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Assessing the Impact of Drug Use and Drug Selling on Violent Offending in a Panel of Delinquent Youth

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Abstract

Despite a vast number of empirical studies arguing for or against a causal relationship between illegal drug use and selling and violent behavior, the debate continues. In part this is due to methodological weaknesses of previous research. Using data from the Rochester Youth Development Study, the current study seeks to improve on prior research designs to allow for a more precise examination of the mechanisms that lead from an individual's drug use (chiefly, marijuana use in the current sample) and drug selling to violent action. Results will allow for greater confidence in making causal inference regarding a long-standing concern in the discipline.

Keywords

drug offending; violence; random effects; fixed effects; causal analysis

Introduction

Effectively demonstrating a causal relationship between individuals' drug use and drug selling and their violent crime is one of the most persistent challenges in criminological research, reaching as far back as the early 1900s (e.g., Kolb, 1925). The supposed relationship appears in many of the "classics" of criminology, such as the early work of the Chicago School (C. R. Shaw & McKay, 1942; Thrasher, 1927) as well as cornerstone criminological theories (Merton, 1938; Sutherland, 1947). In addition to its influence on academic research, the drugs and violence relationship has perpetually influenced social policy and criminal law. Along with the goal of reducing drug use, the presumed threat of drug offenders preying on society is an impetus behind punitive legislation that has resulted in the United States incarcerating its citizens more than any other country in the world (see Kuziemko & Levitt, 2004; Langan, 1991; Marvel & Moody, 1994).

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However, despite its nearly ubiquitous presence in the minds of academics and criminal justice practitioners, there is hardly an agreement on how it is that drugs lead to violence. Some empirical studies show that drugs are related to violence at the aggregate level. Typically, this involves a correlation between some macro-level indicator of drug activity (such as drug use, production, or seizure) and violent crime rates. Other studies suggest drug activity is related to violent crime at the individual level. This implication is the focus of other empirical studies. Here, individual-level drug use and drug selling are shown to be associated with various forms of violence, under varying conditions and for varying populations. Due to these varying scope conditions, it remains unclear whether drugs have a causal effect on violent crime at the individual level. Of course, it is logical to ask whether an individual's drug activities are a cause of violence, given the question's influence in academic and applied circles. As a discipline, criminology seems to have a clear understanding of the question but has yet to arrive at an answer despite a wealth of research that supports the notion that drugs and violence are related to one another at macro and micro levels.

As will be elaborated below, an important reason for the lack of a clear answer is that much of the prior research was impeded by methodological deficiencies that prevent causal inference. Although these deficiencies are largely a result of inadequate data for establishing cause, the threats the deficiencies create for the validity of conclusions are both potent and pervasive. Before reviewing the methodological weaknesses of prior research and validity threats they create, an overview of research is presented that supports the drugs and violence relationship.

This study is an attempt to provide a research design more conducive to establishing whether an individual's drug use and drug selling are causally related to an individual's violent offending. This design relies on data from the Rochester Youth Development Study (RYDS), an ongoing longitudinal study of high-risk youth. The data allow the current study to overcome many of the prior methodological weaknesses and to minimize the threats to validity. Analytical techniques beyond linear regression are employed to control for a wide variety of confounding factors surrounding the drugs and violence milieu, and thus to isolate the unique effect of drug use[1] and drug selling on an individual's violence independent of such confounds.

Drugs and Violence

Perhaps two of the most widely researched topics in the field of criminology are drugs and violence. Quite easily, one can locate innumerable empirical and theoretical articles exploring some aspect of these two issues. How the two relate to each other is likewise a long investigated area of research. Indeed, as McBride (1981) observed, "The focus on drugs and crime has always included a concern with the relationship between drugs and violence" (p. 106). Drug control policy has long been driven by an assumption that drugs are a direct cause of crime (McBride, 1981), although this assumption has a less central role in

[1]It is important to note up front that the vast majority of drug use incidents in the Rochester Youth Development Study (RYDS) sample are marijuana use incidents. Throughout the article, the term *drug use* is used, and the reader should be aware of the bias toward marijuana in this measure.

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policy creation in recent years. As many scholars have noted, there are a variety of conduits between drugs and crime (Goldstein, 1985; Walters, 1994). However, the notion that drug offenses (use, sales, and the like) cause other forms of crime holds primacy in research and policy. Goldstein's (1985) tripartite framework, for example, became a foundation for much of the subsequent research in drugs and violence, lending credence to the individual-level relationship (Baumer, 1994; Baumer, Lauritsen, Rosenfeld, & Wright, 1998; Brownstein, Shiledar Baxi, Goldstein, & Ryan, 1992; Fagan & Chin, 1990; Johnson, Golub, & Dunlap, 2000) as well as aggregate-level consequences (Fagan, Zimring, & Kim, 1998; Ousey & Lee, 2004, 2007).

Research has extensively examined the relationship of drugs and violence at the individual level. An individual's use of drugs is associated with violent crimes such as robbery and assault (Baumer, 1994; Baumer et al., 1998; Kinlock, O'Grady, & Hanlon, 2003; Reiss & Roth, 1993) as well as weapon carrying (Lizotte, Krohn, Howell, Tobin, & Howard, 2000). Drug use may also be related to individual homicide offending (Hagelstam & Hakkanen, 2006; J. Shaw et al., 2006), although this is more widely contended than the relationship between drug use and less serious violent offenses.[2] While using drugs is related to individual experiences of violence, so too is drug selling (Fleisher, 2006; Miller, 2001; Valdez & Sifaneck, 2006). Fagan and Chin concluded that "drug selling is etiologically related to violence, but only because violence is *intrinsic* to drug selling" (1990, p. 36). Within drug markets, violence and guns have reciprocal effects (Cook & Laub, 1998; Lizotte et al., 2000), which are only compounded in the context of gangs (Thornberry, Krohn, Lizotte, Smith, & Tobin, 2003).

Considered as a whole, the literature demonstrates a consistent relationship between drugs and crime, particularly violent crimes. Although this relationship is rarely disputed, it has been suggested that "the *nature* [italics added] of that relationship continues to elude researchers and practitioners today" (Kinlock et al., 2003, p. 900). A chief source of the elusiveness has historically been, and continues to be, weaknesses in research designs that challenge the validity of conclusions presented. These weaknesses are reviewed below.

