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Monetary-based consequences for drug abstinence: Methods of implementation and some considerations about the allocation of finances in substance abusers

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Abstract

Conceptualizing drug abuse within the framework of behavioral theories of choice highlights the relevance of environmental variables in shifting behavior away from drug-related purchases. Choosing to use drugs results in immediate, certain consequences (e.g., drug high and relief from withdrawal), whereas choosing abstinence typically results in delayed, and often uncertain, consequences (e.g., improved health, interpersonal relationships, money). Contingency management (CM) increases choice for drug abstinence via the availability of immediate, financial-based gains, contingent on objective evidence of abstinence. In this selective review of the literature, we highlight a variety of methods to deliver CM in practical, effective, and sustainable ways. We consider a number of parameters that are critical to the success of monetary-based CM, and the role of the context in influencing CM's effects. To illustrate the broad range of applications of CM, we also review different methods for arranging contingencies to promote abstinence and other relevant behavior. Finally, we discuss some considerations about how drug-dependent individuals allocate their finances in the context of CM interventions.

Keywords

Contingency management; behavioral choice theory; substance abuse

Substance abuse remains a challenging problem in contemporary society. Over 19.9 million individuals in the United States aged twelve or older use illicit drugs, and nearly one in four smokes cigarettes. The health and economic tolls of substance abuse are both familiar and staggering: The National Institutes of Health estimates that drug, alcohol, and cigarette addiction account for more deaths than all other preventable causes combined, and the cost to society is about \$500 billion per year (1).

Over the past several decades, a number of behavioral theories of choice have advanced our understanding of the environmental determinants of substance abuse (2–4). These theories posit that drug use is operant behavior, or behavior influenced by its consequences (i.e., contingencies of reinforcement and punishment) and the context in which those consequences occur (5,6). Biological and genetic variables also play critical roles in the pathogenesis and maintenance of substance use, but the complex and interdependent relations between these variables and environmental variables is beyond the scope of this article (7). The choices described by behavioral theories are repeated decisions between drug use and abstinence. The dynamic competition between reinforcing (or punishing)

consequences for drug use versus reinforcing (or punishing) consequences for abstinence powerfully influences which choice will occur. The competing contingencies framework has proven useful in understanding drug use, and it also provides a conceptual framework for a behavioral treatment known as contingency management, or CM (5).

Under CM interventions, incentives are provided to individuals contingent on objective evidence of drug abstinence (e.g., biochemical verification via urinalysis). These incentives enable immediate delivery of desirable consequences for drug abstinence. Numerous studies over the past several decades have established the broad applicability and versatility of CM procedures in promoting drug abstinence (8–13). The intervention is efficacious for treating cocaine use among cocaine-dependent patients (14), cocaine use among methadone-maintained patients (15), heroin use (16) and polydrug use (17–19). Contingency management also exerts powerful and precise control of cigarette smoking in both adults and adolescents (20,21). A recent meta-analysis of CM effects on drug abstinence across a range of drug classes concluded that the data “provide strong support for CM as being among the more effective approaches to promoting abstinence during and after the treatment of drug dependence disorders” (p. 1556, (22)).

Methods used to deliver financial-based consequences for drug abstinence

Voucher-based CM

A common method to deliver incentives to promote drug abstinence is voucher-based CM. Under voucher-based procedures, the vouchers are statements of monetary earnings, which can be exchanged for goods or services. The incentives are delivered every time abstinence is verified (e.g., contingent on every drug-free urine sample). For example, in the early studies of voucher-based procedures to promote cocaine abstinence, clients provided urine specimens three times per week and earned vouchers for each cocaine-negative urine specimen (14,15). Vouchers values escalated with each consecutive cocaine-negative specimen, beginning with \$2.50 for the first cocaine-free sample (14). If a client had an unexcused absence from a scheduled urine test or a cocaine-positive test result, the value of the vouchers was reset to the initial low level. Vouchers were exchangeable for goods or services in the community. Clinic staff purchased items requested by clients if the items were consistent with treatment goals. During the first 12 weeks of the program, clients could earn a maximum of approximately \$1,000 in vouchers if all scheduled urine specimens tested negative for cocaine. To provide patients who lapsed an incentive to return to cocaine abstinence, submission of five consecutive cocaine-negative specimens following a positive specimen returned the voucher amount to the value prior to the reset. These contingencies have been employed in scores of studies, and the escalating schedule with a reset contingency is the most common method to deliver voucher-based CM (13).

