Contingency management: an evidence-based component of methamphetamine use disorder treatments

John M. Roll

Washington State University, Spokane, WA, USA

ABSTRACT

Aims To review briefly some of the available evidence regarding the utility of contingency management in treating methamphetamine use disorders. **Design** A literature review was conducted to locate relevant studies for the review. **Findings** The review suggests that contingency management is likely to be a useful component of treatment strategies designed to address methamphetamine use disorders. Results suggest that contingency management can increase the likelihood of providing methamphetamine-free urine samples during treatment. **Conclusions** Evidence suggests that contingency management is a good candidate for inclusion in treatment strategies for methamphetamine addiction.

Keywords Abstinence reinforcement, behavioral therapy, motivational incentives, psychostimulants.

Correspondence to: John M. Roll PhD, Director, Washington Institute for Mental Illness Research and Training, Washington State University, PO Box 1495, Spokane, WA 99210, USA. E-mail: johnroll@wsu.edu

INTRODUCTION

Substance use disorders and their associated sequelae pose difficult problems for societies and individuals. For a variety of reasons described elsewhere in this issue, methamphetamine use disorders are of particular concern at this time. As evidenced by the dramatic increase (more than fivefold) in methamphetamine treatment admissions between 1992 and 2002 in the United States and burgeoning rates of use elsewhere in the world, there is a need for high-quality treatment for methamphetamine use disorders. Unfortunately, there are no evidence-based practices that have been developed specifically for the treatment of methamphetamine use disorders. Some procedures that have been developed to treat other substance use disorders have been adopted successfully for the treatment of methamphetamine use disorders, including the Matrix Model ([1]; Rawson, this issue) and 12-Step facilitation (Donovan, this issue). While there is no medication approved for the treatment of methamphetamine use disorders, in this issue Vocci & Appel discuss some promising results.

Another treatment modality that has data to support its use in the treatment of methamphetamine use disorders is contingency management (CM). CM has a strong basic science foundation and has been demonstrated to be an effective component of treatment strategies for many types of substance use disorders (e.g [2]). In brief, CM for the treatment of substance use disorders is a procedure that decreases the reinforcing efficacy of a drug via the delivery of reinforcement contingent on abstinence and/or the delivery of punishment contingent on drug use. Given that it is accepted (e.g. [3]) and has been recognized for decades (e.g. [4]) that drugs of abuse function as potent positive reinforcers, a procedure designed specifically to decrease a drug's reinforcing efficacy, and hence the control a drug will exert over an individual's behavior, has much to recommend it from a theoretical perspective. CM is such a procedure.

In addition to the strong scientific and theoretical support for CM-based interventions for treating substance use disorders is the impressive record of success these procedures have achieved (e.g. [5–7]). Two recent meta analyses have been reported [8,9], both of which substantiate the efficacy of CM for treating substance use disorders. The current paper differs from these reviews in that it focuses only on recent research into treating

J. M. Roll declares no conflict of interests.

© 2007 The Author(s) Journal compilation © 2007 Society for the Study of Addiction

methamphetamine use disorders with CM-based interventions. In addition, CM has been demonstrated to be effective with a variety of populations and for treating a variety of substance use disorders [7]. Finally, many practitioners already use CM-type practices (e.g. certificates for group attendance, sanctions in drug court settings, etc.). Thus CM procedures should resonate with the current practices of many providers.

With this overwhelming support it is not surprising that CM appears on evidence-based practice lists [10], has been recommended by NIDA [11], has been recommended by the Substance Abuse and Mental Health Services Administration (SAMHSA) [12,13] and was one of the first procedures tested in NIDA's Clinical Trials Network [15,16]. It should be pointed out that CM interventions are delivered typically in conjunction with psychosocial and/or pharmaceutical interventions.

