Available online at www.sciencedirect.com
SCIENCE DIRECT®
Addictive Behaviors 30 (2005) 19–27
ADDICTIVE BEHAVIORS

Decreased substance use following increases in alternative behaviors: A preliminary investigation

Christopher J. Correia[a,*], Trisha A. Benson[a], Kate B. Carey[b]

[a]*Department of Psychology, Auburn University, 226 Thach Hall, Auburn, AL 36849, USA*
[b]*Department of Psychology and Center for Health and Behavior, Syracuse University, 430 Huntington Hall, Syracuse, NY 13244, USA*

Abstract

Research derived from behavioral economic theories has demonstrated reciprocal links between substance use and engagement in substance-free activities. The current study used an experimental manipulation to further investigate the relationship between substance use and substance-free behaviors in a nonclinical sample of 133 young adults. Participants completed surveys on substance use and engagement in specific substance-free behaviors (exercise and creative behaviors) on two occasions separated by a 28-day interval. During the 4 weeks separating assessments, the 105 participants who reported recent substance use were randomly assigned to one of three experimental conditions with corresponding behavioral instructions: substance use reduction (SR), activity increase (AI), and a no-change control. Participants assigned to both the SR and AI conditions reported a significant decrease in their substance use behavior. These results are consistent with previous studies in demonstrating that decreases in substance use can be achieved by increasing engagement in substance-free behaviors.

Keywords: Substance use; Alternative behaviors; Substance-free behaviors

1. Introduction

Research derived from behavioral economic theories has highlighted an inverse relationship between substance use and engagement in substance-free activities. Laboratory studies

* Corresponding author. Tel.: +1-334-844-6480; fax: +1-334-844-4447.
E-mail address: correcj@auburn.edu (C.J. Correia).

0306-4603/$ – see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.addbeh.2004.04.006

(e.g., Vuchinich & Tucker, 1983) have demonstrated that nondependent drinkers show a greater preference for alcohol consumption when the value of an alternative reward is small, the alternative reward is delayed, or the price of an alternative activity is increased. Comprehensive reviews of the experimental literature (Carroll, 1996; Griffiths, Bigelow, & Henningfield, 1980) conclude that the availability of nondrug alternative reinforcers reliably reduces drug self-administration and that the effect generalizes across a variety of species, drugs, routes of administration, and types of alternative reinforcers.

Correlational studies conducted in the natural environment have also revealed a reliable relationship between substance use and alternative reinforcers. Studies with college students have reported an inverse relationship between substance-free reinforcement and the frequency, quantity, and negative consequences of substance use (Correia, Carey, & Borsari, 2002; Correia, Carey, Simons, & Borsari, 2003; Correia, Simons, Carey, & Borsari, 1998). Similar inverse relationships have been reported among male veterans in a treatment program for alcohol dependence (Vuchinich & Tucker, 1996), cocaine abusers (Van Etten, Higgins, Budney, & Badger, 1998), and psychiatric outpatients (Correia & Carey, 1999).

The behavioral economic literature has been used to suggest that substance use can be reduced by increasing the amount of reinforcement derived from substance-free alternatives. The current preliminary study is designed to experimentally test the relationship between substance use and substance-free behaviors in the natural environment. A sample of college students reported on their substance use and their engagement in exercise and creative behaviors. They were then randomly assigned to one of three experimental conditions, each with a specific set of behavioral instructions: substance use reduction (SR), activity increase (AI), or a no-change control. We hypothesized that participants assigned to both the SR and AI conditions would decrease their substance use and that participants assigned to the C condition would report similar levels of substance use across the two assessment sessions. Participants assigned to the AI condition were asked to increase their engagement in both exercise and creative behaviors. These two broad classes of behavior were chosen because they are potentially reinforcing activities that participants can easily increase and self-report. Exercise allows individuals to achieve a pleasurable state without the use of substances (Froelich, 1997) and has been suggested as a potential treatment for substance use (Read et al., 2001). Creative behavior was chosen to provide an alternative for those participants who do not find exercise reinforcing, thus maximizing the likelihood that AI participants would be spending more time engaged in a rewarding activity. In addition, previous research has shown an inverse relationship between introverted activities and binge drinking among college students (Correia et al., 2003).