Motivation for Current Study

Although the wealth of research on the relationship between drugs and violence is extensive, it nonetheless is plagued by a number of commonly found weaknesses. This is particularly true among studies that examine a hypothesized individual-level relationship. Nurco, Kinlock, and Hanlon (2008) condensed these common weaknesses into five general categories (the authors discussed these categories in relation to drugs and crime more generally, but they apply to drugs and violence more specifically, and the examples provided show the weaknesses as they apply to drugs and violence research).

First, studies commonly employ deficient measures of criminality (for example, official arrest records). Reliance on official data as measures of criminal offending threatens the

[2]Certainly, macro-level drug use is related to homicide rates. For example, drug use in the United States is related to the violence and murders surrounding drug trafficking in Mexico currently. The studies referenced here however assert that an individual's drug use is related to his or her own likelihood of homicide offending, a micro-level relationship.

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construct validity of research designs. Because the ostensible goal is to determine the extent to which an individual's drug behaviors influence the amount of crime he or she commits, employing official arrests as the measure of crime threatens the construct validity of such studies. Rather than being a measure of how much an individual *actually* engages in crime, official arrest records measure how often an individual is *discovered* engaging in crime (Chaiken & Chaiken, 1982; Inciardi & Chambers, 1972). Such studies may not actually be examining the relation of drugs to crime but rather to criminal sanction.

Second, studies are typically preoccupied with assessing whether the drugs or the crime come first in a causal chain, or limitation to a single causal variable. This preoccupation causes researchers to ignore the heterogeneity of drug users, who vary greatly along a number of dimensions, including criminality (see Preble & Casey, 1969; Shaffer, Nurco, & Kinlock, 1984). Qualitative studies of addicts readily show that this assumption of homogeneity is incorrect. Rather, there are many types of drug users and drug addicts (Clatts, Welle, Goldsamt, & Lankenau, 2008; Kubiak, Arfken, & Boyd, 2006; Lankenau & Clatts, 2008; Preble & Casey, 1969; Shaffer et al., 1984; Vaddiparti, Bogetto, & Callahan, 2006; Valdez, Kaplan, & Cepeda, 2006).

The third category of weaknesses, related to the second, involves the failure to identify empirical precursors, correlates, possible or plausible determinants, and patterns of criminality, and ignoring such factors in populations of drug users. Whereas single-cause descriptions of the drugs and crime relationship impede research by leading to overly restricted research designs, failing to identify the empirical factors listed above impedes research in as much as they lead to incomplete analytical models. Whereas the former produces errors in causal reasoning, the latter produces errors in statistical conclusions (and both present threats to internal validity).

Fourth, studies fail to apply measures of criminality over time. That is, these studies do not measure crime at multiple points in time to understand how they might change as an individual ages. Research has soundly documented that many individuals alter their patterns of offending through time. Specifically, people tend to "age out" of crime, desisting as they get older (see Blumstein, 1995; Blumstein & Cohen, 1987; Laub & Sampson, 1993, 2001; Nagin & Land, 1993). Therefore, an individual's reduction in drug activity and other forms of crime could both be due to maturation and movement through the individual's life course. To correct for this, Blumstein and Cohen (1987) recommended carefully following individual criminals through time, namely, through longitudinal designs, to collect reliable data that reflect patterns of crime specific to individuals.

The final category of weaknesses involves the use of "captive" samples of drug users, namely, individuals in correctional institutions or drug treatment facilities. The above four deficiencies challenge internal validity as they have the potential to generate inaccurate results as they examine a relationship different from that intended (or only a portion of that intended). The fifth deficiency, the use of captive samples, creates a challenge to external validity. Drawing samples from persons under some form of supervision is an effective way to produce larger sample sizes and give studies greater statistical power. However, those persons under supervision may differ greatly from persons not under such supervision. This

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makes generalizations from results tenuous, if at all possible. In such research designs, conclusions may be accurate within the narrowly defined scope of the particular study, but the ability to extend those results beyond that scope is diminished.

Together, these common weaknesses pose substantial hazards to making the causal argument that an individual's drug offending causes his or her violent offending. When considered in conjunction, the methodological weaknesses pose very real threats to the validity of empirical studies. Although the deficiencies are quite common in the literature, it is in no way implied that every piece of prior research is plagued by all the deficiencies. Indeed, although many studies feature one of them, and some feature more than one, studies with three or more are quite rare in number. However, it is also very difficult to find empirical research that features none of the deficiencies. Because of this, the body of knowledge presented in the literature is incomplete. To bridge the gap between the current state of knowledge and a full understanding of the relationship between drugs and crime, a multitude of studies are necessary. These studies should exhibit none of the common methodological deficiencies, seek to minimize all challenges to validity, and examine the full spectrum of drug activities and other criminal behavior.

The present study is an attempt to fill a small part of the gap. The primacy in criminological and social research of the impact of drugs on violent activity provides a useful point of departure. The literature is far from agreement on the nature of this relationship and even on its existence. In other words, because of weaknesses in research design, we cannot be certain that drug activity is a sufficient condition of violence. It is therefore the intention of the current study to present a research design more conducive to permitting causal inference. A robust data set will be employed to analyze the contribution of drug use and drug selling to violent behavior among a longitudinal panel of high-risk youth. As will be elaborated below, the robustness of the data allows the present study to avoid devotion to single-cause descriptions as well as to account for an extensive variety of correlates and precursors. The longitudinal nature of the data allows for exanimation of the relationship through time. The panel is representative to a general population, rather than being applicable to only incarcerated or institutionalized persons. Finally, because the data contain information gathered from multiple sources (including the participants, parents and guardians, schools, and police), the current study is not reliant solely on official data and can thus remove the bias such reliance creates. No singular empirical study will be capable of resolving all the issues surrounding research in drugs and violence, and it is not suggested that this study will provide the final word on the matter. Rather, it is hoped the current study will be one of many to move us closer to being able to assess causality between drug offending and violent crime.

Method

Data

Data for the current study are drawn from the RYDS, an ongoing longitudinal study of a panel of youth at high risk for violence and delinquency. The RYDS project began in 1988 and selected 1,000 seventh and eighth graders in the Rochester (New York) Public School System to be interviewed, along with a parent or guardian. To date, RYDS has completed 14

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waves of interviews for the panel, reaching participants ages in the early 30s. Data are drawn from Wave 4 through Wave 9, when respondents were between the ages of 14 and 18.[3] The decision to begin at Wave 4 was made for two reasons. First, prior to Wave 4, the questions regarding delinquent offending were not consistent. Second, in the first three waves, the RYDS participants showed very little variation on the measures of delinquency, particularly violence.

