

RAND

Modeling the Demand for Cocaine

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DRUG POLICY RESEARCH CENTER

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**Prepared for the Office of
National Drug Control Policy
United States Army**

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Approved for public release; distribution unlimited

This report documents the development of a model of the demand for cocaine that was fit to 20 years of data on the current cocaine epidemic in the United States. It also describes the analysis performed, including the estimation of incidence, prevalence, cohort retention, and consumption. The impetus for the model's development was a parallel RAND analysis of cocaine-control programs (see *Controlling Cocaine: Supply Versus Demand Programs*, C. Peter Rydell and Susan S. Everingham, MR-331-ONDCP/A/DPRC, 1994), of which this analysis is a key component. However, the model of cocaine demand is useful in its own right, leading to new insights on the nature of the cocaine problem.

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Although the status of the "war against cocaine" was still being debated just a few years ago, now it is generally understood that even though the overall number of cocaine users is decreasing, the proportion of those users that are the so-called heavy users is increasing. To elevate the policy debate to a new level, a more precise and quantitative understanding of these trends is required. Toward the goal of designing effective drug control policy, we created a model of how the demand (i.e., the number of users together with how much those users consume) for cocaine changes over time that incorporates available data and interprets them. Specifically, demand is determined by a two-state Markovian model of the user flows that has been fitted to 20 years of historical data on cocaine usage derived from the National Household Survey of Drug Abuse (NHSDA) and other sources.

The Markovian approach to modeling prevalence (the number of people who use drugs) in this analysis can usefully be distinguished from purely statistical techniques such as multiple capture, Poisson estimation, and synthetic estimation, and from elaborate behavioral models such as the system dynamics models. By a Markovian model, we mean one that incorporates one or more states and the transition parameters that determine the flows between those states. We have adopted a two-state, four-parameter model because it supports the most important behavioral distinction, that between light and heavy use, without encumbering the model with unnecessary detail. The four parameters governing transition flows are selected to match the historical data.

Prevalence is a primary indicator of the extent of the illicit drug problem. The principal survey instrument for estimating drug-use prevalence in the United States is, and has been for the last two decades, the NHSDA sponsored by the National Institute on Drug Abuse (NIDA). As its name indicates, the NHSDA reports drug usage among people living in households in the United States. This sampled population includes the vast majority of people 12 and older, but it overlooks some segments of the U.S. population that may include a substantial proportion of drug users, such as the incarcerated and the transient homeless. The prevalence estimates used to establish the model parameters were based upon the NHSDA estimates of the prevalence of cocaine use among the household population supplemented by estimates of cocaine use among the incarcerated and the homeless. The overall prevalence estimates obtained for NHSDA survey years are shown in Figure S.1.

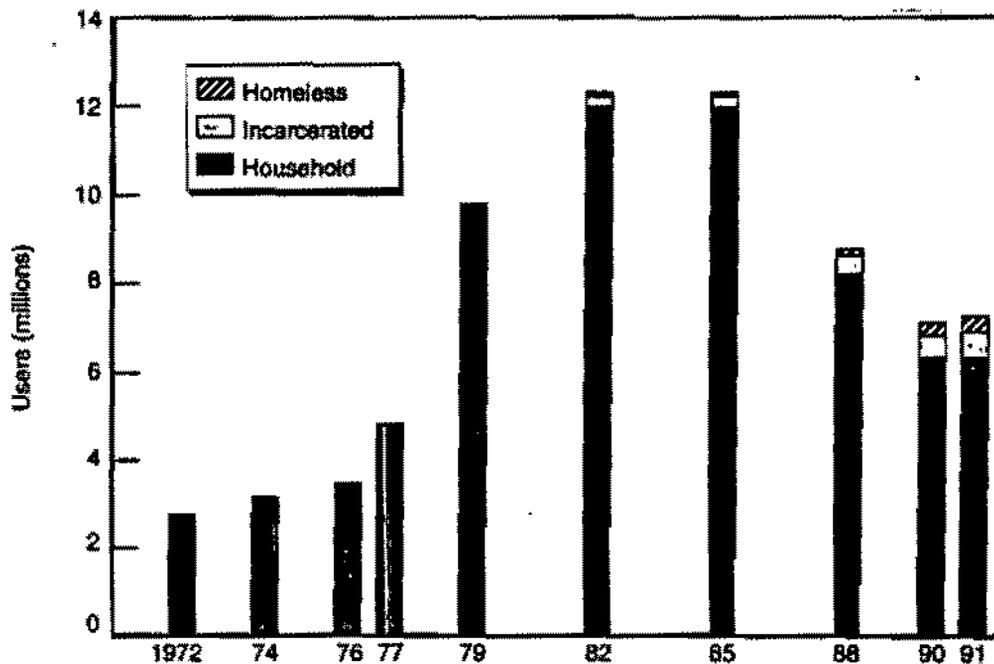


Figure S.1—Overall Prevalence of Cocaine Users in the United States

As a modeling convenience, users were separated into just two categories: light users and heavy users. (Modeling the entire spectrum is neither practical nor necessary, and modeling a single average user is insufficient.) For this model, the distinction between light and heavy use was based simply upon frequency of use. People who said they used at least weekly (or several times a month) were defined as heavy users, and the rest were light users. NHSDA information was used to estimate that the average heavy user consumes eight times as much cocaine as does the average light user.

The Markovian model is required to fit (1) the overall prevalence data; (2) the fraction of all users that were heavy users in 1985, 1988, and 1990; and (3) the fraction of a cohort of initiates that are still using drugs ten years later, i.e., the ten-year cohort retention rate. The incidence (the number of people who initiate drug use) into light cocaine use, which has varied greatly over the years, is an input to the model. (Consequently, the model cannot predict future prevalence; it can only project prevalence given a hypothetical incidence scenario.) The fitting procedure is essentially an exhaustive search of the four-dimensional parameter space. The goodness-of-fit is demonstrated in Figures S.2, S.3, and S.4.

The model demonstrates that the fraction of all cocaine users that are heavy users has varied greatly over time (implying overall prevalence is an incomplete measure of the cocaine epidemic), and that peak heavy usage followed peak incidence (which occurred around 1980) by about ten years (see Figure S.5). Consequently, the effect on heavy cocaine usage of government programs that reduce incidence (such as pre-

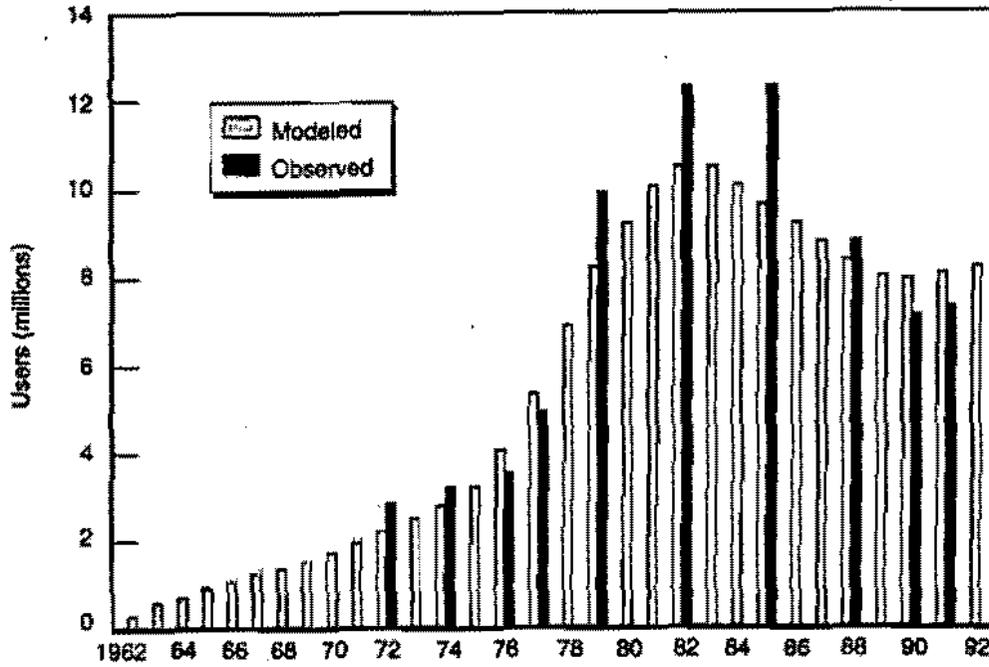


Figure 5.2—Overall Prevalence of Cocaine Users: Modeled vs. Observed

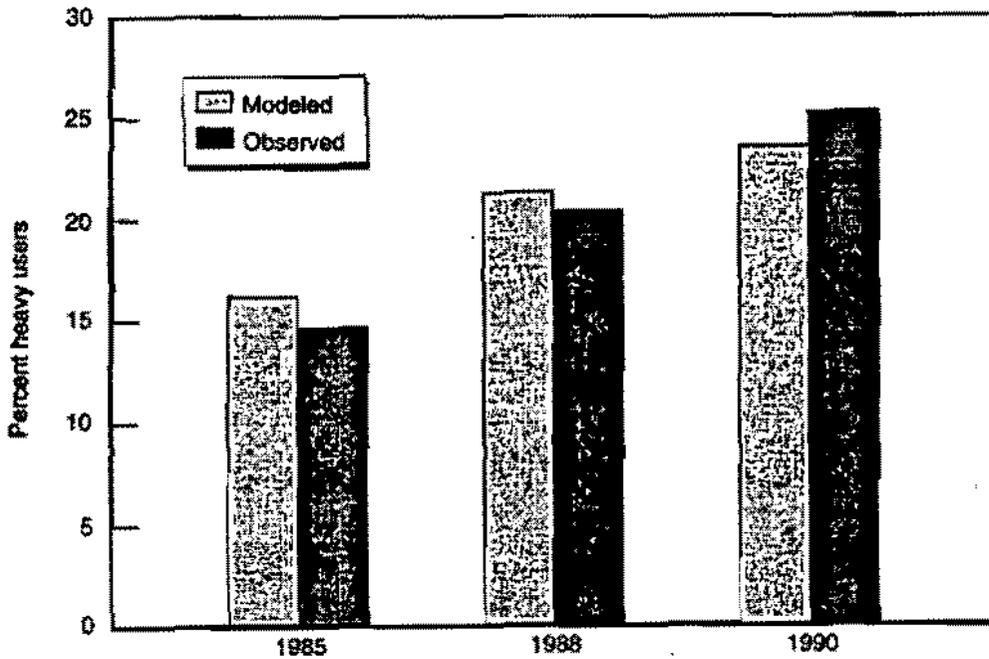


Figure 5.3—Percentage of Users That Are Heavy Users: Modeled vs. Observed

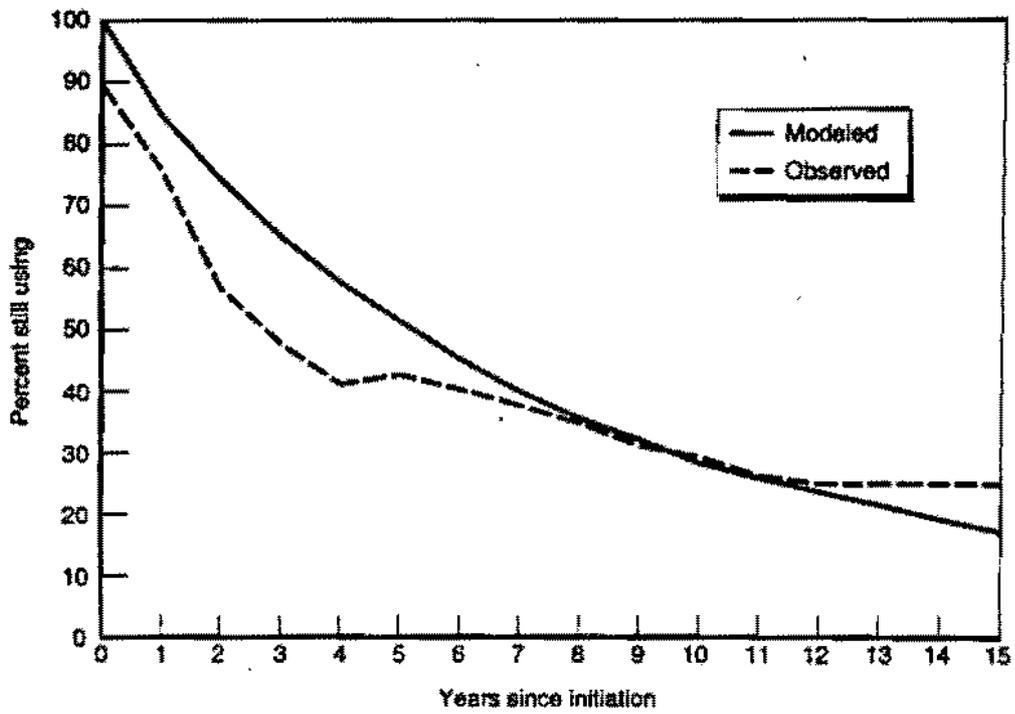


Figure S.4—Cohort Retention: Modeled vs. Observed

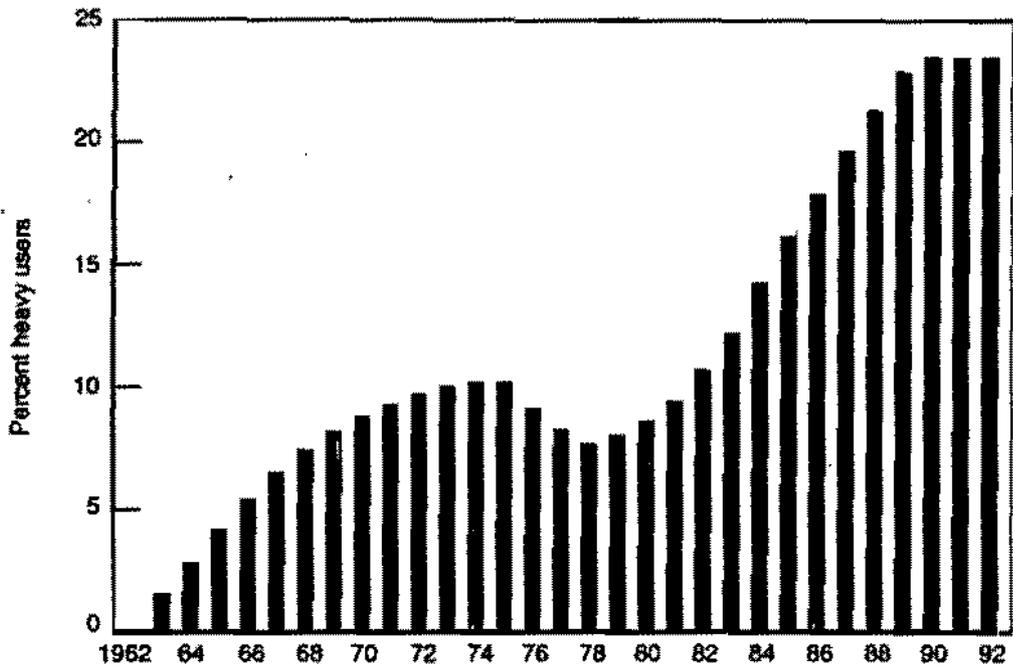


Figure S.5—Modeled Percentage of Users That Are Heavy Users: Variation over Time

vention programs) will only be realized many years later, and part of the effectiveness of local law enforcement programs and other programs that influence drug use in multiple ways (affecting incidence, flow rates, and the consumption rates of current users) also will be delayed. The fact that the various control programs focus upon different aspects of drug use (prevention on incidence, treatment on heavy usage, etc.) means that some strategies may be most appropriate for specific stages of the epidemic.

Figure S.6, a graph of modeled prevalence over time, reveals the underlying contributions to the prevalence estimates by both light and heavy users. The *overall* prevalence curve has characterized the course of the cocaine epidemic in the eyes of many policymakers. But while both overall and light-user prevalence have recently declined and leveled off, the number of heavy users continues to increase.

In contrast to prevalence's overall decline during the past decade, consumption has merely leveled off (see Figure S.7). And even if overall prevalence continues to decline, large amounts of cocaine will still be consumed in the United States because more and more of the remaining users will be heavy users. Given this increasing prevalence of heavy users and its effect on total cocaine consumption, the bottom line is that the "war against cocaine" has by no means been "won."

Although the model cannot predict incidence, it can project the course of the cocaine-use epidemic given any hypothetical incidence scenario. The value of such projections lies in the fact that they bound the analysis in a useful way. Figures S.8 and S.9 plot 15-year projections of prevalence and consumption, respectively, assuming that incidence remains constant at about one million new users per year. The graphs imply that constant incidence, even at the current low level, will result in an increase in both prevalence and consumption.

Assuming (optimistically and probably quite unrealistically) that incidence is reduced to zero and does not resurge, the maximum effect that reduced incidence can have on the future course of the cocaine epidemic can be estimated. From Figure S.10, we see that prevalence is reduced to about two million cocaine users in 15 years. But most of those users are heavy users, so the decrease in consumption is not nearly as dramatic: in 15 years, consumption is only halved (see Figure S.11). Thus, even in the absence of incidence it will take about 30 years for the current epidemic to (nearly) disappear, unless the flow rates out of cocaine use increase.

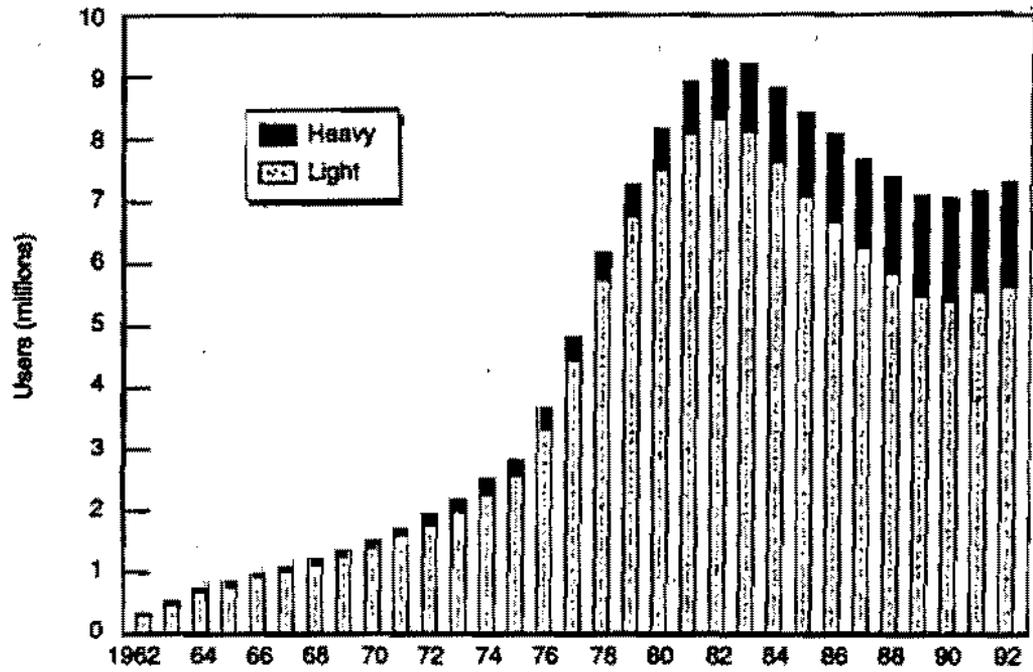


Figure S.6—Modeled Prevalence: Heavy vs. Light Users

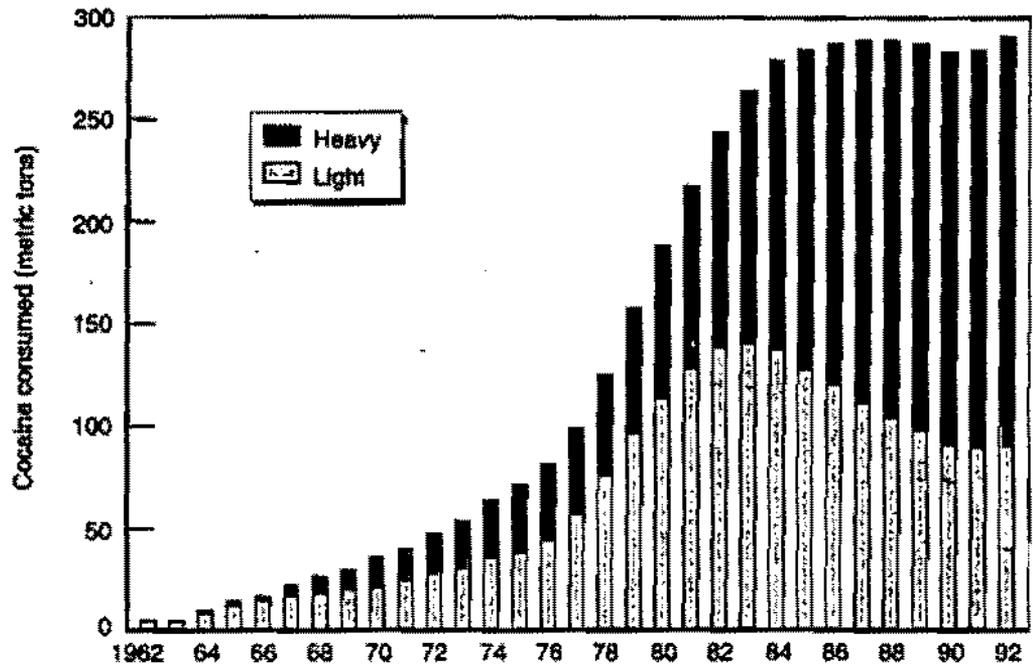


Figure S.7—Modeled Consumption: Heavy vs. Light Users

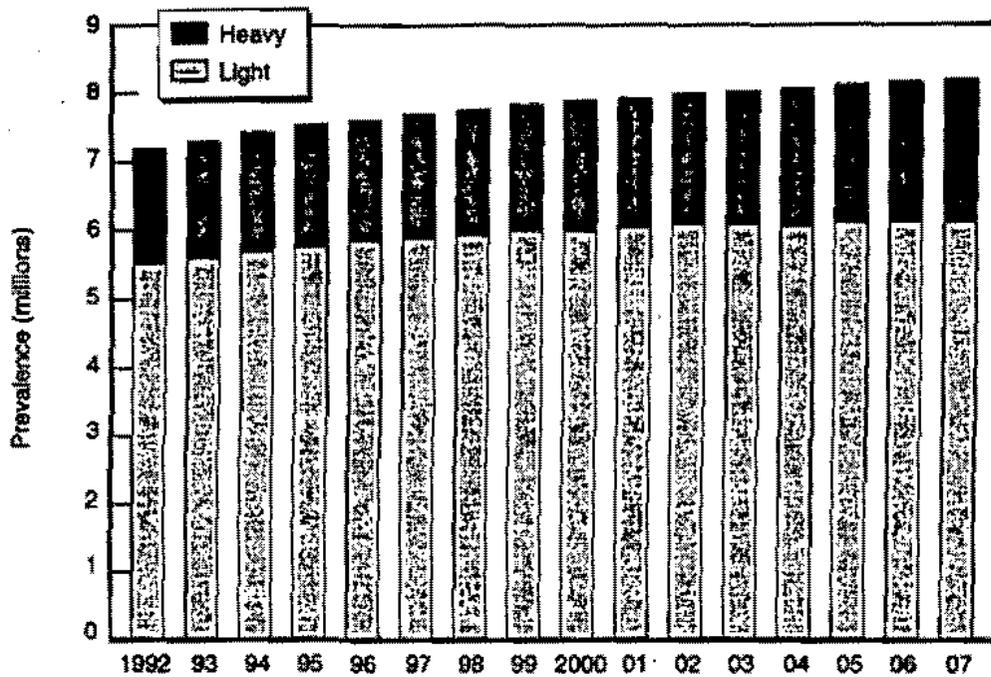


Figure S.8—Prevalence Assuming Constant Incidence

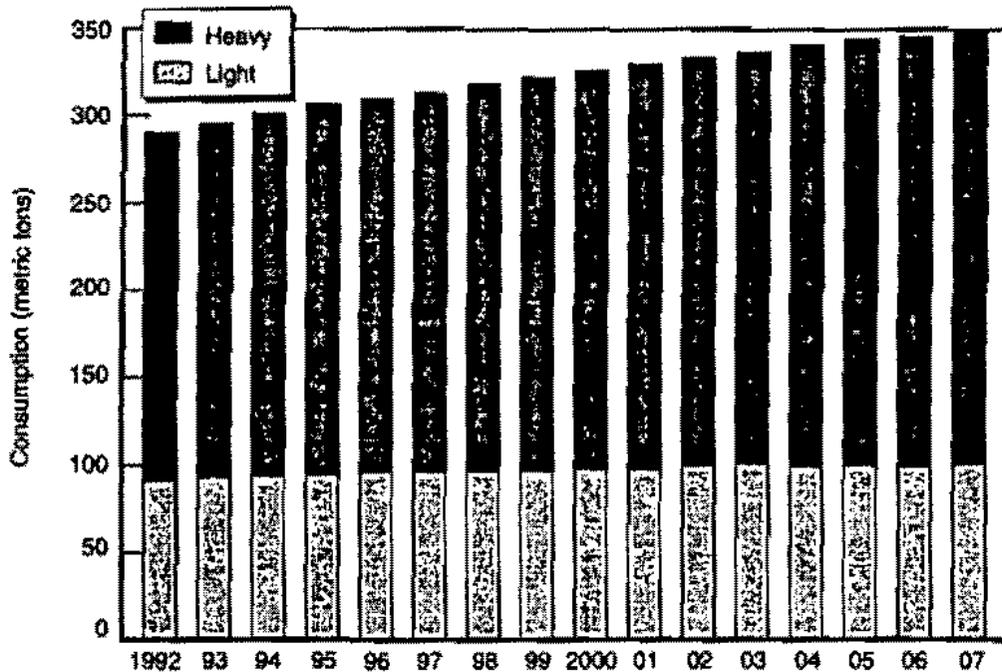


Figure S.9—Consumption Assuming Constant Incidence

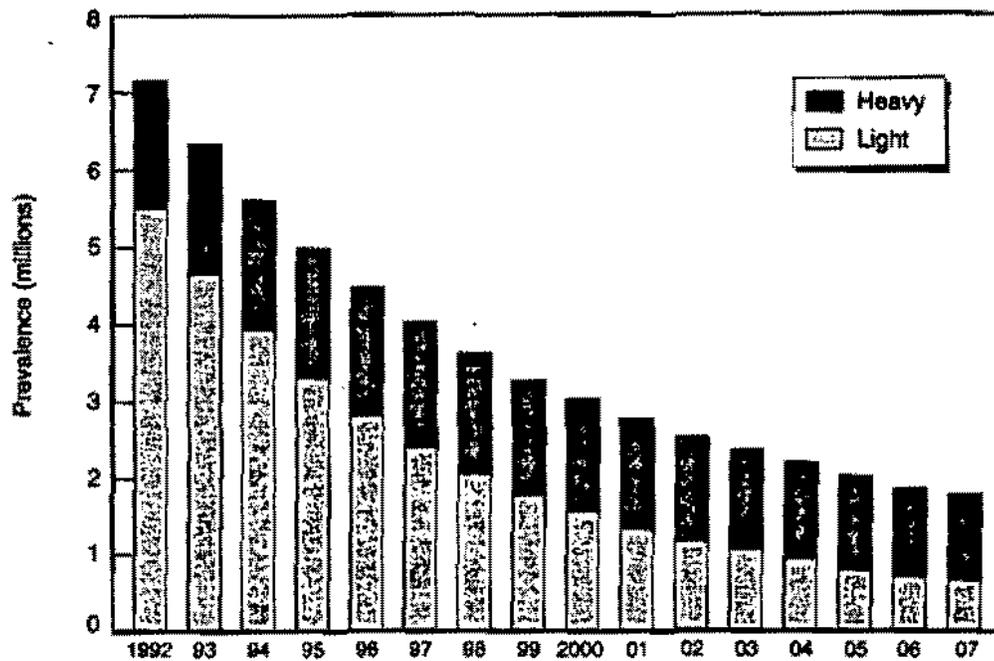


Figure S.10—Prevalence Assuming Zero Incidence

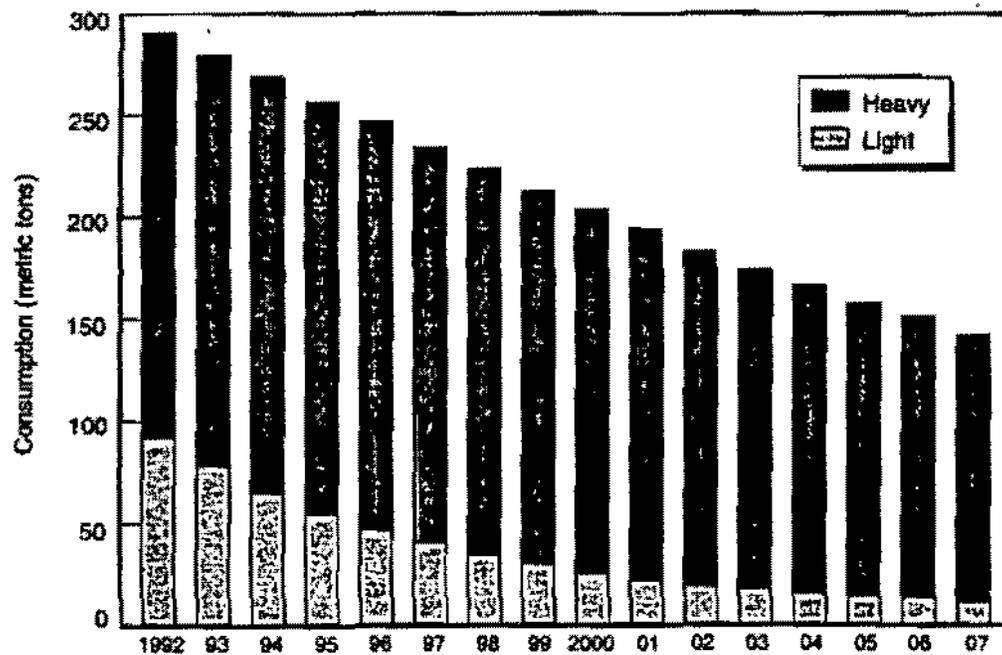


Figure S.11—Consumption Assuming Zero Incidence

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OBJECTIVE

Have the problems with cocaine use in the United States been getting worse or better? Until recently (and occasionally still today), there seemed to be no satisfactory resolution to the debate. Some pointed to the declining estimates of use among the household population and concluded that the situation was improving. Others pointed to indicator data, such as the number of hospital emergency room mentions of cocaine,¹ and asserted that the situation could only be degenerating. The debate was muddled because people failed to recognize a simple fact: as the cocaine epidemic evolves, different measures of its severity are affected in different ways.

The extent of the cocaine problem in the United States can be measured in a number of different ways: number of users, amount of cocaine consumed, number of people requiring treatment to desist in cocaine use, how often hospitalization is related to cocaine use, societal cost of cocaine use, and so on. Various instruments exist for estimating these quantities. Perhaps the most generally known and used is the National Household Survey of Drug Abuse (NHSDA) sponsored by the National Institute on Drug Abuse (NIDA), which measures the prevalence of cocaine use (i.e., the number of cocaine users) among the U.S. household population. (It is this prevalence data that supports the belief that the cocaine problem is decreasing.²) Unfortunately, the data produced by these various instruments are often incomplete, erratic, and contradictory. Thus, integrating the data to produce an overall picture of the cocaine problem in the United States that can sufficiently support decisions about drug control policy is a difficult task, as evidenced by the aforementioned debate.

It is now generally understood that even though the overall number of cocaine users is decreasing, more and more of the users that persist are either addicted users or serious abusers, the so-called "heavy" users. To elevate the debate to a new level, we must now understand more precisely the magnitude of these trends. For effective policy analysis, we must be able to test hypotheses about such trends; for example, has the decrease in the total number of users led to decreased consumption, or has

¹Emergency room mentions of drug use are tracked by the Drug Abuse Warning Network (DAWN).

²Additional evidence of the decline in cocaine usage is found in the Monitoring the Future surveys of high school seniors.

the increase in the number of heavy users more than offset the decrease in total users, causing consumption to increase?

In designing effective drug control policy, a model of how the demand³ for cocaine changes over time—i.e., a model that incorporates some of the various available data and interprets them—is a useful integrative tool. This report describes a simple version of such a model and presents an analysis aimed at extending the current qualitative understanding of the cocaine situation by providing quantitative estimates of the trends in cocaine demand. We begin by synthesizing data about “what” has happened in the recent cocaine epidemic; we then go on to explore “how” and “why” by modeling the flow of users into and out of cocaine use. Specifically, demand is determined by a two-state Markovian model of the user flows, implemented on a spreadsheet, that has been fitted to 20 years of historical data on cocaine usage derived from the NHSDA and other sources.

This research on the demand for cocaine complements recently completed research on the supply of cocaine.⁴ The combined understanding from these two studies clarifies the ways in which the cocaine epidemic responds to alternative cocaine-control programs—supply-control programs such as interdiction, and demand-control programs such as drug treatment. The research described here also feeds into a broader analysis by providing a baseline model of cocaine-demand dynamics that can be used to measure and compare the effects of policy changes.⁵

In addition to supporting the broader analysis, the model elucidates information that is difficult or impossible to extract or intuit directly from the data sources, and facilitates comparison of those data. It allows exploration of the dynamics of the cocaine epidemic, both the trends and the flows. Moreover, given a hypothetical scenario of incidence (i.e., a specified number of new cocaine users in a given period of time), it can project a course for the cocaine epidemic (the validity of the projection will, of course, depend on the accuracy of the incidence scenario).

BACKGROUND

The Markovian approach to modeling prevalence in this analysis can usefully be distinguished from purely statistical techniques such as multiple capture, Poisson estimation, and synthetic estimation,⁶ and from elaborate behavioral models such as the system dynamics models.⁷ Compared to the purely statistical methods, which offer only a point estimate of prevalence, our Markovian model has more behavioral content—i.e., flows into and out of use, and consumption rates. Compared to system

³Demand combines the number of cocaine users with the amount of cocaine they are consuming.

⁴See Dombey-Moore, Resetar, and Childress (forthcoming).

⁵The broader analysis, in which various drug control policy options are compared, is described in Rydell and Everingham (1994).

⁶See, for example, Rhodes (1993).

⁷See the recent review articles by Hser (1993) and Wickens (1993).

dynamics models, however, our model has less behavioral content.⁸ In particular, it does not include the feedback effect of prevalence on incidence. As Musto (1973) points out in his historical analysis of a century of drug use, drug epidemics eventually end when, with time, a new generation becomes sufficiently aware of the dangers to impede the inflow of new users. Unfortunately, after two (or so) generations have passed, awareness of the dangers fades, and incidence can resurge.

Rather than modeling incidence and this feedback effect, our model scripts incidence. That is, incidence estimates determined from historical data are used when fitting the model, and incidence scenarios are used for projecting the future. While not suited for modeling epidemics on the macro scale, our approach is useful for short- and intermediate-range prevalence estimation. It is particularly useful for analysis of an ongoing epidemic, as is currently the case with cocaine.

DATA USED TO FIT MODEL

The NHSDA was the primary instrument used to determine the model parameters. It is an occasional (more recently, annual), extensive survey of drug usage in the United States. The NHSDA focuses on the U.S. household population and therefore misses institutionalized populations (such as the incarcerated) and (until recently) the homeless. The NHSDA estimates were modified by adding estimates of the number of cocaine users among the incarcerated and homeless, and then the model was fit to this composite population estimate. This adjustment is important because drug users are more prevalent among the incarcerated and homeless populations than among the U.S. population in general. It turns out that the sizes of these additional populations are small compared to the household population, so the effect on the overall prevalence estimates presented here is minor. However, since heavy users are overrepresented among these nonhousehold populations, the effect on heavy-user prevalence is more dramatic than that on total prevalence.

LIMITATIONS OF THE MODEL

One shortcoming of this analysis is that the prevalence estimates implied by the NHSDA may be too low, even after adjustment to account for the nonsurveyed populations (the homeless and the incarcerated).⁹ Studies have established point estimates of the prevalence of drug usage via other and/or broader means (Rhodes, 1993), but they too are subject to significant uncertainty. For the purposes of this analysis, a series of prevalence estimates over time was required. No existing data other than the NHSDAs are sufficiently consistent over time to serve as the basis for this modeling exercise. Our prevalence estimates could conceivably have been im-

⁸For example, see Levin (1975) and Homer (1990, 1993).

⁹This shortcoming results from possible nonresponse and underreporting biases. Since the NHSDA relies on self-report of drug use, the potential for underreporting bias certainly exists (see, for example, Falck et al., 1992), even though Mieczkowski (1990) found that self-reported drug use is often accurate. Regarding the NHSDAs, the response rate in all but two surveys was good (at least 80 percent), and the 1988 and 1990 surveys (at least) were adjusted to account for nonresponse bias. The magnitude of the bias linked to the pattern of nonresponse in the NHSDAs is likely to be small (Harrison, 1991).

proved, but not without considerable effort. And in any case, uncertainties inherent in the data would have remained to overshadow the improvement.

Obviously, the validity of the model hinges upon the validity of the data on which it is based. Better estimates of prevalence among the homeless and the incarcerated than ours (which are only rough) and better estimates of the history of incidence would no doubt improve the model's validity. However, our findings would be unlikely to change, as sensitivity excursions have demonstrated.

This analysis attempts neither to measure changes in the flow rates nor to explain the forces behind those changes. In particular, when estimating the flow rate parameters in the model of cocaine demand, we did not control for changes over time in the price of cocaine or the availability of treatment. The general trends during the period were that the price of cocaine fell and the availability of treatment increased. These trends tend to have opposite effects on the flow rates (i.e., decreasing price should decrease outflow, whereas increased treatment should increase outflow). In essence, we ignored these dynamic effects and fit the parameters to the "average conditions" in price and treatment over the period modeled (from the early 1960s to the beginning of the 1990s).

We use *cocaine* to mean either crack or powder. This analysis thus covers both but does not distinguish between them. The introduction of crack in the late 1980s may have altered the patterns of cocaine use—for example, crack users may move more rapidly than powder users from casual use to addiction. Understanding such differential effects was beyond the scope of our modeling effort.

REPORT ORGANIZATION AND OVERVIEW

The rest of this report is divided into seven chapters. The first of these, Chapter Two, describes the generic Markovian modeling concept and explains the rationale for the two-state, four-parameter model structure.

Chapter Three then presents in detail the prevalence data to which the model was fit. This model separates users into two categories: light users and heavy users. This approach represents a compromise between modeling the entire spectrum (which is infeasible) and modeling a single average user (which is insufficient). It is consistent with the intuitive belief that heavy users should be viewed and counted differently than light users because of the different social costs associated with heavy cocaine consumption. Heavy users are defined to be people who use cocaine at least weekly. In addition to the overall prevalence numbers, the fraction of all users that are heavy users and the relative consumption rates of light and heavy users are discussed in Chapter Three.

A cohort retention rate gives the fraction of a cohort of initiates still using the drug after a given period of time. We calculate cohort retention rates from NHSDA data in Chapter Four; various estimates of annual incidence, which is an input to the model, are described in Chapter Five.

The four unknown parameters of the Markovian model, the flow rates, are determined by the fitting procedure explained in Chapter Six. This procedure requires the model to match (1) the overall prevalence data for the entire course of the current epidemic, (2) the fraction of all users that are heavy users over recent time, and (3) the ten-year cohort retention rate. This analysis determines the *fixed* flow rates that best match the historical data.¹⁰

Interesting observations about the history of demand that are not directly evident from the data alone but are highlighted by the model are discussed in Chapter Seven. Prevalence projections based on hypothetical incidence scenarios are presented in Chapter Eight.

¹⁰The dynamic nature of the modeled system deserves emphasis: along with prevalence and incidence, flow rates and consumption rates also vary with time.

By a Markovian model, we mean one that incorporates one or more states and the probabilities of transition between them. The transition probabilities depend only upon the existing state of the system. The model can be represented by a simple system of (possibly nonhomogeneous) linear difference equations: $Q(t) - Q(t-1) = A \cdot Q(t-1) + F(t)$, where t is the discretized time variable, Q is some vector quantity representing the states of the system, A is the matrix of transition probabilities, and F is the optional nonhomogeneity known as the forcing function. The corresponding differential equation is $dQ(t)/dt = A \cdot Q(t) + F(t)$.

The simplest Markovian model is one that includes only one state, in which Q , A , and F are scalar quantities. From elementary calculus, one recognizes that the solution to the corresponding homogeneous differential equation (i.e., $F(t)$ is identically zero) is $Q(t) = Q(0) \cdot \exp(A \cdot t)$. This system is either constant, exponentially growing, or exponentially decaying. The solution to the homogeneous, higher-dimensional system is also straightforward. It can be represented by the same solution equation if $\exp(A \cdot t)$ for a matrix A is defined appropriately. The geometry of the solution is again one of only a handful of possibilities. The presence of a forcing function (the nonhomogeneity $F(t)$) greatly complicates the geometry, regardless of the dimension of the system.

The goal of this research was to develop a dynamic (i.e., time-dependent) model of the number of cocaine users in order to better understand the flow of users into and out of drug use. For this application, we considered the population of non-users to be unlimited in size, so non-use is not a quantified state in the model. Moreover, we assumed that a flow is only dependent on the magnitude of the source; that is, the flow from state 1 to state 2 is proportional to the size of the state 1 pool only.¹ Therefore, the flow of people from non-use to use, the incidence, is quantified by a time-dependent forcing function. The time step of the model, consistent with the available data, is one year.

¹More complicated, usually nonlinear, models, in which the flow from a source is a function of the sizes of pools other than the source, are commonly hypothesized in many applications, including epidemiology. For example, one could hypothesize that the flow into drug use is proportional to the number of current users, since current users are the agents of "infection." The development of such models would be of significant theoretical and practical interest, but it is unclear if enough data exist to support their validation. As such, our approach was to create a simple but credible model that can later be further developed, which is the only prudent way to develop a model of a very complicated system.

There are several such models, ranging in complexity, that are applicable. The simplest is the one-state model diagrammed in Figure 2.1. The year is represented by t , the annual incidence is represented by $I(t)$, the number of users is represented by $U(t)$, and the flow of users to non-use is represented by $a \cdot U(t)$. As discussed in Chapter One, the values of the unknown parameters (the transition probabilities) that make the model best fit the available data are determined by the analysis; this model has only one unknown parameter, the transition probability a . This model, however, was deemed too simplistic for two reasons. First, it does not distinguish between light and heavy users, and analysis of NHSDA data supports the importance of this distinction (see Chapter Three). Second, it could not be well fit to the prevalence and cohort retention data (i.e., no value of a provided for an adequate fit of the data).

If users are divided into two groups—light and heavy users—that are counted separately, then a two-state, four-parameter model is generated (see Figure 2.2). This model could be further refined in one of two ways, both of which increase the number of unknown parameters that must be fit to the data and hence add to the complexity of the model and the fitting procedure.

The first possible refinement is to divide the users into more than two groups (such as light, medium, and heavy users). This option was deemed superfluous and not supportable by the available data. The second possible refinement is to have users flow into “previous user” pools instead of returning to the non-user pool. This option, not covered in our analysis, does have merits (such as permitting a distinction to be made between incidence and relapse) that suggest it should be further explored. The reality is that the dynamics of cocaine use could be represented by many different such Markovian models. Of course, fitting to these more complex models, which have more than four unknown parameters, would be significantly more difficult.²

We adopted the two-state, four-parameter model for this analysis because it is complex to a necessary and sufficient degree. It supports the most important behavioral

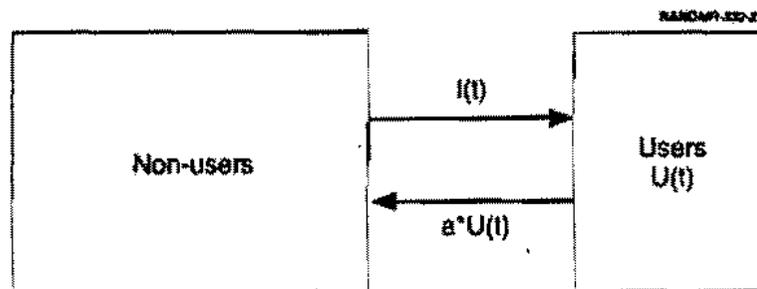


Figure 2.1—A One-State Markovian Model

²Dividing users into only two groups is, indisputably, a modeling convenience, since users exhibit not just two, but rather a wide variety of behavior patterns. However, model building always requires a compromise between simplicity and detail, the main driver of which is the character of the supporting data.

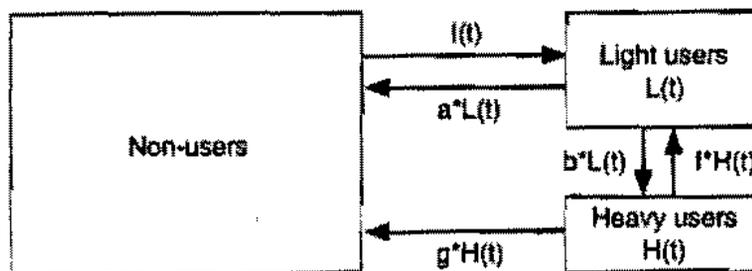


Figure 2.2—A Two-State Markovian Model

distinction, that between light and heavy use, without encumbering the model with unneeded detail and without requiring excessive extrapolation of the available data. The data to which the model was fit are described in Chapters Three and Four.