Not withstanding the foregoing, CM has been criticized for its perceived cost and complexity, as well as for not promoting lasting behavior change (e.g. [16]). Certainly, to the extent that these perceptions hinder the adoption of CM by community-based treatment providers, they are valid; however, I am unaware of any data that substantiates the essence of the claims. It is true that many individuals relapse following a period of abstinence initiated with CM (e.g. [17]); however, this is also the case for other treatment modalities. Many definitions of substance use disorders include reference to the chronic, relapsing nature of the affliction. It is noteworthy that several groups of researchers have reported for various drugs of abuse, including methamphetamine, that the best predictor of sustained abstinence post-treatment is durability of abstinence during treatment [18–20]. To the extent that CM produces superior rates of in-treatment abstinence; it should be expected to result in a greater likelihood of remaining abstinent post-treatment. However, there have been relatively few studies of CM which have incorporated long-term follow-up periods (e.g. [9]).

While it is not within the scope of this brief paper to provide a review of CM (several excellent reviews exist, e.g. [5–7]), it is useful to describe the two most commonly used CM strategies for treating stimulant use disorders, as they are the procedures that have been employed in the treatment of methamphetamine use disorders. One type of CM intervention for treating stimulant use disorders (primarily cocaine) has been investigated extensively by Higgins and colleagues (e.g. [21,22]). In this procedure patients receive vouchers for the provision of biological samples (typically urine or breath) that indicate no recent illicit drug use. Hence, the procedure is often called voucher-based reinforcement therapy (VBRT). These vouchers are withheld when the biological sample indicates recent drug use. As conceived originally, these vouchers were to be for goods or services that would help the patient initiate or re-establish behavior that resulted in non-drug-based reinforcement. Thus, the vouchers could be conceptualized as tools for acquainting, or reacquainting, individuals in treatment to non-drug sources of reinforcement available in their environment, with the expectation that these environmentally derived reinforcers will compete with drug use once the intervention ends.

VBRT has proved successful at initiating periods of abstinence compared to standard treatment regimens [7] and has been shown to produce relatively long periods of abstinence [20,23,24]. Many individuals achieve some period of sobriety with this approach.

Another contingency management technique has been popularized and refined by Petry and colleagues (e.g. [25–27]) and is referred to as the variable magnitude of reinforcement procedure. This technique has many similarities to VBRT. Patients receive draws, often from a number of slips of paper kept in a container, for providing a biological specimen that indicates no recent drug use. Provision of a sample indicating recent drug use results in the withholding of draws. Each draw has a chance of winning a 'prize', the size of which varies. Typically, about half the draws result simply in the participant receiving a slip of paper that says 'good job!' (e.g. no monetary value). The other half of the draws results in the earning of a prize. Most of the prizes are 'small' and are valued at about $1, some prizes are 'large' and are worth about $20 and typically there is one 'jumbo' prize, which is worth about $80. Each time a participant draws a prize he or she has a small chance of winning a jumbo prize, a moderate chance of winning a large prize and a greater chance of winning a small prize. Results suggest that VBRT and variable magnitude of reinforcement procedures are approximately equivalent in their ability to initiate and maintain abstinence if reinforcement schedules are kept comparable [28].

Regardless of the procedure, three important modulators of the efficacy of CM have been isolated: reinforcer magnitude, reinforcement schedule and delay to reinforcement. To be maximally effective reinforcers need to be of a sufficient magnitude to be salient to the consumer (e.g. [29,30]). In order to maximize in-treatment periods of abstinence the reinforcers should be delivered with a schedule that incorporates increases in reinforcer magnitude for consecutive instances of abstinence and reductions in magnitude for failures to abstain (e.g [31,32]). Finally, reinforcers need to be delivered as close as possible to the provision of a biological sample indicating no use as practicable in order to be maximally effective (e.g. [29]).

© 2007 The Author(s) Journal compilation © 2007 Society for the Study of Addiction

METHAMPHETAMINE-SPECIFIC SUPPORT FOR CONTINGENCY MANAGEMENT

Laboratory study

In a human behavioral pharmacology [33] model of contingency management it was demonstrated that humans would forgo the opportunity to self-administer methamphetamine when given a choice between methamphetamine and a monetary reinforcer [34]. Furthermore, the likelihood of administering methamphetamine decreased as the magnitude of the monetary alternative increased [34]. This laboratory analogue study demonstrated that methamphetamine use was amenable to modification via the presentation of an alternative reinforcer of sufficient magnitude. This provides support for undertaking clinical trials investigating contingency management for the treatment of methamphetamine use disorders.

