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12 Does Drug Use Cause Poverty?

Robert Kaestner

12.1 Introduction

To a majority of Americans, illicit drug use and poverty go hand in hand. Poverty is concentrated in inner-city neighborhoods that are also characterized by high rates of drug use and drug-dealing activity. Similarly, the homeless population primarily found in cities consists of a high proportion of drug users. On a more personal level, drug use of acquaintances, friends, and family members often becomes known only at a time of crisis when the drug-using individual has experienced some type of significant personal setback, often characterized by a worsening economic position. Thus, the public has a significant amount of empirical evidence, some anecdotal and some systematic, that links drug use and poverty. Furthermore, based on the public's support and willingness to pay for antidrug programs, it would appear that there is a widespread belief that drug use causes many negative social and economic outcomes, including poverty.

An important contribution of social science is to validate or refute conventional wisdom. In this case, the relevant question is whether drug use really does cause poverty. There has been a substantial amount of prior research on this issue, although not always directly focused on poverty.[1] For example, there have been several studies of the effects of drug use on various determinants of poverty: wages, labor supply, marital status, out-of-wedlock birth, and welfare participation. Surprisingly, these studies have presented only limited evidence suggesting that drug use is a cause of poverty. For example, past research has

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1. Only one previous paper that I am aware of directly examines the effect of drug use on poverty. Kaestner (1996a) examines the effect of drug use on receipt of Aid to Families with Dependent Children (AFDC) benefits.

shown that drug use has relatively few adverse effects on wages and employment, two major determinants of poverty.[2] In contrast, studies examining the effect of drug use on family composition and fertility document strong positive associations between drug use and marital delay, marital dissolution, and out-of-wedlock birth.[3] Thus, the question of whether drug use causes poverty is unresolved, and it remains an important public policy issue. Indeed, the government spends considerable sums of money to eradicate drug use, and part of the justification for that spending is the supposedly adverse effects of drug use on economic well-being.[4]

The purpose of this paper is to directly examine the effect of drug use on poverty, as opposed to the effect of drug use on the determinants of poverty. The main objective of the paper is to provide descriptive empirical information about the relationship between drug use and poverty, and to explore, in a preliminary fashion, the question of whether drug use causes poverty. Toward this end, I present the results of both descriptive and multivariate analyses of the relationship between drug use and poverty for two national samples of young adults. One sample is drawn from the National Household Survey of Drug Abuse (NHSDA); the other is from the National Longitudinal Survey of Youth (NLSY). The results of the analysis indicate that for both samples, drug use is associated with greater poverty.

12.2 Pathways of Influence

Figure 12.1 provides a simple overview of the various ways that drug use may affect poverty. In figure 12.1, poverty is primarily determined by labor market outcomes, but it is also affected by family composition. Family composition affects poverty by altering family size, and sources and quantity of nonearned income. Labor market outcomes are determined by a person's human capital, which in this case is summarized by a person's level of education and other human capital investments (e.g., training and health). Labor market outcomes may also be affected by family composition. For example, single parents may not be able to work as many hours as childless individuals.[5] Drug use and poverty are related because drug use affects the determinants of poverty: education, human capital investments, marriage, and fertility. Finally, person-

2. See for example Kaestner (1991, 1994a, 1994b), Gill and Michaels (1992), Register and Williams (1992), Kandel and Davies (1990), and Kandel, Chen, and Gill (1995).

3. See Kaestner (1996b, 1997), Yamaguchi and Kandel (1985, 1987), Mensch and Kandel (1992), and Elliot and Morse (1989).

4. For example, in 1995, the federal government spent $13.2 billion on drug control programs (National Criminal Justice Reference Service 1997). The most recent data on state government spending is 1991, and in that year state governments spent $15.9 billion on drug control programs. Approximately half of all federal spending, and 75 percent of all state spending, on drug control is related to the criminal justice system.

5. In addition to constraints on labor supply, family composition may affect wage rates. See Korenman and Neumark (1991, 1992) for an analysis of this issue.

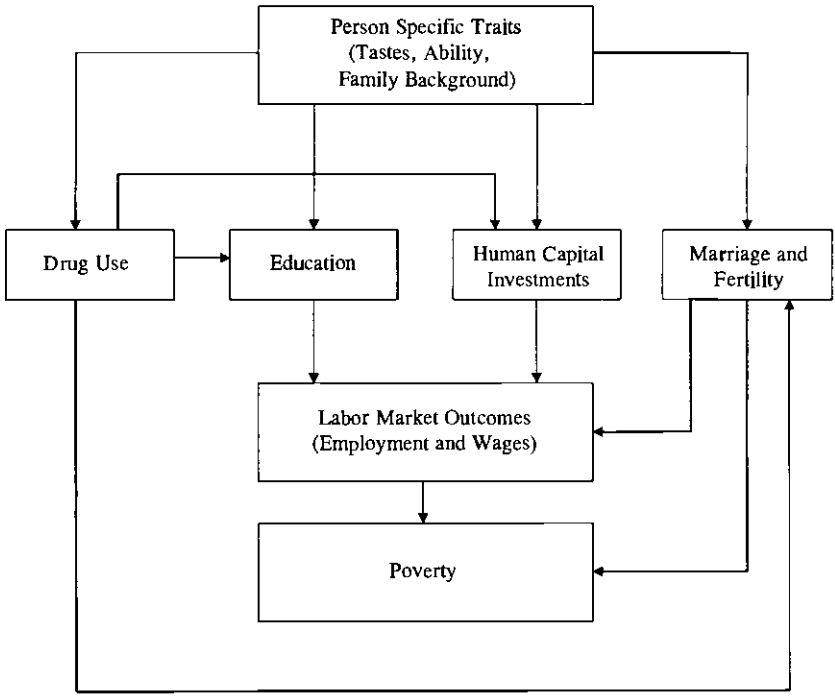

Fig. 12.1 A simple behavioral model of drug use and poverty

specific factors such as ability, preferences, and family background affect drug use, as well as educational achievement, skill accumulation, marriage, and fertility.

For the most part, the implied relationships in figure 12.1 are obvious and consistent with intuition, the prime example of this statement being the effect of drug use on human capital. The physiological effects of drug use, particularly those related to chronic drug use, suggests that drug use is expected to result in a reduction of physical and cognitive abilities. Consequently, drug use is expected to lower productivity, reduce earnings, and result in an increased likelihood of poverty. Similarly, drug use may adversely affect educational achievement, or attainment, and hence lower earnings and increase poverty. Somewhat less obvious, however, are the ways in which drug use may affect poverty through its effect on marriage and fertility.[6] There are several reasons why drug use may affect marriage and fertility. Drug use may affect a person's ability to use contraception, or their judgment related to contraception use, and lead to more out-of-wedlock births. Or drug use may cause more marital strife

6. For a more thorough discussion of the effects of drug use on marriage and fertility see Kaestner (1995, 1996b, 1997) and Yamaguchi and Kandel (1985).

and lead to marital dissolution. Finally, drug use may affect the likelihood of finding a spouse because of preferences (e.g., stigma) regarding persons who use drugs. All of these potential consequences of drug use would tend to increase poverty.

The relationship between drug use and poverty portrayed in figure 12.1 provides a simple guide for an empirical analysis of this issue. For example, most prior research on the effects of drug use on economic well-being has focused on the link between drug use and labor market outcomes (e.g., wages and employment). In most cases, these studies have held family composition, education, and other observed components of human capital constant and, as a result, obtained estimates of the effect of drug use on labor market outcomes that work through unobserved determinants of human capital.[7] Since many of these analyses incorporate a relatively extensive set of human capital determinants, there may be little role left for drug use to play once these factors have been held constant. An alternative strategy that is currently pursued is to estimate the reduced-form effect of drug use on poverty. The reduced-form estimate of the effect of drug use is obtained by omitting education and the other determinants of poverty from the multivariate empirical analysis. The reduced-form estimate measures the total effect of drug use on poverty that works through all of the determinants of poverty.

Figure 12.1 also illustrates the important part that ability, preferences, and family background may have in determining both poverty and drug use. For example, a person with a high rate of time preference is more likely to use drugs, make fewer human capital investments, and experience more poverty than would an otherwise similar person with a lower rate of time preference. Thus, it is important to control for these factors if the objective is to estimate a causal effect of drug use on poverty.

There are two issues that figure 12.1 ignores. The first is that poverty may cause drug use. This possibility is most relevant if poverty is primarily a demand-determined phenomenon where opportunities for work and pay are limited.[8] In these circumstances, drug use may be encouraged by the absence of significant positive returns on human capital investments. Drug use may adversely affect human capital development and, as a result, income. Therefore, in addition to the direct monetary cost of drugs, there is another cost of drug use that is associated with a diminished level of human capital and lower earnings. In areas where there is limited economic opportunity and relatively low returns on human capital investment, the full price of drugs is low, and as a result, drug use is more likely to occur. In this case, a lack of economic

7. Kaestner (1991) and Gill and Michaels (1992) estimate switching regression models. In these models, the drug use may affect the return to a given level of human capital, or to marriage, but this specification still ignores the effect of drug use on the level of human capital determinants (e.g., education).

8. This previous discussion ignores the effect of income on drug consumption. Depending on whether drug use is a normal or inferior good, income will either be positively or negatively correlated with drug use. In either case, the direction of causality is from income (poverty) to drug use. I assume that the income effect is small.

opportunity has caused both poverty and drug use. One way to address this issue is to include measures of economic opportunity (demand-side factors) in the multivariate empirical analysis.

A second issue obscured by figure 12.1 is the possible reverse causality among the determinants of labor market outcomes (e.g., education) and drug use. As presented, figure 12.1 implies that drug use affects education, human capital investments, marriage, and fertility. It is possible, however, that these factors affect drug use. This point is important, because it affects the specification of the reduced-form model and the interpretation of the reduced-form estimate of the effect of drug use on poverty. For example, if marital status causes drug use and poverty, then the reduced-form model should include marital status. If marital status is incorrectly omitted from the reduced-form model, the estimated effect of drug use is capturing not only the effect of drug use but also some of the effect of marital status on poverty.

One piece of evidence supporting the causal model of figure 12.1 is that initiation of drug use usually occurs prior to marriage, child bearing, and many human capital investments. For example, among those who report some prior marijuana use, 75 percent had first used marijuana by age 18, and 95 percent had first used marijuana by age 21. For cocaine, the age of initiation is somewhat higher, but even in this case, 50 percent of all individuals reporting some prior use also report that they had first used cocaine by age 19; and 75 percent of this group report first using cocaine by age 22. All of these figures come from the 1994 NHSDA and pertain to a sample of adults between the ages of 18 and 40. These relatively early ages of initiation are consistent with the specification of the causal model in figure 12.1. Patterns of drug use and risk of drug use are established at relatively early ages, prior to the time of most investments in human capital and before marriage. Moreover, models of rational addiction such as that of Becker and Murphy (1988) would suggest that drug users are forward looking, and that these early consumption choices establish a pattern of use that should be little affected by planned investments in education and human capital. Indeed, early consumption choices are made with full knowledge regarding expected future choices of drug use, education, marriage, fertility, and other human capital investments.

There is also some prior empirical evidence that is consistent with the specification of the causal model in figure 12.1. In earlier work (Kaestner 1995), I explicitly tested for the endogeneity of drug use in an analysis of the effect of drug use on family formation and dissolution. I found little evidence that marital choices significantly affect drug use, but strong evidence that drug use affects marital choices. For other variables of interest, there is relatively little past empirical work investigating the causal relationships specified in figure 12.1.[9]

9. The causality issue has been examined in regard to drug use and labor market outcomes, in particular wages and labor supply (Kaestner 1991, 1994a, 1994b; Gill and Michaels 1992; Register and Williams 1992). Currently, however, interest is focused on the causal relationships between drug use and the determinants of labor market outcomes.

In summary, past research examining the relationship between drug use and poverty has focused on the effect of drug use on the determinants of poverty as opposed to poverty itself. In econometric terms, these studies have attempted to estimate the structural parameters associated with figure 12.1. One problem with this approach is that any individual link, or structural relationship, between drug use and poverty may be relatively weak. Therefore, estimates of individual structural parameters may not be significant and may lead to the potentially misleading conclusion that drug use does not affect poverty. The effect of drug use on poverty may be diffuse, however, and apparent only when its total effect is examined. Accordingly, I focus on estimating the reduced-form model and on obtaining the reduced-form estimate of the effect of drug use on poverty. The reduced-form estimate measures the total effect of drug use on poverty.

