PRIZE BASED REINFORCEMENT TO ENCOURAGE SMOKING CESSATION AMONG COLLEGE STUDENTS

Sophia I. Key

A Thesis Submitted to the University of North Carolina Wilmington in Partial Fulfillment of the Requirements for the Degree of Masters of Arts

Department of Psychology
University of North Carolina Wilmington

2011

Approved by

Advisory Committee

Christine E. Hughes
Nora E. Noel

Raymond C. Pitts
Wendy D. Washington, Chair

Accepted by
Dean, Graduate School
# TABLE OF CONTENTS

ABSTRACT ........................................................................................................................................ iv

ACKNOWLEDGEMENTS ................................................................................................................ v

LIST OF TABLES .................................................................................................................................. vi

LIST OF FIGURES ........................................................................................................................ vii

INTRODUCTION ........................................................................................................................... 1

  Behavior Analysis ................................................................................................................... 2

  Behavioral Pharmacology .................................................................................................... 4

  Early Drug Studies ............................................................................................................... 6

  Contingency Management .................................................................................................. 11

  Early CM Studies ............................................................................................................... 11

  Voucher Reinforcement ..................................................................................................... 18

  Nicotine Studies ................................................................................................................ 19

  Fishbowl Studies ................................................................................................................ 32

  Current Study ..................................................................................................................... 43

METHOD ....................................................................................................................................... 43

  Participants ......................................................................................................................... 43

  Screening ............................................................................................................................. 44

  Materials ............................................................................................................................... 46

  Procedure ............................................................................................................................. 46

  Data Analysis ....................................................................................................................... 49

RESULTS ...................................................................................................................................... 50

DISCUSSION ................................................................................................................................ 57
ABSTRACT

Smoking is the number one cause of preventable death in the U. S. (CDC, 2007). Nearly half of all smokers attempt to quit each year but only 4-7% are successful (CDC, 2007). Contingency management (CM) procedures arrange for the systematic application of reinforcing or punishing consequences. Past studies (e.g., Higgins et al., 1991) have shown that CM procedures relying on continuous reinforcement are effective but costly. Studies using intermittent reinforcement (e.g., Petry & Martin, 2002) have shown to be effective at reducing substance use and are more cost effective. The purpose of this study was to determine the effectiveness of an intermittent prized-based schedule to reinforce smoking abstinence in college students. Seven college students participated in a 10 day study. Participants had to submit breath CO samples twice a day and were allowed prize drawings if their CO levels were ≤ 6 ppm during CM phases. All participants showed a decrease in breath CO levels. Of all the breath CO samples submitted, 70.83% were negative and the average breath CO level during CM conditions was 5.71. Average earnings for each participant were $48. This study shows that a prize-based schedule of reinforcement can be a cost-effective way to promote smoking abstinence in college students.
ACKNOWLEDGEMENTS

I would like to thank my mentor, Dr. Wendy Donlin Washington for her guidance through my graduate program and thesis. I am also very thankful for the assistance provided by my committee members, Dr. Christine Hughes, Dr. Raymond Pitts and Dr. Nora Noel. I am also thankful to my undergraduate research assistants: Lisa Witt, Nick Schilly, and David King.
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Participant Characteristics from FTND</td>
<td>70</td>
</tr>
<tr>
<td>2.</td>
<td>Individual Items from Motivation and Confidence Questionnaire</td>
<td>71</td>
</tr>
<tr>
<td>3.</td>
<td>Individual Items from H &amp; H Withdrawal Questionnaire</td>
<td>72</td>
</tr>
<tr>
<td>4.</td>
<td>Individual Items from SCQ-S Questionnaire</td>
<td>73</td>
</tr>
<tr>
<td>5.</td>
<td>Individual Items from Exit Questionnaire</td>
<td>76</td>
</tr>
<tr>
<td>6.</td>
<td>Individual Items from Surveys and Treatment Outcome</td>
<td>77</td>
</tr>
<tr>
<td>Figure</td>
<td>Individual Subject Data</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.......................................................... 78</td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCTION

Cigarette smoking is the leading cause of preventable death in the U.S., accounting for approximately 1 of every 5 deaths (443,000) people each year (Centers for Disease Control and Prevention [CDC], 2010). On average, smokers die 13 to 14 years earlier than nonsmokers; heart disease is the leading cause of death among smokers (CDC, 2010). Cigarette smoking poses serious health concerns for those who smoke, and it is strongly suggested by medical professionals that they quit. Smoking is also an expensive addiction; people in the U.S. spend an estimated $82 billion a year on cigarettes (CDC, 2010). The health consequences associated with smoking are responsible for an estimated $193 per year billion in health-related economic losses in the U.S. (CDC, 2010). Most smokers (70%) report a desire to quit, but few of them actually do (CDC, 2010). Most smokers try their first cigarette before the age of 18 years, thus the college years serve as an important transition from occasional smoking to nicotine dependence. Approximately 29% of all college students are current cigarette smokers. (CDC, 2010). Early intervention is a key part of smoking cessation because smokers are more likely to quit if they have only smoked for a few years as opposed to many years (e.g. 10, 20, or 30 years) of smoking. Finding a smoking cessation program that is effective and easy to implement is an important health concern that may not only save billions of dollars but also save many lives as well.

Forty-four percent of smokers report that they try to quit each year with only 4-7% actually quitting (CDC, 2010). To help smokers cope with the physical withdrawal symptoms associated with smoking, nicotine replacement therapies can be used. These treatments deliver safe amounts of nicotine to the body (7-21mg). Common nicotine replacement therapies include the nicotine patch and gum. Both are available over the counter and deliver safe doses of nicotine.
through the skin or orally. The nicotine nasal spray delivers nicotine quickly to the bloodstream allowing for quick control over withdrawal symptoms and is only available with a prescription. Bupropion (Zyban®) does not contain nicotine. It is a prescription antidepressant that reduces the symptoms of nicotine withdrawal and may be used in combination with nicotine replacement. All have been effective in aiding smoking cessation but they are only designed to help smokers cope with the physical symptoms of withdrawal, not the psychological symptoms. “Among current smokers who attempted to stop for at least 1 day in the past year, only 21.7% used cessation medication” (CDC, 2010).

Other treatment options include hypnosis and acupuncture, though both are lacking scientific evidence for support. Group or community therapies such as 1-800-QUIT-NOW and smokefree.gov, can be accessed online and provide educational materials as well as hotlines to aid those wanting to quit. Clinical interventions such as counseling have been found to be effective, especially when combined with the use of medication (CDC, 2010). The most promising types of non-nicotine replacement therapies involve behavioral therapies to reduce cigarette smoking.

**Behavior Analysis**

The field of behavior analysis views substance abuse as a behavior that can be modified by manipulating the environment. Substance abuse is not a behavior that is unique to humans, and past research (Carroll, 1985) has shown that drugs function as reinforcers in animals. Basic behavioral principles can be applied to drug-taking behavior to modify it in the same manner as other behaviors. These principles discovered through the analysis of behavior are valuable tools to understanding the mechanisms of drug use and altering drug taking behavior.
Work by Thorndike emerged, showing how behavior could be controlled by its consequences. The concept of behaviorism emerged by Watson in the early 1920s who argued that behavior deserved to be a science in its own right. Behavior can be defined as “that portion of an organism’s interaction with its environment that involves movement of some part of that organism” (Johnston & Pennypacker, 2009). Watson argued that behavior was what could be observed and measured. He also believed that behavior was an important part of our biology and evolutionary context. Pavlov’s work on conditioned reflexes showed how reflexes could be manipulated through the environment and respondent conditioning emerged. The concept of operant and respondent behavior was furthered developed by B. F. Skinner who argued that the environment controls behavior and behavior was controlled by its consequences.

In behavior analysis, behavior is viewed as a scientific subject matter. Skinner formalized operant behavior and defined it as behavior that is controlled by its consequences. This relation between a behavior and the environment that lead to fairly permanent changes in behavior is a process called learning. By bringing behaviors under strict experimental control in laboratory settings, it was discovered that behaviors could be produced and reproduced across settings, regardless of species. These behaviors could be controlled by manipulating the consequences of a behavior. These consequences determine the future likelihood of the behavior occurring again. If a behavior is reinforced, a consequence of a response leads to an increased probability of the response. If a stimulus is presented after the response, this is positive reinforcement. If a stimulus is removed after the response, this is negative reinforcement. An example of positive reinforcement in the laboratory would be a food deprived rat placed in an operant chamber and trained to press a lever. As a consequence to lever pressing the rat is presented with a food pellet which increases the probability that the rat will press the lever again. Food is reinforcing and
maintaining the rats lever pressing (Ferster & Skinner, 1957). A form of negative reinforcement would be if a rat was placed in an operant chamber and given a shock. By pressing on a lever the rate can escape the shock, therefore lever pressing increases to stop the shock.

If a behavior is punished, then a stimulus is presented or removed as a consequence of a response that leads to a decrease in responding. The stimulus is typically viewed as “unpleasant” because it will lead to behaviors that will avoid or escape the stimulus. For example, in the laboratory, a rat is placed in an operant chamber and trained to lever press for food. Now a mild shock is given for a lever press in the place of food. This will lead to a decrease in lever presses; therefore, the shock acted as a punishing stimulus and is positive punishment. An example of negative punishment would be removing food from the rat after a lever press which would lead to a decrease in lever pressing because as a consequence, food has been removed.

Understanding the concepts of reinforcement and punishment is important in behavior analysis because this is how much of behavior is controlled. Drugs can have reinforcing effects on behavior, as well as punishing. It is important to understand these concepts to better understand how drugs affect behavior. Behavioral pharmacology is one major area within the field of behavior analysis that attempts to understand how drug affect behavior.

