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10 Employment as a Drug Abuse Treatment Intervention: A Behavioral Economic Analysis

Kenneth Silverman and Elias Robles

10.1 Introduction

10.1.1 Associations between Drug Use and Unemployment

Descriptive and experimental data suggest that employment may be useful in the treatment of drug abuse. Descriptive data from a variety of sources show that unemployment and drug use are closely associated. A review of data from the 1991 National Household Surveys on Drug Use (Substance Abuse and Mental Health Services Administration [SAMHSA] 1993; Gfroerer and Brodsky 1993) reveals striking and statistically significant relationships in the general population between unemployment and an increased prevalence of use of heroin, cocaine, crack, marijuana, hallucinogens, and PCP; heavy alcohol use; and nonmedical use of sedatives, tranquilizers, and analgesics. Similar relationships between unemployment and drug use have been observed in previous surveys (National Institute on Drug Abuse [NIDA] 1988, 1990). This relationship between drug use and unemployment is illustrated in figure 10.1, which shows rates of illicit drug use by employment status based on the National Household Surveys on Drug Abuse from 1988 to 1993 (SAMHSA 1996). This figure shows that both employed and unemployed adults in the United States report using illicit drugs, but across all years of this survey, unemployed adults reported the highest rates of illicit drug use and full-time workers reported the lowest rates. Across these years, rates of illicit drug use among unemployed

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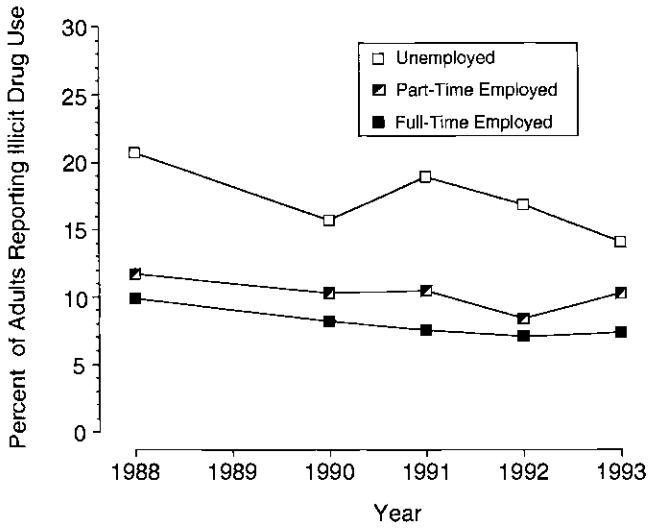

Fig. 10.1 Percentage of adults (18–49 years old) reporting illicit drug use by employment status from 1988 to 1993

Source: Adapted from table 2.1 in SAMHSA (1996).

Note: Data are derived from the National Household Survey on Drug Abuse, which is a survey conducted periodically by the U.S. federal government of residents of households, noninstitutionalized group residences (e.g., shelters), and civilians living on military bases. Points represent the percentage of respondents reporting that they used illicit drugs in the past month.

adults ranged from 1.7 to 2.5 times higher than the rates of illicit drug use among adults employed full time.

Unemployment and drug use appear to be associated within the population of drug abusers participating in treatment, as well. This is evidenced, in part, by the fact that a substantial proportion of patients in drug abuse treatment programs are unemployed. The large-scale Treatment Outcome Prospective Study (TOPS; Hubbard et al. 1989) of 11,000 drug abusers who were treated in 41 different drug abuse treatment programs in the United States shows the high rates of unemployment among drug abuse treatment patients. In this study, patients from three different treatment modalities (outpatient methadone, residential, and outpatient drug-free treatment) were asked about their employment status from the period starting one year before treatment and ending five years after treatment. Fewer than 50 percent of individuals from any of the treatment modalities reported full-time employment, and fewer than 30 percent of the methadone patients reported full-time employment in any of the years assessed.

Furthermore, among persons in drug abuse treatment, unemployment has been associated with poor treatment outcome. Unemployment has been correlated with poor treatment retention, higher rates of drug use during treatment,

and increased relapse rates (Frykholm, Gunne, and Huitsfeldt 1976; McLellan et al. 1981; McLellan et al. 1983; Platt 1995; Stephens and Cottrell 1982; Vaillant 1966a, 1966b, 1988). Some of the most impressive data are provided in a classic study by Vaillant, who followed 100 hospital-treatment heroin addicts for 20 years after hospital discharge. In one analysis, Vaillant (1988) compared 30 heroin addicts who remained most chronically addicted to heroin during the 12 years following discharge to 30 addicts who achieved 3 or more years of sustained abstinence during the follow-up period. Sustained abstinence was significantly associated with long employment histories: Sixty-three percent of addicts who achieved sustained abstinence had been employed for half or more of their adult life, whereas none of the chronically addicted persons had such employment histories. While these associations do not demonstrate that unemployment is a cause of drug abuse or that increasing employment could decrease drug use, the unequivocal relationship between unemployment and drug use strongly suggests the need to investigate further the potential role of employment in drug abuse, and particularly in drug abuse treatment.

10.1.2 Work as an Alternative Operant Behavior to Drug Use

The suspicion that employment may be useful in the treatment of drug abuse is further raised by two very general and interrelated findings in the field of operant conditioning. The first finding is that drug use is operant behavior, maintained and modifiable by its consequences. This has been shown in a large number of controlled, laboratory studies that have demonstrated that drugs can serve as reinforcers that maintain drug-seeking and drug self-administration in humans and in nonhumans (Griffiths, Bigelow, and Henningfield 1980; Johanson and Schuster 1981; Pickens, Meisch, and Thompson 1978). The second finding is that drug self-administration can be decreased by reinforcing an alternative and incompatible behavior with nondrug reinforcers. Laboratory studies in animals and in humans have shown that self-administration of a range of drugs can be decreased by reinforcing alternative incompatible responses with a range of nondrug reinforcers (Bickel and DeGrandpre 1995). Reinforcing work with money as an alternative to drug use surely fits within this model (cf. Bickel and DeGrandpre 1995; Bickel et al. 1995).

The effects on drug self-administration of reinforcing work with money is illustrated in a recent experiment by Bickel et al. (1995). In this study, cigarette smokers reported to the laboratory for three-hour sessions during which they could earn two puffs on a cigarette each time they completed a specified number lever pulls on a computer-controlled response console. The price of cigarette puffs was varied across days by varying the number of lever pulls required to earn cigarette puffs. On some days, subjects could also earn money for emitting a different response (400 pulls on a different lever). Two results of this study are important to note. First, cigarette smoking was decreased in all subjects when subjects could earn money for emitting an alternative response.

Second, although reinforcing an alternative response with money decreased cigarette smoking, smoking persisted to some extent even when the alternative response was reinforced.

10.1.3 Studies of Supportive Employment in Drug Abusers

Although the descriptive and experimental studies described above provide good reason to expect that employment may reduce drug use, a few controlled evaluations of supported employment interventions in drug abusers have failed to show consistent effects on drug use. Supported employment programs provide persons with severe employment problems subsidized employment under conditions that are designed to shape effective work and work-related skills. Three studies have been done in which drug abusers were randomly assigned to receive a supported employment intervention or a no-treatment control condition (Bass and Woodward 1978; Friedman 1980; Dickinson and Maynard 1981). Their results can be illustrated by one study conducted by Dickinson and Maynard (1981). In that study, 1,154 drug abusers were randomly assigned to a supported work or control group. Supported work subjects participated in the supported work program for 12 to 18 months; the controls had to find their own work. Supported work subjects were given labor-intensive jobs at wage rates slightly below fair market value. During the first three months, 86 percent of supported work subjects participated. Experimental subjects worked significantly more hours than controls; however, the number of hours worked dropped sharply across the first 15 months of the study. Supported work significantly reduced criminal activity as indicated by decreased arrest rates, convictions, and time incarcerated. Supported work did not affect self-reports of drug use, but it did significantly decrease self-reports of daily alcohol use. After termination of supported employment, the differences between supported work subjects and controls were diminished, possibly due to the lack of job opportunities. The studies on supported employment had methodological limitations (Hall 1990), so it is difficult to draw firm conclusions from them, but supported employment appeared to have, at best, inconsistent effects on drug use: Supported employment did not reduce drug use in two of the studies (Dickinson and Maynard 1981; Friedman 1980), and may have had beneficial effects in one (Bass and Woodward 1978).

10.1.4 Employment Features That May Affect Drug Use

The apparent beneficial effects of employment on drug use suggested by the epidemiological and operant laboratory data has raised suspicions that employment can serve to decrease drug use among drug abuse treatment patients (Bickel and DeGrandpre 1995). Yet the experimental evaluations of supported work programs fail to show clear and reliable effects of employment on drug use. These conflicting results raise important questions as to the relationship between employment and drug use. Most importantly, it would be useful to determine if there are conditions under which employment can reliably de-

crease drug use. The focus of this chapter is to identify the features of employment that should determine, at least in part, employment's effect on drug use. Three features of employment and their expected effects on drug use will be considered. First, employment may have an unintended and undesirable effect of increasing or sustaining drug use by providing monetary pay that can be used to purchase drugs. Second, employment may reduce drug use by occupying time and thereby restricting the amount of time available for drug use. Third, employment may decrease drug use to the extent that drug use results in loss of wages. The ultimate aim of this analysis is to guide the development of an employment-based drug abuse treatment intervention to utilize and maximize the potential therapeutic effects of employment.