In our analysis, people are considered either non-users of cocaine (a group assumed to be unlimited in size), light users, or heavy users.³ New users enter only the light-user pool. The flow of non-users to light use, which is the incidence I , is a scripted input to the model. That is, the counts of light users are adjusted each year (the time step of the model) by an (external) estimate of the number of new users.⁴

Some light users flow on to heavy use, but most flow out of the light-user pool into non-use, reflecting the natural tendency of most initiates to quit using cocaine. Heavy users flow back to light use or out of cocaine use. $L(t)$ and $H(t)$ represent the time-dependent (i.e., year-dependent) numbers of light and heavy users, respectively. The fraction of light users that flow out of cocaine use each year is denoted by a , the fraction of light users that flow on to heavy use is denoted by b , the fraction of heavy users that flow back to light use is denoted by f , and the fraction of heavy users that flow out of cocaine use is denoted by g . These four flow rates (also known as transition probabilities) are the fractions of people who flow from the various states during a given year. They are the unknown parameters that must be chosen to fit the historical data.⁵

The model can be represented by a system of two linear, nonhomogeneous difference equations:

$$L(t) - L(t-1) = -(a + b) \cdot L(t-1) + f \cdot H(t-1) + I(t)$$

$$H(t) - H(t-1) = -(f + g) \cdot H(t-1) + b \cdot L(t-1)$$

³This Markovian model is called a two-state model because two pools (light users and heavy users) are tracked in size. Changes in the size of the non-user pool are not tracked.

⁴Chapter Five presents the annual incidence estimates assumed for the model. They count only new users, i.e., people who have used cocaine in the past year for the first time. Cocaine users who quit for a number of years and then relapse are not explicitly modeled.

⁵As discussed in Chapter One, even though flow rates probably vary with time, our analysis determines the fixed flow rates that best match the historical data.

ESTIMATES OF THE PREVALENCE OF COCAINE USE OVER TIME

A primary indicator of the extent of the illicit drug problem is prevalence, or the number of people who use drugs. The importance of this indicator is highlighted by the degree to which the government's policymakers rely on various prevalence estimates, especially those derived from the NHSDA, to measure the drug problem. In fact, six out of eleven of the goals detailed in the *National Drug Control Strategy* (Office of National Drug Control Policy, 1992) are based on prevalence. Although prevalence is not the only relevant indicator,¹ it is clearly an important element of the overall picture. Accordingly, the prevalence of cocaine use in the United States was one of the pieces of information used to determine the parameters of our model.

The principal survey instrument for estimating drug-use prevalence in the United States is, and has been for the last two decades, the NHSDA, which is sponsored by NIDA. The NHSDA reports drug usage among people aged 12 and older who are living in households in the United States.² Although the sampled population includes the vast majority³ of people twelve and older living in the United States, it omits some segments of the U.S. population that may include a substantial proportion of drug users, such as the incarcerated and the transient homeless. The prevalence estimates we used to establish the model parameters were based upon the NHSDA-derived prevalence estimates supplemented by estimates of cocaine use among the incarcerated and homeless.

ESTIMATES OF PREVALENCE DERIVED FROM THE NATIONAL HOUSEHOLD SURVEY OF DRUG ABUSE

The NHSD, which has been administered intermittently since 1971⁴ and annually since 1990, selects a random sample of the entire population of the United States

¹Others include (1) the estimated need for drug addiction treatment, as is championed by and estimated in a report by the Institute of Medicine (Gerstein and Harwood, 1990); (2) the number of drug-related emergency room episodes, which is compiled by DAWN; and (3) the attitudes of high school students toward drugs, which are monitored in an annual survey administered to the nation's high school seniors that is known as both Monitoring the Future (MTF) and the High School Senior Survey (HSSS). (See Ebener, Feldman, and Fitzgerald, 1993, for a list of drug-related databases.)

²The 1991 survey included, for the first time, some nonhousehold populations (described below).

³More than 99 percent, according to the U.S. Department of Health and Human Services (1991).

⁴Respondents were first asked about cocaine use in the 1972 NHSDA.

living in households (and, since 1991, living in some group quarters, such as civilians in military installations, students in college dormitories, and homeless in shelters). For each of several illicit and licit drugs, each respondent is asked (utilizing procedures designed to assure confidentiality) about any lifetime use, use during the past year, and use during the past month. Some respondents are also asked about their drug-use behaviors (such as frequency, quantity, age at first use).

Table 3.1 shows the estimated sizes of the populations at risk (i.e., the surveyed populations). It also shows the percentages of those populations that reported lifetime, past-year, or past-month cocaine use for each of the ten surveys conducted from 1972 to 1991 for which results regarding cocaine use were available.

These data, translated into the number of people reporting lifetime, past-year, and past-month cocaine use, are plotted in Figure 3.1.⁵ That the past-year and past-month curves were (until 1991) decreasing has been considered evidence that the nation's cocaine problem was becoming less severe.⁶ The recent leveling-off in the decline in past-year and past-month use has been recognized as a deceleration in progress against drug use. This deceleration has been credited to the fact that chronic, addictive drug use is much harder to combat than is casual, experimental use; progress is expected to become increasingly more difficult as a greater percentage of the users become chronic, addicted drug users (Office of National Drug Control Policy, 1992). The prevalence of drug usage thus may be an insufficient measure of the extent of the drug problem, a possibility that is further explored in Chapter Seven.

Table 3.1

Estimates of Populations at Risk and Percentage of Population Reporting Cocaine Use

Survey Year	Population at Risk (millions)			Percentage of Population Reporting Lifetime/Past-Year/Past-Month Cocaine Use ^a		
	Ages 12-17	Ages 18-25	Ages 26 and up	Ages 12-17	Ages 18-25	Ages 26 and up
1972	24.662	27.978	107.584	1.5/1.5/0.6	9.1/0.0/0.0	1.6/0.0/0.0
1974	25.047	30.158	112.422	3.6/2.7/1.0	12.7/8.1/3.1	0.9/0.0/0.0
1976	24.797	31.516	116.223	3.4/2.3/1.0	13.4/7.0/2.0	1.6/0.6/0.0
1977	24.938	30.553	117.266	4.0/2.6/0.8	19.1/10.2/3.7	2.6/0.9/0.0
1979	23.419	31.985	123.954	5.4/4.2/1.4	27.5/19.6/9.3	4.3/2.0/0.9
1982	23.304	33.072	126.105	6.5/4.1/1.6	28.3/18.8/6.8	8.5/3.8/1.2
1985	21.640	32.490	136.660	4.9/4.0/1.5	25.2/16.3/7.6	9.5/4.2/2.0
1988	20.250	29.687	148.409	3.4/2.9/1.1	19.7/12.1/4.5	9.9/2.7/0.9
1990	19.978	29.020	152.189	2.6/2.2/0.6	19.4/7.5/2.2	10.9/2.4/0.6
1991	20.144	28.496	154.218	2.0/1.5/0.4	18.0/7.7/2.0	12.0/2.5/0.6

SOURCE: NHSDA, various years.

^aWhere NHSDA estimates were unavailable or too low to be of sufficient precision, estimates of 0.0 were used.

⁵The 1988 survey reported fewer lifetime users than did the 1985 survey, which is not possible unless a disproportionate and highly unlikely number of lifetime users died in the interim. This discrepancy was corrected by interpolating adjacent data points.

⁶See, for example, the report by the Office of National Drug Control Policy (1992).

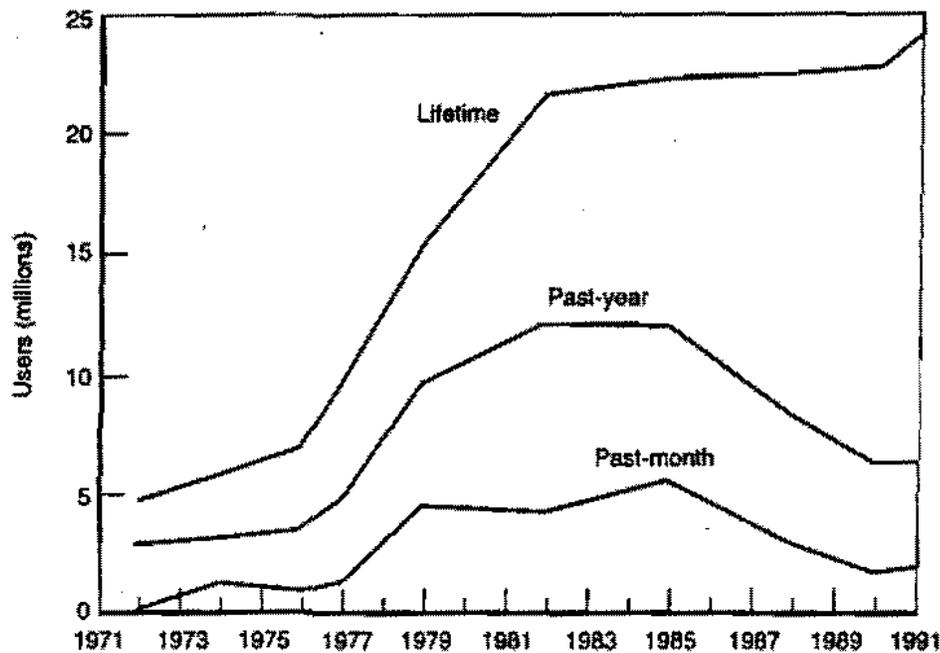


Figure 3.1—Number of People Reporting Lifetime, Past-Year, and Past-Month Cocaine Use

The numbers of people reporting past-year use were the basis for the prevalence estimates used to determine the model parameters. The estimates of the number of lifetime users were utilized to determine incidence in the procedure described in Chapter Five. The number of people reporting past-month use is sometimes regarded as a surrogate for the number of people currently and regularly using cocaine, but was not so regarded in this study. One problem with past-month counts is that they include people who use cocaine infrequently but by chance used it in the past month. Another problem is that regardless of the survey interviewer's assurances of confidentiality, the fact that cocaine consumption is an illegal activity may make some people unwilling to admit to past-month use, even if they will accurately report past-year use.

DEFINITION OF LIGHT AND HEAVY USERS

Like any human behavior, cocaine usage varies across a spectrum. Some people use very little cocaine and only infrequently, some use a large amount daily, and some exhibit just about every behavior in between. As a modeling convenience, users were separated into just two categories: light users and heavy users. Modeling the entire spectrum is neither practical nor necessary, and modeling a single average user is insufficient (as discussed in Chapter Two and further explored in Chapter Seven). The average quantity consumed per user per year has changed substantially over the years because, as shown below, the distribution of user types has changed.

The conditions under which a cocaine user is considered to be a heavy user are not unambiguously defined. A number of criteria—including frequency of use, quantity of cocaine consumed, history of drug use, and the extent of adverse consequences to drug consumption—are all clearly relevant. For example, heavy and light users could be defined by the amount of cocaine consumed by each user. The problem with this approach, however, is that individuals are unlikely to precisely estimate how much they have consumed over a long period of time. They may be able to recollect how much they used the last time, but are unlikely to know how much they used several months ago.⁷ Presumably people estimate frequency of use more accurately. So, for this modeling exercise, the definition of light and heavy use was based simply upon frequency of use. The NHSDA asks people who used cocaine in the last year how frequently they used it. People who said they used it at least weekly were defined as heavy users.⁸ All other people who had used cocaine in the last year were defined as light users.

Clinicians and researchers commonly divide drug consumption into three levels: use (experimental, occasional, social consumption), abuse (regular, sporadically heavy, intensified consumption), and dependence (compulsive or addictive consumption).⁹ While these distinctions are undoubtedly clinically significant, this categorization of users is not easily derived from current prevalence estimating tools. In Gerstein and Harwood (1990), questions in the 1988 NHSDA similar to the World Health Organization's ICD-10 and the American Psychiatric Association's DSM-III-R diagnostics are used to determine the extent of the need for drug treatment. The latter two categories of abuse and dependence together approximately make up the group in need of treatment; this group roughly corresponds to the category of heavy use in our analysis.

Table 3.2 shows the percentage of users in each of the eight frequency categories from the 1990 NHSDA. By our frequency definition, 78 percent of all cocaine users (in 1990) would be considered light users. Notice that the category with the largest percentage of users is that corresponding to least frequent usage. Presumably there is a tendency among users to underreport both frequency and quantity of drug consumption. For this analysis, we assumed there was no significant bias in that underreporting—i.e., that light users underreport to the same degree as heavy users do.

The NHSDA asks cocaine users who responded positively to the past-month use question how much they consumed in that month. Crossing these data with the fre-

⁷Some users might be able to estimate how much money they have spent on drugs. But if they share their purchases or if the price of the drug is volatile, total amount of money spent would not translate well into an estimate of usage.

⁸For this analysis, "several times a month" and "at least weekly" were considered equivalent.

⁹The criteria for abuse and dependence are codified in the tenth edition of the *International Statistical Classification of Diseases, Injuries, and Causes of Death* (ICD-10), recently produced by the World Health Organization, and the third revised edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-III-R), produced in 1987 by the American Psychiatric Association. Each system offers an array of nine criteria, such as "progressive neglect of alternative pleasures or interests in favor of substance abuse" and "marked tolerance," any three of which trigger a diagnosis of dependence. Abuse is characterized by persistent substance use despite adverse consequences (DSM-III-R) or evidence that the substance causes the user actual psychological or physical harm (ICD-10). (Gerstein and Harwood, 1990.)

Table 3.2
Definition of Light and Heavy Cocaine Use

Category	Reported Frequency of Use During Year	Type of User	Percentage of All Users	Cumulative Percentage
1	1-2 days/year	Light	39.4	39.4
2	3-5 days/year	Light	18.9	58.3
3	Every other month or so	Light	9.6	67.9
4	1-2 times a month	Light	10.2	78.0
5	Several times a month	Heavy	10.2	88.2
6	1-2 days/week	Heavy	6.2	94.4
7	3-6 days/week	Heavy	4.4	98.8
8	Daily (6 days/week or more)	Heavy	1.2	100.0

SOURCE: 1990 NHSDA.

quency data provides an estimate of how much cocaine is consumed by people in each of the eight NHSDA frequency categories. These data from the 1990 NHSDA are displayed in Table 3.3.

The resulting past-30-day consumption by all members of each frequency group is shown in Table 3.4.¹⁰ Seventy-eight percent of all users in 1990 were considered light users by our frequency definition, but that group consumed only about 30 percent of the cocaine. Heavy users, a group that was smaller in number by a factor of

Table 3.3
Reported Number of Past-Month Cocaine Users Distinguished by Frequency and Amount
(in thousands)

Category	Past-Month Users	Grams Consumed During Past 30 Days ^a						
		0.125	0.25	0.5	1.0	2.0	3.0	4.0
1	264.0	142.9	29.0	19.6	0.0	0.0	0.0	0.0
2	157.9	58.9	30.3	15.9	0.0	19.0	0.0	0.0
3	124.2	72.6	0.0	1.9	0.0	0.0	0.0	0.0
4	289.6	57.5	44.3	49.5	10.0	103.3	0.0	0.0
5	326.5	60.6	34.6	93.5	12.8	9.8	42.0	40.2
6	198.9	20.6	68.5	0.0	40.2	52.4	0.0	6.1
7	130.3	23.8	0.0	0.0	0.0	22.2	36.0	30.7
8	36.9	0.0	0.0	0.0	2.8	0.0	1.4	31.7
N/A ^b	73.1	32.2	0.0	0.0	4.5	0.0	0.0	9.6

SOURCE: 1990 NHSDA.

^aThese totals include cocaine consumed both as powder and as crack. The conversion factor of 0.1 grams of cocaine per vial of crack was assumed.

^bNo answer provided.

¹⁰The total amount consumed during the past 30 days by people in each frequency group was determined as follows. The number of past-month users in each frequency group was adjusted up to account for the past-month users who did not respond to the frequency question. Then, the total amount consumed during the past 30 days by all people in a given frequency group was calculated by multiplying the number of people in an amount category by the corresponding amount, summing over all seven amount categories, and adjusting the number upward to account for the past-month users who did not respond to the amount question.

Table 3.4
 Estimated Amount of Cocaine Consumed During Past 30 Days by All
 Frequency Groups

Category	Cumulative Percentage of Users	Percentage of Consumption	Cumulative Percentage of Consumption
1	39.4	3.2	3.2
2	58.3	5.1	8.3
3	67.9	1.1	9.4
4	78.0	18.8	28.2
5	88.2	28.1	56.3
6	94.4	13.3	69.6
7	98.8	21.3	90.9
8	100.0	9.1	100.0

SOURCE: 1990 NHSDA.

almost four, consumed the rest of the cocaine.¹¹ Simply put, a large group of people used a small fraction of all the cocaine consumed in the United States, and a relatively small group of people used the rest—i.e., the vast majority. This finding is reflected in the concavity of the Lorenz curve, the (smoothed) cumulative percentage of consumption versus the cumulative percentage of users, plotted in Figure 3.2.

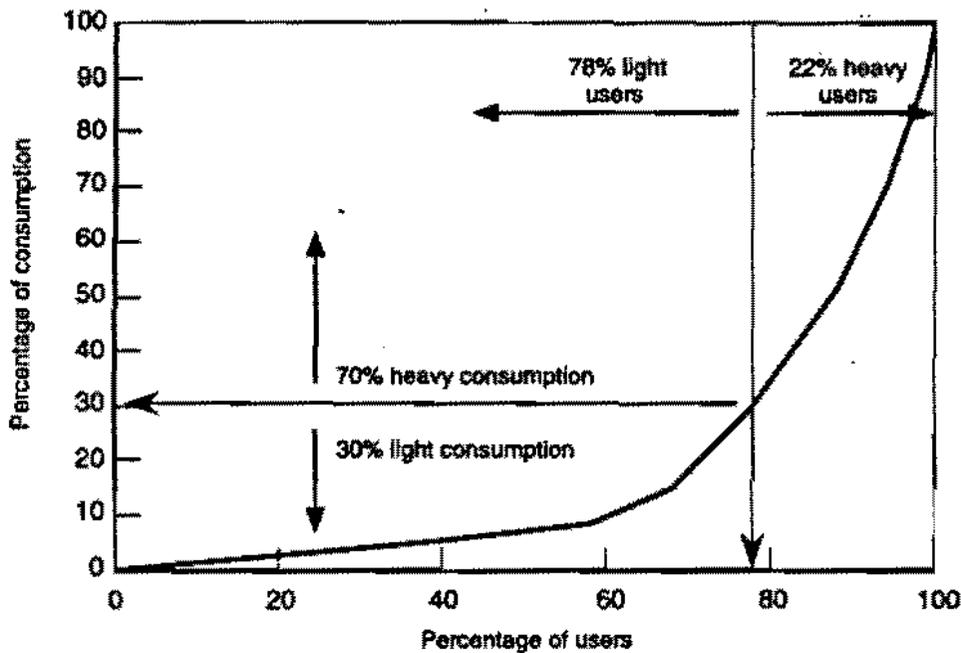


Figure 3.2—Cumulative Percentage of Consumption vs. Cumulative Percentage of Users

¹¹These fractions are by no means constant; see below.

This (smoothed) information can also be used to determine that heavy users on the average consume annually eight times as much cocaine as do light users, since $(30.0/78.0)/(70.0/22.0) = 1/8$ (see Figure 3.3).¹² Note that if the model considered only an average cocaine user, the fact that some users consume significantly more cocaine than others (and thus are perhaps more amenable to treatment) would be lost.

If the NHSDA accurately estimates both the number of users and how much those users consume, it should be possible to estimate the total amount of cocaine consumed by all users (in 1990) by simply multiplying the total consumption, 1585.7 kilograms, by the number of 30-day periods in a year (365/30). This calculation, however, leads to a total of only 19.3 metric tons, which is far less (more than an order of magnitude lower) than the amount estimated by other means to be consumed in the United States.¹³ Thus, either the number of past-month users or the amount those users consumed in the past 30 days, or both, must be significantly too low.¹⁴

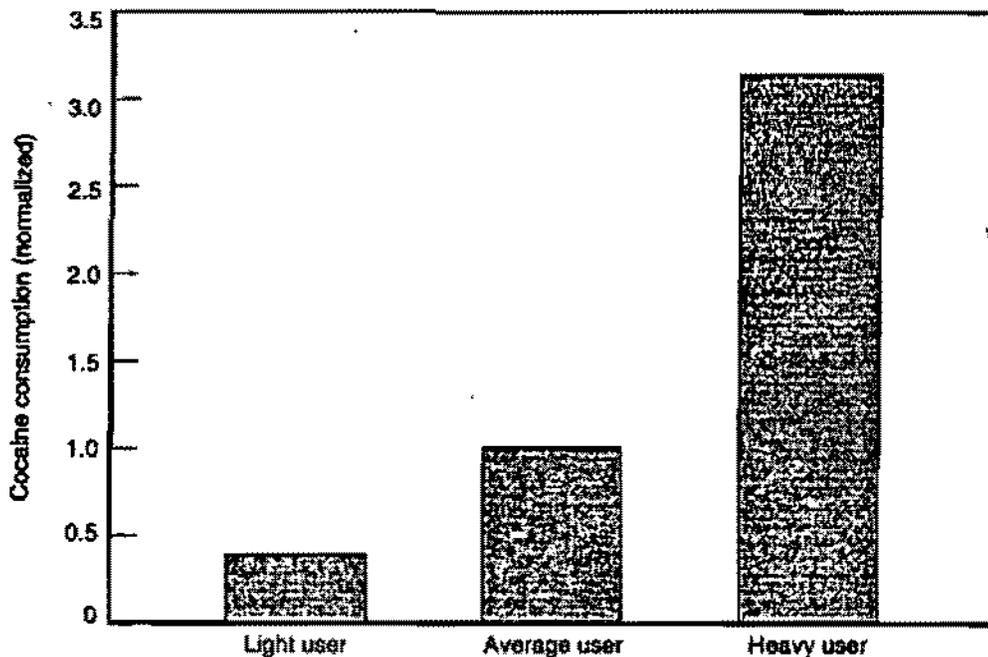


Figure 3.3—Average Annual Amount of Cocaine Consumed by Light and Heavy Users Normalized to Average Amount Consumed by Average Users

¹²Unlike the ratio of light to heavy users, this ratio of average light user consumption to average heavy user consumption is assumed constant for all years of the epidemic.

¹³See, for example, Rydell and Everingham (1994). A rough estimate of the amount of cocaine seized by law enforcement agencies is about 100 metric tons; if only 20 or so metric tons are consumed, this implies that 80 percent of all cocaine in the United States is interdicted, which is highly implausible.

¹⁴The number of past-month users was estimated from the NHSDA to be around 1.6 million in 1990. Since it is unlikely that this figure is off by an order of magnitude or more, it is very likely that the survey respondents' estimates of how much they have consumed in the last month are generally quite low.

As mentioned above, we assumed both heavy and light users underreport to the same degree, so the ratio of light-user to heavy-user consumption, one to eight, is justified by the above analysis, even if the actual amounts consumed on an annual basis by light and heavy users are not.

In sum, light users were defined as those who use less often than several times a month (i.e., less often than weekly), and heavy users were defined as those who use several times a month or more. The average heavy user annually consumes about eight times as much cocaine as does the average light user, and the average heavy user's consumption is more than three times the average consumption of all cocaine users. Although the consumption estimates are not relevant to establishing the Markovian model of demand, they were used to analyze consumption trends once the Markovian model was established. Exactly how much cocaine each average heavy user and each average light user consumes annually must be determined using a reasonable estimate of the total cocaine consumed in the United States in a year. This was done for the reference year 1992 (see Chapter Seven), in which consumption was estimated to be 291 metric tons (Rydell and Everingham, 1994).

VARIATION IN THE FRACTION OF HEAVY USERS OVER TIME

We assume that all new users are light users. So near the onset of the epidemic, nearly all users are light users. But with time, light users flow on to heavy use and the number of heavy users increases. There is no reason to expect that the fraction of all users that are heavy users remains constant with time, and in fact it does not. Table 3.5 reports the numbers of light and heavy users in 1985, 1988, and 1990 estimated from the corresponding NHSDA surveys, and the corresponding percentage of all users that are heavy users. The percentage of all users that are heavy users increases from 13.7 percent in 1985 to 22.0 percent in 1990. Two effects contribute to this increase: light users are flowing on to heavy use, and incidence (assumed into light use) is decreasing.

The Markovian model is required to match not only overall prevalence (the number of all users, whether light or heavy) over time (i.e., for every survey year from 1972 to 1991), but also the percentage of all users that are heavy users over time (for 1985, 1988, and 1990, the three survey years for which enough data were available to con-

Table 3.5
Percentage of All Household Users That Were Heavy Users in 1985,
1988, and 1990

Year	Users (millions)			Percent Heavy
	Light	Heavy	Total	
1985	10.3	1.6	11.9	13.7
1988	6.7	1.5	8.2	18.4
1990	4.9	1.4	6.2	22.0

SOURCES: 1985, 1988, and 1990 NHSDAs.

duct the frequency analysis¹⁵). Both the overall prevalence and the percentage of users that are heavy users estimated from the NHSDA were first adjusted to account for cocaine use among two populations not represented in the NHSDA, the homeless and the incarcerated. Our estimations of the number of homeless and incarcerated cocaine users are detailed in the next two sections, after which the estimates are combined to establish the overall prevalence estimates to which the model was fit.

ESTIMATES OF PREVALENCE AMONG THE HOMELESS

Presented here are very rough estimates of (1) the size of the homeless (or near-homeless¹⁶) population in the United States over the past several years, and (2) the number of light and heavy cocaine users within that population, which varies over time. The available estimates for the number of homeless are very broad, sometimes contradictory, and limited to just a few years; estimates of how many homeless people nationwide use cocaine do not seem to be available at all. The scarcity of good data on either the number of homeless or the prevalence of drug use among the homeless severely limited the accuracy of these estimates. We thus make no claims about them except that we believe they are reasonable and the best available.

The Number of Homeless and Near-Homeless

Estimates of the number of homeless and near-homeless people in the United States over the past three decades were derived as follows. A mid-range estimate of the number of homeless in 1983 is 300,000, reflecting Department of Housing and Urban Development (HUD), National Bureau of Economic Research (NBER), and ICF, Inc., estimates, as reported by the Urban Institute (Burt and Cohen, 1989, p. 25). The Urban Institute's estimate of the number of homeless in 1987 is approximately 500,000 based on a sampling of service-using homeless (i.e., homeless in shelters or using soup kitchens) and assuming 20 non-service-using homeless for every 100 service-using homeless.¹⁷ Estimates for other years reported by the Urban Institute are based on nominal constant annual growth rates, but since those nominal rates are not supported by empirical evidence, we did not use those estimates.

Until 1987, a constant annual growth rate (geometric growth) was assumed, the magnitude of which was determined by the 1983 and 1987 estimates.¹⁸ The annual growth rate based on the 1983 and 1987 estimates turned out to be about 15 percent, which is similar to those nominally assumed in other studies.¹⁹ After 1987, linear

¹⁵Although the 1991 NHSDA population estimates were available for our study, the detailed data necessary to differentiate between light and heavy users by frequency of consumption were not.

¹⁶That is, marginally housed (see discussion below).

¹⁷The Urban Institute suggests that assuming as many as 50 non-service-using homeless for every 100 service-using homeless would also be reasonable. However, most studies report street-to-shelter ratios that are lower than 50/100, and service-using homeless include not only those in shelters, but also those using soup kitchens. (Burt and Cohen, 1989, pp. 29-30.)

¹⁸This assumption has been used in other studies, for example, Burt and Cohen (1989, p. 25).

¹⁹See Burt and Cohen (1989, p. 25).

growth of 50,000 per year was assumed.²⁰ This population includes both adults and children. The Urban Institute estimates that about 15 percent of the service-using homeless in 1987 were children;²¹ assuming this fraction to be constant, the annual number of homeless adults was determined.²²

Thus far are included the number of homeless people on the streets or in shelters at a given point during the year. It is estimated that many more experience homelessness at some time during the year—two to three or more times as many. The people who are not homeless but who have unstable housing arrangements—i.e., the *marginally housed* or *near-homeless*—are unlikely to be represented in households and are thus unlikely to be counted in the NHSDA.²³ Assuming the number of near-homeless to be 1.5 times the number of homeless,²⁴ and assuming the fraction of children in this population is the same as it is for the homeless, the number of homeless/near-homeless adults was calculated. The estimates of the numbers of homeless (with the two original data points indicated), homeless/near-homeless, and adult homeless/near-homeless are plotted in Figure 3.4.²⁵

The Fraction of Homeless That Use Cocaine

Fischer (1987) provides some insight into the prevalence of drug use and abuse among the homeless prior to 1987. Her paper reviews a number of then-recent studies and presents the reported estimates of illicit drug use. She states (1987, p. 6):

Since definitions and measures of drug use were not comparable in most cases, estimates were grouped in two categories consisting of reports of ever or occasionally using drugs and recent or regular use. This is a crude indicator of "casual" use versus abuse in homeless individuals. The estimates of drug use ranged from 3 percent to 31 percent.

²⁰Estimation of the number of homeless after 1987 based on continued geometric growth led to implausibly (but not impossibly) high numbers for recent years. Because good nationwide estimates of the number of homeless in recent years were not available, we adopted the more conservative assumption of constant annual growth. Under the pre-1987 assumption of constant annual growth rate, the number of homeless increased about 0.5 million between 1986 and 1987; this was the post-1987 growth we assumed.

²¹Burt and Cohen (1989, p. 28). The authors do not explicitly define the age at which young people are considered adults. We assumed that their definition of children corresponds to people too young to use cocaine.

²²The Institute of Medicine reports that about 75 percent of the homeless are unattached adults and the rest are mostly single mothers with children (Gerstein and Harwood, 1990, p. 84). This finding is not inconsistent with the Urban Institute estimate: 75 percent of the homeless are unattached males, 8 percent are unattached females, 8 percent are single mothers with children, 2 percent are other families with children, and the rest are other family groups without children (Burt and Cohen, 1989, p. 39).

²³Some stay temporarily during these intervals of homelessness with family or acquaintances, but nonetheless they are excluded from the household population (Gerstein and Harwood, 1990, p. 84).

²⁴The Institute of Medicine claims that "200,000 to 700,000 people . . . are homeless on any given night and as many as 2 million experience homelessness at some point during a year" (Gerstein and Harwood, 1990, p. 84). The Urban Institute calculates that about twice as many people experience homelessness at some time during the year as are homeless during a month (Burt and Cohen, 1989, p. 32).

²⁵Only the counts from about 1972 and later are relevant to the analysis, since 1972 is the first NHSDA survey year for which cocaine data are available. We included the earlier years so that our model of the cocaine epidemic would have an initial tail instead of an abrupt start.

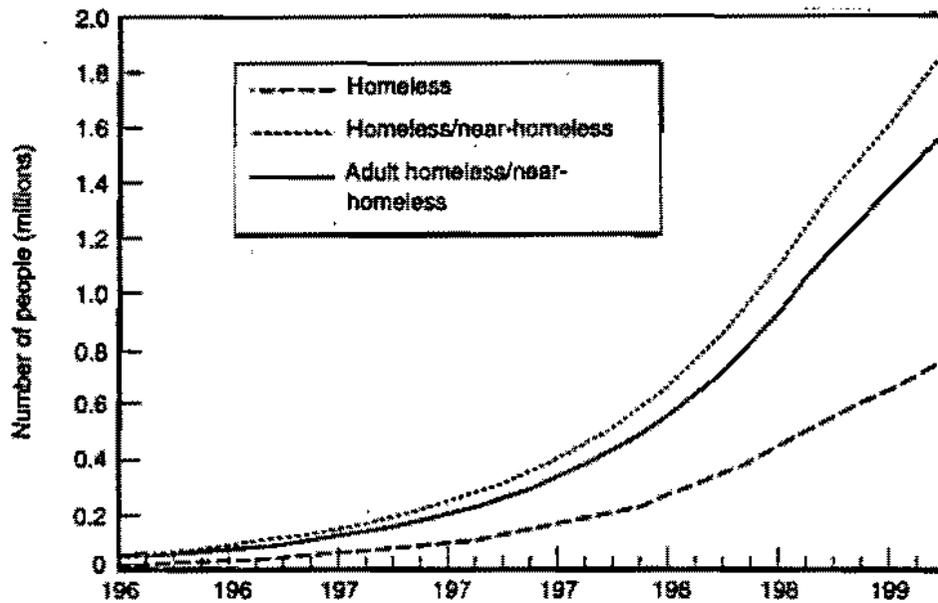


Figure 3.4—Numbers of Homeless, Homeless and Near-Homeless, and Adult Homeless/Near-Homeless Over the Past Two Decades

For lack of better information, we assumed that ever/occasional use corresponded to light use, and recent/regular use corresponded to heavy use. Only one of the studies covered by Fischer (one published in 1987 and thus presumably representing 1986 conditions) was national. It reported (Fischer, 1987, Table 5) that 10 percent of the nation's homeless were recent/regular drug users, but did not report what percentage were ever/occasional users. Averaging the ratio of ever/occasional to recent/regular percentages in those studies that did report both (each of which focused upon a particular city) suggests that it is reasonable to estimate that the percentage of ever/occasional drug users among the nation's homeless was around 20 percent (twice the recent/regular prevalence rate) in 1986.

How much of that drug use can be attributed to cocaine? Fischer states (1987, p. 2) that "although alcohol is the drug of choice among the homeless, partly due to economics, there is evidence suggesting that [illicit] drug abuse also affects substantial proportions." Prior to the introduction of crack, which was sometime before 1987 (the first year the NHSDA surveyed crack usage), cocaine was probably not widely used by the homeless. Assuming that one-fourth of the illicit drug use among the homeless in 1986 can be attributed to cocaine, we estimate that about 5 percent of the homeless were light cocaine users and 2.5 percent were heavy cocaine users in that year. These prevalence rates are comparable to (although a bit higher than) the estimates (based on the NHSDA) of the prevalence of light and heavy cocaine users in the household population. Prevalence rates among the homeless for years prior to 1986 were determined by adjusting the 1986 light and heavy prevalence rates (5 per-

cent and 2.5 percent, respectively) by rough estimates of the light and heavy prevalence rates in the household population.²⁶

Estimating the extent of cocaine use among the homeless for the years after 1986 is more difficult. According to unpublished data collected by Audrey Burnam of RAND, there is evidence that a dramatic increase in drug usage and dependence among the homeless in Los Angeles occurred recently (from 1985 to 1991), presumably *because of an increase in cocaine, and particularly crack, usage*. If this pattern is also true nationally, then assuming that the cocaine usage rates after 1986 are the same as in 1986 leads to a serious underestimate of cocaine usage among the homeless. Burnam's data show that recent drug use (within the past six months) among the homeless in Los Angeles increased from 10 percent to 29 percent, lifetime use increased from 31 percent to 51 percent; and a startling 21 percent of the homeless in Los Angeles are *dependent* on cocaine. For our analysis, it was assumed that both the light and heavy prevalence rates increased linearly to 20 percent in 1991. (If drug usage among the homeless has increased because of crack addiction, assuming the light rate is twice the heavy rate is no longer justifiable.)

The Numbers of Light and Heavy Cocaine Users in the Homeless/Near-Homeless Population

Finally, we assumed that the prevalence rates among the near-homeless are one-half the prevalence rates among the homeless.²⁷ Figure 3.5 depicts the numbers of light and heavy cocaine users in the homeless/near-homeless population for each year of the cocaine epidemic. This estimation suggests that the numbers of light and heavy cocaine users were not significant prior to 1985, but that they became increasingly significant after 1986. Hereafter, the combined homeless/near-homeless population will be referred to as simply the homeless population.

ESTIMATES OF PREVALENCE AMONG THE INCARCERATED

Estimation of the number of cocaine users among those who are incarcerated is also a two-step process. First, the size of the incarcerated population for each year in the past three decades is assembled, and then the fractions of the incarcerated population that are light and heavy cocaine users, which vary over time, are roughly estimated. These figures determine the number of light and heavy cocaine users among the incarcerated that must be added to the NHSDA-derived counts. By incarcerated cocaine users, we mean people who would be users if they were not incarcerated. Incarcerated people consume little if any cocaine, reflecting the incapacitation effect of incarceration.²⁸ However, those people using drugs before entering jail or prison

²⁶The rough estimates were derived from an early version of the Markovian model (fit to NHSDA data only, and unadjusted for homeless and incarcerated users). Using the household prevalence rates, instead of the prevalence numbers, ensures that homeless prevalence rates during the early years of the cocaine epidemic are not overestimated.

²⁷The Institute of Medicine report (Gerstein and Harwood, 1990, p. 84) makes a similar assumption.

²⁸Between July 1, 1989, and June 30, 1990, 0.4 percent of drug tests in federal prisons and 1.4 percent of drug tests in state confinement facilities were positive for cocaine. However, these numbers may

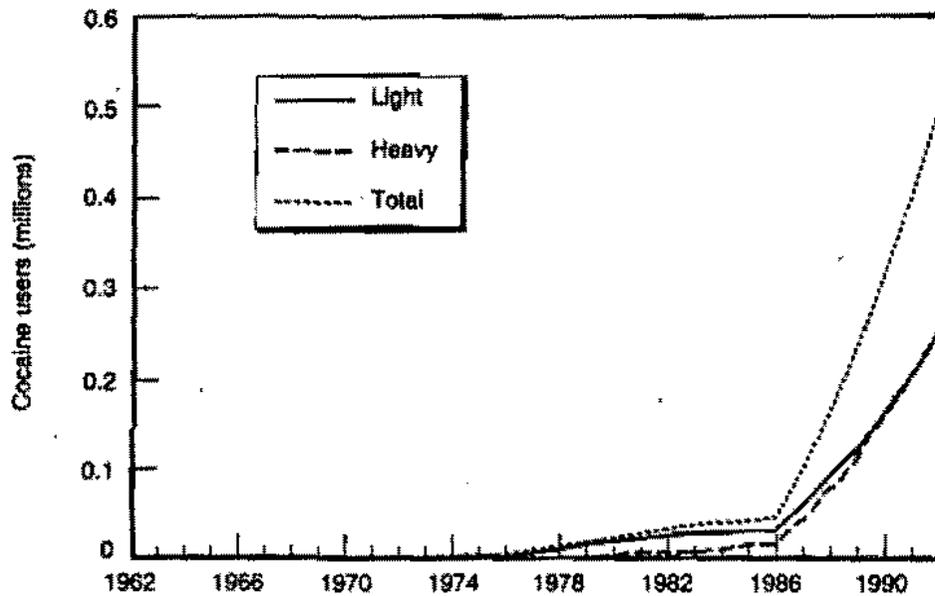


Figure 3.5—Light, Heavy, and Total Cocaine Users in the U.S. Homeless/Near-Homeless Population

will likely use drugs after release, unless treated for drug abuse/addiction while incarcerated. We thus considered people who were drug users before incarceration to be drug users, even though they did not use drugs while incarcerated.

The Size of the U.S. Incarcerated Population

The numbers of people in federal prison, state prison, or jail for each year from 1960 to 1990 are displayed in Table 3.6. The numbers represent average prisoner counts on any given day during the year, not the total number of people cycled through the system in a given year. As such, they represent the size of the population not counted in the NHSDA surveys. These data (combined with estimates of the missing data) are then plotted in Figure 3.6.

The Fraction of the Incarcerated Population That Use Cocaine

An analysis of the data from the 1986 Survey of Inmates of State Correctional Facilities showed that 43.7 percent of state prison and jail inmates admitted to having ever used cocaine, and that 22.2 percent admitted to having used cocaine regularly (once a week or more). Unfortunately, these data do not correlate directly with the NHSDA-derived data, since the inmates were not asked if they had used cocaine in

somewhat overstate the actual prevalence because they include tests that were for cause, not just random and systematic screens (Bureau of Justice Statistics, 1991).

Table 3.6
 Counts of Various Incarcerated Populations
 (in millions)

Year	Federal and State Prison	Federal Prison	State Prison	State Jail	Total ^a
1960	0.212	0.023	0.189	0.119	0.331
1961	0.220				0.342
1962	0.218				0.344
1963	0.217				0.346
1964	0.214				0.346
1965	0.210	0.021	0.189		0.346
1966	0.199				0.338
1967	0.194				0.336
1968	0.187				0.332
1969	0.196				0.345
1970	0.196	0.020	0.176	0.152	0.348
1971	0.198				0.345
1972	0.196			0.141	0.337
1973	0.204				0.348
1974	0.218				0.365
1975	0.240	0.024	0.216		0.390
1976	0.262				0.414
1977	0.278				0.433
1978	0.294			0.158	0.452
1979	0.301				0.472
1980	0.315	0.020	0.295		0.499
1981	0.353				0.550
1982	0.394	0.023	0.371		0.604
1983	0.419	0.026	0.393	0.223	0.642
1984	0.443	0.027	0.415	0.234	0.676
1985	0.480	0.032	0.447	0.256	0.735
1986	0.522	0.036	0.485	0.274	0.795
1987	0.560	0.039	0.521	0.295	0.855
1988	0.603	0.042	0.560	0.343	0.945
1989	0.680	0.047	0.633	0.395	1.075
1990	—	0.050	0.688	0.405	1.143

SOURCES: (1) Bureau of Justice Statistics, *Source Book of Criminal Justice Statistics*, 1990, p. 604; (2) *Statistical Abstracts of the United States*, 1967, p. 163; 1972, p. 162; 1975, pp. 167-168; 1992, p. 197.

^aSummation of federal and state prison and state jail populations (columns 2 and 5). The number of people in state jails for years without data is estimated by linear interpolation of the state jail data.

the past year (data we used to determine prevalence), and the question about regular use did not specify how recently that regular use had occurred. However, since past-year users are a subset of lifetime users and recent weekly users are a subset of people who have used weekly at some point, 43.7 percent and 22.2 percent are upper bounds on the fractions of inmates (in 1986) that were users and heavy users of cocaine, respectively. The fraction of all inmates that are light or heavy cocaine users was estimated using these upper bounds.

For years after 1986, we assumed the fraction of all inmates that are light users (21.5 percent) and the fraction that are heavy users (22.2 percent) remained constant. For

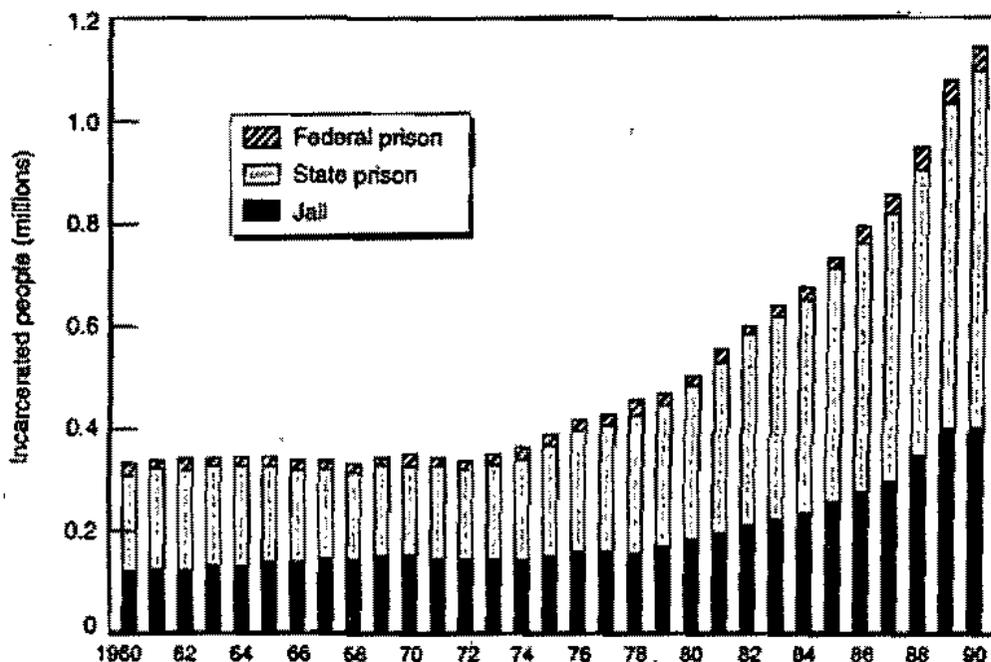


Figure 3.6—Federal Prison, State Prison, and Jail Populations in the United States over Time

years prior to 1986, these fractions were adjusted to be proportional to estimated light and heavy prevalence numbers.²⁹

The Numbers of Light and Heavy Cocaine Users in the Incarcerated Population

Combining the size of the incarcerated population with the fractions representing light and heavy cocaine users determines the number of light and heavy cocaine users among the incarcerated. Figure 3.7 shows the numbers of light users and heavy users and the total for each year of the recent cocaine epidemic. The numbers become gradually more significant with time, reflecting in part the rapid increase in the prison population since the late 1970s. The numbers for years after 1990 are assumed to be the same as for 1990.

OVERALL PREVALENCE ESTIMATES

The homeless estimates and prison/jail estimates were combined with NHSDA-derived estimates of light and heavy cocaine users to derive total prevalence esti-

²⁹As was done for the homeless estimation, the estimates were derived from an early version of the Markovian model (fit to NHSDA data only, and unadjusted for homeless and incarcerated users).