**Behavioral Pharmacology**

Behavioral pharmacology is a scientific field combining behavior analysis and pharmacology. Peter Dews is often viewed as the father of behavioral pharmacology due to his work showing the schedule dependence of drugs. Behavioral pharmacology uses the methodology of behavior analysis and emerged from two research areas. One of these areas involved laboratory studies showing that animals seek out and self-administer drugs. Another research area discovered that chlorpromazine could be used as an antipsychotic drug to treat
those with schizophrenia, but the drug caused behavioral side effects. Behavioral pharmacology has a strong scientific basis and is focused on examining how drugs affect behavior. The core goal of behavioral pharmacology is to “employ sophisticated behavioral techniques to analyze the mechanisms of action of behaviorally active drugs,” (Branch, 2006, p. 407).

The early 1950s was considered the “Golden Age” of behavioral pharmacology because drugs were being developed to treat mental illnesses such as schizophrenia, depression and anxiety (Barrett, 2006). During this time, Peter Dews began conducting research on these drugs by studying how they affected behavior and behavioral pharmacology emerged. It was once presumed that drugs affected emotional states and motivation. Drugs were also known to affect the brain in some biochemical way, but the technology had not yet developed to make studying how drugs affect neurotransmitters possible. Dews chose to focus on behavior because it was quantifiable and easy to measure because it could be directly observed. He also felt that by focusing on behavior, a clear understanding of how drugs affected the physiology of the brain was not necessary. What mattered was the drugs’ effect on behavior.

Throughout Dew’s research a dominant finding was that the behavioral effect of a drug could depend on ways in which that behavior had been controlled by its consequences (Barrett, 2006). Dews realized that the “behavioral effects of a drug are frequently critically dependent on schedule influences on behavior” (Dew & Morse, 1960, p.152). Dews conducted much more research showing how schedules, types of reinforcement, and the type of environment in which the drug is administered can all alter the behavioral effects of a drug in many ways.

Behavioral pharmacological research has been essential in the field of substance abuse in understanding how the environment affects drug taking behavior and how drugs interact to change the expression of behavior. Behavioral pharmacology has shown how drugs can function
as reinforcers and that drug taking behavior is no different than other forms of behavior. By understanding how drugs function as reinforcers, more effective drug treatments and our understanding of reinforcement as a behavioral process can be developed further (Branch, 2006).

A study by Spragg (1940) showed how drugs could function as reinforcers for non-human animals. Spragg gave a chimpanzee injections of morphine for crawling in his lap to get food. Later, the chimpanzee would indicate that he wanted more injections by going to the same location of the injections, handing Spragg a needle, and pointing to the injection site. Later, Spragg gave the chimpanzee two sticks that would open a box containing either food or morphine. The chimpanzee chose the box with the morphine exclusively. This showed that non-humans found drugs reinforcing and that drug use was not a human only phenomena.

Early drug studies (Carroll & Meisch 1979; Carroll, 1985) have been very important in developing drug treatment programs by arranging contingencies in the environment. This can be done by increasing the response requirement for a drug, adding a punishment contingency for drug use, lowering the rate of drug delivery and drug magnitude and introducing alternative forms of reinforcement or behaviors that are incompatible with drug use (Branch, 2006). One way to decrease substance use is to offer an alternative form of reinforcement.

**Early Drug Studies**

Concurrent schedules have been used to study if drugs function as reinforcers in lab animals. By presenting drugs and water concurrently, a study by Carroll and Meish (1979) showed that orally delivered drugs do function as reinforcers. A study by Carroll (1985) showed how responses were maintained by concurrently presenting drug and nondrug reinforcers. This was done to see if an additional nondrug reinforcer would compete with a drug and reduce drug taking behavior. In this experiment, a noncaloric drug, phencyclidine, and saccharine were
presented under a concurrent fixed-ratio (FR) schedule. Another objective of this study was to
determine if “concurrent presentations of a fixed concentration of saccharin would serve as a
standard for comparing the relative reinforcing efficacy of different phencyclidine
concentrations” (p. 132).

Six adult male rhesus monkey served as subjects for this study and four of them were
experimentally naïve. Each monkey was maintained at 85% of its free feeding body weight.
Experimental chambers were stainless steel with two brass water spouts. When lip contact was
made with each spout, a solenoid was activated releasing 0.55 ml of liquid. When drug solution
was available from a spout, two green keys lit up from behind the spout. When it was water or
saccharin solution, two white keys lit up. A large key above each spout was illuminated with a
green, yellow, or a green-blinking light when water, saccharin, or drugs were available,
respectively.

Prior to the beginning of this experiment, the monkeys had been trained to self-administer
phencyclidine under a concurrent FR 16 schedule. Three saccharine concentrations were
presented (0.003%, 0.03%, and 0.3%) in a random order concurrent with phencyclidine under
independent FR 16 schedules. No changeover delays were programmed. For each saccharin
concentration, six phencyclidine concentrations and water were also tested. Sessions took place
daily (7 times a week), and each 3-hr session was followed by a 1-hr timeout.

Carroll (1985) found that drug intake increased as a function of drug concentration. As
saccharin concentrations increased, drug intake decreased. Drug intake was lowest when low
concentrations of phencyclidine were available concurrently with higher concentrations of
saccharin, but there was little or no change in drug intake at higher drug concentrations. This
shows that saccharin reduced levels of drug intake, especially with higher concentrations of
saccharin solution. If a high concentration of saccharin was presented with a high concentration of the drug, then drug intake was higher. When water replaced the saccharin solution, drug intake returned to previous levels.

The results suggest that as concentrations for both drug and saccharin solutions increased, the monkeys “preference” increased as well, suggesting an increase in reinforcer magnitude. This study also shows that saccharin reduced drug taking behavior, especially at high concentrations of saccharin and low concentrations of the drug where the monkeys almost exclusively chose saccharin. This study shows that by presenting a nondrug reinforcer as “competition” for drug reinforcers, drug taking can be reduced. This also shows that this reduction can vary as a function of reinforcer magnitude for both alternatives.

Campbell, Thompson, and Carroll (1997) examined how non-drug alternative reinforcers impacted the initial acquisition of phencyclidine (PCP) by non-human primates that have never been exposed to drugs. Variables such as alternative non-drug reinforcers have shown to decrease the self-administration of drugs. While studies (Carroll, 1985; Campbell et al., 1997) have focused on procedures to decrease drug administration in non-human primates, not many have looked at factors that may reduce the initial acquisition of drug use and maintenance.

Twenty-one adult male rhesus monkeys served as subjects. All but four were experimentally naïve. The four with an experimental history were exposed to brief and low doses of drugs. They had no previous history of PCP exposure. The monkeys were maintained at 85% of their free-feeding body weight. A stainless-steel operant chamber was used that contained two brass drinking tubes mounted to Plexiglas. Above each tube was a green LED stimulus light that flashed at 10 Hz to signal PCP availability. When water was available the lights stayed green continuously. Behind the Plexiglas wall were four smaller stimulus lights. Two green lights
indicated lip contact with PCP and two white lights indicated lip contact with water. To gain access to the liquid released by the spout a FR was used.

Phencyclidine access occurred daily, 7 days a week in 3-hr sessions that were preceded by a 2-hr timeout and followed by a 1.5-hr timeout to change liquids and measure intake. Three groups of seven monkeys each were studied. Each group had a different PCP dose and non-drug alternative reinforcer. One group received a low dose (LD) of PCP (0.30 ml) and two groups received high doses of PCP (1.2 ml). One of the high dose groups received water as a non-drug alternative reinforcer (HD) while the other received saccharin (HDS). Drug doses varied to determine how choices for the drug or saccharin would change as a function of concentration for both. All of the naïve subjects were randomly assigned to one of the three groups. The four monkeys with experimental history were specifically assigned to HD or LD groups (two per group). The non-drug reinforcer and PCP were submitted sequentially to ensure contact with each by subjects. Initially an FR 1 schedule was in place, and the monkeys only received water from the spouts for 5 days. Over the next 10 days, only PCP was available from both spouts. Also during this phase, for the HDS group water was substituted for saccharin during intersession periods. So when subjects in the HDS group were not under the in between sessions, they were originally given water, but this was replaced with saccharin for the HDS group. This was done to expose subjects in that group to saccharin. The other subjects still received water during these periods of time. During these phases, food was not restricted. After baselines were collected, food was restricted for all animals to 85% of their free feeding body weight and subjects received PCP from both spouts for the next 10 days. Over the next 10 days food was restricted and subjects were fed 30-min before the sessions started. For both 10 day conditions, PCP was delivered according to an FR 1 schedule. Fixed ratio schedules for liquid deliveries
were then gradually increased from 1 to 2, 4, and 8 with 5 days of stable responding at each. For the next 5 days, all animals were on an FR 8 schedule with PCP, and water presented concurrently. For the next 5 days, animals in the LD and HD group were presented with water and PCP concurrently, whereas the HDS group was presented with PCP and saccharin concurrently.

Responding for the four monkeys with experimental histories was no different than the other monkeys. As the FR value increased, so did responding for each group. Mean liquid intake was similar during baseline sessions for all groups. Once PCP was made available, intake for high dose groups was significantly higher than the LD group across all FR values. There was no significant difference in PCP intake between the two high dose groups although monkeys in the HD did appear to have slightly higher intake than the HDS group.

When PCP was presented concurrently with water, all monkeys consumed substantially more PCP than water with a significant difference found in the HD groups establishing PCP as a reinforcer. The HD group consumed more PCP than either LD or HDS group with these groups consuming less than half the amount of the HD group, but differences did not reach significance. Six of the seven monkeys (85.7%) reached the acquisition criteria and three of the seven (42.8%) met the acquisition criteria for both LD and HDS groups once saccharin replaced water for the HDS group. For the HDS group saccharin intake increased substantially when presented concurrently with water, establishing it as a reinforcer.

This study shows how drug dose affects drug acquisition with lower doses resulting in lower intake. The HDS group had fewer subjects meet the criteria for drug acquisition which shows that an alternative, non-drug reinforcer can decrease drug self-acquisition. This study noted a lot of variability between subjects, as in many drug studies. It would have been beneficial
to also report individual data along with group data. This study shows that non-drug alternative reinforcers can reduce drug intake and possibly slow initial drug acquisition.

