Journal of Substance Abuse Treatment 47 (2014) 73–77

Contents lists available at ScienceDirect

Journal of Substance Abuse Treatment

Contingency management voucher redemption as an indicator of delayed gratification

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ARTICLE INFO

Article history:
Received 20 November 2013
Received in revised form 31 January 2014
Accepted 3 March 2014

Keywords:
Delayed gratification
Contingency management
Men who have sex with men
Methamphetamine
Opiates

ABSTRACT

This prospective analysis tested whether frequency of voucher redemptions during a contingency management (CM) substance use intervention was significantly associated with participants' ongoing substance use. Homeless, substance-dependent men who have sex with men ($N = 131$) were randomized into either a "full" or "lite" voucher-based CM intervention. All participants earned vouchers for attendance and participation; participants in the CM-full condition also received vouchers for substance abstinence and enactment of prosocial and/or health-promoting behaviors. Multivariate longitudinal negative binomial regression analyses ($n = 118$) assessed the association between substance use during the intervention and frequency of voucher redemptions. Participants who used methamphetamine (IRR = 0.66; 95% CI = 0.44–0.99) and/or opiates (IRR = 0.60; 95% CI = 0.40–0.99) during the intervention exhibited less time between voucher redemptions than individuals who achieved abstinence from these substances. Voucher redemption logs can be cost-effective and unobtrusive tools for measuring study participants' tendency to delay gratification.

1. Introduction

1.1. Substance dependence and delayed gratification

A central feature of substance dependence is the tendency to disproportionately discount the value of delayed rewards in favor of immediate gratification (Bickel & Marsch, 2001; Businelle, McVay, Kendzor, & Copeland, 2010; Crean, de Wit, & Richards, 2000; Higgins, Heil, & Lussier, 2004). Such excessive "delay discounting" leads to an overvaluation of the proximal rewards of substance use and a corresponding undervaluation of the long-term benefits associated with sobriety (MacKillop et al., 2011). This preference for immediate gratification in favor of potentially more valuable distal rewards is a critical mechanism in addiction (Goldstein & Volkow, 2002; Kalivas & Volkow, 2005; Perry & Carroll, 2008), and may be an important factor in relapse after achieved substance abstinence (Doran, Spring, McChargue, Pergadia, & Richmond, 2004; Moeller et al., 2001). Such decreased tendency to delay gratification has been observed among those diagnosed with dependence on alcohol (Bobova, Finn, Rickert, & Lucas, 2009; Dom, D'haene, Hulstijn, & Sabbe, 2006), cocaine (Coffey, Gudleski, Saladin, & Brady, 2003; Heil, Johnson, Higgins, & Bickel, 2006), methamphetamine (Hoffman et al., 2006; Hoffman et al., 2008; Monterosso et al., 2007), and/or opiates (Kirby, Petry, & Bickel, 1999; Madden, Petry, Badger, & Bickel, 1997), among others (Bickel & Marsch, 2001; Bickel et al., 2007; MacKillop et al., 2011; Madden & Bickel, 2009).

Evidence is still inconclusive as to whether overvaluation of immediate reward is a risk factor for (i.e., precedes) or a consequence of (i.e., succeeds) such substance abuse. Some research suggests that increased delay discounting is part of the etiology of substance use disorders (Audrain-McGovern et al., 2009; Verdejo-García, Lawrence, & Clark, 2008); other studies have provided evidence that increased delay discounting can result from substance abuse (Perry & Carroll, 2008; Petry, 2001). Given such dual corroboration, it may be that preference for immediate gratification influences addiction at both stages of the process: overvaluation of immediate reward may increase the likelihood of substance abuse, and substance abuse in turn may make subsequent delay of gratification more difficult and/or unlikely to achieve (Bickel, Jarmolowicz, Mueller, Koffarnus, & Gatchalian, 2012; MacKillop et al., 2011; Mitchell, 2004; Perry & Carroll, 2008).

Though controlled, experimental assessment of individuals' preference for immediate vs. delayed reward is of clear benefit to addiction research, a common critique of existing delay discounting measures (e.g., Green & Myerson, 2004; MacKillop et al., 2011; Mazur, 1987; Mitchell, Fields, D'Esposito, & Boettiger, 2005; Myerson, Green, & Warusawitharana, 2001) is their reliance upon contrived economic decisions as the source of their data (Bickel & Marsch, 2001; Frederick,

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http://dx.doi.org/10.1016/j.jsat.2014.03.003

Loewenstein, & O'Donoghue, 2002; Kirby, 1997; Madden, Begotka, Raiff, & Kastern, 2003). Though years of robust findings certainly corroborate the value and usefulness of such measures, it is also true that observation of real-life economic decisions might be a preferable source of data, insofar as they reflect actual choices made by participants and not artificial choices conceived of by experimental researchers. In pursuit of such an ecologically valid measure, we suggest that voucher redemption logs that are standard in contingency management (CM) substance use interventions may serve as useful and unobtrusive measures of the tendency to delay gratification among individuals with a substance use disorder.

