

*THE RELATIVE CONTRIBUTION OF ECONOMIC VALENCE TO
CONTINGENCY MANAGEMENT EFFICACY: A PILOT STUDY*

JOHN M. ROLL AND JONI T. HOWARD

WASHINGTON STATE UNIVERSITY

We investigated the extent to which a contingency management (CM) procedure that deducted money from a grand total available at the end of the study compared to a procedure in which money accumulated with continued abstinence from cigarette smoking. Results suggested that the procedure in which money increased contingent on abstinence resulted in a significantly greater likelihood of obtaining a clinically relevant (i.e., 48-hr) period of abstinence. In terms of attendance, participants in the condition in which monetary reinforcement accrued with consecutive instances of abstinence were significantly less likely to miss consecutive appointments than those in which money was deducted for failure to abstain.

DESCRIPTORS: cigarette smoking, contingency management, reinforcement

Recently, efforts have been undertaken to examine the different components involved in the delivery of contingency management (CM) interventions in order to understand which factors are necessary to maximize treatment success and to attempt to make the interventions more suitable for use in community-based clinics. The procedure discussed in this report adopts this strategy by examining a factor that may alter the efficacy of CM interventions. Specifically, we describe a pilot examination of the differential effectiveness of interventions based on economic gain (traditional reinforcement-based procedure) or economic loss (novel punishment-based procedure). Even though punishment is often eschewed for a variety of reasons (e.g., Sidman, 2001), it is becoming apparent that when combined with positive reinforcement, it can exert control over drug-use behavior (e.g., Roll & Higgins, 2000; Roll, Higgins, & Badger, 1996). For instance, many

CM interventions incorporate a reset contingency for provision of a positive drug test or missed visit, which decreases the magnitude of positive reinforcement available for delivery of the next drug-negative sample. This reset contingency is a punisher, yet its presence seems to enhance CM efficacy (e.g., Roll & Higgins). In this report we describe a pilot study designed to assess the degree to which a CM intervention in which the emphasis is placed on monetary loss (punishment) alters efficacy relative to a procedure based on monetary gain. As in our previous work designed to isolate factors that contribute to the efficacy of CM interventions, we employed an analogue design with cigarette smokers who did not wish to quit smoking (see Roll et al. for further discussion of the use of analogue models).

METHOD

Participants

Participants were 19 adult community volunteers recruited for a 5-day study. All had to have an initial carbon monoxide (CO) reading of ≥ 18 ppm at time of consent. This is a frequently used demarcation between regular and sporadic smokers or nonsmokers (Stitzer & Bigelow, 1984). The reading is easily obtained

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Address correspondence John M. Roll, Program of Excellence in the Addictions, Washington State University, P.O. Box 1495, Spokane, Washington 99210 (e-mail: johnroll@wsu.edu).

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by having the participant blow through a small handheld device. Participants needed to be at least 18 years of age. In addition, they needed to answer the following question in the negative: Are you currently trying to or do you want to quit smoking?

Participants were not enrolled in the study if they reported regular use of smokeless tobacco products or had current depression as assessed with the CES-D self-report depression scale (e.g., Radloff, 1977). This criterion was implemented to preclude participation by those whose cigarette smoking may be moderated by depression (e.g., Brown, Madden, Palenchar, & Cooper-Patrick, 2000), because they may not be a representative group and because smoking cessation may exacerbate depression.

Procedure

Participants were randomly assigned to one of two 5-day interventions (economic gain and economic loss, which are described below). All participants were Caucasian. Mean age was 31 years ($M_s = 33$ and 30 for gain and loss, respectively). Participants in the gain condition reported smoking a mean of 19 cigarettes per day prior to the study, and participants in the loss condition reported smoking a mean 17 cigarettes per day. While each of the interventions was in effect, the following procedures took place. Participants were instructed to use their "willpower" to stop smoking. Willpower was selected because it has been reported that this is what individuals attribute their ability to terminate drug use to when participating in CM-based treatment programs (e.g., Silverman et al., 1998). Participants provided three breath samples for CO monitoring per day. Following the procedure used by Roll and Higgins (2000), these samples were collected in the morning, afternoon, and evening. CO samples were collected using a portable Bedfont CO meter. This handheld device is simple to use, with participants simply blowing through a disposable mouthpiece. CO samples were usually collected at our offices. However, research staff did travel

to a participant's residence or a convenient place selected by the participant to collect the CO sample if a participant requested. Per the Society for Research on Nicotine and Tobacco's recommendations, a CO level of 8 ppm was taken as an indication of abstinence. Participants were given immediate feedback about their test results.