These animal studies (Carroll, 1985; Cambell & Thompson, 1998) of drug taking are the premise for modern behavioral treatments of drug abuse. They show how drugs can function as reinforcers and how variables can be manipulated in the environment by introducing alternative reinforcers to decrease drug use. Drug dose can be manipulated to alter drug taking behavior but reducing the dose of a drug may not decrease substance use. Instead an organism may take many more doses of a lower dose of a drug to try and counteract the decrease in dosage. For example, a pack of cigarettes may contain half the amount of nicotine but someone may smoke twice as much to get the same effect as before. The results from these studies (Carroll, 1985; Cambell & Thompson, 1998) contribute to drug treatment programs and make them more successful. One approach called contingency management (CM) uses this methodology of providing alternative reinforcers to decrease substance use in humans and has found to be very effective.

**Contingency Management**

Contingency management is a treatment approach derived from the basic principles of learning. Contingency management procedures arrange for the systematic application of reinforcing or punishing consequences (Higgins, Silverman, & Heil, 2008). In substance abuse, a contingency is arranged in which a positive reinforcer (e.g. voucher, prize, money) is delivered based on evidence of abstinence or a specified decrease in substance use. Unlike previous animal studies (Carroll, 1985; Capmbell & Thompson, 1998) the alternative reinforcer is not presented concurrently with the drug, but for not using or decreasing drug use. Typically an escalating schedule is used in which the value of the reinforcer increases with each successive negative
sample. Resetting voucher values or denying access to reinforcers can be viewed as a punishing consequence to substance use.

**Early CM Studies**

Early CM studies offered alternative reinforcers to decrease substance use or reinforced decreased amounts of substance use. Bigelow, Cohen, Liebson, and Faillace (1971) reduced the amount of alcohol consumed by chronic alcoholics. Their goal was to decrease substance use to a level of moderate use instead of encouraging complete abstinence. They chose to do this because many alcoholics have difficulty abstaining, especially early in treatment. In this study, subjects were 19 male, chronic alcoholics that lived in a token economy behavior-research ward as a part of a treatment program. If subjects participated in an experiment, 95-proof alcohol was available for consumption. During CM phases, limiting alcohol consumption to 5 oz was reinforced and during control phases no contingency was in place. Subjects could ask staff for small amounts of alcohol which were delivered by staff members and recorded. Amounts of alcohol were restricted so that no more than 10-24 oz were given in an entire day and no more than 6 oz were given in a 2-hr period. The reinforcer used was access to an “enriched” environment which was a recreation room with a TV, pool table, games, and nurses available. This subjects to socialize with other patients and nursing staff. They could also receive visitors and work for the hospital doing laundry for $1.00 per hour. If subjects drank more than the allotted 5 oz then they were moved to an “impoverished” environment and did not receive any of these privileges. They found that excessive drinking (more than 5 oz) only occurred on 9.7% of the contingent days. All the subjects drank excessively when no contingency was in place. This study shows how CM can be used to decrease substance use.
A study by Bigelow, Strickler, Liebson, and Griffiths (1976) showed how CM management could be used through a contracting method. To ensure that outpatient alcoholics maintained disulfiram ingestion, a security-deposit contingency contracting procedure was used. Twenty male volunteers with histories of alcohol abuse participated and gave experimenters $100-$150 ensuring that the amount was large enough to the patient to try and earn back. Subjects came to a clinic to receive disulfiram from a physician once a day, 7 days a week. Patients or their significant others were asked if they had been drinking and breathalyzers were also given, but no contingency was in place for abstinence. If subjects did not come in or refused to ingest their disulfiram then a portion of their deposit was sent to a charity. The remaining balance was returned to each subject at the end of the study. Subjects only missed 7.8% of their scheduled clinic visits. Drinking only 1.6% of the time. This study shows how CM procedures can be used to increase clinic visits and reinforce behaviors that may be incompatible with alcohol use such as taking disulfiram.

Stitzer, Bigelow, and Liebson (1979) used CM procedures to reduce benzodiazepine self-administration in methadone maintenance clients by offering methadone clinic privileges based on reduction in drug use. Eight clients with past histories of narcotics use enrolled into methadone-maintenance clinics. Clients had to report to the clinic once a day, 7 days a week and ingest the methadone while supervised. Urine samples were collected twice a week to test for narcotics use. Clients were also free to request diazepam throughout the study, but doses were given in controlled amounts by the clinic. Contingent and noncontingent periods alternated for 6 weeks throughout the study. If clients refused to take the diazepam they, were given methadone instead, but this was only during the contingent phases. If the client received the take home method of methadone delivery then a dose of methadone was given to them to take the following
day and time of the usual clinic visit. If the dose self-regulation method was given, they could alter their dose of methadone on a single day by $+20 \text{ mg}$ or $+50\%$ of the stable dose, whichever was smaller. The dose self-regulation method allowed subjects some control over how much methadone they could receive. In order to receive these privileges, clients had to refuse diazepam for 3-4 consecutive days. When take-home privileges were available, only 11.2% of diazepam doses were requested compared to 95.6% during baseline weeks and 69.7% when dose self-control was given. The take home method was more effective than the dosage self-control method which may suggest that the magnitude of the dose may alter the effectiveness of methadone as a reinforcer. This study shows the effectiveness of contingent reinforcement based on reductions in substance use.

Early CM studies (Bigelow, Cohen, Liebson, & Faillace, 1971; Bigelow, Strickler, Liebon, & Griffiths, 1976) laid the groundwork for future CM studies. Contingency management interventions have been found to be one of the most effective interventions for the cessation of drug use. While past studies have shown that the availability of alternative non-drug reinforcers reduces drug use (Carroll, 1985), it has been argued that these studies have not arranged contingencies analogous to CM interventions because specific periods of abstinence have not been defined. Instead, subjects have had to choose between a drug or a non-drug reinforcer using a discrete-trials task which is not analogous to the free-operant environment of a drug user therefore, may not reflect CM interventions used in substance abuse programs. Contingency management interventions involve a differential-reinforcement schedule that is contingent upon the non-occurrence of a target behavior (drug-use). Differential schedules of reinforcement are effective in reducing the occurrence of a target behavior. Lesage (2009) used a differential-reinforcement-of-alternative behavior (DRA) schedule of sucrose delivery on nicotine self-
administration in rats. This was done to reflect conditions more similar to human CM interventions in an animal model for CM. In a DRA schedule, a target alternative behavior is selected for reinforcement which is more similar to human models of CM because intervals of abstaining and engaging in an alternative behavior are reinforced. This is similar to a person abstaining from drug use and submitting a negative sample for reinforcement.

Sixteen Male Sprague-Dawley rats were used in this study and were food restricted (18/20 g/day). All sessions were conducted in eight operant chambers with two response levers. The left lever activated a sucrose pellet dispenser to reinforce the alternative behavior. The right lever activated the delivery of nicotine which was delivered by a catheter.

Rats were trained to self-administer nicotine during 1 hour sessions in which stimulus light above the drug lever were illuminated, and an FR 1 schedule was arranged. Each lever press produced one infusion of nicotine (0.03 mg/kg/inf). Once responding began, the ratio was increased to an FR 3 schedule. Rats met self-administration criteria when they received eight nicotine infusions per session. Rats were randomly assigned to an abstinence-contingent sucrose delivery group (DRA) or non-contingent sucrose delivery group (FT). To induce sucrose-maintained behavior, rats in the DRA group began each session with a multiple schedule which was a 1-hr component of nicotine self-administration during which a FR 3 schedule for drug delivery was implemented. A 5-min timeout period began afterwards, followed by a 30-min period of sucrose delivery. During the period of sucrose delivery, a FR 1 was arranged in which a stimulus light above the sucrose lever illuminated and a sucrose pellet was available after a variable inter-trial interval (ITI) of 1 min had elapsed. A tone signaled the availability of a sucrose pellet and a lever press on the sucrose lever resulted in the delivery of a sucrose pellet and turned off the light and tone. For the FT group a similar multiple schedule was used, except
no lever press was required for the delivery of a sucrose pellet. Instead a variable time (VT) schedule of 1-min was arranged and after the interval elapsed, a 1-s tone was presented, followed by the delivery of a sucrose pellet and the light and tone turned off. These schedules continued until responding stabilized for sucrose and drug self-administration. These sessions served as baseline sessions to ensure sucrose responding was maintained. Each group was exposed to one of two conjoint schedules. The DRA group was exposed to an interlocking FR 3 nicotine DRA t-sec sucrose schedule (Lesage, 2009, p. 16). Under this schedule, a response on the nicotine lever produced nicotine infusions under an FR 3 schedule, while pauses in responding based on the DRA interval length, resulted in a tone which signaled the availability of sucrose. During the tone, a single response on the sucrose lever illuminated the light above and delivered a single sucrose pellet and turned off the tone. Each response on the nicotine lever reset the DRA interval and if a response occurred on the nicotine lever before the DRA interval had elapsed, the interval started over. DRA intervals of 40, 80, and 160 s were used in a random order. Under this schedule, rats could obtain infusions of nicotine for responding on the nicotine lever under the FR 3 schedule, or pause responding for a given amount of time and be able to respond on the sucrose lever to obtain sucrose. The FT group received nicotine under a FR 3 schedule and a FT, t-sec sucrose schedule. Rats in the FT group received sucrose pellets based on averages obtained from rats in the DRA group as a yoking procedure.

Drug infusions per session were the primary dependent measure for drug self-administration. The delivery of sucrose pellets was the primary measure for sucrose maintained behavior. Rats exposed to the DRA condition decreased nicotine self-administration significantly more than those in the FT group. For the DRA group, self-administration decreased by 73%, 69%, and 59% for the 40, 80, and 160 s intervals respectively relative to baseline sessions. The
average number of sucrose pellets delivered under each DRA interval was 82.5, 39.9, and 18.3 for the 40, 80, and 160 s intervals respectively. Rats exposed to the DRA condition exhibited a decrease in drug self-administration within the first 10-min of the session, whereas rats in the FT condition did not. The DRA schedule significantly reduced drug infusions by 43.8%, on average. Rats in the FT group did not significantly reduce drug infusions.