12.3 Econometric Strategy

The objective of the empirical analysis is to estimate the reduced-form model of poverty. Based on the assumptions underlying figure 12.1, the reduced-form model may be written as

$$\begin{aligned} \text{POVERTY}_{it} &= \alpha_0 + \alpha_1 \text{AGE}_{it} + \alpha_2 \text{RACE}_i + \alpha_3 \text{FAMILY}_i \\ &\quad + \alpha_4 \text{DEMAND}_{it} + \alpha_5 \text{DRUGS}_{it} + \varepsilon_{it}. \end{aligned} \tag{1}$$

In equation (1), person i's poverty status in year t is a function of his or her age, race, family background, local economic conditions (i.e., demand factors), and drug use. If the causal relationships in figure 12.1 are correct, the coefficient on drug use measures the total effect of drug use on poverty. It is the sum of the indirect effects of drug use on poverty that works through education, marriage and fertility, and investments in human capital.

To gain insight into the particular ways that drug use affects poverty, equation (1) can be expanded to include some of the determinants of labor market outcomes and poverty. For example, education could be added to the model. In this case, the coefficient on drug use measures the total effect of drug use on poverty net of any indirect effect of drug use on poverty that works through education. Taking the difference of the two estimates yields an estimate of the effect of drug use on poverty that works through education. A similar methodology may be used for other determinants of poverty. The end result of this process is the identification of several of the structural parameters plus the reduced-form estimate.

12.4 Empirical Results

12.4.1 Data and Descriptive Analysis

The National Household Survey of Drug Abuse

I use two data sets in the empirical analysis: the 1994 National Household Survey of Drug Abuse (NHSDA), and the National Longitudinal Survey of Youth (NLSY). The first survey I will discuss is the 1994 NHSDA. The 1994 NHSDA is the 14th of a series of surveys intended to measure the prevalence and correlates of drug use in the United States. It is a national sample of the noninstitutionalized population, and it contains extensive information on drug use, as well as economic and demographic information about the respondents.[10] For the purposes of this study, I limit the sample to adults between the ages of 18 and 40. This subset of the adult population has had the most exposure to drug use during their lives, and they have the highest rates of drug use. Older adults grew up during periods when drug use was less widespread, and have relatively low rates of use. I also limit the focus of the study to two drugs: marijuana and cocaine. These two drugs are the most frequently used illicit substances, and rates of use of other illicit drugs are so low that they result in sample sizes that prevent meaningful analysis.

Tables 12.1 and 12.2 present sample means by drug use for the 1994 NHSDA. Table 12.1 presents data for the female sample, and table 12.2 contains information related to males. Focusing first on drug use, the data in table 12.1 show that among females, 15 percent report some prior cocaine use, but only 3 percent report past-year use. The prevalence of marijuana use among females is much higher than the prevalence of cocaine use: 43 percent of females report some prior marijuana use, and 12 percent report past-year use. In general, males have higher rates of drug use than females, as can be seen in table 12.2. Among males, 23 percent of the sample report prior use of cocaine, and 52 percent report prior use of marijuana. In regard to past-year use, 7 percent of the male sample reports past-year cocaine use, and 21 percent report past-year marijuana use.

One point to note about the drug use figures is the systematic, almost mechanical, relationship between age and drug use. Past-year drug users tend to be younger than persons who did not use drugs in the past year. This fact reflects the pattern of initiation of drug use since young adults are the persons most likely to be starting drug use and to be observed to have used drugs in the past year. Thus, the group of past-year drug users contains a mixture of new users and chronic users, and this heterogeneity among users needs to be addressed in the multivariate analysis that is presented later. Similarly, heavy drug users, as measured by lifetime frequency of use, tend to be older than nonusers

10. The NHSDA oversamples both blacks and Hispanics. Sampling weights have not been used in any of the analyses in this paper since I control for race and ethnicity in the multivariate analyses.

Table 12.1 **Incidence of Poverty and Receipt of Public Assistance by Drug Use, Females 18–40, 1994 National Household Survey on Drug Abuse**

Drug Use	*N* (%)	Family Income < $12,000	Receive Food Stamps	Receive Public Assistance	Age	Black	Hispanic	Education	Married	Never Married	Children < 12	Poor Health	Drinks per Month
Lifetime cocaine use													
None	4,924 (85)	0.22	0.24	0.16	28.17	0.26	0.27	12.43	0.46	0.41	1.20	0.08	6.43
1–11 times	518 (9)	0.15	0.23	0.16	29.05	0.16	0.14	13.07	0.45	0.37	1.08	0.09	16.25
12 or more times	365 (6)	0.24	0.32	0.22	30.36	0.22	0.15	12.48	0.43	0.32	1.27	0.14	26.20
Past-year cocaine use													
None	5,651 (97)	0.21	0.24	0.16	28.38	0.25	0.25	12.50	0.46	0.40	1.20	0.08	7.78
1 or more times	156 (3)	0.38	0.44	0.31	28.44	0.32	0.20	12.22	0.21	0.51	1.14	0.19	39.04
Lifetime marijuana use													
None	3,315 (57)	0.24	0.25	0.16	28.10	0.28	0.33	12.24	0.45	0.42	1.23	0.09	4.15
1–11 times	1,312 (23)	0.19	0.24	0.16	28.21	0.22	0.16	12.90	0.46	0.39	1.15	0.08	11.24
12–99 times	592 (10)	0.16	0.21	0.14	29.14	0.20	0.13	13.08	0.48	0.38	1.08	0.08	14.84
100 or more times	588 (10)	0.22	0.31	0.21	29.63	0.21	0.12	12.42	0.42	0.37	1.23	0.12	21.10
Past-year marijuana use													
None	5,129 (88)	0.21	0.24	0.15	28.71	0.25	0.26	12.49	0.48	0.38	1.23	0.08	6.41
1–5 times	290 (5)	0.27	0.24	0.19	25.58	0.22	0.20	12.86	0.29	0.58	0.83	0.11	17.90
6 or more times	388 (7)	0.30	0.38	0.27	26.23	0.30	0.14	12.26	0.25	0.58	1.04	0.11	31.11

Table 12.2 **Incidence of Poverty and Receipt of Public Assistance by Drug Use, Males 18–40, 1994 National Household Survey on Drug Abuse**

Drug Use	*N* (%)	Family Income < $12,000	Receive Food Stamps	Receive Public Assistance	Age	Black	Hispanic	Education	Married	Never Married	Children < 12	Poor Health	Drinks per Month
Lifetime cocaine use													
None	3,464 (77)	0.16	0.11	0.03	27.53	0.20	0.31	12.32	0.41	0.52	0.81	0.06	22.55
1–11 times	543 (12)	0.13	0.12	0.03	28.53	0.12	0.25	12.75	0.39	0.48	0.72	0.09	46.75
12 or more times	503 (11)	0.16	0.17	0.04	30.10	0.17	0.24	12.16	0.41	0.45	0.78	0.10	50.40
Past-year cocaine use													
None	4,209 (93)	0.15	0.11	0.03	27.97	0.18	0.29	12.40	0.42	0.50	0.80	0.06	26.07
1 or more times	301 (7)	0.22	0.23	0.06	27.38	0.25	0.32	11.62	0.25	0.63	0.69	0.14	65.96
Lifetime marijuana use													
None	2,150 (48)	0.16	0.12	0.03	27.39	0.20	0.38	12.10	0.42	0.52	0.83	0.06	18.19
1–11 times	891 (20)	0.14	0.11	0.02	27.83	0.18	0.24	12.61	0.42	0.50	0.79	0.06	31.21
12–99 times	567 (13)	0.12	0.09	0.03	28.57	0.18	0.18	13.06	0.42	0.48	0.74	0.05	32.53
100 or more times	902 (20)	0.18	0.15	0.05	28.93	0.19	0.21	12.25	0.38	0.49	0.74	0.09	48.04
Past-year marijuana use													
None	3,559 (79)	0.14	0.11	0.03	28.40	0.18	0.32	12.36	0.46	0.46	0.86	0.06	20.94
1–5 times	293 (6)	0.19	0.12	0.01	26.28	0.21	0.23	12.60	0.22	0.65	0.58	0.07	48.88
6 or more times	658 (15)	0.21	0.15	0.04	26.14	0.25	0.20	12.20	0.23	0.68	0.55	0.09	61.80

and moderate users. Again, there is a somewhat mechanical relationship between age and a lifetime measure of drug use. It is not necessarily the case, however, that respondents who report heavy drug use are more involved in drugs than those who report less drug use. Given the crudeness with which drug use is measured, there is considerable heterogeneity among drug users in a given category of drug use. For example, a 40-year-old respondent may have used marijuana once a month for five years when in his or her 20s, but may not have used marijuana since that time. He or she would still be classified as a moderate marijuana user, as would a 25-year-old who used marijuana weekly for the past year. Empirically, it is important to consider the respondent's age and timing of use, as well as the total frequency of use, when examining the effects of drug use on poverty.

Tables 12.1 and 12.2 also present indicators of poverty by drug use. Three indicators of poverty are examined: (i) whether the respondent's family income in the past 12 months was less than $12,000; (ii) whether anyone in the respondent's household received food stamps in the past 12 months, and (iii) whether anyone in the respondent's household received public assistance in the past 12 months. The $12,000 family income figure was chosen because that was approximately the federal poverty threshold for a family of three in 1994, and it corresponded to one of the income intervals reported in the 1994 NHSDA. The data in tables 12.1 and 12.2 do indicate a systematic relationship between drug use and poverty. In general, greater involvement in drug use is positively correlated with poverty. In regard to measures of lifetime drug use, there appears to be a U-shaped relationship between drug use and poverty. Those who have never used drugs tend to have higher rates of poverty than those with relatively moderate drug use, but those with relatively heavy use have the highest rates of poverty. For past-year use, the relationship between drug use and poverty is more linear: Past-year users have higher rates of poverty than nonusers, and greater levels of past-year use are associated with higher poverty rates.

The descriptive numbers in tables 12.1 and 12.2 provide preliminary evidence that drug use and poverty are significantly related. However, it is important to note that there are other differences among drug users (e.g., users versus nonusers) besides rates of poverty. As shown in tables 12.1 and 12.2, drug users differ from nonusers along several dimensions. For example, past-year drug users are much more likely to be never married and tend to be younger than nonusers. Similarly, black and Hispanic respondents have lower levels of lifetime drug use than other racial/ethnic groups. Finally, drug users tend to be in worse health and to consume more alcohol than nonusers. All of these noted differences, along with other differences between drug users and nonusers illustrated in tables 12.1 and 12.2, may confound or mediate the simple relationship between drug use and poverty. This suggests the need for a multivariate analysis that can control in a systematic way for the effects of confounding and mediating influences.

The National Longitudinal Survey of Youth

The second data source is the National Longitudinal Survey of Youth (NLSY). The NLSY is a national sample of youths that were 14 to 21 years of age in 1979.[11] Each year, beginning in 1979, these individuals have been interviewed about a variety of subjects, including their employment experiences, marital and fertility decisions, and educational attainment. In addition to this information, a variety of family background data was obtained about each respondent, and several psychological and cognitive achievement tests were administered. The retention rate is extremely high for surveys of this type, and was approximately 90 percent as of 1993 (Center for Human Resource Research 1994).

Most important to the current study is the information contained in the NLSY about drug use. In 1984, 1988, and 1992, the NLSY gathered information about a respondent's lifetime and current use of marijuana and cocaine. The NLSY also contains detailed information about an individual's personal and family income and participation in the AFDC and food stamps programs. Thus, the NLSY is well suited to study the issue of drug use and poverty. In 1988, the year around which I focus the empirical analysis, respondents are between the ages of 23 and 32.

Tables 12.3 and 12.4 present descriptive statistics for the NLSY sample by drug use. Its presentation is similar to that in tables 12.1 and 12.2. Drug use in tables 12.3 and 12.4 refers to past drug use at the time of the 1988 interview. I chose 1988 as the year around which to center the analysis, because I wanted to exploit the longitudinal data available in the NLSY. In particular, I wanted to examine the effect of past drug use on future poverty. This empirical strategy reduces potential problems associated with the direction of causality between drug use and poverty.