10.1.5 A Population of Interest: Methadone Patients

This chapter will focus on research involving chronically unemployed methadone patients. Both unemployment (Hubbard et al. 1989) and continued illicit drug use (U.S. General Accounting Office [GAO] 1990) are serious and widespread problems in methadone patients. Cocaine abuse in methadone patients has increased to alarming rates in recent years (Condelli et al. 1991; Dunteman, Condelli, and Fairbank 1992; Rawson et al. 1994), and relatively few treatments have been shown to be effective in addressing this problem (Silverman, Bigelow, and Stitzer 1998). Heroin use often persists in a large proportion of patients (GAO 1990), even when adequate doses of methadone and state-of-the-art psychosocial treatments are employed (e.g., McLellan et al. 1993).

10.2 Pay for Work May Be Used to Purchase Drugs

Under some conditions, offering an unemployed drug abuser money for work may maintain workplace attendance and work. But whether this reinforcement contingency increases, decreases, or has no effect on drug use depends in part on the interactions between the two reinforcers, money and drugs, that maintain the behaviors of work and drug use, respectively. "Behavioral economics specifies a range of interactions that may occur among reinforcers available to a subject" (Hursh 1993, 169). Two reinforcers can be substitutes, complements, or independent. "If consumption of one reinforcer (commodity B) increases with increases in price of another (commodity A), then commodity B is said to be a substitute for commodity A. . . . If consumption of a reinforcer decreases with increases in the price of another, then the first is said to complement the other" (Hursh 1993, 169).

Importantly, these reinforcer interactions have been observed under carefully controlled laboratory conditions (Green and Freed 1993). This point is illustrated well in a classic experiment by Hursh (1978). Two rhesus monkeys earned all of their food and water in a chamber equipped with several levers. The monkeys could earn food by pressing on two of the levers; they could earn water by pressing on a third lever. One of the main manipulations in the

experiment was to increase the rate of food presentation for responses on one of the levers and assess the effects on the other two levers (i.e., the other food lever and the water lever). Increasing the rate of food presentation for responses on one of the food levers decreased responding on the other food lever. Food from the two sources served as perfect substitutes. However, this manipulation had the opposite effect on water consumption: As rate of food presentation for responses on the one lever increased, the rate of responding for water and the amount of water consumed also increased. Food and water served as complements.

This study illustrates two possible effects of giving a drug abuser money for performing a job. If money is a substitute for drugs, then drug use might decrease when the drug abuser is paid for work performed. Alternatively, if money and drugs are complements, then pay for work might increase drug use. The complementary nature of money and drugs was illustrated in a laboratory study in which cigarette smokers could earn money that could be used to purchase puffs on a cigarette (DeGrandpre and Bickel 1995). That study found that, in general, as the wage rate for lever pressing increased, cigarette smoking also increased.

Similarly, because money can be used to purchase drugs in the natural environment, employment may have an undesirable effect of increasing or maintaining drug use by providing a monetary pay that can be used to purchase drugs. Money and drugs may serve as complementary reinforcers in that increasing the availability of money may increase the consumption of drugs. Two types of data provide indirect evidence that money and drugs can serve as complementary reinforcers. The first type of evidence comes from what drug abusers say about the relationship between money and drugs. Kirby et al. (1995) asked 265 cocaine-experienced methadone patients to identify the types of situations in which they were likely to use cocaine. The three most frequently identified situations were having the drug present (86 percent of patients), being offered the drug (85 percent of patients), and having money available (83 percent of patients). These data suggest that receiving monetary pay for work could possibly increase the likelihood that these methadone patients would use cocaine. These data are consistent with conventional wisdom that having money in hand frequently leads to drug use in many drug abusers.

The second type of evidence comes from descriptive studies that investigate the relationship between the increase in availability of money and drug use in clinical populations. Shaner et al. (1995) studied patterns of cocaine use of 105 cocaine-dependent schizophrenic patients who were receiving disability benefits from the Social Security Administration or from the Veterans Administration. This study showed that the percent of patients who provided cocaine-positive urine samples was highest at the beginning of each month, shortly after patients received their disability checks, suggesting that patients were using their disability benefits to purchase cocaine. This study suggests that giving these patients cash payments may increase cocaine use, and provides

some evidence that money and drugs can serve as complementary reinforcers.

It should be noted that there may be other mechanisms by which work can increase drug consumption. For example, it frequently has been assumed that people sometimes use drugs of abuse to meet behavioral requirements following drug ingestion. For example, it has been suggested that the stimulant drug "ice," a form of methamphetamine, is used in the workplace because it improves performance of work-related tasks (Cotton 1990; Holand 1990; Lerner 1989) or that teenagers use methamphetamine to study for long periods of time (O'Koon 1989). In support of this, laboratory studies have shown that requiring research volunteers to engage in a computer vigilance task after drug ingestion can increase consumption of *d*-amphetamine (Silverman, Kirby, and Griffiths 1994) and caffeine (Silverman, Mumford, and Griffiths 1994), and decrease consumption of a prototypic sedative/hypnotic, triazolam (Silverman, Kirby, and Griffiths 1994).

10.3 Work Occupies Time and Thereby Restricts Access to Drugs

A job can occupy a substantial portion of a person's day with work, thereby reducing the amount of time available for consumption of drugs and other reinforcers. In behavioral economic terms, the duration of access to available reinforcers has been referred to as income (Carroll and Rodefer 1995). This is a slightly odd use of the term *income,* but in the world of behavior, the opportunity to respond for a reinforcer is the primary resource needed to obtain available reinforcers, so it bears a reasonable relationship to conventional and technical definitions of income. A number of laboratory studies in nonhumans have varied income by increasing or decreasing the amount of time per day available for seeking and consuming the drugs under study (e.g., Elsmore et al. 1980; Carroll and Rodefer 1993, 1995; see also Carroll, chap. 11 in this volume). These studies show that drug use can be decreased by decreasing the duration of access to the drugs, and that the amount of decrease in drug use depends on a variety of interacting factors, including, but not limited to, the availability of other reinforcers, the price of available reinforcers, and the magnitude of the income restrictions.

The study by Elsmore et al. (1980) illustrates an effect of restricting income in two baboons responding for food and intravenous infusions of heroin. Twenty-four hours per day, each baboon was given repeated trials in which they could choose between an infusion of heroin (0.1 mg/kg heroin HCl) or four food pellets (750 mg Noyes pellets). The experiment assessed the effects of increasing the amount of time between choice trials. The period between trials (i.e., the intertrial interval) was increased from 2 minutes to 12 minutes. Increasing the intertrial interval decreased the amount of time per day available for consuming the available reinforcers of heroin and food. When the intertrial interval was short, 2 minutes, the baboons could consume maximum amounts of both food and heroin. In fact, under this condition, on most choice trials,

the baboons did not consume either heroin or food. But as the intertrial interval increased, the number of choice trials available for consuming these two reinforcers decreased, and the animals could no longer easily maintain the high rates of consumption of both reinforcers. Food consumption remained relatively stable across the increasing intertrial intervals, but heroin consumption was substantially reduced at the higher intertrial intervals. It is important to note that even at the extreme intertrial interval of 12 minutes, heroin consumption still persisted, albeit at substantially reduced rates (between 10 and 20 infusions per day). This study illustrates two points that are supported in other studies that have evaluated changes in income on drug use (e.g., Carroll and Rodefer 1993, 1995): Reducing the duration of access to available drug reinforcers can decrease drug consumption, but it probably will not eliminate drug use completely, except under extreme conditions.

Evidence that employment-associated restrictions in the duration of access to drugs can reduce drug use is provided by recent studies that have assessed the effects of smoking restrictions in the workplace (Stitzer 1995; see also Ohsfeldt, Boyle, and Capilouto, chap. 1 in this volume). In recent years, large numbers of workplaces have begun restricting smoking in the workplace. The effects of these smoking bans in the workplace provide some interesting data relevant to the current issue in that smoking bans dramatically restrict the amount of time available for smoking. To assess the effects of the bans on smoking, Brigham, Gross, and Stitzer (1994) studied 34 employees at a Baltimore city hospital four weeks before and four weeks after the hospital went smoke-free. Data from these subjects were compared to 33 employees of other Baltimore hospitals that did not go smoke-free. Subjects in the smoke-free hospital did reduce their smoking when the smoking ban was imposed; however, none of the smokers in the smoke-free hospital quit smoking when the ban was instituted, and the decreases appeared limited primarily to work hours. The number of cigarettes smoked per day did not change for control subjects. In general, these results were corroborated by measures of saliva nicotine and breath CO levels.