Lesage (2009) showed that a DRA schedule significantly reduced the number of drug infusions while noncontingent delivery of reinforcers showed no effect. This is consistent with previous studies (Carroll, 1985; Cambell, Thompson, & Carroll, 1997) in showing that access to alternative reinforcers can decrease drug self-administration in nonhumans. Lesage (2009) also shows that providing reinforcement contingent upon drug abstinence can lead to a reduction in drug use making this study more analogous to CM interventions. Some subjects in the FT schedule did show some decreases, suggesting that the noncontingent reinforcers may have caused “superstitious” behavior in the rats and they decreased responding on the drug lever. This may be because some instances of pausing may have been followed by access to sucrose, even though this contingency was not in affect for this group. Future research may use a wider variety of DRA intervals because in human research, abstinence from drug use must typically occur for at least a few hours before reinforcement is delivered. Lesage (2009) shows the effectiveness of reinforcing abstinence from a drug for a specified period of time as in most CM interventions.

Early CM studies (Bigelow et al., 1971; Bigelow et al., 1976) have used monetary reinforcement as an alternative reinforcer to drugs. This has raised some ethical concerns because of issues regarding giving money to substance abusers. The concern has been that they will use the money to purchase drugs, but this has never been proven. Today, typical CM treatments use vouchers instead of money. Vouchers are similar to money in that they can be
used in exchange for goods but only through a set up system which is usually created in CM programs. Contingency management procedures using vouchers are proving to be a very effective method of substance abuse treatment.

**Voucher Reinforcement**

The first formal voucher reinforcement procedure for substance abuse was a study by Higgins, Delaney, Budney, Bickel, Hughes, Foerg, and Fenwick, (1991). In this study, CM techniques were used to achieve abstinence in cocaine-dependent individuals. Twenty-five patients were randomly assigned to two groups: standard or behavioral. In the standard group, 12 patients received standard 12-step counseling sessions. In the behavioral group, 13 patients received the same standard 12-step counseling as individuals in the standard group along with CM procedures. Urine specimens were collected 4 times a week for 12 weeks for both groups. Patients were informed of their results immediately after. Patients in the behavioral group were under an escalating schedule of reinforcement for submitting negative drug samples. For each negative sample, points were awarded, each point was worth $0.15. The first negative sample was worth 10 points ($1.50). This schedule escalated by 5 points for each consecutive negative sample submitted. Ten dollar bonuses were awarded for every fourth negative sample submitted. The maximum amount a patient could earn if they submitted all negative samples was $1,038. If a positive sample was submitted, the schedule reset back to the initial $1.50 and began from there. Vouchers could be exchanged for activities within the community (i.e. ski lift tickets, bicycling, fishing equipment). A significant other was allowed to join patients during the activity. Missing specimens were coded both positive and negative to determine if this would affect treatment results. Missing samples were coded as positive under the assumption that patients failed to come in because they had used, therefore they would submit a positive sample
and not receive anything. Patients in the behavioral group showed significantly longer periods of abstinence than those in the standard group independent of how missing samples were coded. Eleven of the thirteen patients in the CM condition continued the study for the entire 12 weeks as compared to five patients in the standard. Ten of the patients in the CM group achieved 4 weeks of continuous abstinence as compared to three in the standard group. Six patients achieved continuous abstinence after 6 weeks after 8 weeks and three after 12 weeks in the CM group. No one in the standard condition met 8 weeks or more of continuous abstinence. This shows the effectiveness of CM as an effective treatment for cocaine abuse and may generalize to other substances such as cigarette smoking. Higgins et al. (1991) is a landmark study for CM procedures because it is the premise for all CM studies today and most are modeled after this one.

**Nicotine Studies**

A study by Alessi, Badger, and Higgins (2004) used CM techniques to gain control over smoking cessation rates over a period of 12 consecutive days to more closely resemble the 2 week abstinence period commonly reported in clinical trials. Abstinence early in treatment is a strong predictor of overall treatment success.

Participants were 37 adult smokers who reported intention of quitting, although, they did join the study but probably to earn money. All participants were over the age of 18 years and smoked at least 10 cigarettes a day. Participants who joined were randomly assigned into two groups: For one group incentives were contingent upon abstinence, and for the other group incentives were not contingent on abstinence.

A baseline session was conducted on a Friday. Beginning the following Monday over the next 12 days, experimental sessions were conducted three times a day (i.e. morning, afternoon
and evening). Participants in the contingent condition were given incentives if they met the criteria for abstinence which was $< 4$ ppm. Participants in the noncontingent condition were told that they would receive monetary compensation regardless of their breath CO reading. Participants in the noncontingent condition were yoked to individual participants in the contingent condition and received reinforcement when the individual they were yoked to did. All participants were unaware of the yoking procedure. Participants in the contingent condition received monetary reinforcement after each sample was submitted if they were abstinent. Payment began at $3$ and increased by $0.50$ for each consecutive negative sample. For every three negative samples, participants could receive a bonus of $10$. If a participant reached $10$ for every negative sample, monetary reinforcement stayed at that level and did not increase, but participants could still receive bonuses. Each participant could earn a maximum of $427.50$. If a participant failed to submit a negative sample compensation, the next negative CO reading was reset back to $3$. Three consecutive negative CO readings reset the monetary value back to the value obtained prior to reset. After completion of the study, all participants received $50$ for completing the study.

There was a significant difference between the contingent and noncontingent groups with regard to breath CO levels. In the contingent condition, 86% of participants submitted samples meeting the abstinence criteria, whereas only 5% of all participants met the abstinence criteria in the noncontingent group. Fifty-nine percent of individuals in the contingent group remained abstinent throughout the entire 12 day study. None of the participants in the noncontingent group remained abstinent throughout the entire study.
Alessi et al. (2004) showed the effectiveness of contingency management and smoking cessation. If the first two weeks of treatment do predict later treatment outcomes, this shows that CM can be used in the initial weeks of treatment to increase future success rates.

Lussier, Higgins, and Badger (2005) examined the relations between achieving smoking abstinence during the initial weeks of cessation as a predictor of long-term success. Past studies (Alessi et al., 2004) have shown that achieving abstinence during the first 2-weeks of treatment as a reliable predictor of smoking status at the end of treatment. Therefore, those at greater relapse risk are those who do not reach abstinence within the first few weeks of treatment. This Lussier et al. (2005) used CM techniques to manipulate the duration of prior smoking abstinence and see if this lead to changes in the reinforcing effects of smoking as a function of prior abstinence.

Sixty-three people were included in the study. All were between the ages of 18-55 years and smoked over 10 cigarettes a day, blew an initial CO breath reading >18 ppm. All participants attended an orientation session in which they were randomly assigned to one of three conditions: 1-day (1C), 7-day (7C), or 14-day (14C) condition. During each condition, participants submitted a breath CO reading in a lab or convenient location three times a day. After each reading, participants were given immediate feedback about their reading and given monetary compensation for achieving abstinence. The abstinence criterion was set at < 4 ppm. For the 14C condition, this was done for the entire 14 days. For the 14C condition, participants received $3.00, for their first negative sample and $0.50 for each consecutive negative sample. A bonus of $10.00 was given for every three consecutive negative samples. Participants in the 14C condition could receive a maximum of $507.50 for remaining abstinent throughout the entire study. If participants failed to submit a sample or submitted a positive sample, their payment rate reset to
$3.00 but after the participant provided three consecutive negative samples payment returned to the highest value previously obtained. For those in the 1C and 7C conditions, payment was independent of CO reading during Days 1-13 and 1-7, respectively. This means that participants in the 1C condition only received money based on CO reading on the last day of the study. Participants in the 7C condition received payment based on CO reading during the last 7 days of the study. When participants in these conditions transitioned over to the CM payment schedules, they received what participants in the 14C condition received on those days (i.e., for the 7C condition payment was based on what participants in 14C received on Day 8 (on average) and escalated from there. To ensure participants finished the study, a $50 bonus was given at the end of the study. After 14 days, each participant conducted a smoking-preference session in which they chose between smoking or money. They were allowed 20 choices. The participants preferred brand of cigarettes, a lighter, and an ashtray were all present. Participants were told they could smoke if they chose to smoke over the money. If they chose money, their totals were added and shown on a video monitor.

Mean CO levels were significantly lower in the 14C condition than in the other two conditions. Overall, CM was an effective method in reducing smoking. During the smoking-preference session, 19% of those in the 14C condition smoked, 57% in the 7C group, and 62% in the 1C group. Those in the 14C group also made significantly fewer choices for smoking during the smoking preference session.

Lussier et al. (2005) showed the effectiveness of CM in the use of smoking cessation and how longer CM conditions and longer periods of abstinence result in lower smoking rates. This implies that reaching abstinence early in treatment may be a predictor of successful outcome
when treatment ends. Longer periods of initial abstinence may be a better indicator of treatment success, and future studies may want to focus on longer treatment periods.

Lamb, Galbicka, Morral and Kirby (2005) examined the use CM in smokers who reported no intention of quitting. Smokers with no intentions to quit are identified as hard-to-treat, and contingencies for abstinence are typically not effective for this group. Percentile schedules may shape reduced carbon monoxide (CO) breath readings which may be helpful for this hard-to-treat group. “Percentile schedules set reinforcement criteria such that behavior in the best xth percentile or better of an individual’s recent behavior is targeted for reinforcement” (Lamb et al., 2005, p.83). When determining what schedule to use, a more lenient criteria for reinforcement may be more effective than schedules closer to the ultimate target behavior. A lenient criteria would include reducing breath CO levels. Using a criteria based on reductions in breath CO levels would more closely resemble behaviors that already exist in an individual’s repertoire because they would reduce their smoking levels instead of quitting. Lamb et al. (2005) examined if percentile-based schedules of CM can reduce breath CO readings in smokers with no intentions to quit and if a more lenient schedule is more effective. They also examined how percentile schedules affects motivation to quit in participants.