Although voucher-based CM interventions have been used primarily to promote drug abstinence, there are a range of alternative and complementary behaviors that have been targeted in drug treatment clinics. For example, recent work has extended the CM approach to promote adherence to antagonist medications, such as naltrexone, for the treatment of opioid dependence (23,24). Similarly, a small number of recent studies have demonstrated that CM exerts robust effects on highly-active antiretroviral therapy (HAART) adherence among drug users (25–27). Finally, although the majority of CM interventions have targeted one drug of abuse, polydrug use is common. To address this concern, several studies have examined the feasibility and effectiveness of targeting multiple drugs with voucher-based CM interventions (17–19). All of the studies demonstrated that it was feasible to use CM with multiple drug targets (e.g., opioids, cocaine, amphetamine, alcohol, marijuana). However, procedures that targeted abstinence from several drugs simultaneously were generally less successful than procedures that employed progressively stringent shifts in

which drugs were targeted (28). It is possible that either the response effort of abstinence from multiple drugs simultaneously was too high, or the reinforcer magnitude was too low for meeting the goal of abstinence from multiple drugs (19).

Intermittent prizes

In some cases it may not be feasible to reinforce every instance of abstinence as indicated by biochemical measures, as in voucher-based methods, either for practical or financial reasons. Thus, Petry and colleagues (29) investigated an alternative method to deliver incentives that they termed the “fishbowl prize” method. In their initial study, participants withdrew a slip of paper from a bowl contingent on demonstrating abstinence. The bowl contained 250 slips of paper, each of which represented one of four possible outcomes: (a) 50 slips contained no prize, (b) 169 slips resulted in a low magnitude prize valued at approximately \$1.00 (e.g., food coupons, toiletries, or bus tokens), (c) 17 slips contained a medium prize valued at approximately \$20.00 (e.g., CDs, phone cards), and (d) 1 slip contained a large prize valued at approximately \$100.00 (e.g., stereo, DVD, television). Using this fishbowl method, participants achieved significantly higher levels of alcohol abstinence, relative to standard care alcohol treatment.

The fishbowl method has also been combined with the commonly-used escalating schedule of voucher earnings, whereby participants retrieve an increasing number of slips of paper contingent on consecutive weeks of abstinence (30,31). In addition to increasing alcohol abstinence, this same method has also been applied to cocaine and opioid abstinence (32), poly-drug abstinence (30,33), and drug abstinence with individuals who have a history of gambling (34). Individuals with a history of gambling did not engage in a higher rate of gambling when exposed to the fishbowl method, which could be a concern given that gambling is also maintained on an intermittent schedule of reinforcement. Finally, the fishbowl method was tested recently as part of the Clinical Trials Network, which was conducted in a number of methadone and psychosocial treatment facilities, and showed that the method was effective and generalized to a variety of clinic settings (30,31,33).

The fishbowl method has been discussed as a means of reducing the costs associated with CM interventions (32,35). In two studies, however, the fishbowl method was compared to voucher-based incentive schedules, and both methods produced comparable outcomes at comparable costs (36,37) see (38) for further discussion of the cost-effectiveness of these two methods). Regardless of the method, there may be conditions under which low-cost CM interventions can be effective (39). A recent observational study suggests that low-cost, prize-based CM can be delivered in a community substance abuse treatment program for adolescents (40). Expenses related to CM were minimal at \$0.39 per patient per day, and the percentage of urine samples positive for multiple drugs decreased from 33.3% to 23.4%.

Employment-based CM

Another method to structure CM interventions for drug abstinence is to use contingent access to employment settings. Several studies have integrated CM into employment settings in which wages for work are used to reinforce abstinence (41–44). Although there was some variation in the way in which these interventions were implemented, they all arranged access to paid employment contingent on biologically verified drug abstinence. In addition, rather than terminate an employee based on evidence of drug use, these interventions typically arranged a procedure in which wages returned to a low value following a lapse (41,44). A return to work, while remaining abstinent, reinstated the participant’s level of earnings prior to the relapse. In contrast to the potentially punitive contingencies found in most workplaces that utilize drug testing, these contingencies are therapeutic in the sense that they encourage a return to abstinence.