Both of these types of research show that reducing the duration of access to drugs can reduce drug use under some circumstances, although these studies do not directly address the effect that this type of intervention would have on the heroin or cocaine use of methadone patients. We do know that heroin and cocaine use can occur at fairly high rates in methadone patients even when they are employed full time. This point is clearly illustrated in figure 10.2, which shows data on the heroin and cocaine use of 151 methadone patients during the first five weeks of methadone maintenance treatment in a research clinic in Baltimore. The left panel shows that unemployed patients reported injecting heroin or cocaine about 17 times per week. Employed patients reported injecting slightly, but not significantly, less than that, averaging about 12 injections per week. The right panel shows data from urine samples that were collected under observation 3 times per week during this five-week pe-

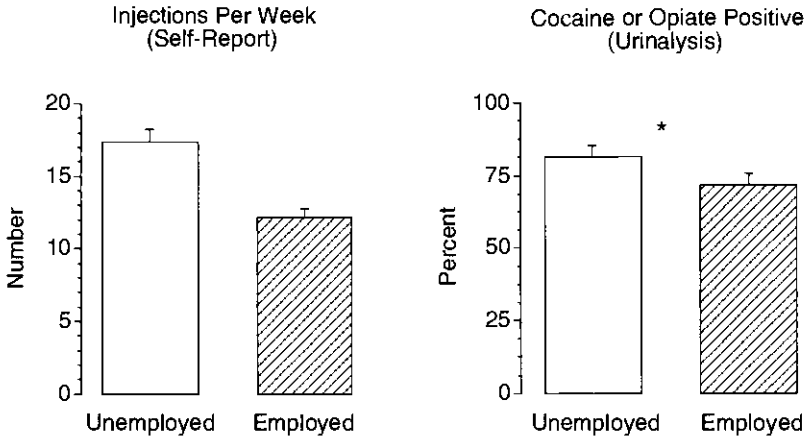

Fig. 10.2 Drug use of employed and unemployed methadone patients during the first five weeks of methadone maintenance treatment

Note: Employed patients ($N = 50$) are indicated by *hatched bars;* unemployed patients ($N = 101$) by *open bars.* The methadone treatment consisted of 60 mg methadone per day. The left panel shows the number of injections per week reported by patients over the five-week period. Self-reports were collected once per week with computerized questionnaires. The right panel shows the percentage of urine samples positive for opiates or cocaine over the same time period. Urine samples were collected three times per week. Bars represent mean values; brackets represent +1 S.E.M. An asterisk indicates that the means for the employed and unemployed were significantly different (t-test; $P \leq .05$).

riod. About 81 percent of the urine samples provided by unemployed patients were positive for either opiates or cocaine. Employed patients provided significantly fewer positive samples, but still 71 percent of their samples were drug positive. These data show that although occupying time with work may have a beneficial effect on drug use in methadone patients, simply spending 40 hours per week at a job is in no way incompatible with substantial amounts of heroin and cocaine use.

10.4 Drug Use Can Result in Loss of Wages

There is a substantial amount of research to suggest that employment could decrease drug use if drug use results in an opportunity cost such as a loss of wages or job termination. The extent to which drug use results in loss of wages or continued employment varies considerably across occupations and employers. At one extreme, there are employers that have mandatory and random drug testing, with specific economic sanctions for drug-positive urine samples (e.g., Osborn and Sokolov 1989; 14-day suspension after first drug positive, termination after second). More commonly, drug use may result in loss of wages or job termination only if it results in poor performance or attendance, which over time leads to disciplinary action, including termination.

Data from the National Household Survey (Hoffman, Larison, and Sanderson 1997), which questions a representative sample of residents in households, noninstitutionalized group quarters, and military bases, show that illicit drug use is associated with a variety of performance problems. Relative to nondrug users, more illicit drug users worked for three or more employers in the past year (32.1 percent versus 17.9 percent), missed two or more days due to illness in the past month (11.6 percent versus 9.9 percent), skipped one or more days of work in the past month (12.1 percent versus 6.1 percent), voluntarily left an employer in the past year (25.8 percent versus 13.6 percent), and had a workplace accident in the past year (7.5 percent versus 5.5 percent). Similar patterns were reported for heavy alcohol users. Although illicit drug use appears to be associated with an increase in problems at work, it is not clear to what extent employers arrange explicit consequences for illicit drug use or for performance problems that might be associated with illicit drug use. Although more illicit drug users reported being fired by an employer in the past year compared to persons who did not report illicit drug use (4.6 percent versus 1.4 percent), only a small percentage of current illicit drug users reported being fired (only 4.6 percent). Perhaps most importantly, to arrange explicit and reliable consequences for drug use, employers must conduct mandatory and random drug testing. However, mandatory and random urine testing is relatively rare, and probably occurs in no more than 20 percent of all worksites (Hoffman, Larison, and Sanderson 1997). Analyses of other data sets show that it is not at all clear whether illicit drug use results in a decrease in wages, and there is some evidence that the opposite may sometimes be the case (Kaestner 1991, 1994). Overall, it appears that explicit and reliable consequences for drug use are rare in most employment settings.

10.4.1 Contingency-Management Procedures

The primary and most direct data on the utility of opportunity cost in promoting drug abstinence come from drug abuse treatment research on contingency-management procedures. For almost 20 years, drug abuse treatment researchers have been investigating the effectiveness of contingency-management procedures in promoting drug abstinence (Hall et al. 1979; Stitzer, Iguchi, and Felch 1992; Stitzer and Higgins 1995). Although until recently (Higgins 1996) this research has been done without specific reference to behavioral economics, it is an intervention based on maximizing the opportunity cost of drug use. Under contingency-management procedures, drug abuse patients receive reinforcers (e.g., money or privileges) contingent on providing objective evidence of drug abstinence (e.g., drug-free urine samples); drug use results in loss of the available reinforcers. Contingency-management procedures have been used extensively in methadone patients and have been effective in promoting abstinence from opiates (Hall et al. 1979; McCaul et al. 1984; Higgins et al. 1986; Silverman, Wong, Higgins, et al. 1996), cocaine (Kidorf and Stitzer 1993; Silverman, Higgins, et al. 1996), benzodiazepines

(Stitzer et al. 1982), and polydrug use (Kidorf and Stitzer 1996; McCarthy and Borders 1985; Milby et al. 1978; Stitzer, Iguchi, and Felch 1992).

10.4.2 A Monetary-Based Contingency-Management Intervention

A novel and promising contingency-management intervention developed by Higgins and colleagues (Higgins et al. 1991, 1994) for the treatment of cocaine dependence is particularly relevant to the current problem because it is a monetary-based intervention. Under this contingency-management system, urine samples are collected three times per week (frequently enough to detect most or all instances of cocaine use), and patients receive a voucher each time they provide a cocaine-free urine sample. The vouchers have monetary values and can be exchanged for goods and services that are considered consistent with the goals of treatment. To reduce the chance that patients will use their earnings to purchase drugs, voucher purchases are made for patients by the program staff (an implicit recognition that money and drugs can serve as complements, as discussed above). A unique and important aspect of the procedure is the schedule of escalating voucher pay for sustained cocaine abstinence used in this procedure. Initially, the voucher values are low, but they increase as the number of consecutive drug-free urine samples that the patient provides increases. If a patient provides a cocaine-positive urine sample, he or she does not receive a voucher and the value of the next voucher the patient receives gets reset to the initial low value. This contingency of escalating voucher pay for sustained abstinence was designed specifically to reinforce periods of sustained cocaine abstinence. Higgins and colleagues have used this voucher intervention with considerable effectiveness in the treatment of cocaine-dependent patients. (For a discussion of the use of this voucher system with primary cocaine-dependent outpatients, see Higgins, chap. 6 in this volume.)

10.4.3 Voucher-Based Abstinence Reinforcement in Methadone Patients

Several studies have evaluated the effectiveness of this voucher-based contingency-management intervention in promoting abstinence from cocaine and from heroin in methadone maintenance patients. The first study (Silverman, Higgins, et al. 1996) assessed the effectiveness of voucher-based reinforcement in producing sustained cocaine abstinence. Patients in this study were selected from 52 consecutively admitted intravenous heroin abusers in methadone maintenance treatment at the treatment-research clinic of NIDA's intramural research program. Patients with heavy cocaine use during a 5-week baseline period ($N = 37$) participated. After the 5-week baseline, patients were randomly assigned to an abstinence-reinforcement or yoked control group and then participated in a 12-week intervention period. Patients in the abstinence-reinforcement group received a voucher for each cocaine-free urine sample (i.e., negative for benzoylecgonine) provided three times per week throughout the 12-week intervention period; the vouchers had monetary values that increased as the number of *consecutive* cocaine-free urine samples increased.

Patients in this group could earn up to $1,155 in vouchers for providing cocaine-free urine samples throughout the 12-week period. Control patients received noncontingent vouchers that were yoked (matched) in pattern and amount to the vouchers received by patients in the abstinence-reinforcement group. To achieve this yoking, each control patient was yoked to a reinforcement patient who had already begun the voucher condition. On every urine collection day number from 1 to 36 (three per week for 12 weeks) that the reinforcement patient earned a voucher for a cocaine-free urine sample, the control patient received a voucher of equal value for attending the clinic. Control patients were told that they could receive vouchers according to an unpredictable schedule and in unpredictable amounts. This procedure kept the pattern and amount of voucher presentation relatively constant across the two groups; the two groups differed only in that abstinence-reinforcement subjects received vouchers contingent on providing cocaine-free urine samples.

Figure 10.3 shows the longest duration of sustained cocaine abstinence that subjects achieved during the 12-week intervention evaluation. On average, abstinence-reinforcement subjects achieved durations of sustained abstinence significantly longer than those of control subjects. Nine abstinence-reinforcement subjects (47 percent) achieved between 7 and 12 weeks of sustained cocaine abstinence. In contrast, only one yoked control subject (6 percent) achieved more than 2 weeks.

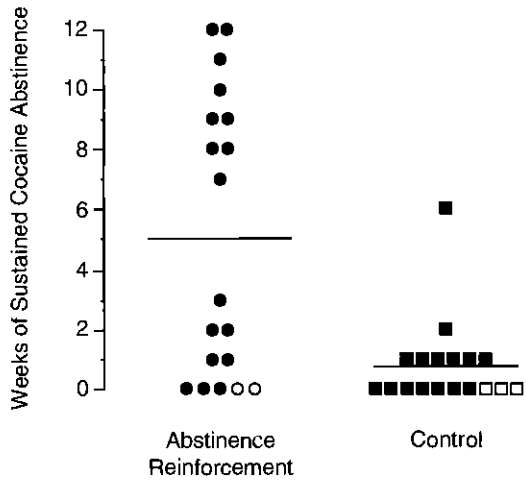

Fig. 10.3 Longest duration of sustained cocaine abstinence achieved during the 12-week voucher condition

Source: Silverman, Higgins, et al. (1996).