2. Method

2.1. Participants

Participants were 133 undergraduates attending a large private university who were recruited from psychology classes and received extra credit for completing the study. The

mean (+S.D.) age of the sample was 19.76 (+3.76); 69% were female and 22% minorities. Nine percent of the sample reported affiliation with the Greek system. The majority of the sample lived in campus dormitories (69%) or in an off-campus apartment (20%). Among the participants who reported the use of substances during the past 28 days (78%, $n = 104$), alcohol and marijuana were used most commonly.

2.2. Measures

2.2.1. Behavior rating form (BRF)

Participants used a BRF to self-report the number of days out of the last 28 days they engaged in the both exercise and creative behaviors. Written instructions specified that both exercise and creative behavior had to last at least 10 min in order to count as a single occasion, and that occasions of exercise had to be marked by physiological changes typically associated with physical exertion (e.g., perspiration, increased heart rate). Numerous examples of each class of behavior were provided. Correlations between baseline and follow-up data for the control group for exercise (r=.51, $P < .001$) and creative behaviors (r=.65, $P < .001$) suggest a moderate amount of stability in both classes of behavior over the 28-day assessment interval.

2.2.2. Substance use assessment

Participants completed portions of the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985) to indicate the frequency and quantity of alcohol use during the previous 28 days. Parallel versions of alcohol-related items were used to assess the frequency of use for other psychoactive substances during the previous 28 days. Extensive research supports the validity of self-reported drug use when participants' confidentiality is assured (Johnston & O'Malley, 1985). Correlations between baseline and follow-up data for the control group for the number of substance (alcohol and/or illicit drugs) use days (r=.81, $P < .001$), alcohol use days (r=.60, $P < .001$), and total standard drinks consumed (r=.58, $P < .001$) suggest a moderate amount of stability in substance use behavior over the 28-day assessment interval.

2.3. Experimental procedures

Participants attended group sessions to provide informed consent and complete the baseline assessment measures. Immediately following baseline assessment, eligible participants were assigned to one of three experimental conditions. Five of the 133 initial participants did not return for the follow-up assessment session. Of those participants that completed the study, 33 were assigned to the SR group, 31 to the AI group, and 36 to the control (C) group. Twenty-eight participants reported abstinence during the previous 28 days and were not assigned to a condition but did complete the follow-up assessment.

An investigator met individually with each assigned participant to provide an oral and written review of the instructions associated with each condition. Participants assigned to the SR condition were instructed to reduce the frequency of their substance use during the next 28 days. Reductions were quantified as a 50% decrease in the number of substance use days (i.e.,

participants who reported 10 substance use days during the previous 28 days were instructed to use on no more than 5 of the next 28 days). Participants assigned to the AI condition were instructed to increase the number of days they engaged in both exercise/physical activity and creative/artistic activity, each by 50%. Both SR and AI participants were given written instructions that included their individualized behavioral targets and were asked to sign a contract indicating they understood the instructions and intended to follow them. However, participants were also told that their extra credit was contingent on completion of the study and was not linked to their compliance with the behavioral instructions regarding behavior change.

Over the next 4 weeks, members of the SR and AI groups were asked to self-monitor their target behaviors. Members of the SR group were asked to record the number of standard drinks consumed each day and to indicate whether or not they had consumed any other substances. Members of the AI group were asked to record the number of minutes they spent engaged in exercise or physical activity and the number of minutes they engaged in creative behaviors. Each monitoring card included space for a code name and for recording 7 days of behavior. Participants were asked to record a weeks worth of behavior on each card and then place the cards in a locked drop box located in the Department of Psychology. The self-monitoring procedure was used to increase salience of the behavioral instructions (Mace & Kratochwill, 1988; the data were not intended for use in formal hypothesis testing and are not available for analysis).