Treatment studies

To date, four clinical assessments of CM's efficacy in treating methamphetamine use disorders have been published. The following section describes briefly these four trials, one using the variable magnitude of reinforcement procedure [18] and three using the VBRT procedure [17,35,36].

Variable magnitude of reinforcement

The first study was conducted as part of NIDA's Clinical Trials Network initiative. Detailed descriptions of this project can be found in existing publications [14,18]. In the original project, patients diagnosed with stimulant use disorders (cocaine or methamphetamine) were randomized to receive variable magnitude of reinforcement CM or treatment as usual (TAU) at various drug-free clinics around the country. The overall outcomes of that project have been reported elsewhere and suggest that the CM procedure was effective at retaining individuals in treatment and initiating abstinence [14]. The overall study consisted largely of cocaine-addicted individuals (72%). The remaining 113 individuals were diagnosed with a methamphetamine use disorder.

These 113 methamphetamine-addicted patients came from community-based treatment sites. Patients were randomized to one of two study conditions: treatment as usual (TAU) or CM. Following randomization, the intervention was in effect for 12 weeks, during which time participants were enrolled concurrently in TAU at their respective clinics. All participants were expected to attend two study visits per week on non-consecutive days. Participants were expected to provide a urine sample at each of the twice-weekly study visits during the 12-week period for a total of up to 24 samples. If a patient failed to give a valid sample or attend a scheduled visit, the sample was considered missing.

TAU consisted of group, individual and family psychotherapy. Specific modolitie, included cognitive behavioural therapy relapse prevention, and Matrix psychotherapy. In addition to TAU, described above, patients assigned to the contingency management condition earned the chance to win prizes each time they tested negative for methamphetamine.

Those who tested negative for all primary target drugs (methamphetamine, cocaine, alcohol) were invited to draw between one and 12 square plastic chips from a container containing 500 chips. Each chip was marked with a reinforcer value: 250 (50%) were marked 'good job', 209 (41.8%) were marked 'small', 40 (8%) were marked 'large', and one (0.2%) was marked 'jumbo'. Good job chips meant that no tangible reinforcer was delivered. Prizes associated with 'small' chips were worth approximately $1. Items available as 'large' prizes were worth about $20. 'Jumbo' prizes were worth $80–100.

The number of draws earned for providing drug-negative tests was determined by a schedule that was base on drug use (e.g. [32]). Specifically, the number of draws increased by one for each week in which all submitted samples tested negative for the target drugs. The number of draws earned reset to a single draw after an unexcused absence or submission of a sample positive for one or more target drug. This escalating schedule with a reset contingency has been demonstrated to produce relatively more continuous, in-treatment abstinence than other schedules to which it has been compared (e.g. [31]). Participants who provided all scheduled urine and breath samples throughout the study and who were negative for all drugs earned 204 draws, resulting in an average of approximately $400 in prizes. Additional contingencies were in effect for marijuana and opioid use and are described by Petry and colleagues [14].

Data from this randomized clinical trial showed that demographic variables did not differ between the two conditions. Retention was not statistically different between groups. Cox regression analysis showed no significant differences between CM and TAU conditions in terms of number of weeks retained in the study.