Reported drug use in the NLSY is similar, but somewhat lower, than that reported in the 1994 NHSDA. This may reflect three things: (i) differences in the age and other characteristics of the samples, (ii) differences in the years of analysis, and (iii) differences in the accuracy of drug use reporting in the two surveys. Differences in the years of analysis are probably not the reason for the reported differences in drug use. If anything, the use of 1988 as opposed to a later year would lead to greater reported drug use in the NLSY than in the NHSDA because the overall prevalence of drug use was higher in 1988 than in 1994.[12] Therefore, the differences must be due to other reasons. To examine whether the differences in reported drug use were due to the different age of

11. The NLSY oversamples blacks, Hispanics, and low-income whites. Sampling weights have not been used in the analysis. The multivariate analysis controls for race and ethnicity, and the low-income subsample was not used in the analysis.

12. Higher rates of drug use in 1988 as compared to 1994 are found in all time-series surveys of drug use. See Johnston, O'Malley, and Bachman (1994) and NIDA (1995).

Table 12.3 **Incidence of Poverty and Receipt of Public Assistance by Drug Use, Females 23–32, 1988 National Longitudinal Survey of Youth**

Drug Use	*N* (%)	Family Earnings < Poverty	Food Stamp Receipt	AFDC Receipt	Age	Black	Hispanic	Education	Married	Never Married	Number of Children	Poor Health	Drinks per Month
Lifetime cocaine use													
None	3,100 (86)	0.27	0.16	0.10	27.54	0.33	0.20	12.75	0.53	0.32	1.30	0.06	5.72
1–9 times	400 (11)	0.19	0.13	0.10	27.37	0.20	0.18	13.14	0.41	0.40	0.97	0.06	15.09
10 or more times	127 (4)	0.22	0.13	0.10	28.35	0.11	0.19	13.19	0.44	0.34	0.85	0.06	14.02
Past-year cocaine use													
None	3,567 (98)	0.26	0.15	0.10	27.56	0.31	0.13	12.81	0.52	0.32	1.25	0.06	6.68
1 or more times	60 (2)	0.27	0.18	0.11	26.74	0.31	0.20	12.28	0.23	0.58	0.92	0.03	28.65
Lifetime marijuana use													
None	2,161 (60)	0.27	0.16	0.11	27.49	0.33	0.22	12.77	0.53	0.32	1.25	0.05	5.96
1–9 times	1,106 (31)	0.22	0.13	0.09	27.55	0.28	0.17	12.92	0.51	0.33	1.24	0.07	7.97
10–99 times	235 (7)	0.31	0.19	0.14	27.88	0.31	0.14	12.60	0.47	0.33	1.18	0.07	11.40
100 or more times	125 (3)	0.21	0.14	0.10	28.08	0.12	0.15	12.84	0.50	0.33	1.29	0.06	9.39
Past-year marijuana use													
None	3,357 (93)	0.26	0.15	0.10	27.01	0.31	0.20	12.80	0.53	0.32	1.26	0.06	6.18
1 or more times	270 (7)	0.28	0.21	0.16	27.55	0.33	0.12	12.86	0.30	0.46	1.07	0.05	17.82

Table 12.4 **Incidence of Poverty and Receipt of Public Assistance by Drug Use, Males 23–32, 1988 National Longitudinal Survey of Youth**

Drug Use	*N* (%)	Family Earnings < Poverty	Food Stamp Receipt	AFDC Receipt	Age	Black	Hispanic	Education	Married	Never Married	Number of Children	Poor Health	Drinks per Month
Lifetime cocaine use													
None	2,418 (80)	0.22	0.05	0.01	27.44	0.33	0.19	12.71	0.48	0.44	0.85	0.04	19.45
1–9 times	486 (16)	0.22	0.05	0.02	27.45	0.29	0.21	12.81	0.39	0.48	0.80	0.04	23.54
10 or more times	144 (5)	0.16	0.06	0.03	27.94	0.22	0.24	12.53	0.44	0.43	0.82	0.06	24.75
Past-year cocaine use													
None	2,967 (97)	0.21	0.05	0.01	27.49	0.32	0.19	12.73	0.47	0.59	0.85	0.04	20.19
1 or more times	81 (3)	0.30	0.04	0.02	26.79	0.32	0.31	12.16	0.22	0.44	0.73	0.02	25.95
Lifetime marijuana use													
None	1,631 (54)	0.22	0.05	0.01	27.37	0.31	0.20	12.80	0.46	0.47	0.78	0.04	17.99
1–9 times	917 (30)	0.20	0.05	0.02	27.43	0.32	0.21	12.69	0.46	0.44	0.88	0.04	21.55
10–99 times	272 (9)	0.25	0.07	0.02	27.74	0.34	0.18	12.51	0.47	0.37	0.93	0.04	28.49
100 or more times	228 (8)	0.26	0.06	0.01	27.98	0.27	0.16	12.46	0.50	0.39	1.00	0.05	22.50
Past-year marijuana use													
None	2,716 (89)	0.21	0.05	0.01	27.55	0.31	0.20	12.77	0.48	0.43	0.86	0.04	18.74
1 or more times	332 (11)	0.26	0.07	0.03	26.77	0.38	0.19	12.31	0.30	0.58	0.74	0.04	33.47

the samples, I recalculated the means for the variables in tables 12.1 and 12.2 using a sample of adults between the ages of 23 and 32 from the 1994 NHSDA. Mean drug use for the comparably aged 1994 NHSDA sample was still higher than that reported in the NLSY. Besides age, however, there are other differences between the samples that may explain the different levels of drug use. For example, the 1994 NHSDA contains more Hispanic and fewer black respondents than the NLSY. In addition, the NLSY sample has higher levels of education and fewer average children than the 1994 NHSDA sample. These differences may explain the differences in drug use, as may differences in the accuracy of reported drug use.

Another difference between tables 12.1 and 12.2, and tables 12.3 and 12.4 relates to the poverty indicators. Instead of the total family income measure used in the 1994 NHSDA, I use the wage and salary income of the respondent and spouse (if present) to define poverty in the NLSY. If the family wage and salary income is below the federal poverty threshold for that family, I assign that person to be in poverty. I chose to use the wage and salary income instead of total family income because the latter was missing in many cases (e.g., 15 to 20 percent of the time). In addition, for the NLSY sample, I measure poverty over a four-year period between 1988 and 1991.[13] For example, instead of a simple indicator that the respondent or his or her spouse received food stamps in a given year, I measure receipt of food stamps as the proportion of years that the respondent or his or her spouse received food stamps between 1988 and 1991. Similarly, I measure the proportion of years that the respondent or his or her spouse received public assistance. Measuring poverty over a four-year period reduces measurement error and focuses on a more permanent state of poverty. As a result of these differences in measuring poverty, the incidence of poverty is lower in the NLSY than in the 1994 NHSDA. There are at least three reasons why this is not surprising. First, the use of a four-year average to measure poverty would tend to lower the incidence of poverty. Second, the 1994 NHSDA questions about public assistance refer to receipt by any member of the respondent's household, whereas in the NLSY, the public assistance questions refer only to the respondent and respondent's spouse. Finally, the NLSY asks about specific public assistance programs, and I have chosen to use only two: food stamps and AFDC. In contrast, the 1994 NHSDA question I used asks respondents about receipt of any public assistance, and does not specify one particular program.

The data in tables 12.3 and 12.4 do not indicate as clear a relationship between drug use and poverty as those in tables 12.1 and 12.2. Past-year drug use and poverty do seem to be positively related, but the strength of the relationship in tables 12.3 and 12.4 is weaker than it was in tables 12.1 and 12.2. In the

13. Note that use of income information from 1988 results in some overlap between the period used to measure drug use and the period used to measure poverty. The 1988 NLSY interviews were centered around August 1988, and income and receipt of public assistance was measured during the 1988 calendar year. For the most part, however, the NLSY analyses examine the effect of past drug use on future poverty.

case of lifetime drug use, there does not appear to be any systematic relationship between drug use and poverty. For example, among females, respondents with the greatest amount of past marijuana and cocaine use have the lowest levels of poverty. For males, the figures in table 12.4 indicate that drug use and poverty are basically unrelated.

What factors may explain the different relationship between drug use and poverty between the NLSY and the 1994 NHSDA? It is not the different ages of the samples. When the NHSDA sample is restricted to respondents between the ages of 23 and 32, the newly calculated means indicate the same positive relationship between drug use and poverty observed in tables 12.1 and 12.2. It is also not the difference in the length of period during which poverty was measured. I recalculated the means in tables 12.3 and 12.4 using one-year indicators of poverty, and the results were basically unchanged. Thus, similar to the findings with regard to the prevalence of drug use, the differences between the NLSY and the 1994 NHSDA are due to differences in the mean characteristics other than age of the samples, or to differences in the accuracy of reporting drug use.

12.4.2 Multivariate Analysis

As the results in tables 12.1 through 12.4 demonstrate, drug users and nonusers differ by a variety of characteristics besides poverty. Some of these characteristics are what I refer to as confounding factors, and others are what I refer to as mediating factors. For example, age and race may be correlated with both drug use and poverty. Since drug use cannot possibly affect age and race, these are confounding variables. On the other hand, marital status may be correlated with both drug use and poverty, but since I assume that drug use affects marital status, this is a mediating variable. The primary purpose of this study is to estimate the reduced-form effect of drug use on poverty. Thus, it is critical that I control for confounding factors. A secondary goal of the analysis is to provide information about the structural parameters of the model. Toward this end, I add mediating factors to the model and measure the change in the estimated effect of drug use. The change in the estimate of the effect of drug use can be interpreted as an estimate of the structural parameter related to the mediating factor.

The National Household Survey of Drug Abuse

I begin the multivariate analysis with the 1994 NHSDA sample. A limitation of this data set is that it contains few measures of what I consider to be confounding variables. For example, it has no family background measures. Given this limitation, even the reduced-form estimates of the effect of drug use on poverty need to be interpreted with caution since there may be significant unobserved person effects that cause both drug use and poverty. As noted previously, the empirical strategy is to estimate the basic reduced-form model and then to add mediating variables sequentially.

Tables 12.5 and 12.6 contain the estimates of the multivariate regression

Table 12.5 **OLS Estimates of the Effect of Drug Use on Poverty and Receipt of Public Assistance, Females Age 18–40, 1994 National Household Survey on Drug Abuse**

	Family Income < $12,000 (Mean = 0.22; N = 4,951)			Receive Food Stamps (Mean = 0.24; N = 5,301)			Receive Public Assistance (Mean = 0.16; N = 5,310)		
Variable	(1)[a]	(2)[b]	(3)[c]	(4)[a]	(5)[b]	(6)[c]	(7)[a]	(8)[b]	(9)[c]
Lifetime cocaine use									
1–11 times	0.003	0.005	−0.008	0.012	0.017	0.005	0.018	0.022	0.009
	(0.022)	(0.022)	(0.021)	(0.022)	(0.021)	(0.019)	(0.019)	(0.018)	(0.016)
12 or more times	0.083***	0.065**	0.043	0.065**	0.040	0.015	0.056**	0.037	0.014
	(0.028)	(0.027)	(0.027)	(0.028)	(0.026)	(0.024)	(0.024)	(0.023)	(0.021)
Lifetime marijuana use									
1–11 times	−0.008	−0.003	−0.016	0.047***	0.054***	0.041***	0.030**	0.035***	0.022**
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)	(0.013)	(0.012)	(0.011)
12–99 times	−0.032	−0.028	−0.037**	0.015	0.022	0.017	0.002	0.007	0.002
	(0.021)	(0.020)	(0.020)	(0.021)	(0.020)	(0.018)	(0.018)	(0.017)	(0.016)
100 or more times	0.016	−0.000	−0.024	0.109***	0.086***	0.060***	0.064***	0.047**	0.024
	(0.024)	(0.024)	(0.023)	(0.024)	(0.023)	(0.021)	(0.021)	(0.020)	(0.018)
Past-year cocaine use	0.143***	0.118***	0.067*	0.148***	0.116***	0.058*	0.108***	0.084***	0.029
	(0.039)	(0.038)	(0.037)	(0.037)	(0.035)	(0.033)	(0.032)	(0.031)	(0.028)
Past-year marijuana use									
1–5 times	0.046*	0.057**	0.034	−0.007	0.010	0.013	0.022	0.034	0.035*
	(0.026)	(0.025)	(0.025)	(0.026)	(0.025)	(0.023)	(0.022)	(0.022)	(0.020)
6 or more times	0.037	0.025	−0.008	0.107***	0.088***	0.062***	0.078***	0.065***	0.039**
	(0.026)	(0.025)	(0.024)	(0.025)	(0.024)	(0.022)	(0.021)	(0.021)	(0.019)

