0.053
log(county pop)	0.718 *	0.418	0.057	0.299
% of county pop < 18	0.092	3.026	9.524 ***	2.537
% of county pop black	0.151	3.146	-2.015	2.840
% of county pop other race	-6.555	5.029	-5.729	3.816
% of county pop Hispanic	-6.965 **	3.139	-9.127 ***	2.355
Real per capita income	-1.41E-02 **	7.16E-03	4.33E-03	7.54E-03
Unemployment rate	0.013	0.013	0.006	0.009
Year	0.002	0.015	0.026 **	0.013
Crime per officer			0.467 ***	0.064
Drug arrests/total crime			-1.704 ***	0.324
Constant	-8.122	30.964	-48.733	26.608

All models include as additional regressors city fixed effects.
*** Indicates significance at 1% level (two-tailed test), ** indicates significance at 5% level (two-tailed test) and * indicates significance at the 10% level (two-tailed test).

APPENDIX

Table A1. Marginal Effects and Robust Standard Errors from Probit Estimation of Prob(Using Marijuana)[a]

	MJ50		MJ72HR		UNDERMJ	
Price MJ	-0.0011	*	-0.0011	*	-0.0006	**
	(0.001)		(0.001)		(0.000)	
MALE	0.1491	***	0.0863	***	0.0266	***
	(0.003)		(0.003)		(0.001)	
BLACK	0.0294	***	0.0439	***	0.0059	***
	(0.004)		(0.004)		(0.002)	
HISPANIC	-0.0722	***	-0.0592	***	-0.0114	***
	(0.005)		(0.004)		(0.002)	
OTHR RACE	-0.1022	***	-0.0676	***	-0.0108	***
	(0.009)		(0.008)		(0.004)	
AGED 18-24	0.0375	***	0.0280	***	-0.0009	
	(0.005)		(0.005)		(0.002)	
AGED 25-34	-0.1381	***	-0.0699	***	-0.0279	***
	(0.005)		(0.005)		(0.002)	
AGED >34	-0.2601	***	-0.1728	***	-0.0566	***
	(0.004)		(0.004)		(0.002)	
EDU12	-0.0584	***	-0.0569	***	-0.0138	***
	(0.003)		(0.003)		(0.001)	
MEDUC	0.0133	**	0.0196	***	0.0033	
	(0.006)		(0.006)		(0.002)	
LEGAL INCOME	0.0000	***	0.0000	***	0.0000	***
	(0.000)		(0.000)		(0.000)	
ILLEGAL INCOME	0.0000	***	0.0000	***	0.0000	***
	(0.000)		(0.000)		(0.000)	
YEAR	0.0051	**	0.0054	**	0.0032	***
	(0.002)		(0.002)		(0.001)	
PRICE BEER	0.0038		0.0339	**	0.0007	
	(0.016)		(0.015)		(0.007)	
Distance Indicator	0.0418	***	0.0119	*	-0.0054	*
	(0.007)		(0.007)		(0.003)	
PRICE COCAINE	0.0004		0.0006		0.0000	
	(0.001)		(0.001)		(0.000)	
QUARTER	-0.0021		-0.0016		0.0005	
	(0.001)		(0.001)		(0.001)	

Statistical significance is designated as follows: *** indicates significance at the 1% level (2-tailed test), ** indicates significance at the 5% level , and * indicates significance at the 10% level.

Table A2.
ADAM Locations and Fipscodes

Albuquerque	35001	Minneapolis	27053
Anchorage	2020	New Orleans	22071
Atlanta	13121	New York	36061
Birmingham	1073	Oklahoma City	40109
Chicago	17031	Omaha	31055
Cleveland	39035	Philadelphia	42101
Dallas	48113	Phoenix	4013
Denver	8031	Portland	41051
Des Moines	19153	Sacramento	6067
Detroit	26163	Salt Lake City	49035
Ft. Lauderdale	12011	San Antonio	48029
Houston	48201	San Diego	6073
Indianapolis	18097	San Jose	6085
Kansas City	29095	Seattle	53033
Laredo	48479	Spokane	53063
Las Vegas	32003	St. Louis	29189
Los Angeles	6037	Tucson	4019
Miami	12086	Washington	11001

NOTE: Sites included in the county analysis are those listed in Table 1 except Kansas City, which did not report any data for 1995-1999. Quarterly data is averaged (annually) for the county-level analysis.

From the ADAM codebooks: "Prior to 1998, samples of arrestees for the ADAM/DUF program were drawn from booking facilities within each of the sites and thus were limited to the types of arrestees booked at these facilities. In 11 sites (Atlanta, Chicago, Cleveland, Denver, Detroit, Houston, Kansas City, Omaha, Philadelphia, St. Louis, and Washington, DC), the catchment area represented the central city. The data from the city of Denver included Denver County in its entirety, and the St. Louis data also encompassed a county. (Kansas City ceased being a DUF site after 1992.) In ten additional sites (Dallas, Ft. Lauderdale, Indianapolis, Miami, New Orleans, Manhattan [New York City], Phoenix, Portland, San Antonio, and San Jose), the catchment area was the county, parish, or borough." Post-1997, ADAM expanded as well as "enhanced each site's collection to include the entire county" (NIJ, 2000b).

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Intimate partner violence and substance use: A longitudinal day-to-day examination

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Abstract

The likelihood of male-to-female physical aggression on days of male partners' substance use, during a 15-month period, was examined. Participants were from married or cohabiting partner violent men entering a drug abuse treatment program ($N = 149$). Compared to days of no drug or alcohol use, the likelihood of male-to-female physical aggression was significantly higher on days of substance use, after controlling for male partners' antisocial personality (ASP) disorder and couples' global relationship distress. Of the psychoactive substances examined, the use of alcohol and cocaine was associated with significant increases in the daily likelihood of male-to-female physical aggression; cannabis and opiates were not significantly associated with an increased likelihood of male partner violence.