The original RYDS sample was stratified on two dimensions to select participants who were at high risk for violence and delinquency. First, males were oversampled (75% vs. 25%) as they are more likely than females to engage in serious and violent offenses (Blumstein et al., 1986; Huizinga, Morse, & Elliott, 1992).[4] Second, students living in areas of the city with high residential arrest rates were also oversampled. This was based on the assumption that adolescents who live in such areas are at greater risk for offending than students living in areas with lower residential arrest rates. High residential arrest areas were identified by assigning each census tract in Rochester a resident arrest rate that reflected the proportion of the tract's total adult population arrested by the Rochester Police Department in 1986.

The participant panel is 68% African American, 17% Hispanic, and 15% White. These proportions are quite close to what was expected given the population characteristics of Rochester schools and the decision to oversample high-risk youth. Participant attrition in the RYDS is quite low when compared with other longitudinal studies. From Waves 2 to 9, we experienced only 1% attrition per year. At Wave 9, 88% (881) of the original 1,000 participants were reinterviewed. A formal test of participant attrition within RYDS revealed that the participants retained did not significantly differ from those not retained on multiple dimensions, including gender, social class, family structure, drug use, delinquency, property crime, and violent crime (see Krohn & Thornberry, 1999).

Measures

In the delinquent offending section of the RYDS interview, the participants were asked about their participation in a wide variety of delinquent and violent activities since the date of the last interview (that is, within the last 6 months). If the participant indicated he or she had committed the offense, the participant was then asked to report how many times he or she had done so. This pattern of questions was consistent from Waves 4 to 9. These questions were used in the creation of the central dependent and independent variables in this study.

This section asked participants about six individual violent offenses. These offenses were as follows: attacking someone with a weapon with the idea of seriously hurting or killing them, hitting someone with the idea of hurting them, being involved in gang or posse fights, throwing objects such as rocks or bottles at people, using a weapon or force to make

[3]It should be noted that for most hard drug users, initiation does not occur until age 20. However, in the RYDS sample specifically, the overwhelming majority (~90%) of drug use is use of marijuana. Use of hard drugs by RYDS participants at any age is low. Furthermore, the delinquency and drug use of participants diminishes rapidly after adolescence. With such little variation on hard drug use in early adulthood, this study is not intended to provide a universal estimate of the effect of drug use on violence. Other studies are of course necessary. The author thanks an anonymous reviewer for raising this point.

[4]The final sample in the current study is 73% male.

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someone give them money or things, and physically hurting or threatening to hurt someone to get them to have sex with them. Between Waves 4 and 9, no participant reported ever engaging in this final offense. Therefore, five violent offenses exhibit some level of variation and are used in creating measures for this study.

Several measures of violence incidence were created. The first such measure is a count of the total number of violent offenses a participant committed during a specific wave. For example, if a participant hit someone twice and attacked someone once during Wave 4, his or her score on this measure would be "3." The second measure is the total number of serious violent offenses committed during a specific wave. This measure is identical to the first violent offense count measure, except that it does not include the offenses of hitting someone to hurt them or throwing an object at people. Furthermore, the study includes a count of the number of times a participant committed each of the five offenses at a specific wave.

Each of these incidence measures has a parallel prevalence measure as well. That is, the study uses a measure that indicates whether or not the participant ever committed violence, serious violence, or a particular violent offense (i.e., one of the offenses listed above) at each wave. These measures were coded "1" if the participant had committed violence, serious violence, or the particular offense, and "0" if he or she had not. The incidence and prevalence measures of violent offending collectively make up the set of dependent variables used in subsequent analyses.[5]

There are two key independent variables in this study. In addition to the violent offenses mentioned above, the delinquency portion of the interview also asked participants to report their drug offenses. Specifically, they were asked whether they had used each of a variety of drugs (including marijuana, cocaine, crack cocaine, heroin, phencyclidine (PCP), hallucinogens such as lysergic acid diethylamide (LSD) or ecstasy, barbiturates or other "downers," amphetamines and methamphetamines, other stimulants or "uppers," and inhalants) since the last interview, and if so, how many times. The participants were also asked whether, since the date of the last interview, they had sold drugs, and if so, which drugs and how many times. From these questions were created the two key independent variables: a count of the total number of times a participant used drugs in a specific wave and a count of the total number of times a participant sold drugs in a specific wave.[6]

Finally, several control variables are employed in the analyses below. The first of these is a dichotomous indicator of a participant's gang membership in a specific wave. It is coded "1" if the participant is a gang member and "0" if the participant is not. Gang membership in the RYDS sample has been shown to be a strong predictor of a participant's violence (see

[5]Variety scores were also created for participants, indicating the number of types of violence or serious violence in which he or she had engaged. The results for these measures were consistent with the results shown below. Full results are not presented in the interest of space.

[6]The author acknowledges that counts are a basic measure of drug offending. For example, using marijuana 20 times is substantively different from using crack cocaine 20 times. However, as previously noted, the incidence of use for drugs other than marijuana in the sample is quite low. The drug use measures herein are consistent with previous measures used in RYDS research. Furthermore, count measures have shown to have remarkably high predictive properties in the RYDS sample (see Krohn, Lizotte, Phillips, Thornberry, & Bell, 2011). The author thanks an anonymous reviewer for raising this issue.

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Thornberry et al., 2003). Although there are multiple methods of assessing whether a participant is in fact a gang member (see Curry, 2000; Curry & Decker, 1998), the method of gang membership assessment used in the RYDS project is self-nomination. In other words, a participant is treated as a gang member if he or she reports being one. This measure has been used and validated in previous research (notably, Thornberry et al., 2003; see also Curry, 2000; Esbensen & Winfree, 2006). The remaining control variables are the participant's race or ethnicity, gender (race and gender are entered as dummy variables), and age at a specific wave.

Analysis

The analytic strategy used in this study is shaped by the goal of making substantial improvements to the common methodological deficiencies of drugs and crime research detailed above. The representative RYDS sample and the longitudinal nature of the project allow the current study to overcome two such deficiencies: reliance on "captive" samples and the inability to follow measures of criminality through time. The measures used herein are created from self-reported items, and thus the study does not rely on official data.[7] The remaining methodological deficiencies revolve around the failure to account for empirical correlates and precursors of drug use and delinquency, and use of the incorrect assumption of a single type of drug user (by focusing on single-cause explanations of drugs and crime) which are both addressed through model specification.