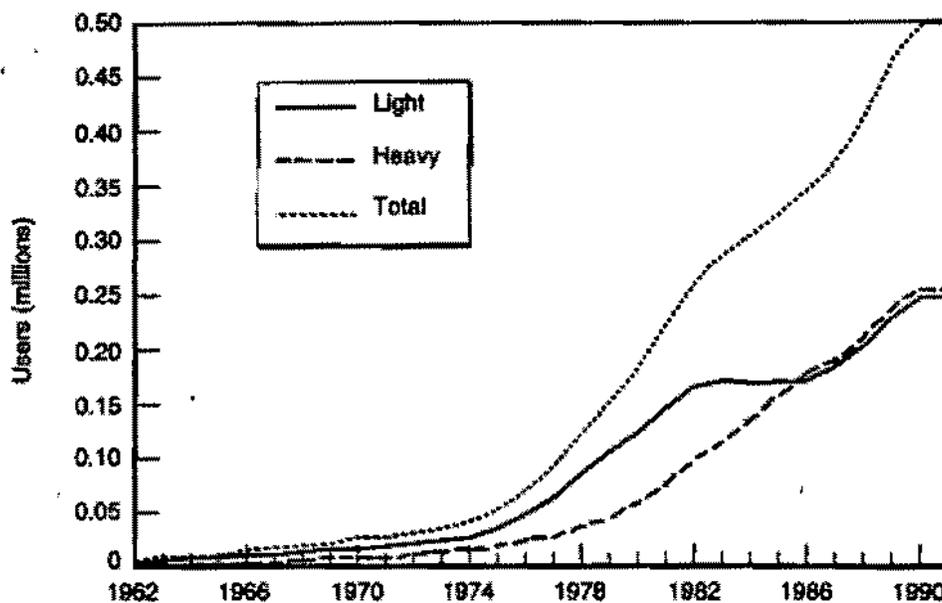


Figure 3.7—Light, Heavy, and Total Cocaine Users in the U.S. Incarcerated Population

mates.³⁰ The overall (light and heavy together) prevalence for NHSDA survey years is shown in Figure 3.8; the Markovian model was fit to these combined data.

The fraction of cocaine users that are heavy users was determined above using only NHSDA data for 1985, 1988, and 1990. A greater proportion of both the homeless and the incarcerated cocaine users are heavy users in our estimation. Therefore, the NHSDA-derived fractions were adjusted to account for these two additional populations. The fractions of all three populations were weighted by the population sizes and averaged in order to determine the fractions to which the Markovian model was fit. These adjusted fractions are displayed in Table 3.7.

It should be noted that some nonhousehold populations remain excluded or not fully included: (1) the institutionalized and hospitalized, which is a very small population; (2) military personnel living in military quarters, a population that presumably exhibits a low prevalence of drug use by virtue of its regimented lifestyle and pervasive drug testing; and (3) college dormitory residents, of which there are over 2 million. (The 1991 NHSDA was the first to survey some nonhousehold populations, including college dormitory residents and the sheltered homeless, but it did not survey the military, the institutionalized, or the transients.) Although the estimates of the num-

³⁰Another minor adjustment to the 1991 prevalence numbers was needed to reflect the fact that the 1991 NHSDA for the first time surveyed the homeless in shelters and to avoid double counting this group. Of the estimated 248,000 homeless and near-homeless light cocaine users, 142,000 are homeless (and not near-homeless). Of these 142,000, 118,000 (5/6) use services (consistent with the assumption that there are 20 non-service-using homeless for every 100 service-using homeless). The Urban Institute (Burt and Cohen, 1989, p. 38) estimates that 3/4 of the service-using homeless use shelters. Thus, 89,000 (3/4 of the 118,000 service-using homeless light cocaine users) use shelters. Thus, the total number of light users in 1991 must be reduced by 89,000. The reduction in the number of heavy cocaine users is the same.

ber of drug users in the United States might improve somewhat if the counts (for years prior to 1991) were adjusted to reflect the college dormitory resident population, this adjustment, if possible at all, would be at best a rough guess, and certainly is not critical for cocaine.³¹

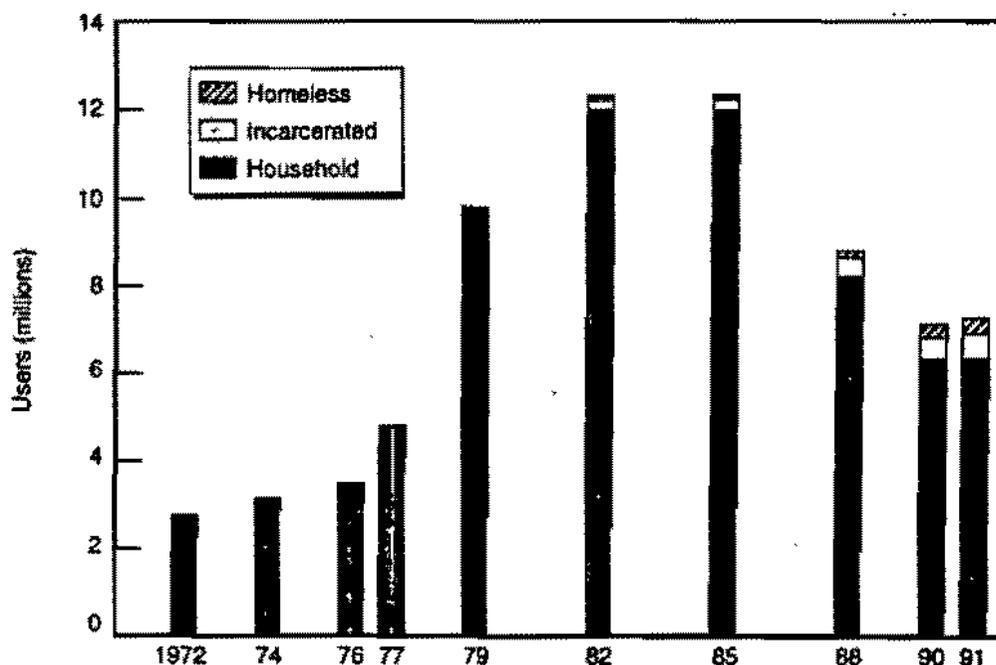


Figure 3.8—Overall Prevalence of Cocaine Users in the United States

Table 3.7

Percentage of All Users That Were Heavy Users in 1985, 1988, and 1990

Year	Household ^a	Homeless ^b	Incarcerated ^b	Total
1985	13.7	30.8	47.9	14.6
1988	18.4	46.3	50.8	20.4
1990	22.0	49.3	50.8	25.3

^aFrom 1985, 1988, and 1990 NHSDAs.

^bDerived from the estimates above.

³¹However, it might be more critical for alcohol and marijuana. As a result of including dormitory residents, the NHSDA prevalence rates of cocaine users aged 18 to 25 are only slightly lower, but the prevalence rates of alcohol and marijuana users are higher (National Institute on Drug Abuse, 1991).

COCAINE USER COHORT RETENTION

There is a well-understood fact about illicit drug use: many users, as they mature, naturally desist in using drugs, and only some users continue to use drugs for a long period of time. One may ask, Of a cohort of people who all begin using drugs at approximately the same time, how many will still be using drugs one, two, five, ten, etc., years later? The fraction of a cohort of initiates that is still using drugs *N* year later is called the *N*-year cohort retention rate. This is another characteristic of the system (in addition to prevalence) that can be used to describe the dynamics to be modeled.¹

Cohort retention rates can be calculated from the NHSDA in the following way. For each person who responded positively to the lifetime cocaine-use question, subtracting the person's age at first use from his current age determines the number of years since initiation. This establishes a set of cohorts of people who initiated use at the same time. The fraction of people in each cohort that are still using cocaine is determined by examining the responses to the past-year use question. This procedure looks at a cross section of the population for each year since initiation, combining people of different ages, races, incomes, sexes, etc. Thus, the *N*-year retention rate cannot necessarily be interpreted as the likelihood that an individual user will continue to use for *N* years, since different subgroups probably exhibit different retention rates. It can be interpreted as an average characteristic of the drug-consuming population.

As attitudes about drug use change, so do retention rates. Therefore, we might expect that cohort retention rates calculated with NHSDA data from different survey years will vary. Each curve in Figure 4.1 plots cohort retention rate as a function of time (smoothed with a three-year running average).² Three of the curves are derived from different years of the NHSDA; one plots the average of those three years. The data for cohorts that initiated use over 15 years ago are too noisy to be useful. The retention rates seem to have declined between 1985 and 1990, but the estimates are imprecise, so this observation is made with some caution.

¹It is logically equivalent to the reciprocal of the time required for (nearly) all users to flow out of use in the absence of incidence.

²By definition, 100 percent of a cohort is still using zero years after initiation. Smoothing the data distorts the zero-year data point.

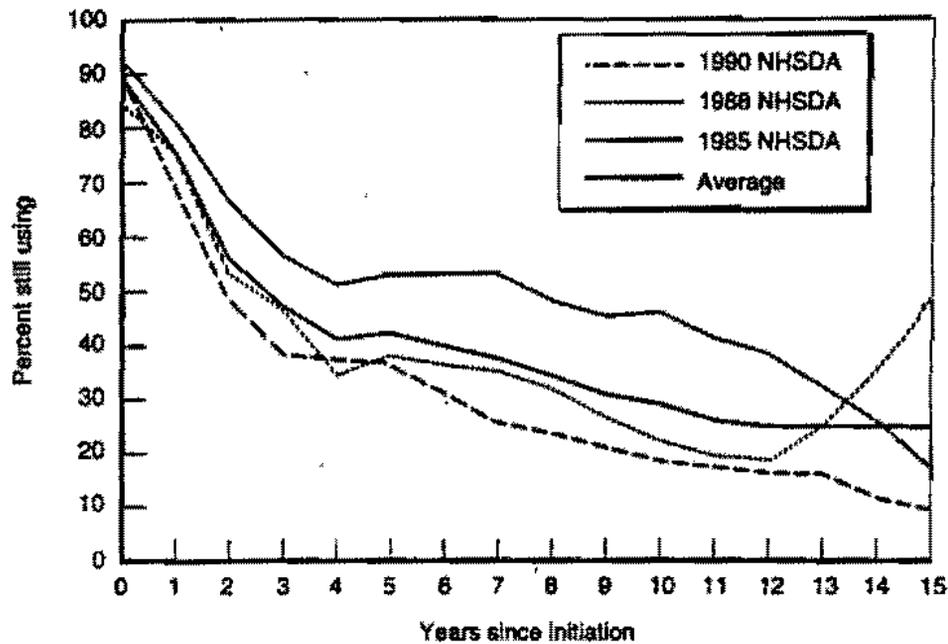


Figure 4.1—Cohort Retention Calculated from Three NHSDAs and the Average

Assuming that the average cohort retention rate curve best characterizes the recent cocaine epidemic, we used this averaged information to fit the Markovian model. By examining the average curve, we see that about 50 percent of initiates are still using two years later, about 40 percent are still using five years later, and about 30 percent are still using ten years later. In other words, a large fraction of the users only use for a short time, but those who continue to use do so for many years. The former category correlates with the experimental users, whereas the latter corresponds to the habitual and addicted users.

ESTIMATES OF THE INCIDENCE OF COCAINE USE OVER TIME

Incidence of cocaine usage has varied greatly during the past 20 years. It is hypothesized that illicit drug use is "transmitted" to non-users (much like an infectious disease, hence the phrase "cocaine epidemic") by drug consumers in the early stages of use. These users, who have not yet experienced the most objectionable consequences of drug consumption, proselytize their friends with descriptions of euphoria and protestations of drug usage's social acceptability. However, since the exact nature of the transmission mechanism is not fully understood, predicting incidence of drug use is much more complicated than predicting incidence of other infectious pathologies. Even measuring incidence is difficult, given the illicit nature of drug consumption; it is not surprising that there is no useful direct count of annual incidence.¹

Nonetheless, incidence is a critical component of the system to be modeled. It will be shown that a pronounced peak in incidence (of this most recent epidemic) preceded by almost a decade the peak in prevalence that occurred in the mid-1980s. In fact, prevalence is so closely tied to incidence (although with an inherent time delay) that an assumption of constant incidence would preclude a meaningful match of the model to the dynamics of the cocaine epidemic. Thus, to model the dynamics of the epidemic requires detailed incidence information over time. Although direct counts of annual incidence for the entire duration of the epidemic are not available, annual incidence can be derived from the NHSDA in either of two straightforward ways.

The NHSDA asks subjects if they have used cocaine in the past 30 days, in the past year, or ever in their lifetime. The difference in the lifetime estimates between successive surveys represents incidence between surveys. The surveys until recently were administered intermittently rather than annually, so annual incidence was determined by dividing the between-survey incidence by the number of intervening years.² These data were smoothed using a three-point moving average to generate

¹The 1974-1982 NHSDAs included direct questions on subjects' first-time use of drugs during the past year, but since these questions were not included in the more recent surveys, this method was not used in more than a comparative sense for our analysis.

²Adjustments to account for the specific months in which successive surveys were administered were not incorporated in this analysis. As discussed in Chapter Three, the fact that the lifetime prevalence estimate in 1988 was lower than in 1985 (implying negative incidence!) was corrected by interpolating the lifetime prevalence data so that incidence could be derived for all years. (See Croerer and Brodsky, 1992, for an alternative difference estimation.)

the *difference estimate* of the annual incidence for each year between the first and the most recent survey. (The number of users who responded positively to the lifetime-use question the first time the survey was administered in 1972 was assumed to reflect a constant annual incidence between the nominal start of the epidemic in 1962 and the time of the 1972 survey.³)

Those who respond positively to the lifetime-use question are asked at what age they began to consume cocaine. This information, the respondent's age at the time of the survey, and the date of the survey can be used to determine the year of first use for each respondent, which can then be compiled over several survey years (1985, 1988, 1990, and 1991) to generate the *retrospective estimate* of annual incidence for each year of the cocaine epidemic from 1962 through 1989 (Gfroerer and Brodsky, 1992). The trend from shortly before 1989 was linearly extrapolated to estimate more recent incidence.

Each method is subject to error. The main advantage of the retrospective method is that it is based on a larger sample size, which tends to stabilize the estimate. A third estimate, the *average estimate*, was determined by simply averaging the difference and retrospective estimates. Averaging the two estimates mitigated the potential errors of the separate estimates.

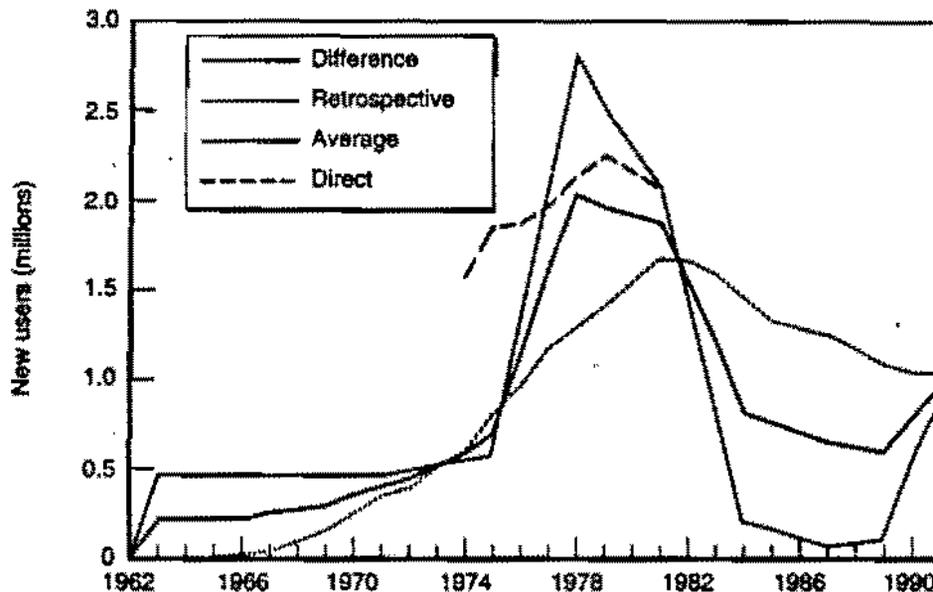


Figure 5.1—Estimation of Annual Incidence: Comparison of Four Methods

³Neither the year of the start of the epidemic nor the shape of the incidence curve before the first survey year is critical, but assuming a gradual smooth start to the model of the epidemic avoids the artificial boundary effect that would result from simply assuming all users started right before the first survey.

Annual incidence of cocaine usage as determined by these three methods is plotted in Figure 5.1. Also plotted is the *direct estimate* for the years between 1974 and 1982 for the purposes of comparison.⁴ There are significant differences between the various estimates; for example, the incidence peaks are displaced by as much as five years, and the retrospective estimate displays no evidence of a recent upturn in the incidence of cocaine usage.

Initial results from this demand modeling analysis indicated that neither the retrospective nor the difference estimate of incidence provided acceptable model parameter estimation. Thus, because it is intermediate to the other two estimates, the average estimate was used.

⁴These data were extracted from Gfroerer and Brodsky (1992). Data for missing years between 1974 and 1982 were determined by linear interpolation.

The model to which the observed data were fit is a two-state, four-parameter Markovian model (see discussion in Chapter Two and depiction in Figure 2.2). This model was chosen because it is the simplest sufficiently detailed model capable of generating the requisite historical trends.

THE FITTING PROCEDURE

The nature of the observed data—noisy, imprecise, and sparse—precludes the effective employment of a rigorous fitting procedure (such as a regression). Instead, the four-dimensional parameter space¹ was exhaustively searched for choices that best matched data identified as characterizing the system, the definition of “best match” being, admittedly, somewhat subjective (see below).

Three types of information about drug usage were utilized in the parameter estimation procedure: total prevalence of cocaine use (light and heavy together) over time, fraction of all cocaine users that are heavy users, and cohort retention rate. (The first two of these were defined and the observed data described in Chapter Three; the third was discussed in Chapter Four.)

- *Total prevalence over the course of the epidemic.* Specifically, the prevalence estimates from the ten survey years from 1972 to 1991 were compared to the modeled prevalence estimates from those same ten years. The mean squared error between the observed and the modeled prevalence was the measure of merit.
- *Fraction of heavy users over recent time.* The proportion of all cocaine users that are heavy users is not constant because all new users are light users, and new heavy users originate only from the light-user pool. The fraction of heavy users over three recent survey years, 1985, 1988, and 1990, increased from 0.15 to 0.25. The modeled fraction of heavy users was compared to the observed fractions for those three years.

¹By definition, a , b , f , and g must be between 0.0 and 1.0. Constraints in the model reduce the size of the parameter space even further; for example, $a + b$ and $f + g$ must both be less than 1.0.

- *Ten-year cohort retention rate.* As discussed in Chapter Four, cohort retention rate is the fraction of a cohort of initiates that will still be using cocaine after some period of elapsed time. Cohort retention rates can be determined from the NHSDA utilizing the age-at-first-use data of the lifetime users and their responses to the question about use in the past year. The ten-year cohort retention rate of the model was required to match the average of the observed 8-, 9-, 10-, 11-, and 12-year average (i.e., averaged over three survey years) cohort retention rates, which was close to 29 percent.

There is no obvious way to define a single measure of the goodness-of-fit of the model by combining these data. Since a perfect fit of all the data is generally quite unlikely (and in this case was discovered to be impossible), criteria for defining the best possible fit were needed. The fitting procedure required that the mean square error over the ten survey years be near-minimal. (The model parameters that correspond to the minimal mean square error were close to, but not the same as, those that optimized the other two measures of merit.) The fitting procedure also required the model to reproduce the trend and to approximately match the three fractions of heavy users (for 1985, 1988, and 1990). The ten-year cohort retention rate was required to be as close to the observed value as the discretization of the four-dimensional parameter space supported.

To search the four-dimensional parameter space, first f and g were fixed and a and b were varied (with step sizes of 0.005 and 0.002, respectively). The best a and b for the fixed f and g were selected. Then f and g were varied (with step sizes of 0.01 each), and the process of selecting the best a and b was repeated. Finally, the overall best set of parameters a , b , f , and g was selected.

More important than the details of the fitting procedure is a demonstration that the selected parameters lead to a good fit of the model to the observed data, and an illustration of the sensitivity of the fit to variation in the parameters.² Figure 6.1 shows the sum squared prevalence delta (which is proportional to the mean squared delta, or error) versus both a and b for fixed f and g (the fixed values are those that ultimately were selected).³ The elevation plot shows that the sum squared delta must be greater than 10.0 and that it is minimized for values of a and b corresponding to the middle band.

Figure 6.2 plots the ten-year cohort retention rate as a function of a and b for the same fixed f and g . The diagonal line at the bottom of the darkest band in the elevation plot corresponds to a retention rate of 29 percent. Crossing this plot with the previous elevation plot (bottom, Figure 6.1) determines a set of values for a and b that are pretty good (for these fixed f and g).

²In addition, it is comforting to see that the functions are very well behaved (i.e., not at all erratic).

³The three-dimensional plot (the top one) allows visualization of the surface, whereas the accompanying elevation plot (the bottom one) allows easier determination of the functional values.

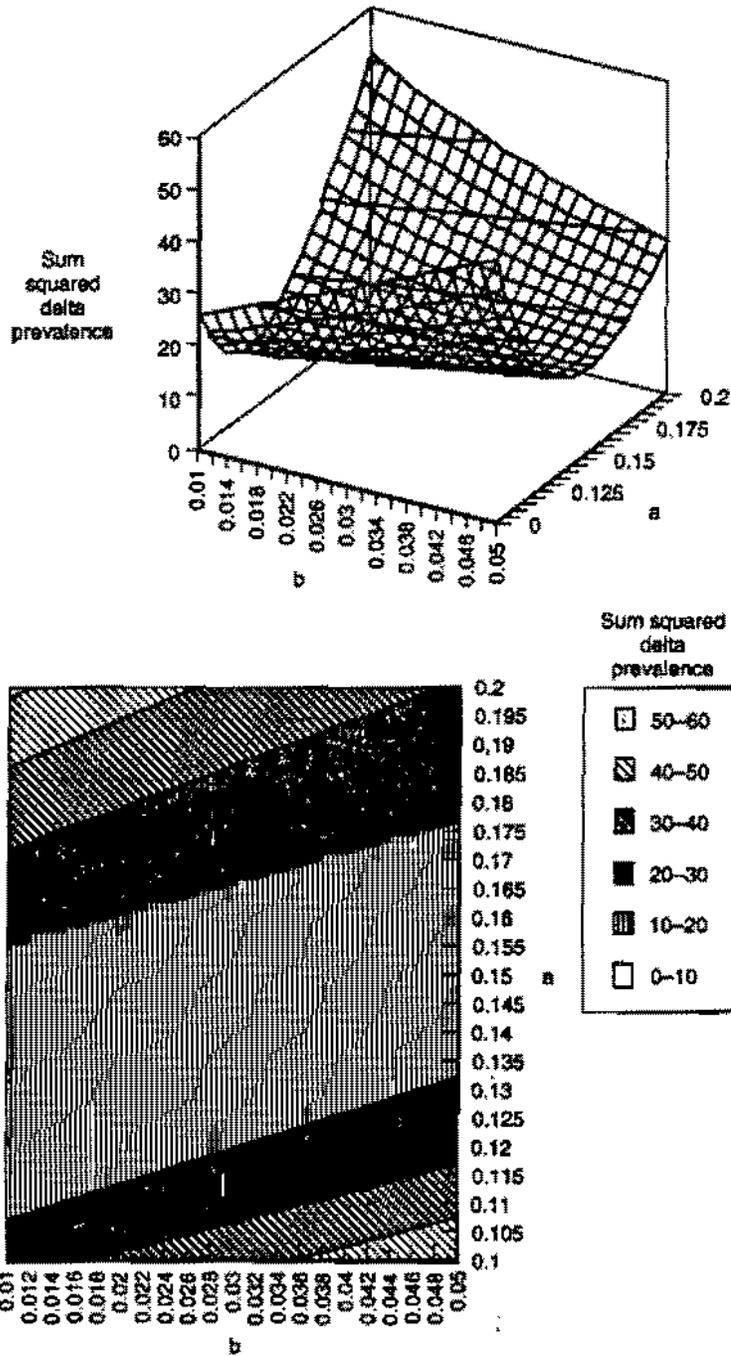


Figure 6.1—Sum Squared Delta Prevalence for Fixed $f=0.04$ and $g=0.02$

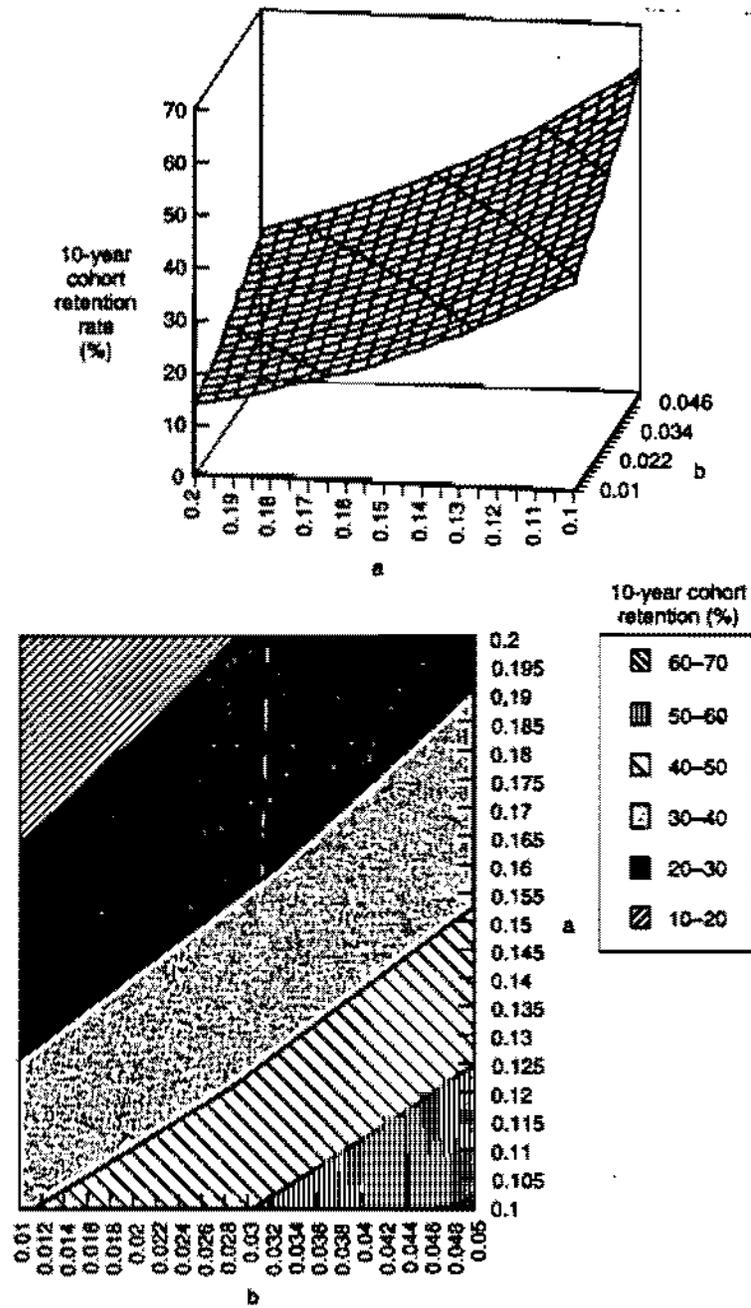


Figure 6.2—Ten-Year Cohort Retention for Fixed $f = 0.04$ and $g = 0.02$

The search reveals that for all near-optimal f and g , the value of a must be about 0.15. In Figure 6.3, the modeled fraction of all users that are heavy users as a function of b is plotted for fixed a , f , and g . It is apparent that no single value of b satisfies the requirement of matching the observed values for all three years. Any value between the vertical arrows is an acceptable compromise.

This analysis was then repeated, this time for fixed a and b , varying f and g . Figure 6.4 illustrates that to minimize the sum (or mean) squared delta in the prevalence estimate, the value of g must be quite small.

Figure 6.5 plots the ten-year cohort retention rate as a function of f and g for the same fixed a and b . In the elevation plot (bottom), the line at the top of the darkest band (the fourth band from the lower left corner of the plot) corresponds to a 29 percent ten-year cohort retention rate. As before, crossing the two elevation plots (in Figures 6.4 and 6.5) leads to a set of pretty good values for f and g (for these fixed values of a and b , 0.15 and 0.024, which were the values ultimately chosen).

Figures 6.6 and 6.7 plot the fraction of all users that are heavy users for three fixed parameters (a , b , and either f or g) and as a function of the fourth (g or f). Note that as either f (in Figure 6.6) or g (in Figure 6.7) increases, the curves begin to merge. This suggests that low values of both f and g are necessary for the model to adequately reproduce the observed trend in the fraction of all users that are heavy users.

Figures 6.1 through 6.7 illustrate the fitting procedure and demonstrate the adequacy of the values of the parameters chosen for the model: $a = 0.15$, $b = 0.024$, $f = 0.04$, and $g = 0.02$. Moreover, these figures roughly illustrate the sensitivity of the model to

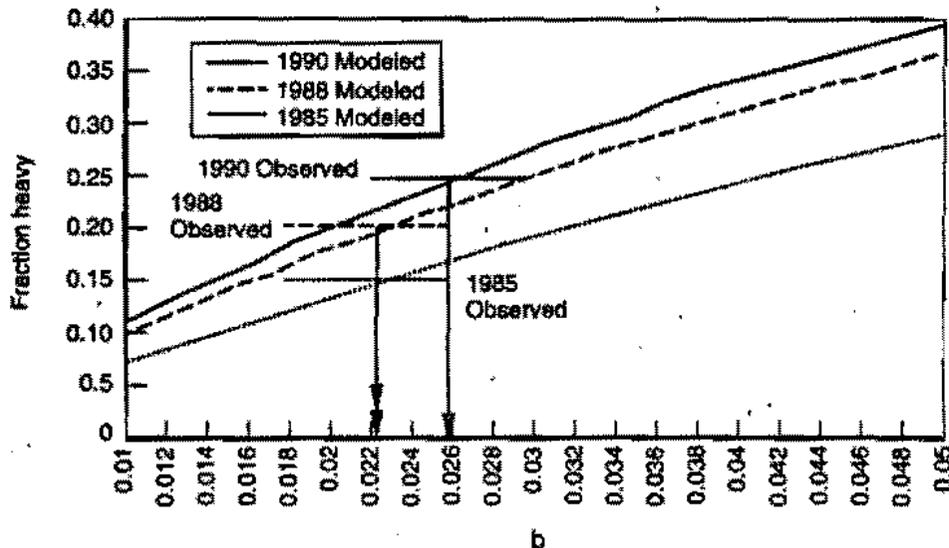


Figure 6.3—Fraction of Users That Are Heavy Users for Fixed $f = 0.04$, $g = 0.02$, and $a = 0.15$

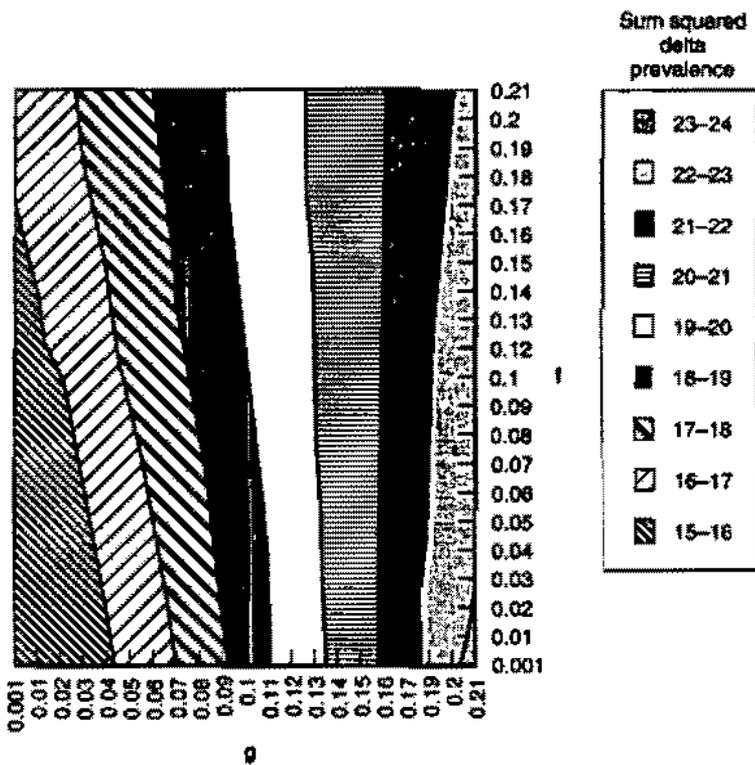
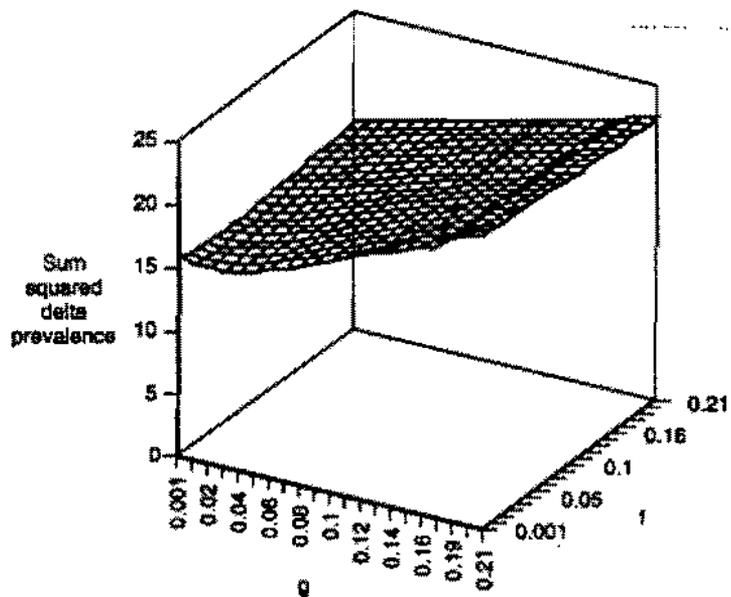


Figure 6.4—Sum Squared Delta Prevalence for Fixed $\alpha = 0.15$ and $\beta = 0.024$

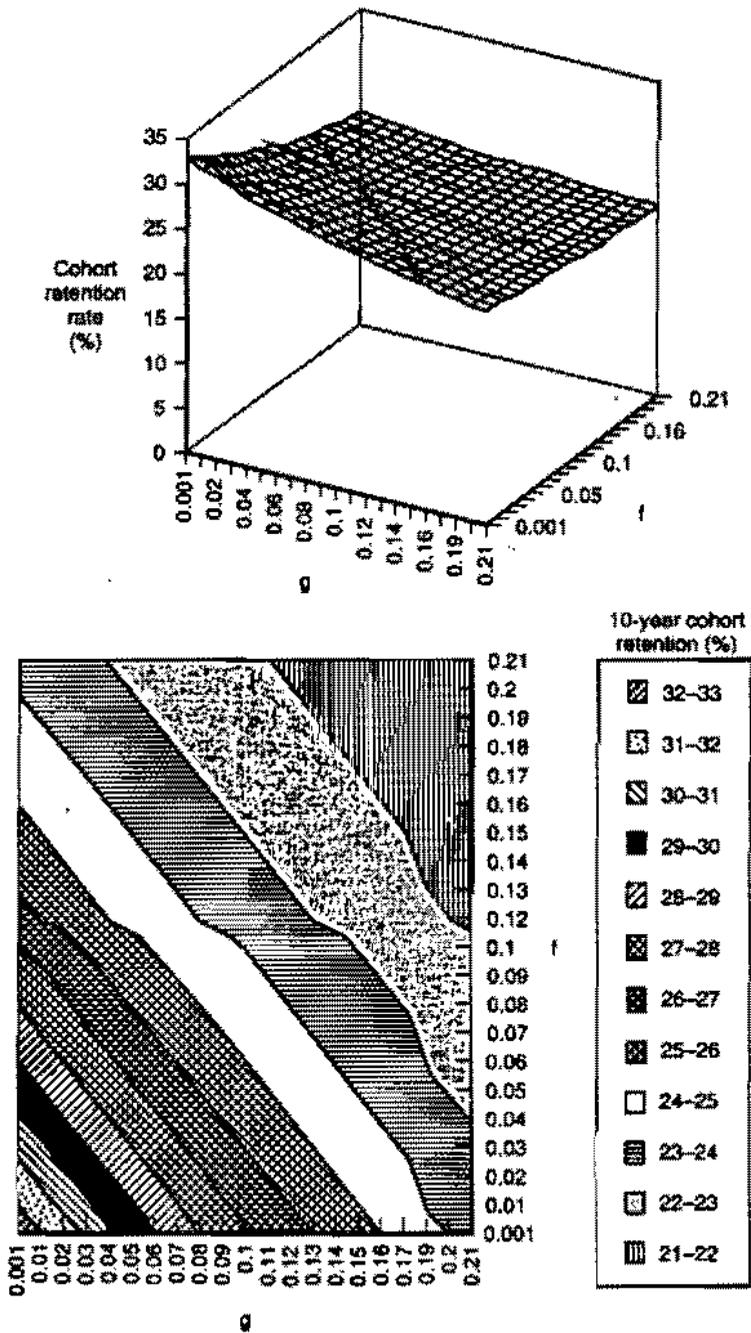


Figure 6.5—Ten-Year Cohort Retention for Fixed $a = 0.15$ and $b = 0.024$

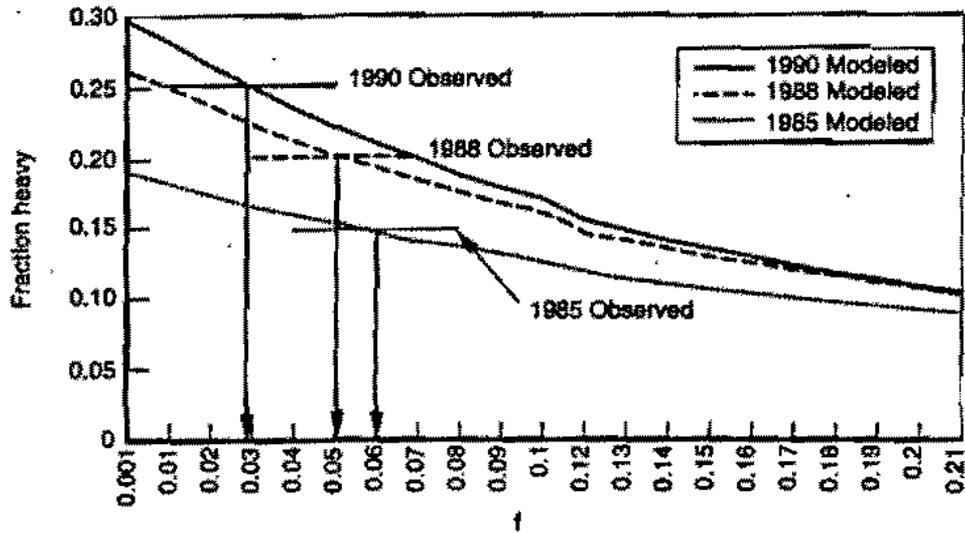


Figure 6.6—Fraction of Users That Are Heavy Users for Fixed $a = 0.15$, $b = 0.024$, and $g = 0.02$

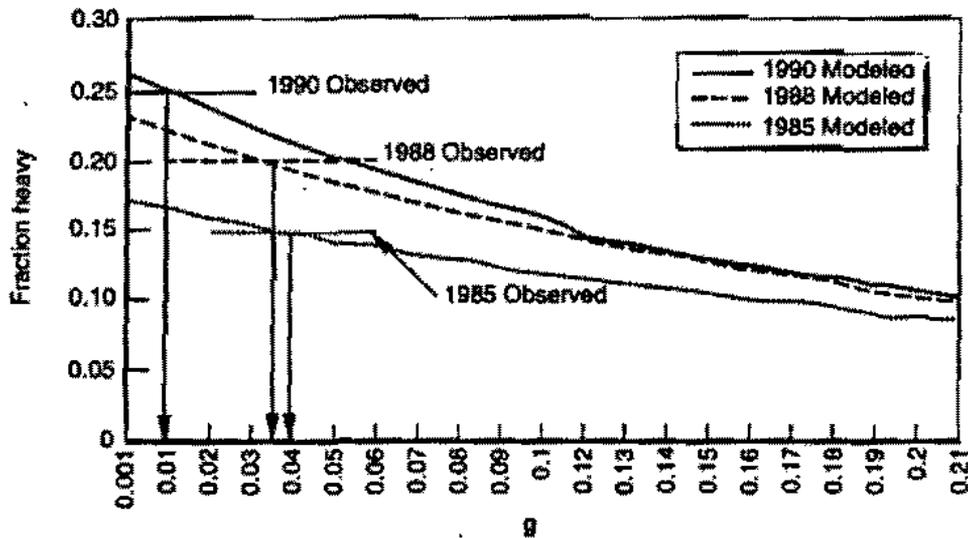


Figure 6.7—Fraction of Users That Are Heavy Users for Fixed $a = 0.15$, $b = 0.024$, and $f = 0.04$

variation in the parameter values. The set of parameter values chosen for the model is not uniquely determined, since many other combinations of values for the four parameters also provide equally good fits to the data. The ranges of values that lead to equally good fits are quite limited, however. Any choices of f and g such that the sum of the two parameters is less than 0.09 are adequate; the choices of f and g that best match the increasing trend in the percentage of users that are heavy users are those whose sum is less than 0.06. For all adequate choices of f and g , a must be about 0.15 and b must be somewhere between 0.02 and 0.03.

The results of the overall fitting procedure suggest that the outflow from heavy use to non-use (represented by the parameter g) is not critical to the model. A simpler model with only the backflow from heavy use to light use (represented by the parameter f) and the two flows out of light use (a and b) would be sufficient to fit the data.

THE FITTED MODEL

As summarized in Figure 6.8, the parameter values that make the model best fit the data are $a = 0.15$, $b = 0.024$, $f = 0.04$, and $g = 0.02$.⁴ A combined outflow from heavy cocaine use of 6 percent per year seems low because it implies an average heavy-use career of about 17 years. However, the estimated parameter values are those that enable the model to best replicate the observed data (see Figures 6.1 through 6.4). Below we compare the estimates generated by this model with the observed data.

Figure 6.9 plots modeled and observed overall prevalence (light and heavy prevalence together). The fit to the overall prevalence data is about as good as could be expected, and is sufficient in light of the uncertainty surrounding the prevalence estimates. The overall shape of the prevalence curve is correct, the time of peak prevalence suggested by the model is close to that indicated by the data, and the modeled average prevalence (6.7 million) is quite close to the observed average prevalence (7.2 million).⁵ Not surprisingly, the model cannot exactly reproduce the prevalence data. Because the model is smooth by design, it tends to lower the peaks and raise the valleys in the prevalence curve, as indicated in Figure 6.9.

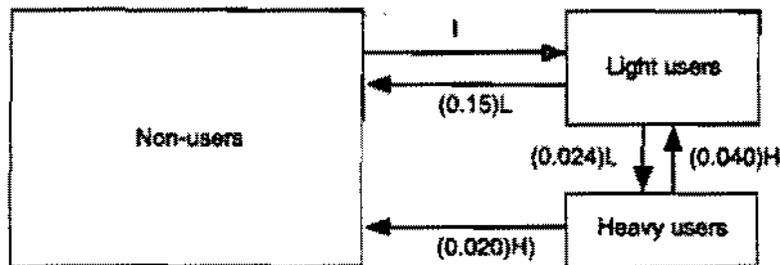


Figure 6.8—The Fitted Model

⁴Although these flow rates are traditionally called transition probabilities, they must be interpreted with great caution. For example, a is the annual flow rate out of light use. In a sense, it is the overall probability that a light user will flow back to non-use in any given year. However, the assumption that all initiates have a 0.15 probability of quitting each year is a misinterpretation, in part because the light-user pool also contains the backflow from heavy use. It is important to note that the parameters were chosen without regard to any data about the likely behavior of cocaine users; they were selected solely based on the fit of the two-state Markovian model to the three criteria discussed above. That the fitted model is a very simplified model of the system suggests that the four parameters are just that, parameters, possibly without deeper meaning.

⁵The average is over the ten survey years.

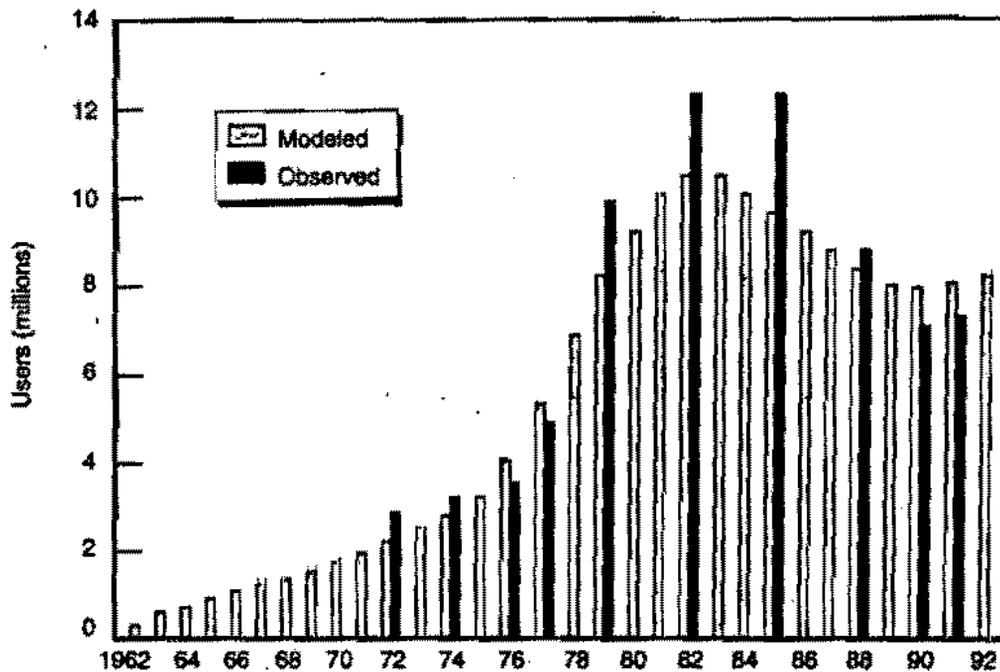


Figure 6.9—Overall Prevalence of Cocaine Users: Modeled vs. Observed

Figure 6.10 shows that the observed percentage of users that are heavy users increased from 15 percent to 25 percent from 1985 to 1990, and that the modeled percentage increased from 16 percent to 24 percent. The best-fit model is incapable of matching the observed numbers exactly, but it reproduces the trend and approximates the values.