Keywords: Partner violence; Substance use; Physical aggression

1. Introduction

Although once viewed as primarily a private family matter, intimate partner violence (IPV) has become increasingly recognized as a significant public health concern during the last 20 years. Nationally representative surveys of couples in the United States indicate 15–20% of dyads experience an incident of IPV each year (e.g., Schafer,

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Caetano, & Clark, 1998; Straus & Gelles, 1990). As pervasive as IPV is in the general population, its prevalence is substantially higher among couples in which one or both partners abuse alcohol or other drugs. For example, the prevalence of male-to-female physical aggression among married or cohabiting men seeking treatment for alcoholism is four to six times higher than demographically matched nonsubstance-abusing individuals (e.g., Murphy & O'Farrell, 1994). A similarly high prevalence of male-to-female physical aggression has been found among married or cohabiting men seeking treatment for abuse of drugs other than alcohol (e.g., Fals-Stewart, Kashdan, O'Farrell, & Birchler, 2002).

Although multiple studies have found a fairly strong relationship between the use of alcohol and the occurrence of IPV (for reviews, see Hotaling & Sugarman, 1986; Leonard, 1993; Schumacher, Feldbau-Kohn, Slep, & Heyman, 2001), the functional role of alcohol consumption in episodes of IPV has been the subject of considerable and, at times, heated debate. Some have argued that alcohol intoxication, via its psychopharmacologic effects of ethanol on cognitive processing (e.g., Chermack & Taylor, 1995) or the expectancies associated with intoxication (Critchlow, 1983), facilitates all types of violence, including IPV. This explanation of the link between alcohol use and violence is often referred to as the proximal effects model. However, others have countered that the relationship between alcohol use and violence is spurious (e.g., alcohol use and violence are related to another variable, such as the presence of antisocial personality (ASP), and thus appear directly connected when they, in fact, are not) or is largely indirect (e.g., drinking leads to poor relationship adjustment, which creates an environment conducive to aggression). Although these competing explanations have focused mostly on the relationship between alcohol use and IPV, they also apply more broadly to the relationship between the use of and intoxication from any psychoactive substance and violence (e.g., Wekerle & Wall, 2002).

Implicit in the proximal effects model is that there should be a temporal relationship between substance use and violence, that is, it would be expected that episodes of violence (including IPV) would most likely occur after drinking or drug use and within a comparatively brief time period after consumption (i.e., when the perpetrator is experiencing the intoxicating effects of the ingested substance or suffering from the residual effects of intoxication, such as withdrawal). Unfortunately, because of limitations in data collection and general assessment methods, it has been difficult to ascertain the temporal association between substance use and IPV. Most investigations to date have relied largely on correlational analyses, demonstrating, for example, that individuals who report more frequent drug or alcohol use are more likely to report engaging in IPV compared to individuals who use psychoactive substances less frequently or not at all. Although the information from such studies provides some support for the role of substance use in IPV, the inherent difficulty in drawing more substantive conclusions from these findings is that it is not clear when the substance use and when the episodes of violence occur. From most studies, it cannot be ascertained whether substance use and the episodes of IPV even occurred on the same day; as such, drawing valid inferences about the proximal relationship of intoxication in IPV is not possible.

However, in a study recently completed by our group (Fals-Stewart, 2003), we addressed many of these issues. In this investigation, we collected detailed daily diaries, covering a 15-month period, about the occurrence and timing of daily episodes of drinking and male-to-female physical aggression from male and female partners with histories of IPV in which the male partners were entering an alcoholism or domestic violence treatment program. The diaries contained information about not only the occurrences of male-to-female aggression but also information about (a) the time of day these episodes happened, (b) whether the male partner drank alcohol during the same day when the violence occurred, and (c) what time of day the drinking started and ended. This allowed for a detailed examination of the daily temporal relationship between male-to-female aggression and drinking. Counting alcohol and male-to-female aggression as linked only on days when the drinking occurred before the IPV episode, for men entering the domestic violence treatment program (alcoholism treatment program odds in parentheses), the odds of any male-to-female physical aggression were more than 8 times (11 times) higher on days when men drank than on days of no alcohol consumption. The odds of severe male-to-female physical aggression were more than 11 times (11 times) higher on days of men's drinking than on days of no drinking. Moreover, in both samples, over 60% of all episodes occurred within 2 h of drinking by the male partner. From an assessment and methodological standpoint, this investigation was an important advancement and increased our understanding of the role of alcohol use and intoxication in episodes of male-to-female physical aggression.

However, a major limitation of this investigation was its exclusive focus on alcohol use. In their extensive review of the link between substance use and violence, Miczek et al. (1994) note that the association between alcohol use and aggression is, by far, the most widely researched and most well established. Research on the links between use of other drugs and the occurrence of violence in general, and IPV in particular, is not nearly as evolved as alcohol-violence research. Most of the research exploring the relationship between illicit drug use and IPV has been correlational in nature, with the temporal association between drug use and IPV remaining unexplored. Moreover, the relationship between violence and illicit substance use is obfuscated by the presence of ASP characteristics observed among many individuals who abuse drugs, which can serve to create a spurious relationship between the occurrence of violence (both in general and between intimate partners) and substance use.

Thus, the purpose of the present study is to examine the day-to-day relationship between substance use and IPV among men seeking treatment for drug abuse who reported a history of male-to-female aggression. This present investigation used the same methods of assessment and data collection used in our earlier work focusing on alcohol use, thus, allowing for the day-to-day examination of the relationship between the occurrence of male-to-female physical aggression and the male partners' use of various psychoactive drugs, in addition to alcohol. In these analyses, we controlled for the presence of ASP among male partners', which could have spuriously inflated the relationship between substance use and violence. Because alcohol and other drug use is associated with relationship distress (e.g., Fals-Stewart, Birchler, & O'Farrell, 1999), which may create a context for IPV and thus spuriously inflate

the day-to-day association between substance use and violence, we also controlled for couples' levels of dyadic adjustment.