Note: Each point represents data for an individual patient, and the lines represent group means. The 19 abstinence-reinforcement patients are displayed in the left column (*circles*), and the 18 control patients in the right column (*squares*). Open symbols represent patients who dropped out of the study early.

This study showed that voucher-based reinforcement of cocaine abstinence can produce sustained cocaine abstinence in a substantial proportion of hard-core cocaine-abusing methadone patients. In addition, the study showed that the contingency between cocaine use and voucher presentation was critical in achieving the abstinence outcome. Both groups of subjects in this study received vouchers in approximately equal amounts; however, only the group that received vouchers contingent on cocaine-free urines achieved sustained cocaine abstinence. This study clearly illustrated the powerful effects of an opportunity cost intervention on cocaine use in methadone patients.

The effectiveness of this voucher-based contingency-management intervention in methadone patients has now been replicated in a number of treatment-research clinics, showing that voucher-based contingency-management intervention can be used to promote abstinence from cocaine (Silverman, Wong, Umbricht-Schneiter, et al. 1996), opiates (Silverman, Wong, Higgins, et al. 1996), and polydrug use (Tusel et al. 1995).

Although a slight digression from the central theme of this chapter, it is worth noting that the reinforcement of cocaine abstinence in methadone patients has had some broad beneficial effects, beyond its obvious effects on cocaine use (Silverman, Wong, Umbricht-Schneiter, et al. 1996). Most notably, contrary to some expectations, in two separate studies (Silverman, Higgins, et al. 1996; Silverman, Wong, Umbricht-Schneiter, et al. 1996), reinforcement of cocaine abstinence has produced increases in opiate abstinence, even though patients were not required to provide opiate-free urine samples to earn vouchers. From a behavioral economic perspective, these data suggest that cocaine and heroin may be complementary reinforcers in some patients.

10.4.4 Manipulating Magnitude of Abstinence Reinforcement and Opportunity Cost

While the voucher-based contingency-management interventions have been clearly effective in these studies, many patients exposed to these interventions have not achieved sustained abstinence. Data from the study by Silverman, Higgins, et al. (1996) illustrates this point. As can be seen in figure 10.2, although about half of the patients in this study achieved sustained cocaine abstinence when exposed to the intervention in which they could earn up to $1,155 in vouchers for providing cocaine-free urine samples (abstinence-reinforcement group), about half of the patients appeared relatively resistant to the intervention and failed to achieve sustained abstinence. (Analyses of urine samples collected during the baseline period before patients were exposed to the voucher intervention showed that the treatment-resistant patients [i.e., patients who failed to achieve five or more weeks of sustained cocaine abstinence] had higher pretreatment rates of cocaine use than the treatment-responsive patients.)

To address this problem, Silverman, Chutuape, et al. (1997) conducted a study to determine if sustained cocaine abstinence could be promoted in

treatment-resistant patients by increasing the magnitude of voucher reinforcement. Reinforcement magnitude has been shown in a large body of research to be an important determinant of operant behavior. Twenty-nine methadone patients who failed to achieve sustained abstinence when exposed to a 13-week intervention in which they could earn up to $1,155 in vouchers (exchangeable for goods and services) for providing cocaine-free urine samples participated in this study. Each patient was exposed, in counterbalanced order, to three, nine-week voucher interventions (separated by four-week baseline periods), in which they could earn up to $0, $380, or $3,400 in vouchers for providing cocaine-free urine samples. Twenty-two patients completed all three voucher conditions. Analyses of urine samples from those 22 patients showed that the longest duration of sustained cocaine abstinence was significantly related to voucher magnitude. Ten of the 22 patients in the high-magnitude condition achieved four or more weeks of sustained cocaine abstinence, whereas only 2 of 22 patients in the low-magnitude condition and no patients in the zero-magnitude condition achieved more than two weeks of sustained abstinence. The percentage of patients abstinent per week was also significantly related to voucher magnitude. Whereas fewer than 10 and 20 percent of subjects were abstinent at any given time point of the zero- and low-magnitude conditions, respectively, between 50 and 60 percent of subjects were abstinent during many weeks of the high-magnitude condition. These results show that high-magnitude voucher-based abstinence reinforcement can promote sustained cocaine abstinence, even in treatment-resistant patients.

10.5 Conclusions

The analysis proposed in this chapter is essentially an analysis of the interactions of drug use and work as operant behaviors. The conditions under which increases in employment should decrease drug use depend on a range of environmental factors. Under typical employment conditions, employment occupies time and thereby restricts the amount of time available for drug use; however, reinforcement contingencies for drug abstinence or penalties for drug use are usually absent or inconsistent. Under these conditions there is little reason to think that employment should markedly reduce drug use. In fact, because money and drugs may serve as complementary reinforcers, employment may increase or sustain drug use by providing money to purchase drugs. Consistent with this notion, two randomized controlled studies evaluating the effects of employing drug abusers in supported jobs (Friedman 1980; Dickinson and Maynard 1981) failed to show that employment affected drug use. In these studies, participants were employed in low-paying jobs without explicit contingencies on drug use. Perhaps more to the point, this chapter presented data showing that methadone maintenance patients used heroin and cocaine at fairly high rates even while employed full time (fig. 10.2).

Research on the contingency management of drug use in treatment popu-

lations, and particularly research on voucher-based abstinence reinforcement, shows that providing monetary-based vouchers contingent on drug-free urine samples can exert a powerful influence on drug use. Voucher-based reinforcement of cocaine can promote long periods of cocaine abstinence in cocaine-abusing methadone patients who have proven difficult to treat effectively by other means. This intervention is also effective in promoting abstinence from opiates and from polydrug use. At high voucher magnitudes, the intervention can even produce robust results in some of the most treatment-resistant methadone patients. These results suggest that employment could potentially provide therapeutic benefit and reduce drug abuse to the extent that salary for work is made contingent on verified drug abstinence. This contingency might be accomplished, for example, by requiring that an employee provide a drug-free urine sample each day to gain entrance to the workplace; then pay could be provided contingent on completed workshifts. This chained schedule would essentially make pay contingent both on drug abstinence and work. The studies in treatment-resistant patients suggest that the effectiveness of an employment intervention will depend not only on whether salary is made contingent on drug abstinence but also on the magnitude of the salary. Specifically, high abstinence-contingent salaries will be needed to promote abstinence in patients with the most serious drug abuse problems.

The need for high salaries creates a practical dilemma because many chronically unemployed methadone patients lack skills that they would need to earn high salaries (Brewington et al. 1987; Dennis et al. 1993). As an example, figure 10.4 shows the academic skill levels of 48 patients of the Center for Addiction and Pregnancy, a drug abuse treatment program in Baltimore for pregnant drug abusers (Silverman et al. 1995). The left portion of this figure shows subjects' estimated grade levels in reading, spelling, and arithmetic based on the Wide Range Achievement Test. Most subjects were at or below the seventh grade level of academic achievement in reading, spelling, and arithmetic, and approximately 25 percent of subjects were at or below the fourth grade level in these areas. The right-most column shows the highest grade of education that subjects completed and shows that over half of these patients did not complete high school. Thus, an effective employment intervention may need to include an intensive skills-training program that could equip patients with the skills needed to compete for high-paying jobs, thereby establishing a mechanism whereby high salary could be earned and made abstinence-contingent. It is important to note that much of the educational technology needed to teach this population the skills they will need to function effectively in the workplace is currently available (Engelmann and Carnine 1982; Johnson and Layng 1992), although it appears that for a substantial proportion of drug abuse patients, reinforcement contingencies for participation in training will be needed in addition to the existing educational curriculum and teaching practices (Silverman, Chutuape, et al. 1996).

We are currently developing an employment-based treatment intervention

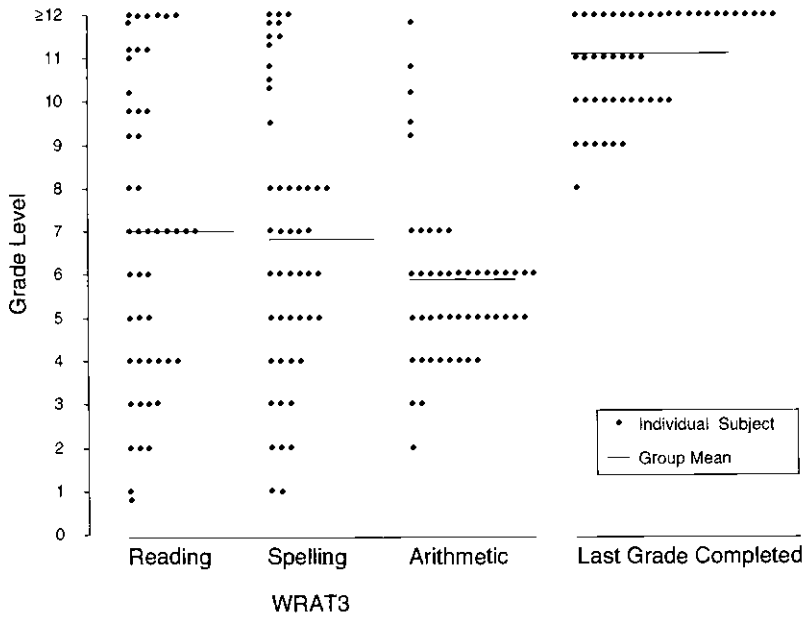

Fig. 10.4 WRAT3 reading, spelling, and arithmetic grade levels and the highest grade level actually completed during school years for 48 subjects

Source: Reprinted from Silverman et al. (1995) with permission from Elsevier Science.