Figure 6.11 shows the results for cohort retention. The "observed" curve is the cohort retention curve (i.e., the cohort retention rate as a function of time since initiation) determined by averaging the cohort retention curves calculated from three different years of the NHSDA (1985, 1988, and 1990). This is compared to the cohort retention curve generated by the fitted Markovian model. As required, the modeled ten-year cohort retention rate exactly matches the observed ten-year rate. Because the modeled and observed curves are characterized by approximately the same shape, we concluded that fitting to only the ten-year retention rate (and not to other N -year retention rates, where $N < 10$) was adequate.

In summary (see Table 6.1), the fitted Markovian model tracked the historical data fairly well. Prevalence over the ten survey years from 1972 to 1991 was tracked satisfactorily, as can be seen by the table's first entry, which shows that the average modeled prevalence roughly matches the average observed prevalence. The percentage of all users that are heavy users was required to follow the trend from 1985 to 1990, and to approximately match the values for the three survey years. The second line of the table shows that the heavy-percentage fit was good. The modeled ten-year cohort retention rate was required to match the observed rate. It did, as reflected by the third line of the table.

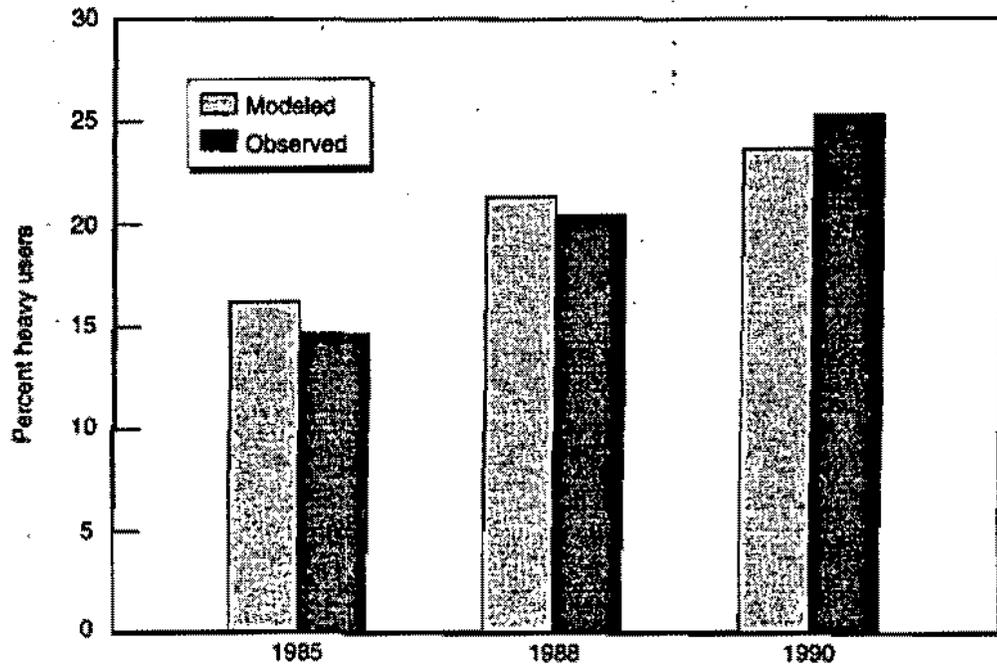


Figure 6.10—Percentage of Users That Are Heavy Users: Modeled vs. Observed

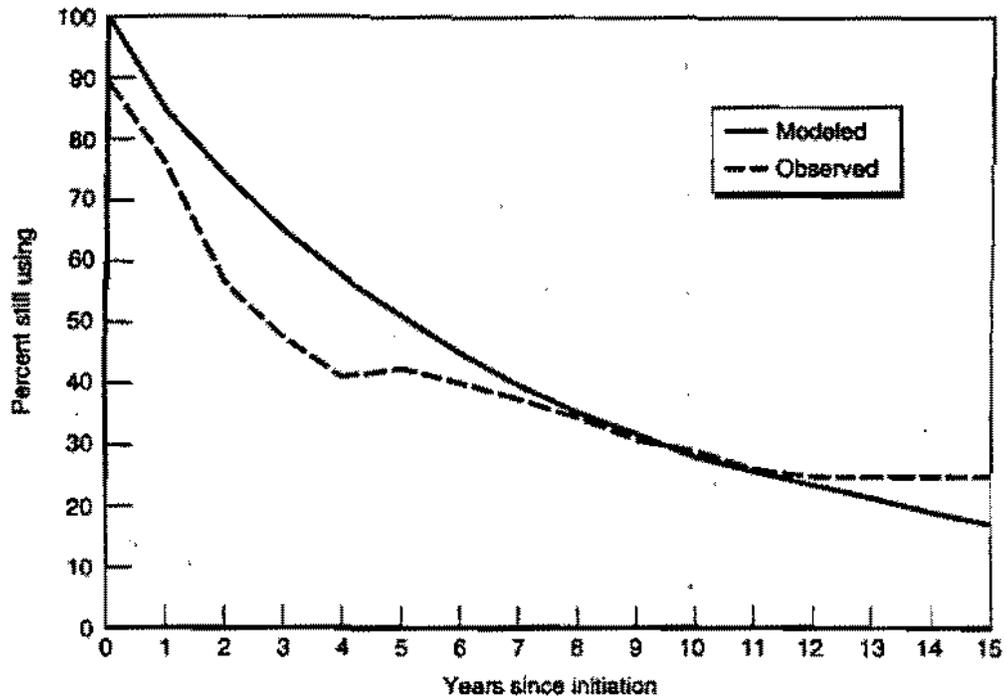


Figure 6.11—Cohort Retention: Modeled vs. Observed

Table 6.1
Summary Measures of Model Performance

Measure	Observed	Modeled
Prevalence (averaged over NHSDA survey years from 1972 to 1991)	7.2 million	6.7 million
Percent heavy users (averaged over 1985, 1988, and 1990)	20.1%	20.4%
Ten-year cohort retention	29.1%	29.0%

One valuable application of the model is to use it to explore various aspects of the cocaine epidemic history that are not obvious from examining the raw data. The graph in Figure 7.1 depicts the modeled percentage of all users that are heavy users over time. The dip in the percent-heavy-user curve just before 1980 corresponds to the rapidly increasing incidence that occurred around that time (a consequence of the fact that all new users are light users). Since that time, the percentage of all users that are heavy users has increased dramatically.

As was discussed in Chapter Five, incidence to cocaine use peaked around 1980 and has subsequently decreased (until, perhaps, very recently). Figure 7.1 suggests that *on the macro scale*, there is a delay of about ten years between incidence and heavy

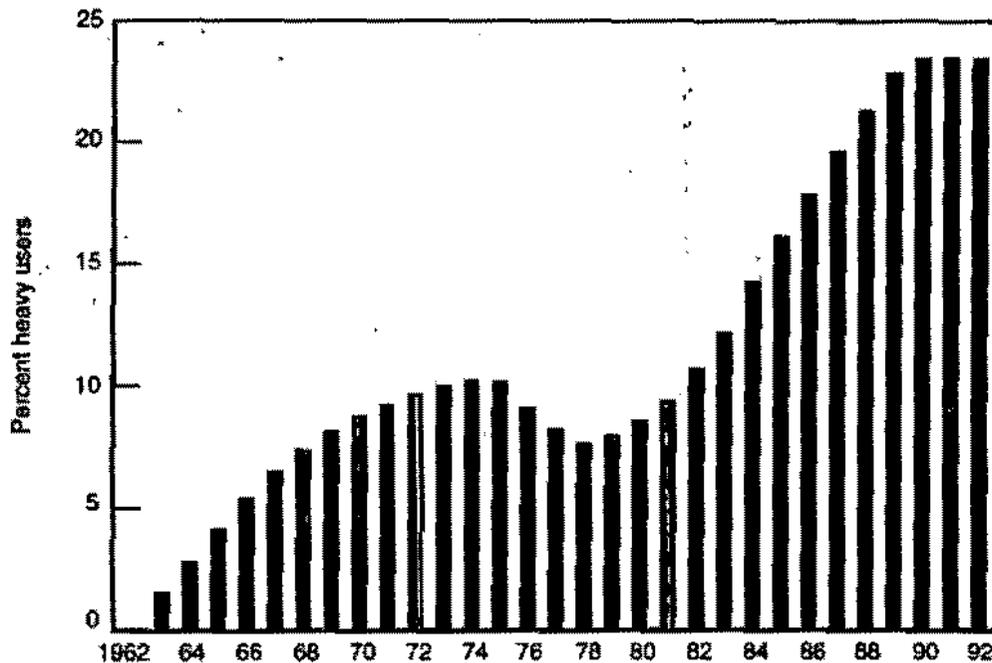


Figure 7.1—Modeled Percentage of Users That Are Heavy Users: Variation over Time

usage.¹ Consequently, the effect on heavy usage of government programs that reduce incidence (such as prevention programs) will only be realized many years later. And part of the effectiveness of local law enforcement and other programs that influence drug use in multiple ways (affecting incidence, flow rates, and the consumption rates of current users) will also be delayed. Thus, it is critical that such delays be considered when the benefits of these types of programs are measured. (Heavy-user treatment programs will affect the number of heavy-users more directly and immediately, but the effects of treatment programs are also delayed in the sense that most users need to undergo treatment regimes several times for the treatment to be "effective.")

The significant variation in the heavy-user percentage implies that overall prevalence is an incomplete and insufficient measure of the status of the cocaine epidemic. When a larger fraction of the overall prevalence is associated with heavy users, a different cocaine control strategy might be desirable. For example, prevention programs (which are hypothetically most effective in the early part of the epidemic when users are few, most of the users are light users, and potential users are many) could be scaled back while treatment programs are expanded to respond to the greater proportion of heavy users that emerge in the latter part of an epidemic.

The graph of modeled prevalence over time in Figure 7.2 reveals the underlying contributions to the prevalence estimates by light users and heavy users. Both the overall prevalence and the light-user prevalence exhibit a peak in the early part of the last decade and a more recent leveling off. In fact, this *overall* prevalence curve has characterized the course of the cocaine epidemic in the eyes of some policymakers. But while both overall and light-user prevalence have recently declined and leveled off, the number of heavy users has continued to increase. This strongly suggests that the "cocaine problem" is not disappearing (as some responsible for drug control in the government are eager to announce). To the contrary, the "problem" may be getting worse. (Of course, this depends on how "problem" is defined.)

Combining estimates of how much cocaine light and heavy users consume with the modeled prevalence information (Figure 7.2) gives a picture, displayed in Figure 7.3, of how cocaine consumption has varied over time. Here we use an estimate of 291 metric tons of cocaine consumed in 1992 (Rydell and Everingham, 1994). This total consumption estimate, the estimated (modeled) number of light and heavy users in 1992 (i.e., 5.5 million light and 1.7 million heavy users at the start of 1992), and the ratio of heavy- to light-user annual consumption (calculated in Chapter Three as about 8:1) can be combined algebraically to determine that, on the average, light users consume about 16.4 grams per year and heavy users consume about 118.9 grams per year.²

¹Note that this is not necessarily true for an individual user; this false conclusion is an example of the fallacy of division.

²These averages include the incarcerated population, which consumes only negligible amounts of cocaine. The average light and heavy consumption rates for the cocaine-using populations are 17.2 and 140.0 grams per year, respectively.

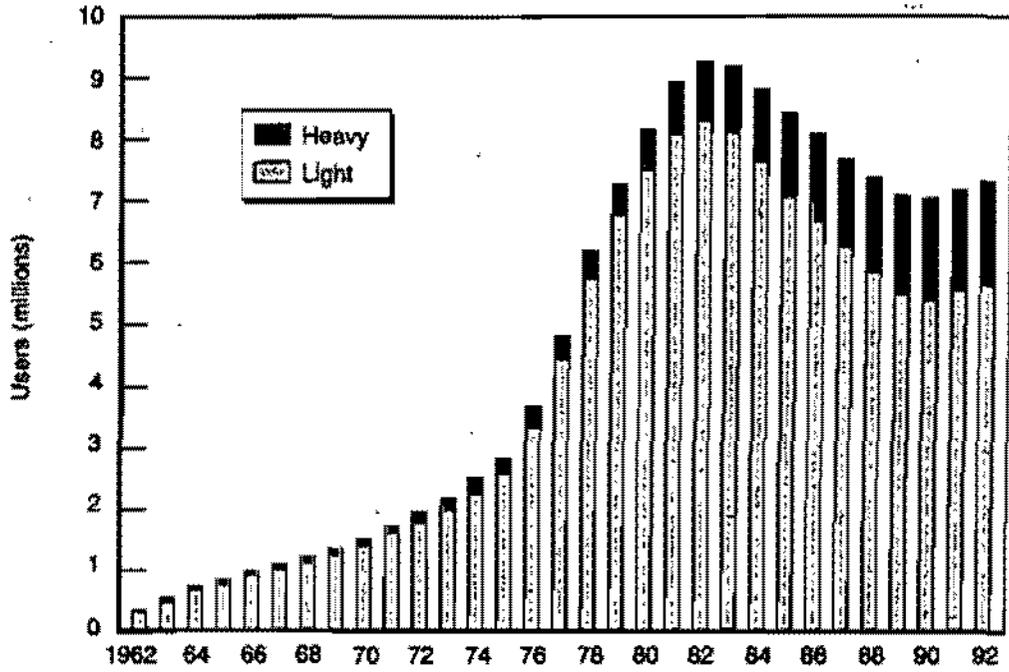


Figure 7.2—Modeled Prevalence: Heavy vs. Light Users

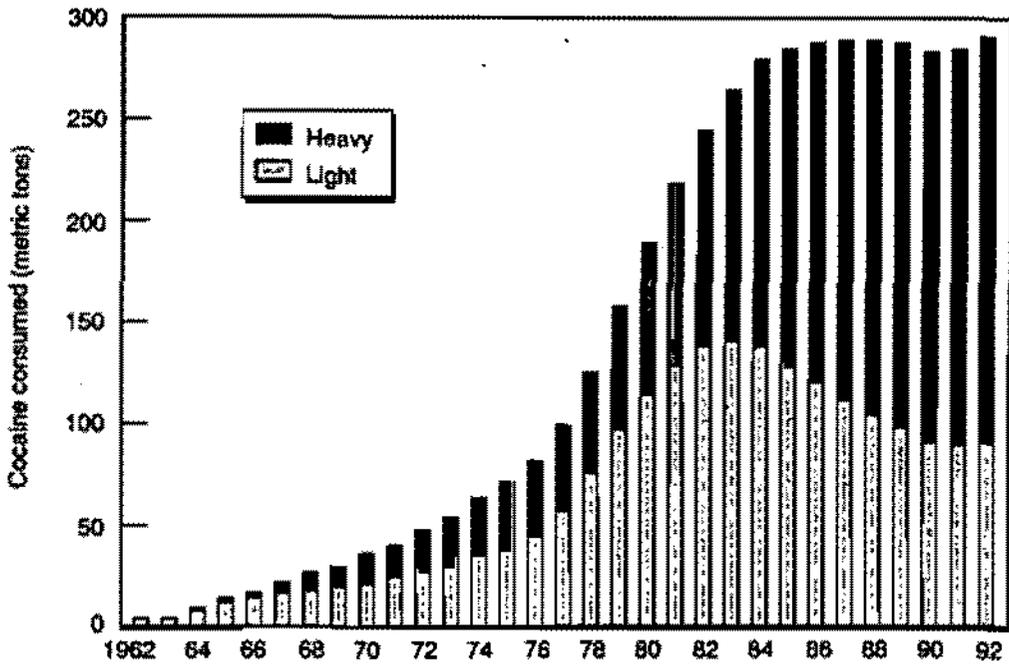


Figure 7.3—Modeled Consumption: Heavy vs. Light Users

In contrast to the overall decline in prevalence over the past decade, consumption has merely leveled off, as is evident from Figure 7.3. If incidence continues to decline, consumption will also decline, but this decline will not be noticeable for years. Even while overall prevalence is declining, large amounts of cocaine will still be consumed in the United States by the remaining users because more and more of them will be heavy users. To counter this trend, cocaine control programs that focus upon reducing consumption by heavy users are required.

The bottom line is that, not only in terms of the prevalence of heavy users, but also in terms of total cocaine consumption, the "war against cocaine" has by no means been "won." This conclusion supports those who argue that the cocaine problem is worsening. The effectiveness and costs of various cocaine control programs must be compared to determine what control strategy is optimal at this point in the epidemic.³

³This is the topic of the companion document to this one: Rydell and Everingham (1994).

Because cocaine incidence is an input to the model and the course of the cocaine epidemic depends so strongly upon incidence, our model by itself is not predictive of the future course of the epidemic. However, given a script for future incidence, the model can answer certain questions about the future. For example, it can show how long it would take for the epidemic to (nearly) disappear if there were no future incidence. More generally, the model can project the course of the epidemic given any hypothetical incidence scenario.

Obviously, whether such a projection actually predicts the future course of the epidemic strictly depends on whether the corresponding incidence scenario proves to be true. But the hypothetical incidence scenarios, and the resulting prevalence and consumption projections, are much more than futile guesses destined to be wrong because future incidence cannot be predicted with any certainty. On the contrary, the value of such projections lies in the fact that they bound the analysis in a useful way.

In this chapter, the 15-year course of the epidemic is projected for a number of different incidence scenarios. For each scenario, incidence, light and heavy prevalence, and light and heavy consumption (assuming constant consumption rates) are plotted separately. Figure 8.1 shows the three graphs for the first incidence scenario, the worst case considered, for which it is assumed that annual incidence remains at the level estimated for 1991: 0.988 million new users per year.¹ From the prevalence and consumption graphs, it is evident that constant incidence, even at a magnitude as low as it has been in recent years, implies both an increase in prevalence of about 1 million users over the course of 15 years, and a substantial increase in the amount of cocaine consumed in the United States. Thus, in the absence of cocaine control programs that significantly alter the flow rates, incidence must decrease if cocaine use is to be counteracted.

Figure 8.2 shows the results for scenario 2, in which we assume incidence is halved in the next 15 years. (This is roughly equivalent to the incidence trend between 1984 and 1989—see Figure 5.1.) Halving the incidence reduces current overall prevalence by only about 1 million users (second graph) and does not reduce consumption at all (third graph).

¹Of course, this is not the worst possible case, since incidence could once again follow an increasing trend.

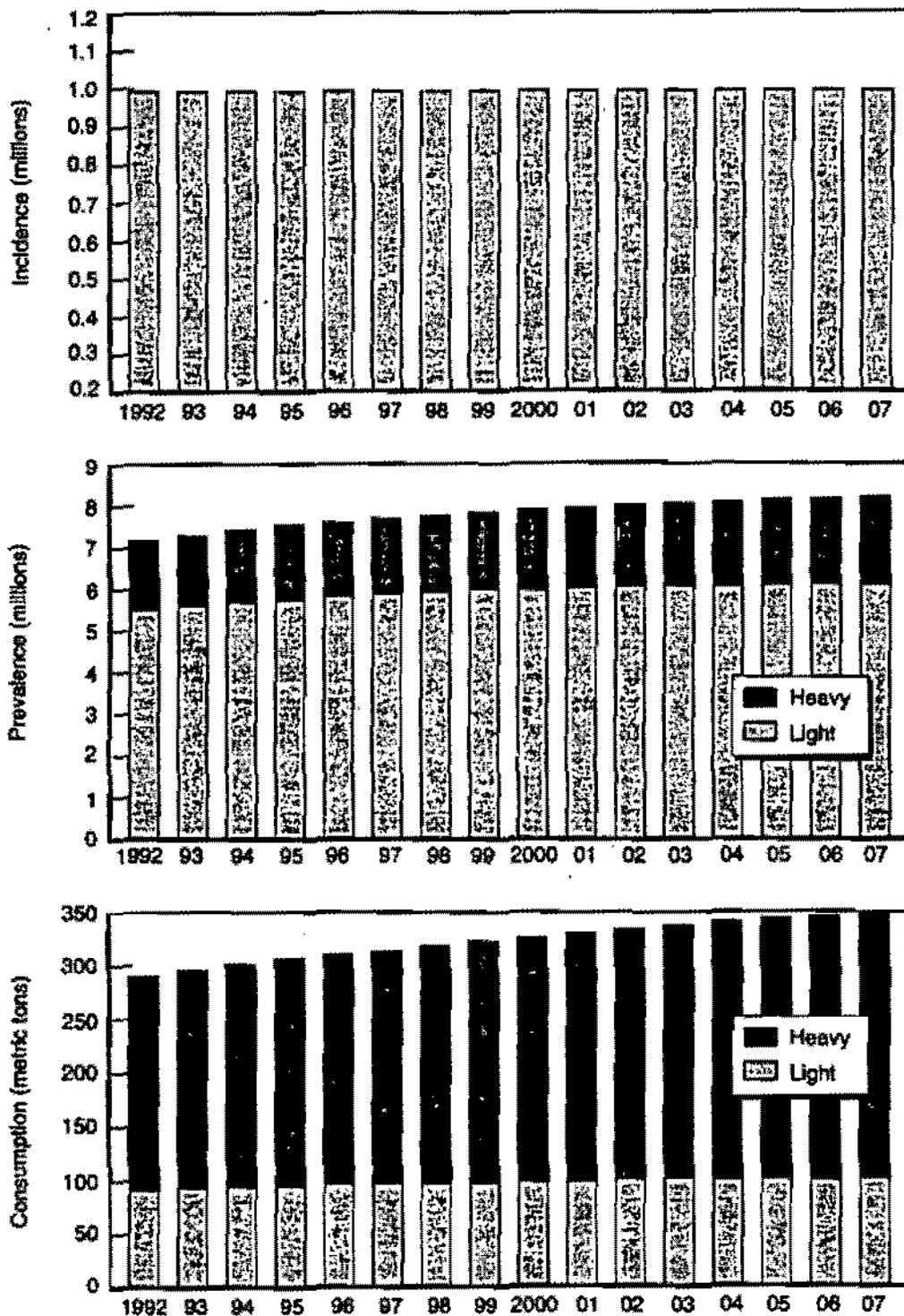


Figure 8.1—Hypothetical Scenario 1: Constant Incidence

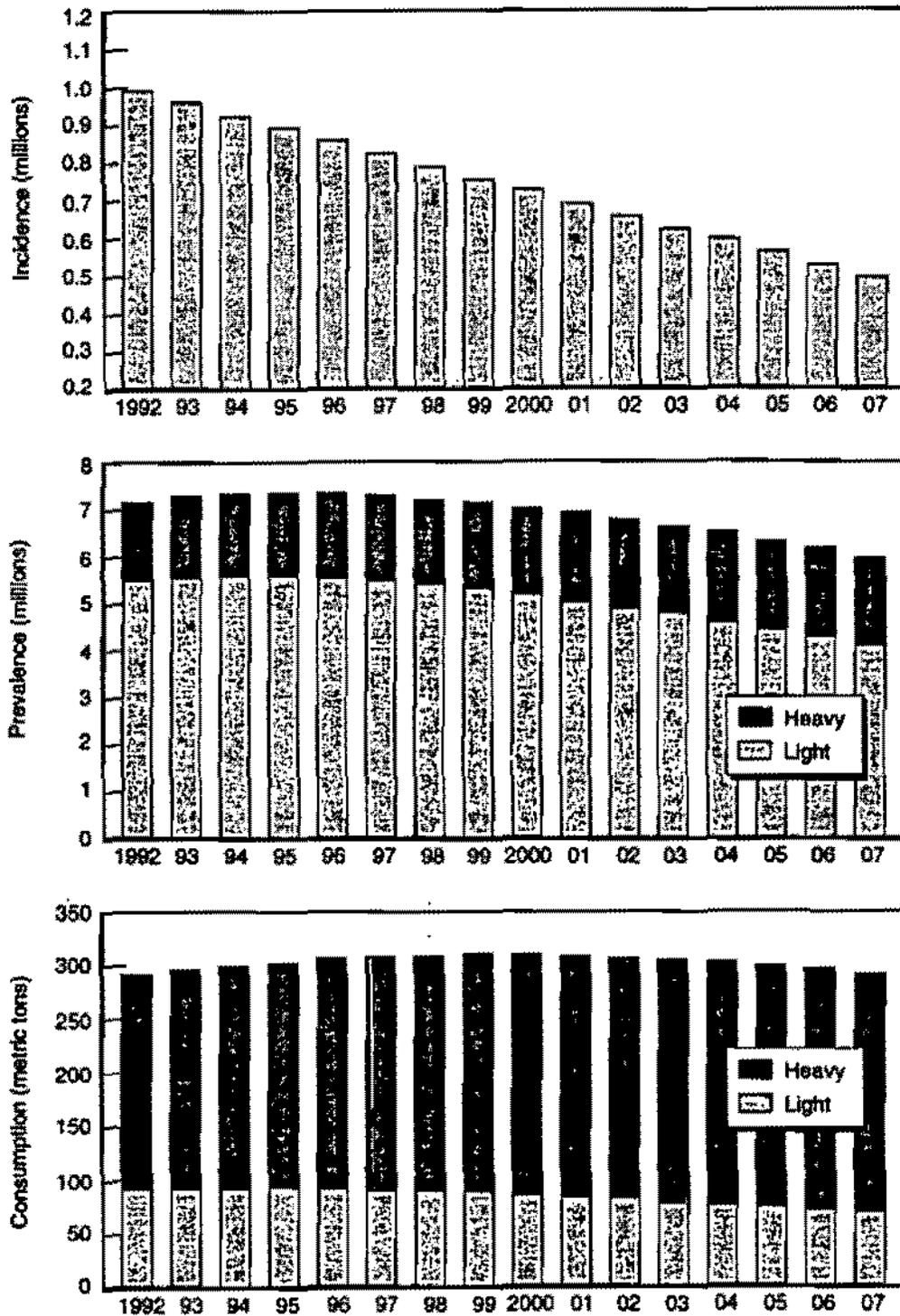


Figure 8.2—Hypothetical Scenario 2: Incidence Halved in 15 Years

A third, more optimistic scenario is plotted in Figure 8.3. This one involves an incidence decline extrapolated from the retrospective estimate of incidence (instead of the average estimate—see Chapter Five), which is near zero in 15 years. The corresponding prevalence is less than it was in the previous scenario by about 1 million users over 15 years (see second graph in Figure 8.3); however, in spite of the optimistic incidence projection, consumption decreases only marginally over the 15-year period (see third graph). This is a direct consequence of the persistence of heavy users and suggests that reducing incidence, while necessary, is by no means sufficient.

How would a sudden but temporary surge in incidence, perhaps as the result of a short-term cut in prevention funding, affect the epidemic over several years? In this fourth scenario, shown in Figure 8.4, incidence is halved over the course of 15 years (as in the second scenario), except for one year in which it is drastically increased. By comparing the prevalence and consumption graphs here with those in Figure 8.2, we see that it takes just about 15 years to recover from the temporary surge in incidence.

Having observed that a steady decline in incidence only marginally affects the course of the epidemic, one wonders what is the maximal decrease that incidence, or rather the lack thereof, could cause in prevalence and consumption. Assuming (optimistically and probably quite unrealistically) that incidence is reduced to zero and does not resurge, the maximum effect that reduced incidence can have on the future course of the cocaine epidemic can be estimated. Figure 8.5 shows the results for this fifth scenario. As the second graph shows, prevalence is reduced to about 2 million cocaine users in 15 years. But, since most of those users are heavy users, the decrease in consumption (third graph) is not nearly as dramatic: in 15 years, consumption is only halved. Thus, even in the absence of incidence, it would take about 30 years for the current epidemic to (nearly) disappear, unless programs that increase the flow rates out of cocaine use are expanded.

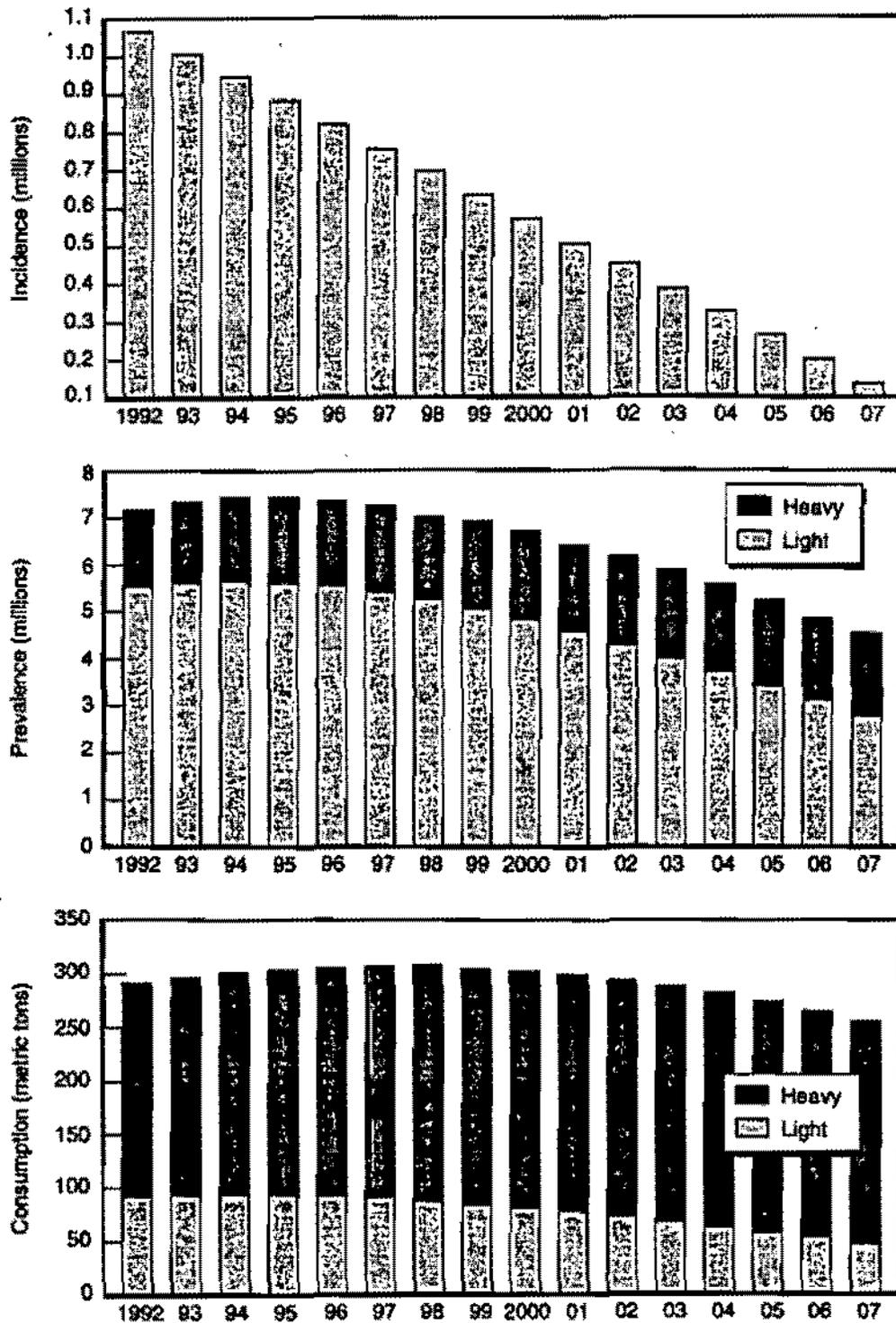


Figure 8.3—Hypothetical Scenario 3: Incidence Extrapolated to Near-Zero in 15 Years

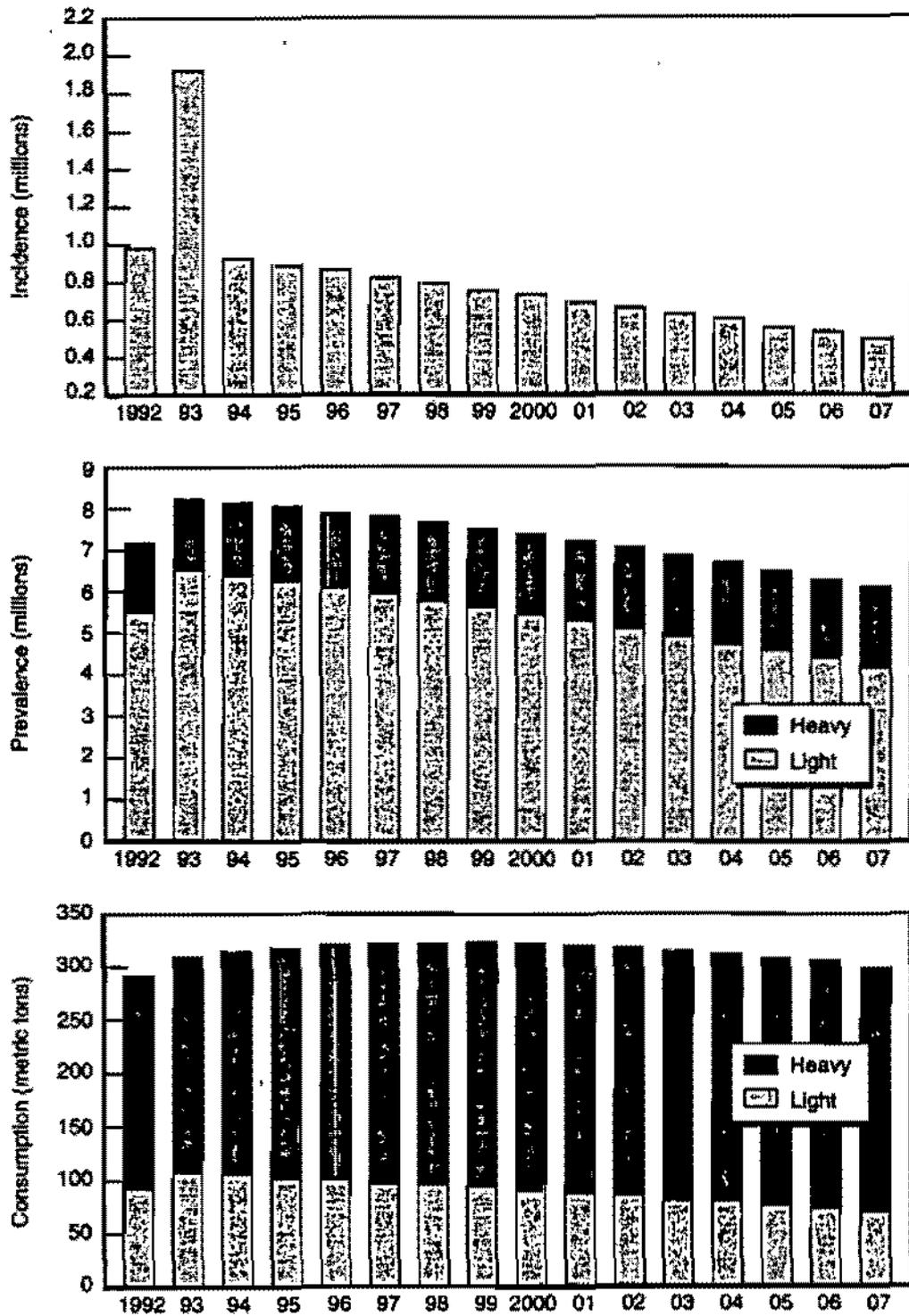


Figure 8.4—Hypothetical Scenario 4: Temporary Surge in Incidence

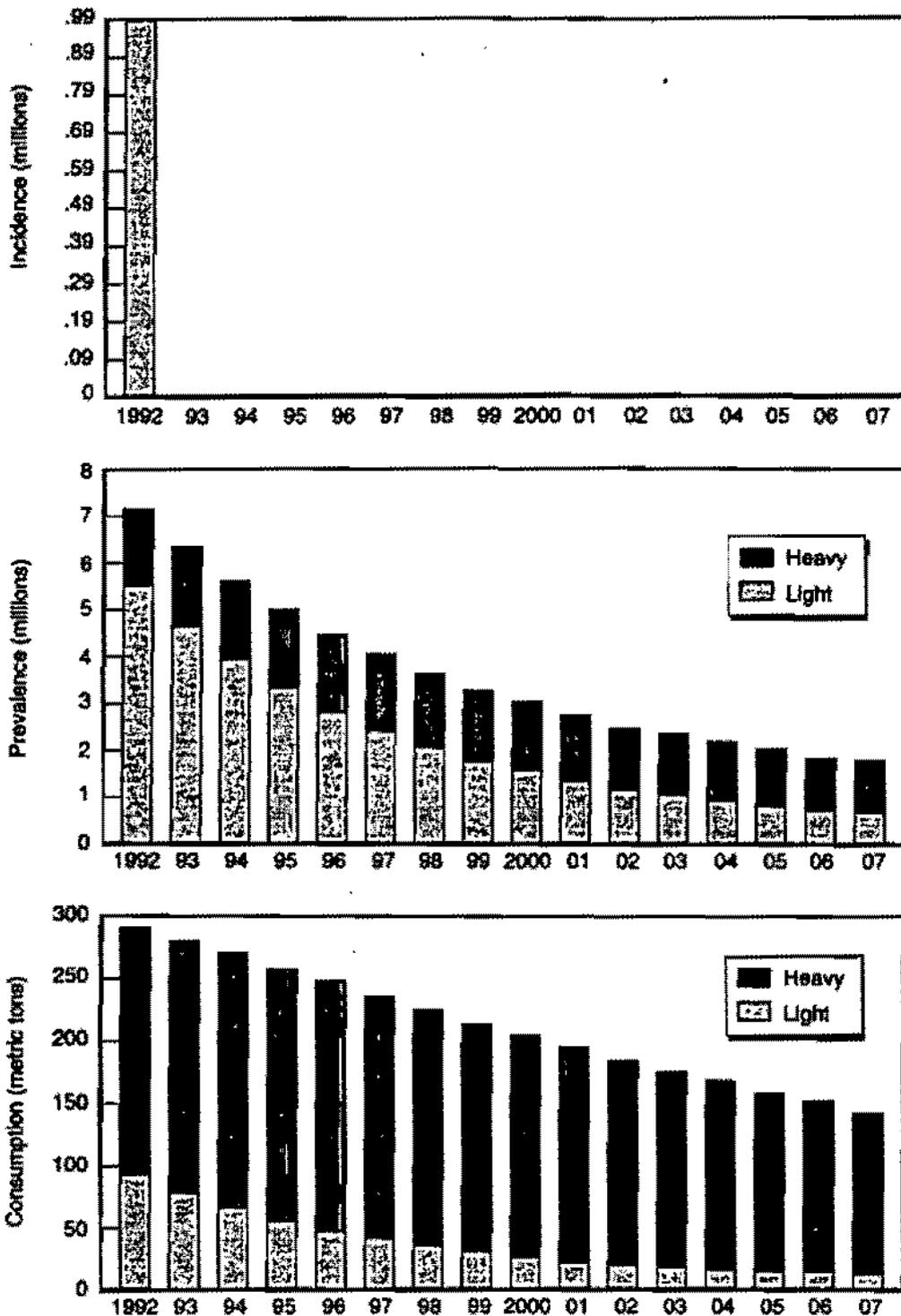


Figure 8.5—Hypothetical Scenario 5: Zero Incidence

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*D*rug Procurement
Practices
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A Cooperative Agreement for AIDS
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EXECUTIVE SUMMARY

At the request of the Office of National Drug Control Policy (ONDCP), the National Institute on Drug Abuse (NIDA) sponsored a study of the drug procurement practices of active injecting drug users (IDUs) and crack users. Using a community-based research infrastructure developed by NIDA to respond to emerging drug-related issues, trends, and consequences, including human immunodeficiency virus (HIV) infection, the study designed a rapid response assessment of patterns of drug use, methods of obtaining drugs, and income sources and expenditures for drugs in a noninstitutionalized, out-of-treatment population. The identification of patterns and procurement practices of chronic drug-using populations can be useful in the formulation of drug abuse policy decisions.

The sample includes 1,154 male and female active injecting drug users and crack users (approximately 120 respondents from each site) recruited by targeted sampling designs in 10 cities across the United States participating in the NIDA Cooperative Agreement for AIDS Community-Based Outreach/Intervention Research Program. The selected sites provide regional representation and diversity in demographic composition, the price of street drugs, procurement patterns, and resources used to obtain illicit drugs. Data collection was performed using structured interviews.

Aggregated results of all cooperating sites are presented in this report based on a typology of drug use. The typology characterizes users by patterns of multiple forms of cocaine and heroin use in the 30 days preceding the interview. (The typology takes this focus since data on marijuana, other opiate, and amphetamine use indicated relative consistency across groups.)

Data collection at each Drug Procurement Study site was guided by the primary objective of providing a sample of the population of out-of-treatment, noninstitutionalized drug users based upon local knowledge of patterns and trends. Collectively, these data provide broad-based estimates and characteristics of drug users who are out of treatment. These data do not provide prevalence estimates of the use of crack cocaine or injection drugs in the general population. Further, while the data represent 10 geographically diverse cities, without the estimate of true parameters of the out-of-treatment drug-using population, it is difficult to determine the national representativeness of this sample. Factors related to the research design, including issues of targeted sampling designs, self-selection, and nonresponse, cannot be fully ascertained.

Analysis focused on three principal issues of drug use and drug procurement—overall patterns of drug use and

expenditures, patterns of drug acquisition, and sources of income. Findings for each are presented below.

Patterns of drug use and drug expenditures: Results indicate that this population (noninstitutionalized, out-of-treatment drug users) engages in behaviors that cause considerable harm to themselves, their dependents, and society in general. Most respondents (56 percent) reported injecting drugs. While 53 percent reported previous formal drug treatment, the majority of respondents continue to use cocaine and heroin with great frequency. Although there is considerable variation in the use of primary drugs (powdered cocaine, heroin, speedball, crack cocaine), the use of cocaine, particularly in the form of crack, is pervasive in the aggregated sample across all primary drug user groups. Multiple forms of heroin and cocaine use are common to all user groups, with the single exception that primary crack smokers were less likely to engage in other drug use forms. In this sample, women were more likely to be in the crack only group than in the crack primary group or in the other drug groups.

The extensive use of drugs by respondents in the study requires an outlay of a significant portion of respondents' resources for the purchase of drugs, undoubtedly limiting the amount of money available for other expenses such as housing, food, clothing, and medical care. Almost two-thirds of cash expenditures of the sample in the past 30 days were reported to be spent on drugs.

Acquisition of drugs: The majority of respondents reported that drugs are easily acquired when cash is available. Conversely, most respondents indicated a lack of cash rather than a reduced availability of drugs as the primary obstacle in drug acquisition. While the use of cash or cash in combination with other means are most common, other acquisition forms reported include obtaining drugs for free, trading sex for drugs, and selling drugs to acquire drugs for personal use.

Respondents who found drugs difficult to obtain in the past 30 days were more likely to engage in selling/dealing drugs or in trading goods for drugs. Those with higher levels of drug use were more likely to report engaging in drug selling/dealing. Primary crack use was associated with trading sex for drugs.

Sources of income: The majority of respondents reported some source of legal income in the past 30 days. These legal sources included employment, public assistance, or support from family or friends. Nearly half of the sample indicated income in the past 30 days from some type of employment, including day work paid in cash.

More than half of the respondents reported involvement in cash-generating criminal activities in the past 30 days. Drug sale-related activities, including selling drugs to nondealers, finding buyers, holding drugs, providing space, or other drug preparation activities, were the most frequently reported income-generating criminal activities in this sample. Men and women were very similar in terms of percentages reporting legal income, illegal income, or a combination of legal and illegal income. Women were more likely to report income derived from commercial sex; men were more likely to report a variety of illegal income sources, including involvement in drug trade, shoplifting, numbers running, motor vehicle theft, or buying/receiving stolen goods. Illegal income was more likely among respondents with higher levels of primary drug use and those reporting hardship in acquiring drugs. Results in this sample indicate that those in cocaine (smoked and injected) primary groups had the greatest likelihood of being involved in criminal activities.

Drug Use, Crime, and Public Health—Policy Issues for the Future

Drug-using behaviors have complex health and social consequences that require the attention of the Nation's public health, drug control, and criminal justice systems. These data show that this sample population of injecting drug users and crack users is involved in chronic drug use,

engages in illegal activities to acquire drugs, and is exposed to the risk of HIV infection and sexually transmitted diseases through injection practices and through trading sex for drugs. Twelve percent of this population, for example, tested positive for HIV antibodies.

Given the extensive use of personal resources to obtain drugs, and a considerable percentage of respondents who have already been in drug treatment but continue to use drugs, findings indicate the need for strategies that "bridge" to formal drug treatment, such as community-initiated and community-based prevention programs. Traditional drug control and criminal justice policies have emphasized demand and supply reduction. The findings from this study support an increased emphasis on harm reduction, including innovative strategies to reduce high-risk drug-using behaviors and to recruit, engage, and retain drug users in treatment. Intervention programs must be located in neighborhoods where people buy and use drugs and designed with an awareness that chronic drug users often do not seek treatment, are less likely to benefit from treatment, and continue to place themselves at high risk of acquiring and transmitting HIV. Creating a research infrastructure to support periodic and coordinated data collection and developing the capacity to respond rapidly to emerging issues related to patterns and consequences of drug use are critically important.