Past-year/Lifetime cocaine use									
Past-year/1–11 times	0.036	0.015	−0.038	0.125**	0.103*	0.045	0.057	0.042	−0.014
	(0.059)	(0.057)	(0.056)	(0.057)	(0.055)	(0.050)	(0.050)	(0.048)	(0.043)
Past-year/12 or more times	0.211***	0.177***	0.126***	0.181***	0.134***	0.071*	0.157***	0.122***	0.063*
	(0.049)	(0.048)	(0.047)	(0.045)	(0.043)	(0.040)	(0.039)	(0.038)	(0.034)
Past-year/Lifetime marijuana use									
Past-year/1–11 times	0.065**	0.070**	0.044	0.033	0.039	0.034	0.079***	0.084***	0.078***
	(0.031)	(0.030)	(0.029)	(0.030)	(0.029)	(0.026)	(0.026)	(0.025)	(0.023)
Past-year/12–99 times	0.003	−0.000	−0.025	−0.004	−0.005	−0.012	−0.004	−0.004	−0.012
	(0.034)	(0.033)	(0.032)	(0.034)	(0.032)	(0.029)	(0.029)	(0.028)	(0.025)
Past-year/100 or more times	0.048*	0.042	0.011	0.107***	0.097***	0.076***	0.065***	0.057**	0.035*
	(0.029)	(0.028)	(0.028)	(0.028)	(0.026)	(0.024)	(0.024)	(0.023)	(0.021)

*$p \leq .10$.

**$p \leq .05$.

***$p \leq .01$.

[a]The additional explanatory variables included for columns (1), (4), and (7) are age, race, and geographic area.

[b]The additional explanatory variables included for columns (2), (5), and (8) are age, race, geographic area, education, and health.

[c]The additional explanatory variables included for columns (3), (6), and (9) are age, race, geographic area, education, health, marital status, number of children, and alcohol.

Table 12.6 **OLS Estimates of the Effect of Drug Use on Poverty and Receipt of Public Assistance, Males Age 18–40, 1994 National Household Survey on Drug Abuse**

	Family Income < $12,000 (Mean = 0.15; N = 3,986)			Receive Food Stamps (Mean = 0.12; N = 4,109)			Receive Public Assistance (Mean = 0.03; N = 4,123)		
Variable	(1)[a]	(2)[b]	(3)[c]	(4)[a]	(5)[b]	(6)[c]	(7)[a]	(8)[b]	(9)[c]
Lifetime cocaine use									
1–11 times	−0.021	−0.023	−0.028	0.026	0.027	0.028*	0.004	0.004	0.004
	(0.019)	(0.019)	(0.019)	(0.017)	(0.017)	(0.016)	(0.009)	(0.009)	(0.009)
12 or more times	−0.006	−0.019	−0.026	0.054***	0.036*	0.037**	−0.007	−0.012	−0.012
	(0.023)	(0.022)	(0.022)	(0.020)	(0.019)	(0.019)	(0.011)	(0.011)	(0.011)
Lifetime marijuana use									
1–11 times	−0.014	−0.012	−0.013	0.012	0.015	0.012	−0.007	−0.006	−0.006
	(0.015)	(0.015)	(0.015)	(0.014)	(0.013)	(0.013)	(0.007)	(0.007)	(0.007)
12–99 times	−0.001	0.004	0.002	−0.003	0.003	−0.003	−0.000	0.001	0.002
	(0.019)	(0.019)	(0.019)	(0.017)	(0.016)	(0.016)	(0.009)	(0.009)	(0.009)
100 or more times	0.058***	0.051***	0.046**	0.037**	0.025	0.026	0.024***	0.022**	0.022**
	(0.020)	(0.019)	(0.019)	(0.017)	(0.017)	(0.016)	(0.009)	(0.009)	(0.009)
Past-year cocaine use	0.034	0.016	0.011	0.108***	0.081***	0.078***	0.024**	0.018	0.017
	(0.025)	(0.025)	(0.025)	(0.022)	(0.021)	(0.021)	(0.012)	(0.012)	(0.012)
Past-year marijuana use									
1–5 times	0.028	0.029	0.018	−0.006	−0.000	−0.001	−0.018*	−0.017	−0.017
	(0.023)	(0.023)	(0.023)	(0.021)	(0.020)	(0.019)	(0.011)	(0.011)	(0.011)
6 or more times	0.055***	0.049***	0.035**	0.018	0.008	0.011	0.007	0.004	0.005
	(0.018)	(0.018)	(0.018)	(0.016)	(0.015)	(0.015)	(0.008)	(0.008)	(0.008)

Past-year/Lifetime cocaine use									
Past-year/1–11 times	−0.061*	−0.069*	−0.071**	0.087***	0.076**	0.070**	0.057***	0.054***	0.054***
	(0.037)	(0.036)	(0.036)	(0.033)	(0.032)	(0.031)	(0.017)	(0.017)	(0.017)
Past-year/12 or more times	0.084***	0.061**	0.054*	0.112***	0.076***	0.078***	−0.000	−0.010	−0.009
	(0.031)	(0.031)	(0.031)	(0.027)	(0.027)	(0.026)	(0.015)	(0.015)	(0.014)
Past-year/Lifetime marijuana use									
Past-year/1–11 times	0.023	0.018	0.010	0.003	0.000	0.006	−0.020	−0.022*	−0.020
	(0.028)	(0.027)	(0.027)	(0.024)	(0.024)	(0.023)	(0.013)	(0.013)	(0.013)
Past-year/12–99 times	−0.000	0.006	−0.006	−0.049**	−0.037	−0.034	−0.014	−0.011	−0.012
	(0.026)	(0.026)	(0.026)	(0.023)	(0.023)	(0.022)	(0.012)	(0.012)	(0.012)
Past-year/100 or more times	0.079***	0.071***	0.057***	0.042**	0.029*	0.028*	0.013	0.010	0.010
	(0.020)	(0.019)	(0.020)	(0.017)	(0.017)	(0.017)	(0.009)	(0.009)	(0.009)

*$p \leq .10$.

**$p \leq .05$.

***$p \leq .01$.

[a]The additional explanatory variables included for columns (1), (4), and (7) are age, race, and geographic area.

[b]The additional explanatory variables included for columns (2), (5), and (8) are age, race, geographic area, education, and health.

[c]The additional explanatory variables included for columns (3), (6), and (9) are age, race, geographic area, education, health, marital status, number of children, and alcohol.

models: Table 12.5 pertains to the female sample, and table 12.6 lists the results for males. The organization of tables 12.5 and 12.6 is as follows. For each of the three dependent variables, nine separate models were estimated. Models differed according to the measures of drug use and the set of other explanatory variables included in the model. Drug use was measured in three basic ways: lifetime frequency of use, frequency of past year use, and a combined measure of past-year and lifetime use. The combined measure of past-year and lifetime drug use distinguishes between persons who have initiated use in the past year from those who are chronic users. Past-year users with very little lifetime use are most likely to have initiated use. Three sets of explanatory variables were specified. In the first model, what I refer to as the basic reduced-form model, only age, race, and geographic location (e.g., census division, metropolitan statistical area) were included in the regression. The geographic measures control for differences in economic opportunities that may affect poverty. In the second model, education and health are added to the regression, and finally, marital status, the number of children, and alcohol are included in a third specification.

I begin with the female sample, and the results in table 12.5. The estimates of the effect of drug use listed in table 12.5 present strong evidence that drug use is positively related to poverty. This conclusion applies to each of the dependent variables. In the case of family income, past-year use of marijuana or cocaine increases the likelihood that family income will be less than $12,000. The magnitudes of the effects are substantial. For example, the estimate associated with past-year cocaine use in column (1) indicates that past-year cocaine use raises the probability of having family income below $12,000 by 14 percentage points, which represents a 63 percent increase over the mean. This effect is reduced to approximately 7 percentage points (col. [3]) when the full set of mediating variables is included in the regression. The most important mediating variables are marital status and children as shown by the size of the reduction in the estimates between columns (2) and (3). Greater frequency of lifetime cocaine use also increases the probability of having family income below $12,000, and heavy lifetime use combined with past-year use has the greatest effect on family income. The only measure of drug use that is not significantly related to family income and poverty is lifetime marijuana use.

For the two other measures of poverty, receipt of food stamps or public assistance payments, drug use has similar effects. In both cases, lifetime and past-year use of both marijuana and cocaine increase the probability of participating in one of these public assistance programs. The sizes of the effects are significant. For example, using marijuana 100 or more times increases the probability of participating in one of the two public assistance programs by between 2 and 11 percentage points. As was the case with family income, the most important mediating factors are marriage and children.

Estimates of the effect of drug use on poverty for the male sample are found in table 12.6. In general, males have a lower incidence of poverty than females. Whereas 24 percent of households in the female sample received food stamps,

only 12 percent of households in the male sample received food stamps. Similar differences are observed for the other two poverty measures. Even though poverty rates are relatively low for males, drug use does significantly increase male poverty rates. Past-year and frequent lifetime use of marijuana increase the probability that family income will be below $12,000. One particularly interesting result is related to the different effects of past-year cocaine use on family income. Respondents who report past-year cocaine use and only moderate lifetime cocaine use are less likely to have family incomes below $12,000 than nonusers, but past-year users who also report heavy lifetime use are more likely to have family incomes below $12,000. These estimates illustrate the importance of distinguishing among types of past-year drug users. Finally, note that education plays a more important mediating role in the male sample than it did in the female sample.

Drug use also significantly affects participation in public assistance programs among males. Lifetime and past-year use of cocaine increases the probability of receiving food stamps, as does frequent lifetime use of marijuana. In regard to receipt of public assistance cash payments, past-year cocaine use and frequent lifetime use of marijuana increase the probability of receiving such payments.

In summary, the results presented in tables 12.5 and 12.6 indicate that drug use does increase poverty for both the female and male samples. Indeed, some of the reduced-form estimates are quite large. Moreover, the sensitivity of the estimated effects of drug use on poverty to the addition of mediating variables provides evidence about the ways in which drug use affects poverty. Among females, the indirect effect of drug use on poverty that works through marriage and fertility is in most cases larger than any other effects of drug use. On the other hand, the indirect marriage and fertility effect is not that large for males. Education plays a larger mediating role in the male sample, as do other factors that were not directly observable, as evidenced by the size of the residual effect of drug use on poverty.

The National Longitudinal Survey of Youth

The second sets of estimates of the effect of drug use on poverty were obtained using the NLSY. There are three advantages of using this data. First, it contains an extensive set of family background measures that can be used to control for possibly confounding effects. This point is particularly important given the intergenerational nature of a substantial proportion of poverty. Second, the longitudinal nature of the data enables me to measure poverty over a longer time period and to examine the effect of drug use on what may be considered measures of permanent or long-term poverty. Finally, the longitudinal nature of the data reduces the empirical problems associated with the potential structural endogeneity of drug use. The NLSY can be used to examine the effect of past drug use on future poverty. The temporal ordering of the events diminishes the potential endogeneity of drug use.