Fifty-eight participants with an average age of 40 years completed the 3-month study. Participants smoked an average of 23 cigarettes per day, and all reported no intention to quit within the next 6 months. Participants submitted CO samples once a day, Mon-Fri, between 11:30 a.m. and 5:30 p.m. For each sample, participants were given $1 throughout the entire study. The baseline condition consisted of the first 10 days, and participants only received money for submitting a sample. During the CM condition, participants were randomly assigned to one of two conditions. During both CM conditions, participants received money for submitting
samples that were at or better than the 60th percentile of their most recent sample. The window in which this percentile was calculated differed between each group. In one group, the window was based on an individual’s past 4 samples and 9 in the other. The abstinence criterion was set at 4 ppm. Payments began at $2.50 and increased by $0.50 for each consecutive negative sample.

A bonus of $10 was delivered for every 5th sample meeting the criteria based on the percentile schedule. If a sample was submitted that did not meet the criteria, their reinforcement value was reset to $2.50. After delivering 5 consecutive samples that met criteria, the value reset to the highest previously obtained with a $10 bonus.

There were no significant differences among attendance between each condition and a total of 86.5% of participants completed the study. The number of incentives received did not differ significantly among conditions, but the 4-sample condition received slightly more incentives than the 9-sample condition (50.1 and 41, respectively). Breath CO levels reduced significantly during the CM conditions as compared to baseline. The 4-sample group had lower CO levels than the 9-sample group. More participants in the 4 sample group (83%) delivered CO readings less than 4 ppm than the 9-sample group (63%), this difference was not significant. Participants in the 4-sample group achieved abstinence faster than the 9-sample group.

Lamb et al. (2005) showed that CM was effective in smoking cessation among those who reported no plans to quit in the next 6 months. They found that participants in the more lenient group (4-sample condition) submitted more samples meeting criteria based on their percentile schedules as well as the criteria for abstinence. This suggests that future CM studies using percentile schedules may want to use more lenient criteria as opposed to abstinence because CM procedures using shaping may make smoking cessation more successful by reinforcing gradual reductions in breath CO level. This may because it is an easier criterion for smokers to reach,
therefore they come into contact with reinforcement more often. Shaping procedures provide an effective way to reduce procedures reinforcing abstinence from the beginning of the study.

While previous studies (Lussier et al., 2005; Lamb et al., 2005) have shown CM to be an effective treatment for smoking, few college campuses implement this technique. Correia and Benson (2006) used CM to reduce cigarette smoking among college students using CM techniques. College students were chosen because “the college years are a transition period during which students move from occasional smoking to daily smoking and nicotine dependence (Correia & Benson, 2006, p. 171). Few universities offer cigarette prevention programs, even when students express desires to quit. Universities that offer programs usually provide support groups and very few use CM techniques.

Participants were undergraduate college students between the ages of 18-24 years who self-reported smoking 15 cigarettes a day. All provided an initial CO reading of 18 ppm which indicates heavy smoking. Of the 88 enrolled students, 39 provided data throughout the study. A breath CO reader was used to determine periods of cigarette abstinence. A reading below 8 ppm was the determined level for abstinence. An ABA design was used, with each phase lasting one week for 3 weeks. Participants were also asked to report the number of cigarettes they had that day and were reminded that it would not affect their monetary earnings.

The first week of the study was the baseline phase (Baseline 1). Participants came into the laboratory Monday-Friday in the morning (8:00 a.m.-10:00 a.m.) and in the afternoon (4:00 p.m.- 6:00 p.m.). A CO sample was collected each time, and each participant received $4 per session regardless of CO reading. The second week of the study was the intervention week in which CM was applied. There were two conditions: low magnitude reinforcement and a high magnitude reinforcement condition. The only difference between these conditions was the value
of reinforcement. Participants continued to give samples during the same times as during baseline and report their cigarette use. Participants would received payment if their CO levels met their abstinence criteria of > 8 ppm. For their first abstinent sample, participants received $1 and consecutive abstinence readings would earn them an additional $.50 (e.g. the next consecutive sample would result in payment of $1.50, then $2 and so on). After five consecutive negative samples, they earned a bonus of $3.75. Failure to submit a negative sample, or a sample at all, resulted in a reset of payment to $1, and they began the escalation schedule again. Payment was disbursed immediately after the CO sample reading was obtained. Participants could earn a maximum of $40 for abstinence across all 10 sessions. For the high magnitude condition, participants were paid $2 for the first negative sample and payment escalated $1 for each consecutive negative sample. Bonuses of $7.50 were given for five consecutive readings. Participants earned a maximum of $80 per week. During the third week, conditions returned to baseline. If participants attended all sessions throughout baseline they earned $25 regardless of CO sample reading.

Significantly more negative samples were submitted during the intervention phase than baseline overall. More negative samples were submitted during the high magnitude condition. Correia and Benson’s (2006) results supported the use of CM techniques to reduce cigarette smoking in college students. These results are consistent with Lussier et al. (2005) that have reported reduction of smoking with the use of CM. A weakness was that smoking returned to baseline levels after the CM intervention, suggesting short term effects of CM. Increasing the length of the contingency period or increasing reinforcer magnitude could increase effectiveness.

Although CM has proven to be effective in smoking cessation programs, CM programs are not always accessible or convenient for people who plan on quitting. There are obstacles to
overcome that may limit its application. Subjects submitting a negative breath carbon monoxide (CO) reading are given some type of prize or reward. This requires them to show up to submit a sample to gain their prize, but they may not show up if they have been smoking because they would not get anything for their time. Breath CO levels must be measured twice a day which may make it difficult for subjects to come into a laboratory and submit a sample every single time.

To solve this problem, Dallery, Glenn, and Raiff (2006) used an internet-based study that allowed participants to submit breath CO samples from their home which is more convenient and practical for participants. Twenty participants were between the ages of 18 and 60 years and considered heavy smokers that expressed some desire to quit. They were informed that they would receive $100 for completing the study and could earn a maximum $171.50 in vouchers for remaining abstinent throughout the study. All participants were loaned a laptop that was set up by researchers. Each laptop contained a tracking device to discourage stealing. Researchers explained how to use the laptops, the web camera, and the CO monitor to participants. Participants were required to submit two video clips a day of them breathing into the CO monitor and their reading. A website was created so participants could see a graph of their CO results, their total number of voucher earnings, and a link to websites where they could use their vouchers to make purchases (e.g. amazon.com). The website also posted links to smoking cessation websites.

The first phase was the baseline phase that lasted 5 days in which participants could earn $5 a day for submitting two samples a day regardless of breath CO value. The next phase was the shaping phase which lasted 4 days. Participants could earn $3 for specific reductions in CO readings. For each participant, an average CO was calculated during baseline. Progressively
lower CO values were calculated so that over 8 samples the last CO would be < 7 ppm which was the abstinence criteria. The abstinence induction phase took place over the next 10 days. The first negative sample resulted in a $3 voucher. For each successive negative sample the voucher value increased by $0.25. For every third consecutive sample a $5 bonus was given. If participants failed to submit a sample or submitted a positive sample the voucher value reset to $3 for the next negative sample. After three consecutive negative samples, the voucher value returned to the highest previously obtained. Over the next 4 days, a thinning phase was implemented in which participants received $5 for their fourth and eighth negative samples. A return to baseline phase was then implemented that was identical to the first baseline phase.

A high percentage of CO samples was collected during this study (97.5%), which shows that this was an effective way to collect CO samples. There was a significant increase in the percentage of negative samples collected during the abstinence induction phase when compared to both baseline phases. Ten participants remained abstinent during the return to baseline condition which suggests that there may be some long term effects to CM procedures.

Dallery et al. (2006) showed that an internet-based method is feasible, and an effective way to promote smoking cessation. The shaping phase was done to increase the likelihood that participants would submit negative samples. Longer treatment phases may decrease the likelihood that participants return to smoking which is a major concern since many smokers relapse. Shaping may be an effective way to increase the likelihood of participants submitting negative samples.

Lamb, Morral, Kirby, and Galbicka (2010) used shaping to increase the likelihood that individuals identified as hard to treat would quit smoking. Most smoking cessation programs use initial abstinence as criteria for reinforcement. If individuals do not start out abstinent they will
not obtain reinforcers early in treatment which could lead them to not do well throughout treatment. Those identified as hard-to-treat (HTT) are individuals who do not meet criteria early in treatment and are likely to not have good treatment outcomes. Shaping may provide a way to help these individuals have successful treatment outcomes by making the criteria for reinforcement a portion of the present behavior, rather than total abstinence. This allows for more contact with reinforcement since the criteria for reinforcement is not as difficult to achieve and the individual can gradually move towards abstinence.

Participants were 146 individuals over the age of 18 years that expressed a desire to quit smoking. A 10 visit preintervention period took place during which participants came in once a day during the weekday to submit a breath CO sample between 11:00 a.m. and 5:30 p.m. at a predetermined time. On the first day, participants were given $2.50 if they blew less than 4 ppm. They were first informed of the criteria and that it could be achieved if they did not smoke for an entire day. During Days 2-10, participants came in once a day to submit a sample and received $1.00 for coming in. No other contingencies were in effect. They were told by researchers that they wanted to see how well they did on their own. If participants submitted at least more than one sample during Days 2-10 that was less than or at 4 ppm they were classified as easy-to-treat (ETT). If they did not, they were classified as HTT. Fifty participants were identified as ETT and 96 as HTT. Participants were then asked if they planned on using medication to aid their smoking cessation or not and were categorized based on their answers. So they could be ETT with or without medication, or HTT with or without medication, creating four groups. Each group was randomly assigned to regular CM or CM with shaping procedures (CMS). During the CM condition, participants came in once a day, for 60 days to submit a sample and received reinforcement if they blew < 4ppm. Payment began at $2.50 and escalated by $0.50 for
each consecutive negative sample. Five consecutive negative samples resulted in a $10.00 bonus. If a sample was positive, the payment reset to $2.50, and after five consecutive negative samples the payment returned to the highest payment value previously achieved. The maximum earnings was $1,157.50 if all samples were negative.