INTRODUCTION

Policymakers in the United States rely on more than 38 Federal drug abuse databases and a growing body of related research to assist them in understanding the nature and extent of problems associated with drug abuse; these resources also contribute to discussions about strategies to address drug abuse problems (Bureau of Justice Statistics 1990, 1992). While each of the existing databases adds to our knowledge of the consequences of illegal drug use (for both the individual and society) and the impact of drug abuse-related programs, each limits its focus to selected aspects of the drug problem (for example, estimates of the use of different drugs, numbers and patterns of drug-related health emergencies, rates of drug use among those arrested for serious crimes, drug prices and purity indicators, and crime statistics); the complex relationships among drug abuse, crime, and health and social consequences remain obscured (Bureau of Justice Statistics 1992; U.S. General Accounting Office 1993).

These sources indicate, for example, that in 1991, approximately 75.1 million Americans (37 percent of the population) had used illicit drugs one or more times in their lives (Substance Abuse and Mental Health Services Administration 1992); estimates of the numbers of injecting

drug users in the United States range from 1.1 to 1.5 million (Dondero 1987; Turner et al. 1989). Americans spent approximately \$30 billion on cocaine, \$9 billion on heroin, \$8 billion on marijuana, and \$2 billion on other illegal drugs in 1991 (Rhodes et al. 1993).

It is estimated that about 5.5 million persons, more than 2 percent of the adolescent and adult population, need treatment for drug abuse (Gerstein and Harwood 1990). In 1992, more drug users than ever—an estimated 433,000—received emergency medical treatment for drug-related episodes; since 1990, there has been an upward trend in emergency room admissions during which patients mention cocaine use (Substance Abuse and Mental Health Services Administration 1993). The societal costs of the use of drugs other than alcohol—including treatment, lost productivity, motor vehicle accidents, crime, and stolen property—have been estimated at \$58.3 billion per year (Rice et al. 1991).

An important tradition in research on drugs and crime has focused on heroin users, particularly injecting heroin users. While heroin remains the drug of choice among many drug users, cocaine and crack have gained unprec-

edented notoriety due to their increasing supply, declining price, and association with violent crime (Goldstein et al. 1993). Existing drug abuse research also concentrates heavily on male users, even though women have always constituted a significant proportion of drug users (Ashbrook and Solley 1979, p. 27; Cisin et al. 1978; Glynn et al. 1983; Prather and Fidell 1978). (See also the appendix, *Selected Background Resources*, page 19.)

Recent changes in drug use patterns (e.g., widespread and increasing use of cocaine and its derivative, crack) and consequences (e.g., proliferation of drug trade activity, violence, and the continuing epidemics of HIV infection and tuberculosis) make it clear that information from sources other than existing databases may be required to guide formulation of a more targeted and comprehensive drug control policy. The increasing availability of cocaine and crack has further increased the number of female users, sometimes as a result of what appears to some to be drug "marketing" strategies aimed specifically at women (Massing 1989).

The widespread use of crack cocaine has had criminal justice implications for women and racial minorities. In a study of arrestees in major cities in the United States, the National Institute of Justice found that increasing supplies of crack have resulted in particularly high rates of use among women (National Institute of Justice 1988). Drug Use Forecasting (DUF) data have consistently demonstrated that rates of drug use in general, and cocaine use in particular, are extremely high among women who come into contact with the criminal justice system (National Institute of Justice 1992). These findings have been supported by other studies: in their research on women and drug use, Hser et al. (1990) reported that female drug users are involved in property crime, drug dealing, and prostitution to support their drug habits.

In addition to gender-related trends associated with changing patterns of drug use, there have been recent reports in both popular and professional publications focusing on the nexus among race/ethnicity, drugs, and crime. Reports of increases in drug-related arrests among African Americans and wide disparities in arrests among African Americans and whites have coincided with the emergence of crack cocaine during the 1980s. One study, based on 1990 census records and arrest data reported to the Federal Bureau of Investigation, found that in 30 major cities, drug-related arrests among African Americans were at least 10 times greater than those among whites (Meddis 1993). While the number of non-Hispanic whites in State prisons for drug-related crimes increased by 16,000 to a total of almost 30,000 between 1986 and 1991, the number of African Americans imprisoned under similar circum-

stances during the same period increased by 65,000 to a total of almost 80,000 (Meddis 1993). Since the early 1970s, drug-related arrest rates for whites have been relatively stable at about 300 per 100,000; among African Americans, these rates have grown at about 15 to 20 percent per year, peaking at nearly 1,500 per 100,000 in 1989 and declining somewhat in 1990 and 1991 (Blumstein 1993).

Another major social and economic problem linked to both drug injection and crack use is the HIV/AIDS epidemic. Payment for illicit drugs is often "income in kind"; for example, dealers sometimes keep some portion of their drugs for personal use and often accept sex or other goods in payment for drugs. Of the more than 339,250 AIDS cases in the United States reported through September 1993, slightly more than one-third occurred among injecting drug users, their sexual partners, and/or their children (Centers for Disease Control and Prevention 1993). In the context of increased risk of HIV transmission, the relationship between drug use and commercial sex takes on particular significance. Trading sex for drugs or money and/or paying for sex with money and/or drugs have been reported in several studies (Inciardi et al. 1993; Hser et al. 1990; Carlson and Siegal 1991; Siegal et al. 1992). The examination of the drugs-crime connection takes on new urgency in light of recent reports that crack use is associated with increased sexual activity, not only for women but for men as well, and that crack use is common among all types of drug users (Rutner 1993), including chronic drug users who inject drugs.

There have been a number of small-scale but important studies on expenditures in drug use. Johnson et al. (1985) reported that the average user spent about \$4,000 per year on heroin; when "income in kind" was taken into account, average annual expenditures were about \$7,000. Reuter et al. (1990) found that the median expenditure for drugs was about \$400 a month. These studies were restricted to samples from single communities, and/or individuals who had committed crimes. For elaboration on other studies of expenditures, see the ONDCP report *What America's Users Spend on Illegal Drugs* (Rhodes et al. 1993).

In response to changing drug use patterns, the increasingly complex consequences of drug abuse, and the limits of extant data on the chronic, out-of-treatment, drug-abusing population, the National Institute on Drug Abuse, at the request of the Office of National Drug Control Policy, conducted a study to examine drug procurement practices of noninstitutionalized, out-of-treatment injecting drug users and crack users and to provide data that can facilitate the discussion of policies and strategies related to drug abuse.

PURPOSE OF THE STUDY

This report presents information on the following research questions:

1. *Patterns of drug use:* Which drugs are being used by whom and how frequently are they used? What patterns, characterizations, or typologies can be observed?
2. *Expenditures for drugs:* How much do respondents spend on drugs? Who spends the most on drugs?
3. *Methods of obtaining drugs:* How easy is it to obtain drugs and how are drugs obtained? What role does bartering (for example, sex for drugs) play in the drug market, and what relationships between drug use and method of acquisition can be observed?
4. *Sources of income:* What are respondents' sources of income? What relationships can be observed between patterns of drug use, ease of obtaining drugs, drug use intensity, demographics, and sources of illegal income?

METHODS

The Drug Procurement Study was conducted as part of a larger, ongoing NIDA research initiative, the Cooperative Agreement for AIDS Community-Based Outreach/Intervention Research Program (hereinafter referred to as the Cooperative Agreement Program). The Cooperative Agreement Program is designed to monitor community-level trends in drug use practices, health risk behaviors, and HIV seroprevalence rates among a noninstitutionalized, out-of-treatment sample of injecting drug users and crack smokers in 21 program sites throughout the United States. A primary function of these monitoring efforts is to assess the effectiveness of community-based interventions in preventing the spread of HIV infection and other diseases among out-of-treatment drug users.

Ten of the Cooperative Agreement Program's 21 programs participated in the Drug Procurement Study, contributing data based on both the Drug Procurement and Cooperative Agreement data collection instruments. These sites reflect regional differences that were believed to be theoretically apparent in such key variables as racial/ethnic or gender characteristics of drug-using populations, the price of street drugs, procurement patterns, and resources used to obtain illicit substances. Sites were located in:

Dayton/Columbus, Ohio; Denver, Colorado; Detroit, Michigan; Houston, Texas; Long Beach, California; Miami, Florida; New York, New York; New Orleans, Louisiana; Oakland, California; and San Juan, Puerto Rico.

The sample for this study was drawn from neighborhoods characterized by illegal activities resulting from the presence of crack, heroin, cocaine, and speedball (an injectable combination of heroin and cocaine). Sampling plans within each site were developed using modified targeted sampling¹ (Watters and Biernacki 1989; Lambert 1990). Targeted sampling relies on aspects of snowball, quota, and survey sampling and ethnographic observation to construct a study sample that can provide representative data on drug use and disease risk behaviors within selected communities.

Data collection was guided by the primary objective of providing a sample of the population based upon knowledge of patterns and trends among IDUs and crack cocaine users in given neighborhoods. Generalizations from these data to the out-of-treatment population should acknowledge several factors that potentially diminish the representativeness of the sample.²

- 1 Targeted sampling plans for the Cooperative Agreement studies were developed in three stages. In the first stage, profiles of geographic areas and populations characterized by high drug use and disease risk were constructed from available data resources within the participating communities. From these profiles, sampling quotas were developed based on relevant geographic and individual characteristics. The derived sampling quotas were then used as a sampling plan that "targeted" certain drug users residing in specified geographic areas. In the second stage of sampling, ethnographic observational methods were used to locate and gain access to drug-using networks. Networks that were accessed were matched to the targeted sampling communities and personal characteristics of the drug users within the networks. In the third stage, trained outreach workers used contacts within the identified networks to recruit individual drug users to participate in the study. The resulting samples are presumed to be "theoretically representative" of known populations of drug users residing within the targeted geographic areas. To ensure that adequate numbers of women were recruited for the study so that gender differences could be investigated, a quota of 30 to 50 percent women was imposed. In addition, a sampling quota of 50 to 70 percent drug injectors and 30 to 50 percent crack cocaine smokers was used to ensure that adequate numbers within each drug utilization group were included.
- 2 The availability and accessibility of subjects recruited within the sampling frame will be affected by seasonal and other factors. The potential for bias in characterizations of the population at risk based on these data diminishes significantly as the size of the sample increases. Second, problems of self-selection and nonresponse in the sample must be acknowledged. The impact of refused responses is unknown, although data are not reported for variables with substantial missing/refused responses. Finally, the reliability of self-reported data is dependent on the accuracy of the subject's recall as well as the rapport established with the subject by the interviewer.

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Each site adhered to study eligibility criteria. Participants in the study were crack users and/or injecting drug users 18 years of age or older who used heroin or cocaine in the 30 days prior to study participation, as evidenced by a positive urine screen or recent needle marking, with no formal drug intervention or treatment in the past 30 days.

Data collection was performed using structured interviews.³ The interview schedule used in this study was designed as a supplement to the Risk Behavior Assessment (RBA) questionnaire currently used by the Cooperative Agreement sites. All sites used the RBA to collect data on participants' demographic characteristics, needle-sharing behavior, needle-related hygienic practices, and drug use behavior (drug use within the prior 30 days, routes of administration, and frequency of use).

Information was also collected regarding risk-related sexual practices, history of criminal justice system involvement, HIV antibody testing history, and involvement in community-based treatment. The instrument concluded with an interviewer assessment of respondent understanding, honesty, accuracy, and ability to answer the questions. The RBA required 30 to 45 minutes of respondent time and was administered in English or Spanish by trained interviewers. Data were collected between October 1992 and December 1992.

Following the RBA, respondents were asked supplemental questions as part of the Drug Procurement Study. These questions related to income sources, drug procurement costs, involvement in the drug distribution industry, types of drugs used and their monetary value, and sources of legal and illegal income during the preceding 30 days (including bartering goods and/or

services for drugs). The supplemental questions required approximately 30 minutes, and inclusion of these additional questions was the only deviation from the standard Cooperative Agreement process. Respondents were compensated for their time. The final questionnaire was pilot-tested prior to implementation.⁴

Results are presented in this report for drug use patterns of the target samples. While the two target samples of injecting drug users and crack users were appropriate designations for purposes of data collection, results revealed that they fail to distinguish accurately the many specific patterns of crack, cocaine, heroin, and speedball use among respondents. Studies of drug users often categorize individuals by type of drug used; however, because most drug users in this sample used multiple drugs, characterizing the sample composed of crack users and IDUs obscures the reality of their drug use. Thus, there was a need to redistribute the sample into drug use categories that could consider multiple drug use and frequency of drug use.

A drug typology was developed for the Drug Procurement Study to facilitate data analysis. *Exhibit 1* summarizes the drug typology decision rules. The typology is

Exhibit 1. Drug Typology Elaboration
Drug Use in the Past 30 Days

Typology Category ¹	Primary Drug Use	Secondary Drug Use ²
Crack Only	Crack use \geq 15 days	No powdered cocaine, heroin, or speedball
Crack Primary	Crack use \geq 15 days	Possible powdered cocaine, heroin, or speedball use <14 days
Cocaine Primary	Powdered cocaine use \geq 15 days	Possible heroin use <14 days, possible speedball or crack use 0-30 days
Heroin Primary	Heroin use \geq 15 days	Possible crack, powdered cocaine, or speedball use 0-30 days
Speedball Primary	Speedball use \geq 15 days	Possible powdered cocaine or heroin use <14 days, possible crack use 0-30 days
Less Frequent Users	No primary drug \geq 15 days	Possible crack, powdered cocaine, heroin, or speedball use <14 days

1. This typology focuses on forms of cocaine and heroin and does not include use of other drugs such as alcohol, marijuana, or amphetamines. The hierarchy is imposed as follows: (1) heroin, (2) cocaine, (3) speedball, and (4) crack when more than one drug exceeds 15 days of use in the past 30 days.

2. Most respondents reported the use of one or more secondary drugs in addition to their primary drug during the specified period.

3. Self-reports have always been an integral component of drug research. Results of research studies indicate a high degree of variability in self-report validity, both within and between studies (Anglin et al. 1993; Skog 1992; Faick et al. 1992; Mieczkowski et al. 1991; Maisto et al. 1990; Magura et al. 1987; Wish and O'Neil 1991; Weatherby et al. 1993).

4. A draft of the drug procurement questionnaire was pilot-tested at three sites (Denver, Detroit, and Long Beach). As a result of the pilot study, several questions were reworded and reformatted, and instructions to the interviewer were improved. No questions were removed or added. A test-retest reliability study of the drug procurement questionnaire was conducted at the three pilot-test sites. Both individual items and composite measures that were used in data reporting were analyzed for their test-retest reliability. These included 45 original items and four composite items measured at baseline and 24 hours later. The observed Pearson correlation coefficients indicate that variables reported here are acceptable measures in terms of test-retest reliability, with reliability coefficients greater than .70 for income and expense-derived variables and greater than .74 for drug use variables. Test-retest correlation analyses indicate that the measures in this study taken from the RBA demonstrate moderate or good reliability. Estimates are based on a reliability study conducted at five Cooperative Agreement sites (N=196). Coefficients ranged from 0.65 to 0.85 for 30-day measures (Needle et al. 1993). An assessment of the validity of respondents' self-reports of their drug use in the past 48 hours was conducted by comparing self-reported drug use (or nonuse) to urine test results. The percentage of agreement is consistently greatest for amphetamines at 98 percent agreement of the self-report to the urine test results (a drug with low prevalence of usage in this sample) and is lower for cocaine (74 percent) and opiate drugs (79 percent) (Weatherby et al. 1993).

based on the recent use of heroin and cocaine in the past 30 days. Six categories of drug users were developed from the data: crack only; crack primary; cocaine primary; heroin primary; speedball primary; and less frequent users who did not use any form of heroin or cocaine more than 15 of the past 30 days. The typology does not include the use of alcohol, marijuana, or amphetamines, since the use of these drugs was relatively consistent across all typology groups. Typology decision rules were developed based on several analyses of the frequency of drug use in the sample that revealed the ability to identify a primary drug for most individuals, the predominance of the use of crack that necessitated a hierarchy that focused on injection drug use, and the emergence of a group of users who did not use heroin or cocaine for 15 or more days in the past 30 days. While the typology is based on recent use, it is consistent with information on the drug acquisition, drug expenditure, and income-generating criminal activity questions that were also based on behavior in the past 30 days. Further, the typology provides an analytical framework that acknowledges the predominance of the use of cocaine and heroin in multiple forms in this population and provides a heuristic approach for analysis.

An examination of the data revealed that, within multiple use patterns, a primary drug could be identified for most respondents by using a midrange cutoff (15 days, or the equivalent of drug use at least every other day during a 30-day period). If a drug was used at least 15 of the last 30

days, it was classified as primary. Some respondents used more than one drug at least 15 of the last 30 days, and these respondents were assigned to a single primary drug category according to a hierarchy of: 1) heroin; 2) cocaine; 3) speedball; and 4) crack.

For instance, a respondent who used both heroin and crack at least 15 of the last 30 days was assigned to the "heroin primary" category; a respondent who used cocaine, speedball, and crack at least 15 of the last 30 days was assigned to the "cocaine primary" category. The hierarchy reduces the effect of the pervasive use of crack in characterizing other important patterns of drug use.⁵ Respondents who had used only crack more than 15 of the last 30 days (no powdered cocaine, heroin, or speedball use) were classified as "crack only" users. If no drug was used in 15 days or more, the respondent was classified as a "less frequent" user.

Following elaboration of drug use patterns, results are presented for drug expenditures, drug trade activities, drug acquisition, and income sources. Multivariate analyses were performed to examine characteristics of those who engaged in each of three noncash methods of drug acquisition (drug selling/dealing, trading sex for drugs, and trading goods for drugs), as well as those who reported illegal income from three specific sources (commercial sex, property crime, and drug sale-related crime). Analyses included linear multiple regression, logistic regression, and discriminant analysis.

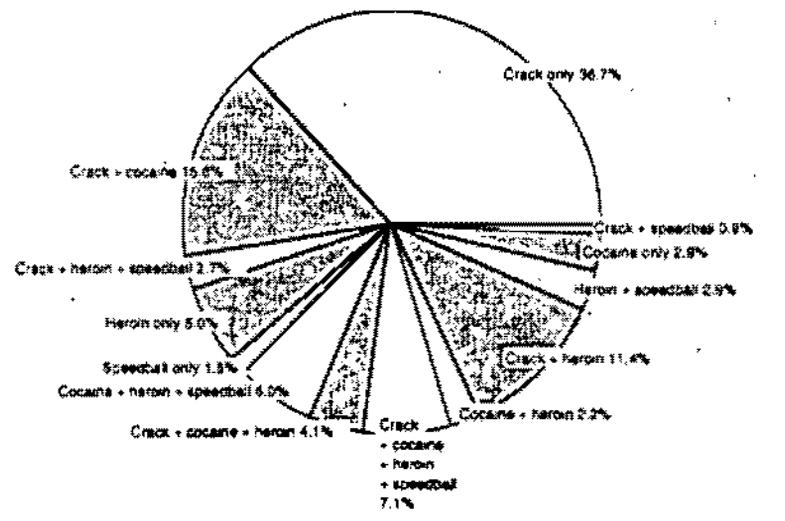
RESULTS

Drug Use Patterns

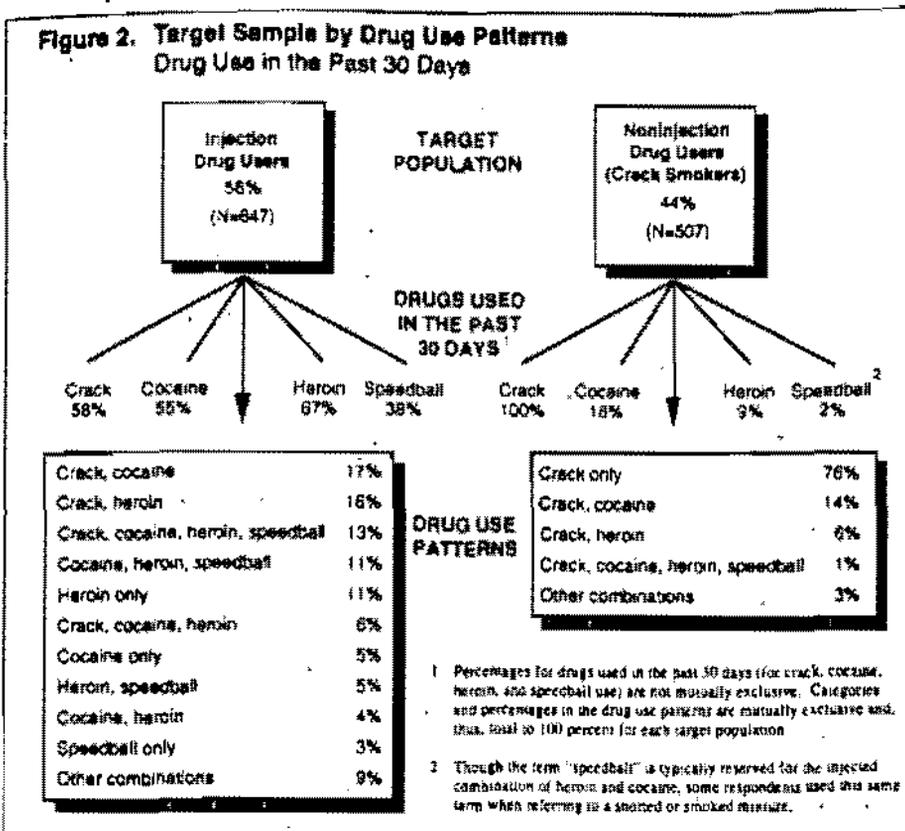
The final sample was composed of 1,154 drug users from the 10 sites. The sample included 63 percent male respondents. The race/ethnicity distribution was 64 percent African American, 14 percent Puerto Rican, 9 percent white, 8 percent Mexican/Mexican American, and 4 percent other. The median age of respondents was 36 years of age. Overall, 71 percent of the sample had been in jail and 53 percent had been in drug treatment. Forty-one percent of the respondents reported being employed in the past 30 days.

Figure 1 shows the drug use patterns of the past 30 days for the total sample. Crack use was widespread throughout the sample; more than 78 percent of the respondents reported using crack in the past 30 days.

**Figure 1. Consumption Patterns
Heroin and Cocaine Use in the Past 30 Days**



⁵ This hierarchy was imposed because of the high prevalence of crack use across all user groups that would have resulted in a predominance of crack primary users if crack had been moved up in the hierarchy. A secondary objective of the hierarchy was to categorize speedball users as either heroin primary or cocaine primary drug users, where respondents' multiple forms of drug use made this appropriate.



together composed 39 percent of the sample. Nine percent of the respondents in the sample were primarily cocaine users, 27 percent primarily heroin, and 5 percent primarily speedball. Twenty percent were classified as less frequent users because for any drug used, their use was less than 15 of the last 30 days.

It is important to note that in each typology group except the crack only category, the majority of respondents used two or more of the four typology drugs. In fact, except for crack use, rather small percentages of respondents in each group reported using only a single drug. For instance, in the cocaine primary group, only 13 percent reported using only cocaine in the past 30 days, and only 19 percent of respondents classified as heroin primary reported using only heroin. Reports of use of more than one

drug almost always included crack in addition to other substances.

Given the extensive use of crack cocaine, results are presented separately for crack cocaine and powdered cocaine. Results are also presented for heroin and speedball. Over half of the respondents in the sample reported using more than one of these distinct drug forms in the last 30 days. However, a significant number of crack users reported no use of powdered cocaine, heroin, or speedball.

drug almost always included crack in addition to other substances.

Table 1 presents the demographic profile of the typology groups. Women were more likely to be in the crack only group than in the crack primary group or in the other drug groups. Crack primary and crack only users in

Figure 2 further elucidates the use patterns for the target samples of injecting drug users and crack cocaine smokers. Over half of the IDUs in the sample used crack in the past 30 days. The most common use patterns among IDUs were cocaine along with crack use (17 percent) and injection of heroin along with crack use (16 percent). Eleven percent used heroin only, 5 percent used powdered cocaine only, and 3 percent used speedball only. For 76 percent of the crack sample, crack was the only one of the four drugs used. The combination of highest frequency in the crack sample was of crack and powdered (noninjected) cocaine (14 percent).

The sample was then distributed into the typology groups described earlier. The crack only and crack primary groups

Table 1. Demographic Profile of Typology Groups

	Crack Only (N=303)	Crack Primary (N=141)	Cocaine Primary (N=106)	Heroin Primary (N=316)	Speedball Primary (N=56)	Less Frequent Users (N=233)	All Users (N=1,184)
	%	%	%	%	%	%	%
Gender							
Male	58.1	70.9	72.6	64.2	87.3	60.3	63.1
Female	43.9	29.1	27.9	35.8	32.7	39.5	36.9
Race							
African American	80.2	75.2	52.8	50.8	32.7	67.8	64.2
White	4.6	8.5	7.3	15.8	18.4	8.9	9.4
Mexican	1.0	5.0	12.3	9.9	9.1	15.0	8.0
Puerto Rican	9.9	9.9	17.9	21.2	34.5	6.0	14.1
Other Hispanic	2.3	1.4	5.7	1.9	3.8	3.8	2.5
Other	2.0	0.0	3.5	1.3	3.7	1.7	1.8
Age							
18-29	33.0	19.9	15.1	11.4	18.2	23.6	21.2
30-39	46.3	46.8	43.4	39.6	40.0	41.2	43.5
40-49	15.2	27.0	35.8	38.6	32.7	30.9	29.2
50 or older	2.5	8.4	5.7	10.4	9.1	4.3	6.1
Median	33.0	38.0	36.9	39.0	38.0	38.0	38.0
Ever in Drug Treatment	40.9	56.0	52.8	72.0	63.6	40.8	53.4
Ever in Jail	66.0	83.1	89.8	83.2	85.5	62.2	70.9
Employed	42.6	48.4	41.5	34.6	40.7	43.8	40.6

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this sample were more likely to be African American. In addition, crack only users were the youngest group, with a median age of 33 years and 82 percent under the age of 40. The heroin primary group was the oldest group, with a median age of 39 years and 49 percent over the age of 40.

Percentages for previous drug treatment varied by typology group. Respondents in the crack only group were the least likely of the primary drug groups to have been in drug treatment; they were no more likely than the less frequent users to have been in drug treatment. Those in the heroin primary group were the most likely to have been in drug treatment. Percentages also varied for having ever been in jail, with the highest percentages for the heroin primary and speedball primary groups. These patterns appear to reflect differences in age and length of drug-using careers among the typology groups.

Primary drugs were used very frequently; the use of other drugs was infrequent, with the exception that crack primary users reported frequent use of powdered cocaine. For instance, among those respondents classified as crack primary, 71 percent reported using powdered cocaine between 1 and 14 days of the past 30 days, and 38 percent reported similar levels of heroin use. Similarly, among cocaine primary respondents, 43 percent reported frequent use of crack (15 or more days of the past 30). Within each group, the primary drug had been used at least an average of 23 days per month (the averages were 26 days of crack use for crack primary users, 26 days of heroin use for heroin primary users, 23 days of cocaine use for cocaine primary users, and 24 days of speedball use for the speedball primary group). Analyses were replicated using the level of use of each drug instead of the typology. Findings from these analyses gave evidence of the general validity of the typology.⁶

The drug use typology represents differences among respondents in their use of drugs in the past 30 days. An examination of the long-term use patterns is presented in *table 2*. Results reveal that respondents in the heroin primary group reported the

longest association with their primary drug—59 percent of the heroin primary users had been using heroin for more than 10 years. Not surprisingly, large percentages of respondents in the speedball primary group reported longstanding use of both heroin and cocaine.

Respondents in the crack only group and crack primary group reported significantly different long-term experience with powdered cocaine and heroin. Forty percent of respondents in the crack only group reported never using powdered cocaine, and 78 percent reported never using heroin. Among respondents in the crack primary group, only 2 percent had never used powdered cocaine in their lives, and 40 percent reported they had never used heroin. These differences exist despite the fact that the two groups displayed similar crack use histories, with median years of crack use of 6 and 7 years, respectively.

Table 2. Drug Use History of Typology Groups

	Crack Only (N = 303)	Crack Primary (N = 141)	Cocaine Primary (N = 108)	Heroin Primary (N = 318)	Speedball Primary (N = 58)	Less Frequent Users (N = 232)	All Users (N = 1,154)
	%	%	%	%	%	%	%
Years Using Crack							
Never Used	0.0	0.0	28.4	23.7	21.8	18.7	15.8
<1	1.0	5.0	7.8	15.5	48.1	7.8	9.9
1-5	47.5	30.7	24.9	37.0	21.8	31.9	42.2
6-10	41.3	41.8	25.5	19.3	5.5	21.0	28.1
11+	10.2	13.5	5.2	4.4	1.8	2.8	4.7
Median (years)	6.0	7.0	3.0	2.0	4.0	3.8	4.0
Years Using Cocaine							
Never Used	40.4	2.1	0.0	10.8	0.0	22.3	13.8
<1	33.0	7.8	4.5	26.8	14.8	21.0	22.5
1-5	13.6	27.0	17.1	19.9	29.1	23.8	20.1
6-10	7.0	30.5	31.4	12.9	25.5	14.8	18.4
11+	6.0	32.6	46.7	28.5	30.9	18.5	22.8
Median (years)	0.0	9.0	10.0	4.0	7.8	1.0	3.0
Years Using Heroin							
Never Used	78.5	40.4	34.0	0.0	0.0	48.5	30.8
<1	19.5	14.2	11.3	15.2	20.0	14.8	13.8
1-5	2.8	15.8	13.2	13.0	20.0	10.7	10.5
6-10	1.0	5.4	10.4	12.7	18.5	7.7	7.9
11+	2.3	23.4	21.1	59.2	41.8	18.5	28.3
Median (years)	0.0	0.0	1.5	13.0	8.0	0.0	0.0

6 Overall results indicate that the typology has considerable face validity based upon the frequency of drug use. Less frequent consumption (between 1 and 14 days in the past 30 days) was reported by small percentages of respondents in each category. The single exception to this is the high percentage of respondents in the crack primary category who reported the use of powdered cocaine. There are at least three possible reasons for this association between frequent cocaine use and frequent crack use. First, since the effects of smoking, snorting, or injecting cocaine are somewhat similar in type, if not degree, users may frequently switch back and forth between these routes of administration. Second, sources for obtaining powdered cocaine may be the same as or overlap with sources for crack cocaine, making both forms readily available to users of each. Finally, users of crack cocaine may themselves be involved in processing powdered cocaine into rock form and, thus, have access to both forms.

An examination of the use of marijuana, other opiates, and amphetamines was performed to examine the possibility of misclassification within the drug typology due to heavy use of drugs other than cocaine or heroin. Results revealed that marijuana use is relatively consistent across all groups, with less than 10 percent of the sample overall reporting heavy use of marijuana (15 or more days used in the past 30 days). Very few respondents reported heavy use of other opiates or amphetamines: the only occurrence of heavy use was reported by heroin primary respondents, of whom 10 percent reported using opiates 15 or more days and 8 percent reported using amphetamines 15 or more days in the past 30 days. These results are consistent with study eligibility criteria of active crack or injection drug use and further support the face validity of the drug use typology that focuses on forms of cocaine and heroin use.

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While some respondents in the cocaine primary group reported longstanding use of crack and/or heroin, many more appeared to have only recently begun using these drugs. Compared with a median 10 years of cocaine use, these respondents reported medians of 3 years of crack use and 1.5 years of heroin use. Twenty-six percent reported having never used crack, and 34 percent reported having never used heroin.

Some respondents classified as less frequent users on the basis of their drug use in the past 30 days reported drug use histories of many years. More than 23 percent had used crack for at least 6 years or longer, 33 percent had used cocaine for 6 years or longer, and 26 percent had used heroin for 6 years or longer.

Drug Expenditures

Expenditures for drugs in the past 30 days in this sample varied from zero (for those obtaining drugs solely by barter acquisitions or for free) to \$12,000. Overall, more than two-thirds of the sample reported spending more than \$200 in the past month for drugs, more than one-third of the sample reported spending more than \$500, and almost one-fifth of the sample spent more than \$1,000.

Examining expenditures for drugs as a proportion of total expenditures in the past 30 days, the median proportion of total month expenditures spent on drugs was almost

two-thirds of all expenditures. Most respondents spent at least half of their monthly outlay on drugs, and for almost 40 percent of the sample, three-quarters of their month's expenditures were for drugs. For 8 percent of the sample, the only expenditures reported for the past 30 days were for drugs.

Figure 3 displays the relationship of drug expenditures to the number of days of primary drug use.⁷ Clearly, as the frequency of primary drug use increases, the amount of expenditures for drugs in the past 30 days increases in this sample. Overall, men were likely to spend more than women on drugs, particularly those at higher drug use levels.

Table 3 summarizes the expenditures for drugs for the typology groups. The heroin primary group reported the highest monthly expenditure for drugs. As expected, the lowest reported expenditure for drugs was in the less frequent user group. While differences across groups exist, given the skewed nature of the data, it is important to stress the relative consistency across all user groups of large expenditures for drugs in the 1-month period.

Figure 3. Drug Expenditures by Days of Primary Drug Use
Drug Use in the Past 30 Days (N=1,023)

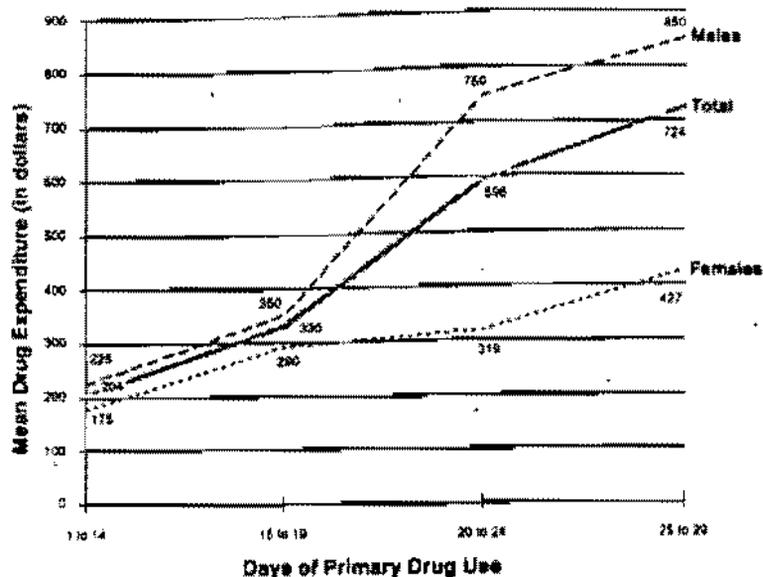


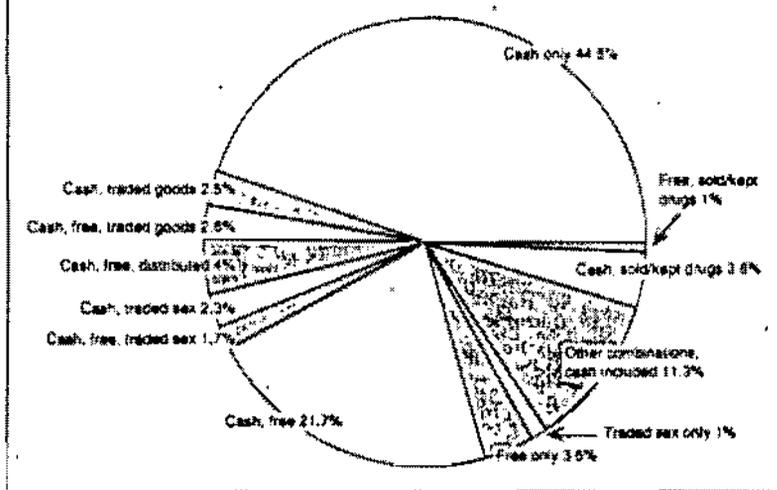
Table 3. Drug Expenditures by Typology Group

	Crack Only (N=300)	Crack Primary (N=141)	Cocaine Primary (N=106)	Heroin Primary (N=318)	Speedball Primary (N=55)	Less Frequent Users (N=233)	All Users (N=1,154)
	%	%	%	%	%	%	%
EXPENDITURE FOR DRUGS							
None	3.4	4.3	5.0	6.0	7.4	10.0	6.3
\$1-99	12.9	7.2	7.9	10.2	7.4	28.4	14.2
\$100-199	16.3	8.0	5.6	7.6	11.1	17.9	12.1
\$200-499	32.7	35.5	36.8	24.8	25.9	31.0	30.6
\$500-999	19.4	22.5	23.8	21.9	22.2	7.0	18.4
\$1000+	14.3	22.5	20.8	29.0	25.9	4.8	18.5
Median	\$300	\$400	\$400	\$500	\$400	\$130	\$300
% OF TOTAL MONTH EXPENDITURES SPENT ON DRUGS							
None	3.1	3.0	5.0	6.3	5.8	9.0	5.4
1-24%	10.6	4.4	8.0	7.0	7.7	20.0	10.3
25-49%	17.5	23.7	15.0	13.0	11.3	27.4	18.5
50-74%	31.8	30.3	24.0	30.3	25.0	25.6	29.3
75-99%	28.4	31.1	33.0	37.7	32.7	12.1	26.8
100%	9.6	4.4	15.0	9.7	17.3	3.4	7.8
Median	54.8	64.9	71.9	69.8	74.6	42.1	60.2

⁷ For each individual, a measure of days of primary drug use was computed. For example, for heroin primary users, the days of heroin use in the past 30 days were used and for cocaine primary users, the days of cocaine use in the past 30 days were used. For the less frequent users, the number of days using the most frequent drug was used for computing days of primary drug use. This measure was used in subsequent multivariate analysis to examine the relationship of intensity of primary drug use to outcome measures.

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Figure 4. Drug Acquisition Patterns Past 7 Days



Although respondents reported spending significant sums of money for drugs, many respondents had obtained drugs in ways other than cash acquisitions in the past 7 days. *Figure 4* elaborates the drug acquisition patterns of the respondents in the past 7 days. Overall, 45 percent indicated that they had paid cash only and 49 percent had used cash in some combination with another medium of exchange. Only 7 percent of the sample reported no cash acquisitions of drugs in the past week; these respondents relied solely on getting drugs for free, trading sex, or accessing drugs by selling drugs. Notably, 41 percent of the sample indicated acquisition combinations that included obtaining drugs for free. Fifteen percent of the respondents reported combinations that included selling drugs while keeping what they needed; 16 percent had traded/faced goods to get drugs. Eight percent had received drugs for distributing drugs. Two percent reported that they had stolen drugs.

Comparing respondents by typology group, respondents in the crack only and crack primary groups were more likely than other respondents to indicate trading sex for drugs. These respondents were also more likely to report receiving drugs for free or obtaining drugs as a result of making (processing) or distributing drugs. This is consistent with these respondents' access to markets for both powdered and crack cocaine.

Drug Trade

For many respondents, the acquisition of drugs was facilitated by their direct involvement in various aspects of the drug trade, such as the preparation of drugs for sale, the actual sale and distribution of drugs, and other drug market activities. These results are presented in *table 4*.

Overall, 32 percent of respondents reported being involved in any drug-related activities in the past 30 days. The most common activity reported was selling drugs to a nondealer (22 percent), followed by finding buyers (16 percent), steering (10 percent), and holding money or drugs (10 percent). Eight percent of the sample indicated being involved in cutting, packaging, or cooking drugs, 8 percent reported selling or renting pipes/works/rigs, and 9 percent provided other drug users with a place to use drugs.

Comparing the typology groups, the crack primary users were the most likely to report involvement in drug-related activities. Relatively high percentages of the crack primary group were involved in finding buyers for drug dealers (25 percent), cutting, packaging, or cooking drugs (13 percent), or selling/renting paraphernalia (14 percent). Respondents in the heroin primary group were the most likely to have sold to street dealers.

Drug Acquisition

The majority of respondents (72 percent) indicated that drugs were easy to obtain in the past 30 days. Of the 28 percent who indicated any difficulty in obtaining drugs, the most common reasons included having no money (59 percent), difficulty in finding a source (27 percent), supply shrinkage (25 percent), and increased policing (18 percent). Some respondents indicated an increase in drug users in the area (8 percent) or the increased cost of drugs (4 percent) as reasons for difficulty. Women were slightly more likely than men to indicate that they had encountered difficulty in

Table 4. Drug Sale-Related Activities Past 30 Days

	Crack Only (N=303)	Crack Primary (N=141)	Cocaine Primary (N=106)	Heroin Primary (N=316)	Speedball Primary (N=55)	Less Frequent Users (N=233)	All Users (N=1,154)
	%	%	%	%	%	%	%
Any Drug-Related Activity	30.7	28.3	20.2	33.5	23.6	30.0	31.8
Selling Drugs to Another Person (Not a Dealer)	21.9	24.1	17.0	23.3	22.2	18.9	21.5
Finding Buyers	13.0	25.5	18.9	15.3	5.8	17.2	18.2
Steering	7.6	15.6	9.4	11.2	3.7	7.3	9.5
Holding Drugs or Money	7.3	18.4	10.4	9.3	1.9	8.6	9.5
Providing Space	9.0	9.9	12.3	9.8	3.7	6.9	8.8
Cutting, Packaging, or Cooking Drugs	7.0	12.8	3.8	8.9	5.6	5.2	7.5
Selling or Renting Pipes/Works/Rigs or Other Paraphernalia	7.8	14.2	10.4	8.1	5.8	5.3	7.5
Selling Drugs to Street Dealers	3.0	5.4	4.7	7.7	3.7	4.7	5.2
Providing Street Security	4.0	7.1	4.7	5.1	3.7	1.3	4.2

obtaining drugs. Thirty-one percent of the women and 26 percent of the men indicated any difficulty in obtaining drugs in the past 30 days.

Since having no money was reported so often as the principal obstacle to drug acquisition, a series of detailed multivariate analyses was conducted to determine the factors associated with three noncash drug acquisition behaviors: drug selling/dealing, trading sex for drugs, and trading goods for drugs. Respondents were asked whether they had engaged in any of these activities in the last 30 days as a means to obtain drugs. Overall, 18 percent of the sample had engaged in drug selling/dealing, 5 percent had traded sex for drugs, and 6 percent had traded goods for drugs.

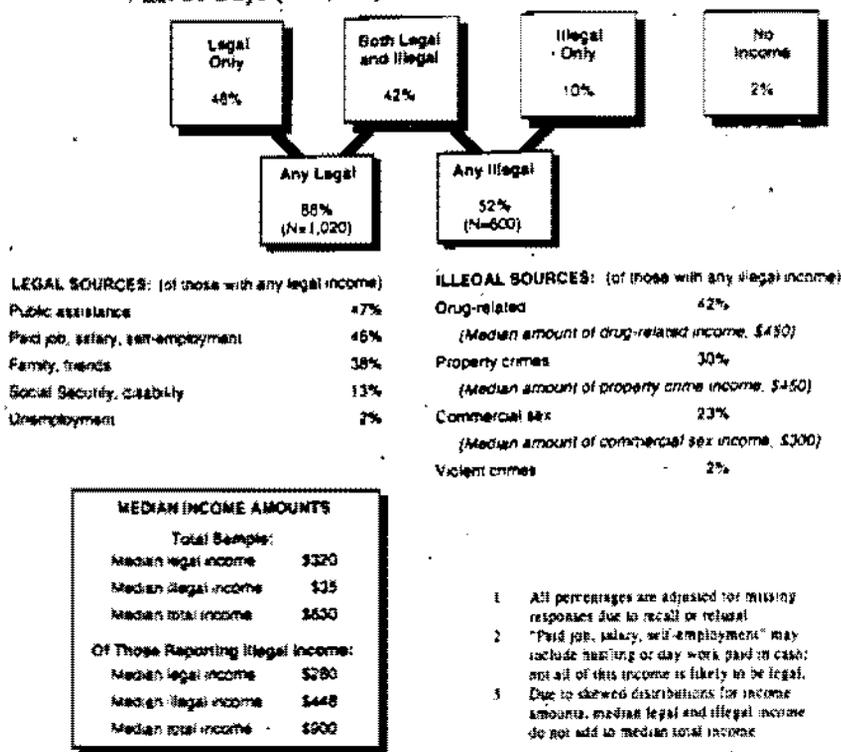
Linear multiple regression, logistic regression, and discriminant analyses consistently yielded several findings.⁸ First, respondents who found drugs difficult to obtain in the last 30 days were more likely than others to report having engaged in selling/dealing drugs or in trading goods in order to obtain drugs for themselves (which is consistent with the finding that a lack of cash was the most frequently cited obstacle to acquiring drugs). Second, respondents with higher levels of drug use were more likely than others to report engaging in drug selling/dealing. Third, respondents in the crack only and crack primary categories were more likely than others to report trading sex for drugs.

Income and Criminal Activities

In this sample, income was derived from a variety of sources. Most respondents had some legal sources of income (88 percent). Half of the respondents (52 percent) reported having some illegal income. Forty-six percent of the sample derived income from legal sources only in the past 30 days; 42 percent reported both legal and illegal sources. Ten percent of the sample indicated that all of their past month's income was derived from illegal sources. Two percent of the sample indicated that they had no income in the past 30 days.

Results for income amounts are presented in *figure 5* and income sources in *table 3* (page 12). Of those reporting legal income (N=1,020), the most common sources reported

**Figure 5. Income Amounts^{1, 2, 3}
Past 30 Days (N=1,154)**



included public assistance (47 percent), work-related income (46 percent), and family/friends (38 percent). Of those reporting illegal income sources (N=600), the most common sources included drug-related income (42 percent) and property crime income (30 percent). The most common sources of property crime income included shoplifting and panhandling.