Tables 12.7 and 12.8 contain the estimates of the effect of drug use on

Table 12.7 **OLS Estimates of the Effect of Drug Use on Poverty and Receipt of Public Assistance, Females Age 23–32, 1988 National Longitudinal Survey of Youth**

	Family Earnings below Poverty (Mean = 0.23; N = 2,824)				Average Food Stamp Receipt (Mean = 0.15; N = 3,299)				Average Public Assistance Receipt (Mean = 0.10; N = 3,295)			
Variable	(1)[a]	(2)[b]	(3)[c]	(4)[d]	(5)[a]	(6)[b]	(7)[c]	(8)[d]	(9)[a]	(10)[b]	(11)[c]	(12)[d]
Lifetime cocaine use												
1–9 times	−0.027	−0.019	−0.016	−0.029	−0.000	0.014	0.018	0.008	0.012	0.019	0.022	0.011
	(0.023)	(0.023)	(0.022)	(0.021)	(0.017)	(0.016)	(0.015)	(0.013)	(0.014)	(0.014)	(0.013)	(0.012)
10 or more	0.019	0.037	0.027	0.003	0.038*	0.056***	0.049**	0.043**	0.047***	0.057***	0.051***	0.044***
times	(0.023)	(0.031)	(0.030)	(0.029)	(0.021)	(0.021)	(0.020)	(0.018)	(0.180)	(0.018)	(0.018)	(0.016)
Lifetime marijuana use												
1–9 times	−0.011	−0.006	−0.018	0.028*	−0.002	0.003	−0.005	−0.012	−0.005	−0.004	−0.009	−0.015*
	(0.017)	(0.016)	(0.016)	(0.015)	(0.012)	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.008)
10–99 times	0.045*	0.052**	0.039*	0.033	0.017	0.020	0.012	0.003	0.013	0.015	0.009	0.000
	(0.025)	(0.024)	(0.023)	(0.022)	(0.017)	(0.017)	(0.016)	(0.014)	(0.015)	(0.014)	(0.014)	(0.012)
100 or more	0.011	0.0004	−0.005	−0.034	0.015**	0.041**	0.033*	0.000	0.041**	0.038**	0.031*	0.004
times	(0.030)	(0.029)	(0.028)	(0.027)	(0.021)	(0.020)	(0.019)	(0.017)	(0.018)	(0.018)	(0.017)	(0.015)
Past-year cocaine use	0.004	0.013	0.007	−0.007	0.009	0.014	0.014	0.007	0.008	0.011	0.011	0.003
	(0.033)	(0.033)	(0.031)	(0.030)	(0.023)	(0.022)	(0.021)	(0.019)	(0.020)	(0.019)	(0.019)	(0.017)
Past-year marijuana use	0.046**	0.044*	0.030	−0.012	0.080***	0.085***	0.072***	0.039***	0.076***	0.078***	0.069***	0.038***
	(0.023)	(0.023)	(0.022)	(0.021)	(0.016)	(0.015)	(0.015)	(0.013)	(0.014)	(0.013)	(0.013)	(0.012)

Past-year/Lifetime cocaine use												
Past-year/1–9 times	−0.028	−0.021	−0.021	−0.044	−0.009	−0.005	−0.006	−0.026	−0.013	−0.010	−0.011	−0.032
	(0.050)	(0.048)	(0.046)	(0.044)	(0.034)	(0.033)	(0.032)	(0.028)	(0.030)	(0.029)	(0.028)	(0.025)
Past-year/10 or more times	0.029	0.046	0.029	0.002	0.037	0.047*	0.041	0.031	0.045*	0.051**	0.046**	0.036*
	(0.040)	(0.039)	(0.037)	(0.036)	(0.027)	(0.026)	(0.025)	(0.022)	(0.023)	(0.023)	(0.022)	(0.020)
Past-year/Lifetime marijuana use												
Past-year/1–9 times	0.109**	0.098**	0.064	0.024	0.122***	0.108***	0.095***	0.074***	0.073***	0.069***	0.052**	0.033
	(0.043)	(0.042)	(0.041)	(0.038)	(0.030)	(0.029)	(0.028)	(0.025)	(0.026)	(0.026)	(0.025)	(0.022)
Past-year/ 10–99 times	0.035	0.041	0.041	0.034	0.025	0.032	0.036	0.025	0.005	0.009	0.012	0.000
	(0.039)	(0.038)	(0.037)	(0.035)	(0.026)	(0.026)	(0.024)	(0.022)	(0.023)	(0.023)	(0.022)	(0.019)
Past-year/100 or more times	0.030	0.012	0.001	−0.030	0.081***	0.075***	0.061***	0.033	0.083***	0.077***	0.067***	0.041**
	(0.037)	(0.036)	(0.035)	(0.033)	(0.025)	(0.025)	(0.023)	(0.021)	(0.022)	(0.022)	(0.021)	(0.018)

*$p \leq .10$.

**$p < .05$.

***$p \leq .01$.

[a]The additional explanatory variables included for columns (1), (5), and (9) are age, race, and geographic area.

[b]The additional explanatory variables included for columns (2), (6), and (10) are age, race, geographic area, and family background.

[c]The additional explanatory variables included for columns (3), (7), and (11) are age, race, geographic area, family background, education, and health.

[d]The additional explanatory variables included for columns (4), (8), and (12) are age, race, geographic area, family background, education, health, marital status, number of children, and alcohol.

Table 12.8 **OLS Estimates of the Effect of Drug Use on Poverty and Receipt of Public Assistance, Males Age 23–32, 1988 National Longitudinal Survey of Youth**

	Family Earnings below Poverty (Mean = 0.17; N = 2,641)				Average Food Stamp Receipt (Mean = 0.05; N = 3,023)				Average Public Assistance Receipt (Mean = 0.01; N = 3,023)			
Variable	(1)[a]	(2)[b]	(3)[c]	(4)[d]	(5)[a]	(6)[b]	(7)[c]	(8)[d]	(9)[a]	(10)[b]	(11)[c]	(12)[d]
Lifetime cocaine use												
1–9 times	−0.005	0.006	0.006	−0.001	0.002	0.005	0.005	0.005	0.002	0.003	0.003	0.004
	(0.019)	(0.019)	(0.019)	(0.018)	(0.008)	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)	(0.004)
10 or more times	0.039	0.053**	0.043*	0.021	0.001	0.006	0.003	0.005	0.005	0.005	0.004	0.006
	(0.025)	(0.025)	(0.024)	(0.024)	(0.010)	(0.010)	(0.010)	(0.010)	(0.005)	(0.005)	(0.005)	(0.005)
Lifetime marijuana use												
1–9 times	−0.001	−0.004	−0.007	−0.005	0.006	0.005	0.004	0.003	0.007*	0.006*	0.006*	0.006
	(0.017)	(0.017)	(0.016)	(0.016)	(0.007)	(0.007)	(0.007)	(0.007)	(0.004)	(0.004)	(0.004)	(0.004)
10–99 times	−0.005	0.001	0.001	0.003	0.003	0.006	0.007	0.006	0.006	0.007*	0.007*	0.007*
	(0.019)	(0.019)	(0.018)	(0.018)	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.004)	(0.004)	(0.004)
100 or more times	0.029	0.023	0.007	0.009	0.014	0.010	0.005	0.002	−0.001	−0.003	−0.004	−0.005
	(0.022)	(0.022)	(0.021)	(0.021)	(0.009)	(0.009)	(0.009)	(0.009)	(0.005)	(0.005)	(0.005)	(0.005)
Past-year cocaine use	0.052**	0.054**	0.052**	0.039*	−0.005	−0.005	−0.005	−0.002	−0.006	−0.006	−0.006	−0.004
	(0.023)	(0.023)	(0.022)	(0.022)	(0.010)	(0.010)	(0.009)	(0.009)	(0.005)	(0.005)	(0.005)	(0.005)
Past-year marijuana use	0.019	0.018	0.009	−0.009	0.020***	0.020***	0.016**	0.014*	0.011***	0.011***	0.010***	0.010**
	(0.018)	(0.017)	(0.017)	(0.017)	(0.007)	(0.007)	(0.007)	(0.007)	(0.004)	(0.004)	(0.004)	(0.004)

Past-year/Lifetime cocaine use												
Past-year/1–9 times	0.040	0.035	0.042	0.027	0.007	0.005	0.008	0.008	−0.003	−0.005	−0.003	−0.002
	(0.033)	(0.033)	(0.032)	(0.031)	(0.014)	(0.014)	(0.014)	(0.014)	(0.007)	(0.007)	(0.007)	(0.007)
Past-year/10 or more times	0.085***	0.086***	0.078***	0.057**	−0.003	−0.002	−0.004	−0.000	−0.001	−0.001	−0.002	−0.001
	(0.029)	(0.028)	(0.027)	(0.027)	(0.012)	(0.012)	(0.011)	(0.012)	(0.006)	(.006)	(0.006)	(0.006)
Past-year/Lifetime marijuana use												
Past-year/1–9 times	0.095*	0.084**	0.052	0.026	0.040**	0.037**	0.027*	0.028*	0.031***	0.030***	0.028***	0.030***
	(0.039)	(0.038)	(0.037)	(0.036)	(0.016)	(0.016)	(0.016)	(0.016)	(0.008)	(0.008)	(0.008)	(0.008)
Past-year/ 10–99 times	−0.038	−0.026	−0.016	−0.026	−0.013	−0.008	−0.005	−0.006	0.009*	0.011**	0.012**	0.012**
	(0.026)	(0.025)	(0.025)	(0.024)	(0.011)	(0.011)	(0.011)	(0.010)	(0.006)	(0.006)	(0.006)	(0.006)
Past-year/100 or more times	0.014	0.012	−0.006	−0.009	0.022**	0.018*	0.013	0.009	−0.000	−0.002	−0.003	−0.004
	(0.025)	(0.024)	(0.024)	(0.023)	(0.010)	(0.010)	(0.010)	(0.010)	(0.005)	(0.005)	(0.005)	(0.005)

*$p \leq .10$.

**$p \leq .05$.

***$p \leq .01$.

[a]The additional explanatory variables included for columns (1), (5), and (9) are age, race, and geographic area.

[b]The additional explanatory variables included for columns (2), (6), and (10) are age, race, geographic area, and family background.

[c]The additional explanatory variables included for columns (3), (7), and (11) are age, race, geographic area, family background, education, and health.

[d]The additional explanatory variables included for columns (4), (8), and (12) are age, race, geographic area, family background, education, health, marital status, number of children, and alcohol.

poverty for the NLSY samples. The organization of tables 12.7 and 12.8 is similar to that of tables 12.5 and 12.6. For this sample, however, I have added an extra regression model for each of the three dependent variables. The extra model is similar to the basic reduced-form model but includes family background measures in addition to age, race, and local area measures.[14] In general, the addition of family background measures had little impact on the estimates of the effect of drug use on poverty. This result implies that family background has only a minor role in determining who uses drugs since many of the family characteristics were significantly related to poverty.

Estimates of the effect of drug use on poverty for the female sample are listed in table 12.7. In general, the estimates of the effects of drug use in table 12.7 are not as uniform as the estimates in table 12.5, but nevertheless indicate that drug use is positively related to poverty. More consistent estimates of the effect of drug use on poverty are found for the public assistance measures of poverty. This result is somewhat surprising because in contrast to the income measure used in the 1994 NHSDA samples, the income measure used here is adjusted for family size. There is some measurement error in this variable, however, because family income consists of the respondent's earnings and his or her spouse's earnings, if present, but family size refers to the size of the household. Similar to previous findings, drug use has a sizable impact on poverty. For example, past-year marijuana use increases the probability of participating in a public assistance program by between 4 and 8 percentage points. This represents between a 25 and 80 percent increase in the probability of participating in these programs.

In addition, estimates in table 12.7 indicate that past-year and lifetime measures of both marijuana and cocaine use are related to poverty, although past-year use appears to have larger and more consistent effects. This result is in line with the notion that past-year use is a better indicator of chronic use and is more likely to be related to poverty. Indeed, with respect to past-year cocaine use, those with little lifetime use are less likely to be in poverty. Finally, the estimates in table 12.7 indicate that marriage and children are again playing an important mediating role in the relationship between drug use and poverty.

The last set of estimates to be reviewed pertains to the male NLSY sample. Drug use does not have as consistent an impact on poverty for the male sample as it did for the female sample. This finding is similar to that for the 1994 NHSDA samples. Frequent lifetime and past-year cocaine use increase the likelihood of having family earnings below the poverty level, and past-year marijuana use is positively related to public assistance program participation.

14. To control for local economic opportunities and demand conditions, I include the median family income of the respondent's county of residence, the percentage of families below poverty level in the county of residence, and the local unemployment rate.