Follow-up sessions were completed 28 days after baseline and assessed behavior that occurred during the previous 28 days. Once again, participants were reminded that they would receive their extra credit regardless of their adherence to the instructions associated with their condition and asked to provide honest reports of their behavior.

2.4. Data analysis

Three primary outcome measures—number of substance use days, alcohol use days, and standard drinks consumed—were collected during the follow-up sessions. Preliminary analyses were used to confirm relative equivalence among groups at baseline. Separate ANCOVA was used to determine group differences at follow-up while controlling for baseline values, first for exercise and creative behaviors, and then for the substance use variable. All ANCOVAs were followed with planned contrasts to determine between-group differences and by paired sample *t* tests to identify within-group changes.

3. Results

3.1. Preliminary analyses

An analysis of baseline measures revealed that participants from the four groups (AI, SR, control, and abstainers) did not significantly differ from one another in terms of engagement in exercise or creative behaviors (see baseline columns of Table 1). By definition, significant differences existed between abstainers and other participants on questions related to recent

Table 1
Mean and standard deviations for substance-free behavior at baseline and follow-up

	Exercise days			Creative days	
	n	Baseline	Follow-up	Baseline	Follow-up
Abstainers	29	12.10	12.48[1]	9.00	9.56[1,2]
		(8.34)	(8.34)	(10.68)	(9.47)
Control	34	10.83	11.59[1]	10.56	10.62[1]
		(8.19)	(7.18)	(7.86)	(8.40)
AI	36	13.09	19.00***,[2]	11.65	17.48***,[3]
		(7.41)	(6.10)	(9.55)	(7.41)
SR	35	11.26	9.34*,[3]	8.10	6.87*,[2]
		(7.64)	(7.18)	(6.74)	(6.47)

Notes: Groups did not significantly differ from one another on either variable at baseline. Groups not sharing a numerical subscript were significantly different from one another at follow-up at the $P < .10$ level. Within-group changes from baseline to follow-up are identified with asterisks attached to the follow-up value.

*$P < .05$.

***$P < .001$.

substance use (i.e., alcohol use days, marijuana use days, substance use days, total standard drinks). However, participants in the AI, SR, and control groups reported statistically equivalent levels of substance use behavior (see baseline column of Table 2).

3.2. Substance-free variables

Table 1 presents the means and standard deviations for the number of exercise and creative days across the four groups. Four participants attended the follow-up session but failed to complete the BRF, leaving 124 participants available for analyses of substance-free behavior.

Table 2
Means and standard deviations for substance use behavior at baseline and follow-up

	Substance use (days)			Alcohol use (days)		Total standard drinks	
	n	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
Control	34	7.72	7.47[1]	5.69	5.91[1]	8.22	8.22[1]
		(7.67)	(7.17)	(5.44)	(4.42)	(8.17)	(7.93)
AI	36	9.59	7.58*,[1]	7.94	6.97[1]	11.26	9.16*,[1]
		(7.34)	(6.10)	(6.22)	(4.98)	(10.04)	(7.72)
SR	35	10.38	5.30***,[2]	7.55	5.18**,[2]	11.94	7.93**,[2]
		(7.31)	(4.89)	(5.62)	(4.23)	(8.40)	(7.51)

Notes: Groups did not significantly differ from one another on any of the substance use variables at baseline. Groups not sharing a numerical subscript were significantly different from one another at follow-up at the $P < .10$ level. Within-group changes from baseline to follow-up are identified with asterisks attached to the follow-up value.

*$P < .05$.