Note: Subjects were patients of the Center for Addiction and Pregnancy. Solid points indicate grade levels for individual subjects; horizontal lines represent group means.

for chronically unemployed heroin and cocaine abusers based on the principles and research reviewed in this chapter. This therapeutic workplace intervention has three main components: (i) voucher-based reinforcement for abstinence and work, (ii) skills training, and (iii) supported work. Each day, prior to entering the workplace, participants are required to provide a urine sample. If the sample is drug negative, the participant is allowed to work that day. When the participants then complete the day's work shift, they receive a monetary voucher. Voucher values increase as the number of consecutive days of abstinence and workplace attendance increases. Drug-positive urine samples or unexcused absences reset the voucher value back to the initial low value. During work hours, participants receive training that they will need to perform a variety of office jobs, including training in basic academic skills, typing, number entry, and computer use. Participants who complete this training or who enter the program skilled in these areas are given actual work experience performing data-entry and word-processing jobs. Preliminary results from the randomized trial comparing methadone maintenance patients who do (therapeutic workplace group) and do not (control group) receive this intervention suggest that the intervention is attractive to a large proportion of patients and appears to increase abstinence from opiates and cocaine.

Controlled research has shown voucher-based abstinence reinforcement to be one of the more effective interventions currently available to treat heroin and cocaine abuse and dependence in hard-core drug abusers (cf. Silverman, Bigelow, and Stitzer 1998). While this research has demonstrated the potential utility of abstinence reinforcement and opportunity cost in the treatment of drug abuse, the research has not identified a practical means of applying these interventions on a large scale, and herein lies the main point of this chapter: The analysis and research presented suggest that employment could well serve as a vehicle for funding, implementing, and sustaining on a large scale powerful reinforcement contingencies for drug abstinence and substantial opportunity cost for drug use. Research investigating this potential role of employment in drug abuse treatment is only just beginning, but the empirical basis for such a role and the preliminary results of a reinforcement-based employment intervention for drug abusers provide good grounds for continuing this line of development and investigation.

References

Bass, U. F., and J. A. Woodward. 1978. *Services research report. Skills training and employment for ex-addicts in Washington, D.C.: A report on TREAT.* DHHS Publication no. (ADM) 78-694. Rockville, Md.: National Institute on Drug Abuse.

Bickel, W. K., L. Amass, S. T. Higgins, R. A. Esch, and J. R. Hughes. 1994. A behavioral treatment for opioid dependence during a burprenorphine detoxification: A preliminary report. In *Problems of drug dependence, 1993*, ed. L. S. Harris, 455. NIDA Research Monograph no. 141. NIH Publication no. 94-3749. Washington, D.C.: U.S. Government Printing Office.

Bickel, W. K., and R. J. DeGrandpre. 1995. Price and alternatives: Suggestions for drug policy from psychology. *International Journal of Drug Policy* 6:93–105.

Bickel, W. K., R. J. DeGrandpre, and S. T. Higgins. 1993. Behavioral economics: A novel experimental approach to the study of drug dependence. *Drug and Alcohol Dependence* 33:173–92.

Bickel, W. K., R. J. DeGrandpre, S. T. Higgins, J. R. Hughes, and G. J. Badger. 1995. Effects of simulated employment and recreation on drug taking: A behavioral economic analysis. *Experimental and Clinical Psychopharmacology* 3:467–76.

Brewington, V., L. Arella, S. Deren, and J. Randell. 1987. Obstacles to the utilization of vocational services: An analysis of the literature. *International Journal of Addictions* 22:1091–118.

Brigham, J., J. Gross, and M. L. Stitzer. 1994. Effects of restricted work-site smoking policy on employees who smoke. *American Journal of Public Health* 84:773–78.

Carroll, M. E., and J. S. Rodefer. 1993. Income alters choice between drug and an alternative nondrug reinforcer in monkeys. *Experimental and Clinical Psychopharmacology* 1:110–20.

———. 1995. Concurrent self-administration of ethanol and an alternative nondrug reinforcer for monkeys: Effects of income (session length) on demand for drug. *Psychopharmacology* 120:1–9.

Condelli, W. S., J. A. Fairbank, M. L. Dennis, and J. V. Rachal. 1991. Cocaine use by

clients in methadone programs: Significance, scope, and behavioral interventions. *Journal of Substance Abuse Treatment* 8:203–12.

Cotton, P. 1990. Medium isn't accurate "ice age" message. *Journal of the American Medical Association* 263:2717.

DeGrandpre, R. J., and W. K. Bickel. 1995. Human drug self-administration in a medium of exchange. *Experimental and Clinical Psychopharmacology* 3:349–57.

Dennis, M. L., G. T. Karuntzos, G. L. McDougal, M. T. French, and R. L. Hubbard. 1993. Developing training and employment programs to meet the needs of methadone treatment clients. *Evaluation Program Planning* 16:73–86.

Dickinson, K. and R. Maynard. 1981. *The impact of supported work on ex-addicts: National supported work demonstration.* Vol. 4 of *Final report on the supported work evaluation.* New York: Manpower Demonstration Research Corporation.

Dunteman, G. H., W. S. Condelli, and J. A. Fairbank. 1992. Predicting cocaine use among methadone patients: Analysis of findings from a national study. *Hospital and Community Psychiatry* 43:608–11.

Elsmore, T. F., G. V. Fletcher, D. G. Conrad, and F. J. Sodetz. 1980. Reduction of heroin intake in baboons by an economic constraint. *Pharmacology, Biochemistry and Behavior* 13:729–31.

Engelmann, S., and D. Carnine. 1982. *Theory of instruction: Principles and applications.* New York: Irvington Publishers.

Friedman, L. 1980. Employing the ex-addict: An experiment in supported work. In *Quantitative explorations in drug abuse policy,* ed. I. Leveson. Jamaica, N.Y.: Spectrum Publications.

Frykholm, B., M. Gunne, and B. Huitsfeldt. 1976. Prediction of outcome in drug dependence. Addictive Behaviors 1:103–10.

Gfroerer, J. C., and M. D. Brodsky. 1993. Frequent cocaine users and their use of treatment. *American Journal of Public Health* 83:1149–54.

Green, L., and D. E. Freed. 1993. The substitutability of reinforcers. *Journal of the Experimental Analysis of Behavior* 60:141–58.

Griffiths, R. R., G. E. Bigelow, and J. E. Henningfield. 1980. Similarities in animal and human drug-taking behavior. In *Advances in substance abuse,* ed. N. K. Mello, 1–90. Greenwich, Conn.: JAI Press.

Hall, S. M. 1990. Clinical trials in drug treatment: Methodology. In *Drugs in the workplace: Research and evaluation data. Volume II. Research monograph 100,* ed. S. W. Gust, J. M. Walsh, L. B. Thomas, and D. J. Crouch, 88–105. DHHS Publication no. (ADM) 91-1730. Rockville, Md.: National Institute on Drug Abuse.

Hall, S. M., A. Bass, W. A. Hargreaves, and P. Loeb. 1979. Contingency management and information feedback in outpatient heroin detoxification. *Behavior Therapy* 10: 443–51.

Higgins, S. T. 1996. Some potential contributions of reinforcement and consumer-demand theory to reducing cocaine use. *Addictive Behaviors* 21:803–16.

Higgins, S. T., A. J. Budney, W. K. Bickel, F. Foerg, R. Donham, and M. S. Badger. 1994. Incentives improve outcome in outpatient behavioral treatment of cocaine dependence. *Archives of General Psychiatry* 51:568–76.

Higgins, S. T., D. D. Delaney, A. J. Budney, W. K. Bickel, J. R. Hughes, F. Foerg, and J. W. Fenwick. 1991. A behavioral approach to achieving initial cocaine abstinence. *American Journal of Psychiatry* 148:1218–24.

Higgins, S. T., M. L. Stitzer, G. E. Bigelow, and I. A. Liebson. 1986. Contingent methadone delivery: Effects on illicit opiate use. *Drug and Alcohol Dependence* 17:311–22.

Hoffman, J. P., C. Larison, and A. Sanderson. 1997. *An analysis of worker drug use and workplace policies and programs.* DHHS Publication no. (SMA) 97-3142. Rockville, Md.: Department of Health and Human Services, Public Health Service, Substance Abuse and Mental Health Services Administration.

Holand, L. 1990. All about "ice": New drug nice kids can get hooked on. *Good Housekeeping*, no. 210:215.

Hubbard, R. L., M. E. Marsden, J. V. Rachal, H. J. Harwood, E. R. Cavanaugh, and H. M. Ginzburg. 1989. *Drug abuse treatment: A national study of effectiveness.* Chapel Hill: University of North Carolina Press.

Hursh, S. R. 1978. The economics of daily consumption controlling food- and water-reinforced responding. *Journal of the Experimental Analysis of Behavior* 29:475–91.

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

Johanson, C. E., and C. R. Schuster. 1981. Animal models of drug self-administration. In *Advances in substance abuse: Behavioral and biological research*, ed. N. K. Mello, 219–97. Greenwich, Conn.: JAI Press.

Johnson, K. R., and T. V. J. Layng. 1992. Breaking the structuralist barrier: Literacy and numeracy with fluency. *American Psychologist* 47:1475–90.

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

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

Kidorf, M., and M. L. Stitzer. 1993. Contingent access to methadone maintenance treatment: Effects on cocaine use of mixed opiate-cocaine abusers. *Experimental and Clinical Pharmacology* 1:200–206.

———. 1996. Contingent use of take-homes and split-dosing to reduce illicit drug use of methadone patients. *Behavior Therapy* 27:41–51.