2. Method

2.1. Participants

2.1.1. Sociodemographic characteristics

Participants were married or cohabiting male and female partners who reported at least one act of male-to-female physical aggression in their relationship during the previous year. Participants were recruited from partner violent male patients entering a 12-week outpatient substance abuse treatment program and their female partners.

Of the 421 married or cohabiting men consecutively admitted to the program, at least one of the partners in 245 (58%) of these dyads reported at least one act of male-to-female aggression during the year before the pretreatment assessment and were asked to participate. Of these, 32 (13%) men refused to be in the investigation. The intimate female partners of 23 men (9%) who initially agreed to be in the study refused to participate when the investigation was described more fully; data from these couples were not included. Men in 20 couples (8%) who agreed to participate left treatment before complete baseline assessment data were collected. For 21 couples (9%), one or both partners dropped out of the study at some point during the follow-up period (i.e., they could not be located or refused to provide required data) and thus did not provide full information about IPV, substance use, or both.[1] Thus, 149 male patients and their partners were included in the investigation.

The demographic and background characteristics of the final sample are located in Table 1. Statistical comparisons of these characteristics of the couples that participated and the 96 dyads that were not included, using analysis of variance and binomial tests, revealed the partners who were not included were significantly (P's $< .05$) younger (M = 30.4 years, S.D. = 7.2) and had shorter lengths of relationship with their partners (M = 3.1 years, S.D. = 5.9).

2.1.2. Description of substance abuse treatment

As noted, the male partners were recruited from a substance abuse treatment program. The program specialized in the treatment of individuals who primarily abused psychoactive substances other than alcohol, although the majority of patients treated in this setting also

[1] The approach of eliminating participants who did not provide complete data (i.e., listwise deletion) can result in biased parameter estimates. Although other alternatives for handling missing data were considered (e.g., multiple imputation, maximum likelihood methods), the problem we faced was not only missing data about whether substance use or violence occurred, but also specifically when these events occurred on a given day. Because we had fairly good participant compliance and did not have many dropouts, it was decided to report the analyses of complete data versus making any estimates, based on some type of imputation, about the occurrence and specific timing of the behaviors under consideration.

Table 1
Baseline characteristics of final sample ($N = 149$)

Characteristics	Statistic
Mean (S.D.)	
Male partners' age	36.1 (8.2)
Female partners' age	34.9 (11.6)
Male partners' education	12.4 (1.1)
Female partners' education	12.5 (1.2)
Years married or cohabiting	8.1 (4.9)
Annual income (in thousands of U.S. dollars)	27.6 (19.0)
Number (%) cohabiting but not legally married	44 (30)
Male partners' (and female partners') race/ethnicity	
White	90 (94)
African American	39 (33)
Hispanic	13 (14)
Other	5 (6)
Mean (S.D.) couple DAS score	90.2 (20.4)
Mean (S.D.) PDA for male participants	28.2 (34.3)
No. (%) of male partners meeting criteria for the following DSM-IV substance use dependence disorders	
Alcohol	91 (61)
Cocaine	77 (52)
Opiates	58 (39)
Cannabis	18 (12)
'Other'	36 (24)
Number (%) of male partners meeting *DSM-IV* criteria for Antisocial Personality Disorder	57 (38)
Mean (S.D.) CTS subscale score for male-to-female	
Verbal aggression	64.6 (17.9)
Overall violence	6.5 (3.2)
Severe violence	1.9 (2.6)
Mean (S.D.) CTS subscale score for female-to-male	
Verbal aggression	34.8 (33.6)
Overall violence	7.9 (5.1)
Severe violence	1.5 (1.9)

DAS = Dyadic Adjustment Scale; PDA = percentage of days abstinent derived from the TLFB; *DSM-IV = Diagnostic and Statistical Manual of Mental Disorders*, 4th ed. (American Psychiatric Association, 1994); CTS = Conflict Tactics Scale. For partners' race/ethnicity, the number of male partners in each category is provided outside the parentheses; the number of female partners in each category is provided within the parentheses.

had alcohol use disorders in addition to other drug use disorders. Participants received weekly individual and group counseling over a 12-week period. The intervention followed a traditional 12-step facilitation model of substance abuse treatment, while also encouraging participants to engage in self-help support meetings. According to treatment providers in this program, partner violence was only discussed if the issue was raised in the context of group or individual treatment. Patients who reported that they engaged in IPV were referred

to a domestic violence treatment program after completion of the drug abuse treatment program.[2]

It is important to emphasize this study was not a treatment outcome study; men were recruited from the treatment program because the setting allowed for convenient access to and recruitment of men who had engaged in partner violence, along with their intimate partners, both of whom could then be trained in the use of the substance use and partner violence diaries. Use of the diaries was a critical component of the investigation, increasing the reliability of daily reports of both substance use and violence.

2.2. Materials and measures

2.2.1. Diaries

Upon admission to the study, male and female partners participated in extensive didactic training on the use of the daily diaries, conducted by a research assistant (RA), during which they were each given a 15-month supply of log books and were instructed how to fill out the daily log sheets. Each logbook contained a 5-month supply of diary sheets to record daily episodes of male partner's drinking and other drug use and male-to-female physical aggression. The daily substance use log included space for four different drinking or other substance use episodes per day. For each day of substance use by the male partners, both partners were asked to record each time a substance use episode (i.e., drinking or other drug use) began and ended (defined as the last use of a substance).