With regard to methamphetamine use during treatment, participants in the CM condition provided significantly more (M = 13.9, SEM = 1.2) stimulant-negative samples than did participants in the TAU condition (M = 9.9, SEM = 1.0). Smilarly, participants in the CM condition produced longer mean periods of abstinence (M = 9.3 consecutive samples, SEM = 1.2) than did participants in the TAU condition (M = 5.6 consecutive samples, SEM = 0.9). Abstinence rates across treatment visits were assessed with generalized estimating equation

© 2007 The Author(s) Journal compilation © 2007 Society for the Study of Addiction

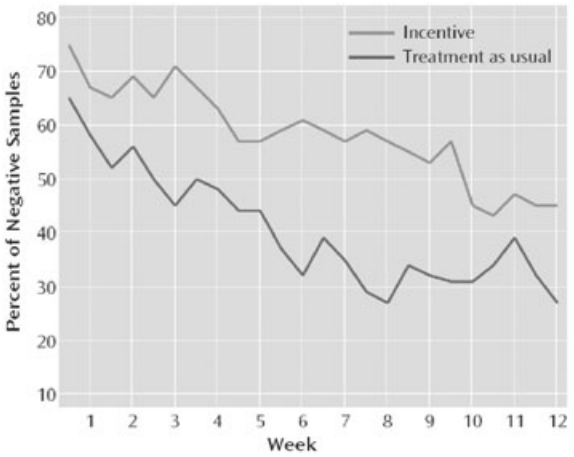

Figure 1 Methamphetamine use during the course of the 12-week intervention. Reprinted with permission from Roll *et al.* [20]

(GEE) analysis, which indicated that the CM participants were more likely to submit negative urine samples than usual care participants (see Fig. 1). Additionally, 18% of those individuals in the CM condition were abstinent throughout the entire trial compared to only 6% in the TAU condition. This difference approached significance. The two groups did not differ in terms of abstinence at a 6-month follow-up visit. Please note that Petry *et al.* [14] and Roll *et al.* [18] provided additional procedural and outcome details.

These results are noteworthy for several reasons. First, they represent the first controlled trial of variable magnitude of reinforcement CM as an adjunct to psychosocial treatment of methamphetamine use disorders. The results demonstrate clearly the benefits of adding CM to standard treatment. Participants receiving a combination of CM and psychosocial treatment were abstinent more often during the 12-week intervention and were abstinent for longer continuous periods during the intervention than participants receiving psychosocial treatment alone. Notably, this study was conducted at multiple locales and in community-based treatment centers as opposed to a single facility designed for research.

VBRT

One published study examining the efficacy of VBRT CM for the treatment of methamphetamine abuse was conducted with a population of treatment-seeking gay and bisexual men (GBM) [36]. As indicated elsewhere in this supplement, the GBM population has been hard-hit by methamphetamine.

In this study participants were randomized to one of four conditions [CBT, CM, CM + CBT or a specific form of CBT designed for gay and bisexual men (GCBT)]. The study examined a number of outcomes related to drug use and risky sexual behavior. The following discussion is limited to the drug use and attendance outcomes. A total of 162 participants was randomized. CM consisted of VBRT. Initial voucher value was $2.50 and each consecutive urine sample that tested negative for methamphetamine increased the value of the voucher by an additional $2.50. Provision of three consecutive methamphetamine-negative samples resulted in the delivery of a 'bonus' voucher worth $10 (see discussion of reinforcement schedules below). Urine samples were collected thrice-weekly and analyzed to detect recent methamphetamine use. Treatment episodes lasted for 16 weeks.

Patients in the conditions receiving CM out-performed participants in the other conditions with regards to continuous abstinence and treatment retention. Participants in the CBT condition were retained for approximately 9 weeks, those in the CM condition for approximately 12 weeks, those in the CM + CBT condition for approximately 13 weeks and those in the GCBT for approximately 11 weeks. Overall percentage of methamphetamine-negative samples was high for all conditions (CBT = 75%, CM = 76%, CBT + CM = 78% and GCBT = 69.7%) and did not significantly differ between conditions. However, with regard to continuous abstinence during treatment, the patients in the CM conditions out-performed patients in the other conditions. Patients in the CBT condition achieved approximately 2 weeks of consecutive abstinence, patients in the CM condition achieved approximately 5 weeks of continuous abstinence, patients in the CBT + CM condition achieved approximately 7 weeks of continuous abstinence and patients in the GCBT obtained approximately 3.5 weeks of consecutive abstinence.