1.2. Voucher-based contingency management

Voucher-based CM interventions (Higgins et al., 1993; Higgins et al., 1994) rely on the principle of operant condition (Skinner, 1953) to promote substance abstinence in participants, with rewards coming in the form of vouchers redeemable for valued goods. The value and desirability of these goods are pitted against the reinforcing nature of drug use, thereby substituting immediate rewards for abstinence (i.e., vouchers) in place of the immediate rewards associated with substance use (e.g., euphoria). Voucher-based CM has been efficacious in the treatment of a wide range of substance abuse and dependence disorders (Lussier, Heil, Mongeon, Badger, & Higgins, 2006; Peirce et al., 2006; Prendergast, Podus, Finney, Greenwell, & Roll, 2006; Reback et al., 2010).

In most cases, participants enrolled in a CM intervention can redeem the vouchers they earn at any rate they choose, meaning they can choose to spend them immediately on smaller items (e.g., bag of chips, a soda), or they can save up over the course of the intervention for more impactful rewards (e.g., a cell phone, a bicycle). Many CM interventions keep logs of these voucher redemptions (Higgins, Silverman, & Heil, 2007), including what was bought, when, and by whom. Furthermore, nearly all CM-based substance use interventions also routinely collect biomarker data to confirm participant abstinence during the course of the intervention (Stitzer & Petry, 2006). In combination, these two data sources supply a longitudinal view of participant substance use and economic decision-making, and can therefore serve to corroborate or reject the hypothesis that substance use leads to increased preference for immediate gratification. This research agenda is further supported by two recent studies on the voucher spending and substance use patterns of CM participants.

First, Bickel and colleagues (Bickel et al., 2010) showed that observed rates of voucher redemption during a CM substance abuse intervention were positively correlated with experimentally assessed rates of delay discounting. This finding corroborates the logical assertion that real-life economic behavior should exhibit concurrent validity with established experimental methods, and serves as a "proof of concept" that CM voucher logs can be used to assess participants' tendency to discount the value of delayed rewards.

Second, Ling-Murtaugh and colleagues revealed a significant positive association between rates of CM voucher redemption and biomarker-confirmed substance abstinence (Ling Murtaugh, Krishnamurti, Davis, Reback, & Shoptaw, 2013), corroborating the existence of an empirical link between substance use and real-life decision making. Results showed that treatment-seeking, substance-dependent gay and bisexual men were more likely to submit clean urine samples if they redeemed their CM vouchers with greater frequency, a result the authors ascribed to the "substitutability" of the rewards offered through voucher redemption. This proposed causal sequence (i.e., economic decision-making influences substance use) is a reversal of the logic most commonly expressed in the literature (i.e., that substance use influences economic decision-making), and contradicts the expected finding that drug-using participants would spend their vouchers more impulsively (i.e., at a higher rate) than substance-abstinent participants. Given the unexpected nature and direction of the findings, further research is indicated.

Both of these innovative recent studies (Bickel et al., 2010; Ling Murtaugh et al., 2013) reveal the importance of CM voucher redemption logs as valuable sources of data, and in combination have inspired the research question and analytical design of the current study. This prospective analysis of a randomized controlled trial tested whether the frequency of participants' voucher redemptions during a CM intervention was associated with ongoing substance use. It was hypothesized that ongoing substance use during the CM intervention would be associated with reduced time between participants' voucher redemptions.

2. Materials and methods

2.1. Participants

Study procedures, intervention design, and primary outcomes have been previously described (Reback et al., 2010). Eligible participants were recruited from a community-based, low-intensity, health education/risk reduction HIV prevention program serving homeless, substance-using MSM in the Hollywood/West Hollywood area of Los Angeles County. Eligibility criteria for the study included being male, over 18 years of age, dependent on at least one substance (SCID-verified), non-treatment-seeking, self-reported sex with a male in the previous 12 months, and current homelessness.

2.2. Procedures

Participants provided informed consent and were randomized into either the CM-full ($n = 64$) or CM-lite ($n = 67$) condition for a 24-week intervention, with follow-up evaluations at 7-, 9-, and 12-months post randomization. Participants in both conditions received CM vouchers for program attendance and participation (max = $364.00). Participants in the CM-full condition also received vouchers for engaging in verified drug/alcohol abstinence and targeted prosocial and health-promoting behaviors; there was no limit to the number of vouchers a participant in the CM-full condition could earn for verified prosocial/health-promoting behaviors (for full CM payout schedules and procedures, see: Reback et al., 2010). Each point earned was equivalent to $1 in purchasing power. Voucher points earned during the 24-week intervention were redeemable at an onsite store that participants could access at any time during normal business hours (10:00 am to 6:30 pm, Monday through Friday). No restrictions were placed on how many earned voucher points a participant could redeem at one time. To maximize the reinforcing potential of the intervention, the store was stocked with participants' preferred products (as determined by biannual focus groups) and priced with items for all earning levels (valued from 1–200 points). Participants' points expired 1 week following their final 12-month follow-up evaluation. All procedures followed were reviewed and approved by the Friends Research Institute's Institutional Review Board.

2.3. Measures

2.3.1. Cross-sectional measures

2.3.1.1. Substance dependence. The Structured Clinical Interview for DSM-IV (SCID-II; First, Spitzer, Gibbon, & Williams, 1996) was administered at baseline to determine substance dependence (an eligibility criterion).

2.3.1.2. Sociodemographics. The Addiction Severity Index (McLellan et al., 1985) includes measures of basic sociodemographic characteristics (i.e., race/ethnicity, age, HIV status, etc.) and was administered at baseline.