The CMS condition was identical to the CM condition, except the criteria for reinforcement was based on specified reductions in breath CO level based on a percentile schedule. Participants received reinforcement if their breath CO was at or below the seventh lowest of the past nine samples or < 4 ppm. This provides a moving window which allows for behavior that already exists in the participant’s repertoire to be reinforced as well as providing incentives for reduced breath CO levels, thus keeping reinforcement rate constant. Participants were told what their CO criteria would be for the next visit but not told how this criterion was determined.

Clusters analyzed were ETT with regular CM, ETT with CM and shaping (CMS), HTT with regular CM and HTT with CM and shaping (CMS). Groups based on whether or not participants received medication were collapsed into these four clusters because no differences were found between the medication or no medication groups. The four clusters did not differ based on demographics, but HTT participants were older, had fewer smoke-free days, were more likely to be allowed to smoked at work, and had higher breath CO levels at intake. Participants in the HTT-CM and HTT-CMS groups did not differ. The CMS was designed to provide reinforcement on 70% of visits. During the study, participants in the CMS group actually earned reinforcement on 60% of visits. Half the participants in the CM group earned incentives at least 10% of the time. Every participant in the CMS group received reinforcement compared to 63% of participants in the CM group. The average number of incentives earned in the CM group was
3.5, where as participants in the CMS group, on average earned 44. Incentive contact differed for the two HTT groups but did not for the two ETT groups.

Participants in each cluster were assigned to one of four groups based on treatment outcomes: stable success, improving, deteriorating, during visits that had been divided into sets of 10 (e.g. Visits 1-10, 11-20). These criteria were based on the number of breath CO samples that met abstinent criteria from a past study by Morral, Iguchi, Belding and Lamb (1997). Stable success was defined as submitting at least 90% negative of all samples submitted in a set of visits. Improving was defined as starting out submitting relatively low negative samples, and rapidly increasing the number of negative samples submitted after a set of 3 or 4 visits. Deteriorating was defined as entering treatment and submitting samples meeting criteria early, but rapidly decreasing after a set of 3 or 4 visits to 60% negative of all samples submitted or above. Stable poor was defined as submitting less than 10% negative in a set of visits throughout the entire study. Those in the CMS group were significantly more likely to belong to the stable success or improving group and were more likely to be abstinent at the end of treatment. Those in the HTT CMS group had better chances of being abstinent at the end of treatment and more in the stable success and improving clusters. Participants in either ETT group were significantly more likely to be abstinent at the end of treatment than those in the HTT group. Treatment outcomes for those in the ETT-CM group or ETT-CMS group did not differ.

Lamb et al. (2010) showed that individuals identified as HTT would benefit from shaping procedures. This may be because they come into contact with reinforcement early in treatment compared to no reinforcement in treatments that reinforce abstinence early in treatment. For individuals identified as ETT, shaping did not increase success rates which suggest that shaping
should only be used in participants identified as HTT. Participants in the ETT group still did better than those in the HTT-CMS group. Future research is needed to determine why this is and how treatments can be developed to change these differences.

These studies (Lussier et al., 2005, Dallery et al., 2006) rely on continuous reinforcement which can be expensive and there are debates over the cost-efficacy of those techniques. In basic behavioral research, continuous reinforcement results in quicker extinction than an intermittent schedule of reinforcement which could generalize to the applied setting as well. An intermittent schedule of reinforcement may provide a more cost-effective method with treatment effects that are long term.

**Fishbowl Studies**

Treatments using intermittent schedules of reinforcement could provide treatment effects that maintain abstinence longer than those using continuous schedules once the reinforcement contingency is no longer in place. This assumption is based upon basic behavioral research studies in which intermittent reinforcement has been shown to produce higher rates of responding and more resistance to extinction. Contingency management procedures using intermittent schedules may be a more effective treatment option. Treatments using this schedule often use a “fishbowl” system in which participants draw from a prize bowl if they are able to provide proof of a decrease in substance use or abstinence.

Petry and Martin (2002) examined the effectiveness of low cost CM interventions among methadone maintenance patients. Forty-two cocaine using methadone maintenance patients in community treatment programs were used. Evaluations were conducted at intake that include the Addiction Severity Index (ASI) and were administered again at weeks 4, 8, 12, and 24. Participants were randomly assigned to one of two groups: one only received standard treatment
and the other also received CM treatment. All participants in this study received standard treatment. All also had to provide urine samples 2 or 3 times a week. Participants assigned to the CM condition could earn one draw for submitting negative urine samples. If they submitted negative samples for both cocaine and opioids for one week, they could receive 4 draws that day. If they provided negative samples weekly they could earn 5 bonus draws which escalated by one for each consecutive week of abstinence. If they did not provide a sample or produced a positive sample, they received no bonus draws that week, and the number of draws reset to the original level (1 draw). A week of abstinence would reinstate the 5 bonus draws and draws would return to the highest level previously achieved by that patient. The bowl contained 250 slips of paper: half of them said “Sorry, try again,” 109 were small prizes ($1), 15 were large ($15) and 1 jumbo prize was worth $100.

Retention rates did not vary significantly with slightly more, 89%, in the CM group, and 87% in the standard group. Patients in the CM group submitted significantly more negative urine samples and remained abstinent for the longest amount of time. The average cost of the prizes won by patients was $137. During the 12 week follow up, more patients in the CM condition remained abstinent with 54% submitting negative samples, and 34% for the standard group.

Petry and Martin (2002) showed the effectiveness of using CM treatment in addition to standard substance abuse treatment using an intermittent schedule of reinforcement. There also appears to be some long term effects when treatment has ended. Since cocaine and opioids were tested, this shows that CM can promote abstinence in multiple drugs at one time. Petry and Martin (2002) demonstrated the effectiveness of low cost procedures suggesting that prize-based CM is an effective, low cost way to produce abstinence in substance abuse.
Alessi, Hanson, Weiners, and Petry (2007) examined the effects of CM in treatment at community-based programs which provided group therapy. Participants were 103 adults above the age of 18 years who had entered one of three community-based substance abuse treatment programs. Participants were current cocaine, opiate or alcohol abusers. All participants took place in an intake evaluation in which they all gave a urine sample. Each received a $15 gift certificate for completing the intake evaluation. Each site implemented a different condition which was determined randomly. Site A received the standard treatment first and then began CM procedures. Sites B and C got the conditions in reverse order. Each condition lasted 12 weeks.

Participants in the standard treatment condition received standard outpatient treatment that was administered by at least 3 counselors and included group therapy. Participants were expected to submit drug samples twice a week during the first 6 weeks and once during the last 6 weeks. Submitting a sample would earn participants $1 per sample regardless of the sample reading.

During the CM condition, participants received the same standard treatment and compensation for samples submitted as the standard group. Participants in this condition could also participate in drawings for attendance. At the beginning of each group session, participants wrote their names of pieces of paper to place in a drawing. Bonus drawings were allowed for consecutive group attendance. Missing a session resulted in no draws for that week and reset their number of draws to one until the next full week of attendance. On Mondays, 10 names were drawn and the first 8 people received a prize worth $1, and a $20 prize was given to the 9th person. Before the 10th name was drawn, a die was rolled and if it landed on 1, a $100 prize was given to that person. If it landed on numbers 2-6, a $20 prize was given. On Tuesdays through Fridays, five names were drawn and the first four people received a $1 prize. Before the 5th
name was drawn, a die was rolled. If it landed on an odd number, that person received a $20 prize or a $1 prize if it landed on an odd number.

Drawings were based on abstinence from cocaine and opioids, as well as negative alcohol breath readings. They were conducted during individual meetings with participants and researchers. For the first negative sample, an individual earned one draw from the prize bowl. This number escalated by one for each consecutive negative sample. A participant could earn a maximum of 10 draws. A positive sample or failure to submit a sample resulted in no draws that day and a reset to 1 draw for the next negative sample. The prize urn contained 500 cards: 250 cards said “Good Job,” 219 cards were worth $1 in prizes, 30 cards were worth $20 in prizes and one card was worth $100 in prizes. Cards were replaced after each drawing to ensure that the probabilities remained constant.

Attendance for the CM and standard treatment groups were similar, although there were slightly higher attendance rates for the CM condition. Participants in the CM condition abstained for significantly longer periods of time than those in the standard condition. More participants in the CM condition achieved at least 6 weeks of abstinence and more abstained for the whole 12 weeks of treatment than those in the standard treatment group. Overall, percentages of negative samples did not reach significant differences between conditions, but more negative samples were submitted during the CM condition.

Follow up tests for abstinence were done 6 and 9 months after the end of the 24 week study. At month 6, rates for submission of positive samples were similar across conditions. At month 9, participants in the CM condition submitted less positive samples than those in the standard condition (32.3% and 61.5% respectively). Alessi et al. (2007) supports the use of CM
as an effective intervention for substance use disorders and suggests that it is feasible to implement CM techniques into community-based treatment programs.

Previous research (Alterman et al. 1997) has shown that success during a drug treatment program can be predicted by urinalysis test results at the beginning of treatment. A positive sample would predict a decrease in the likelihood that the program would lead to abstinence. Contingency management techniques have proven very effective in improving treatment outcomes in substance abuse. Drug-positive intake samples could differentiate treatment responses in these individuals because it would be more difficult for these individuals to respond to treatments that give participants a chance to earn incentives that require abstinence. So if participants submit positive samples initially, they may be less likely to have a positive treatment outcome because they are not receiving reinforcement early in treatment. Stitzer et al. (2007) conducted a study to determine if incentives are effective for participants who test stimulant positive and stimulant negative at study entry, and if any differences in treatment outcome existed between groups.