**$P < .01$.

***$P < .001$.

An ANCOVA revealed significant group differences for the number of reported exercise days [$F(3,123) = 11.74$, $P < .001$] at follow-up, after controlling for the baseline measures of exercise days. Planned contrasts revealed that AI participants reported significantly more exercise days than participants in the SR, control, and abstinence groups (P's $< .001$ for all comparisons). Planned contrasts also revealed that participants in the SR condition reported fewer exercise days than member of the AI ($P < .001$), control ($P < .05$), and abstinence ($P < .05$) groups. Paired sample t tests were used to look at within-group difference between baseline and follow-up. Members of the AI group increased the number of days they engaged in exercise [$t(30) = 5.87$,$P < .001$], and members of the SR group decreased the number of exercise days [$t(31) = 2.60$, $P < .05$]. The number of exercise days remained stable for abstaining and control participants.

A second ANCOVA revealed significant group differences for the number of reported creative days [$F(3,121) = 12.19$, $P < .001$] at follow-up, after controlling for a baseline measure of creative days [$F(1,123) = 95.27$, $P < .001$]. Planned contrasts revealed that AI participants reported significantly more creative days than participants in the SR, control, and abstinence groups (P's $< .001$ for all comparisons). Planned contrasts also revealed that participants in the SR condition reported fewer creative days than members of the AI ($P < .001$) and control groups ($P < .10$). From baseline to follow-up, members of the AI group increased the number of days they engaged in creative behaviors [$t(30) = 6.29$, $P < .001$], and members of the SR group decreased the number of creative days [$t(31) = 2.60$, $P < .05$]. As with exercise days, the number of creative days remained stable for abstaining and control participants.

3.3. Substance use variables

Table 2 presents data from the reported frequency and quantity of substance use at baseline and follow-up. After excluding abstainers, separate ANCOVA were conducted to examine the effect of group assignment on three different dependent variables: alcohol use days, substance use days (alcohol and/or illicit drugs), and total standard drinks consumed during a typical week. Evidence of group differences at follow-up were found for the number of substance use days [$F(2,99) = 7.54$, $P < .001$] after controlling for baseline measures of substance use days [$F(1,99) = 115.18$, $P < .001$]. Planned contrasts revealed that SR participants reported significantly fewer substance use days than AI ($P < .05$) and control ($P < .001$) participants. A series of paired sample t test revealed decreases in the number of substance use days from baseline to follow-up for both the SR [$t(32) = 6.21$, $P < .001$] and AI [$t(30) = 2.18$, $P < .05$] groups.

A second ANCOVA found group differences the number of alcohol use days reported at follow-up [$F(1,99) = 65.92$, $P < .001$] after controlling for the baseline measure of alcohol use days [$F(1,99) = 65.92$, $P < .001$]. Planned contrasts revealed that SR participants reported significantly fewer alcohol use days than AI ($P < .10$) and control participants ($P < .05$), and a paired sample t test revealed reductions in the number of alcohol use days from baseline to follow-up for the SR group [$t(32) = 3.08$, $P < .01$].

A final ANCOVA failed to find any evidence of group difference in the number of standard drinks reported at follow-up [$F(2,99) = 1.37$, $P > .10$] after controlling for the effects of baseline reports of standard drinks consumed [$F(1,99) = 68.43$, $P < .001$]. However, members of both the SR [$t(32) = 3.12$, $P < .01$] and AI [$t(30) = 2.29$, $P < .05$] groups reported significant differences in the number of standard drinks consumed. Participants who abstained or were assigned to the control group reported consistent levels of substance use from baseline to follow-up. Member of the control and abstainers groups did not show within-group changes from baseline to follow-up on any of the substance us variables.