In the diaries, participants recorded the time each episode of IPV happened and the type of partner violence that occurred. Violence type was classified by the categories used in the Conflict Tactics Scale (CTS; Straus, 1990): (a) threw something at partner, (b) pushed, grabbed or shoved, (c) slapped, (d) kicked, bit, or hit, (e) hit, or tried to hit, with something, (f) beat up, (g) threatened with a knife or gun, (h) used a knife or gun, or (i) other types of physical aggression not otherwise specified. It is possible more than one type of violent act could occur as part of any circumscribed violent episode (e.g., within a single conflict, a male partner might shove his partner and also throw something at his partner); all types of partner physical aggression occurring on a given day and during a given episode were recorded in the log. As with the CTS, items d–h are considered types of severe violence. On each day, the log also required respondents to note if they had any face-to-face contact with their identified partner. Partners were considered to have face-to-face contact even in circumstances in which the contact was brief (e.g., picking up children for visitation). Any face-to-face contact represented an opportunity for male-to-female physical aggression to occur between partners. Days in which partners did not have any face-to-face contact were not included in the analytic models because there was no opportunity for IPV to occur.

[2] The information collected from the couples about the occurrence of IPV was not shared with the clinical providers in the treatment program. A review of the clinical charts of the men who participated in the investigation revealed that 14 (9%) were referred to a domestic violence treatment program after treatment. According to data collected as part of the posttreatment data collection, only one of these men attended the domestic violence treatment program to which they were referred.

Each partner was asked to mail his or her diary to investigators each week, using prepaid addressed envelopes. If a weekly diary was not received at or before 4 days after it was supposed to be mailed, the participant who had failed to mail the diary was contacted by telephone by an RA, who then queried the participant about substance use and episodes of violence for the week covered by the missing diary. Participants were paid US$5.00 for each weekly diary that was completed and mailed. The information recorded by the partners on their diaries was transferred to daily calendars, which covered the 15-month period under consideration. Partners also participated in face-to-face interviews with RAs every 3 months, during which the calendars were reviewed, evaluated, and corrected (if necessary). This combination of diaries and timeline calendar interviewing has been shown to be a reliable and valid method of collecting information about the daily occurrence of IPV (Fals-Stewart, Birchler, & Kelley, 2003).

2.2.2. Relationship violence

The CTS was used to assess the frequency of male- and female-perpetrated verbal aggression, overall violence, and severe violence. Respondents rated each CTS item on a seven-point scale (never, once, twice, 3–5 times, 6–10 times, 11–20 times, more than 20 times) for the frequency that they and their intimate partners engaged in the behavior during the last 12 months. Straus (1990) recommended scoring the frequency of violent acts using the middle of yearly frequency range for each CTS response category as follows: never = 0; once = 1; twice = 2; 3–5 times = 4; 6–10 times = 8; 11–20 times = 15; more than 20 times = 25. A combined self- and partner-report was used. For example, if either the male partner or his intimate partner reported the male partner had been violent in the last year, he would be coded as violent. This approach is frequently used to address concerns about underreporting and leads to higher prevalence rates than self-reports alone.

The CTS Verbal Aggression subscale has six items (e.g., yelled and/or insulted, threatened to hit or throw something at the partner). The CTS Violence subscale has eight items: (a) threw something at the partner; (b) pushed, grabbed, or shoved; (c) slapped; (d) kicked, bit, or hit; (e) hit, or tried to hit, with something; (f) beat up; (g) threatened with a knife or gun; and (h) used a knife or gun. Frequency scores based on all eight items are labeled overall violence; scores based on items d–h provide a measure of severe violence (Straus, 1990).

2.2.3. Substance use

The Timeline Followback Interview (TLFB; Fals-Stewart, O'Farrell, Freitas, McFarlin, & Rutigliano, 2000) is a well-validated semistructured interview designed to assess frequency of drug and alcohol use. The TLFB uses a calendar and other memory aids to gather retrospective estimates of an individual's daily drinking and other drug use over a specified time period, up to 12 months from the interview date. The substance use index derived from the TLFB used in the present investigation was percentage of days abstinent (PDA), which was operationally defined as the percentage of days in the measurement interval the patient reported no alcohol or drug use and was not in jail or a hospital for reasons related to drug or alcohol use.

Male partners were interviewed with the psychoactive substance use modules of the Structured Clinical Interview for *DSM-IV* (SCID; First, Spitzer, Gibbon, & Williams, 1995),

administered by one of two master's-level RAs (both of whom were trained by William Fals-Stewart, who has extensive experience administering the SCID). Interrater reliability was assessed using a paired-rater design. Videotaped interviews of 20 patients entering a drug abuse treatment center were independently observed by both primary interviewers and by the author. Kappas between the two primary interviewers for the substance use disorders ranged from .80 to 1.0. Kappas between William Fals-Stewart and the primary interviewers also ranged from .90 to 1.0. These kappa coefficients reflect good-to-excellent observer agreement (Landis & Koch, 1977).

2.2.4. ASP disorder

Male partners were interviewed with the ASP module from the SCID by master's-level RAs. Using the same approach to assess interrater reliability that was used with the substance use disorders (i.e., review of 20 patient interviews rated independently by the RAs and by William Fals-Stewart), the RAs and William Fals-Stewart had perfect agreement on ASP diagnosis for the videotaped cases.

2.2.5. Relationship disharmony and conflict

Partners completed the Dyadic Adjustment Scale (DAS; Spanier, 1976), a widely used inventory of general relationship adjustment and satisfaction. Higher scores indicate higher levels of general relationship satisfaction. Traditionally, scores less than 98 indicate significant relationship dissatisfaction. Previous studies have revealed the DAS to have high reliability, with alpha coefficients typically exceeding .90 and stability coefficients exceeding .85 (e.g., Carey, Spector, Lantigna, & Krauss, 1993). As reported in the original reference, the DAS also reliably discriminates between distressed and nondistressed couples. For this investigation, partners' scores were averaged to get a couple-level measure of relationship distress.