To assess the impact of drug use and drug selling on adolescent violent behaviors, the following structural model is used:

$$Y_{it} = \alpha_0 + \alpha_1 U_{it} + \alpha_2 S_{it} + \alpha_3 G_{it} + \alpha_4 S_{it} \times G_{it} + \alpha_5 A_{it} + \lambda_i + \varepsilon_{it},$$

where i refers to individuals and t refers to time represented by the wave of interview. In the above model, Y_{it} is an individual's violent behavior at time t (recall that multiple violent measures are used), U_{it} is an individual's drug use at a given wave, S_{it} is an individual's drug selling at a given wave, G_{it} is the dichotomous indicator of a participant's gang membership status at a given wave, A_{it} is a participant's age at a given wave, λ_i is an unobserved individual effect (representing time-stable characteristics specific to each individual), and ε_{it} is an individual error term. It is important to simultaneously include U_{it} and S_{it} because drug use and drug selling are markedly different activities, with many individuals engaging in one but not the other. The correlation coefficient between drug use and drug selling in the current sample is only moderate, at .317.

As mentioned above, the level of drug selling by RYDS participants while in a gang is quite high (see Thornberry et al., 2003). Because gang membership and drug selling are hypothesized to affect a participant's violence, the two may combine to produce an

[7]Of course, self-report measures come with their own concerns, most centrally being the concern that the participant provides incorrect information. Self-report measures were developed to overcome the biases in official data (Krohn, Thornberry, Lizotte, Bell, & Phillips, 2011) but are only as good as the information provided by the participant. Formal comparisons of official and self-reported data in the RYDS sample provide evidence of a high degree of truthfulness. For example, 80% of the sample was in agreement when comparing official measures of arrest with self-reported measures (Krohn, Lizotte, et al., 2011) RYDS has also gone to great length to garner the trust of its participants, including confidentiality statements, conducting interviews in private settings, and using laptops to record answers to further ensure privacy.

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additional effect on violence if a participant sells drugs while in a gang. In other words, drug selling and gang membership may each have main effects, but there may also be an interaction effect. To test this hypothesis, the model includes an interaction term, $S_{it} \times G_{it}$.

Two sets of models are estimated with the data, which impose varying assumptions regarding the time-stable unobservables.[8] The first set of models are random-effects models. Random-effects models control for unmeasured heterogeneity in the population, manifested in the time-stable individual effect, λ_i. The individual effect is assumed to be drawn randomly from a normal distribution with a mean of 0 and whose standard deviation is estimated by the model. This assumption makes random-effects estimates statistically efficient. In random-effects models, the individual effect is assumed to be independent of the regressors. In this case, that means the individual effect is assumed to be uncorrelated with drug use and drug selling. For example, a person's temperament (an unobserved individual characteristic) cannot be correlated with his or her drug use or drug selling. When this assumption is violated, the estimates are biased and inefficient. Because random-effects models decompose the individual error term into two components, a time-stable component and a time-varying component, random-effects models control from unmeasured individual differences and can also provide estimates for measuring time-stable individual traits, such as race/ethnicity or gender.

The second set of models are fixed-effects models. In these models, individual-specific means for variables are subtracted from the value at each time period. Because the individual effect, λ_i, does not vary over time, it is swept out of the model by this subtraction. In effect, fixed-effects models control for the individual effect by removing it, even though it is unmeasured or unobserved. Compared with random-effects models, fixed-effects models are less contingent on the assumption that the individual effect is uncorrelated with the regressors (although they are not completely free from this assumption either). Again as an example, a person's temperament cannot be correlated with his or her drug use or selling in fixed-effects models. A chief concern with fixed-effects models is that because they remove the individual effect, they cannot provide estimates for time-stable individual variables, even when measured. For example, because a participant's gender will not change from wave to wave, fixed-effects models cannot estimate the effect of gender on violence. However, that also means fixed-effects models cannot provide an estimate for the regressors of interest, namely, drug use and drug selling, if these never change for an individual.

We can see that the two models offer advantages and disadvantages. But, both models are able to control for population heterogeneity and empirical correlates of drug use and criminality. In this way, the present study is able to improve on prior research. Furthermore, by simultaneously including measures of drug use and drug selling in the model, estimates are generated that assess the impact of one behavior on violent offending *net of the influence of the other*. In other words, covariation between drug use and drug selling is held constant.

[8]Because drug use, drug selling, and violence are rare events in the sample, the estimations are based on Poisson models to correct for highly skewed distributions.

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However, because fixed-effects and random-effects models operate differently, they can produce differing estimates and results. This can leave the researcher with the dilemma of having conclusions depend on whether the fixed-effects or the random-effects estimates are selected. To solve this problem, the Hausman test can be used to determine which estimate is statistically preferred. Both the fixed-effects and random-effects estimates will be provided for each dependent variable below, along with the results of the Hausman test for each coefficient.

Results

Prevalence of violence

We will begin by discussing the results of models predicting the violence prevalence outcomes, the measures indicating whether the participant ever committed the violent offense during a particular wave. These models examine whether drug use, drug selling, and gang membership predict the likelihood a participant will ever be violent. Results from the seven random-effects models are presented in Table 1. Examining the drug use coefficients, one will notice that they are significant (and positive) in all but two models. This proportion (five of seven) is well beyond a chance finding. The random-effects estimates indicate that the more often a participant uses drugs, the higher his or her likelihood of ever committing a violent offense (except hitting someone with the idea of hurting them and being involved in a gang or posse fight). Similarly, the coefficients for drug selling are significant and positive in all seven random-effects models. The more often a participant sells drugs, the higher his or her likelihood of ever committing any violent offense. These findings agree with other studies showing a relationship between drug selling and violence (Fagan & Chin, 1990; Ousey & Lee, 2007; Thornberry et al., 2003). Gang membership is highly significant and positive in all seven models, a finding that is hardly surprising. After all, this variable was included specifically because of its well-known and consistent relationship with violence. This agrees with much prior research (Cook & Laub, 1998; Thornberry et al., 2003; Valdez & Sifaneck, 2006).