In a recent randomized controlled trial, contingent access to a workplace (based on a negative cocaine urinalysis) produced higher rates of cocaine abstinence (79.3%) compared to a condition in which access to the workplace was permitted regardless of cocaine use (50.7%, (41)). There are at least three noteworthy features of this study. First, participants included in this study were those who showed persistent cocaine use during treatment in a standard methadone community clinic. Second, employment-based CM continued for 1 year, which is a much longer period than the vast majority of CM interventions targeting cocaine use (cf. (45)). Third, participants were paid in the form of checks rather than vouchers. Fourth, the study indicated additional public health benefits by showing that CM significantly reduced rates of HIV risk behaviors. Specifically, participants reported significantly lower rates of trading sex for drugs or money.

Another study found that employment-based CM can maintain higher rates of abstinence over a 3-year period (46), which is one of the longest sustained CM interventions reported in the literature. Participants in this study were those who failed to stop their use of heroin and cocaine when exposed to a state-of-the-art substance abuse treatment program for pregnant and postpartum women (47). Compared to a usual care group, participants in the workplace showed higher rates of cocaine (28% vs. 54%) and opiate (37% vs. 60%) abstinence based on urinalysis over the 3-year period. Overall, this study and others offer strong support for the utility of integrating CM into employment settings to promote long-term abstinence. Indeed, several authors have argued that the development of long-term sustainable interventions is one of the most important challenges in substance abuse treatment research (41,46,48). Employment-based CM may be an ideal long-term treatment for cocaine dependence (41). Many employment settings not only control powerful reinforcers, they can monitor drug status over long periods by virtue of the fact that drug testing is already used in work-places.

Cash vs. vouchers

Many CM interventions employ voucher-based abstinence reinforcement (10,14,15,49) in which vouchers have monetary value and can be exchanged for goods and services, as described earlier. Typically, the exchange is made in consultation with clinic staff, and the purchase cannot be used for drugs or other illegal products. Voucher purchases are approved by clinic staff if the purchases accord with the patient's therapeutic goals (e.g., increasing recreational activities that might compete with drug use; 12). An alternative to vouchers, and one that does not entail consultation about purchases, is to use cash as a consequence for abstinence. One obvious risk is that cash might be used to purchase drugs or other counterproductive goods or services. For this reason, cash may be viewed by community providers and policy makers as a less acceptable form of incentive than vouchers. Several studies, however, suggest that using cash as a consequence for abstinence does not result in a subsequent increase in drug use relative to alternative incentive methods (50,51). For example, Vandrey et al. (51) found no difference in cocaine abstinence rates (as detected by quantitative urinalysis testing) after receipt of \$100 in checks than during control (no-incentive) conditions. Similarly, Festinger et al. (50) randomly assigned drug treatment patients to receive cash or gift certificate payments for completing a 6-month follow-up assessment (50). Rates of drug use during the following week after receipt of the incentives did not significantly differ based on incentive type (7–14% for cash, 8–25% for gift certificates).

Another potential benefit of using cash is that it can reduce the delay to reinforcement (52). CM is most effective when the consequences are delivered after relatively short, as opposed to long, delays (52–54). Perhaps not surprisingly, drug users prefer cash when given the choice between cash and vouchers (55), and they also have been shown to discount the monetary value of vouchers by approximately 10–20% of their face value (56). Also, several

studies have found that cash-based consequences promote higher rates of behavior change than alternative voucher-based strategies. In the Vandrey et al. study (51) cash produced higher cocaine abstinence (71%) compared to voucher-based consequences (42–48%). Similarly, cash-based consequences for attendance at a follow-up appointment resulted in higher follow up rates relative to gift certificates (48% vs. 37%, respectively; (50)). Another study found that the rate of return visits to learn the results of a purified protein derivative (PPD) skin test reading in patients with HIV was 95% for those receiving \$10 cash, 86% for those receiving grocery store coupons, 83% for those receiving either bus tokens or fast-food coupons, 47% percent for those receiving an educational session, and 49% for those receiving simply encouragement (57). Collectively, these results suggest that cash consequences may be more effective in promoting behavior change than alternative but equivalently valued commodities. Although a small number of studies suggest that cash-based incentives do not lead to increased substance use, more extensive, randomized-controlled trials will be necessary to verify that cash-based incentives can produce superior results without increasing substance use or other risky behavior.