4. Discussion

The current study used an experimental design to further investigate the relationship between substance use and engagement in alternative behaviors. The manipulations used in the current study were derived from the behavioral economic perspective (Vuchinich & Tucker, 1988) and linked to two proposed methods of SR: increased utilization of alternative reinforcers and increased constraints on access to substances. Participants assigned to an instructional set calling for increased utilization of alternative reinforcers did report an increase in exercise and creative behaviors. These participants also reported a significant decrease in the frequency of substance use days and in the quantity of alcohol consumed. Importantly, these participants were not rewarded contingent upon increasing their engagement in substance-free behaviors. In fact, their instructions emphasized that they would receive credit for participating in the study regardless of their reported behavior. The results of the current study are consistent with previous research that suggest decreases in substance use and substance-related behaviors can be achieved by increasing the value of substance-free alternative reinforcers (Carroll, 1996; Vuchinich & Tucker, 1988) or by increasing engagement in substance-free behaviors (Correia et al., 2002). More research is needed to determine the types of substance-free activities that facilitate reductions in substance use. Increased exercise and physical activity has been suggested as a possible component in the treatment of alcoholism (Read et al., 2001). The current results suggest that further research into the relationship between exercise and substance use among young, nonproblem drinkers is also warranted.

Regarding the second mechanism, increased constraints on access to substance use were operationalized as an instructional set calling for a reduction in the frequency of substance use. Participants assigned to this condition did report a decrease in the frequency and quantity of substance use. Surprisingly, the participants who were asked to reduce their substance use also reported a significant decrease in the number of exercise days. Thus, it may be that trying to decrease the frequency of substance use may have had the unintended effect of decreasing other valued sources of reinforcement. From a clinical perspective, Cox, Klinger, and Blount (1991) note that negative goals, such as "I need to drink less," may have broad and deleterious effects on behavior. The findings underscore the fact that decreases in substance-related behaviors are not automatically followed by increases in substance-free behaviors. Thus, more work is needed to determine the optimal

way to decrease substance use while simultaneously increasing engagement in alternative behaviors.

This study has five notable limitations. First, our assessment of exercise and creative behaviors consisted of single-item frequency measures. Future studies in this will have to include well-validated, multidimensional measures. Second, while statistically significant, the findings regarding reductions in substance use for the AI group are not as robust as those found for the SR group. Member of the AI group did report statistically significant decreases in substance-related behaviors from baseline to follow-up, as revealed by the paired sample *t* test. However, AI and control participants did not significantly differ from one another on follow-up measures of substance use, which would have provided stronger evidence that the AI condition led to meaningful changes in substance use. Third, the number of comparisons would normally call for a correction to protect against Type I errors. Given the preliminary nature of the paper, we elected to present the full range of findings, including those at the $P < .10$ level of significance, to encourage continued exploration of relationships between substance use and substance-free alternatives. Fourth, although anonymity, attention to honesty, and lack of incentive were incorporated into the methodology of the study, it is still possible that demand characteristics influenced how the participants responded. Specifically, it is possible that SR participants underreported substance use and AI participants overreported engagement in substance-free activities at follow-up. It appears unlikely, however, that demand characteristics would account for the decreased substance use among AI participants. Fifth, it should be noted that the manipulations were applied to a nonclinical, predominantly female sample of college students. Thus, the generality of these effects need to be demonstrated.

It is notable that in spite of the limitation reviewed above, a relatively simple experimental manipulation was associated with behavioral changes in this sample. As previously noted, numerous laboratory-based studies have demonstrated a causal relationship between drug-taking behavior and the availability of alternative reinforcers. Despite the strong empirical foundation, relatively few studies have experimentally investigated the relationship between substance use and alternative reinforcers in the natural environment. A notable exception is the use of contingency management, which treats substance abuse and dependence by providing tangible reinforcers for evidence of abstinence from drugs (Higgins & Silverman, 1999). One hallmark of contingency management is the use objective measures of behavior (e.g., urinalysis to detect drug use and verify periods of drug abstinence), as opposed to a reliance on self-report. Future investigations might improve on the design of the current study by using more objective measures of both substance-related and substance-free behaviors. Such an approach would reduce concerns related to demand characteristics and would allow researchers to more effectively investigate the relationship between substance use and alternative reinforcers in the natural environment.

Acknowledgements

This work was supported in part by National Institute on Alcohol Abuse and Alcoholism Grant R01 AA12518 awarded to K.B. Carey.