A second study examined the efficacy of VBRT CM delivered in conjunction with CBT and sertraline for the treatment of methamphetamine addiction in 229 patients [35]. In this placebo-controlled double-blind trial patients were randomized to receive CM plus sertraline, sertraline only, placebo plus CM or placebo only. VBRT details were similar to those described above. Results indicate that patients receiving CM were significantly more likely than those not receiving CM to achieve a clinically relevant (i.e. 3-week) period of in-treatment abstinence (CM = 47% and no CM = 33%)

Finally, in a recent study of 171 stimulant abusers a small proportion of the sample (approximately 10%) was methamphetamine-dependent [17]. This study compared three treatments: CM, CBT, CM + CBT. While the results were not broken down specifically for methamphetamine dependence and cocaine dependence the overall results are still informative. Regarding in-treatment outcomes, those patients receiving CM, alone or in combination with CBT, consistently out-performed patients receiving CBT alone. Patients receiving

© 2007 The Author(s) Journal compilation © 2007 Society for the Study of Addiction

CM provided approximately twice as many stimulant-free urine samples during treatment (M = 27.6 versus M = 15.5). In this study the in-treatment benefits of CM relative to CBT were not evident at several follow-up periods.

These three studies suggest that methamphetamine use can be addressed clinically with VBRT CM. These results and those for the variable magnitude of reinforcement procedure strengthen the position that methamphetamine use, like most compulsive drug use, is a form of operant behavior. Given the laboratory results described earlier, the numerous demonstrations of the applicability of CM in other populations and the results of the four randomized clinical trials described above, I believe that CM can be described accurately as an evidence-based practice for promoting in-treatment abstinence from methamphetamine. Future research is needed to discern the best practices for promoting long-term abstinence from methamphetamine.

While there are a number of interesting questions to answer about the use of CM for the treatment of methamphetamine use disorders, one area that has received specific research attention is the investigation of the optimal procedure (i.e. schedule of reinforcement) for delivering vouchers or prizes. These trials support the position that the most effective reinforcement schedule for delivering vouchers or prizes is the one proposed initially by Higgins and colleagues (e.g. [37]). This scheduling arrangement incorporates an escalating reinforcer magnitude for consecutive instances of abstinence, a reset in reinforcer magnitude for failure to abstain and a bonus for consecutive instances of abstinence. Using analog studies with cigarette smokers, the importance of the combination of the reinforcer escalation and the reset contingencies in promoting continuous, in-treatment abstinence has been demonstrated [31,32].

In order to assess the efficacy of different scheduling arrangements in the treatment of methamphetamine abuse, Roll and colleagues conducted two pilot studies [38,39]. In the first of these studies [39], participants seeking out-patient behavioral treatment for methamphetamine use disorders were assigned randomly to one of five conditions each of which delivered VBRT for methamphetamine use. The conditions differed, in that each one provided abstinence-contingent vouchers according to a different schedule of reinforcement. Each schedule delivered approximately the same magnitude of reinforcement (i.e. $990–1005). Four of these schedules were developed by clinicians experienced in the treatment of substance abuse and these were compared to the schedule developed by Higgins. The four clinician-generated schedules varied initial magnitude, rate and pattern of escalation and reset contingencies. In all five conditions participants provided urine samples three times per week. If the sample indicated no recent use, the participant received a voucher of the specified monetary value. Failure to provide a urine sample was treated the same as the provision of a positive urine sample for reinforcement scheduling purposes.

All five schedules resulted in considerable abstinence. There were no statistically significant differences between the groups in either mean total number of abstinences during treatment or in terms of the mean longest period of continuous abstinence. However, as in previous analog studies, the likelihood of maintaining in treatment abstinence was greater when using the schedule developed by Higgins than in any of the other conditions.