2.3. Procedure

2.3.1. Assessment

Partners were interviewed by master's-level RAs at pretreatment, posttreatment, and quarterly thereafter for 1 year. At pretreatment, partners completed the DAS, CTS, SCID, and TLFB (to assess male partners' frequency of substance use during the previous 12-month period). As noted, they were also trained in the use of the daily diaries. At the scheduled end of treatment (i.e., 3 months after program admission), and quarterly thereafter for 12 months, partners were also interviewed separately in the drug treatment program facility by an RA. During that interview, the partners were provided copies of the calendars on which male-to-female physical aggression and substance use behavior were recorded. At this interview, any time periods for which information was not complete or if there were other additions or corrections the partners wished to make, they could do so during these face-to-face contacts. Although all interviews were to be conducted in a face-to-face format, a small proportion of interviews were conducted by telephone (i.e., less than 10%) when participants were either away from the area or refused to participate in face-to-face interviews. Partners were paid for participation in the baseline, posttreatment, and all follow-up interviews.

Partners demonstrated fairly high compliance with completing and mailing the weekly diaries. On average, participants mailed the weekly diaries on time roughly 65% of the time (i.e., they were received within 4 days of the mailing date by the designated RA). Moreover, in roughly 85% of instances when diaries were not completed on time or otherwise were not received (e.g., lost in the mail), partners were successfully contacted by telephone and the necessary data were gathered on the occurrence and timing of substance use (i.e., drug and alcohol use) and male-to-female physical aggression.

2.4. Statistical analytic method

2.4.1. General analytic approach

To examine the daily conditional relationship between substance use and male partner physical aggression, two-level hierarchical generalized linear model analyses (HGLM; Raudenbush & Bryk, 2002) were conducted using the MLWin program, Version 1.2 (Goldstein et al., 1998). In these logistic regression time series models, the occurrence of male-to-female physical aggression on a given day was the dependent measure and male partners' substance use on the same day was the primary independent measure of interest. The focus of the analysis was on the joint dependency of these two behaviors (i.e., on the extent to which the likelihood of an event or behavior is influenced by the occurrence of another behavior). The change in the odds of male-to-female physical aggression occurring on days of face-to-face contact between partners when the male partner used a psychoactive substance (i.e., alcohol or another drug) before the violent episode compared to days of no substance use or substance use only after the occurrence of violent episodes was examined.[3]

Because the dependent measure can take values of either 0 (i.e., no partner violence) or 1 (i.e., occurrence of partner violence), the HGLMs used a Bernoulli sampling distribution and a logit link function. Use of the different psychoactive substances was treated as a Level 1 time-dependent covariate. Partner violence and substance use were nested within participants (Level 2). A first-order autoregressive structure was used and penalized quasi-likelihood was implemented for parameter estimation.

Partner physical aggression and substance use by the male partners were counted as linked on a given day only if the first episode of substance use preceded the first act of male-to-female violence. For the present study, if multiple types of violence occurred on a given day, the type of violence occurring on the day was considered 'severe' if any of the violent acts were severe.

Although obtained from both partners, data provided by the female partners regarding episodes of male-to-female physical aggression and their reports of face-to-face contact were used in the analyses reported. Female reports of male-to-female physical aggression were used

[3] For six episodes of male-to-female aggression, substance use occurred and ended close to the end of one day (i.e., shortly before midnight) and the episode of violence closely followed but occurred the day after the substance use (i.e., shortly after midnight). Using our criteria for determining if substance use was linked on a given day, these particular episodes of substance use and violence were not classified as linked because they occurred on different days. In the models presented, these episodes of IPV and substance use were not, in fact, counted as linked. This decision was deemed the most conservative in this analysis; however, if these substance use and violence episodes are counted as linked, the results reported do not change substantively.

because some studies suggest, perhaps because of issues related to social desirability, that men report fewer episodes of male-to-female physical aggression than their female counterparts (e.g., Archer, 1999).

Additionally, substance use information provided by the male partners was used in the analytic models. Although men's reports of their own substance use could also be influenced by positive impression management or dissimulation, the male participants were, of course, the only individuals in the dyads who have full knowledge of when they drank or used other drugs, particularly given that much of the male partners' substance use can occur in settings where the female partner is not present. An important advantage of using different partners' reports of violence and substance use, respectively, is that the effect of the perception bias held by any single member of the dyad that violence and substance use are related is largely reduced or eliminated if the reports of the behaviors of interest are given by different respondents.[4]

2.4.2. Control variables

In these models, to control for levels of male partners' ASP characteristics, the SCID diagnostic classification of ASP was entered as a Level 2 predictor. To control for level of couples' relationship distress, partners' mean DAS scores were also included in the models as Level 2 variables. In addition to serving as control variables, including ASP diagnosis and DAS couples score in the model allowed for the examination of these variables' main effects on likelihood of violence on a given day, regardless of substance use.

2.4.3. Model building approach

Among the male participants in the investigation, the following psychoactive substances were used on a sufficient number of days to model their potential impact on the occurrence of male-to-female aggression: (a) alcohol, (b) cocaine, (c) cannabis, and (d) opiates.[5] We used a sequential approach to examine the relationship between the use of these drugs and the occurrence of male-to-female aggression. First, we examined the univariate relationship

[4] We also had reports about occurrences of male-to-female physical aggression from the male partners and reports of male partners' substance use by the female partners. For episodes of violence, male and female partners' reports moderately related, pooled across all couples, the kappa coefficient was .61 ($P < .001$). Using male reports of violence in the models did yield substantively different results than those that are reported. In terms of substance use, however, female partners reported that they were aware of drinking or other drug use by their male partners, but in many instances could not report times or were unable to identify the substances used. In the quarterly interviews, female partners reported that the male partners often drank or used drugs while not in their presence (e.g., with friends after work). Use of female reports about substance use in the models yielded a significant day-to-day relationship between substance use and male-to-female physical aggression (which was also found when using men's reports). However, use of female reports about male partners' use of specific substances and the timing of such use was not practical due to the amount of missing information in those reports.