References

Carroll, M. E. (1996). Reducing drug abuse by enriching the environment with alternative non-drug reinforcers. In L. Green, & J. Kagel (Eds.), *Advances in behavioral economics, vol. 3* (pp. 37–68). Norwood, NJ: Ablex Press.

Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology*, *53*, 189–200.

Correia, C. J., & Carey, K. B. (1999). Applying behavioral theories of choice to drug use in a sample of psychiatric outpatients. *Psychology of Addictive Behaviors*, *13*, 207–212.

Correia, C. J., Carey, K. B., & Borsari, B. (2002). Measuring substance-free and substance-related reinforcement in the natural environment. *Psychology of Addictive Behaviors*, *16*, 28–34.

Correia, C. J., Carey, K. B., Simons, J., & Borsari, B. (2003). Relationships between binge drinking and substance-free reinforcement in a sample of college students: A preliminary investigation. *Addictive Behaviors*, *28*, 361–368.

Correia, C. J., Simons, J., Carey, K. B., & Borsari, B. E. (1998). Predicting drug use: Application of behavioral theories of choice. *Addictive Behaviors*, *23*, 705–709.

Cox, W. M., Klinger, E., & Blount, J. P. (1991). Alcohol use and goal hierarchies: Systematic motivational counseling for alcoholics. In W. R. Miller, & S. Rollnick (Eds.), *Motivational interviewing: Preparing people to change addictive behavior* (pp. 260–271). New York: Guilford Press.

Froelich, J. C. (1997). Opioid peptides. *Alcohol Health and Research World*, *21*, 132–135.

Griffiths, R. R., Bigelow, G. E., & Henningfield, J. E. (1980). Similarities in animal and human drug-taking behavior. In N. K. Mello (Ed.), *Advances in substance abuse: Behavioral and biological research, vol. 1* (pp. 1–90). Greenwich, CT: JAI Press.

Higgins, S. T., & Silverman K. (Eds.) (1999). *Motivating behavior change among illicit-drug abusers: Research on contingency management interventions*. Washington, DC: American Psychological Association.

Johnston, L. D., & O'Malley, P. M. (1985). Issues of validity and population coverage in student surveys of drug use. In B. A. Rouse, N. J. Kozel, & L. G. Richards (Eds.), *Self-report methods of estimating drug use: Meeting current challenges to validity (National Institute on Drug Abuse Research Monograph No. 57, ADM 85-1402)* (pp. 31–54). Washington, DC: National Institute on Drug Abuse.

Mace, F. C., & Kratochwill, T. R. (1988). Self-monitoring. In J. C. Witt, S. N. Elliot, & F. M. Gresham (Eds.), *Handbook of behavior therapy in education* (pp. 489–522). New York: Plenum.

Read, J. P., Brown, R. A., Marcus, B. H., Kahler, C. W., Ramsey, S. E., Dubreuil, M. E., Jakicic, J. M., & Francione, C. (2001). Exercise attitudes and behaviors among persons in treatment for alcohol use disorders. *Journal of Substance Abuse Treatment*, *21*, 199–206.

Van Etten, M. L., Higgins, S. T., Budney, A. J., & Badger, G. J. (1998). Comparison of the frequency and enjoyability of pleasant events in cocaine abusers vs. non-abusers using a standardized behavioral inventory. *Addiction*, *93*, 1669–1680.

Vuchinich, R. E., & Tucker, J. A. (1983). Behavioral theories of choice as a framework for studying drinking behavior. *Journal of Abnormal Psychology*, *92*, 408–416.

Vuchinich, R. E., & Tucker, J. A. (1988). Contributions from behavioral theories of choice to an analysis of alcohol abuse. *Journal of Abnormal Psychology*, *97*, 181–195.

Vuchinich, R. E., & Tucker, J. A. (1996). The molar context of alcohol abuse. In: L. Green, & J. Kagel (Eds.), *Advances in behavioral economics, vol. 3* (pp. 133–162). Norwood, NJ: Ablex Press.