In the second study [38], a similar strategy was used to further isolate important components of reinforcement schedules in the treatment of methamphetamine use disorders. In this study participants were randomized to one of two conditions, both of which included an escalating voucher magnitude for consecutive instances of abstinence. However, only one of them included a reset for failure to abstain. Results indicated that the schedule with the reset out-performed the other schedule with regard to total number of abstinences and longest duration of in-treatment abstinence.

These results suggest that the greatest likelihood of initiating and maintaining abstinence during CM-based treatment will be produced when high-magnitude reinforcers are delivered according to a reinforcement schedule incorporating escalating reinforcer magnitude for consecutive instances of abstinence and a reset in reinforcer value for a failure to abstain.

CONCLUSION

The results from the laboratory study [34] and the four treatment studies [17,18,35,36] builds upon a large body of evidence suggesting that most types of substance use disorders are amenable to treatment via CM (e.g. [5]). These studies add methamphetamine use disorders to the list of substance use disorders for which CM is an useful intervention. Demonstrating the sensitivity of methamphetamine dependence to CM strengthens further the position that drug abuse can be characterized usefully as operant behavior. This is strengthened further by the two studies documenting the sensitivity of methamphetamine use to reinforcement schedule manipulation.

CM is combined easily with both psychosocial and pharmacological treatment strategies. The results discussed in this manuscript suggest that adding CM to many treatment strategies would increase in-treatment abstinence in many methamphetamine treatment settings. Given the relatively high levels of psychiatric comorbidity [40], medical comorbidity [41] and criminal

© 2007 The Author(s) Journal compilation © 2007 Society for the Study of Addiction

activity associated with methamphetamine use I believe it would be unwise to treat this disorder with only CM [42]. Instead, I recommend that CM be a component of a holistic treatment strategy that addresses the psychosocial, medical, psychiatric and criminal justice issues that often co-occur with methamphetamine use disorders.

Acknowledgements

Preparation of this paper was supported by the National Institute on Drug Abuse grants R01-017407 and R01-017084.