It was hypothesized above that there could be an interaction between drug selling and gang membership. That is, gang members who sell drugs could have even higher likelihoods of committing violence. Results in Table 1 show that this is not the case. The interaction term is significant in only one model, attacking someone with a weapon. This finding is not distinguishable from chance. Age is significant in four models, but with three negative coefficients and one positive. This is somewhat ambiguous and will be further discussed after comparing the results to the fixed-effects models. The dummy variable indicating male gender is significant and positive in five models. Being a male raises a participant's likelihood of ever committing serious violence, hitting someone to hurt them, being involved in a gang or posse fight, and throwing an object at people, relative to females. The dummy variable for African American race is a significant predictor of ever committing serious violence and throwing an object at people. The Hispanic dummy is never significant.

Table 2 presents the results from fixed-effects models predicting the prevalence of violent outcomes. These models include the same regressors as the random-effects models, except that they do not include coefficients of the dummy variables for gender and race (recall that

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time-stable covariates are "washed out" of fixed-effects models). These models are somewhat peculiar considering the previous results. The drug use coefficients are significant predictors only of serious violence and throwing an object at people. The drug selling coefficients are significant in only three models: serious violence, attacking someone with a weapon, and throwing an object at people. The gang membership variable is significant in six models, the exception being forcibly taking money from someone. Similar to the findings in the random-effect models, the interaction term for drug selling and gang membership is never significant in the fixed-effects models. Finally, the age variable is significant in five models. The fixed-effect estimate of age does not predict ever attacking someone with a weapon or ever forcibly taking money from someone.

We can see that the results from the random-effects and fixed-effects estimates do not completely agree with each other. As a case in point, the drug use coefficient predicts overall violence in the random-effects model but not in the fixed-effects model. This creates the problem of having to choose between the two to decide whether a coefficient has an effect on the dependent variable. The Hausman test can be conducted to compare the random-effect coefficient with the fixed-effect coefficient and determine which is statistically preferred.[9] The Hausman test was used to select the preferred coefficient for each of the time-varying regressors for each model. Table 3 summarizes the results of this process. Table 3 lists the preferred coefficient for each regressor (either fixed or random). If the preferred coefficient is also significant, it is shown in bold. In this way, we can see a clearer picture of the effect of drug use, drug selling, and the controls on the prevalence of violent offenses.

Table 3 shows that the preferred estimate of drug use is significant in five of seven models. All the preferred coefficients are positive, indicating that as a participant's frequency of drug use rises, so too does his or her likelihood of ever committing a violent offense (except hitting someone or being involved in a gang fight). Likewise, the preferred drug selling coefficient is significant and positive in six models. Thus as a participant's frequency of drug selling rises, so too does his or her likelihood of ever committing a violent offense (except being in a gang fight). Not surprisingly, the preferred gang membership coefficient is always significant. Being a gang member elevates the participant's likelihood of ever committing any violent offense. Unexpectedly, the preferred drug selling and gang membership interaction term is never significant. Selling drugs while in a gang does not raise the likelihood of ever committing violence. The preferred age coefficient is significant in six models as well. However, five of these coefficients are negative (the coefficient predicting ever forcibly taking money is positive). This suggests that as participants grow older, they are less likely to engage in violence.

[9]There is a specification test that can be conducted to adjudicate between random-effects models and fixed-effects model. The test, known as a Durbin-Wu-Hausman test (or more simply, the Hausman test), formalizes the trade-off between efficiency and consistency. The Hausman test is distributed as a standard normal random variable (i.e., it is a *z* test). If this statistic exceeds a threshold such as 1.96, it indicates that the random-effects model is sufficiently inconsistent that the fixed-effects model overcomes its inefficiency. A "large" statistic thus constitutes a rejection of random effects in favor of fixed effects on consistency grounds. However, a "small" statistic means either that the random-effects model is consistent or that fixed-effects model is so inefficient that its consistency advantage is undermined.

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It is clear from these results that using drugs, selling drugs, and being in a gang elevate a participant's likelihood of engaging in violence. However, there is no interaction effect from selling drugs while being in a gang beyond the main effects. In other words, drug selling and gang membership do not combine to raise the likelihood of violence further. Results from the violence incidence measures below will determine whether these same measures can also predict how often the violence will occur.

Incidence of violence

We now consider the models predicting the violence incidence variables,[10] the number of violent acts committed by a particular participant. Whereas the prevalence models above predict whether a participant ever committed a violent act, the incidence models will examine how well drug use, drug selling, and gang membership predict the frequency of violence. Results from the seven random-effects models are shown in Table 4. The effect of drug use on the violent outcomes is significant in only two of seven models. However, the coefficient for drug selling is significant in all seven of the random-effects models. Furthermore, all coefficients are positive in sign, indicating that the more often a participant sells drugs, the more frequently he or she is predicted to commit violent offenses of all sorts. The gang membership coefficient is significant (and positive) in all seven models. Being a gang member unilaterally raises a participant's predicted number of violent offenses.

Substantially different from what we saw in the prevalence models, the interaction term between drug selling and gang membership is significant in five of seven models. However, the signs of the coefficients are not consistent. The interaction term is positive when predicting serious violence and being in a gang or posse fight but negative when predicting attacking someone with a weapon, throwing an object at people, and forcibly taking money from someone. In other words, although selling drugs while in a gang increases a participants' predicted number of serious violent incidents and gang fights, doing so actually *reduces* the predicted number of these last three offenses. Reasons for these findings are discussed below.

Considering the control variables, the coefficients for age, gender, and race are never significant in any of the random-effects models. This suggests that the number of violent offenses (of any sort) a participant commits is not influenced by his or her age, gender, or race.

Table 5 presents the results from the seven fixed-effects models predicting violence incidence. Just like the random-effects models, the drug selling coefficients are significant and positive in all seven fixed-effects models. Different from the random-effects models, the coefficient for drug use is significant in only one of the seven models, hitting someone with the idea of hurting them. This is not distinguishable from chance. There is no evidence indicating that an individual's drug use has an impact on his or her violent offending. Again, the gang membership control is highly salient, being significant in all seven models. Finally,

[10]It is important to mention that because violence is a somewhat rare occurrence, one could take the natural log of the violence incidence measures to produce more reliable estimates. This was done in the current study, and the results were identical to the unlogged measures. Because the logged results are more difficult to interpret, only the unlogged results are presented.

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the control for a participant's age was significant in only two models, serious violence and being involved in gang or posse fights.