Study participation always began on a Monday. Prior to participation, participants provided consent and a baseline CO sample, reported on how many cigarettes they smoked per day during the preceding week, and completed several smoking questionnaires. During the 5 days of participation, participants provided three CO samples per day.

Conditions

Economic gain. This was largely the standard procedure we have used previously to model typical voucher-based reinforcement procedures (e.g., Roll & Higgins, 2000; Roll et al., 1996), except that money was delivered at the end of the 5-day study. This schedule incorporates all of the elements generally included in CM procedures including escalating reinforcer magnitude for consecutive instances of abstinence, bonus reinforcer for the provision of three consecutive instances of abstinence, and a reset in voucher magnitude to the initial low level following an instance of drug use.

Specifically, this schedule programs reinforcement delivery in the following fashion: The initial abstinence is worth \$3.00. Each consecutive instance of abstinence increases the magnitude by \$0.50, and every three consecutive instances of abstinence result in the provision of a \$10.00 bonus. Failure to abstain results in the withholding of the programmed reinforcer and resets the magnitude of the next available reinforcer to the original \$3.00 value, from where the progression and delivery of bonuses begin again. For example, if an individual was abstinent on Test 1, he or she would receive \$3.00, abstinent on Test 2 he or she would receive \$3.50, and abstinent on Test 3 he or she would receive \$4.00 plus a \$10.00 bonus. If he or she then tested positive (i.e.,

relapsed) on Test 4, he or she would receive nothing, and the next abstinence would result in the delivery of \$3.00. The total amount of money a participant could earn for abstaining on all 15 trials during this condition was \$147.50. All money was paid at the time of their last CO sample on the Friday of their participation. Failure to provide a scheduled CO sample was treated as providing a positive sample.

Economic loss. This procedure programmed the exact same rate of reinforcement as did the gain procedure. Participants were told that if they abstained for the entire week they would receive \$147.50 on the final Friday visit of their participation. Should they fail to abstain, their initial failure would reduce their total earnings by \$3.00; each consecutive failure to abstain would reduce their total earnings by an additional \$0.50. In addition, three consecutive failures to abstain would result in an additional loss of \$10.00. For example, if a participant failed to abstain on their first visit, their earnings would be reduced by \$3.00; if they failed to abstain on their second visit, their total earnings would be reduced by another \$3.50; failure to abstain on their third visit would reduce their earnings by an additional \$14.00, and so forth. An instance of abstinence reset the penalty for their next failure to abstain to \$3.00. It is important to note that even though the focus was on loss (punishment) for drug use, the procedure was still a positive reinforcement procedure, because participants received the portion of the \$147.50 that was remaining at the end of the intervention.

Maximum earnings. Both procedures (gain and loss) provided identical total amounts of reinforcement (\$147.50). The only difference was the manner in which the money was scheduled for delivery.

RESULTS AND DISCUSSION

Cumulative records for each individual participant are presented in Figure 1. Inspection of the cumulative records indicates a

generally better performance for participants in the gain condition. This is borne out by several significant statistical comparisons. First, to assess the effects of the procedure, we compared the number of participants in each condition who were able to obtain at least 48 hr of continuous abstinence. This time period was selected because research has indicated that much relapse to smoking occurs during the first several days of a quit attempt (e.g., Hughes et al., 1992). Results of that comparison reveal that 90% of the participants in the gain condition were able to maintain this period of abstinence, but only 44% of the participants in the loss condition maintained this period of abstinence (Fisher's exact test, $p = .05$). With regards to attendance, participants in the gain condition were less likely to have continuous bouts of missed visits (i.e., two or more consecutive missed visits) than participants in the loss condition. No participant in the gain condition missed more than one visit in a row, but 44% in the loss condition missed consecutive visits (range, 2 to 15 visits; Fisher's exact test, $p = .02$).