Deposit contract procedures

Another method to incentivize abstinence, and one that has received less attention relative to the methods described above, is to require an up-front financial allocation by the participant in the form of a deposit contract. The deposit can be earned back based on evidence of abstinence, and in this sense the up-front allocation serves as the contract between the person trying to quit and research staff. The main difference between this method and traditional CM is that the participant's own funds are used to incentivize abstinence instead of (or in addition to) external funds. There is a long history of using deposit contracting to reduce or eliminate a range of target behaviors, particularly cigarette smoking (20,58–61). For example, Winett (61) assessed the effects of reimbursing a \$55 deposit for smoking reductions and then abstinence over a relatively brief period (two to four weeks). During a two-week maintenance phase, only 1 out of 25 participants (excluding three dropouts) continued to smoke. These participants recouped their deposit contingent on self-reported reductions and abstinence, which were also compared to reports by significant others. In contrast, only seven of seventeen in a non-contingent control group maintained abstinence over the same period. After six months, 50% of the participants in the contingent group reported not smoking, compared to 23.5% in the non-contingent control group.

A small feasibility study suggested that the deposit contract method can be used with CM for smoking cessation (20). Eight smokers were randomly assigned to a deposit contract (\$50) or to a no-deposit group. The no-deposit group experienced a traditional CM program, in which the maximum amount for continued abstinence was \$78.80. Participants in the deposit group could recoup their \$50 deposit for smoking reductions and abstinence (breath carbon monoxide ≤ 4 ppm) during treatment phases, plus an additional \$28.80 in vouchers (total of \$78.80). As expected, there were no differences between groups in terms of abstinence (and amount of money earned), with 65% (\$156.90) and 63% (\$178.90) negative samples for the deposit and no-deposit groups, respectively. However, because \$200 was paid to researchers by participants in the deposit group, a \$43.10 surplus remained in this group. The surplus was used to supplement experimental costs in the no-deposit group (e.g. vouchers).

The use of deposit contracts could, depending on the amount of the deposit and the amount recouped, reduce the costs associated with CM interventions. Several practical issues would have to be addressed before a deposit contract method could be extended to community providers. For instance, it will be necessary to explore the relations between the amount of the deposit, treatment acceptability, and treatment effectiveness (58,59). One possibility to increase acceptability while maintaining effectiveness would be to use a sliding deposit

scale, and corresponding earnings rate, based on income. Another straightforward possibility would be to allow the patient to choose the initial deposit amount.

Contextual variables and the effects of CM

One prediction of several behavioral theories of choice is that the context of reinforcement will influence the effectiveness of reinforcing consequences for a target behavior (62). A reinforcer in an enriched context will be less valuable because of the competing sources of reinforcement, whereas a reinforcer in an impoverished context will be more valuable because of fewer competing sources of reinforcement. For the purposes of this discussion, the target behavior could be drug use or abstinence. The context could refer to two sources of reinforcement: (a) reinforcement derived from activities, people, and things, all sources except for reinforcement derived from the target behavior (e.g., drug use), or (b) reinforcement derived from income (e.g., the socioeconomic status of the individual). We shall address each in turn.

A number of studies have found that the number of non-drug, alternative sources of reinforcement can predict treatment outcome in adolescent and adult alcohol users (63–65). A reinforcement survey scale was used to assess reinforcement derived from a range of activities (e.g., going to class, work, exercise, dating, time with kids, etc). The scale accounted for unique variance in predicting outcome following a motivational intervention for alcohol use (63). One implication of this research is that enriching the context of reinforcement, or providing reinforcement for behavior incompatible with drug use, should decrease drug use. For example, Correia et al. (65) found that experimentally manipulated increases in substance-free activities (e.g., exercise and creative activities) lead to decreases in alcohol use. It may be worthwhile to explore further a combination of this approach with CM interventions.