[5] The participants in this sample did use other drugs other than alcohol, cocaine, opiates, and cannabis. These included LSD, amphetamines, methaqualone, phencyclidine, and anxiolytics. However, the number of days of use of any of these drugs, pooled across the sample, was less than 3% of the total number of days of face-to-face contact with their partners, compared to greater than 15% of the days or more for use of alcohol, cocaine, opiates, and cannabis by the male participants. Thus, the small number of days of use of these other substances precluded a meaningful examination of their effect on IPV.

between the use of any of these drugs and the occurrence of violence. If we found this conditional relationship to be significant, we then planned to examine the effects of each substance individually using model building strategies and methods for logistic regression described by Hosmer and Lemeshow (1989). Specifically, we initially conducted univariate analyses with the use of each substance considered in separate models. All substances in the univariate analyses that had a P value of less than .25 were then retained as candidates for inclusion in the multivariate HGLM (Mickey & Greenland, 1989). All of the univariate and multivariate HGLMs conducted included ASP diagnosis of the male partners and couple DAS scores as control variables.

3. Results

3.1. Male partners' substance use and male-to-female physical aggression during the assessment period

The mean (S.D.) number of days of face-to-face contact between partners was 249.3 (104.6). Among these couples, 52 (35%) of the female partners reported at least one act of male-to-female physical aggression and 102 (68%) of the male partners reported drinking or using another psychoactive substance on one or more of the days of face-to-face contact. Pooled across couples, the number of days of male-to-female physical aggression was 499; of these, 179 (36%) were episodes of severe aggression. On 299 (60%) days of any physical aggression and on 128 (72%) days of severe violence, the male partner drank or used drugs before the violent episode.

3.2. The day-to-day relationship between substance use and the occurrence of male-to-female physical aggression

After controlling for ASP and couple DAS scores, the likelihood of any male-to-female physical aggression was significantly higher on days of substance use compared to days of no substance use, $B = 1.22$, S.E. $= 0.14$, $z = 8.71$, $P < .001$, odds ratio (OR) $= 3.38$. Similarly, the likelihood of severe male-to-female physical aggression on a given day was significantly higher on days of substance use compared to days of no substance use, $B = 1.39$, S.E. $= 0.13$, $z = 10.69$, $P < .001$, OR $= 4.01$.

With ASP and couple DAS scores included in the models as control variables, the day-to-day univariate relationships between each of the psychoactive substances and the occurrence of any male-to-female physical aggression and severe male-to-female physical aggression are located in Table 2. Three of the four drugs (i.e., alcohol, cocaine, and heroin) met the selection criterion for inclusion in the final multivariate model (i.e., all had P's $< .25$) for any male-to-female physical aggression and two of the four drugs (i.e., alcohol and cocaine) met the selection criterion for inclusion in the final multivariate model for severe male-to-female physical aggression. Cannabis did not meet the selection criterion for consideration to be entered into the final multivariate models for any or severe violence.

Table 2
Parameter estimates for univariate hierarchical generalized linear models examining the day-to-day relationship of alcohol, cocaine, opiates, or cannabis and the occurrence of any and severe male-to-female physical aggression

Fixed effects	*B*	S.E.	*z*	OR
Any physical aggression				
Alcohol	1.79	0.09	19.91•••	5.99
Cocaine	1.28	0.13	9.85•••	3.60
Opiates	0.30	0.16	1.87••	1.34
Cannabis	−0.06	0.05	−1.10•	0.94
Severe physical aggression				
Alcohol	1.92	0.08	36.51•••	6.82
Cocaine	1.11	0.14	7.93•••	3.03
Opiates	0.13	0.11	1.08•	1.13
Cannabis	−0.10	0.09	−1.04•	0.90

In these models, the presence of ASP disorder and couple DAS score were entered as control variables. All substances were evaluated in separate models (i.e., they were not entered simultaneously). Use of substances that was related to violence at $P<.25$ were eligible for inclusion in the final multivariate models.

• $P>.25$.
•• $P<.10$.
••• $P<.001$.

The final multivariate models for any male-to-female physical aggression and severe male-to-female aggression are located in Table 3. Alcohol and cocaine were significantly associated with an increased likelihood of any male-to-female physical aggression; opiate use was not significant in this model. Even after controlling for ASP and DAS, the odds of male partner violence increased more than fourfold on days of drinking and nearly threefold on days of cocaine use. Similarly, alcohol and cocaine were significantly associated with an increased likelihood of the occurrence of severe violence. The odds of severe male-to-female physical aggression were over five times higher on days of drinking and nearly three times higher on days of cocaine use.

In the models for any and severe physical aggression, we also explored whether the combination of alcohol and cocaine was significantly associated with an increased likelihood of violence. We explored other substance combinations as well (e.g., opiates and cocaine, alcohol and cannabis, alcohol and opiates). In all of the models for any and severe physical aggression, use of multiple drugs on a given day did not significantly increase the likelihood of male partner violence above the increases in violence attributable to the individual substances (i.e., all *P*'s for the combinations were less than .05). Interactions between each substance and the presence of ASP were also not significant in any models.

3.3. Examination of the trend in the temporal relationship between substance use and IPV

If it is assumed that substance intoxication or withdrawal serves to facilitate acts of partner violence, it would follow that, on days when substance use and violence co-occur, most acts of male partner aggression should occur close in time to episodes of male partners' substance use.