12.5 Conclusions

In this paper, I have obtained a variety of estimates of the effect of marijuana and cocaine use on poverty using two national samples of young adults. A large preponderance of the estimates indicated that marijuana and cocaine use significantly increase the probability of being poor. Drug users had lower family incomes and were more likely to participate in public assistance programs than nonusers. In some cases, estimates were quite large, implying 50 percent or higher increases in the rate of poverty, as measured in this paper. These results indicate that drug use is a serious problem, and they suggest that public policies focusing on reducing drug use would have some positive economic effects on people's lives.

The study provided other information about the relationship between drug use and poverty that can help inform policy. Surprisingly, an extensive set of family background measures had little influence on the estimates of the effect of drug use on poverty even though these measures were significant predictors of poverty. This result is surprising because drug use is often associated with disadvantaged family backgrounds, as is poverty. Thus, one would expect that family background would be a significant confounding factor in the relationship between drug use and poverty. This turns out not to be the case.

In terms of mediating factors, marriage and fertility played very important mediating roles for the female sample, but not for the males. Indeed, the most important effect of drug use on female poverty was the effect of drug use that works through marriage and fertility. Once these factors were controlled for in the analysis, the residual effect of drug use was often insignificant, and smaller than the structural effect that worked through marriage and fertility. Among males, however, marriage and fertility had only a small mediating effect. For this sample, education played a more important mediating role, but the residual effect of drug use was still larger than the structural effects estimated. For example, after controlling for education, marital status, number of children, and confounding factors, the estimated effect of drug use remained relatively large in the male sample. In all cases, it was larger than the implied structural effects estimated.

I will end with a note of caution. While the results of this study strongly suggest that drug use is positively associated with poverty, and may even be a causal factor of poverty, there were several empirical limitations that make this a less than definitive analysis. First, there may be person-specific factors that account for both drug use and poverty. The analysis of the NLSY sample included a somewhat extensive number of family background measures, and even some psychosocial measures, but there remains considerable heterogeneity in the sample, and this may account for the relationship between drug use and poverty. It would be helpful if future work could address this problem in a more definitive way than did this paper. Second, the causal model of figure 12.1

relied on many assumptions that may not be valid. For example, educational achievement and attainment may significantly affect drug use. As individuals receive more education, their preferences may change, or as Becker and Mulligan (1995) suggest, education may change a person's rate of time preference. These consequences of education make it a cause of drug use, and the reduced-form model should reflect that by including education. More generally, what does cause drug use? In this paper, I have assumed that it is only the consumption value of drug use that causes individuals to use drugs, but this may be incorrect. Drug use may play a role in the production of other goods (e.g., rebellion) whose consumption is caused by a variety of environmental factors that may also cause poverty. Thus, future work should explore the validity of other causal models than that used here in more detail. Finally, the measures of drug use in this paper were relatively crude and were based on potentially biased self-reports. Thus, measurement error and unobserved heterogeneity among user categories may have confounded estimates of the effect of drug use on poverty. Similarly, important segments of the drug using population are homeless or institutionalized and are not in the sample, and thus the effect of chronic drug use on poverty may be understated.

References

Becker, Gary S., and Casey Mulligan. 1995. On the endogenous determination of time preference. Center for the Study of the Economy and State Working Paper no. 98. Chicago: University of Chicago Press.

Becker, Gary S., and Kevin M. Murphy. 1988. A theory of rational addiction. *Journal of Political Economy* 96 (August): 675–700.

Center for Human Resource Research. 1994. *NLS Handbook 1994.* Columbus: Ohio State University.

Elliott, Delbert S., and Barbara J. Morse. 1989. Delinquency and drug use as risk factors in teenage sexual activity. *Youth and Society* 21:32–60.

Gill, Andrew M., and Robert J. Michaels. 1992. Does drug use lower wages? *Industrial and Labor Relations Review* 45 (3): 417–34.

Johnston, Lloyd D., Patrick M. O'Malley, and Jerald G. Bachman. 1994. *National survey results on drug use from the Monitoring the Future study, 1975–1993.* Rockville, Md.: National Institute on Drug Abuse.

Kaestner, Robert. 1991. The effect of illicit drug use on the wages of young adults. *Journal of Labor Economics* 9 (4): 381–412.

———. 1994a. New estimates of the effect of marijuana and cocaine use on wages. *Industrial and Labor Relations Review* 47 (3): 454–70.

———. 1994b. The effect of illicit drug use on the labor supply of young adults. *Journal of Human Resources* 29 (1): 126–55.

———. 1995. The effects of cocaine and marijuana use on marriage and marital stability. NBER Working Paper no. 5038. Cambridge, Mass.: National Bureau of Economic Research.

———. 1996a. Drug use and AFDC participation: Is there a connection? NBER Working Paper no. 5555. Cambridge, Mass.: National Bureau of Economic Research.

———. 1996b. Drug use, culture, and welfare incentives: Correlates of family structure and out-of-wedlock birth. *Eastern Economic Journal* 24 (4): 395–416.
———. 1997. The effects of cocaine and marijuana use on marriage and marital stability. *Journal of Family Issues* 18 (2): 145–73.
Kandel, Denise, Kevin Chen, and Andrew Gill. 1995. The impact of drug use on earnings: A life-span perspective. *Social Forces* 74:243–70.
Kandel, Denise, and Mark Davies. 1990. Labor force experiences of a national sample of young adult men: The role of drug involvement. *Youth and Society* 21:411–45.
Korenman, Sanders, and David Neumark. 1991. Does marriage really make men more productive? *Journal of Human Resources* 26 (2): 282–307.
———. 1992. Marriage, motherhood, and wages. *Journal of Human Resources* 27 (2): 233–55.
Mensch, Barbara, and Denise B. Kandel. 1992. Drug use as a risk factor for premarital teen pregnancy and abortion in a national sample of young white women. *Demography* 29 (3): 409–29.
National Criminal Justice Reference Service. 1997. *Fax on demand.* Rockville, Md.: National Criminal Justice Service.
National Institute on Drug Abuse (NIDA). 1995. *National household survey on drug abuse: Main findings.* Rockville, Md.: U.S. Department of Health and Human Services.
Register, Charles A., and Donald R. Williams. 1992. Labor market effects of marijuana and cocaine use among young men. *Industrial and Labor Relations Review* 45 (3): 435–48.
Yamaguchi, Kazuo, and Denise B. Kandel. 1985. On the resolution of role incompatibility: A life history analysis of family roles and marijuana use. *American Journal of Sociology* 92:836–78.
———. 1987. Drug use and other determinants of premarital pregnancy and its outcome: A dynamic analysis of competing life events. *Journal of Marriage and the Family* 49:257–70.

Comment on Chapters 11 and 12

Christopher J. Ruhm

Robert Kaestner and Marilyn Carroll have each presented an interesting and provocative analysis from which I learned quite a lot. The two studies illustrate both the promise and the difficulties in integrating the econometric and behavioral approaches to understanding the detriments of drug abuse and the possible strategies for reducing it. After reading these papers, and some of the others presented at the conference, I am convinced that the two approaches are complementary and have the potential to inform each other. But, I must hasten to add, this will not occur easily. Many of my remarks elaborate on the difficulties and emphasize important issues not fully addressed in these papers but which, I hope, will be the focus of extensions of these interesting areas of research.

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The Kaestner and Carroll contributions address the opposite sides of a common question. Carroll asks how income and, to a lesser extent, price affect the consumption of drugs and nondrug substitutes. Conversely, Kaestner examines how drug use affects poverty rates and the receipt of government transfers. Presentations in other sessions of this conference suggest that this dichotomy may be more widespread—that economists tend to study how substance use affects economic outcomes, whereas behaviorists more frequently investigate how economic status affects drug consumption. However, this dichotomy is certainly not complete. For instance, some of my own work has examined how income and employment affect alcohol use and drinking problems.

Carroll's paper was particularly interesting to me because it represented my first exposure to the behavioral economic approach to the analysis of drug problems. Her major findings are consistent with the predictions of "standard" economic models. Income elasticities are positive for most goods but vary with the type of drug and the presence of potential complements or substitutes. She also obtains some evidence of negative price elasticities.

I find it reassuring that the predictions of economic theory are generally confirmed, and I was especially interested in the methods used to model the "income" of nonhuman subjects (i.e., the frequency and duration of feedings and the number of "free" feedings). However, given my lack of familiarity with this approach, I would have liked a fuller description of both the methods and many of the results. I also found some of the terminology confusing. For instance, my understanding is that a nondrug "reinforcer" can, in the language of economics, be either a complement or a substitute. Of course, noneconomists may have just as much trouble understanding the writings of many economists, which serves as a useful reminder that clarity of exposition is particularly important when addressing an interdisciplinary audience.

Several limitations raise questions regarding the extent to which results of the behavioral research can be generalized to humans. It is interesting to ask whether our priors would change if the animal studies had *not* confirmed the predictions of economic theory. For instance, if consumption was completely unrelated to "income," would we assume that income elasticities are zero for people as well? I think not. Similarly, it is not obvious to what extent the results have implications for policies designed to reduce drug problems. In part, my hesitation arises because current behavioral studies do not account for important issues such as information and learning, multiperiod investments, and the endogeneity of income and drug abuse.

Let me use the example of "children and chocolate" to illustrate these concerns. I could probably construct a behavioral experiment, similar to that used by Carroll, to examine how "income" affects my two small children's consumption of chocolate. To do so, I would vary the frequency or duration of the sessions during which they could perform specified activities in order to "earn" chocolate. I would probably find that, as their income increased, chocolate consumption would also rise, although possibly at a different rate if a nondrug

reinforcer (such as milk?) was available. I might conclude that consumption of this "drug" would be reduced by decreasing my children's "income" and generalize this result to adults.

However, my experiment misses several important points. As a parent, I have a variety of methods of teaching my children to use chocolate "responsibly." For instance, I might provide information on the dangers of irresponsible use or occasionally allow (or encourage) them to overuse the "drug" in relatively low-risk situations, in the hope that they would learn about the dangers of future overconsumption. Indeed, even if I did none of these things, they might obtain the information or learn these lessons on their own. A challenge for behavioral research is to design experiments that capture the effects of learning, both at a point in time and over longer periods, since this is of key importance for preventing or ameliorating drug use.

Let me turn next to Kaestner's work. This paper builds on provocative prior research examining how drug use affects a variety of labor market outcomes. Among the most interesting results are those of Kaestner's earlier research suggesting that drug use does not lower earnings and may even be associated with higher wages. By contrast, this analysis finds that consumption of illegal drugs is positively related to poverty rates and the receipt of transfer payments. In my opinion, the econometric evidence supporting this result is quite weak and should be viewed as preliminary. Moreover, it may be difficult to provide convincing evidence using the data sets commonly employed in this type of analysis.

Several factors limit my confidence in the findings. First, the econometric results are not particularly robust. Drug use is not always associated with increased poverty, and when it is, higher levels of consumption do not necessarily correlate more strongly with low incomes than more moderate use. Even the estimates with the "right" sign are frequently statistically insignificant. Second, the predicted effects of illegal drug consumption often differ substantially between men and women, and across the two surveys. Third, there is a potential simultaneity problem because recent drug use could be caused by poverty. This concern is lessened in the analysis of the NLSY data, since current drug use is used to predict future poverty rates. But the problem is not completely eliminated if either drug use or economic outcomes are serially correlated, as is likely. Fourth, the interpretation of the effects of mediating factors may be problematic. For instance, a reduction in the drug coefficient occurring when marital status is added to the model is interpreted as indicating the portion of the effect of drug use on poverty that operates through changes in marital status. However, it is at least as likely that, when marital status is excluded, the drug coefficient partially captures the independent (causal) effect of the former on poverty.

The methods of addressing many of these issues (e.g., instrumental variables or natural experiments) are well known and do not require discussion. More fundamentally, I doubt that the data sources analyzed can address the key ques-

tion of interest—whether drug use causes poverty. Most poverty is almost certainly unrelated to drugs, and small amounts of substance use will rarely be expected to have much effect on economic status. Conversely, extremely heavy drug consumption could have a substantial impact on earnings and marginally increase the overall incidence of poverty.