An alternative view of context is that it refers to the economic status of the individual. Most CM interventions have been conducted with relatively low-income, low socio-economic status participants. Rash et al. (66) examined whether income affected abstinence outcomes with a CM intervention in a combined sample of 393 treatment-seeking cocaine abusers from three clinical trials. The authors found that there was no relation between treatment response (CM or standard care) and income. In terms of overall income, the participants in these studies were similar to the general population of treatment seekers for drug dependence. The authors examined data from the 2003 National Survey on Drug Use and Health and found that an estimated 70% of responders reported past year income from all sources of less than \$20,000. This compares to 73% of their combined sample earning \$20,000 or less from all sources. Thus, this comparison supports the generality of the finding to the majority of treatment seekers for alcohol and drug dependence, but generalizing to even higher income populations is premature. Rash et al.'s findings are consistent with a previous study examining CM outcomes and income (67), and several other studies showing that income does not predict outcome in other substance abuse treatment modalities (68). However, the finding that “financial context” does not affect the efficacy of CM appears to contradict the predictions of behavioral theories of choice. There are at least two possible explanations for this: (a) the range of income was not large enough to detect an effect of income on outcomes, or (b) the increased finances did not represent an increase in reinforcing context. That is, the finances may have been spent on necessities rather than on activities or commodities that could substitute for drug reinforcement.

Variables that influence the effects of CM on abstinence

Contingency management interventions are comprised of a number of components that could be implemented in a variety of ways. Behavioral theories of choice provide a rich

history of empirical research that has been used as a guide for identifying the most effective means of implementing CM interventions.

Schedule of reinforcement

The most common schedule of reinforcement used in CM interventions is the escalating schedule of voucher delivery with resets of the voucher value for evidence of lapses or missed samples (52,69,70). One study compared the effects of a constant, fixed monetary schedule to the most commonly used schedule that involves escalating the monetary value of vouchers for each consecutive negative drug sample (71). The fixed value was always \$9.80 for negative samples. One escalating schedule started at \$3.00 and escalated by \$0.50 for each consecutive negative sample, plus a \$10.00 bonus for every third consecutive negative sample. Another escalating schedule specified the same parameters, but with the addition of a reset contingency in which a positive or missing sample resulted in the monetary value for the next negative sample resetting to \$3.00. If participants remained abstinent the entire time, they could earn the same amount of money in all three conditions. The authors found a significant difference between the schedules in the percentage of smokers who initiated and sustained abstinence, with the fixed schedule resulting in 17% of participants, compared to 22% in the escalating without a reset, and 50% in the escalating schedule with a reset contingency.

One potential problem with an escalating schedule of reinforcement is the low initial value of the consequence for abstinence. Several researchers have noted that a number of participants in clinical trials evaluating CM do not contact the monetary reinforcers for abstinence (72,73). It is possible that the low initial value is not high enough to motivate initial abstinence. One study suggested that increasing the initial voucher earnings did not result in a higher rate of cocaine abstinence compared to the standard escalating schedule of reinforcement (74). Another study, however, found that participants who received a high magnitude voucher immediately upon demonstrating abstinence showed longer periods of sustained cocaine abstinence, relative to the traditional escalating schedule with a reset contingency (75). A number of schedule variables varied in this study (e.g., immediacy, frequency, and overall magnitude), so it is unclear whether the higher rates of abstinence were a result of the initial higher magnitude or because of some other variable. Another study provided some preliminary support that descending schedules of reinforcement, which start with the highest magnitude possible and then descend in magnitude with each consecutive negative sample, resulted in a greater number of smokers initiating, but not necessarily maintaining, smoking abstinence than traditional escalating schedule (76). Again, it is not clear if the schedule or differences in the magnitude of reinforcement was responsible for the differences in abstinence initiation.

Another possible reason why some participants do not achieve abstinence is that most CM interventions require an abrupt transition to complete abstinence. Gradual reductions in drug use may permit greater contact with monetary reinforcers for changing drug use behavior. Several studies suggest that gradual reductions in drug use, or shaping procedures, can generate high initial rates of abstinence in cocaine (73) and nicotine dependent individuals (77–79).