The fixed-effects results for the drug selling and gang membership interaction term exactly replicate the random-effects findings. The term is significant and positive when predicting serious violence and being in a gang fight but significant and negative when predicting attacking someone with a weapon, throwing an object at people, and forcibly taking money from someone.

At this point, we can be certain that drug selling and gang membership are predictors of violence, regardless of model selection. For other covariates, results are not as straightforward. To help clarify, a summary table is again created to compare the random-effects estimates with the fixed-effects estimates. The Hausman test was used to select the preferred coefficient for each of the time-varying regressors for each model. Table 6 displays the results of this process.

This summary table shows that drug use is a significant predictor only of general violence and hitting someone with the idea of hurting them. Both of the preferred significant coefficients are positive. Therefore, the participants who have higher levels of drug use are predicted to have higher frequencies of general violence and hitting others. All seven of the preferred drug selling coefficients are significant and positive. Participants with higher frequencies of drug selling have offenses. The preferred coefficient of gang membership is significant in all seven models. Overall, the findings indicate that a participant who is a gang member has a higher predicted frequency of all types of violence. This finding is consistent with past research on gang membership in the RYDS sample (Thornberry et al., 2003) and is in no way unexpected. The preferred coefficient of the drug selling and gang membership interaction term is significant in five models. Selling drugs as a gang member increases a participant's predicted number of serious violence incidents and gang fights. Doing so reduces the participant's predicted number of times he or she attacks someone with a weapon, throws objects at people, and forcibly takes money from someone.

Finally, the preferred coefficient for age is significant in predicting only serious violence. Again, this is probably a chance finding. Net of drug use, drug sales, and gang membership, age is not a key predictor of how often a participant is likely to commit violence. The violence incidence models clearly show that drug selling and gang membership are consistent predictors of the frequency of violence, regardless of model estimation. Drug selling while in a gang predicts several forms of violence, increasing the incidence of some forms whereas decreasing the incidence of others.

Discussion

The current study attempts to make substantial improvements to prior methodological weaknesses in research regarding drugs and violence. To do so, a prospective longitudinal study with a sample representative of the general population was used to gather data on individuals' drug use (again, chiefly marijuana use), drug selling, and participation in a variety of violent behaviors. The longitudinal nature of the data set allows the current study

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to measure criminal offenses at multiple points in time. To allow for more precise estimates of the causal effect of drug use and drug selling on violence, fixed-effects and random-effects Poisson models were used to assess their impact on violence, while controlling for unmeasured person-specific characteristics. By including drug use and drug selling in the models simultaneously, their respective effects were estimated net of the influence of the other. Finally, the study purposefully conceptualized violence in a variety of ways, including incidence and prevalence measures for particular forms of violence as well as aggregates of general violence and serious violence.

The results described above support several conclusions. An individual's frequency of drug selling is a consistent predictor of his or her frequency of violent offending. This finding holds regardless of how one operationalizes violence. Increases in frequency of drug selling predict increases in frequency of general violence, serious violence, and all particular forms of violence included herein. Likewise, drug selling is a strong predictor of an individual's participation in violence. The drug selling coefficient was not a significant predictor only in the case of prevalence of gang fighting. Referring back to Table 2, we can see that the coefficient for gang membership in the model predicting being in a gang fight is substantially larger than any other model. This is rightly so; being a gang member should elevate one's likelihood of being in a gang fight. It is likely that drug selling was not significant in this model because it was overwhelmed by the gang membership regressor. Even so, we can be confident in concluding that increases in an individual's frequency of drug selling increase that individual's violent offending. This conclusion comports with Goldstein's (1985) suggestion that the illicit drug markets are settings where violence is intrinsic, a notion supported widely in the literature (Baumer et al., 1998; Black, 1983; Fagan & Chin, 1990; Ousey & Lee, 2004, 2007).

Selling drugs while in a gang increases the predicted frequency of a participant's serious violence and gang fighting. This is not surprising, given that the correlation between gang membership and drug selling is extremely high, .918. In other words, gang fighting drives the serious violence measure as it is the most common serious violent offense in the data. However, selling drugs while in a gang lowers the predicted number of times a participant will attack someone with a weapon, throw an object at someone to hurt them, and forcibly take money from someone. It has been shown previously that while in a gang, RYDS participants are very active in drug selling (Thornberry et al., 2003). The results here suggest that the participants are so focused on drug selling that they engage in violence only if it relates to their gang (i.e., gang fighting) and forego other forms of violence. That the interaction between drug selling and gang membership never significantly predicts any violence prevalence measures suggests that drug selling while in a gang is not a casual behavior and neither is gang violence rare for such individuals. It is something done often, and therefore, the interaction term does not help to distinguish between participants and nonparticipants in violence.

Drug use is a significant predictor of five of the violence prevalence measures. This proportion is well beyond chance. By contrast, drug use significantly predicts the frequency of only two violent offenses: general violence and hitting someone to hurt them. This is not surprising given that hitting someone to hurt them is a common violent offense. However,

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the coefficients were quite small compared with other regressors. Furthermore, the proportion of significant coefficients (two out of seven) is not much more than chance. Considered as a whole, the models suggest that although increases in the frequency of drug use slightly raise the likelihood that an individual will engage in violence, these increases do not accurately predict how often he or she will offend. In other words, drug use can distinguish participants from nonparticipants in violence, but it cannot predict the offending frequency of the participants. One possible reason for this is the vast majority of drug use in the RYDS sample (>90%) is use of marijuana (most of the rest is cocaine). This particular drug has not shown a pharmacological relationship to violence in the literature (see Brownstein et al., 1991; Goldstein, 1985). That is, the use of marijuana is not thought to make an individual more prone to violence. This study supports this notion.

A word of caution is warranted before proceeding. The reader will recall that the drug use measure contains an overwhelming majority of marijuana use incidents and was a significant predictor of five of the seven violence prevalence outcomes. However, it is not the intention of this article to support the idea that marijuana use is a direct cause of individual violent offending.[11] It is argued that marijuana use is predictive of violence but not in a causal way. After all, the drug use measure did not show a relationship beyond chance with the violence incidence measures. It is possible that in this sample, marijuana use is correlated with any number of unmeasured variables that are causes of this increased likelihood of violence. Drug use, as measured here, can do little to predict how violent a participant is likely to be during adolescence. The drug use measure can then be thought of as an indicator or bellwether of violence, but falls short of a direct causal relationship.