Legal sources were common to all groups and highest for less frequent users. Illegal income was most evident among crack primary and cocaine primary users. Drug trade was relatively consistent across typology groups. Cocaine primary users were most likely to report property crime income. Very few respondents reported engaging in violent crime. Slightly more than 4 percent of speedball users reported income from violent crime; no other category of users exceeded this percentage. None of the less frequent drug users reported such income. Total median income for the sample was \$630 in the past 30 days, with the bulk derived from legal sources. Highest median total income was reported by respondents in the heroin primary, crack primary, and cocaine primary groups. These three groups also reported the highest median illegal income.

⁸ Several levels of analyses were conducted to examine relationships based on frequency of drug use and on typology group assignment in order to elaborate consistent multivariate findings. Results reported were consistent using multiple analytical techniques.

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**Table 5. Income Sources by Typology Group
Past 30 Days**

	Crack Only (N=303)	Crack Primary (N=141)	Cocaine Primary (N=106)	Heroin Primary (N=216)	Speedball Primary (N=55)	Less Frequent Users (N=233)	All Users (N=1,154)
	%	%	%	%	%	%	%
INCOME SOURCES							
Legal Only	46.2	34.8	38.8	41.1	50.9	59.7	48.0
Both Legal and Illegal	41.9	54.6	50.9	42.7	38.4	32.8	42.4
Illegal Only	8.9	7.1	10.4	14.0	10.8	4.7	9.6
No Income	1.0	3.5	1.9	1.6	1.8	3.0	7.0
LEGAL SOURCES							
Job/Self-Employment ¹	42.6	45.4	41.5	34.6	40.7	43.8	40.8
Supplemental Security Income	3.0	2.8	4.7	3.5	3.7	7.9	4.7
AFDC/Food Stamps	36.3	45.4	38.7	40.0	24.1	43.8	39.8
General Assistance	10.2	12.1	5.7	10.5	14.8	9.9	10.2
Spouse/Family Support	41.8	28.4	39.6	34.0	37.0	37.8	36.7
Other Legal Sources	11.9	14.8	11.3	11.1	13.0	9.9	11.6
ILLEGAL SOURCES							
Drug-Related Crimes							
Drug Trade	25.4	26.2	17.9	26.9	23.6	17.6	23.6
Property Crimes							
Panhandling ²	12.5	17.0	10.4	9.8	16.4	7.7	11.4
Numbers Running	3.6	3.5	8.8	5.4	1.8	3.6	4.9
Con Games	5.8	5.0	4.7	4.4	9.0	1.7	4.1
Shoplifting	5.8	7.8	20.4	18.8	10.9	7.3	11.4
Theft-Motor Vehicle	1.0	2.8	2.8	3.2	7.0	1.3	2.3
Pick-Pocketing/ Purse-Snatching	0.7	1.4	0.9	3.5	0.0	0.0	1.4
Buying/Receiving Stolen Property	6.6	7.8	5.7	6.0	9.1	3.4	6.0
Breaking/Entering	0.6	1.6	2.2	0.6	2.2	1.2	1.3
Commercial Sex							
Prostitution	13.9	14.9	9.4	13.9	12.7	3.4	11.4
Pimping, Commercial Vice	3.0	2.8	1.9	1.8	0.0	1.3	2.0
Violent Crime							
Mugging, Armed Robbery, Bank Robbery	1.3	0.6	5.1	1.7	4.4	0.0	1.3

¹ "Job/self-employment" may include hauling or day work paid in cash; not all of this income is likely to be legal.
² Panhandling may not be illegal at all sites; however, it is included in analysis within the illegal income sources.

compared with 23 percent of the women. Women were somewhat more likely than men to report receiving financial aid from a spouse or family. Differences between men and women occurred in the sources of illegal income as well. Women were much more likely than men to report deriving income from commercial sex. Men were more likely to report a variety of illegal income sources, such as involvement in the drug trade, numbers running, shoplifting, motor vehicle theft, and buying or receiving stolen goods.

Linear multiple regression, logistic regression, and discriminant analyses were used to identify other factors associated with receiving income from drug sale-related activities, from commercial sex, or from property crimes. Results across analytical methods were consistent in showing several findings. First, for each of the three, the likelihood of illegal income was greatest among respondents with higher levels of drug use. Second, respondents who reported that drugs were difficult to obtain were more likely than others to report illegal income from drug dealing/selling, commercial sex, or property crimes. Third, respondents in the cocaine primary category were more likely than others to report illegal income from property crimes or drug

Men and women were very similar in terms of percentages reporting legal income, illegal income, or a combination of legal and illegal income. However, more than half of the men had legal income derived from employment,

selling/dealing. Fourth, women were as likely as men to report illegal income, although they were more likely than men to be involved in commercial sex. Finally, respondents in the crack primary category were more likely than others to report deriving illegal income from commercial sex.

LIMITATIONS AND DATA INTERPRETATION

Several factors potentially diminish the generalizability of these findings. The sample, although geographically diverse, may not be representative of the national population of drug users nor of the 10 geographic areas from which the sample was taken, since the universe of characteristics of chronic drug users and the distribution of these characteristics are unknown. The availability and accessibility of respondents recruited within the sampling frame at each site have been affected by seasonal factors and other factors related to targeted sampling designs. This has important implications for how the data can be interpreted.

The preponderance of males (63 percent) and African Americans (64 percent) in the sample does not imply corresponding distributions in the population of out-of-treatment drug users.

Nevertheless, these data provide some basis for generalizations regarding perceived relationships between demographic characteristics and patterns of drug use or other illegal activity. For instance, this sample suggests several broad tendencies in *drug use patterns* among chronic injecting drug users or crack users according to

gender or race: women are more likely to be in the crack only group than in the crack primary group; it is reasonable to conclude that chronic drug use among women differs from chronic drug use among men in that it more frequently develops around crack *exclusive of other drugs* (and exclusive of cocaine in other forms); African Americans are more likely to be in the crack only, crack primary, or infrequent user groups; and Puerto Ricans are more likely to be in the cocaine primary or speedball groups. However, even these simple assertions must be made cautiously in the context of a nonprobability sampling design. To a significant degree, the limited generalizability of these findings is offset by the advantages of incorporating a rapid response design within the structure of an existing education and intervention assessment project.

Issues related to self-selection and nonresponse should also be acknowledged. It is likely that there is some impact of refused responses but its extent cannot be fully ascertained. The reliability of self-reported data is dependent on the accuracy of the respondent's recall as well as the rapport established with the respondent by the interviewer. The risk entailed in disclosing recent illegal activity (such as property or violent crimes) makes it likely that at least some

respondents underreported these activities. In this regard, these data suffer the same limitations that affect the broad base of surveys of criminal activities.

Finally, it should be noted that respondents from some sites are unevenly distributed across the typology categories. For example, the speedball primary group contains disproportionately more respondents from Puerto Rico and Long Beach, which results in a greater number of Hispanics of Puerto Rican origin in this category. Similarly, more than one-third of the respondents in the crack only group are from Miami, and more than one-third of the respondents in the cocaine primary group are from New Orleans. Other sites are proportionately well distributed across typology categories.

Results described in this report provide a detailed characterization of the patterns of drug use, drug procurement, and related illegal activities of chronic, out-of-treatment, noninstitutionalized drug users. While the data do not provide a basis for inferences to other types of drug users or drug users in general, they constitute an important piece in understanding the connections between drug use and other illegal activities.

CONCLUSIONS

This study provides an opportunity to examine the understudied, hidden population of noninstitutionalized, out-of-treatment, chronic drug users. Data collected from 10 cities across the United States provide a broad-based characterization of relevant behaviors among these drug users. While the data do not provide the opportunity for estimating prevalence outside of the specific population from which subjects were recruited, several conclusions can be drawn that have policy implications.

Results indicate that the majority of this sample can be identified as chronic, heavy drug users with long-term use patterns. Even though more than half of the respondents had been in drug treatment, the majority of respondents continued to use cocaine and heroin in high frequency. The use of the primary drug was very frequent in the 30-day period studied, with the average respondent using the primary drug at least 23 days.

Although there was considerable variation in the use of primary drugs (powdered cocaine, heroin, speedball, crack), the use of cocaine, particularly in the form of crack, was pervasive in the aggregated sample across all primary drug user groups. Even within the targeted population of injecting drug users, crack use was reported by 58 percent of the IDUs. In addition, multiple forms of heroin and cocaine use were common to all user groups and multiple forms of use almost always involved the use of crack.

There was an all-encompassing economic impact of drug use on the lives of most of the users in this study. Clearly, drug use was the dominant economic reality for these individuals. The median amount of money spent on drugs in the sample represents more than two-thirds of the total dollars spent by the typical respondent. Those who reported more than 25 days of primary drug use reported spending, on average, more than \$724 in the past 30 days for drugs. Thus, it is clear that the quest to find money to pay for drugs was a pervasive factor in the lives of these users.

The majority of respondents reported that drugs were easily acquired when cash was available. While the use of cash or cash in combination with other means were most common, other acquisition forms reported included obtaining drugs for free, trading sex for drugs, and selling drugs to acquire drugs for personal use. During times of drug acquisition hardship, most respondents indicated a lack of cash as the primary reason rather than a lack of availability of drugs.

More than half of the respondents in this sample had turned to income-generating illegal activities in the past 30 days. Of these individuals, 42 percent were involved in some form of drug-related activity, with much of this activity directly involved in selling or in directing persons to sellers. Thus, in the 30-day period studied, the street

Drug Procurement Practices of the Out-of-Treatment Chronic Drug Abuser

drug industry provided significant employment activities for these users.

These data reveal several significant differences between male and female chronic drug users. On average, the women in this sample were younger than the men. They were also more likely than men to be in the crack only or the less frequent user categories. In terms of income sources, women were more likely than men to report legal financial support other than wages, such as public assistance or support from family. Women reported deriving more illegal income than men from commercial sex. Women reported spending less than men on drugs, both in terms of number of dollars and in terms of the proportion of their total expenditures. Finally, women in the sample were less likely than men to have ever been in jail.

While the data reveal these differences between men and women in the sample, they also show several similarities. Men and women who injected drugs were similar in

terms of the frequency of injection. Also, men and women were equally likely to report having been in drug treatment. Finally, the overall likelihood of reporting income-generating criminal activity in the past 30 days was the same for men and women.

The results of this study support previous findings reported by Reuter et al. (1990) that many drug users engage in legitimate employment while engaging in drug-related income activities. Infrequent users in this sample were the most likely to indicate sources of legal income. Results also support previous work by Hunt et al. (1984 and 1986), who have reported on the relationship of escalating cocaine use with increased property crimes. In this sample, cocaine primary users were the most active in property crimes. Further, similarities found in this study between men and women in terms of the likelihood of reporting illegal income are consistent with those reported by Hser et al. (1990).

IMPLICATIONS

The Office of National Drug Control Policy recently stated in an interim report on *Breaking the Cycle of Drug Abuse* that "the principal drug problem today lies with chronic drug use" (ONDCP 1993). Previous efforts have focused attention on the casual or intermittent user. Strategies targeted to chronic drug users take on added importance in light of the fact that drugs are generally easy to obtain, despite major commitments to supply reduction strategies. The data from this study indicate that there is considerable variation in the population of users classified as chronic. Attention must focus on the chronic users, on those whose drug-using behavior is an indication that progression to daily use of drugs is likely (those we referred to as "less frequent users"), and on crack users who do not report using other drugs or injecting drugs.

Historically, drug use control efforts and policies have been aimed at reducing both the supply of and demand for drugs. Supply reduction programs—eradication of crops, disruption of smuggling routes and distribution networks, interdiction or seizure of drugs at U.S. borders and warehouse/distribution centers, and strong law enforcement and criminal justice system responses against producers, importers, distributors, and users—attempt to lower drug use by making drugs more expensive or more difficult to obtain. Demand reduction programs—including education about the consequences of illicit drug use—aim to lower drug use directly by changing the behavior of current and potential drug users. While both types of efforts are needed in the control of drug use, this study shows that drugs are generally easy to obtain, suggesting the need for an

increased focus of attention on demand reduction. Even when drug procurement is difficult—mostly due to a lack of cash, not a scarcity of drugs—users either barter for drugs or simply do without until more cash is available, and then immediately resume old patterns of drug use.

A major effort at reducing drug demand should involve drug treatment. About a million persons are not receiving treatment because of a limited number of treatment slots (ONDCP 1993). Of the participants who have entered the Cooperative Agreement Program, 56 percent have previously had drug treatment. This may result in part from the fact that many treatment programs do not adequately address the issue of multiple drug use, which is an inherent aspect of chronic drug use. The quality and accessibility of treatment must be considered in planning responsive services for this population. Research clearly needs to continue to experiment with potentially effective treatments for cocaine and crack use. Health services research on demand, utilization, and cost-effectiveness of providing treatment is also necessary.

Clearly, there is a need for engaging and maintaining chronic drug users in treatment. Treatment services must be sensitive to culture- and gender-related concerns in recognizing the full scope of drug use causal factors as well as the needs, including economic and social support circumstances, of clients, particularly women with children. The results of this study reveal that a significant number of women are involved in drug use, particularly the recently emergent crack cocaine use. Reducing drug use among

women should therefore be a major focus of expanded demand reduction strategies. Treatment services delivered in nontraditional settings (e.g., mobile treatment services taken into the community) and nontraditional forms (e.g., early intervention drug education, HIV transmission education, training in partner negotiation skills, and accessing health and social services) should be included as components of a total drug treatment program. In fact, the definition of treatment should be broadened to take into account less formal types of self-help services within the community.

A significant number of persons involved in this study reported having been involved with the criminal justice system. While more than 71 percent of the respondents indicated that they had been in jail, this did not stop their return to drug use activities after release. Reducing the demand for drugs among drug-involved criminal justice clients is important. Appropriately defined populations of drug-involved offenders should be referred to treatment for minimum lengths of stay to ensure treatment effectiveness. Again, indigenous community workers, either as part of the treatment system or the general social service system, should be more available and visible to help in reinforcing behavior modification learned in treatment settings. Resources should also be expanded to ensure the availability of publicly supported treatment.

Although demand reduction programs appear to be critically important to confronting drug problems today, the public health consequences, violence, crime, and HIV risk associated with chronic drug use require that thought be given to broadening policy options and program initiatives. Because chronic drug users often do not seek drug treatment, often do not remain in treatment, are involved in criminal activities, and continue to place themselves and others at high risk of acquiring and transmitting HIV, a strategy based on the newly emerging concept of harm reduction could be a possible complement to other approaches. The harm reduction approach aims "to create a situation that greatly reduces the risk that the addict harms himself or his environment" (van Ameijden et al. 1992).

The harm reduction perspective focuses on the harmful consequences of drug use, rather than focusing on the drug use itself. Harm reduction efforts are concerned with reducing harmful effects, of which reducing drug use may be the only means. For many types of drug-related harm, however, it is possible to reduce at least some portion of the

harm without eliminating or reducing drug use; for example, the reduction of multiperson use of injection equipment substantially reduces the risk for HIV infection regardless of whether injection drug use is reduced. Harm reduction is an approach that emphasizes attainable short-term goals and multiple, complementary solutions that operate simultaneously. Since the complete elimination of illicit drug use is extremely unlikely, the harm reduction approach provides a basis for designing innovative approaches for interventions with out-of-treatment drug users that are responsive to usage patterns and consequences of drug use.

Of those respondents in this sample who received HIV antibody testing, 12 percent were seropositive. Drug prevention/education programs that inform potential and current users about the harmful consequences of illicit drug use should be an integral part of responsive public health policies. NIDA Community Research Branch studies indicate that indigenous, community-based outreach workers, who may be recovering drug abusers, are effective agents for recruiting out-of-treatment active drug users into prevention and treatment programs, as well as being supportive agents to reinforce prevention and treatment practices. Of the 45,466 IDUs recruited into NIDA's National AIDS Demonstration Research (NADR) study, 14,974 (32.9 percent) entered formal treatment or self-help programs during the 6 months after receiving interventions. (For a detailed review, see National Institute on Drug Abuse 1993.) Unpublished preliminary followup data from the Cooperative Agreement National Database of September 30, 1993, show a reduction in self-reported borrowing of used needles or syringes from 44.6 percent to 21.4 percent after receiving an AIDS prevention and education intervention.

This study was possible because NIDA has supported development of a community-based research infrastructure that can readily respond to emerging drug-related issues, trends, and consequences and mobilize epidemiologists, ethnographers, and evaluation research personnel to monitor and assess problems of drug use and its consequences across the country. The ONDCP recognizes the importance of improving data collection and research efforts to obtain the best information for policymaking and monitoring policy. Community-based field stations, taking advantage of the existing research infrastructure, should be considered.

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Appendix. Selected Background Resources

Heroin and Crime References:

Ball 1993
Compares heroin addicts in New York, Philadelphia, and Baltimore and finds similar crime rates. Most common crimes were shoplifting, fencing stolen goods, numbers racket, and drug trade involvement. Over half of addicts in each city report involvement in crime on 300+ days in previous year.

Caplowitz 1976
Reports that for at least some heroin users, primary income source was legal.

Faupel 1988
Some support found for hypothesis that increased employment is associated with decreased criminality. Drug use and criminal activity may be spurious concomitants of the subculture in which they occur.

Faupel and Klockars 1987
Explores relationship of drug use and criminal activity over the life career of heroin users. Concludes that the proposed hypothesis concerning the financial burden of heroin use and the subculture of use that supposedly promotes criminal activity apply only during some periods of the drug use career.

Hser et al. 1990
Data from 328 female methadone patients show association between narcotics use and property crime and drug dealing. Replicates earlier findings for male addicts, but for males, property crime and drug dealing were negatively contemporaneously related with low levels of prostitution.

Hunt et al. 1984
In-treatment methadone clients and not-in-treatment heroin users report comparable levels of criminal activity, though serious crime such as robbery, burglary, or drug dealing is lower among in-treatment subjects. Frequent cocaine users report higher rates of property crime and drug dealing than those who used cocaine less frequently.

Inciardi et al. 1982
Examines criminal activity among African American female heroin users. Results suggest that criminal activity frequently precedes expensive drug use, thereby questioning the causal link between drugs and supposed resulting crime.

Johnson et al. 1985
Heroin users report high levels of involvement in robbery, burglary, and shoplifting but lower levels of involvement in drug trade activities.

Kowalski and Faupel 1990
Data from 768 subjects suggest that heroin users typically engage in one or two "main hustles" from which they derive the majority of their criminal income. Also suggests that variety of criminal activity is greatest among daily users of heroin.

Nurco et al. 1991
Two hundred and fifty male methadone patients were categorized as to criminal behavior: type, severity, and amount. Authors derive nine categories of criminal involvement.

Speckart and Anglin 1986
Findings suggest that criminality increases following addiction to heroin and a shift to more serious crime occurs as addiction level increases. Dealing drugs is often preferred and replaces/obviates the need for other types of crime.

Appendix. Selected Background Resources (continued)

Cocaine and Crime References:

- Feucht 1991 Using urinalysis, shows that women arrested for prostitution are more likely than other female arrestees to test positive for cocaine.
- Goldstein 1985, 1986, 1989 Develops a tripartite categorization linking cocaine and violent crime. Reports that a substantial portion of violent crime is linked to psychopharmacological properties of cocaine.
- Goldstein et al. 1993 Examines violent crime and cocaine. Links violent crime to amount of cocaine use but not to frequency of cocaine use.
- Harrison and Gfroerer 1992 National Household Survey data show a relationship between cocaine use and greater likelihood of violent crime activity and a strong link between property crime and violent crime.
- Hunt et al. 1984 Frequent cocaine users report greater involvement in property crime than do less frequent users.
- Hunt et al. 1986 Shows increasing cocaine use among methadone clients. Cocaine use is associated with increased criminal activity. Authors suggest this is a result of psychopharmacological properties of the drug, cost of the drug, and lifestyle associated with cocaine use.
- Inciardi and Pottieger 1986 Compares 1977-1978 and 1983-1984 cohorts of drug-using women. Most frequently reported crime in later cohort is vice (prostitution), with substantial involvement in drug sales and theft.
- Simonds and Kashani 1980 Links cocaine consumption to violent crime among juvenile males.

Crack and Crime References:

- Fagan and Chin 1993 Reports that before the onset of crack use, many crack users are involved in crime that is unrelated to drugs.
- Inciardi et al. 1993 Among crack-using women, more report drug trade crimes and petty property crimes (76 and 77 percent, respectively) than prostitution (49 percent). Likelihood of violent offenses, major property crimes, and prostitution is higher with heavier crack use.
- Inciardi and Pottieger 1993 In a study of 254 crime-involved juveniles, daily crack users were more likely to be heavily involved in crack distribution; conversely, big-level dealers of powdered cocaine tended to be occasional users. Daily powdered cocaine users were rarely dealers.

Other References:

- Graspedaal 1992 Reports that the use of drugs is elastic and depends more upon the availability of funds than on physical need.
- Johnson et al. 1988 Among heroin and cocaine users, illegal income, particularly income from robbery, is spent primarily on drugs.
- Reuter et al. 1990 Studies the impact of legal employment upon illegal activity such as drug dealing. More than two-thirds of subjects maintain legitimate employment while engaging in drug trafficking.

Marijuana Situation Assessment

Office of National Drug Control Policy
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Marijuana Situation Assessment

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Executive Summary

By most accounts, marijuana use peaked in the U.S. in 1979 and has declined steadily ever since. However, there are now some indications that this downward trend has slowed, and perhaps even reversed course, among certain sectors of the population. The most recent National Household Survey on Drug Abuse (Household Survey) reports noticeable upturns in use among a number of demographic groups. So too do surveys of junior high school, high school, and college students. In most large cities, higher percentages of arrestees are testing positive for marijuana, and data on drug-related emergency room visits show more episodes where marijuana is involved.

The possibility that marijuana use is on the rise is worrisome. Since marijuana is by far the most widely used illicit drug, small percentage increases in use mean that large numbers of Americans have crossed the line from not breaking the drug laws to breaking them. And although marijuana is not as addictive or toxic as cocaine, its use, especially when heavy, can lead to problems of cognitive, personal, and social functioning. Perhaps the more profound worry about increased marijuana consumption is what it might portend for the use of more dangerous drugs.

One possibility is that marijuana use is a barometer of public attitudes about illicit drug use. If more people are smoking marijuana, it could reflect increased acceptance of illicit drug use in general. Or there could be a "gateway" effect. Smoking marijuana—or seeing others smoke marijuana—might make some individuals more disposed to use other drugs.

Is marijuana use increasing? There is not much indication of an across-the-board rise in the number of users—in the 1993 Household Survey, the estimated percentage of the population that smoked marijuana in the past month was virtually unchanged from the previous year. There is some evidence, however, of a rise in marijuana use among teenagers. The Household Survey reports increased use among those aged twelve to seventeen, and both the Monitoring the Future and PRIDE surveys show increased use for every student age group polled.

Among problem drug users—those whose drug consumption is connected with criminal activity or severe health problems—indicators of marijuana smoking are difficult to interpret. Data from the Drug Use Forecasting Program (DUF) indicates that in 1992, for the first time in years, the percentage of arrestees testing positive for marijuana use increased. But it is hard to draw any firm conclusions from this finding. Are marijuana smokers, previously law-abiding apart from their drug use, now engaging in other crimes? Are criminally active cocaine users switching to marijuana, or simply adding it to their drug menu?

Marijuana-related emergency room episodes, as tabulated by the Drug Abuse Warning Network (DAWN), also rose in 1992. Here too, it is difficult to know what the increase implies about marijuana use. When an overdose involves marijuana and other drugs or alcohol—as the overwhelming majority of marijuana-related emergency room episodes do—rarely is marijuana principally responsible for the adverse reaction. Thus, the data could reflect a spread in marijuana smoking among those using other drugs and alcohol. On the other hand, the data are also consistent with a different story: that more marijuana smokers are becoming polydrug users, mixing marijuana with other illicit drugs and with alcohol.

To the extent that marijuana smoking has become more prevalent among certain groups, it is important to know why. Market supply conditions do not appear to be responsible. When prices are adjusted for inflation and recent increases in potency, marijuana appears to be cheaper than it was a year or two ago, but only by a few percentage points, hardly enough to explain a shift in use patterns. Availability is high: when surveyed in 1993 by the Monitoring the Future program, 83 percent of high school seniors said that marijuana was "fairly easy" or "very easy" to obtain. But this figure is actually within a percentage point of the all-time low for the survey.

A more likely cause of any upturn in marijuana smoking—at least among teenagers—is a change in attitudes and fashions. Among high school seniors, there was, from 1980 to 1991, a steady increase in the fraction of students who considered smoking marijuana once, occasionally, or regularly a “great risk.” In 1992, however, the trend reversed. A similar pattern appears when high school seniors were asked whether they “disapproved” of smoking marijuana once, occasionally, or regularly. Disapproval of occasional and regular use has declined since 1990, and disapproval of trying once has declined since 1992.

It is important to note that these reported attitude changes preceded by one or two years the recent increase in self-reported use. It is also important to point out that interpretation of these results is complicated by the possibility that strongly disapproved-of behavior is more heavily underreported. If marijuana use is now viewed by students as less dangerous and more acceptable, they may be more honest in reporting their use. Thus, the apparent increase in the number of users may overstate the change in actual behavior.

Ominously, teenage attitudes about marijuana use have continued to move since then in the direction of greater acceptance. This suggests that trends in marijuana consumption and supply deserve close attention. On the consumption side, it will be important to see whether the indications of growing teenage use are confirmed by other surveys, and if similar findings appear for other age groups. Even more important to watch for is evidence of any connection with other drug or alcohol use. In terms of supply, domestic marijuana production, which seems to account for half or more of U.S. consumption on a potency-adjusted basis, is the chief concern. When valued at retail prices, domestic production is probably worth \$6 to \$7 billion a year.

Introduction

By most accounts, marijuana use peaked in the U.S. in 1979 and has declined steadily ever since.¹ However, there are now some indications that this downward trend has slowed, and perhaps even reversed course, among certain sectors of the population. The most recent National Household Survey on Drug Abuse (Household Survey) reports noticeable upturns in use among a number of demographic groups. So too do surveys of junior high school, high school, and college students. In most large cities, higher percentages of arrestees are testing positive for marijuana, and data on drug-related emergency room visits show more episodes where marijuana is involved.

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other drugs.

This report provides a summary and analysis of current evidence of trends in marijuana consumption and supply. The report also derives an estimate of total U.S. marijuana consumption and compares the estimate to others that have been produced.

Footnote

¹ See, e.g., Herbert Kleber, "Our Current Approach to Drug Abuse—Progress, Problems, Proposals," *New England Journal of Medicine* 330 (5 Feb. 1994):361-365.

Marijuana Consumption

INDICATORS OF USE

There are two basic sources of information on drug use: surveys and field research (participant observation, direct observation, case studies). The great strength of surveys is that they can describe, with known accuracy and consistency, the characteristics of large populations. Surveys are also apt to be superficial. Field research can provide more depth of understanding, for it involves detailed study of attitudes and behaviors, with particular attention paid to social context and processes.¹ However, because field research is qualitative rather than quantitative, and because its findings have been filtered through the lens of researchers, any conclusions must be considered suggestive.

A literature review failed to reveal any field research specifically addressing recent developments in marijuana use. This is unfortunate, because such research might provide a better understanding of the social and cultural factors motivating these changes. In the absence of such work, we will rely exclusively on surveys.

Drug use surveys vary greatly, both in terms of subject population and measurement technique. The Household Survey, for example, casts a broad net and uses self-reporting for collecting information. In contrast, the Drug Use Forecasting Program (DUF) focuses on a narrow segment of the population (arrestees) and uses urine tests to supplement self-reports.

Self-Report Surveys

The accuracy of self-reported surveys depends on the honesty and memory of those questioned. Because marijuana use is illegal, one can expect some number of untruthful responses.² It is important to note, however, that if the level of deliberate and accidental misreporting is consistent from year to year, trends in survey data may nonetheless be reliable.

The National Household Survey on Drug Abuse

The largest and most comprehensive survey of drug use in the U.S. is the National Household Survey on Drug Abuse. Administered annually since 1990, and every second or third year prior to 1990, the Household Survey polls those aged twelve and older living in households. The table below reports, for the past five surveys, estimates of the percentage of such Americans who used marijuana in the past month and in the past year.

	1988	1989	1990	1991	1992	1993
Used in Past Month	5.9%	—	5.1%	4.8%	4.4%	4.3%
Used in Past Year	10.6%	—	10.2%	9.5%	8.5%	9.0%

NOTE: The National Household Survey on Drug Abuse was not conducted annually until 1990

Source: National Household Survey on Drug Abuse

The figures in the table offer mixed news. The good news is that marijuana use among household members is much less common now than it was in 1988; indeed, according to Household Survey estimates, the prevalence of monthly marijuana use has fallen by sixty percent since 1979. The bad news: the steady decline in use since 1979 appears to have recently stalled.

Moreover, a closer look at the 1993 survey results shows notable increases in marijuana use among youths. The table on the next page

Percentages Reporting Past Month Marijuana Use, 1991-1993

Demographic Characteristic	AGE GROUP (Years)														
	12-17			18-25			26-34			35 and Older			All Ages		
	1991	1992	1993	1991	1992	1993	1991	1992	1993	1991	1992	1993	1991	1992	1993
Total	4.3	4.0	4.9	13.0	11.0	11.1	7.0	8.2	6.7	2.1	1.6	1.9	4.8	4.4	4.3
Race/Ethnicity															
White	4.4	4.1	4.5	13.7	11.6	12.5	6.6	8.8	6.8	1.9	1.6	1.7	4.5	4.4	4.2
Black	4.5	3.4	5.8	14.6	11.2	9.2	11.9	8.2	9.9	3.5	2.5	2.7	7.2	5.2	5.6
Hispanic	4.6	4.8	6.7	9.1	8.0	7.8	4.2	5.6	4.1	2.3	0.7	2.9	4.3	3.7	4.7
Other	1.2	2.9	3.1	4.8	6.4	3.7	6.5	4.8	4.4	*	*	1.7	3.4	2.4	2.7
Sex															
Male	5.0	4.6	5.5	15.7	14.5	16.5	9.5	11.0	9.0	3.0	2.3	2.5	6.3	5.9	6.0
Female	3.7	3.5	4.3	10.5	7.5	5.7	4.5	5.5	4.5	1.3	1.0	1.4	3.4	2.9	2.8
Population Density															
Large Metro	4.4	4.1	5.5	12.9	12.2	9.3	8.6	8.0	6.9	2.6	2.0	1.9	5.4	4.8	4.2
Small Metro	4.7	4.7	5.2	14.5	8.7	14.5	6.2	9.1	6.9	1.8	1.1	2.3	4.8	4.0	5.0
Nonmetro	3.9	3.0	3.5	11.0	11.8	10.1	4.5	7.5	6.0	1.6	1.5	1.4	3.7	4.0	3.5
Region															
Northeast	3.7	2.9	5.0	14.7	13.4	12.2	6.2	9.1	7.3	2.8	0.9	1.4	5.2	4.2	4.2
North Central	4.6	4.7	5.0	11.5	9.0	10.2	7.6	5.9	5.2	2.0	1.8	1.5	4.6	3.7	3.5
South	3.9	3.2	3.7	12.1	10.6	11.2	5.6	7.7	6.1	1.7	1.1	2.1	4.2	3.9	4.3
West	5.5	5.7	6.7	14.8	11.5	10.9	9.2	10.8	8.7	2.3	3.0	2.7	5.8	6.0	5.5
Adult Education															
Less Than															
High School	N/A	NA	N/A	16.0	14.0	15.1	11.7	9.5	10.0	1.3	1.6	1.2	5.1	4.5	4.3
Graduate	N/A	NA	N/A	13.0	11.8	11.6	8.3	8.5	8.3	2.5	1.5	2.0	5.5	4.6	4.8
Some															
College	N/A	NA	N/A	12.7	9.8	9.8	6.2	9.1	6.3	3.2	1.3	2.5	6.0	4.8	4.9
Graduate	N/A	N/A	N/A	7.7	5.5	6.7	3.3	6.3	3.8	1.4	2.1	2.1	2.4	3.4	2.9
Current Employment															
Full-time	N/A	N/A	N/A	11.1	10.3	11.4	6.5	7.9	6.2	3.0	1.7	2.5	5.0	4.5	4.6
Part-time	N/A	N/A	N/A	14.4	10.1	10.4	5.8	8.4	8.6	1.9	1.4	2.5	6.3	5.3	6.1
Unemployed	N/A	N/A	N/A	17.4	19.6	19.0	19.8	15.8	12.9	7.7	4.8	2.5	13.6	11.7	9.5
Other	N/A	N/A	N/A	13.1	8.5	8.0	3.9	5.1	4.7	0.4	1.1	1.0	2.4	2.3	2.1

N/A Not applicable

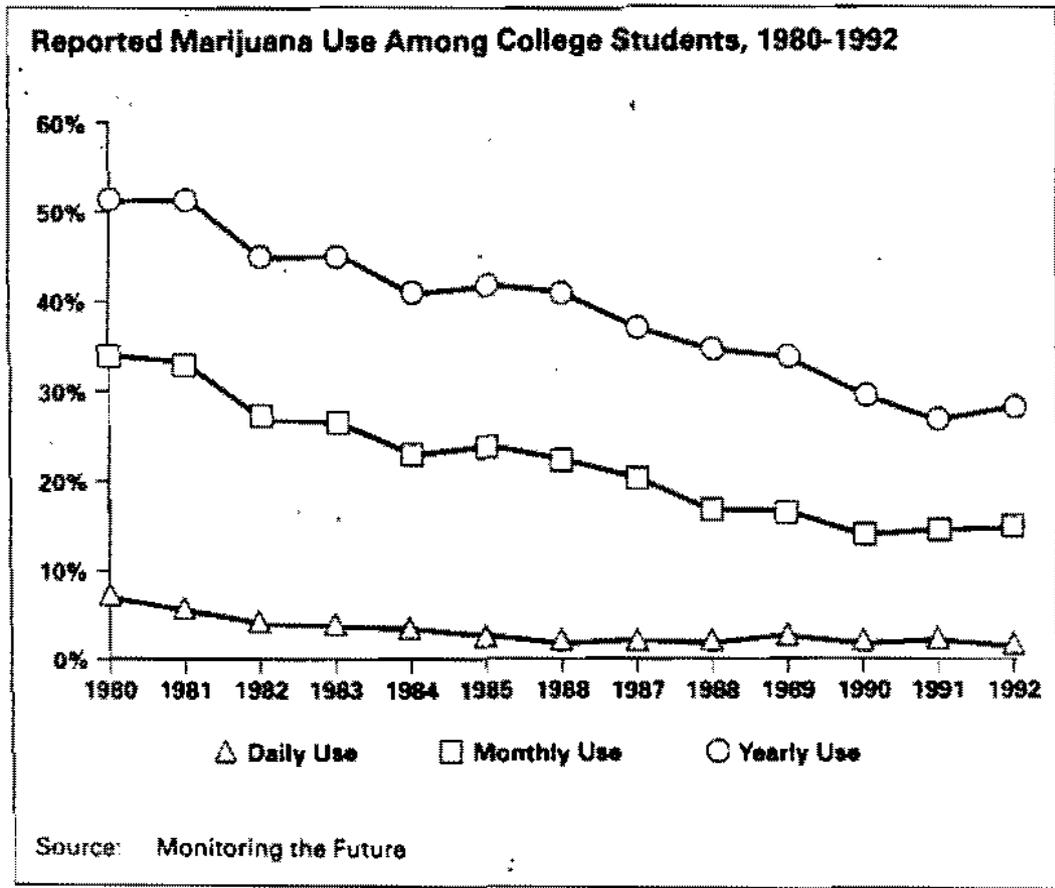
* Low precision; no estimate reported

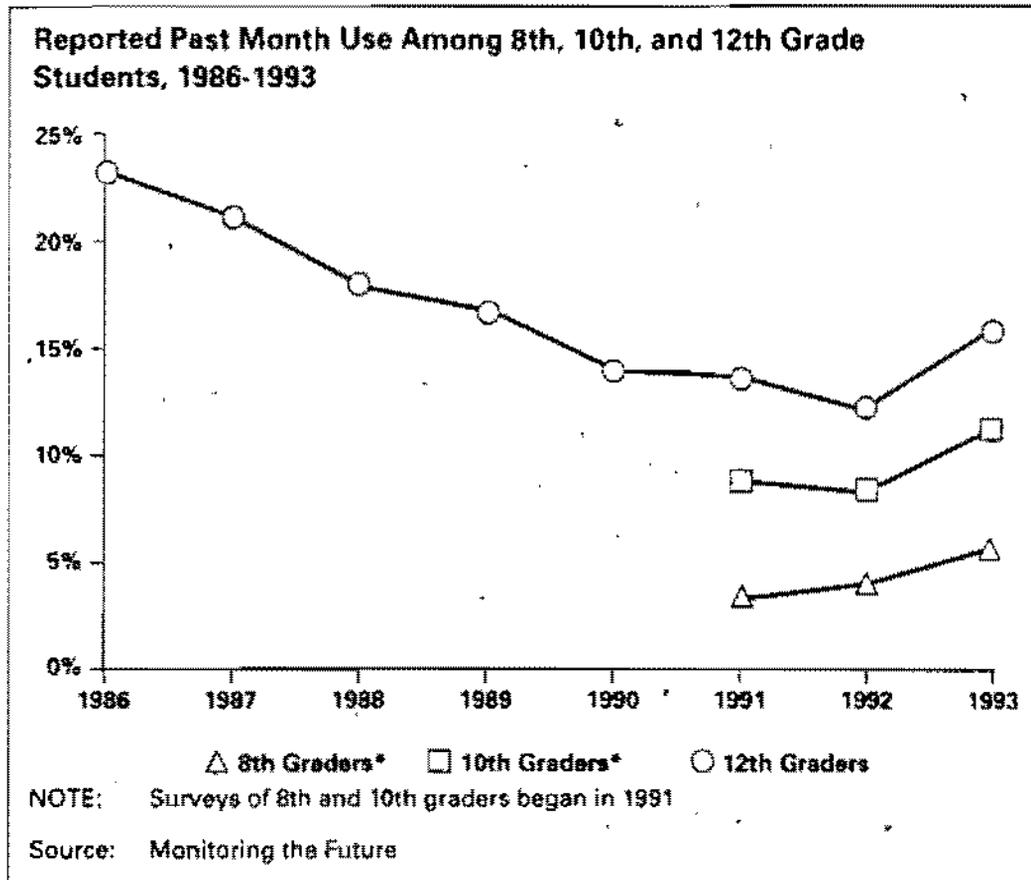
Source: SAMHSA, Office of Applied Statistics, National Household Survey on Drug Abuse

reports, for the 1991, 1992, and 1993 surveys, past month marijuana use for a number of age groups and demographic characteristics. In every demographic group, there is an increase in past month marijuana use among those aged twelve to seventeen. It should be noted, however, that none of these increases is considered statistically significant (at a five percent level of significance).

The Monitoring the Future Survey

The Monitoring the Future survey (sometimes referred to as the High School Senior Survey) surveys college students and students in the eighth, tenth, and twelfth grades. The survey is an important supplement to the Household Survey. For one thing, prior to 1991, the Household Survey did not include in its panel college students living in dormitories. More important, the Monitoring the Future survey may receive fewer dishonest responses, since many of the Household Survey interviews of adolescents are conducted in the presence of parents. On the other hand, the Monitoring the Future survey does not interview school dropouts, some of whom are reached by the Household Survey.





The figure on the preceding page shows reported daily, monthly, and yearly use among college students since 1980. Note that, despite a sharp decline over the course of the entire period, rates appear to have steadied or increased in recent years. Daily use has been level since 1986; monthly use began increasing in 1991; and yearly use increased in 1992.

Such a change in trend is even more evident among eighth, tenth, and twelfth grade students. As illustrated in the figure above, monthly use has increased since 1991 for eighth graders, and since 1992 for tenth and twelfth graders.

PRIDE Survey of Secondary School Children

Each school year, PRIDE, a national drug prevention organization based in Atlanta, conducts a survey of over 200,000 primary and secondary school students (sixth through twelfth grade), asking about the use and availability of drugs and alcohol. One should be careful in drawing broad conclusions from the survey's results; unlike the Monitoring the

Future survey, the PRIDE survey is not a probability sample of the nation's students. Specifically, students in southeastern states are overrepresented, while students in populous states are given too little weight. Also, as in the Monitoring the Future survey, non-student youths are not included in the sample.

With this caveat in mind, the table below reports figures on marijuana use from the 1990-91, 1991-92, and 1992-93 school year surveys. The data suggest that there were across-the-board increases in past-year marijuana use among white and black junior high and senior high students from the 1991-92 to 1992-93 school years. The jumps were slightly greater among black students, although, with the exception of junior high males, marijuana use is still more prevalent among white students. Use overall began increasing in the 1991-92 school year among junior high students. (Prior to the 1991-92 survey, PRIDE did not report data by race and sex.)

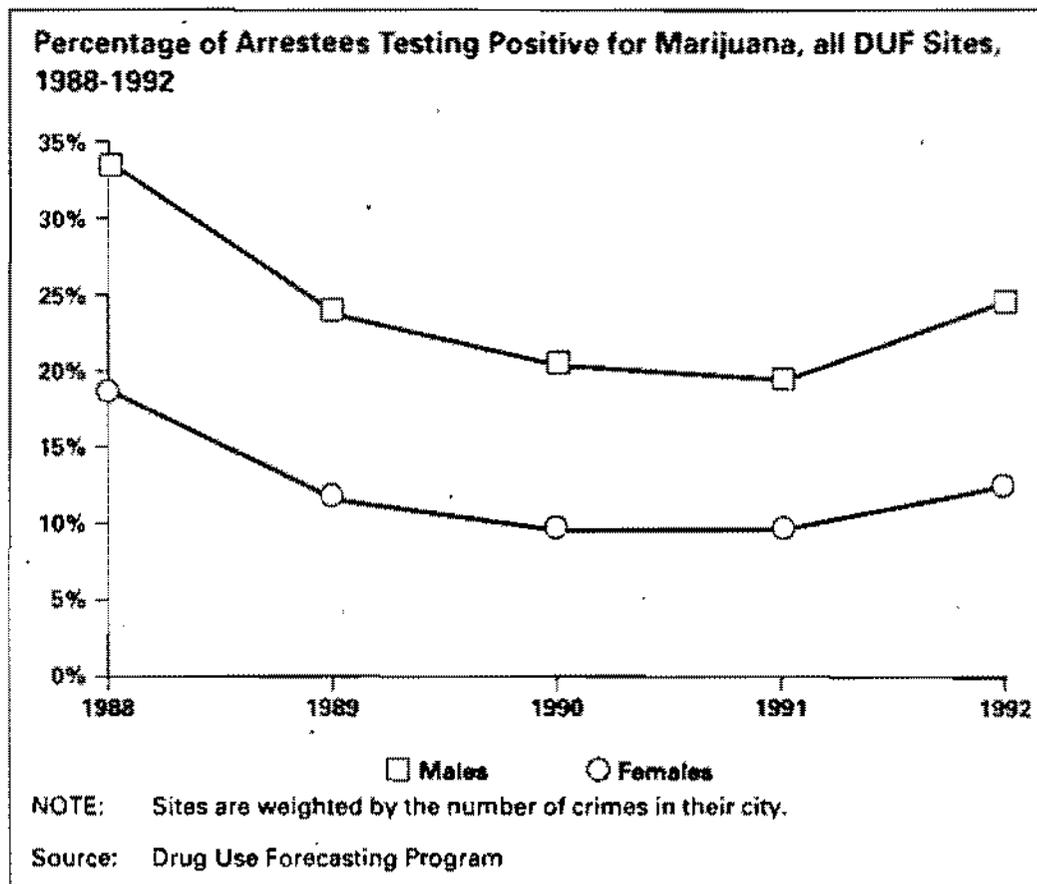
	Junior High (6-8th Grades)			Senior High (12th Grades)		
	1990-91	1991-92	1992-93	1990-91	1991-92	1992-93
Total	4.5%	4.8%	5.8%	16.9%	16.4%	19.0%
White						
Male	—	5.8%	6.4%	—	20.3%	22.4%
Female	—	3.3%	3.9%	—	15.0%	17.0%
Black						
Male	—	4.5%	7.7%	—	13.2%	19.0%
Female	—	1.9%	3.8%	—	5.6%	9.7%

NOTE: PRIDE did not begin reporting data by sex and race until its 1991-92 report.