Reinforcer Magnitude

Although many CM interventions have been shown to be efficacious relative to standard care, some participants do not respond to CM interventions. One well-established finding in behavioral choice research is that higher magnitude reinforcers are more effective than lower magnitude reinforcers in producing behavior change. To explore this possibility in the context of CM, Silverman and colleagues (80) investigated the efficacy of three different

voucher magnitudes in initiating cocaine abstinence among participants who were previously treatment resistant in a CM intervention. The authors compared no vouchers, a low magnitude schedule (total possible earnings = \$382), and a high magnitude schedule (total possible earnings = \$3,480). Significantly more participants provided cocaine abstinent samples during the high magnitude condition (46%), versus the control (8%) and low (14%) magnitude conditions. Most studies that have found magnitude effects in treatment-resistant samples have used high magnitudes that were approximately nine times the value of the low magnitude vouchers (e.g., (19,80). Higher magnitude vouchers have also been shown to retain participants in treatment for longer periods of time and produce longer sustained periods of cocaine abstinence (even when controlling for differential drop-out rates; (81)).

Similar outcomes have been shown with tobacco smoking, where greater rates of abstinence resulted from higher magnitude monetary reinforcers contingent on nicotine abstinence (82). Counseling and job-training attendance rates are also sensitive to the magnitude of reinforcement provided for engaging in these clinical activities (83,84). A recent meta-analysis supported the above findings by showing that voucher magnitude is an important moderator to the efficacy of CM interventions (28). When drug use versus abstinence is viewed as behavioral choice, higher magnitude reinforcers are thought of as being able to “compete” more effectively with the consequences of drug taking.

Delay to reinforcement

Another variable that can influence choice is the delay to the delivery of the consequence following the behavior. More immediate consequences are more effective than delayed consequences, particularly in the context of voucher deliveries in CM interventions (28). For example, one laboratory-based CM study presented smokers with a choice between taking a puff from a cigarette or earning money. When money was delivered immediately, very few puffs were chosen. However, as the delay to receipt of money increased, choice for puffs on the cigarette also increased (52).

In fact, drug use may be thought of as a type of impulsive choice to the extent that choice reflects a preference for small immediate outcomes (e.g., drug effects) over larger delayed outcomes (e.g., health, discretionary income, work, leisure, etc.). One explanation for such preference holds that delayed rewards are discounted to a high degree among individuals who abuse drugs (for a review see (85)). Specifically, delay discounting describes the relationship between changes in the subjective value of a reward as the delay to receipt of the reward increases. The rate at which the value of a reward decays with time has been shown to be greater for some individuals than for others (e.g., drug abusers). Higher rates of delay discounting, or impulsive choice, are associated with various aspects of drug abuse such as drug seeking, self-administration, withdrawal, relapse, and severity of drug use (86). For example, current smokers discount delayed monetary rewards at a higher rate than never and ex-smokers ((87), for a recent, comprehensive review see (88)). A growing body of research suggests that reinforcer immediacy is more important for some individuals than for others (88).

Despite the well established relationship between delay discounting and drug dependence, it is unclear whether individuals who discount delayed rewards more rapidly are therefore more likely to abuse drugs, or whether drug abuse causes individuals to discount delayed rewards more rapidly. Several studies using non-human subjects have shown that exposure to some drugs result in an increase in delay discounting (e.g., methamphetamine and nicotine with rats (89,90), cf. (91), although such effects can differ depending on the drug, drug dose, procedure, and testing conditions. Other studies using rats have shown that pre-drug discounting rates can be used to predict various aspects of drug taking and relapse to

drug use (86,92,93). Finally, higher rates of discounting have been shown to predict relapse to smoking among human smokers in the context of a CM intervention (94,95) and in the context of a laboratory model of CM (96). Therefore, in light of the existing data, it appears that some individuals may have a propensity to use drugs based on pre-drug discounting, and drug use itself may exacerbate an already high rate of discounting.

Some considerations regarding the allocation of finances in substance abusers

Conceptualizing drug abuse within the framework of behavioral choice theory highlights the relevance of environmental variables in shifting choice away from drug-related purchases. Choosing to use drugs results in immediate, certain consequences (e.g., drug high and relief from withdrawal), whereas choosing abstinence typically results in delayed, and often uncertain, consequences (e.g., improved health, interpersonal relationships, money). Contingency management attempts to shift choice towards preference for drug abstinence by making abstinence more appealing via the availability of immediate, financial gains, contingent on objective evidence of abstinence. In this selective review of the literature, we have highlighted a variety of methods to deliver CM in practical, effective, and potentially cost-effective ways.