These pilot data suggest that the gain procedure may be superior to the loss procedure. Certainly, they do not support the position that the loss condition is superior. To a large extent, the data can be accounted for by the poor attendance rate of participants in the loss condition relative to those in the gain condition. Participants in the loss condition may have been escaping the punisher by not providing a CO sample. This idea is strengthened by the observation that participants in the loss condition missed consecutive visits, which may indicate active avoidance relative to participants in the gain condition, who missed sporadic visits, suggesting that random competing occurrences (e.g., flat tire, overslept) accounted for the misses. This finding suggests that the delayed positive reinforcement that was delivered at the end of the week may not have been of sufficient magnitude to overcome the

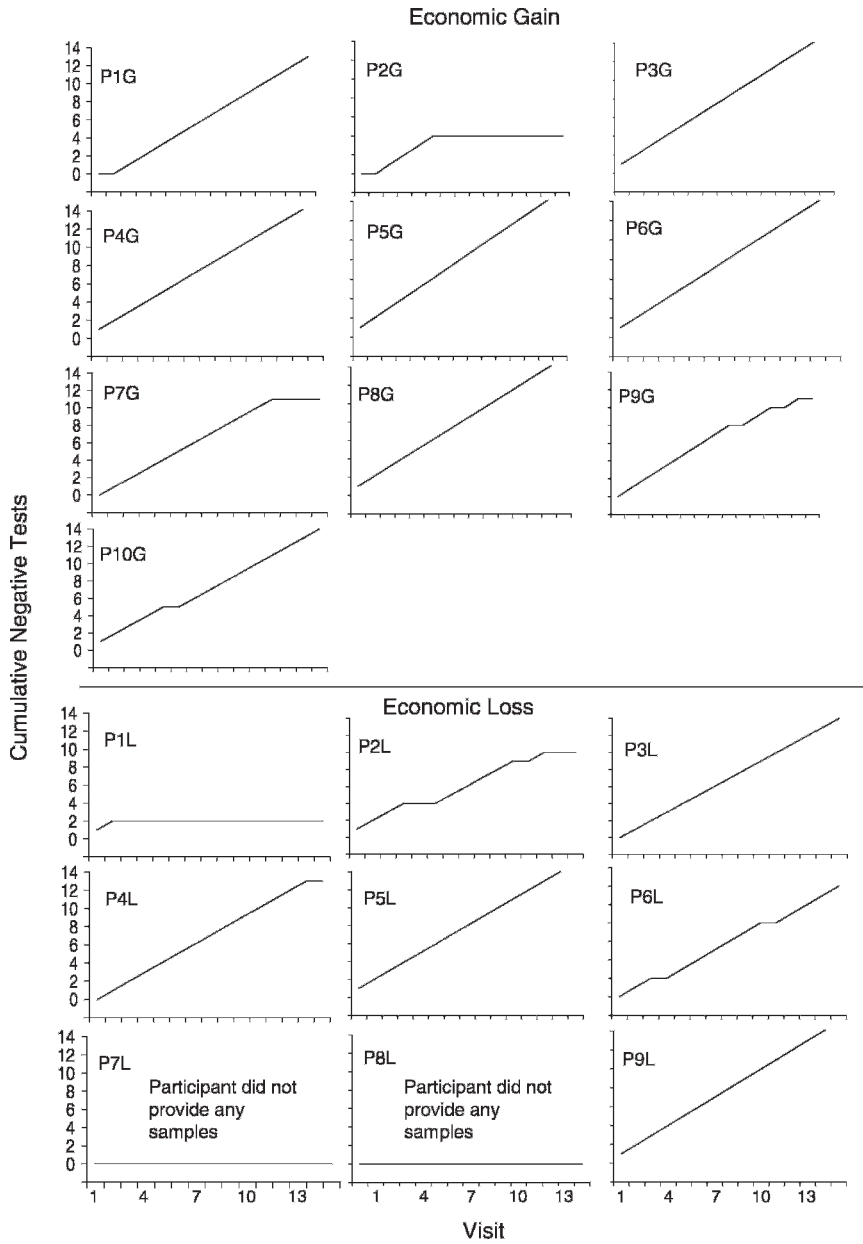


Figure 1. Cumulative records of abstinence ($CO \leq 8$ ppm) for each participant in the gain and loss conditions over 15 trials.

immediate punishing contingency, which resulted in monetary loss.

These pilot data suggest that CM procedures that rely too heavily on punishment contingencies may not satisfactorily engage participants. Future research designed to combine salient positive

reinforcement with punishment in a fashion that engages the participant in treatment while at the same time punishing drug use may further enhance the effectiveness of CM interventions.

Finally, this pilot study further demonstrates the exquisite sensitivity of human drug-use

behavior to reinforcement schedule manipulations. In both the economic gain and the economic loss conditions, participants could earn \$147.50 for abstaining from smoking. The only difference was the way in which the delivery of the money was scheduled; despite this surface similarity, the behavior of participants in the two conditions was different.

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