Unfortunately, neither the National Household Survey of Drug Abuse nor the National Longitudinal Survey of Youth is well suited to model the effects of serious drug abuse. For instance, the open-ended categories in the NLSY indicate lifetime marijuana use of 100 or more times and cocaine use of 10 or more times. These are unlikely to indicate severe drug problems. For example, an individual using marijuana once every two weeks while in college (or twice a week for a single year), but never again, would be placed in the highest use category. And other presentations in this conference suggest that the *weekly* cocaine use of persons in drug treatment programs often exceed the threshold for the highest category of *lifetime* use measured in these surveys. Moreover, relatively few survey respondents report heavy drug use (e.g., only 5 percent of NLSY men claim to have ever used cocaine, and just 3 percent report using it during the last year) making it even more unlikely that the analysis can pick up the kinds of substance abuse likely to result in poverty.

An interesting extension of this work might examine how the poverty status of heavy drug users compares to that of observationally similar individuals who either do not use illegal drugs or do so sparingly. Physiological or medical studies might provide information on the nature of severe drug use likely to have a negative effect on economic outcomes. It would also be useful to better understand the mechanisms by which the consumption has adverse economic effects.

In conclusion, the papers by Carroll and Kaestner indicate possible complementarities between the behavioral and economic approaches and provide some suggestion of how the two disciplines can learn from each other. I look forward to reading future research in each area.

Comment on Chapters 11 and 12

Steven R. Hursh

The paper presented by Marilyn Carroll entitled "Income Alters the Relative Reinforcing Effects of Drug and Nondrug Reinforcers" describes a careful parametric study of demand for PCP and ethanol compared to water or saccharin under conditions of varying income. Demand for PCP was relatively insensitive to income, while demand for saccharin increased substantially with in-

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creased income. As a consequence, when they were of equal price, there was a preference for PCP under low income and a preference for saccharin under high income. Similar results were found with ethanol. The paper presented by Robert Kaestner entitled "Does Drug Use Cause Poverty?" attempts to relate drug use to poverty levels, as measured from multivariate analysis of two national surveys of drug use. The results indicate a positive association between drug use and greater poverty.

In this commentary, I apply my background in behavioral economics as applied to laboratory data, such as those reported by Marilyn Carroll, to the question posed by Robert Kaestner (Hursh 1980, 1984, 1991, 1993). In other words, I analyzed the data reported by Carroll for evidence that the availability of drug use in these primates in any way impoverished these animals compared to circumstances with minimal or no drug use. Did drug use in these animals cause greater poverty? Before considering this question, it is important to define some economic terms as applied to studies of animal behavior in the laboratory.

As used in most economics textbooks, *income* is generally considered to be synonymous with the financial budget of the consumer. It is the constraint on total consumption imposed by limits of available money flows to the consumer. In studies of nonhuman behavior in the laboratory, there is often no medium of exchange, such as money. The animal exchanges labor directly for goods; for example, a certain number of responses on a lever may be required to earn one bite of food, sip of water, or delivery of drug solution. For example, if four responses are required for each bit of food, this is termed a fixed-ratio 4 schedule of reinforcement (FR 4). This response requirement is defined as the price of the good, and a demand curve may be observed by varying the response requirement across conditions of the experiment. Under these conditions, a more general definition of income must be invoked. Income may be defined as some amount of funds, resources, time, or opportunities that constrains the total amount of goods that may be earned per day. In animal studies, four types of constraint have been used to model income changes. The total amount of time in the test apparatus per day sets an upper limit on the amount of responding and amount of consumption that can occur. If the test period is divided into "trials"—that is, opportunities to make responses—income can be manipulated by changing the number of trials in the daily test. The experimenter can set an arbitrary limit on the total number of responses that the subject is allowed to make among the various alternative commodities. Finally, the animal may be allowed to earn "tokens" from a token dispenser that are later exchanged for goods; the total number of tokens that are allowed would impose a limit on income. In the study reported by Marilyn Carroll, the income manipulation was the duration of the test session. Since the price of goods was controlled by the number of responses per unit of goods, this income constraint was indirect. In other words, the subject can partially compensate for time constraints by responding more quickly. Nevertheless, time was manipulated

over a broad range from 20 minutes to 3 hours, so it is reasonable to assume that there was a considerable variation in real income imposed by this temporal constraint, especially when a large number of responses were required for each delivery of the drug or nondrug reinforcer.

Computation of Income Budgets

In order to conduct an income analysis of these data, it is necessary to convert the time constraint on income to a response constraint on income. This was accomplished in the following manner. In these experiments, the subject responded by making licks at a liquid delivery tube. Each lick constituted a single response. This is a very easy and natural response for these primates. Licks may occur rapidly. Just how rapidly was determined by calculating, for each condition of prices for the two alternatives and time available, the average response rate that occurred in that condition. The maximum response rate across all conditions was found to be approximately 4.6 responses per second. Given this maximum ability to respond, table 12C.1 gives the total response income *possible* for each session duration. These incomes were 5,520; 16,560; and 49,680 responses during 20 minute, 60 minute, and 180 minute sessions, respectively.

PCP Consumption

Equipped with this conversion, it is possible to construct for each condition of this study income-expenditure curves for each commodity studied and for several different price levels (Watson and Holman 1977). Figure 12C.1 displays income-expenditure curves for PCP when compared to water (top panel) and saccharin (bottom panel). Income level is shown along the x-axis, and expenditure level is shown along the y-axis. The three income conditions are labeled low, medium, and high. For each income level there is a budget line (*dotted line*) that depicts the range of possible combinations of income not expended versus income expended for PCP. In general, PCP expenditures were relatively insensitive to income. In each panel, three curves obtained under three conditions of price for PCP are depicted: the lowest price (4 responses per reinforcer), the highest price (128 responses per reinforcer), and a moderate price that produced maximum expenditures for PCP (64 and 32 responses per reinforcer for the water and saccharin conditions, respectively). Between the lowest price and this moderate price, demand was inelastic for PCP; above

Table 12C.1 Conversion of Time Income to Response Income

Time Income	Conversion (max response rate)	Response Income
20 min	4.6 resp/sec	5,520 responses
60 min	4.6 resp/sec	16,560 responses
180 min	4.6 resp/sec	49,680 responses

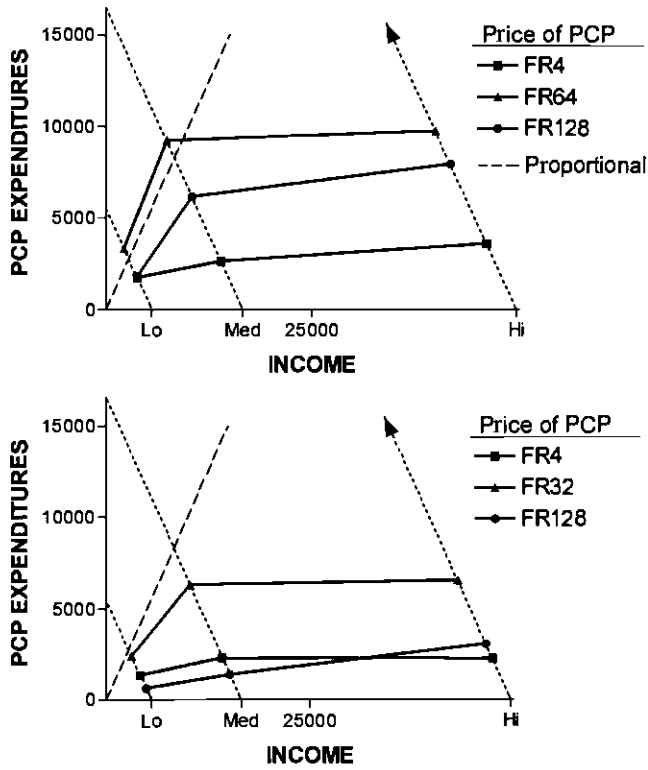

Fig. 12C.1 Income-expenditure curves for PCP when compared to water or saccharin

Note: Comparison of PCP to water is shown in the top panel, and comparison to saccharin is shown in the bottom panel. Income levels are shown along the *x*-axis, and PCP expenditures are shown along the *y*-axis. Budget lines (*dotted lines*) connect all possible combinations of available income and PCP expenditures for the three income conditions. *Solid lines* connect conditions of equal PCP price. The *dashed lines* indicate proportional increases in expenditures with income.

that price, it was elastic. At the moderate price that maintained maximum expenditures (P_{max}), expenditures for PCP were most sensitive to the increase in income from low to medium levels. With water as the alternative, the increase was more than proportional to the increase in income. In all other cases, the increases were less than proportional to the increases in total income.

Figure 12C.2 displays the income-expenditure curves for saccharin compared to PCP. Expenditures for saccharin were much more sensitive to income than were expenditures for PCP. At all prices of PCP, the expenditure for saccharin between low and medium income increased more than proportionately to income. There were additional and substantial increases in expenditures between medium and high income, though not quite proportional to the increase in income. Not surprisingly, the greatest expenditures for saccharin occurred

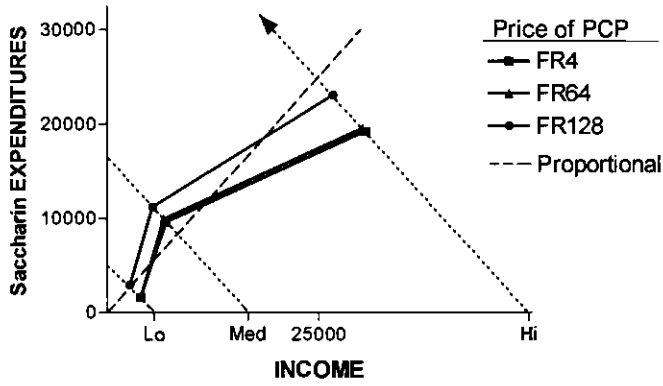

Fig. 12C.2 Income-expenditure curves for saccharin when compared to PCP
Note: Income levels are shown along the *x*-axis, and saccharin expenditures are shown along the *y*-axis. Budget lines (*dotted lines*) connect all possible combinations of available income and PCP expenditures for the three income conditions. *Solid lines* connect conditions of equal PCP price. The price of saccharin was constant at 32 responses per delivery. The *dashed line* indicates proportional increases in expenditures with income.

when the price of PCP was at its maximum, 128 responses per reinforcer. As a result of the different income elasticities of PCP and saccharin, there was a shift in the distribution of expenditures between PCP and saccharin across increases in income. At low income, there tended to be greater expenditures for PCP compared to saccharin; at high levels of income, there were greater expenditures for saccharin than for PCP.

From this analysis, we may now compute the amount of disposable income available after expenditures for PCP, across income levels and with different prevailing prices for PCP. These results are summarized in figure 12C.3, which shows the percentage of income remaining after PCP expenditures as a function of the income levels and for three selected prices of PCP. At the price that maintained the highest levels of PCP expenditures (64 and 32 for water and saccharin alternatives, respectively), there was an income-sensitive reduction of disposable income produced by drug use. At the lowest income, less than 50 percent of income was available after drug use, whereas at high income, over 75 percent of income remained available. In other words, under conditions of low income, when the subjects were least able to afford expenditures for other goods, high drug expenditures had the greatest effect in further reducing available income. PCP consumption further impoverished subjects when they were already under conditions of "poverty" or low income. In this sense, PCP use increased the level of poverty as compared to conditions of relatively low drug use, when the price of PCP was high (128 responses per reinforcer), shown as the right three bars of each panel.