To further test the robustness of the results, the models were reestimated after separating marijuana use from hard drug use incidents. The results were essentially unchanged. The marijuana use measure was significantly related to the same outcomes as the overall drug use measure before. The hard drug use measure showed an insignificant relationship with the outcomes. These measures had high standard errors, suggesting a lack of statistical power. In other words, the hard drug use measures were overpowered by the number of marijuana use incidents. Future research in this area is certainly warranted to better understand how drug use is related to the tendency for violence. Because the results were unchanged, the full models are not shown in the interest of space.

Finally, a note on effect sizes is warranted. The focus of this study was to assess the statistically significant effects of drug use and drug selling on various forms of violence in an attempt to determine the causal nature of individual drug offending on violence. The goal was not to examine how large the hypothesized causal effects may be. However, a careful reader will notice that although significant and consistent, the effects are small. For example, the largest effect of drug selling on violence prevalence (0.016, shown in Table 1) indicates that 1 additional drug sale is predicted to raise the likelihood of attacking someone with a weapon by just above 1%. The gang membership effect in the same model (2.284) is predicted to raise that likelihood by 9.8%. The largest drug selling effect for violence incidence was in the model predicting general violence, at 0.059. It would therefore require

[11]The author thanks an anonymous reviewer for raising these concerns.

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17 additional drug sales to raise the predicted incidence of general violence by one event (0.059 × 17 = 1.003), whereas gang membership increases the predicted number of general violent incidents by six in the same model. Admittedly then, the effects are quite small. What is meaningful is the consistency of the results. Regardless of the conceptualizations of violence, the included controls, or the model specifications, the conclusions hold. The models herein evidence extremely consistent, albeit small, effects.

Although no singular study will be able to resolve all the problems that have plagued research in drugs and violence, this study has aggressively sought to improve on as many as possible. That said, it is important to note the present study's limitations. Most pressing is the inability to be absolutely certain that the drug behaviors preceded the violence. By using a smaller temporal window than most studies of this kind, the problem of establishing temporal order is only reduced. It is by no means mitigated. Future studies would do well to improve on this problem, one of the most significant and persistent in the literature.

A second problem is the lack in variety of drugs used. For all practical purposes, only two substances are present in the RYDS measures of drug use: marijuana and cocaine. To better assess the impact of drug use on violence, future studies should include greater use of substances more likely to elicit violence such as PCP or methamphetamines. In addition, this study uses data drawn from a single city in the United States. Future studies would increase their validity by using data from multiple sites. Similarly, expanding the data to include individuals from other age groups could show that the relationship between drugs and violence varies when comparing adolescents to adults.

It was the intention of this study to improve on prior methodological weaknesses and to assess the impact of drug use and drug selling on violence, in the face of other factors known to contribute to violent offending. As statistical and data collection methods improve, remaining weaknesses can be overcome. The current study is offered as a step in the right direction. The relationship between drug offending and violence is highly contextual, dependent on many situational factors. The effects estimated above therefore are not put forth as mathematical or universal constants. Rather, the consistency of the results are used to argue that drug offending, particularly drug selling, is one of many direct causes of violence within individuals. Other studies that vary the scope conditions and situational contexts are necessary. This study is not the final word but is instead hoped to be among the first of many studies that improve methodological rigor in this area.

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Biography

Matthew D. Phillips is a doctoral candidate at the University at Albany and currently works as a research analyst for the Rochester Youth Development Study. His doctoral dissertation focuses on adolescent drug use and drug selling, and their consequences later in the life course. He is primarily interested in drug offending, violence, drug trafficking, causal analysis, and quantitative methods.

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Table 1

The Impact of Drug Use and Selling on the Prevalence of Violence, Waves 4 to 9, Random-Effects Models

	Violence	Serious violence	Attack with a weapon	Hit someone to hurt them	Gang or posse fight	Throw object	Forcibly take money
Drug use	0.008*** (0.002)	0.007** (0.002)	0.004* (0.001)	0.002 (0.001)	0.001 (0.002)	0.006** (0.002)	0.005* (0.002)
Drug selling	0.011*** (0.003)	0.015*** (0.003)	0.016*** (0.003)	0.006** (0.002)	0.009** (0.004)	0.008* (0.003)	0.016*** (0.004)
Gang member	2.888*** (0.201)	4.264*** (0.207)	2.284*** (0.223)	1.522*** (0.170)	5.058*** (0.253)	2.372*** (0.211)	1.942** (0.607)
Drug sell × Gang	−0.008 (0.008)	−0.007 (0.008)	−0.014* (0.006)	0.001 (0.005)	0.004 (0.008)	−0.010 (0.007)	−0.021 (0.013)
Age	−0.107* (0.043)	−0.025 (0.066)	0.121 (0.078)	−0.048 (0.043)	−0.185* (0.087)	−0.201** (0.073)	0.523* (0.233)
Male	0.673*** (0.170)	0.768*** (0.220)	0.502 (0.261)	0.566** (0.165)	1.047** (0.303)	0.502* (0.241)	1.726 (1.102)
African American	0.330 (0.211)	0.642* (0.269)	0.735 (0.348)	0.076 (0.201)	0.498 (0.332)	1.068** (0.341)	0.571 (0.875)
Hispanic	0.052 (0.260)	0.398 (0.321)	0.448 (0.410)	−0.238 (0.250)	0.269 (0.396)	0.654 (0.402)	−0.270 (1.135)
(Constant)	−0.806 (0.736)	−4.288*** (1.103)	−7.369*** (1.355)	1.771* (0.733)	−2.665 (1.428)	−2.060 (1.229)	−17.937*** (4.240)
Model χ^2	274.42	488.22	167.17	122.17	420.99	171.76	49.17

*$p < .05$.