References

1. Rawson R. A., Marinelli-Casey P., Anglin M. D., Dickow A., Frazier Y., Gallagher C. *et al.* and Methamphetamine Treatment Project Corporate Authors. A multi-site comparison of psychosocial approaches for the treatment of methamphetamin dependence. 2004; **99**: 708–17.
2. Bigelow G., Silverman K. Theoretical and empirical foundations of contingency management treatments for drug abuse. In: Higgins S. T., Silverman K., editors. *Motivating Behavior Change Among Illicit-Drug Abusers: Research on Contingency Management Interventions*. Washington, DC: American Psychological Association; 1999, p. 15–32.
3. Volkow N. D. Stimulant medications: how to minimize their reinforcing effects? *Am J Psychiatry* 2006; **163**: 359–61.
4. Skinner B. F. *Behavior of Organisms*. Acton, MA: Copley Publishing; 1938/1966.
5. Higgins S. T., Heil S. H., Lussier J. P. Clinical implications of reinforcement as a determinant of substance use disorders. *Annu Rev Psychol* 2004; **55**: 431–61.
6. Higgins S. T., Petry N. M. Contingency management. Incentives for sobriety. *Alcohol Res Health* 1999; **23**: 122–7.
7. Higgins S. T., Silverman K. *Motivating Behavior Change Among Illicit-Drug Abusers: Research on Contingency Management Interventions.* Washington, DC: American Psychological Association; 1999.
8. Lussier J. P., Heil S. H., Mongeon J. A., Badger G. J., Higgins S. T. A meta-analysis of voucher-based reinforcement therapy for substance use disorders. *Addiction* 2006; **101**: 192–203.
9. Prendergast M., Podus D., Finney J., Greenwell L., Roll J. M. Contingency management for treatment of substance use disorders: a meta-analysis. *Addiction* 2006; **101**: 1546–60.
10. University of Washington Alcohol and Drug Abuse Institute. *Evidence Based Practices*. 2006. Available at: http://lib.adai.washington.edu/ebpsearch.htm (accessed 30 January 2007).
11. National Institute on Drug Abuse (NIDA). *Principles of Drug Addiction Treatment: a Research-Based Guide.* NIH Publication no. 00-4180. Bethesda, MD: NIDA; 1999.
12. Center for Substance Abuse Treatment. *Treatments for Stimulant Disorders. Treatment Improvement Protocol (TIP) Series 33*. DHHS Publication no. (SMA) 99–3296. Rockville, MD: Substance Abuse and Mental Health Services Administration; 1999.
13. Center for Substance Abuse Treatment. *Substance Abuse Treatment for Persons with Co-Occurring Disorders. Treatment Improvement Protocol (TIP) Series 42*. DHHS Publication no. (SMA) 05–3992. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2005.
14. Petry N. M., Peirce J. M., Stitzer M. L., Blaine J., Roll J. M., Cohen A, *et al.* Effect of prize-based incentives on outcomes in stimulant abusers in outpatient psychosocial treatment programs: a national drug abuse treatment clinical trials network study. *Arch Gen Psychiatry* 2005; **62**: 1148–56.
15. Peirce J. M., Petry N. M., Stitzer M. L., Blaine J., Kellogg S., Satterfield F. *et al.* Effects of lower-cost incentives on stimulant abstinence in methadone maintenance treatment: a National Drug Abuse Treatment Clinical Trials Network study. *Arch Gen Psychiatry* 2006; **63**: 201–8.
16. Kirby K. C., Benishek L. A., Dugosh K. L., Kerwin M. E. Substance abuse treatment providers' beliefs and objections regarding contingency management: implications for dissemination. *Drug Alcohol Depend* 2006; **85**: 19–27.
17. Rawson R. A., McCann M. J., Flammino F., Shoptaw S., Miotto K., Reiber C. *et al.* A comparison of contingency management and cognitive-behavioral approaches for stimulant-dependent individuals. *Addiction* 2006; **101**: 267–74.
18. Roll J. M., Petry N. M., Stitzer M. L., Brecht M. L., Peirce J. M., McCann M. J. *et al.* Contingency management for the treatment of methamphetamine abuse. *Am J Psychiatry* 2006; **163**: 1993–99.
19. Moore B. A., Budney A. J. Relapse in outpatient treatment for marijuana dependence. *J Subst Abuse Treat* 2003; **25**: 85–9.
20. Higgins S. T., Badger G. J., Budney A. J. Initial abstinence and success in achieving longer term cocaine abstinence. *Exp Clin Psychopharmacol* 2000; **8**: 377–86.
21. Higgins S. T., Delaney D. D., Budney A. J., Bickel W. K., Hughes J. R., Foerg F. *et al.* A behavioral approach to achieving initial cocaine abstinence. *Am J Psychiatry* 1991; **148**: 1218–24.
22. Higgins S. T., Budney A. J., Bickel W. K., Foerg F. E., Donham R., Badger G. J. Incentives improve outcome in outpatient behavioral treatment of cocaine dependence. *Arch Gen Psychiatry* 1994; **51**: 568–76.
23. Higgins S. T., Wong C. J., Badger G. J., Ogden DE, Dantona RL. Contingent reinforcement increases cocaine abstinence during outpatient treatment and 1 year of follow-up. *J Consult Clin Psychol* 2000; **68**: 64–72.
24. Silverman K., Higgins S. T., Brooner R. K., Montoya I. D., Cone E. J., Schuster C. R. *et al.* Sustained cocaine abstinence in methadone maintenance patients through voucher-based reinforcement therapy. *Arch Gen Psychiatry* 1996; **53**: 409–15.
25. Petry N. M., Martin B., Cooney J. L., Kranzler H. R. Give them prizes, and they will come: contingency management for treatment of alcohol dependence. *J Consult Clin Psychol* 2000; **68**: 250–7.
26. Petry N. M., Martin B. Low-cost contingency management for treating cocaine- and opioid-abusing methadone patients. *J Consult Clin Psychol* 2002; **70**: 398–405.
27. Petry N. M., Tedford J., Austin M., Nich C., Carroll K. M., Rounsaville B. J. Prize reinforcement contingency management for treating cocaine users: how low can we go, and with whom? *Addiction* 2004; **99**: 349–60.
28. Petry N. M., Alessi S. M., Marx J., Austin M., Tardif M. Vouchers versus prizes: contingency management treatment of substance abusers in community settings. *J Consult Clin Psychol* 2005; **73**: 1005–14.
29. Roll J. M., Reilly M. P., Johanson C. E. The influence of exchange delays on cigarette versus money choice: a