Participants were 415 stimulant abusers seeking treatment at community outpatient drug centers. To be included in the study, participants had to test positive for stimulant use 2 weeks prior to the beginning of the study. All participants were given an initial urine test at the beginning of the study. All participants were compensated $20 for their sample regardless of reading. Participants were then randomly assigned to one of two conditions. One condition would be the usual care given during treatment within the clinic. The other condition would receive the same treatment as the first but an abstinence incentive program was also implemented. Participants in the control group only received feedback about their urinalysis test results. Participants in the incentive group could earn draws from an abstinence bowl containing
500 chips when they submitted negative samples. Of the chips, 50% read “Good Job,” 42% resulted in a small, $1 prize, 8% resulted in a large, $20 prize and one “jumbo” chip resulted in a prize worth $80-$100. The number of draws escalated by one per week during the 12 week study, but only if the samples were consecutively negative. If a sample was not given or was positive, the number of draws reset to zero and would escalate again for consecutive negative samples. Participants could earn a maximum of $400 worth of prizes if they remained abstinent throughout the entire study.

Stimulant positive and stimulant negative participants were compared based on drop-out rates and during the incentive condition. There was a significant effect in retention, with those testing positive at intake less likely to remain in treatment (29% testing positive remained in treatment compared to 47% testing negative). There was also a significant effect during urine test intake and percentage of negative samples submitted. Percentage of negative samples submitted was 54% for those entering stimulant negative and 25% for those entering positive. There was only a significant effect of the CM condition on retention for those who entered stimulant negative. Only those who tested negative at the beginning were significantly more likely stay in the study during CM conditions only. During the CM condition, incentives only had a significant effect for those who entered the study stimulant negative with more participants submitting significantly more negative samples in the CM condition.

Stitzer et al. (2007) showed the value of urine tests at the beginning of treatment as predictors of treatment outcome. Those testing negative are more likely to have a positive treatment outcome than those who test positive. This would suggest that those who enter treatment drug positive may need additional treatment than those testing negative.
While CM has been shown to be an effective treatment, a concern has grown over the cost of the therapy since it relies on delivering prizes contingent upon submitting negative drug tests. It is argued that CM is more expensive to implement than standard treatment alone and due to high relapses rates, may not be a cost-effective form of therapy. Sindelar, Elbel, & Petry, (2006) examined different CM conditions, varying in costs, along with standard treatment.

One hundred and twenty participants entering a cocaine substance abuse treatment center were randomly assigned to one of three conditions: (1) standard treatment with drug testing, (2) a CM condition with a low pay-out rate ($80), and (3) a CM condition with a higher pay-out rate ($240). Each condition lasted 12 weeks. The two CM conditions allowed the same number of draws but differed in the maximum cash value of prizes. Draws were contingent upon providing negative urine samples and for attending allowable meetings (e.g. alcoholics anonymous). Completing three goal-related activities a week resulted in additional drawings. The two bowls for each CM condition contained the same probabilities for prize winnings. In the $80 CM condition, participants could earn prizes worth $0.33 and $5. In the $240 CM condition participants could earn prizes worth $1 and $20. Both conditions contained one prize worth $100. Standard treatment included 3-5 days of group therapy sessions during the first 3-4 weeks, 2-3 days of group therapy during weeks 4-6, and 1 day of treatment during the final 7 weeks. Urinalysis tests were given three times a week during the first three weeks, twice a week for the next 3 weeks, and once a week during the last six weeks. A maximum of 21 samples were collected during the 12 week period. The number of draws increased each week for each consecutive negative sample. If no sample, or a positive sample was submitted, the number of draws reset to one.
The high payout ($240) CM condition had more participants complete the study (31.6%) than the low payout ($80) CM condition (20%), and the standard treatment condition (13.5%). After analysis, the high payout CM condition was more cost-effective than the low CM condition and standard treatment because more people completed the study and more people submitted negative samples. The low payout CM condition did not significantly enhance outcomes whereas the high payout CM condition did. Since CM has been proven to be an effective treatment option for substance abuse; determining its cost-effectiveness is crucial if it is to be implemented into community based treatment programs.

The National Drug Abuse Treatment Clinical Trials Network (CTN) has become interested in testing the efficacy of CM procedures because of their high costs and negative attitudes about giving substance abusers tangible reinforcers. Pierce et al. (2006) determined the effectiveness of intermittent reinforcement while using CM within the CNT across a wide variety of clinics and populations.

Six methadone maintenance clinics within the CNT were used that included 388 outpatients. All participants had to submit a positive urine sample 2 weeks prior to start of the study. Participants were randomly assigned to one of two conditions: usual care or CM. During the usual care condition, participants received usual care services within their treatment program. Participants were also asked to produce breath and urine samples twice a week and were given immediate feedback about their results. If they tested negative, the research staff simply congratulated them. During the CM condition, if the participant tested negative for alcohol breath and urine samples that tested for opioids they could draw a prize from an abstinence bowl containing 500 chips: 50% were marked “Good Job,” 41.8% resulted in a small prize, 8% resulted in a large prize, and 1 chip resulted in a jumbo prize. Small prizes were worth $1, large
prizes were worth $20, and a jumbo prize was worth $100. The number of draws escalated by one per week for each consecutive negative sample. If a positive sample, or missed session occurred, the number of draws reset to zero. For achieving abstinence during the first 2 weeks of the study, participants were awarded 2 bonus draws. If participants remained abstinent for the entire 12 week study they could earn a maximum of $400 in prizes.

By the end of the 12 week period, retention rates were similar across groups with slightly more participants in the CM group (67.1% vs. 64.8%). The two groups also submitted similar numbers of urine samples with the CM group submitting slightly more. The number of therapy sessions attended did not differ significantly between groups. Participants in the CM condition submitted significantly more negative urine samples than the usual care group. At the 6 month follow up, there were no significant differences between the two groups. The average cost of the treatment per participant was $120 per patient, or $1.42 per patient per day during the 12 week study.

Pierce et al. (2006) shows the effectiveness of CM to increase drug abstinence among methadone patients which doubled the likelihood that participants would provide negative samples. Since this procedure used an intermittent reinforcement schedule, the cost of this treatment was considered relatively low, yet highly successful. One issue would be the relapse rates after the termination of the treatment program, but this should not discount the value of the treatment when it is in effect. Lowering the cost of the incentives is a possibility and further cost-benefit analysis would be useful. It would be important to determine how to increase abstinence when CM treatment has ended.

Previous studies (Petry & Martin, 2002; Alessi et al., 2007) using prized based reinforcement in CM have mainly been used with methadone patients and many smoking studies
(Alessi et al., 2004; Correia & Benson, 2006) have only used continuous schedules of reinforcement. Alessi, Petry, and Urson (2008) used a prize based CM procedure to reduce smoking in substance abuse patients.

Participants were 24 males in a residential substance abuse treatment home over the age of 18 years. All had current alcohol, cocaine, or heroine dependence that expressed an interest in quitting smoking. All participants took a quit preparation session which included a guide for smoking cessation, tips for craving control, and set a quit date. The first 12 participants were placed in the CM condition and the last 12 in the standard treatment condition. All participants submitted breath CO samples during the weekdays between 6:00 a.m. and 9:00 p.m.

In the standard care condition, CO samples were collected four times per week during Weeks 1-4, twice per week during Weeks 5-8, and once a week during Weeks 9-12. Cotinine tests were collected on one random day throughout the week. Participants were given one bowl draw each day, regardless of breath CO levels or Cotinine tests. In the CM condition, four breath CO samples were collected in Weeks 1-3, three per week in Weeks 4-6, and twice a week during Weeks 9-12. Cotinine tests were conducted on one random day a week. During Weeks 1 and 2, negative breath CO readings (< 8 ppm) resulted in one draw from a guaranteed bowl where participants would always earn a prize. This bowl contained 25 cards: 17 $1.00 prizes, seven $20.00 prizes, and one $100.00 prize. Draws increased by one for each negative CO reading. If participants tested positive, or had an unexcused absence then the number of draws reset to one, but two consecutive negative tests reset the number of draws to the highest number previously achieved. During Weeks 3-12, draws came from a standard bowl with 500 cards: 250 said “Good Job,” 219 $1.00 prizes, 30 $20.00 prizes, and one $100.00 prize. Draws increased by one per week with a maximum of 12 draws per sample submitted. Five bonus draws could be earned for
negative Cotinine tests. A maximum of $910.00 in prizes could be earned if all samples were negative.

Smokers in CM and standard care did not differ according to demographics (e.g. age, race, employment) or the average number of cigarettes smoked per day, smoking amount, and years smoked. Participants in the CM condition submitted more negative CO samples (70.7%) than those in the standard condition did (12.8%). Participants in the CM condition also had a longer duration of consecutive negative CO samples than those in standard care alone. Only one participant in the CM condition never met CO criteria compared to 4 participants in the standard care condition. Follow up tests after treatment had ended did not reveal group differences at Month 3 or Month 6.

Overall, the prize CM condition resulted in more reductions in smoking than the standard care group showing the effectiveness of a prize based CM procedure for reductions in smoking. Alessi et al. (2008) used participants from a substance abuse treatment facility which may represent a harder to treat population and future studies may want to include populations without substance dependence.