**$p < .01$.

***$p < .001$.

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Table 2

The Impact of Drug Use and Selling on the Prevalence of Violence, Waves 4 to 9, Fixed-Effects Models

	Violence	Serious violence	Attack with a weapon	Hit someone to hurt them	Gang or posse fight	Throw object	Forcibly take money
Drug use	0.003 (0.002)	0.005* (0.002)	0.003 (0.001)	0.001 (0.001)	0.002 (0.003)	0.006* (0.003)	0.009 (0.008)
Drug selling	0.005 (0.003)	0.010*** (0.003)	0.012*** (0.003)	0.002 (0.002)	0.005 (0.004)	0.007* (0.004)	0.015 (0.008)
Gang member	1.891*** (0.204)	2.855*** (0.242)	1.171*** (0.262)	0.829*** (0.177)	3.558*** (0.331)	1.368*** (0.248)	0.764 (0.874)
Drug sell × Gang	−0.001 (0.008)	−0.002 (0.008)	−0.004 (0.007)	0.013 (0.007)	0.006 (0.010)	−0.008 (0.009)	0.111 (0.102)
Age	−0.205*** (0.049)	−0.317*** (0.083)	−0.114 (0.097)	−0.123* (0.049)	−0.638*** (0.117)	−0.420*** (0.091)	0.582 (0.376)
Model χ^2	156.97	288.60	44.59	45.39	328.14	75.38	16.11

* $p < .05$.

** $p < .01$.

*** $p < .001$.

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Table 3

Summary Table of Results From Hausman Tests for the Violence Prevalence Outcomes

	Violence	Serious violence	Attack with a weapon	Hit someone to hurt them	Gang or posse fight	Throw object	Forcibly take money	Consistent and significant?
Drug use	**Random**	**Random**	**Random**	Random	Random	**Random**	**Random**	5 / 7
Drug selling	**Random**	**Random**	**Random**	**Random**	Fixed	**Random**	**Random**	6 / 7
Gang member	**Fixed**	**Fixed**	**Fixed**	**Fixed**	**Fixed**	**Fixed**	**Random**	7 / 7
Drug sell × Gang	Random	Fixed	Fixed	Fixed	Random	Random	Random	0 / 7
Age	**Fixed**	**Fixed**	Fixed	**Fixed**	**Fixed**	**Fixed**	**Random**	6 / 7

Note: Bold indicates the coefficient is significant at the $p < .05$ level.

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Table 4

The Impact of Drug Use and Selling on the Incidence of Violence, Waves 4 to 9, Random-Effects Models

	Violence	Serious violence	Attack with a weapon	Hit someone to hurt them	Gang or posse fight	Throw object	Forcibly take money
Drug use	0.006* (0.003)	0.001 (0.001)	−0.000 (0.000)	0.004** (0.002)	0.001 (0.001)	0.001 (0.001)	0.000 (0.000)
Drug selling	0.059*** (0.006)	0.026*** (0.002)	0.015*** (0.001)	0.018*** (0.003)	0.008*** (0.002)	0.013*** (0.002)	0.003*** (0.000)
Gang member	6.242*** (0.379)	3.324*** (0.163)	0.389*** (0.059)	2.151*** (0.215)	2.780*** (0.137)	0.832*** (0.128)	0.138*** (0.028)
Drug sell × Gang	−0.003 (0.013)	0.019*** (0.005)	−0.013*** (0.002)	−0.004 (0.007)	0.037*** (0.005)	−0.017*** (0.005)	−0.005*** (0.001)
Age	−0.053 (0.077)	−0.034 (0.033)	0.008 (0.012)	−0.020 (0.043)	−0.045 (0.028)	0.015 (0.026)	0.004 (0.006)
Male	0.331 (0.244)	0.107 (0.095)	0.038 (0.035)	0.130 (0.146)	0.058 (0.079)	0.091 (0.074)	0.012 (0.015)
African American	0.396 (0.309)	0.187 (0.120)	0.055 (0.045)	0.081 (0.185)	0.117 (0.100)	0.125 (0.093)	0.016 (0.019)
Hispanic	−0.048 (0.380)	0.067 (0.148)	0.022 (0.055)	−0.182 (0.228)	0.052 (0.123)	0.062 (0.115)	−0.007 (0.024)
(Constant)	1.395 (1.306)	0.685 (0.555)	−0.107 (0.202)	0.733 (0.747)	0.843 (0.466)	−0.242 (0.432)	−0.066 (0.095)
R^2	0.09	0.13	0.07	0.04	0.11	0.02	0.02

*$p < .05$.

**$p < .01$.

***$p < .001$.

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Table 5

The Impact of Drug Use and Selling on the Incidence of Violence, Waves 4 to 9, Fixed-Effects Models

	Violence	Serious violence	Attack with a weapon	Hit someone to hurt them	Gang or posse fight	Throw object	Forcibly take money
Drug use	0.004 (0.003)	−0.000 (0.001)	−0.000 (0.000)	0.004* (0.002)	−0.001 (0.001)	0.001 (0.001)	0.000 (0.000)
Drug selling	0.061*** (0.007)	0.028*** (0.003)	0.015*** (0.001)	0.017*** (0.003)	0.011*** (0.002)	0.014*** (0.002)	0.003*** (0.001)
Gang member	5.800*** (0.452)	3.099*** (0.204)	0.144* (0.072)	2.092*** (0.252)	2.816*** (0.173)	0.597*** (0.159)	0.137*** (0.037)
Drug sell × Gang	0.001 (0.014)	0.020** (0.006)	−0.010*** (0.002)	0.001 (0.008)	0.035*** (0.005)	−0.018*** (0.005)	−0.004*** (0.001)
Age	−0.170 (0.094)	−0.104* (0.042)	−0.005 (0.015)	−0.056 (0.052)	−0.110** (0.036)	−0.009 (0.033)	0.011 (0.008)
(Constant)	3.854* (1.570)	2.077* (0.708)	0.174 (0.253)	1.444 (0.876)	2.064** (0.601)	0.325 (0.554)	−0.160 (0.128)
R^2	0.08	0.12	0.06	0.04	0.11	0.02	0.02

*$p < .05$.

**$p < .01$.

***$p < .001$.

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Table 6

Summary Table of Results From Hausman Tests for Violence Incidence Outcomes

	Violence	Serious violence	Attack with a weapon	Hit some-one to hurt them	Gang or posse fight	Throw object	Forcibly take money	Consistent and significant?
Drug use	**Random**	Random	Random	**Random**	Fixed	Random	Random	2 / 7
Drug selling	**Random**	**Fixed**	**Random**	**Random**	**Fixed**	**Random**	**Random**	7 / 7
Gang member	**Fixed**	**Random**	**Fixed**	**Random**	**Random**	**Fixed**	**Random**	7 / 7
Drug sell × Gang	Random	**Random**	**Fixed**	Random	**Random**	**Random**	**Random**	5 / 7
Age	Fixed	**Fixed**	Random	Random	Fixed	Random	Random	1 / 7

Note: Bold indicates the coefficient is significant at the $p < .05$ level.