Table 3
Parameter estimates for hierarchical generalized linear models examining the day-to-day relationship of alcohol, cocaine, and opiate use and any and severe male-to-female physical aggression

Fixed effects	B	S.E.	z	OR
Any physical aggression				
Intercept	−4.61	0.14	−34.38***	0.01
ASP	0.09	0.03	2.70**	1.09
DAS	−0.06	0.02	−2.44*	0.94
Alcohol	1.48	0.09	16.44***	4.39
Cocaine	1.06	0.08	13.25***	2.89
Opiates	0.13	0.11	1.18	1.13
Severe physical aggression				
Intercept	−6.13	0.21	29.19***	0.01
ASP	0.14	0.04	3.99***	1.15
DAS	−0.04	0.02	−2.19*	1.04
Alcohol	1.69	0.10	16.25***	5.42
Cocaine	1.03	0.09	10.95***	2.80

ASP = Antisocial personality disorder for male partners (coded "1" if present, "0" if absent); DAS = Dyadic Adjustment Scale (couple score). As noted in Table 2, alcohol, cocaine, and opiates were eligible for inclusion in the model for any physical aggression; only alcohol and cocaine were eligible for inclusion in the model for severe physical aggression.

* $P<.05$.
** $P<.01$.
*** $P<.001$.

To explore this hypothesis, all days on which male partners consumed alcohol or used cocaine and male-to-female physical aggression occurred were isolated. We placed our focus only on alcohol and cocaine use based on the results of the multivariate HGLMs described earlier.

On each of these days, the time of day of the first episode of violence was identified from the female partners' reports. From the male partners' reports, all drinking episodes and cocaine use episodes on that day occurring before the episode of violence were marked; of these, the substance use episode occurring closest in time to the act of violence was identified. The substance use episode was considered to be closest if the male-to-female aggression was bracketed in time by the start and completion of a cocaine use or drinking episode. In instances when the violence did not occur during a substance use period, the episode ending nearest in time to the act of violence was considered closest. The amount of time between the end of the closest episode of male partners' drinking or cocaine use and the act of partner violence was calculated; when substance use was occurring when the violent episode took place, the amount of time between drinking and violence was assumed to be zero. The time between substance use and violence was transformed into an ordered multinominal time variable: (a) 0–1 h 59 min, (b) 2–3 h 59 min, (c) 4–5 h 59 min, (d) 6–7 h 59 min, and (e) eight or more hours.

Violence episodes involving cocaine and episodes involving alcohol were examined separately. On days when both substances were used, the violent episode was considered related to the drug that was used closest in time to the aggressive event. For six episodes

of any violence and three episodes of severe violence, it could not be determined which drug was used closest in time to the violent episode; these days were excluded from the analysis.

The relationships between the ordered multinominal time variable and both any and severe partner violence were examined. The percentage of acts of any male-to-female physical aggression happening in each time period related to alcohol use and related to cocaine use are shown in Panel A of Fig. 1. To test the trend of the relationship between the likelihood of any male-to-female aggression and the time of drinking, an HGLM was performed on these data. Occurrences of violence in each time frame were a count dependent variable; the multinominal time variable was a Level 1 predictor. Participants who engaged in violence represented Level 2. Conceptually, the occurrences of male-to-female physical aggression during the different

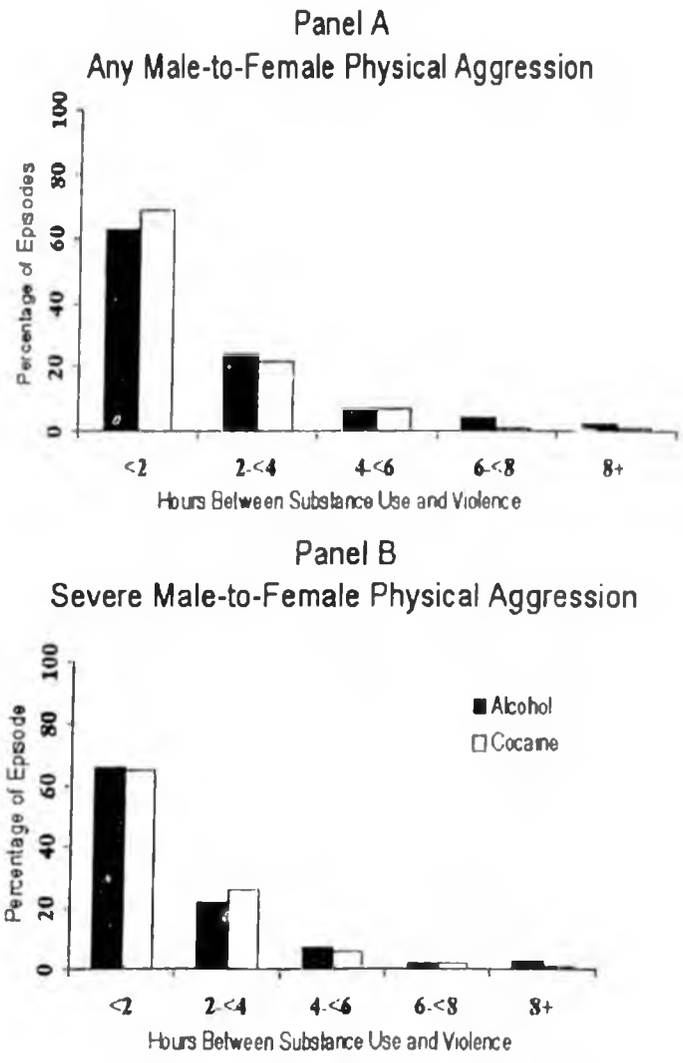

Fig. 1. The percentage of episodes of any male-to-female physical aggression (Panel A) and severe male-to-female physical aggression (Panel B) occurring at different time periods after male partners' use of alcohol or cocaine ended.

abuse often leads to relationship distress, thereby creating a context in which IPV is more likely to occur. However, because both the presence of male partners' ASP and couple DAS scores were controlled in all of the analytic models exploring the IPV–substance use link, these did not account for the significant day-to-day relationships between alcohol use, cocaine use, and male-to-female physical aggression.

The findings of the present investigation provide a replication of our earlier diary study examining the link between alcohol use and IPV (Fals-Stewart, 2003), which also demonstrated significant increases in male-to-female physical aggression on days of alcohol use for partner violent men entering either an alcoholism treatment program or domestic violence treatment program. Moreover, the current study also represents an important extension of that earlier research by exploring the effects of other commonly abused illicit drugs on the occurrence of IPV and demonstrating, for the first time, a significant day-to-day relationship between cocaine use and IPV.