Kirby, K. C., R. J. Lamb, M. Y. Iguchi, S. D. Husband, and J. J. Platt. 1995. Situations occasioning cocaine use and cocaine abstinence strategies. *Addiction* 90:1241–52.

Lerner, M. A. 1989. The fire of "ice." *Newsweek* 114:37.

McCarthy, J. J., and O. T. Borders. 1985. Limit setting on drug abuse in methadone maintenance patients. *American Journal of Psychiatry* 142:1419–23.

McCaul, M. E., M. L. Stitzer, G. E. Bigelow, and I. A. Liebson. 1984. Contingency management interventions: Effects on treatment outcome during methadone detoxification. *Journal of Applied Behavior Analysis* 17:35–43.

McLellan, A. Thomas, I. O. Arndt, D. S. Metzger, G. E. Woody, and C. P. O'Brien. 1993. The effects of psychosocial services in substance abuse treatment. *Journal of the American Medical Association* 269:1953–96.

McLellan, A. Thomas, J. Ball, L. Rosen, and C. O'Brien. 1981. Pretreatment source of income and response to methadone maintenance: A follow-up study. *American Journal of Psychiatry* 138:785–89.

McLellan, A. Thomas, L. Luborsky, G. E. Woody, C. P. O'Brien, and K. A. Druley. 1983. Predicting response to alcohol and drug abuse treatment. *Archives of General Psychiatry* 4:620–25.

Milby, J. B., C. Garrett, C. English, O. Fritschi, and C. Clarke. 1978. Take-home methadone: Contingency effects on drug seeking and productivity of narcotic addicts. *Addictive Behaviors* 3:215–20.

National Institute on Drug Abuse. (NIDA). 1988. *National Household Survey on Drug Abuse: Main findings 1985.* DHHS Publication no. (ADM) 88-1586. Washington, D.C.: U.S. Government Printing Office.

———. 1990. *National Household Survey on Drug Abuse: Main findings 1988.* DHHS Publication no. (ADM) 90-1682. Washington, D.C.: U.S. Government Printing Office.

O'Koon, M. 1989. Dangerous new drugs on the teen market. *Good Housekeeping*, no. 208:235.

Osborn, C. E., and J. J. Sokolov. 1989. Drug use trends in a nuclear power company: Cumulative data from an ongoing testing program. In *Drugs in the workplace: Re-*

search and evaluation data, ed. S. W. Gust and J. M. Walsh, 69–80. Rockville, Md.: National Institute on Drug Abuse.

Pickens, R., R. A. Meisch, and T. Thompson. 1978. Drug self-administration: An analysis of the reinforcing effects of drugs. In *Handbook of psychopharmacology*, ed. L. L. Iversen, S. D. Iversen, and S. H. Snyder, 1–37. New York: Plenum.

Platt, J. J. 1995. Vocational rehabilitation of drug abusers. *Psychological Bulletin* 117:416–33.

Rawson, R. A., M. J. McCann, A. J. Hasson, and W. Ling. 1994. Cocaine abuse among methadone maintenance patients: Are there effective treatment strategies? *Journal of Psychoactive Drugs* 26:129–36.

Shaner, A. E., T. T. Eckman, L. J. Roberts, J. N. Wilkens, D. E. Tucker, J. W. Tsuang, and J. Mintz. 1995. Disability income, cocaine use, and repeated hospitalization among schizophrenic cocaine abusers. *New England Journal of Medicine* 333: 777–83.

Silverman, K., G. E. Bigelow, and M. L. Stitzer. 1998. Treatment of cocaine abuse in methadone patients. In *Cocaine abuse: Behavior, pharmacology, and clinical applications*, ed. S. T. Higgins and J. L. Katz, 363–88. San Diego, Calif.: Academic Press.

Silverman, K., M. A. Chutuape, G. E. Bigelow, and M. L. Stitzer. 1996. Voucher-based reinforcement of attendance by unemployed methadone patients in a job skills training program. *Drug and Alcohol Dependence* 41:197–207.

———. 1997. Reinforcement of cocaine abstinence in treatment-resistant patients: Effects of reinforcer magnitude. In *Problems of drug dependence 1996*, ed. L. S. Harris, 74. NIDA Research Monograph no. 174. NIH Publication no. 97-4236. Washington, D.C.: U.S. Government Printing Office.

Silverman, K., M. A. Chutuape, D. S. Svikis, G. E. Bigelow, and M. L. Stitzer. 1995. Incongruity between occupational interests and academic skills in drug abusing women. *Drug and Alcohol Dependence* 40:115–23.

Silverman, K., S. T. Higgins, R. K. Brooner, I. D. Montoya, E. J. Cone, C. R. Schuster, and K. L. Preston. 1996. Sustained cocaine abstinence in methadone patients through voucher-based reinforcement therapy. *Archives of General Psychiatry* 53:409–15.

Silverman, K., K. C. Kirby, and R. R. Griffiths. 1994. Modulation of drug reinforcement by the behavioral requirements following drug ingestion. *Psychopharmacology* 114:243–47.

Silverman, K., G. K. Mumford, and R. R. Griffiths. 1994. Enhancing caffeine reinforcement by behavioral requirements following drug ingestion. *Psychopharmacology* 114:424–32.

Silverman, K., C. J., Wong, S. T. Higgins, R. K. Brooner, I. D. Montoya, C. Contoreggi, A. Umbritch-Schneiter, C. R. Schuster, and K. L. Preston. 1996. Increasing opiate abstinence through voucher-based reinforcement therapy. *Drug and Alcohol Dependence* 41:157–65.

Silverman, K., C. J. Wong, A. Umbricht-Schneiter, I. D. Montoya, C. R. Schuster, and K. L. Preston. 1996. Voucher-based reinforcement of cocaine abstinence: Effects of reinforcement schedule. In *Problems of drug dependence, 1995*, ed. L. S. Harris, 97. NIDA Research Monograph no. 162. NIH Publication no. 96-4116. Washington, D.C.: U.S. Government Printing Office.

Stephens, R., and E. Cottrell. 1982. A follow-up study of 200 narcotic addicts committed for treatment under the Narcotics Rehabilitation Act (NRA). *British Journal of Addiction* 67:45–53.

Stitzer, M. L. 1995. Policy initiatives to enhance smoking cessation and harm reduction. *Tobacco Control* 4 (supp. 2): S67–S74.

Stitzer, M. L., G. E. Bigelow, I. A. Liebson, and J. W. Hawthorne. 1982. Contingent reinforcement for benzodiazepine-free urines: Evaluation of a drug abuse treatment intervention. *Journal of Applied Behavior Analysis* 15:493–503.

Stitzer, M. L., and S. T. Higgins. 1995. Behavioral treatment of drug and alcohol abuse. In *Psychopharmacology: The fourth generation of progress*, ed. F. E. Bloom and D. J. Kupfer, 1807–19. New York: Raven Press.

Stitzer, M. L., M. Y. Iguchi, and L. J. Felch. 1992. Contingent take-home incentive: Effects on drug use of methadone maintenance patients. *Journal of Consulting and Clinical Psychology* 60:927–34.

Substance Abuse and Mental Health Services Administration (SAMHSA). 1993. *National Household Survey on Drug Use: Main findings 1991*. DHHS Publication no. (SMA) 93-1980. Rockville, Md.: Department of Health and Human Services, Public Health Service, Substance Abuse and Mental Health Services Administration.

———. 1996. *Drug use among U.S. workers: Prevalence and trends by occupation and industry categories*. DHHS Publication No. (SMA) 96-3089. Rockville, Md.: Department of Health and Human Services, Public Health Service, Substance Abuse and Mental Health Services Administration.

Tusel, D. J., N. A. Piotrowski, K. Sees, P. M. Reilly, P. Banys, P. Meek, and S. M. Hall. 1995. Contingency contracting for illicit drug use with opioid addicts in methadone treatment. In *Problems of drug dependence, 1994*, ed. L. S. Harris, 155. NIDA Research Monograph no. 153. Washington, D.C.: U.S. Government Printing Office.

United States General Accounting Office (GAO). 1990. *Methadone maintenance: Some treatment programs are not effective; greater oversight needed, March 1990*. GAO report to the Chairman, Select Committee on Narcotics Abuse and Control, House of Representatives. GAO/HRD-90-194. Washington, D.C.: United States General Accounting Office.

Vaillant, G. E. 1966a. A 12 year follow-up of New York narcotic addicts: I. The relation of treatment of outcome. *American Journal of Psychiatry* 122:727–37.

———. 1966b. A 12 year follow-up of New York narcotic addicts: II. The natural history of a chronic disease. *New England Journal of Medicine* 275:1282–88.

———. 1988. What can long-term follow-up teach us about relapse and prevention of relapse in addiction? *British Journal of Addiction* 83:1147–57.

Comment on Chapters 9 and 10

John Mullahy

Introduction and Overview

The papers by Kenkel and Wang and Silverman and Robles offer novel, stimulating, and complementary perspectives on the interactions between substance abuse and labor market behavior. The particular phenomena of interest to Kenkel and Wang are alcohol dependence, occupational characteristics, and earnings, whereas Silverman and Robles focus chiefly on illicit drug use and employment.

To set the stage, it is instructive to summarize each paper's main conclusions in the authors' words. Kenkel and Wang (section 9.9):

> Our analysis of data from the NLSY suggests that young men who meet criteria for alcohol dependence are indeed in bad jobs. Their jobs are less

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> likely to offer major fringe benefits, are more dangerous, and are at smaller firms. Their jobs also pay less, in part because alcoholics bring less human capital to the job than do their nonalcoholic peers. . . . Particularly because of the important role human capital variables play, some of the benchmark patterns are consistent with the job choices of rational addicts who anticipate the labor market consequences of alcoholism.