Source: PRIDE

Drug Testing of Arrestees

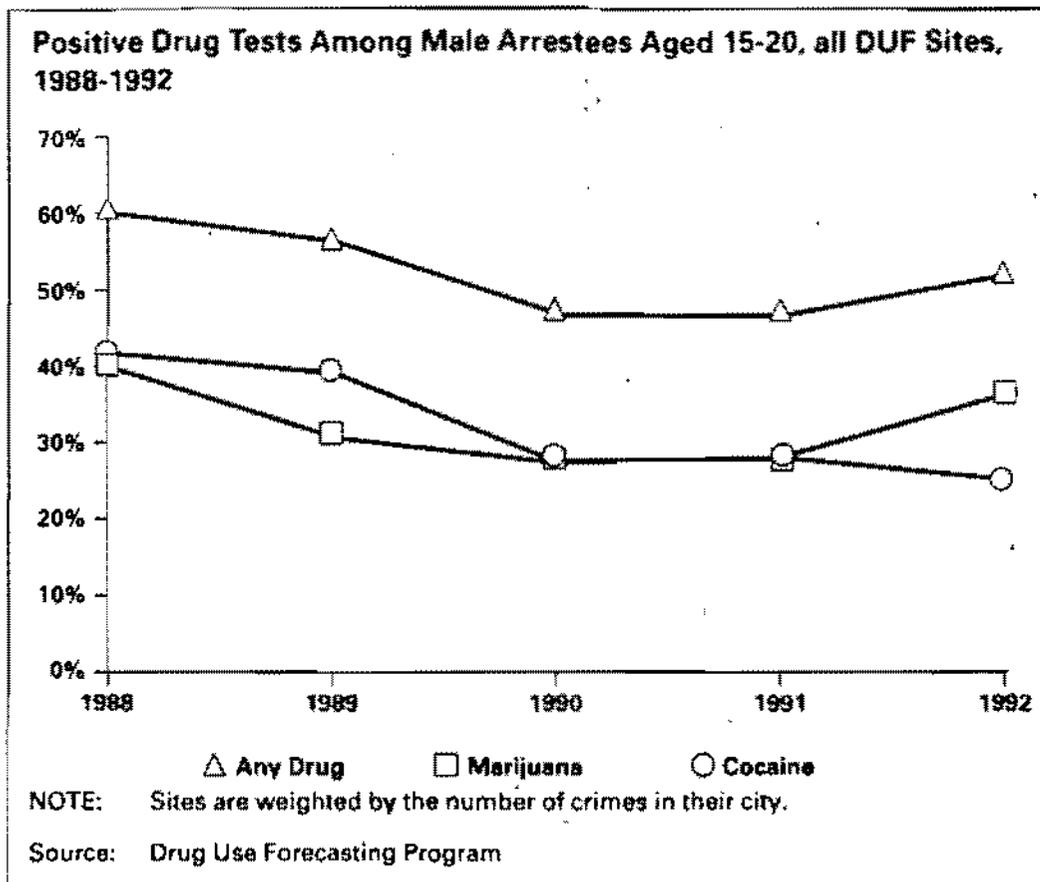
The Drug Use Forecasting Program (DUF), administered by the National Institute of Justice, conducts drug testing and interviews of arrestees in twenty-four cities. DUF data make two important contributions to



tracking trends in marijuana use. First, those who are criminally active are not only likely to go uncounted in population based surveys like the Household Survey, but also tend to have particularly high rates of substance abuse. (Whether DUF is a representative sample of the criminally active in the covered metropolitan areas depends on arrest patterns.) Second, urine tests do not suffer the misreporting problems inherent in self-report surveys.

DUF data are reported only on a city-by-city basis. To obtain an overall index, we constructed a weighted average based on the number of reported crimes in each city. The chart above shows the calculated percentage of male and female arrestees that tested positive for marijuana from 1988 to 1992. As indicated, the percentage of arrestees testing positive for marijuana declined from 1988 to 1991, but rose from 1991 to 1992.

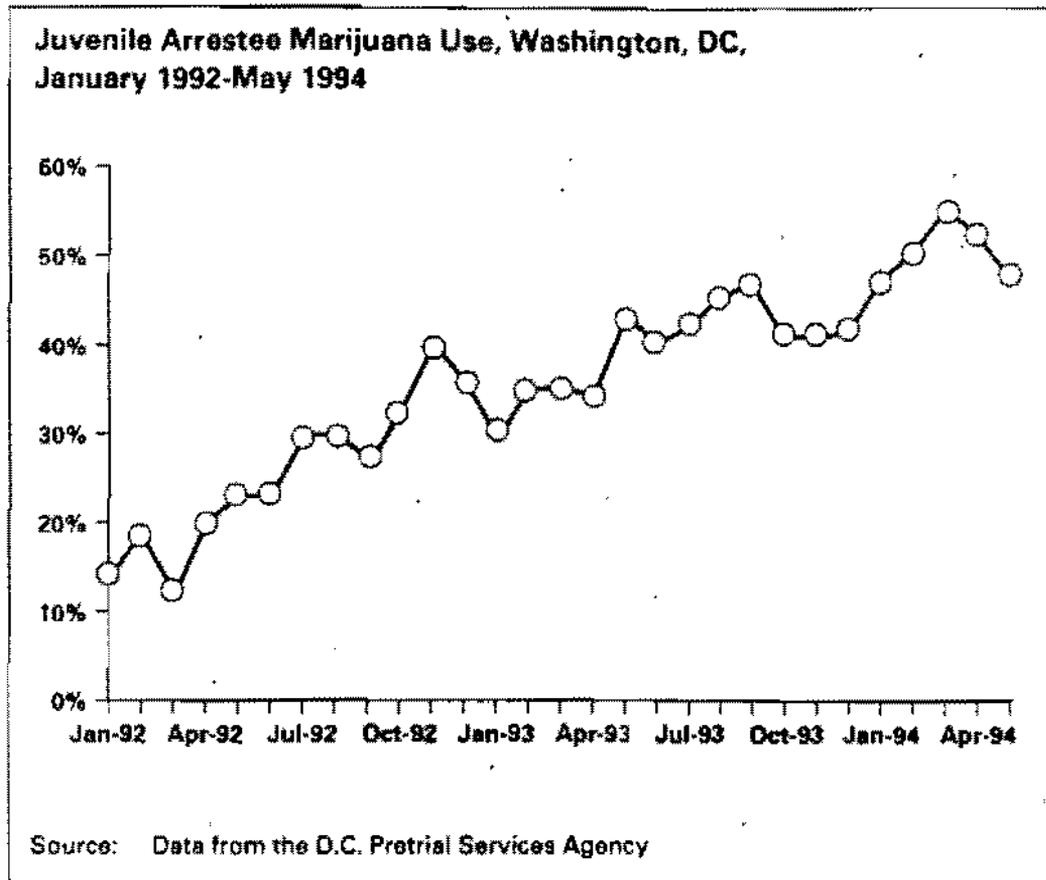
Among arrestees, marijuana use varies significantly across age groups. Use is most prevalent among juveniles and young adults, and so it is worth looking at these groups in isolation. To do this, we constructed



another weighted average, in this case using only males aged fifteen to twenty. The figure above shows the calculated data.³ Again, the percentage of arrestees testing positive for marijuana use increased noticeably in 1992.

Several different mechanisms could lead to an increase in the number of criminally active marijuana users reflected in increased DUF marijuana positives. Non-criminal (apart from their drug use) marijuana users could become criminal; criminally active cocaine users could switch to marijuana; criminally active heroin users could begin using marijuana in addition to heroin; and so on. The graph shows that the increase in positive marijuana tests was similar in magnitude to the decrease in cocaine positives. This is consistent with the idea of young cocaine users switching to marijuana, though direct evidence of such a pattern has not been observed.

DUF is not the only program that conducts drug testing of arrestees: a few local programs do, as well. Perhaps the largest of these is the pro-



gram that tests juvenile arrestees (including those as young as eight years old) in Washington D.C., administered by the D.C. Pretrial Services Agency. Because large numbers of arrestees are tested on a regular basis, the D.C. Pretrial Services Agency can report data on a monthly basis. Test results dating from January 1992 are summarized in the chart above. The increase in positive marijuana tests is startling.

Although an increase in the percentage of arrestees testing positive for marijuana suggests an increase in the absolute number of criminally active marijuana users, there are other possible explanations. Suppose, for example, that the number of criminally active marijuana users declined, while the number of criminally active non-marijuana users (those who do not use drugs, as well as those who use drugs other than marijuana) declined proportionately more. In that case, we would expect marijuana users to comprise a greater share of arrestees, even though their absolute number decreased. In principle, there are several other factors that could also account for the observed trend: a rise in crime or arrest rates among criminally active marijuana users, or a

decline in crime or arrest rates among criminally active non-marijuana users. Another problem with the arrestee data is that it is drawn from urban areas only. It is possible that drug use among arrestees in non-urban areas is quite different from that in urban areas.

Marijuana-Related Emergency Room Mentions

The principal source of data on drug-related emergency room mentions is the Drug Abuse Warning Network (DAWN), until recently managed by the National Institute on Drug Abuse (NIDA), but now under the auspices of the Substance Abuse and Mental Health Services Administration (SAMHSA).

DAWN reports a large increase (48 percent) in the number of marijuana-related emergency room mentions between 1991 and 1992. As can be seen in the table below, there were also large reported increases in cocaine and heroin mentions. (A detail of DAWN data, tabulated by population and city, is included in the appendix.)

	1988	1989	1990	1991	1992	Percentage Increase in Mentions, 1991-1992
Drug						
Cocaine	46.7	50.1	36.2	45.2	52.9	17%
Heroin	17.5	19.0	15.3	16.0	21.2	33%
Marijuana/Hashish	9.2	9.4	7.1	7.3	10.6	45%

Source: Drug Abuse Warning Network

What is not clear is how much of this increase is due to polydrug use (marijuana used in conjunction with other drugs or alcohol) as opposed to marijuana smoking alone. It is a good bet that most of the increase is attributable to a rise in polydrug mentions, since episodes involving marijuana alone are relatively rare. In 1992, DAWN estimated 23,997 emergency room mentions of marijuana; of these, 13,025 also involved alcohol, and 9,689 also involved cocaine. Alcohol and cocaine mentions also rose sharply from 1991 to 1992.

To the extent that the rise in marijuana-related emergency room mentions is a product of polydrug use, it is difficult to know what the increase implies about marijuana use. When an overdose involves marijuana and other drugs or alcohol, rarely is marijuana principally responsible for the adverse reaction. On the one hand, the data could reflect a spread in marijuana smoking among those using other drugs and alcohol. On the other hand, the data are also consistent with a different story: that marijuana smokers are more commonly using other drugs and alcohol.

Overall, marijuana appears to play a small role in drug-related overdoses. The table below shows, for 1988 to 1992, the proportion of drug-related emergency room episodes that involved alcohol (in combination with other drugs), cocaine, and marijuana. Marijuana was involved in only 5.5 percent of the episodes in 1992, and unless past patterns have changed radically, other illicit drugs or alcohol were also involved in the overwhelming majority of those cases.

	1988	1989	1990	1991	1992	Percentage Increase in Proportion 1991 to 1992
Alcohol in Combination	28.7%	29.6%	31.0%	30.9%	32.7%	6%
Cocaine	25.2%	25.8%	21.6%	25.7%	27.6%	7%
Marijuana/Hashish	5.0%	4.8%	4.2%	4.2%	5.5%	33%

Source: Drug Abuse Warning Network

Drug Abuse Treatment

According to data compiled by the Substance Abuse and Mental Health Services Administration and the National Institute on Drug Abuse, there has been, since the mid-1980's, a substantial increase in reported admissions to treatment programs where marijuana is the primary drug of abuse. (See table on next page.)

Were these data to reflect an increase in the underlying demand for marijuana treatment, they would suggest a notable rise in problem marijuana consumption.⁴ However, there are a number of reasons for

	1985	1986	1987	1988	1989	1990	1991
Heroin	87,043	82,927	94,299	115,308	122,612	153,852	142,372
Cocaine	38,323	55,757	81,356	137,343	206,480	235,202	229,703
Marijuana/ Hashish	57,578	68,491	57,473	76,948	95,253	106,885	96,421

Source: SAMHSA, NIDA

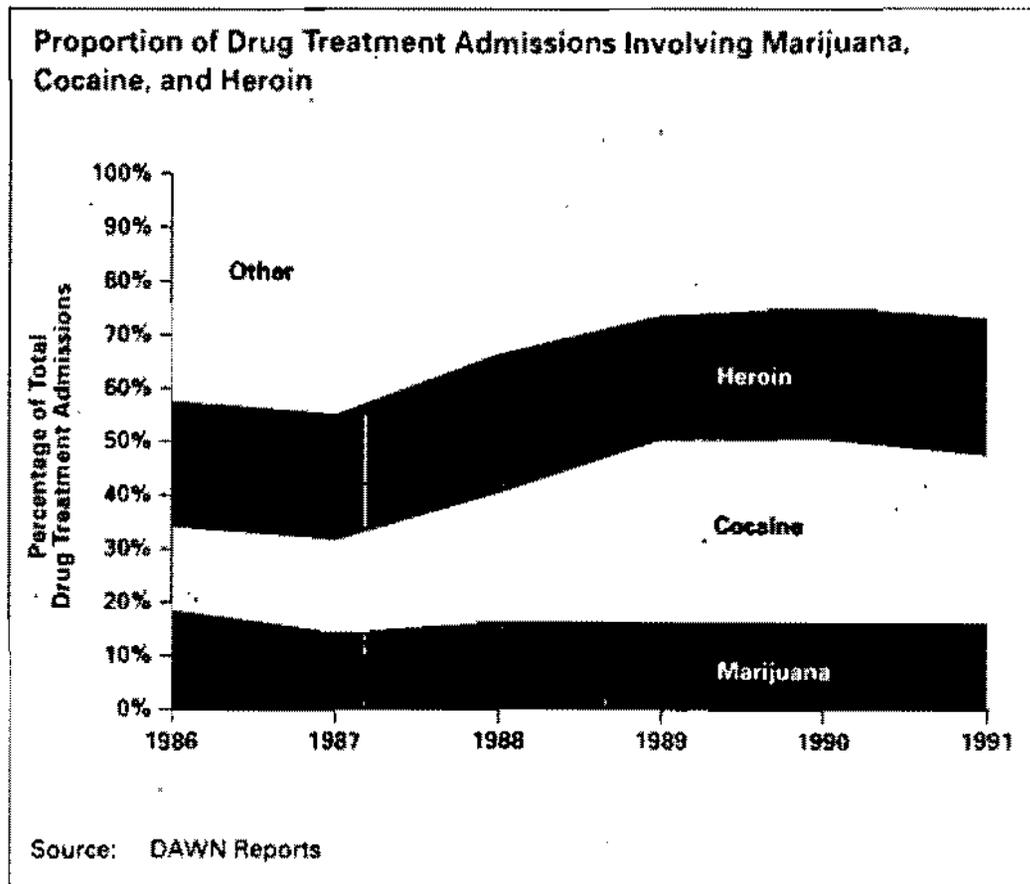
discounting their significance. For one thing, the data are widely acknowledged to be an unreliable indicator of use. Several problems stand out in this regard: (1) there is no accepted federal standard of what does and does not constitute a treatment program; (2) data are submitted voluntarily by State Alcohol and Drug Abuse Agencies; and include data *“for only those programs which received at least some funds administered by the State Alcohol/Drug Agency”*⁵; and (3) since in many areas of the country there is unmet demand for drug treatment—as evidenced by waiting lists for programs—a rise or fall in admissions may denote a change in supply rather than demand.

Since it is likely that these problems would affect data on treatment admissions for all drugs, it is probably more useful to look at the share of admissions where marijuana is the primary drug of abuse. This, at least, might indicate whether marijuana abuse was growing or shrinking in comparison to the abuse of other drugs.

The figure on the next page shows the relative percentage of treatment admissions where marijuana, cocaine, heroin, or some other drug was the primary drug of abuse. It does not appear, from this data, that marijuana abuse is increasing as a proportion of total drug abuse.

ESTIMATES OF TOTAL U.S. MARIJUANA CONSUMPTION

For policy purposes, it would be quite valuable to have an accurate estimate of total U.S. marijuana consumption. On the demand side, it would improve understanding of the use problem. On the supply side, it would enable law enforcement officials to better gauge the size of the illicit market and the achievements of their eradication and interdiction efforts.



In the pages that follow, we derive an estimate of total U.S. marijuana consumption based on data from the self-report surveys examined earlier in the report. We calculated the number of marijuana smokers using data from three government drug use surveys: the National Household Survey on Drug Abuse, the Monitoring the Future survey, and the Drug Use Forecasting Program. Information on user consumption levels was obtained from Household Survey data and through a telephone survey of 46 current marijuana users. The survey sample was an attempt at a cross-section of marijuana users, at least in terms of socioeconomic status and consumption levels, though not by geography; of those interviewed, half resided in or near Boston, Massachusetts, while half lived in other parts of the country. More detailed information on the user survey can be found in the Appendix.

Calculating User Consumption Levels

From the Household Survey and our user surveys, we were able to construct a probability distribution of consumption levels (or habit sizes)

among marijuana smokers. The Household Survey provides useful data on quantity and frequency of use among monthly users, and data on frequency of use among yearly users. Where quantity figures were unavailable, frequency was multiplied by an estimate of per-use consumption. (We estimate that marijuana users consume an average of about one fiftieth of an ounce, or roughly one half of a gram, to get high, and that the average size of a joint is one sixtieth of an ounce.)

Consumption by Users in Households

The Household Survey provided an estimate of the number of marijuana users residing in households. We revised (increased) the Household Survey estimates slightly to account for two instances of apparent underreporting. Those who were interviewed in a more private setting reported higher levels of use than those interviewed with others (sometimes parents) present. Also: the Household Survey estimates lower levels of use among teenagers than the Monitoring the Future survey. From our analysis, we estimate that in 1992, approximately 1,220 metric tons of marijuana were consumed in households.

College Students

Prior to 1991, the Household Survey sample did not cover college students living in dormitories. Thus, for our 1988 and 1990 consumption estimates, data from the Household Survey were supplemented with data from the Monitoring the Future survey, which does interview dormitory residents. We estimate that college students in dormitories consumed approximately 59 metric tons in 1990, the last year in which dormitory residents were not covered by the Household Survey.

Criminally Active Users

Those who are criminally active are likely to go uncounted in the Household Survey. To determine quantity consumed by this population, we examined DUF data on urine tests and self-reported use among arrestees. We estimated monthly marijuana consumption both among those who tested positive for marijuana use and those who tested negative. (Interestingly, about one-third of those who tested negative reported use.) Then, following the synthetic estimation methodology employed by Abt Associates,⁶ we combined these figures with data on

arrest numbers and frequencies to estimate total marijuana consumption among the criminally active. We estimate that criminally active users consumed 379 metric tons of marijuana in 1992.

Total Marijuana Consumption

Combining the above numbers, we estimate that total U.S. marijuana consumption for 1992 was 1,599 metric tons. It should be noted that this estimate has some weaknesses. For starters, it probably misses marijuana consumption in some particularly isolated or difficult-to-reach populations, such as the homeless or transients. However, drug use in the populations, while significant, is probably very small compared to the populations that our methodology covered.

Our estimate may also understate marijuana consumption if underreporting is common in self-report surveys. Although adjustments were made where there was evidence of misreporting, we did not make any across-the-board corrections. While there is ample evidence that errors in reporting do occur, the overall magnitude and direction of the errors are unclear.

A final area of concern: a sizable percentage (16 percent in 1991) of those selected for polling by the Household Survey were not surveyed, either because a meeting could not be arranged or because the interview was refused. It is possible that these individuals differ in their marijuana use patterns from those who were surveyed.

The combined biases of misreporting and nonresponse may be significant. It is worth pointing out that an estimate of total U.S. alcohol consumption calculated from the Household Survey appears to be low by about half. According to data from Household Survey, Americans consume fewer than 50 billion drinks per year; revenues from alcohol taxes indicate annual consumption of more than 100 billion drinks.⁷ Similar calculations with tobacco indicate that cigarette smokers underreport their consumption by about 30 percent.

Trends in Marijuana Consumption

In order to examine recent trends in marijuana consumption, we calculated our consumption estimates for 1988, 1990, 1991, and 1992 (the Household Survey was not conducted in 1989). We also translated con-

sumption estimates into retail dollar and THC (tetrahydrocannabinol) equivalents.⁸ Since THC is the psychoactive agent in marijuana, and since the potency of marijuana varies greatly, THC consumption is in some ways the most relevant estimate of marijuana use.

The table below reports, for the years analyzed, estimates of gross marijuana and equivalent THC consumption (both in metric tons), as well as implied retail cost (in billions of dollars). As indicated, gross consumption appears to have declined from 1988 to 1991 among each user population. From 1991 to 1992, gross consumption appears steady, but with an increase among those involved with the criminal justice system.

	1988	1989	1990	1991	1992
Households (Gross Metric Tons)	1,871	—	1,528	1,326	1,220
College Students (Gross Metric Tons)	77	—	59		
Criminally Active (Gross Metric Tons)	375	—	363	358	379
Total (Gross Metric Tons)	2,323	—	1,950	1,684	1,599
Total (Metric Tons of THC)	102	—	94	81	84
Retail Cost in Billions (nominal dollars)	\$14.0	—	\$14.4	\$13.2	\$13.1
Retail Cost in Billions (1992 dollars)	\$16.6	—	\$15.5	\$13.5	\$13.1

NOTE: The National Household Survey on Drug Abuse was not conducted in 1989.

THC consumption declined similarly from 1988 to 1991, with a slight decline as well from 1991 to 1992. Because of fluctuations in marijuana prices, retail cost estimates suggest a somewhat different pattern. Dollars spent on marijuana were relatively unchanged between 1988 and 1992, except for a sharp drop in 1990.⁹

Footnotes

¹ See, e.g., Norman Zinberg, *Drug, Set, and Setting: The Basis for Controlled Intoxicant Use* (New Haven: Yale Univ. Press, 1984); Bruce D. Johnson, Paul J. Goldstein, Edward Preble, James Schmeidler, Douglas S. Lipton, Barry Spunt, and Thomas Miller, *Taking Care of Business: The Economics of Crime by Heroin Users* (Lexington, Mass.: Lexington Books, 1985).

- 2 However, one would expect self-reports of marijuana use to be more accurate than self-reports of other illegal drug use (such as cocaine or heroin use), since marijuana is the most widely used and least disapproved-of illegal drug.
- 3 It should be noted that the data reports only on those who were tested by the DUF program at adult booking facilities. DUF does conduct some testing and interviews at juvenile facilities; however, as of 1992, such sampling covered only twelve cities.
- 4 Aging of the user population can increase the demand for treatment, but probably not by enough to explain the sharp upturn shown in the table.
- 5 National Institute on Drug Abuse, *State Resources and Services Related to Alcohol and Other Drug Abuse Problems, Fiscal Year 1990* (Washington, D.C.: U.S. Department of Health and Human Services, 1991).
- 6 For an explanation, see William Rhodes, "Synthetic Estimation Applied to the Prevalence of Drug Use," *Journal of Drug Issues* 23 (Spring 1993):297-322.
- 7 See Congressional Budget Office, *Federal Taxation of Tobacco, Alcoholic Beverages, and Motor Fuels* (Washington, D.C.: Congress of the United States, 1990), table A-8, p. 110.
- 8 THC quantities were calculated using potency estimates derived from DEA data. For more detail, see the "Price, Potency, and Availability" section later in the report.
- 9 Our estimates of total spending on marijuana are approximately seventy percent higher than those derived for ONDCP by Abt Associates. See William Rhodes, Paul Scheiman, and Kenneth Carlson, *What America's Users Spend on Illegal Drugs, 1988-1991* (Washington, D.C.: Office of National Drug Control Policy, 1993). For example, Abt's estimate of total spending for 1991 is \$7.69 billion, whereas our estimate is \$13.1 billion. The difference can be accounted for by three factors. First, because of methodological differences in approximating from Household Survey data the number of marijuana users and their average consumption, our estimate of marijuana consumption among those populations represented in the Household Survey is twenty percent higher than the comparable Abt estimate. Second, Abt did not calculate a separate estimate for marijuana consumption among the criminally active. Third, Abt's calculations for 1991 were based on an average marijuana price of \$195 per ounce; our calculations assumed a price of \$222 per ounce.

Attitudes About Marijuana

Changes in public attitudes about any drug are likely to influence consumption. This is especially true in the case of marijuana, where most users are otherwise law-abiding and mainstream. In contrast, many of the heaviest cocaine and heroin users are socially isolated and disengaged, and so their drug use is less likely to respond to general public attitudes.

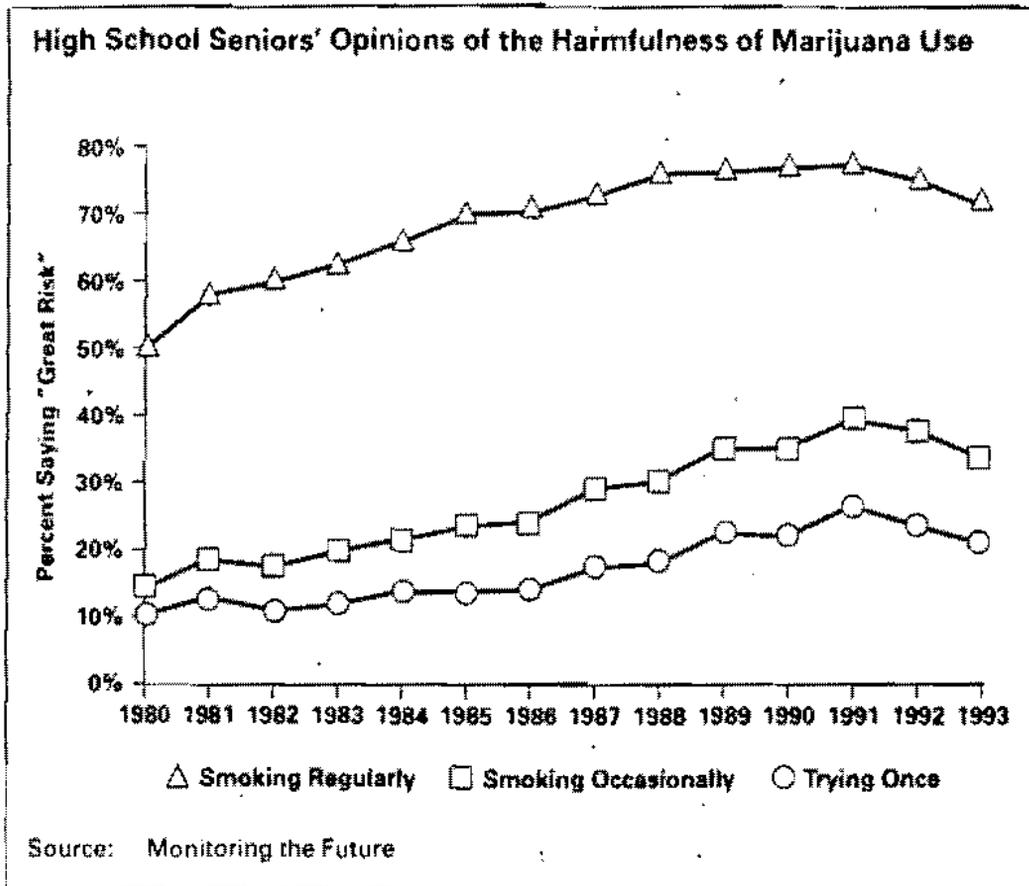
There is some evidence that anti-marijuana attitudes, after a decade of hardening, have begun to soften.

HARMFULNESS AND DISAPPROVAL

The Monitoring the Future survey asks respondents their views about the level of risk associated with marijuana use. The chart on the next page shows the percentage of high school seniors who perceived a "great risk" in smoking marijuana once, occasionally, and regularly. From 1980 to 1991 there was a steady increase in the fraction of students perceiving great risk. Beginning in 1991, however, the trend reversed.

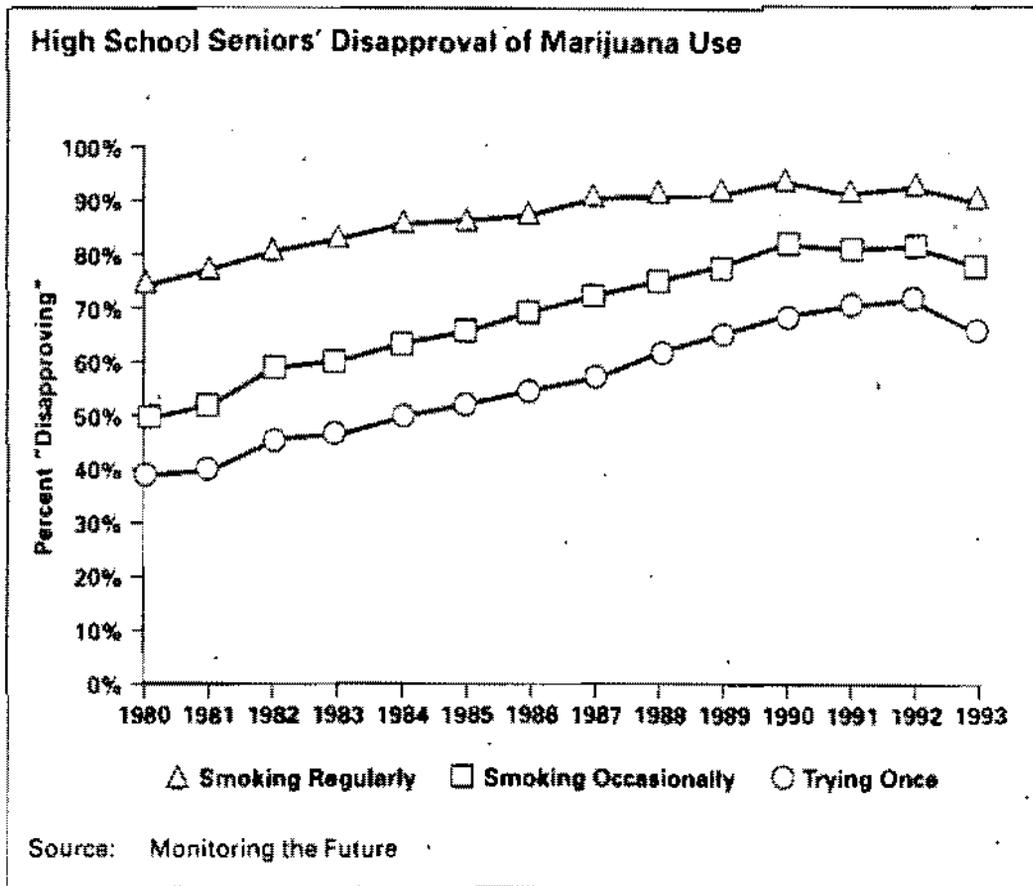
A similar pattern appears when high school seniors were asked whether they "disapproved" of smoking marijuana once, occasionally, or regularly. As the chart that follows shows, disapproval of occasional and regular use appears to have declined since 1990. Disapproval of trying once increased until 1992, and then declined sharply.

It is important to note that the attitude changes reported in the Monitoring the Future survey preceded the increase in self-reported use. It



is also important to point out that interpretation of these results is complicated by the possibility that strongly disapproved-of behavior is more heavily underreported. If marijuana use is now viewed by students as less dangerous and more acceptable, they may be more honest in reporting their use. Thus, the apparent increase in the number of users may overstate the change in actual behavior.

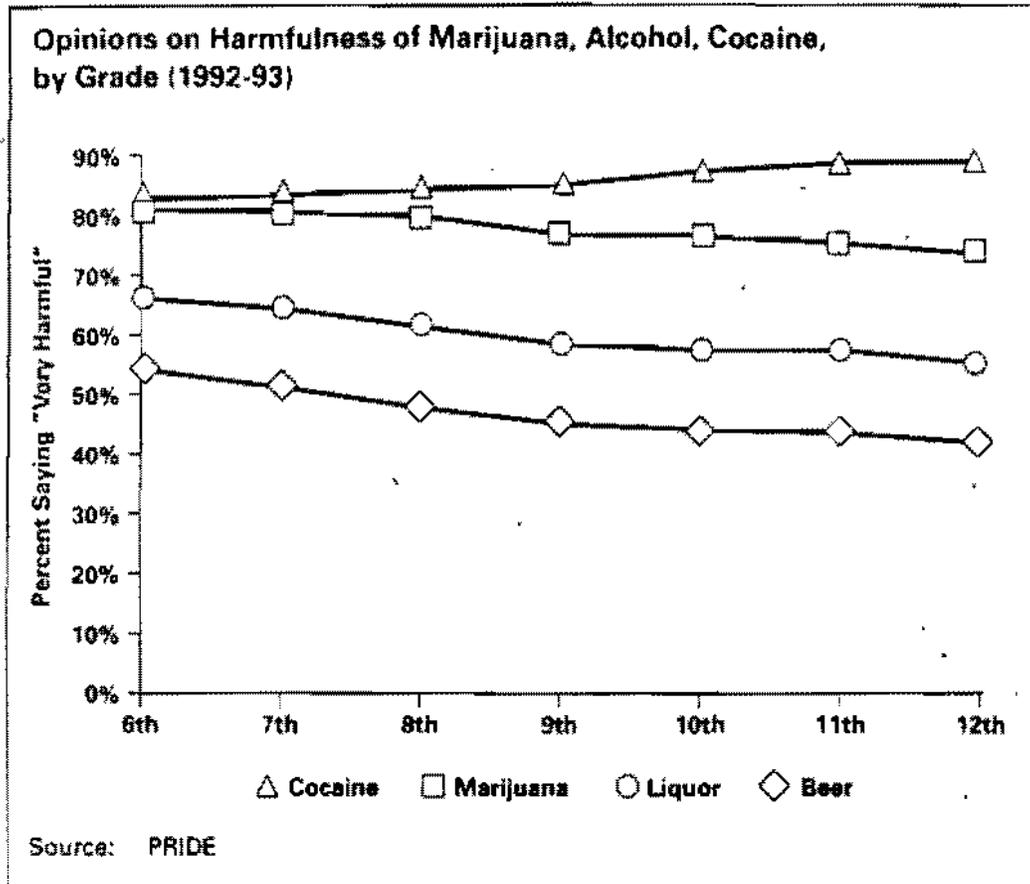
The PRIDE survey asks students in grades six through twelve for their opinions on the harmfulness of marijuana, as well as liquor, beer, cocaine, and other drugs. The graph on page 34 reports grade-by-grade opinions, for the 1992-93 school year, on the harmfulness of these substances. Students see marijuana as more harmful than liquor and beer, but less harmful than cocaine. Particularly interesting are the apparent relationships between risk perception and age. Older students are less likely to view marijuana (and beer and liquor) as harmful, while they are more inclined to regard cocaine as dangerous.



LEGALITY

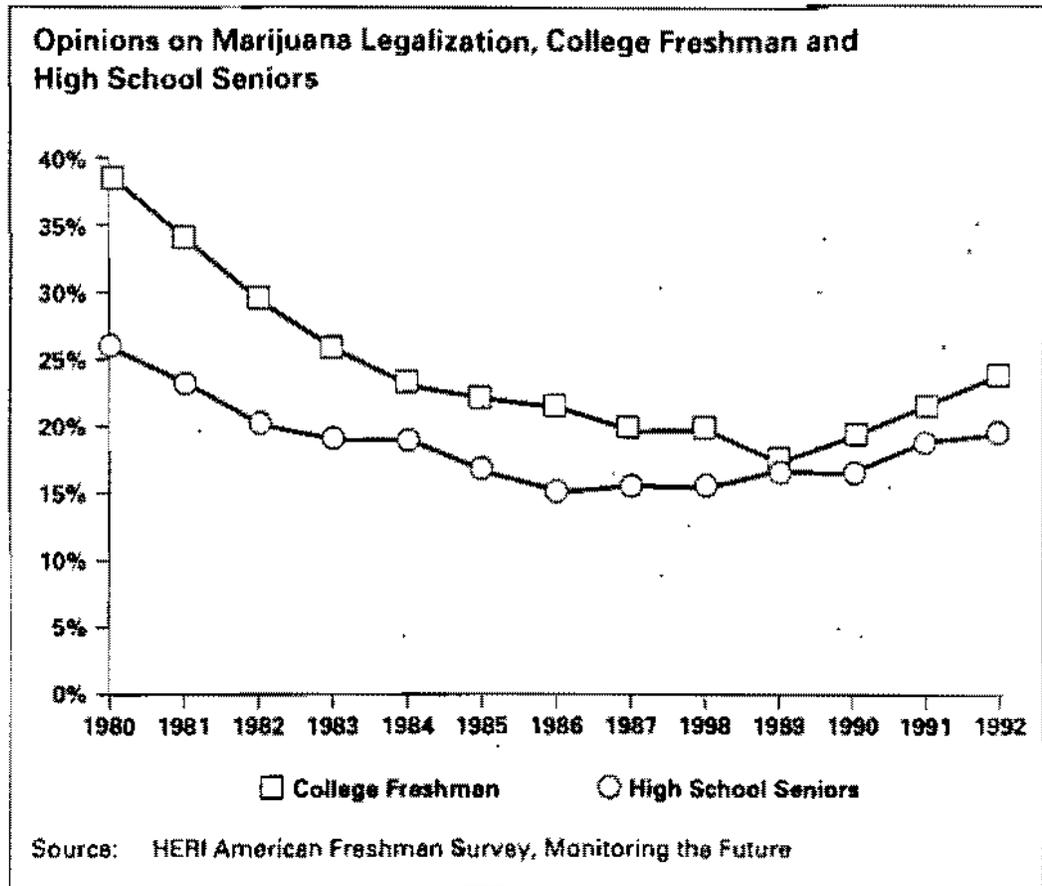
There is no necessary connection between an individual's position on marijuana legalization and his or her attitude about or propensity to use marijuana. Indeed, many of those who advocate drug legalization are vehemently opposed to drug use, just as most of those who are strongly against cigarette smoking do not think that tobacco should be outlawed. Taken as a group, however, one would expect supporters of marijuana legalization to have comparatively benign views about its use, and be more likely to use themselves (presumably marijuana smokers would feel better about their lawbreaking if they disagreed with the law).

According to a survey by the Higher Education Research Institute survey, the percentage of college freshman who believed that marijuana should be legalized declined from 1980 to 1990, but has risen since.



The Monitoring the Future survey reports a similar turnaround among high school seniors: a decline since 1990 in the percentage who believe that marijuana use should be a crime, and an increase since 1986 in the percentage who believe that marijuana should be entirely legal.

Some of these results are summarized in the figure on the next page.



Marijuana Supply and Sales

PRICE, POTENCY, AND AVAILABILITY

Consumption of marijuana, like the consumption of any commodity, is influenced by its price. Other things being equal, one expects falling prices to be accompanied by increased use, and rising prices to go with falling consumption.

The Drug Enforcement Administration (DEA) has reported a rise in marijuana prices over the last several years, and an increase in potency throughout the 1980's and early 1990's. However, in the case of marijuana, DEA's price and potency estimates are not the result of systematic sampling or data analysis. (Considerably more effort is placed on price and purity estimates for cocaine and heroin.) For prices, DEA simply reports a range of low and high prices for a given period. With potency, averages are calculated, but the methodology behind these averages is unclear.

The DEA's drug evidence tracking database, STRIDE (System to Retrieve Information from Drug Evidence), does contain information from marijuana purchases. Yet the number of these purchases, especially at the retail level, is limited. More problematic still is that STRIDE does not contain potency information of any kind, principally because determining potency for large quantities of marijuana is difficult.

In light of these problems, we supplemented DEA price data with information gathered from two user-based sources. One of these was our user survey, described earlier. The other source was price quotes reported in the leading publication devoted to marijuana use, *High Times*.

Price Trends

DEA Intelligence Price Data

DEA reports low-high ranges of marijuana prices for commercial grade marijuana and sinsemilla,¹ at pound and ounce quantities. Ranges are the easiest statistic to produce, but they are not very informative. Without some measure of central tendency, it is difficult to explore trends over time.

Moreover, DEA reports prices without adjustment for potency. This also makes it difficult to analyze trends in prices. From the perspective of users, paying \$400 for an ounce of marijuana with 10 percent THC content is roughly equivalent to paying \$200 for an ounce with 5 percent THC content. Yet a price comparison that is unadjusted for potency makes one purchase appear twice as expensive as the other.

DEA does provide estimates of potency. But it is probably unreasonable to assume that potency is consistent over the range of reported prices. Expensive marijuana tends to be high-potency and cheap marijuana tends to be low-potency. Since there is no reliable way of estimating the potency of high and low price marijuana, we did not construct potency-adjusted price ranges with published DEA data.

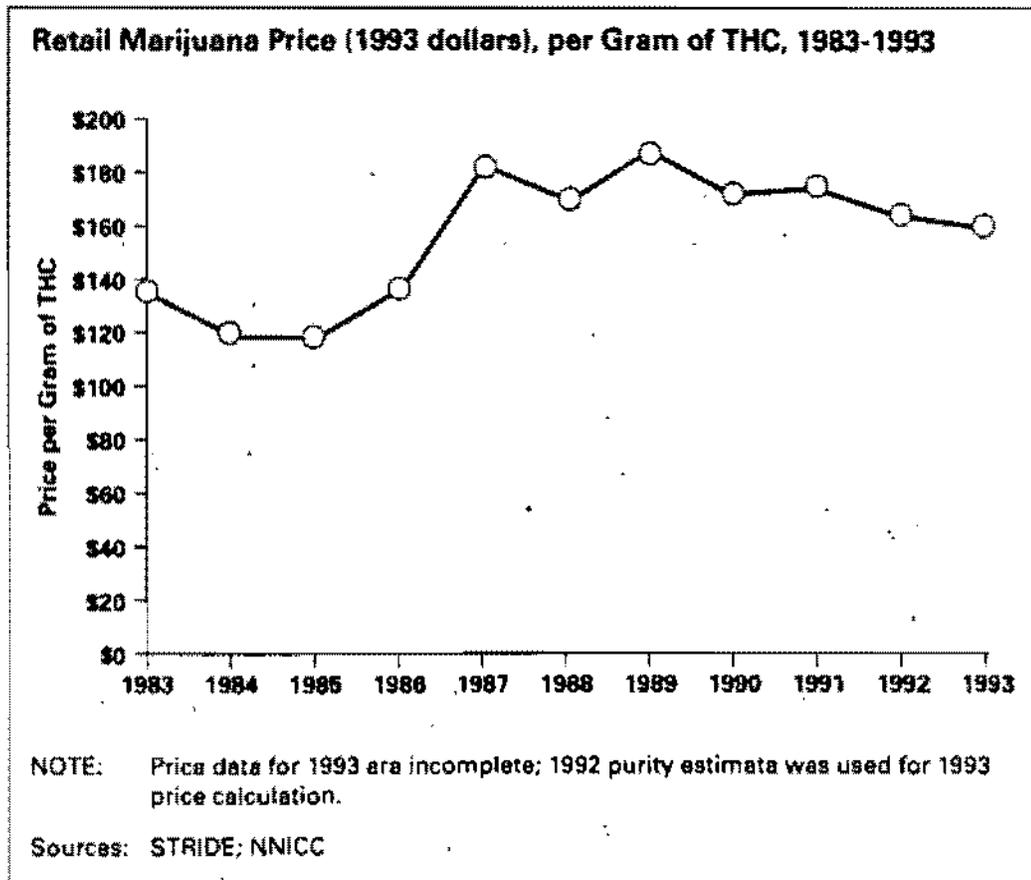
Price Information from the STRIDE Database

In constructing a retail price series from STRIDE, we attempted to correct for a number of data limitations. As noted above, most of the marijuana purchases recorded in STRIDE are not retail-level buys, and STRIDE does not provide information on potency.

We extracted from STRIDE all marijuana purchases from 1983 and 1993 that were between one-sixteenth of an ounce and one-and-a-half ounces in weight. (Retail marijuana purchases typically range from one-eighth of an ounce to an ounce.) Because larger buys tend to be relatively cheaper than smaller ones, we standardized the observed purchase prices to a quantity of one ounce, using a loglinear adjustment that assumed a twelve-percent discount between ounce and quarter-ounce purchases.² We then removed observations with prices above \$500 per gram, judging them to be outliers. And to further mitigate the potential influence of outliers, we calculated median, rather than mean, prices.

To eliminate the influence of inflation, we converted the derived series of median purchase prices to 1993 dollars (using the consumer price index). Lastly, we converted the purchase-unit into a gram of THC, thereby adjusting the prices for changes in potency. To do this, we began with DEA estimates of the average THC content of high-potency (sinsemilla) and low-potency (commercial grade) marijuana. We assumed that forty percent of domestically grown marijuana, and five percent of imported marijuana, is high-potency; the remainder was assumed to be low-potency.³ And we further assumed that the domestic share of the U.S. marijuana market increased from ten to fifty percent from 1983 to 1993.⁴

The chart below shows the derived price series. What is noteworthy is that, when inflation and increased potency are taken into consideration, the changes in marijuana prices over the past decade appear to be much more moderate than generally believed.



User-Reported Price Data

User Survey

According to our user survey, marijuana smokers pay an average of about \$55 for a quarter ounce. Adjusted for quantity discounts and potency (following the procedure used with STRIDE data), this translates into a price of \$144 per gram of THC. By comparison, STRIDE data yielded an estimate of \$157 per gram of THC. Most users thought that prices had not changed since the previous year (1992), but an overwhelming majority thought that they had risen over the past five years.