A central feature of voucher-based CM is that accumulated vouchers must be spent on non-drug activities. Voucher-based CM forces a shift in how financial-based consequences may be used: from drug to non-drug commodities. This shift only occurs for the portion of finances received through the CM intervention; whereas finances received through other sources are not subject to the same constraints on purchases. Although voucher-based CM forces this shift by virtue of how the vouchers are exchanged, it is also possible that contingencies alone (i.e., incentives for drug abstinence) are responsible for how finances are allocated. The fact that using cash instead of vouchers does not increase drug purchases suggests that the contingency, and not the constraint on purchases, is responsible for the shift in allocation in finances.

Even in the absence of an explicit CM intervention, the allocation of finances to purchase non-drug related activities or commodities can be a critical precursor to abstinence. Promoting such a shift in how finances are allocated in the context of CM may have considerable advantages. Indeed, the allocation of finances to purchase drug versus non-drug commodities or activities has been found to predict resolution of problem drinking. Tucker and colleagues (97–99) assessed the proportion of participants' expenditures on alcohol versus money put into savings for future use. Greater relative allocation to savings over alcohol predicted resolution stability at one and two year follow-ups (and drinking severity and other factors associated with resolution stability were controlled for in this analysis). The absolute amount spent on alcohol or put into savings was not predictive of outcome, only the relative proportion allocated was predictive. These findings support the notion, highlighted above, that choice is influenced by the context in which it occurs. Furthermore, the measure of financial allocation used by Tucker et al. (97) showed unique incremental validity compared to several other empirically-derived predictors such as self-efficacy expectations, stages of change, and alcohol reinforcement, and the measure's of predictive validity held regardless of whether participants received formal treatment or were untreated.

Another consideration with respect to allocation of finances in the context of CM interventions is how participants spend the money they previously spent on drugs by virtue of not using drugs. One concern is that this surplus that is the result of abstaining from one drug could be used to purchase other drugs (100). This may be particularly significant in the case of polydrug users - when the CM intervention only targets one of the drugs. This

concern has not been substantiated empirically. For example, Silverman and colleagues (49) found that a CM intervention targeting cocaine use in cocaine and opioid abusing patients produced concomitant decreases in illicit opiate use. Reductions in opiate use occurred despite the fact that such drugs were not formally targeted in the intervention. Thus, earning money for abstaining from one drug does not necessarily result in money spent on other drugs, and may even result in a decrease in money spent on other drugs.

There are several relatively under-explored questions regarding the allocation of finances by individuals undergoing CM interventions. For example, there are few reports of the type of purchases made with vouchers. Roll et al. (101) compared voucher exchanges between individuals involved in the criminal justice system and individuals not involved. In the non-involved sample, vouchers were exchanged for commodities such as gasoline (27%), groceries (27%), purchases at discount/department stores (20%), automobile and home maintenance (6%), restaurants (2%), and entertainment (3%). The purchases in the criminal-justice-involved sample were similar when criminal justice fines and fees were excluded from analysis, but when they were included they constituted 66% of the purchases with vouchers. A second study (102) evaluated the impact of voucher purchase guidelines in cocaine dependent women. Most of the purchases (70%) were consistent with the guidelines. The most frequent purchases were for social/recreational activities (30%), the participant's child (non-basic needs; 17%), and household items (15%). The authors concluded that the findings do not imply that extensive purchase guidelines are necessary for voucher reward programs.

Another question is *when* voucher purchases are made during treatment. Because reinforcer delay is an important variable in CM efficacy (71), immediate voucher exchanges might be able to compete more effectively with drug use, especially for individuals who rapidly discount delayed rewards (103). Most CM interventions allow the participant to spend vouchers whenever they wish. An alternative procedure would be to help individuals wait for some delay before exchanging their vouchers. Such a procedure might provide important experiences for tolerating delays to reinforcement (104). Indeed, given the potential importance of financial decision making in treating drug dependence (105), developing methods to improve such decision making and tolerating delays to financial reinforcers may improve outcomes in CM interventions (106).

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