Silverman and Robles (section 10.5)

> While this research has demonstrated the potential utility of abstinence reinforcement and opportunity cost in the treatment of drug abuse, the research has not identified a practical means of applying these interventions on a large scale, and herein lies the main point of this chapter: The analysis and research presented suggest that employment could well serve this function as a vehicle for funding, implementing, and sustaining on a large scale powerful reinforcement contingencies for drug abstinence and substantial opportunity cost for drug use.

From my vantage point, the main conceptual and empirical contribution of the Kenkel and Wang paper is to take the literature on the "productivity costs of problem drinking" one major step further to recognize that wage/earnings differences between alcoholics and nonalcoholics provide only part of the information required to ascribe productivity reductions to problem drinking. Kenkel and Wang argue compellingly (and support their arguments empirically) that labor supply adjustments involving occupational choice and all that goes with this (fringe benefits, workplace conditions, etc.) will ultimately have important bearing on how and to what extent productivity differentials are ascribed. Kenkel and Wang conclude that the failure of the literature, to date, to account for fringe benefit effects has resulted in a nontrival misstatement of the productivity effects of problem drinking.

Appealing to findings from the behavioral economics literature as well as to their own clinical research, Silverman and Robles offer the reader a set of provocative suggestions as to how and why it might be expected that employment and all that goes with it could be a beneficial form of "treatment" for drug abuse. When the complex set of constraints and costs that typically bind on workers also find a way to bind on drug-abusing workers, Silverman and Robles argue that the "comparative statics" *may* (but need not necessarily) result in reductions in these workers' propensities to use drugs. One major takeaway conclusion is that "magnitudes matter"; that is, the magnitudes, and possibly the signs as well, of these employment-related effects are likely to depend critically on how large the respective incentives are that weigh against the use of drugs.

Structural Model Interpretations

To assess the individual contributions of each paper, as well as to provide a framework within which their approaches and findings might be synthesized,

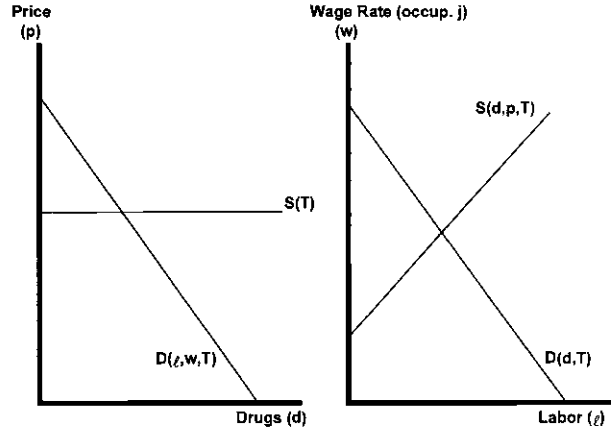

Fig. 10C.1 A structural model of the markets for drugs and labor

it is instructive to postulate a quite general multiple-equation structural model relating some measure(s) of substance abuse behavior (d, e.g., problem drinking, illicit drug use, etc.), some measure(s) of labor market behavior (ℓ, e.g., employment, occupational choice, earnings, etc.), and the exogenous covariates $\mathbf{x}$ that structurally influence these behaviors:

$$g(d, \ell, \mathbf{x}; \alpha) = \varepsilon, \tag{1}$$

where ε represents the unobserved stochastic components of the model.

A graphical depiction of a simple structural model that captures many of the central elements of Kenkel and Wang and Silverman and Robles is given in figure 10C.1, which displays a market for drugs and a market for labor (one occupation of a set of occupations). Wage rates (w) and policy interventions (T), as well as the quantity of labor effort (ℓ), are shifters of the demand for drugs (it is assumed for simplicity that the supply of drugs is elastic and does not respond to the quantity of labor effort or the wage rate). Labor supply is shifted by the price of drugs (p), policy interventions, and the quantity of drugs transacted. Labor demand is shifted both by the quantity of drugs transacted and by policy interventions. The variables p, w, and T play the role of the $\mathbf{x}$ covariates above.

Of course, Kenkel and Wang and Silverman and Robles are each most fundamentally interested in identifying particular components of this multiple-equation structural model. The main concern of Kenkel and Wang is with a structural equation like

$$\ell = \ell(d, \mathbf{x}; \alpha_1) + \varepsilon_1, \tag{2}$$

whereas the main focus of Silverman and Robles is on a structural equation like

$$d = d(\ell, \mathbf{x}; \alpha_2) + \varepsilon_2. \tag{3}$$

In both instances, the analysts' concerns are (presumably) with obtaining consistent estimates of the structural parameters α_j. In both instances, it is useful to keep in mind that the outcomes (d and ℓ) arise because of the interplay of supply and demand behavior in multiple markets.

A related, yet somewhat more straightforward, characterization of the Kenkel and Wang and Silverman and Robles studies is to view them as being concerned with estimation of *treatment effects,*

$$TE(\mathbf{x}) = E[y_1|\mathbf{x}] - E[y_0|\mathbf{x}]. \tag{4}$$

The standard approach of the treatment effects literature (e.g., Manski 1995) is to posit counterfactual outcomes (y_1 and y_0) that represent the outcomes occurring for individuals characterized by covariates $\mathbf{x}$ were they (1) or were they not (0) to receive a particular "treatment."

As such, for Kenkel and Wang, y_1 represents the occupational status or earnings that would obtain if *nonalcoholic,* whereas y_0 represents the occupational status or earnings that would obtain if *alcoholic.* For Silverman and Robles, y_1 represents the drug use behavior that would obtain if *employed,* whereas y_0 represents the drug use behavior that would obtain if *unemployed.*

Characterized either as a general structural equation model or—somewhat more clinically—in terms of treatment effects, it is clear that Kenkel and Wang and Silverman and Robles are ultimately investigating different slices of the same pie.

Analytical Issues

Identification

Translated into a policy context, Kenkel and Wang would like to know the extent to which labor market outcomes would be "better" if public policies, medical technologies, and so forth could turn alcoholics into nonalcoholics, whereas Silverman and Robles would like to know the extent to which drug use outcomes would be "better" if public policies, workplace initiatives, and so forth could turn unemployed drug-using individuals into employed individuals. As such, both papers are interested in counterfactuals. Unfortunately from an analytical perspective, there are—at best—limited real-world marketplace or natural experiment data to mimic these counterfactual conditions.

The main statistical constraint on both research efforts is identification. To their credit, both papers are quite clear about the obstacles involved in attempting to arrive at sound structural conclusions (i.e., estimates of eqs. [2] and [3] above). Appealing to observational information tells us that *given prevailing institutions and incentives,* there are disproportionately high rates of unemployment among drug users (Silverman and Robles) and disproportion-

ately high rates of inferior labor market outcomes among alcoholics (Kenkel and Wang). However, these same observational data are not—in general—generated under the conditions of the natural or clinical experiments that would provide the statistical wherewithal to identify equation (2) and/or equation (3).

Recognizing the possible econometric limitations in treating "alcohol abuse akin to a disease randomly striking a portion of the population," Kenkel and Wang intimate that something akin to instrumental variable (IV) estimation might be sensible. Data limitations constrain such an effort, however, as they typically do in such modeling exercises. Kenkel and Wang do present some reasonably compelling results supporting an argument that econometric endogeneity (or reverse causation) may not be terribly problematic in their sample, however, and they straightforwardly and commendably admit that "the far more demanding empirical task of identifying a structural model" is beyond their scope.

In assessing the impacts of employment on drug abuse propensities, Silverman and Robles assume a more or less classical clinical trial perspective for purposes of identification. Some of the randomized clinical trial results presented by Silverman and Robles are quite provocative, and I found the design of some of the trials they discuss rather clever (e.g., the idea of using so-called yoked voucher values). The major concern here, as with any clinical experimental situation, is generalizability to the world outside the clinic.

As such, identification concerns can be raised for both studies: for Kenkel and Wang because of the possibly questionable implied exogeneity assumptions, and for Silverman and Robles because of the fact that the effects identified in the clinical setting may not correspond well to the effects that would be expected to prevail outside the clinic. To their credit, both sets of authors are quite honest about the potential limitations that such considerations impose on their conclusions.

Preferences and Costs

Individuals *don't* work and *do* consume or abuse drugs and alcohol because—*given the prevailing constraints and incentives they face*—they *want* to; that is, it is in their self-perceived self-interest to do so. Some might object to extending the economic rationality paradigm to settings like unemployment and drug use, but it seems a particularly important consideration in assessing both of the studies at hand. Kenkel and Wang are certainly cognizant of the consideration that the use of alcohol dependency as a regressor at least partially is tantamount to explaining one form of consumption behavior (labor supply) by another form of consumption behavior. Since I reside in a glass house here, I won't throw any stones.

Of greater concern, however, is the impression I have that the Silverman and Robles findings may be limited by a failure to recognize that nonemployment is the outcome of optimizing behavior. Any individual, whether or not he or

she is a drug abuser, must forgo leisure to work. To the extent that drugs and leisure are complements (a prospect articulated nicely by Silverman and Robles), this becomes all the more problematic. Put differently, given market wage offers and reservation wage levels (both of which may be influenced by drug abuse), not working will be the optimal outcome if the latter exceeds the former. The Silverman and Robles paper emphasizes policies that operate to change the market wage or reward structure faced by drug abusers. But without commensurate productivity values to offer employers, it is difficult to conceive of a competitive marketplace wherein labor demanders alter the structure of rewards they offer solely as a means to combat drug abuse.