© 2007 The Author(s) Journal compilation © 2007 Society for the Study of Addiction

laboratory analog of voucher-based reinforcement therapy. *Exp Clin Psychopharmacol* 2000; **8**: 366–70.
30. Dallery J., Silverman K., Chutuape M. A., Bigelow G. E., Stitzer M. L. Voucher-based reinforcement of opiate plus cocaine abstinence in treatment-resistant methadone patients: effects of reinforcer magnitude. *Exp Clin Psychopharmacol* 2001; **9**: 317–25.
31. Roll J. M., Higgins S. T. A within-subject comparison of three different schedules of reinforcement of drug abstinence using cigarette smoking as an exemplar. *Drug Alcohol Depend* 2000; **58**: 103–9.
32. Roll J. M., Higgins S. T., Badger G. J. An experimental comparison of three different schedules of reinforcement of drug abstinence using cigarette smoking as an exemplar. *J Appl Behav Anal* 1996; **29**: 495–504.
33. Higgins S. T., Hughes J. R. Human behavioral pharmacology: an overview of laboratory methods. In: Lattal KA, Perone M., editors. *Handbook of Research Methods in Human Operant Behavior*. New York: Plenum Pres; 1998, p. 579–618.
34. Roll J. M., Newton T. Contingency management for the treatment of methamphetamine use disorders. In: Higgins S. T., Silverman K., Hiel S. H., editors. *Contingency Management in the Treatment of Substance Use Disorders: a Science-Based Treatment Innovation*. New York: Guilford Press; in press.
35. Shoptaw S., Huber A., Peck J., Yang X., Liu J., Jeff Dang Roll J., *et al.* Randomized, placebo-controlled trial of sertraline and contingency management for the treatment of methamphetamine dependence. *Drug Alcohol Depend* 2006; **85**: 12–18 .
36. Shoptaw S., Reback C. J., Peck J. A., Yang X., Rotheram-Fuller E., Larkins S. *et al.* Behavioral treatment approaches for methamphetamine dependence and HIV-related sexual risk behaviors among urban gay and bisexual men. *Drug Alcohol Depend* 2005; **78**: 125–34.
37. Higgins S. T., Budney A. J., Bickel W. K., Hughes J. R., Foerg F., Badger G. Achieving cocaine abstinence with a behavioral approach. *Am J Psychiatry* 1993; **150**: 763–9.
38. Roll J. M., Shoptaw S. Contingency management for the treatment of methamphetamine abuse: schedule effects. *Psychiatr Res* in press.
39. Roll J. M., Huber A., Sodano R., Chudzynski J., Moynier E., Shoptaw S. A comparison of five reinforcement schedules for use in contingency management-based treatment of methamphetamine abuse. *Psychol Rec* 2006; **56**: 67–81.
40. Zweben J. E., Cohen J. B., Christian D., Galloway G. P., Salinardi M., Parent D. *et al.* Psychiatric symptoms in methamphetamine users. Methamphetamine Treatment Project. *Am J Addict* 2004; **13**: 181–90.
41. Meredith C. W., Jaffe C., Ang-Lee K., Saxon A. J. Implications of chronic methamphetamine use: a literature review. *Harv Rev Psychiatry* 2005; **13**: 141–54.
42. Cartier J., Farabee D., Prendergast M. L. Methamphetamine use, self-reported violent crime, and recidivism among offenders in California who abuse substances. *J Interpers Violence* 2006; **21**: 435–45.

© 2007 The Author(s) Journal compilation © 2007 Society for the Study of Addiction

This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.