Although our findings provide support for a potential causal role for alcohol and cocaine use in the occurrence of male-to-female physical aggression, it is important to note that the results of the present investigation cannot rule out noncausal explanations. For example, it is possible that, for some occurrences of IPV, men in this study may have decided to aggress against their female partners and subsequently used alcohol or other drugs to overcome any inhibitions about engaging in such behavior.

Because similar assessment and data collection methods were used, this investigation shares many of the strengths of the Fals-Stewart (2003) study. More specifically, both studies obtained prospective, daily reports of substance use and partner violence over an extended time interval, thus allowing for comprehensive analyses of these behaviors' day-to-day conditional relationship. Perhaps because of the regular contact with participants, there were comparatively few participant dropouts from the study during the course of data collection. We also collected information about male-to-female physical aggression and substance use separately from different partners (i.e., IPV information from the female partner, substance use by the male partner); thus, the effects of any preconceptions about the link between these behaviors on our findings were reduced.

In addition, the present study required participants to mail their diaries each week to a designated RA so information about IPV and substance use could be recorded; participants who failed to mail their diaries in a timely manner were contacted by telephone and interviewed to collect the data. This process ensured that data were solicited and collected about a fairly brief assessment interval (i.e., each week of the 15-month period), reducing the effects of decaying memory on report accuracy. In contrast, participants in the Fals-Stewart (2003) investigation were asked to maintain their diaries and were contacted regularly to encourage consistent recording in the diaries, but participants were not asked to mail the diaries. They were asked to bring the diaries to follow-up interviews every 3 months, where they were then used as memory aids to complete timeline interviews. Thus, it could not be discerned when participants completed the diaries and, in fact, if participants filled out the logs in a timely manner. Given our interest in day-to-day events, efforts to gather data each week and monitoring its collection likely enhanced compliance and accuracy of participants' reports compared to our alcohol–IPV diary study.

With these strengths in mind, the present investigation had several significant limitations. The study focused on the conditional relationship of two behaviors: male partners' substance use and male-to-female violence. Although this conditional relationship is important, we also recognize that IPV has multiple determinants and is typically not unidirectional. Information about other daily behaviors likely to influence IPV was not collected as part of the present study. For example, we did not collect information about female partners' drinking or drug use and how that might have influenced the occurrence of violence. Additionally, we did not collect information about female-to-male physical aggression, which appeared to be more frequent in these dyads than male-to-female aggression during the year before these men entered treatment (based on CTS female-to-male physical aggression frequency scores compared to CTS male-to-female physical aggression frequency scores). Comparatively higher frequency of female-to-male physical aggression has also been observed in other IPV investigations (e.g., Fals-Stewart et al., 2003). Thus, future investigations in this area need to explore the dynamic interplay of the occurrence and timing of different behaviors (e.g., both partners' alcohol use, both partners' drug use, female-to-male violence, male-to-female violence) to better understand the antecedence and consequences of IPV. The diary assessment methods used in the current study lend themselves to such an examination; given the willingness of participants to engage in this study and comply with the procedures, despite the labor-intensive nature of the assessment approach, more comprehensive day-to-day studies of IPV are both possible and practical. Other daily data collection methods, such as interactive voice response technology (e.g., Mundt, 1997), which allows respondents to make daily telephone calls and respond to queries about behaviors occurring during the day, may also yield reliable temporal information about the interrelationship of IPV and substance use.

Compared to examination of the effects of a single psychoactive substance, such as alcohol, on IPV, using participants who regularly ingested multiple substances presented certain challenges that make interpretation of the effect of any single substance difficult. For example, many individuals drink alcohol to ameliorate some of the unpleasant post-acute intoxication effects of cocaine (e.g., irritability, paranoia, anxiety; e.g., Gold, 1997). As noted earlier, when examining the temporal relationship between cocaine use, alcohol use, and male-to-female aggression, we counted the violence episode as linked to the substance used closest in time to the male partners' aggressive behavior. For certain specific episodes of male-to-female aggression, based on the calendar reports, male partners had used cocaine extensively during the day, but had begun to drink after the extended cocaine use had ceased. The violence occurred after the drinking had started and thus was counted as linked to alcohol use. Although this is objectively accurate, it may be that these violence episodes were more a consequence of the cocaine use. Moreover, we make reference to the occurrence of male IPV being related to cocaine or alcohol *intoxication*, but the anecdotal reports of many participants suggest that violence occurred during the post-intoxication phase of these substances, which are often marked by increased irritability, fatigue, anxiety, and so forth. Thus, it is perhaps most accurate to consider violence to be related to the psychophysiological effects of these drugs, which includes both intoxication and withdrawal.

We also were only able to focus on four psychoactive substances in these analyses, primarily because participants from these programs used other drugs rather infrequently. Investigations seeking to explore the effects of other drugs on IPV may have to engage in a different recruitment strategy (e.g., oversampling married or cohabiting amphetamine users) to ensure sufficient use of these other substances to explore their influence on partner violence. We also recruited participants from a substance abuse treatment program, which allowed us the opportunity to recruit individuals who admittedly engaged in drug use and to train partners extensively in the use of the diaries. Although the present investigation was not a treatment outcome study, the effects of treatment on the link between male-to-female aggression and substance use are unclear. Additionally, our results may not generalize to those who are not seeking treatment for substance abuse; efforts need to be undertaken to recruit married or cohabiting alcohol- and drug-abusing individuals from the general populations to examine the effects of different psychoactive substances on IPV.

Despite these limitations, the results of the study provide further support for the facilitative role of alcohol and cocaine use in the occurrence of IPV. Understanding factors that contribute to IPV may lead to improvements in the methods of prevention and intervention used to address IPV in clinical samples and in the community.

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