Policy Context and Summary

Why and *how* might knowledge of the structural models or treatment effects pursued by Kenkel and Wang and Silverman and Robles ultimately be useful? In both instances, estimates of such structural effects would be useful components of cost-benefit or cost-effectiveness analyses of proposed programs, medical technologies, and so forth; given proper accounting for all relevant issues, it would be possible to gain a sense of the value of such interventions. Proper cost-benefit or cost-effectiveness analysis does take the vantage point of the "what if's" that are central in the specification and estimation of treatment effects like those described above.

Suppose one were to accept the Kenkel and Wang and Silverman and Robles findings as reasonable estimates of the treatment effects of interest. Then, the appropriate policy focus would be on (i) how it might be possible to provide interventions that might elicit the kinds of behavioral changes (counterfactuals) that would appear (from the Kenkel and Wang and Silverman and Robles findings) to be desirable; and (ii) how costly it would be to deliver such interventions. How costly is it to society to turn alcoholics into nonalcoholics? How costly is it to turn unemployed drug users into employed (and, as Silverman and Robles would argue to be necessary, reasonably well compensated) drug users?

The Kenkel and Wang and Silverman and Robles studies do not address these issues—nor were they designed to—but understanding the overall societal value of alternative candidate interventions is clearly where it would be useful to push this line of inquiry. A small subset of what is surely a large list of such candidate interventions might include:

1. innovative pharmacologic treatments for problem drinking: Naltrexone, Acamprosate, and so forth
2. restructuring health insurance coverage, treatment guidelines, and such for managed care organizations, behavioral health care providers, and so forth
3. developing workplace incentive, training, and drug-testing programs; Employee Assistance Programs; and so forth
4. providing employment incentives to employers via the tax system.

The extent to which these and others would be (i) effective and (ii) cost effective sets the stage for some of the future research in this stimulating area.

Kenkel and Wang and Silverman and Robles have provided important contributions to our appreciation of the intricate relationships between substance abuse and labor market phenomena. While much work remains, both of these papers have laid solid foundations and have pointed in sensible directions for future research.

Reference

Manski, Charles F. 1995. *Identification problems in the social sciences.* Cambridge, Mass.: Harvard University Press.

Comment on Chapters 9 and 10

Sharon M. Hall

We have heard two conceptually and methodologically diverse papers unified by a common theme: the importance of choice patterns of drug dependent individuals with respect to work and to their addiction. This is a crucial theme because employment is so closely related to successful treatment outcome in the addictions.

We should congratulate Dr. Silverman on an important series of studies. It is exciting to see studies with such marked differences between treated and control groups, differences that are obvious to the eye. I hope that the preliminary results from the Center for Addiction and Pregnancy study are borne out as the sample size increases. It is particularly impressive to see employment data and interventions for women. Dr. Kenkel's work provides quantitative and sobering estimates of the continuing cost of alcoholism on men's job placement. I hope that there are, or will be, resources available to extend these analyses to women who are alcohol dependent.

An immediate and obvious thought when considering these two papers is the question of how the information and methods of one can inform the other. As a clinical intervention researcher, I can imagine mining the data obtained from econometric studies to better guide the design of employment interventions for drug treatment patients. What would need to be done is not conceptually daunting. We would need estimates of alcohol abuse and dependence at different points in time, and wages and fringe benefits at the same time points. Psychological measures—for example, stages of change measures—would

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also be useful. The question of interest would be how job choices differ at times when the alcohol-dependent individual was drinking heavily, versus during abstinence or when drinking moderately. If we were to examine the changes in job characteristics, especially in fringe benefits, that occurred when drinking status shifted, we could determine what kinds of jobs and benefits correlated with abstinence. I say this acknowledging that these are correlational data that, as Dr. Kenkel has so wisely pointed out, are potentially confounded by other variables. Nevertheless, such data might be used as an initial guide in the development of contingencies in employment programs for alcohol treatment patients. For example, while vouchers toward additional job training might not be appealing to users who are in the precontemplation state of change, such vouchers might become an important reinforcer as one's recovery proceeds. This approach might be especially beneficial because it would allow the use of reinforcers that are natural to the job, rather than external, and thus lessen the frequently heard criticism that contingency systems are artificial. Also, such reinforcers could be scheduled to gradually shape prosocial behaviors, much as do those supplied in the current studies of voucher systems.

Conversely, the experimental paradigms developed by the behavioral psychologists might enhance the research of traditional economists. As Dr. Kenkel has pointed out, testing economic theory in the traditional empirical, correlational sense inevitably presents multiple confounds. As I understand it, most analyses are confined to large sample data that are analyzed principally by regression techniques. In controlled experimental situations, however, researchers can vary the relevant parameters one at a time to determine specific-cause effects on the dependent variables and, at the same time, study individual behavior in response to such changes. One could propose a study, for example, wherein crucial questions about alcoholics' preference for fringe benefits could be addressed by direct experimental manipulation of offering different sorts of fringe benefits, or a study wherein differential responses of alcoholics and nonalcoholics in response to availability of fringe benefits are studied. This methodology might complement large-scale empirical studies. I realize that there are papers that use such experimental paradigms elsewhere in the volume, but they seem to be primarily translations of economic theory by psychologists.

Dr. Silverman's paper raises an additional issue for me. As he has noted, it has been over 20 years since the first contingency-management studies were published, by Drs. Bigelow and Stitzer, and by our group. The publication of such studies has continued by Dr. Stitzer and her colleagues and, in the form of voucher reinforcement, by Dr. Higgins and his colleagues. I have not done a thorough count of the number of contingency-management studies published, but a quick perusal of *Psychological Abstracts* indicated approximately 45 studies in the past 20 years, almost all with positive and sometimes striking results. Think, for a moment, of the number of drug treatment programs in the community, in the private sector, or as part of the state or federal government

that have implemented programs based on this work. I suspect few, if any, will come to mind.

The failure of the treatment community to implement contingency-management procedures, in light of the years of positive findings, has long been a disappointment to those who are convinced of their effectiveness. Why are they not widely used? A primary reason is philosophical. Two models have dominated drug treatment in this country, and neither is philosophically congruent with these interventions. The first is the medical model, which conceptualizes drug addiction as a disease; the second, less clearly articulated but more widely held, is the moral model, which proposes that drug addiction is a failure of will and is morally wrong. Contingencies are superfluous to the medical model, which supposes that adequate biological therapy with appropriate rehabilitation are necessary and sufficient to produce a successful outcome.

Positive contingencies are morally repugnant to those who hold a moral model, since the choice to use or not use drugs is based on one's free will. Payment is seen as equivalent to a bribe. Negative contingencies, on the other hand, which have not fared as well empirically, are seen as acceptable as just retribution for "bad" behavior by those who hold a moral model, and are thus widely used. Jail, treatment termination, and legal control are all common responses to drug use. The notion of punishment as an appropriate response to moral failure has widespread societal support.

If the preliminary data from the Center for Addiction and Pregnancy study are borne out, however, they may allow a useful conceptual shift. Few would argue the morality of paying anyone for productive work, whether or not they have a history of drug abuse. I once knew a very seasoned addiction counselor who firmly believed that the goal of addiction treatment was to turn addicts into taxpayers. Today's wage earner is tomorrow's taxpayer. Thus, studies focusing on work rehabilitation may serve as a palatable starting point for the introduction of contingencies into treatment systems beyond those controlled by behavioral researchers.

Both Dr. Silverman's and Dr. Kenkel's papers also bring to mind a second theme: the importance of recognition of nicotine as a drug of abuse, and its potential interrelation with other drugs of abuse. Nicotine may be a "complementary drug"; its use co-occurs so frequently with the use of other drugs. We know, for example, that about 80 percent of alcoholics are nicotine abusers, and estimates of the smoking rates of other drug treatment patients are similarly high. In the natural environment, use often appears to be complementary; imbibing alcohol and cigarette smoking tend to go together. Indeed, when I read Dr. Kenkel's paper, I wondered to what extent the smoking that co-occurred with heavy alcohol use confounded differences in jobs between alcoholics and nonalcohol groups. The additional material he has presented today on the relationship of nicotine to poorer jobs suggests that this may well be the case.

We have not seriously considered decreasing nicotine use as a way of de-

creasing the use of other drugs ("double harm reduction"), but perhaps we should do so. One can envision instances where such a therapy might be a most cost-effective way of treating an addiction. Consider, for example, the effects of eliminating nicotine use in an individual who is both a heavy smoker and a heavy drinker whose alcohol use borders on abuse. One might hypothesize a decrease in alcohol use and posit a substantial reduction in harm.

In 1974, a group of us (Hayden et al. 1974) published a behavioral economics study in the *Journal of Abnormal Psychology*. The central thesis was that a closed economy, such as a token economy, could be used as a laboratory to test economic principles. We found that, indeed, chronic psychotic patients did behave "rationally" when it came to the relation of tokens and cigarettes. We determined that consumption decreased when price increased, and that patients responded to percentage changes in prices rather than absolute changes. No one followed immediately in our footsteps for many reasons. Certainly, one was the lack of a solid underlying model. The work presented here will not meet a similar fate, as evidenced by this conference. Certainly, one reason is that the models underlying it are elegant, and appear to have so much potential in increasing predictive power.

Reference

Hayden, Teresa, Alfred E. Osborne, Sharon M. Hall, and Robert G. Hall. 1974. Behavioral effects of price changes on a token economy. *Journal of Abnormal Psychology* 83:432–39.

VI Substance Use and Income