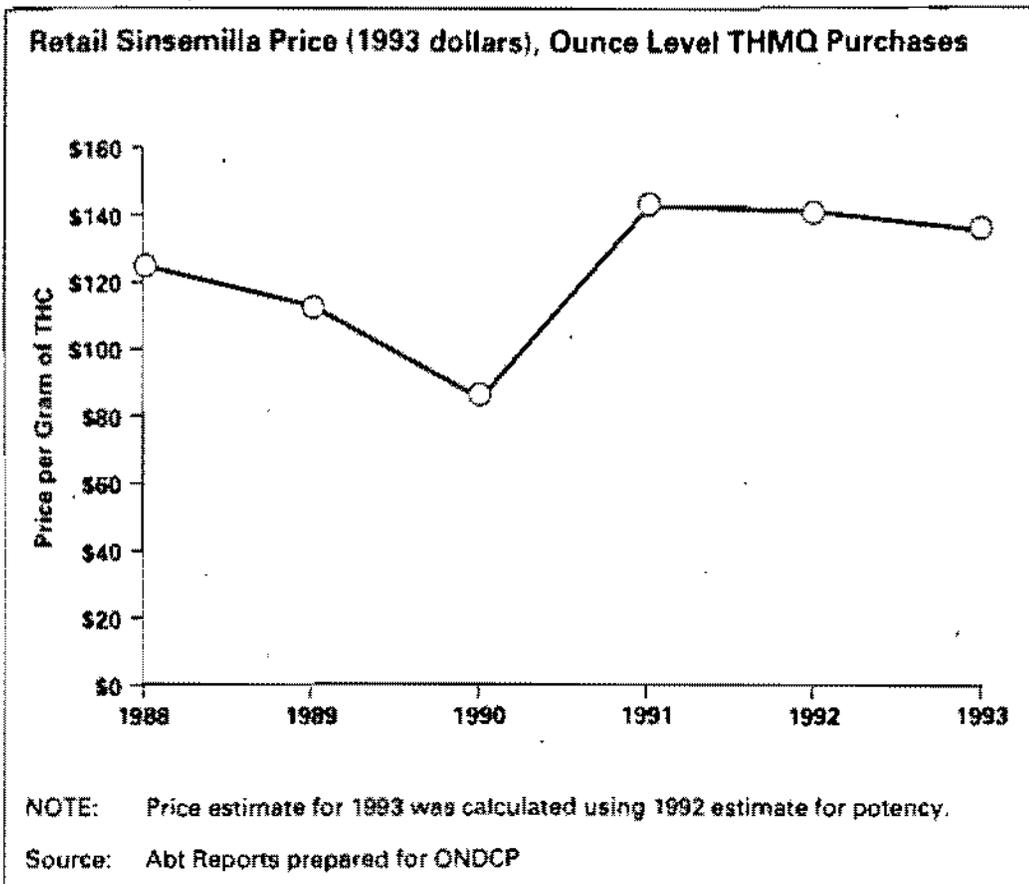
User Reports in High Times

High Times magazine carries a monthly feature called Trans-High Market Quotations (THMQ), which is a compilation of price quotes that often includes additional information on quality, type, and source. The price quotes, which are voluntarily submitted, presumably by *High Times* readers (some of whom might be dealers), list the city and state of each report.

The THMQ data are not a representative sample of marijuana purchases. One would assume that those who submit price quotes to *High Times* have better-than-average contacts with marijuana suppliers. If so, then prices quoted in *High Times* are likely to be cheaper than market averages. (On the other hand, dealers who submit price quotes may overstate them in an effort to inflate the market.)

We tallied THMQ data for each month between March 1992 and October 1993, and for a few months each previous year dating back to 1988. We used only price quotes from the 10 states most commonly cited,⁵ eight of which were among the ten most populous states. In compiling the data, we controlled for purchase unit, with a further adjustment for situations where an individual reported prices at two different quantities. By maintaining this information, we were able to estimate the quantity discounts available for larger purchases.

After compiling the data, we adjusted the prices for differences in potency (again using DEA potency estimates). To do this, we frequently had to guess the type of marijuana purchased, since few of the reports were explicitly identified as sinsemilla or commercial-grade. As a working



rule, we assumed that most, if not all, marijuana grown indoors or grown hydroponically is sinsemilla, since these production methods would be prohibitively expensive to employ in growing commercial grade. We also categorized as sinsemilla any purchase judged to be of "great" quality.

Only the ounce level purchase size had enough cases to provide a valid price series. The graph above shows the calculated price per gram of THC (in 1993 dollars) for purchases deemed to be sinsemilla. The data show prices to be slightly higher in 1993 than in 1988, partly due to a large price jump in 1991.

As noted earlier, the THMQ data allowed us to calculate quantity discounts. We found that on average a buyer received a discount of about twelve percent for buying one ounce of marijuana as opposed to buying one quarter of an ounce four times.

Trends in Potency

The table below reports DEA estimates of potency for sinsemilla and commercial grade marijuana from 1983 to 1992. Also included is an estimated market average, based on the assumption that the market share of high-potency marijuana has increased significantly since 1983.⁶

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
Sinsemilla Potency	7.5	6.7	7.3	8.4	7.9	7.6	7.0	10.2	11.7	8.3
Commercial Grade Potency	2.9	3.5	3.1	3.3	3.5	3.8	3.5	3.6	3.1	3.7
Estimated Market Average	3.3	3.8	3.6	4.0	4.1	4.4	4.0	4.8	4.8	4.7

Source: NNICC and DEA Intelligence Reports

The data suggest that only about half of the increase in average potency is attributable to a rise in THC content; equally significant is the increased market share of domestically grown sinsemilla.

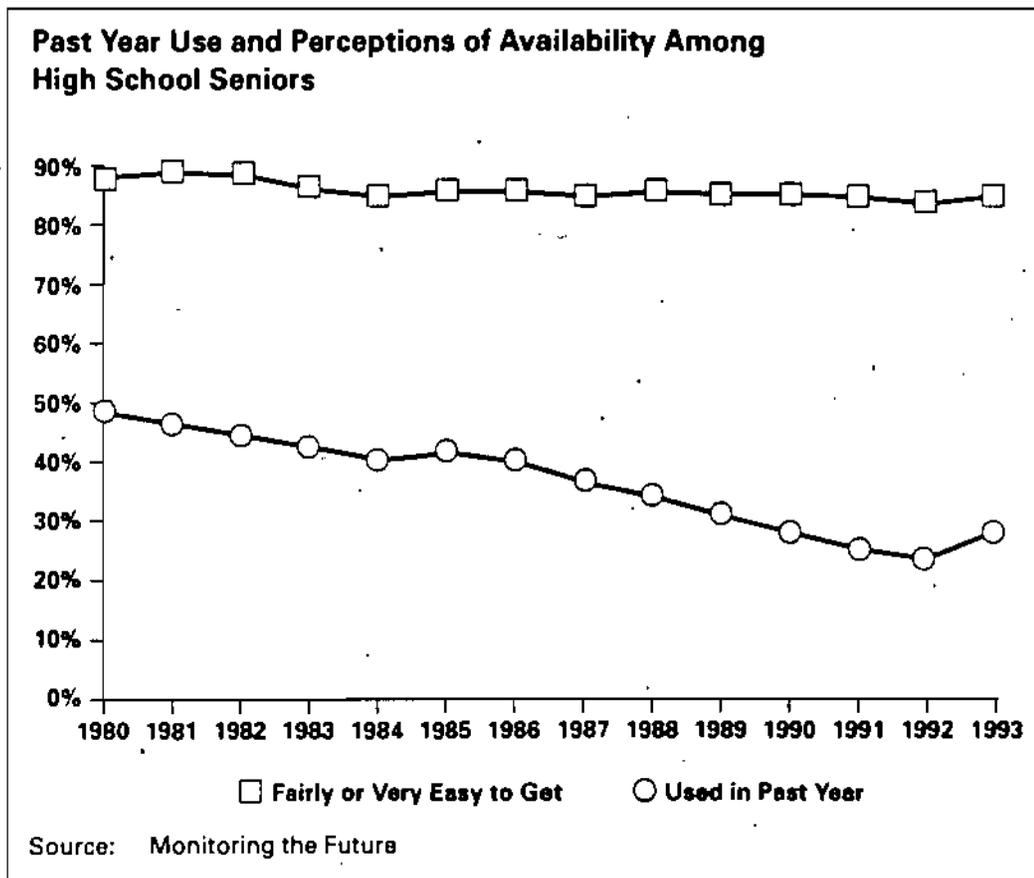
Two factors account for the general rise in THC content: One, particularly affecting sinsemilla, is the widespread introduction of high-technology growing methods beginning in the early 1980's.⁷ The other, mostly impacting the figures on commercial-grade potency, is the declining market share of imported marijuana, which tends to be lower quality.

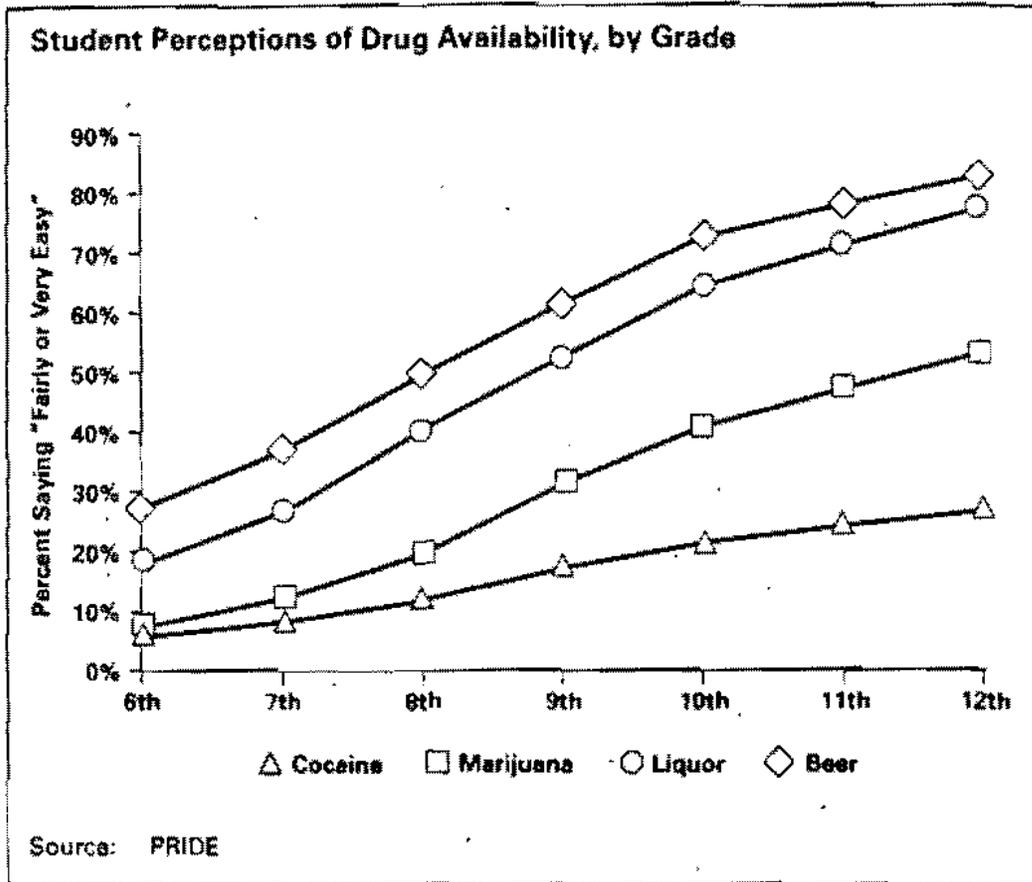
Our user survey corroborated DEA potency data. The majority of those interviewed thought that marijuana quality was about the same now as a year ago, but better than it was five years ago. However, THMQ reports suggested less of an improvement. The percentage of purchases judged "good" or "great" in quality increased only slightly between 1988 and 1993. One possible explanation: *High Times* readers were, in a sense, ahead of the curve, purchasing high-potency marijuana before it became available to less sophisticated buyers. Also, what was considered "great" in 1988 might be judged only "good" today.

The THMQ data does confirm the notion that domestically produced marijuana tends to be more potent than imported varieties. In 1993 price reports, domestic marijuana was judged to be of "great" quality 55 percent of the time, while foreign grown received this accolade only 24 percent of the time. Consistent with this quality difference, THMQ data show domestic marijuana to be consistently more expensive than imported marijuana.

Trends in Availability

Using data from the Monitoring the Future survey, the figure below shows, for 1980 to 1993, the percentage of high school seniors who felt that marijuana was "fairly easy" or "very easy" for them to get. The figure also plots reported levels of past-year use. As indicated, perceptions of availability have fallen only slightly. But it seems hard to connect this in any way to the overall trend in use: in every year since 1980, over 80 percent of respondents thought that marijuana was fairly or very easy to obtain.





In our user survey, we asked respondents if they thought that marijuana was more or less difficult to obtain than it was one and five years ago. The majority of users interviewed thought that marijuana was just as available as it was a year ago, but less available than five years ago.

Survey data can also indicate how availability differs across age groups. The chart above, derived from PRIDE data, compares the availability of marijuana to other drugs and alcohol across grade levels. As one would expect, all of these substances are more available to older students.

DOMESTIC PRODUCTION

Consumption-Based Estimate

Earlier, we estimated U.S. marijuana consumption for 1992 at just under 1,600 metric tons. How much of this is domestically grown is not certain. In our user survey, of those who knew the production source of

their marijuana, two-thirds reported smoking domestic marijuana. Data from the THMQ indicate that half of marijuana purchases were domestic. Since the THMQ has more data, it is probably a more reliable estimate. Combined with our estimate of total consumption, it implies that 800 metric tons of domestically grown marijuana are consumed annually. If we assume that 20 percent of what is grown fails to reach market (because of seizure, failure to harvest, theft, or loss) we obtain a total harvest of 1,000 metric tons.

DEA Estimates

The table below provides DEA estimates of domestic marijuana production for 1988 to 1992.

DEA Estimates Of Domestic Marijuana Production (Metric Tons)					
	1988	1989	1990	1991	1992
Total Production	4,350-4,850	5,000-6,000	5,000-6,000	3,615-4,615	2,595-3,095
Source: NNICC					

Clearly, DEA estimates of domestic marijuana production are not consistent with the consumption-based estimate. Not only is the DEA estimate of 1992 production approximately triple the consumption-based figure, but DEA data also suggest a roughly fifty percent decline in domestic marijuana cultivation from 1990 to 1992. By comparison, user surveys indicate only a twenty percent drop in consumption over the same period.

The Eradication and Suppression Program

The table on the next page presents data from DEA's Domestic Cannabis Eradication and Suppression Program.

If we take the 1992 total eradication figure, and use a conservative yield estimate of one half pound per plant for commercial grade and one quarter pound per plant for sinsemilla (DEA estimates a yield of a full pound per plant regardless of type), the eradication and suppression program appears to have prevented about 1,475 metric tons from being

Domestic Cannabis Eradication and Suppression Program Data						
Type of Plant Eradicated (figures in millions of plants)	1987	1988	1989	1990	1991	1992
Outdoor Commercial Grade	4.33	2.49	3.55	5.29	3.01	5.13
Outdoor Sinsemilla Grade	3.11	2.85	2.08	2.04	2.25	2.36
Indoor					0.28	0.35
Total	7.43	5.34	5.63	7.33	5.54	7.84
NOTE: Commercial Grade may include tended ditchweed						
NOTE: Prior to 1991 Indoor plants eradicated were not reported separately from Outdoor						
	1987	1988	1989	1990	1991	1992
Indoor Growing						
Operations Seized	1,192	1,240	1,398	1,669	2,848	3,849
Number of Arrests	6,502	6,062	5,761	5,729	9,364	12,369
Assets Seized (cash value) in Millions	\$13.67	\$9.85	\$29.54	\$38.69	\$52.83	\$69.27
Source: DEA Eradication and Suppression Program Reports						

harvested. When combined with the estimate of total domestic marijuana production, this implies that roughly sixty percent of domestically grown marijuana is eradicated. This seems unlikely. A plausible explanation for the apparent inconsistency is that a substantial fraction of the marijuana eradicated by authorities and reported as sinsemilla or commercial grade is in fact "ditchweed," a very low potency (generally less than 1 percent THC) variety of marijuana that grows wild in much of the U.S.

FOREIGN PRODUCTION

State Department Estimates

The table on the next page provides the State Department's Bureau of International Narcotics Matters' estimates of foreign marijuana production for 1988 to 1992.

The data illustrate the difficulty in deriving such estimates. The numbers vary considerably from year to year—or sometimes not at all—and

**Potential Foreign Production Estimates in Metric Tons,
1988-1992**

	1988	1989	1990	1991	1992
Mexico	5,655	30,200	19,715	7,775	7,795
Colombia	7,775	2,800	1,500	1,500	1,500
Jamaica	405	190	825	641	263
Other	3,620	3,565	3,560	3,549	3,550

Source: INCSR

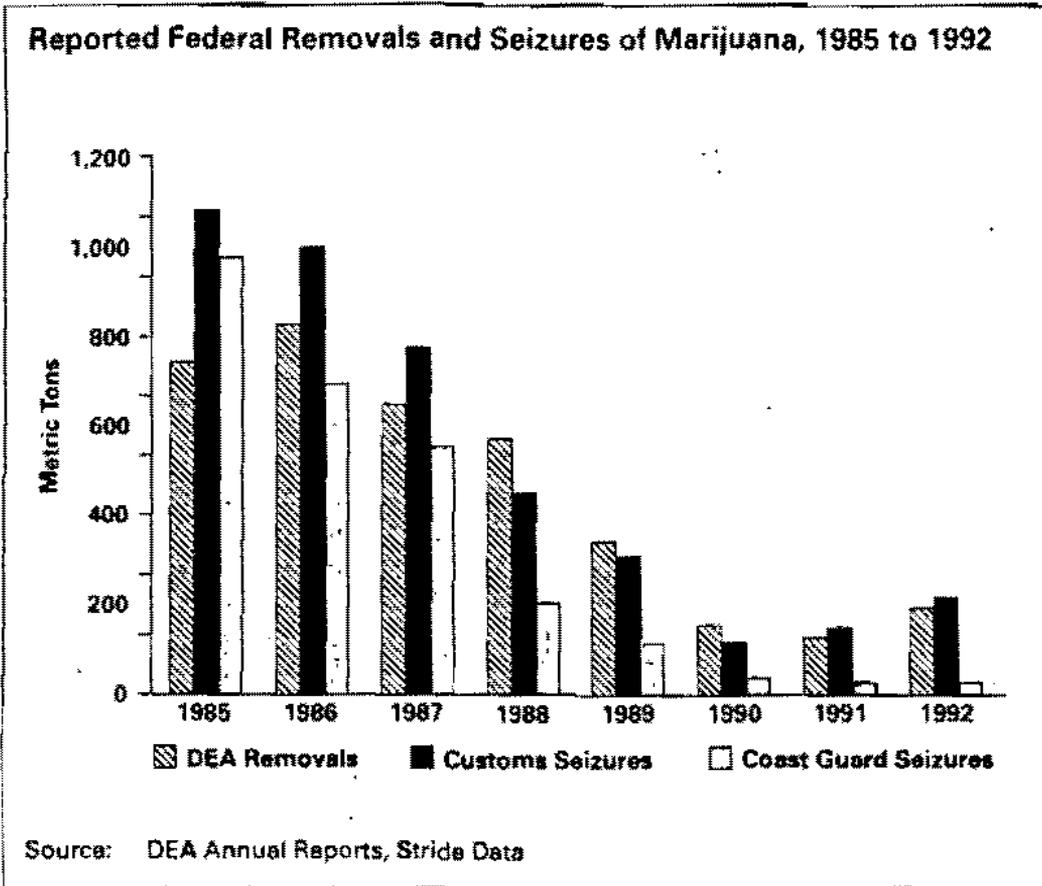
some changes, like the increase in Mexican production from 1988 to 1989, are the result of alterations in estimation methodology.⁸ It is thus difficult to make use of the figures in our analysis. Moreover, even if the production estimates were consistently accurate, they would still not tell us how much foreign production was shipped to the U.S. Marijuana is popular throughout the world, and much of what is grown in Mexico, Colombia, or Jamaica is either consumed at home or exported to countries other than the U.S.

We do not know what fraction of the marijuana grown in Mexico, Colombia, and Jamaica is consumed in those countries or exported to countries other than the U.S. But unless the fraction is very large (over 90 percent), the State Department production estimates for these countries do not jibe with our estimate of U.S. consumption of imported marijuana. Marijuana production for these countries is estimated at 9,558 metric tons for 1992; we estimated U.S. consumption of imported marijuana to be 800 metric tons, and combined Customs and Coast Guard seizures for 1992 were 230 metric tons (see table above).

MARIJUANA SEIZURES

Data on marijuana seizures can often highlight trends in overall supply, trafficking patterns, or interdiction effectiveness. The figure on the next page shows federal removals and seizures of marijuana for 1985 to 1992.⁹

The data clearly show a very large overall decline in seizures. Several factors probably account for this trend. First, imports have declined as a share of U.S. marijuana consumption. Second, a larger portion of



Imported marijuana appears to come from Mexico than in the early and mid-1980's, when Colombia was a major producer. Marijuana shipped from Mexico is more difficult to interdict, since it is smuggled over land rather than by sea. Finally, enforcement agencies have, over the last decade, shifted emphasis from marijuana to cocaine.

Footnotes

- ¹ Sinsemilla is an especially potent form of marijuana, produced from the resin of unpollinated female plants. The sticky resin that forms in the flower of the plant is the most potent (highest THC content) part of the plant, and it aids female plants in catching pollen. If the plant is pollinated, resin production is greatly reduced; keeping the plant unpollinated allows for much more flowering and resin production. To prevent fertilization, sinsemilla growers determine plant sex prior to pollen production and destroy or remove male plants.
- ² The twelve percent discount was estimated from *High Times* price quotes, which are presented later in the report. The discounting methodology is explained in Jonathan P. Caulkins and Andrew Chaisma, *Creating Consistent Price Series* (Washington, D.C.: Office of National Drug Control Policy, 1993).

- 3 Historically, approximately forty percent of the marijuana plants destroyed by DEA's Domestic Cannabis Eradication and Suppression Program are reported to be sinsemilla. Although a commercial grade plant typically yields twice as much marijuana as a sinsemilla plant, commercial grade plants are also more susceptible to detection (since sinsemilla is grown in smaller plots, and more often indoors). The estimate that five percent of imported marijuana is high-potency is rather arbitrary, but it reflects the fact that strains of high-potency imported marijuana have always been available.
- 4 DEA has estimated that domestic sources comprised eleven percent of U.S. marijuana supply in 1983. See *National Narcotics Intelligence Consumers Committee, Narcotics Intelligence Estimate: The Supply of Drugs to the U.S. Illicit Market From Foreign and Domestic Source in 1983 (With Projections Through 1984)* (Washington, D.C.: Drug Enforcement Administration, 1983), p. 9. Data from our user survey and from *High Times* suggests that domestic sources now constitute half of the market.
- 5 California, Colorado, Florida, Michigan, Illinois, New Jersey, New York, Ohio, Texas, and Washington.
- 6 See the earlier section, "Price Information from the STRIDE database," for a more detailed explanation of this assumption.
- 7 There has been a particularly sharp increase in the THC content of the most potent sinsemilla. DEA reports that a recent seizure had a THC content of 30 percent.
- 8 National Narcotics Intelligence Consumers Committee, *The NNICC Report 1989* (Washington, D.C.: The Committee, 1990).
- 9 The total weight of federal marijuana seizures is not equal to the sum of seizures reported by Customs, Coast Guard, and DEA. Because of joint operations, and the passing of custody from one agency to another, a given seizure is often claimed by more than one agency. The Federal-Wide Drug Seizure System (FDSS), which by and large corrects this data problem by assigning every large federal drug seizure a specific identification number, was only recently implemented, and so reliable data on total federal drug seizures is not available for years prior to 1989. FDSS reports total federal seizures of 486 metric tons (mt) of marijuana in FY 1989, 219 mt in FY 1990, 226 mt in FY 1991, 355 mt in FY 1992, and 341 mt in 1993.

Discussion

When examined, some of the indications of increased marijuana use are clearer than others. Although the Household Survey reports increased use in several demographic groups, it reports declines in many others—and overall use is virtually unchanged. That there has been a rise in marijuana use among teenagers in the last year seems more certain—the Household Survey reports increased use among those aged twelve to seventeen, and both the Monitoring the Future and PRIDE surveys show increased use for every student age group polled.

Data from the Drug Use Forecasting Program (DUF) indicate that in 1992, for the first time in years, the percentage of arrestees testing positive for marijuana use increased from the previous year. But it is hard to draw any firm conclusions from this finding. Are marijuana smokers, previously law-abiding apart from their drug use, now engaging in other crimes? Are criminally active cocaine users switching to marijuana, or simply adding it to their drug menu?

Marijuana-related emergency room episodes, as tabulated by the Drug Abuse Warning Network (DAWN) also rose in 1992. Here too, it is difficult to know what the increase implies about marijuana use. When an overdose involves marijuana and other drugs or alcohol—as the overwhelming majority of marijuana-related emergency room episodes do—rarely is marijuana principally responsible for the adverse reaction. Thus, the data could reflect a spread in marijuana smoking among those using other drugs and alcohol. On the other hand, the data are also consistent with a different story: that more marijuana smokers are becoming polydrug users, mixing marijuana with other illicit drugs and with alcohol.

To the extent that marijuana smoking has become more prevalent among certain groups, it is important to know why. Market supply conditions do not appear to be responsible. When prices are adjusted for inflation and recent increases in potency, marijuana appears to be cheaper than it was a year or two ago, but only by a few percentage points, hardly enough to explain a shift in use patterns. Availability is high: when surveyed in 1993 by the Monitoring the Future program, 83 percent of high school seniors said that marijuana was "fairly easy" or "very easy" to obtain. But this figure is actually within a percentage point of the all-time low for the survey.

A more likely cause of any upturn in teenage marijuana smoking—at least among teenagers—is a change in attitudes. Among high school seniors, there was, from 1980 to 1991, a steady increase in the fraction of students who considered smoking marijuana once, occasionally, or regularly a "great risk." In the 1991-92 school year, however, the trend reversed. A similar pattern appears when high school seniors were asked whether they "disapproved" of smoking marijuana once, occasionally, or regularly. Disapproval of occasional and regular use has declined since 1990, and disapproval of trying once has declined since 1992.

It is important to note that these reported attitude changes preceded by one or two years the apparent recent increase in use. This suggests that trends in marijuana consumption and supply deserve close attention. On the consumption side, it will be important to see whether the indications of growing teenage use are confirmed by other surveys, and if similar findings appear for other age groups. Even more important to watch for is evidence of any connection with other drug or alcohol use, although such links are admittedly hard to document. In terms of supply, domestic marijuana production, which may account for better than half of U.S. consumption, is the principal concern. When valued at retail prices, domestic production is probably worth \$6 to \$7 billion a year.

Appendix

DETAIL USE OF TRENDS

Percentage with Positive Marijuana Test Among Male Arrestees, 1988-1992 (DUF)					
	1988	1989	1990	1991	1992
Atlanta	—	—	4%	12%	22%
Birmingham	36%	21%	14%	16%	22%
Chicago	50%	31%	27%	23%	26%
Cleveland	26%	20%	14%	12%	17%
Dallas	36%	27%	20%	19%	28%
Denver	—	—	27%	25%	34%
Detroit	33%	21%	15%	18%	27%
Fort Lauderdale	42%	27%	22%	28%	32%
Houston	43%	24%	21%	17%	24%
Indianapolis	42%	40%	31%	23%	35%
Kansas City	19%	25%	16%	18%	28%
Los Angeles	32%	20%	20%	19%	23%
Manhattan	30%	20%	19%	18%	22%
Miami	32%	29%	—	23%	30%
New Orleans	49%	28%	18%	16%	19%
Omaha	44%	—	20%	26%	38%
Philadelphia	32%	26%	18%	18%	26%
Phoenix	44%	34%	28%	22%	22%
Portland	50%	35%	42%	33%	28%
St. Louis	17%	27%	16%	16%	21%
San Antonio	44%	29%	26%	20%	28%
San Diego	49%	42%	35%	33%	35%
San Jose	—	25%	24%	25%	24%
Washington, DC	—	12%	7%	11%	20%

**Percentage with Positive Marijuana Test Among Female Arrestees,
1988-1992 (DUF)**

	1988	1989	1990	1991	1992
Atlanta	—	—	1%	8%	13%
Birmingham	15%	18%	8%	10%	13%
Chicago	33%	—	—	—	—
Cleveland	—	—	8%	7%	11%
Dallas	25%	14%	18%	11%	24%
Denver	—	—	15%	16%	19%
Detroit	26%	—	9%	4%	11%
Fort Lauderdale	—	12%	16%	14%	21%
Houston	—	16%	11%	8%	12%
Indianapolis	—	23%	21%	22%	26%
Kansas City	16%	19%	13%	13%	18%
Los Angeles	22%	13%	10%	9%	13%
Manhattan	19%	10%	8%	11%	12%
New Orleans	25%	18%	12%	7%	8%
Philadelphia	21%	14%	12%	14%	8%
Phoenix	31%	29%	18%	14%	15%
Portland	38%	23%	27%	28%	17%
St. Louis	15%	20%	10%	8%	11%
San Antonio	18%	15%	9%	9%	16%
San Diego	20%	29%	19%	20%	25%
San Jose	—	12%	12%	13%	18%
Washington, DC	—	10%	7%	6%	8%

**Percentage with Positive Marijuana Test Among Males Aged 15-20,
1989 to 1992 (DUF)**

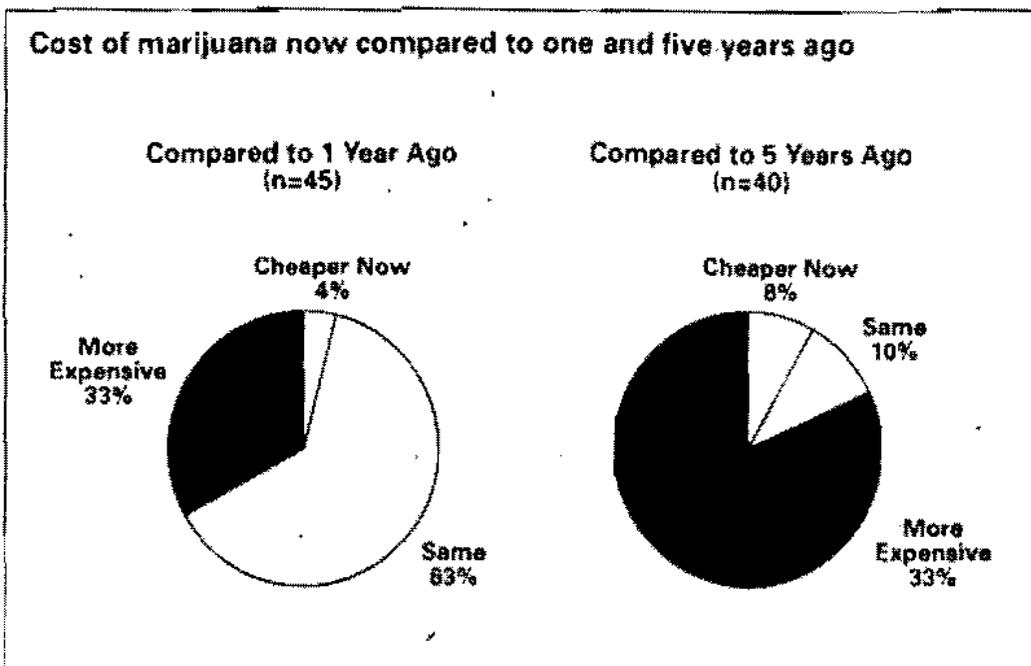
	1988	1989	1990	1991	1992
Atlanta	—	—	4%	18%	30%
Birmingham	31%	29%	16%	20%	30%
Chicago	54%	34%	30%	28%	30%
Cleveland	29%	19%	15%	14%	23%
Dallas	42%	34%	26%	22%	34%
Denver	—	—	34%	27%	49%
Detroit	48%	34%	26%	31%	43%
Fort Lauderdale	46%	35%	31%	37%	52%
Houston	47%	26%	26%	24%	27%
Indianapolis	56%	45%	32%	27%	35%
Kansas City	14%	34%	23%	23%	39%
Los Angeles	45%	26%	26%	25%	32%
Manhattan	35%	31%	31%	34%	41%
Miami	56%	31%	—	39%	43%
New Orleans	51%	27%	18%	18%	23%
Omaha	—	—	21%	36%	42%
Philadelphia	50%	36%	26%	26%	43%
Phoenix	55%	42%	34%	28%	35%
Portland	61%	46%	52%	34%	36%
St. Louis	16%	31%	17%	21%	28%
San Antonio	56%	45%	34%	22%	28%
San Diego	52%	52%	40%	41%	55%
San Jose	—	34%	34%	26%	22%
Washington, DC	—	10%	9%	16%	38%

Percentage of Emergency Room Episodes that Mention Marijuana by Age, Sex, Ethnicity, and Location, 1988 to 1992 (DAWN)						
	1988	1989	1990	1991	1992	Percentage Increase in Percentage 1991 to 1992
Total	4.9%	4.9%	4.2%	4.1%	5.5%	34%
Age						
12-17	5.4%	5.7%	4.4%	4.5%	6.6%	48%
18-25	7.1%	7.4%	6.3%	6.2%	8.6%	40%
26-34	5.1%	4.9%	5.0%	4.5%	5.9%	31%
35+	2.2%	2.2%	1.9%	2.2%	3.0%	38%
Sex						
Male	7.2%	7.1%	6.3%	6.0%	7.8%	31%
Female	2.9%	2.7%	2.4%	2.4%	3.1%	31%
Race/Ethnicity						
White	4.2%	4.1%	3.6%	3.6%	4.4%	23%
Black	6.8%	6.5%	5.9%	5.3%	7.3%	38%
Hispanic	4.5%	4.1%	4.4%	4.2%	6.5%	54%
Location						
Central City	6.0%	6.1%	5.7%	4.8%	6.2%	29%
Outside Central City	7.1%	6.8%	5.2%	5.7%	7.8%	37%

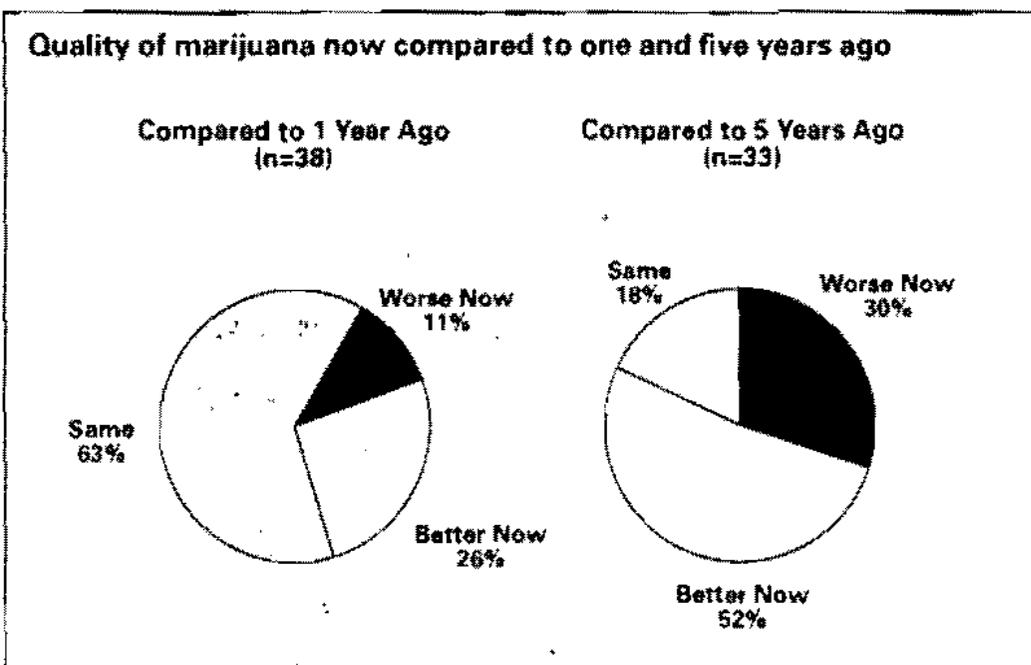
Percentage of Emergency Room Episodes that Mention Marijuana by Metropolitan Area, 1988 to 1992 (DAWN)						
	1988	1989	1990	1991	1992	Percentage Increase in Percentage 1991 to 1992
Atlanta	7.2%	13.5%	7.1%	8.9%	10.9%	22%
Baltimore	3.6%	2.7%	3.0%	3.3%	5.2%	58%
Boston	3.4%	5.2%	4.1%	6.5%	7.9%	22%
Buffalo	1.8%	2.8%	2.4%	3.3%	3.3%	0%
Chicago	7.9%	7.9%	7.0%	5.8%	8.5%	45%
Dallas	11.3%	10.3%	7.8%	5.8%	8.4%	45%
Denver	6.8%	7.1%	5.1%	5.0%	6.3%	26%
Detroit	6.9%	7.7%	5.1%	5.6%	9.4%	67%
Los Angeles	5.3%	5.7%	6.3%	6.1%	6.8%	11%
Miami	3.7%	4.9%	4.5%	9.4%	7.7%	-18%
Minneapolis-St. Paul	4.0%	4.7%	4.1%	3.6%	7.0%	94%
New Orleans	9.2%	6.7%	10.5%	8.3%	9.2%	10%
New York	5.2%	5.1%	4.8%	3.2%	4.5%	38%
Newark	6.2%	5.1%	6.0%	insf.	4.5%	insf.
Philadelphia	5.5%	5.6%	4.8%	4.1%	8.0%	95%
Phoenix	6.1%	2.2%	2.3%	2.2%	2.8%	29%
St. Louis	0.0%	5.2%	4.2%	4.4%	4.9%	10%
San Diego	5.5%	6.9%	6.0%	5.7%	6.8%	20%
San Francisco	4.3%	3.9%	3.7%	2.6%	2.6%	1%
Seattle	4.7%	5.0%	6.0%	6.1%	5.5%	-10%
Washington, D.C.	12.6%	11.6%	8.7%	9.1%	11.8%	30%

USER SURVEY DETAIL

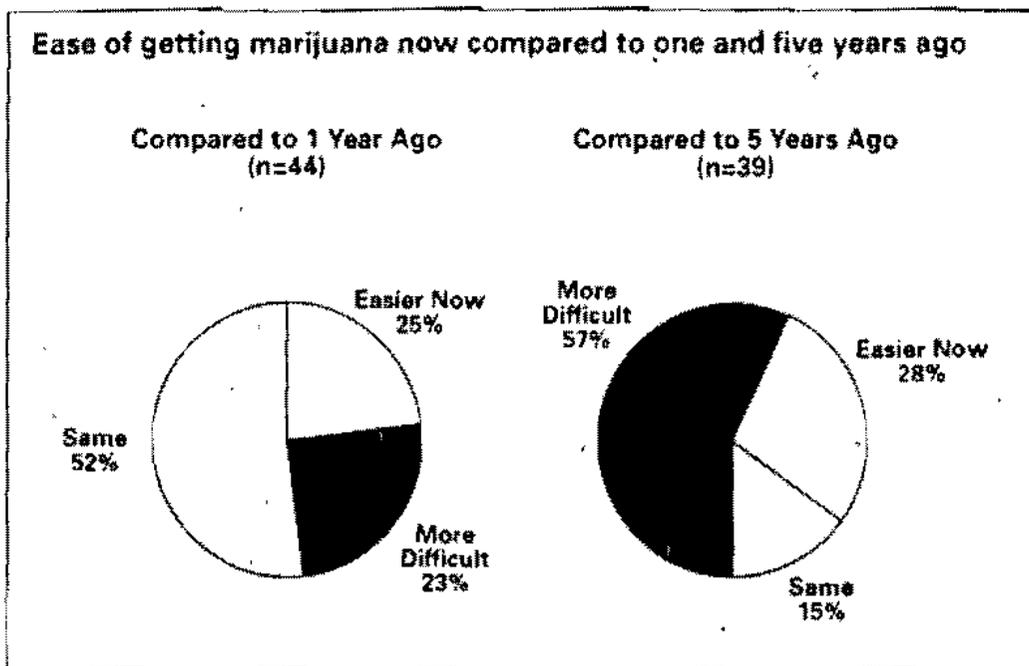
Opinions of Price



Opinions of Quality



Opinions of Availability in User Survey



USER SURVEY METHODOLOGY

We conducted 46 telephone interviews with current marijuana users to supplement the currently available data on marijuana consumption and price. We believe our sample, recruited using the "snowball sampling" technique, is fairly representative of marijuana users in terms of socioeconomic status and consumption levels.

Snowball Sampling and Survey Administration

Using the snowball sampling technique, we recruited marijuana users to participate in an anonymous twenty-minute telephone survey. We tried to vary socioeconomic status and consumption levels of our sample by selecting initial referents of diverse backgrounds. We included one of our former heroin interviewers as a recruiter and paid him a \$10 referral fee for each successfully completed interview. In order to ensure that our sample was not dominated by any particular group, we limited each recruiter to ten referrals. We found that youths, aged 18 and under, were the most difficult group to target given the older ages of our recruiters. Local respondents called us directly and were inter-

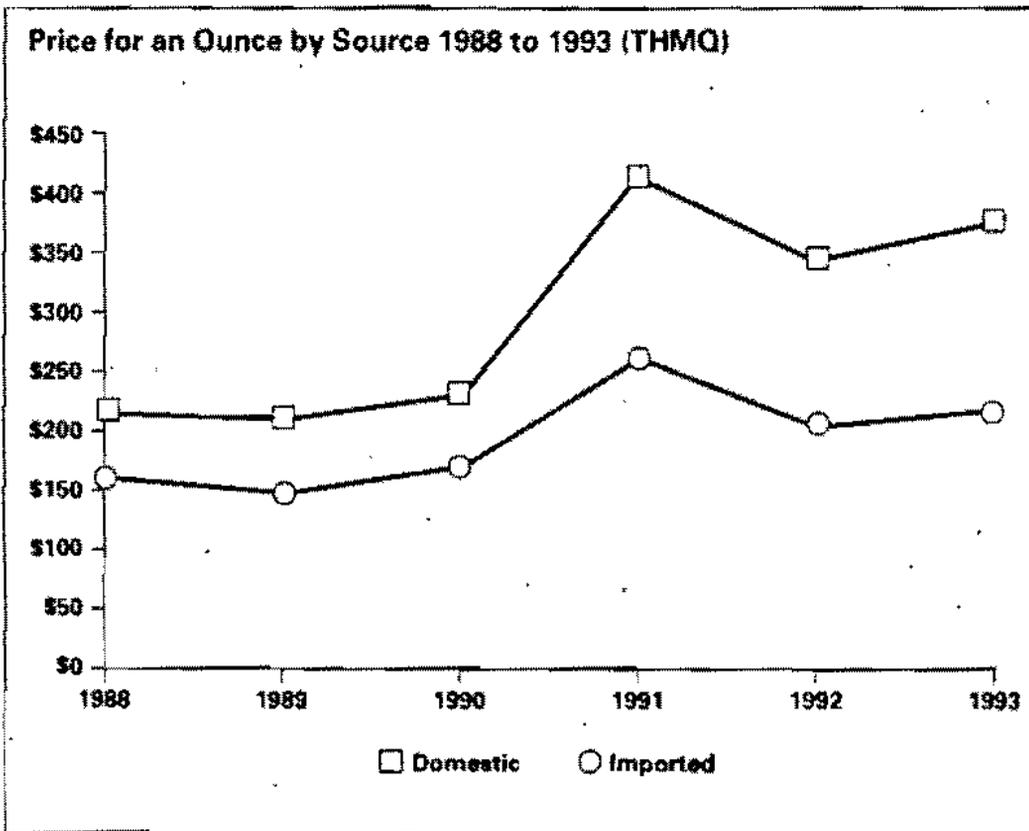
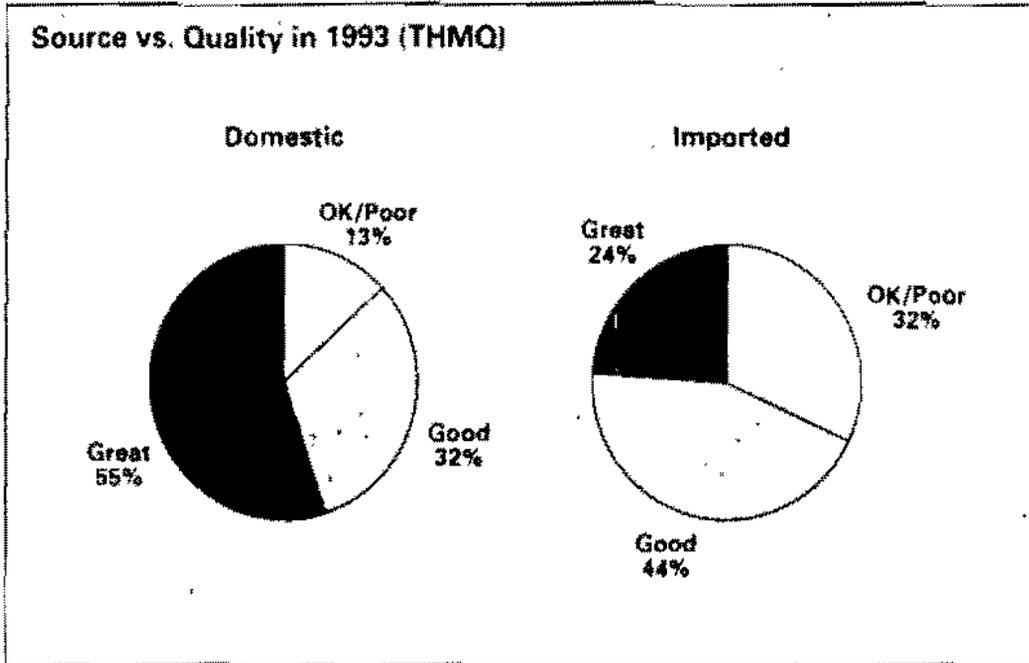
viewed on the spot. Out-of-state respondents were given a toll-free phone number and the option of scheduling an interview outside of standard east coast working hours. Our two selection criteria were that respondents had to purchase marijuana themselves and they had to use on at least a weekly basis. The recruiters paid their successful referrals \$20 cash for their participation in the survey.

Sample Demographics

Most of the 46 participants in the study were white, just over one quarter were African American, and the remainder were Asian and Hispanic; approximately one-third of the respondents were female. The average age was 27.5. The sample included 30 employed individuals, 10 who were either unemployed or on public assistance, and 10 students. Geographically, 25 respondents were from eastern Massachusetts; the remaining respondents were almost evenly split from the west coast and other east coast states.

DETAIL OF THMQ DATA

Mean Price for Selected Years at One Pound Level (THMQ)			
	1989	1992	1993
One Pound Price (n)	\$1,211 (15)	\$2,042(22)	\$2,431 (19)



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