If we consider the availability of saccharin, an attractive alternative—a kind of "intervention" to reduce drug consumption—then it is interesting to note

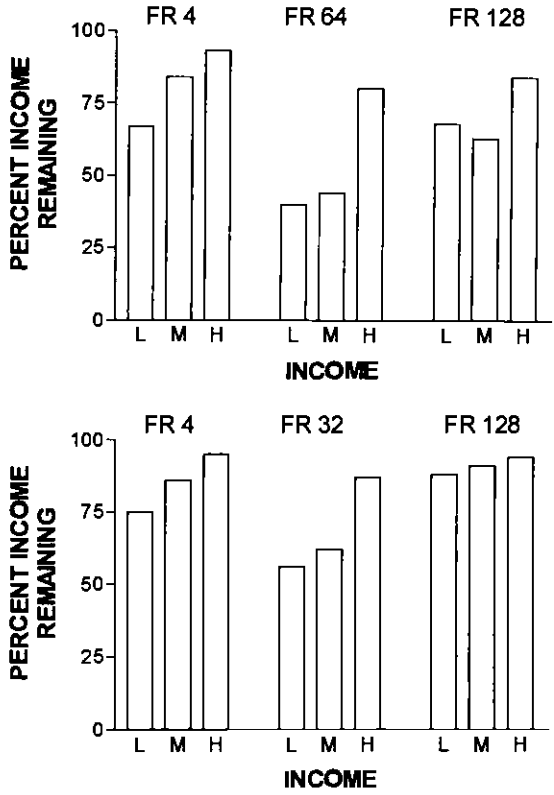

Fig. 12C.3 Percentage of income remaining, or disposable income, after expenditures for PCP with water or saccharin available

Note: The top panel illustrates the condition in which water was available; the saccharin condition is shown in the bottom panel. Groups of bars are the results for conditions of equal PCP price; within each group are results for the three income levels: low (L), medium (M), and high (H).

that saccharin seemed to have its greatest effects on restoring disposable income in the medium and high income conditions. In the low income conditions, less than 50 percent of income remained available, independent of the availability of saccharin.

Ethanol Consumption

The results with ethanol as the drug are very similar in pattern to those found with PCP. Figure 12C.4 displays income-expenditure curves for ethanol versus water (top panel) and ethanol versus saccharin (bottom panel). As with PCP, ethanol expenditures were relatively insensitive to increases in income. Even at the prices that maintained the highest levels of expenditures, FR 64 and FR 32, expenditures increased at a much lower rate than total income.

Figure 12C.5 displays the income-expenditure curves for saccharin when

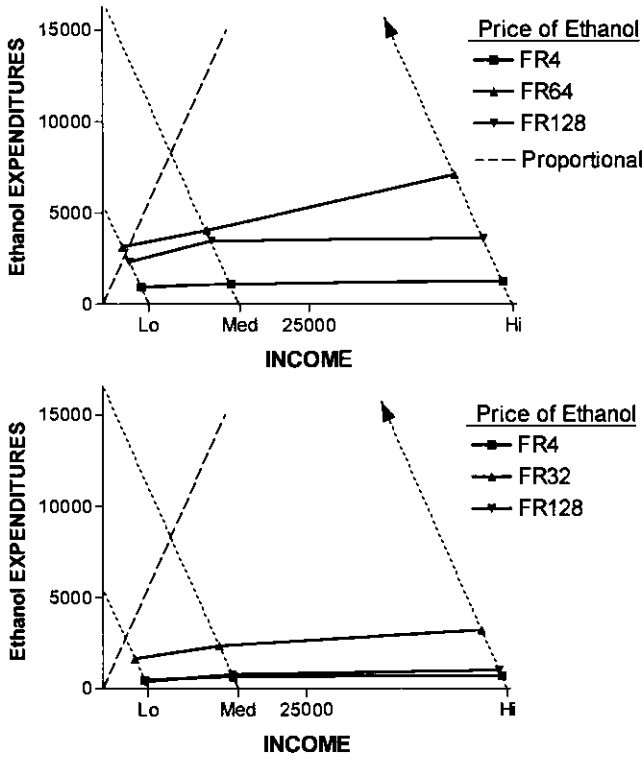

Fig. 12C.4 Income-expenditure curves for ethanol when compared to water or saccharin

Note: The top panel illustrates the condition in which water was available; the saccharin condition is shown in the bottom panel. Income levels are shown along the *x*-axis, and ethanol expenditures are shown along the *y*-axis. Budget lines (*dotted lines*) connect all possible combinations of available income and ethanol expenditures for the three income conditions. *Solid lines* connect conditions of equal ethanol price. The *dashed lines* indicate proportional increases in expenditures with income.

available as an alternative to ethanol. Relative to ethanol, saccharin expenditures were much more sensitive to income increases. When income increased from low to medium levels (a factor of 3 increase), expenditures for saccharin increased almost proportionately. When income was again tripled to the highest value, expenditures increased again at the two lower prices displayed, but at a rate much less than proportional to the increase in income.

Disposable income remaining after expenditures for ethanol are displayed in figure 12C.6. As with PCP, at the prices that maintained the most robust responding for ethanol (FR 64 and FR 32 for the water and saccharin alternative cases, respectively), less than 50 percent of available income remained in the low income condition, whereas over 75 percent of income remained in the high income condition. In fact, at all prices of ethanol, the disposable income

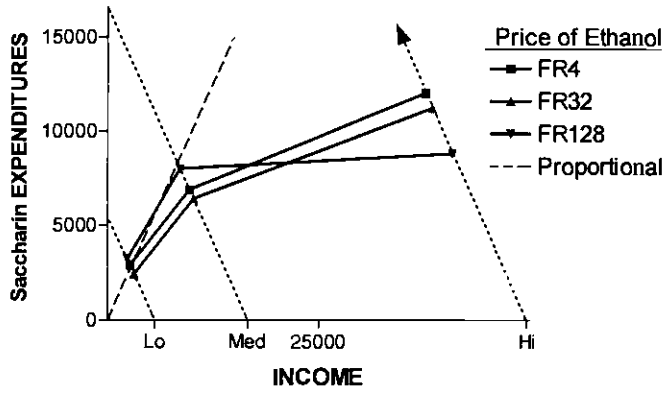

Fig. 12C.5 Income-expenditure curves for saccharin when compared to ethanol
Note: Income levels are shown along the *x*-axis, and saccharin expenditures are shown along the *y*-axis. Budget lines (*dotted lines*) connect all possible combinations of available income and ethanol expenditures for the three income conditions. *Solid lines* connect conditions of equal ethanol price. The price of saccharin was constant at 32 responses per delivery. The *dashed line* indicates proportional increases in expenditures with income.

remaining after drug expenditures was lowest for the low income conditions. Hence, drug consumption had the greatest effect of further lowering available income in the conditions that had the least income to begin with. In this sense, ethanol consumption further impoverished the subjects in the low income conditions.

Labor Supply Analysis

Experiments with nonhuman subjects that do not use a medium of exchange, such as this one with primates reported by Marilyn Carroll, are subject to an entirely different economic analysis. The experiment can be understood as a labor supply problem. The fixed-ratio schedules that define the number of responses required for each delivery of drug can be thought of as a wage rate, rather than a price. The amount of PCP or ethanol that is earned can be thought of as the resulting income. The conditions that limit the time available may be thought of as the duration of employment. As wage rate is increased, one should observe an increase in income of drug and a shift in the distribution of time between work and leisure. Figure 12C.7 is a display of how subjects given the opportunity to work for PCP distributed their time between work and leisure as wage rate increased from one reinforcer for 128 responses (FR 128) to one reinforcer for 4 responses (FR 4). The *y*-axis represents the total amount of PCP earned under each condition, defined as income in this case. The three-session duration conditions are represented by the curves from left to right as low to high durations. For the middle-session duration curve, dotted lines indicate the income possibility curves for each of the three wage rates. For all three session durations, increasing wage rate at first increased work (curve moves to

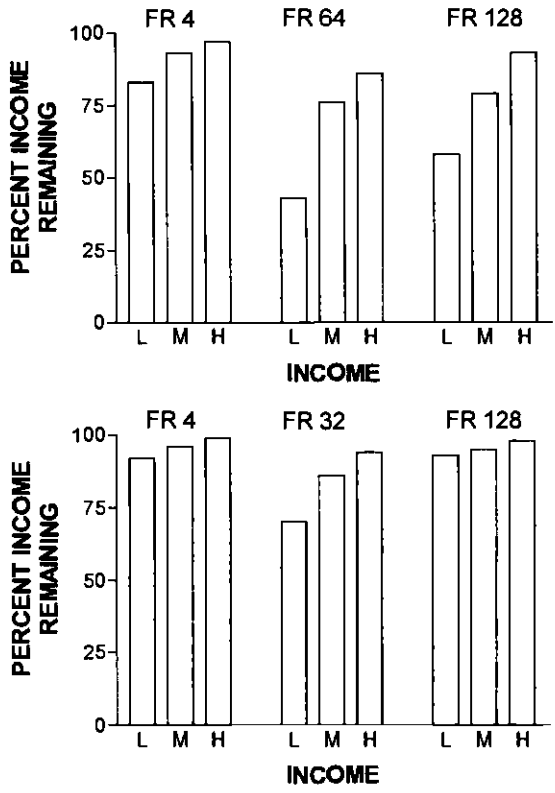

Fig. 12C.6 Percentage of income remaining, or disposable income, after expenditures for ethanol with water or saccharin available

Note: The condition in which water was available is shown in the top panel; the bottom panel illustrates the saccharin condition. Groups of bars are the results for conditions of equal ethanol price; within each group are results for the three income levels: low (L), medium (M), and high (H).

the left) and then decreased work (curve moves to the right). These backward-bending labor supply curves are entirely consistent with labor supply theory (Watson and Holman 1977).

Summary

In this study with nonhuman primates, the effects of drug consumption on disposable income were greatest in the low income conditions. In this sense, drug consumption was like a regressive tax; it had its greatest percent effect at the lowest income levels. This effect on disposable income was highly price sensitive; at low or high prices, the effects of drug consumption on disposable income were minimal. Drug consumption had the greatest impact on disposable income at moderate drug prices. At low drug prices, very little available income is required to "purchase" the drug; at high drug prices, consumption

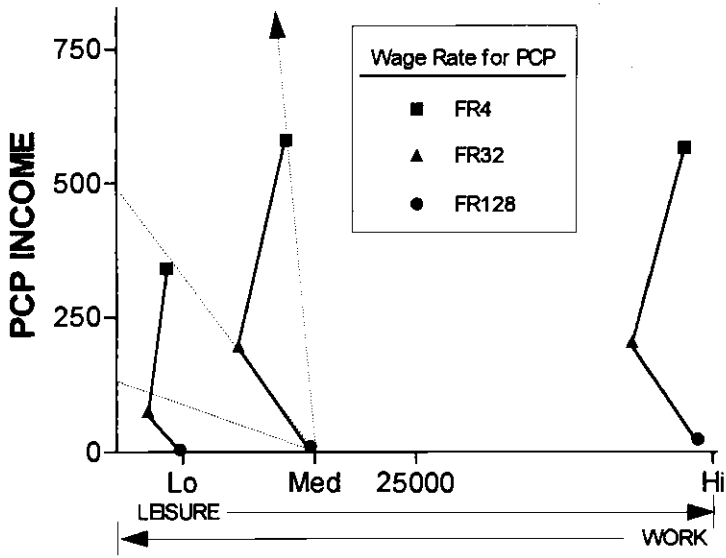

Fig. 12C.7 Wage rate-income curves for PCP when compared to saccharin
Note: Increasing leisure (unexpended possible responses) is shown along the *x*-axis, and income of PCP deliveries is shown along the *y*-axis. Increasing work (complement of leisure) is shown along the *x*-axis from right to left. The three curves from left to right are for low, medium, and high duration sessions, respectively. Each line connects points of varying wage rate, defined as the response-reinforcer ratio. *Dotted lines* indicate the three possible leisure-PCP income lines for the three wage rates with medium time available.

of the drug is low and, again, little income is required to "purchase" the small amounts of drug that are consumed. Finally, the benefits of saccharin as an intervention for PCP consumption were directly related to income; it had the least effect under conditions of low income. Taken together, drug consumption under moderate prices had the effect of further impoverishing the subjects in the low income conditions and, in part, insulating them from the competitive effects of an alternative reinforcer, saccharin.

References

Hursh, Steven R. 1980. Economic concepts for the analysis of behavior. *Journal of the Experimental Analysis of Behavior* 34:219–38.

———. 1984. Behavioral economics. *Journal of the Experimental Analysis of Behavior* 42:435–52.

———. 1991. Behavioral economics of drug self-administration and drug abuse policy. *Journal of the Experimental Analysis of Behavior* 56:377–93.

———. 1993. Behavioral economics of drug self-administration: An introduction. *Drug and Alcohol Dependence* 33:165–72.

Watson, Donald S., and Mary A. Holman. 1977. *Price theory and its uses.* Boston: Houghton Mifflin.