These studies (Alessi et al., 2008; Petry & Martin, 2002) show that an intermittent schedule of reinforcement is an effective way to increase abstinence rates. They also show that these schedules may produce more long term treatment effects and are more cost efficient than continuous reinforcement procedures. This could make it easier to implement in community-based treatments. A prize bowl technique may be a more efficient method to reduce substance abuse. Few published studies have used intermittent reinforcement to encourage smoking cessation.
Current Study

Cigarette smoking has become a widespread health concern across the country and is responsible for billions of dollars in health related economic losses. Many smokers who wish to quit often have difficulties and often relapse suggesting the need for better treatments outside of nicotine replacement therapies. Past studies (Alessi et al., 2004; Dallery et al., 2007) using CM have proven to be an effective method to increase nicotine abstinence rates by reinforcing the submission of objective proof of abstinence (breath CO levels) and providing alternative reinforcers (e.g. vouchers, money) for abstinence. While reinforcing every instance of reduced smoking or abstinence has proven to be effective, it is also costly and may have short term treatment effects. Using a CM procedure based on an intermittent schedule of reinforcement may prove to be more effective and less costly. The purpose of this study will be to examine the effectiveness of prize based reinforcement using an intermittent schedule in college students. Unlike past nicotine studies (Correia & Benson, 2006; Dallery et al., 2007), an intermittent schedule of reinforcement for reductions in breath CO levels or abstinence will be used instead of continuous. Like past studies (Petry & Martin, 2002; Pierce et al., 2006) a prize bowl technique will be used that participants can earn draws from, but reductions or abstinence from smoking will be reinforced using a breath CO monitor for measures. This study was similar to Alessi et al.’s (2008) study, except participants are not in a substance abuse facility and a within subjects design was used instead of a groups design.

METHOD

Participants

Participants were 7 male (4) and female (3) undergraduate and graduate college students between the ages of 18-65 years, attending the University of North Carolina Wilmington.
Students were recruited through the use of flyers placed on campus. Recruiting methods indicated that individuals who wished to quit smoking can join the study and possibly win prizes for abstinence. Of the 15 students that contacted researchers, 8 participated in intake sessions. Of these 8, one did not meet criteria to be included in the study. The other 7 participated in the study. To be included in this study, a participant must currently be smoking and smoke at least 14 cigarettes a day for at least 1 year with an initial breath CO of > 6 ppm. All students were available at least twice a day to provide breath CO samples Monday-Fridays in the morning and afternoon. Finally, all participants must have expressed a desire to quit smoking during the study. Students had to express a desire to quit smoking because we did not want students participating solely to earn prizes. Participants were not given nicotine replacement therapies or medication during the study and none reported using them.

**Screening**

Participants signed up for screening interviews by contacting research assistants thru e-mail. Screening took place during the first session that participants met with research assistants which was the intake session. Upon attending intake, participants were interviewed to determine if they met basic qualifications for the study by research assistants in a private room located at a lab on campus. Participants were asked for proof of their age first to ensure they were at least 18 years of age. Participants also filled out the modified Fagerstrom Test for Nicotine Dependence (FTND) questionnaire. The FTND includes questions about the individuals smoking status such as years smoked and the number of cigarettes smoked per day, on average. This was done to ensure that participants meet all standards for inclusion in the study and gain some basic information regarding each participant's smoking status. After meeting criteria on the FTND, participants were shown how to use the breath CO monitor and told that it was a measure of how
much they had recently been smoking. They were then asked to blow into the machine to submit their first sample. A participant had to blow > 6 ppm to be included in the study to ensure individuals were currently smoking. Participants were not informed of what the criteria were to be included in the study. If participants did not meet criteria they were told by researchers’ that they did not meet criteria to be included in the study, but were allowed one draw from the prize bowl for their time. Each participant filled out an informed consent form and was assigned a subject number for identification on all further instruments.

Participants then filled out a series of surveys which took approximately 10 min to complete. Participants filled out the Motivation and Confidence questionnaire to assess current motivation to quit smoking. Answers were based on a likert scale ranging from 1-7 with a score of 1 indicating no confidence or motivation at all and a score of 7 representing extreme motivation or confidence. The Hughes and Hatsukami Adjectives Withdrawal Questionnaire assessed current mental and physical states that participants might be experiencing due to nicotine withdrawal. Answers were based on a likert scale ranging from 0-3 with a score of 0 representing none and a score of 3 representing severe. The Smoking Consequences Questionnaire (short version) to assessed attitudes and beliefs about the consequences of smoking. Answers were based on a likert scale ranging from 0-9 with a score of 0 representing unlikely and a score of 9 representing likely. A booklet called “Kiss That Butt Goodbye” was distributed to each participant. They were given time to look through the entire booklet and ask researchers questions regarding material from the booklet. Material from the booklet included information about the health risks associated with smoking, withdrawal symptoms to expect, and tips for quitting. See Appendix for copies of all questionnaires and the “Kiss That Butt Goodbye”
booklet. Participants then set up a schedule for all future meetings and were allowed one draw from the prize bowl that was used for all baseline sessions.

**Materials**

A breath carbon monoxide (CO) monitor by SmokeCheck® monitor by Micro Medical Ltd (Kent, UK) was used to assess smoking levels in participants. The monitor returns values between 0-500 ppm CO. Breath CO levels are a measure of carbon monoxide in a breath sample, which is a good indicator of recent smoking status. Values of 0-6 ppm indicate recent abstinence, and higher levels indicate probable smoking in the last 4 hours. Prizes ranged in value from small (< $10), medium ($20-$40), large ($50) and jumbo ($100). Small prizes included items such as candles, nail polish, gum, medium prizes included items such as water filters, web cameras, large prizes included items such as Apple i-pods®, gift certificates, and jumbo prizes were Tom Toms® or portable DVD players.

**Procedure**

For this study a within subjects AB design was used. Baseline took place during the first three 3 days of the study with the first session beginning during intake which always occurred on a Wednesday so participants would complete baseline before the weekend. The following 7 days were considered “treatment” which is when CM techniques were introduced. There was no return to baseline phase due to the lack of funding for this study. During the baseline phase, all participants were encouraged to quit smoking and provided breath samples twice a day at an on-campus lab, Monday-Friday during the morning and afternoon hours. All samples were separated by at least 4 hours due to the short half-life of CO. Participants were asked how many cigarettes they smoked that day or since their last sample and provided a breath CO sample. They were then allowed one draw from a prize bowl for submitting a sample, regardless of breath CO. Half
of all the tickets resulted in no prize and the other half were for small prizes. The prize bowl contained 100 raffle tickets. After drawing a ticket, researchers used an excel sheet that listed all the numbers for the tickets in the bowl to determine what prize to give participants. Which participant drew that ticket was recorded on the excel sheet to keep a record of prizes won. A new ticket replaced the drawn ticket and was added to the excel sheet after each draw to keep the probabilities constant. If a participant did not draw a winning ticket researchers told them “sorry, you did not win but you can try again next session” or something similar since there were different researchers and a script was not used to control what each researcher said to participants. During this phase, participants were not aware that they can only win small prizes. This was done in order to save the bigger prizes for the CM phase.

During the CM phase, participants provided breath CO readings twice a day, Mon-Fri during morning and afternoon hours the same as in baseline phases. They were also asked how many cigarettes they smoked but were told that their draws were not contingent upon this but their CO reading alone. A percentile schedule was used based on the samples participants submit during baseline sessions. Under the percentile schedule, participants were allowed to draw from a prize bowl for specified reductions in CO levels or meeting abstinence criteria. Under the percentile schedule, the criterion was determined based on a 40% reduction of the last sample submitted during baseline and were told to smoke about half of what they were previously smoking in order to meet criteria. This would be done until samples met abstinence criterion which was a breath CO level of < 6ppm. Six was chosen because this should have been a low enough value to indicate no smoking within the past 4 hours. The next time they came in, they had to blow at or below this level in order to receive a draw. For example, if a participant’s last sample was 20 ppm then a 40% reduction would be 12ppm in order to receive a draw. If a 40%
reduction was at or less than 6 ppm then participants were told to quit smoking. All samples were collected in a private location on campus in a lab. Participants were able to draw immediately after their CO reading was confirmed, as long as they met criteria. Draws were done similar to baseline but a different prize bowl was used with higher value prizes which were listed on a separate excel sheet which indicated what size prize was drawn. If participants drew a winning ticket, they were allowed to choose a prize from a prize catalogue that corresponded to the value of the prize drawn. A prize catalogue was created to show the participants all the prizes available to them and what size category they belonged to. This was done so that participants could easily view all the prizes that were available to them. Prizes were retrieved by a researcher to ensure that only the prize chosen was given to the participant. If participants did not draw a winning ticket they were told “sorry, you did not win a prize but maybe next time” or something similar by researchers. Researchers were also supposed to write “Good Job” on the ticket and hand it back to participants, but this did not happen each time and sometimes participants would leave the tickets in the lab. This resulted in the total collection duration on each instance being about 5-10 min. After each draw, tickers replaced to ensure the probabilities remain constant throughout the study. Participants never lost a won prize, even if they reverted back to smoking. After the first 3 participants, it was noted that they were not winning very often which may affect treatment success since participants were not coming into contact with reinforcement. After the third subject, draws were “rigged” so that the first sample that met criteria was always reinforced with at least a small prize. So if a participant drew a non-winning ticket researchers informed them that they won a small prize and noted it on the excel sheet. Participants were not allowed to view the excel sheet at any point in time during the study.
The odds of winning a prize are inversely proportional to the value of the prize. During the CM phase, 50% of the tickets in the prize bowl resulted in no prize, 42% of the slips indicated small prizes worth $1-$10 in value (e.g. candy, sunscreen), 5% were medium prize worth approximately $20-$40 in value (e.g. picture frames), 2% were large prize (e.g. Apple I-pods shuffles) worth approximately $50-$80 in value and 1% were for jumbo prizes worth $150 and $200 in value (e.g. Tom Toms, portable DVD players). Missing samples were coded as both positive and negative to determine if coding would affect the data. Missing samples were coded as positive under the assumption that participants smoked and did not show up because they would not earn a prize. Data that includes missing samples when coded as positive and negative may reveal differences when compared to the data of obtained samples which needs to be taken into consideration if differences are large as it may over or underestimate treatment effects.

Upon the first sample submitted that indicated recent abstinence, participants were asked to fill out the Hughes and Hatsukami Adjectives Withdrawal sheet again. This was done to assess any withdrawal symptoms they are currently reporting experiencing.

After the final sample was collected, participants were asked to fill out exit questionnaire to assess self-reported smoking statues during the study, confidence on achieving or maintaining abstinence at future time points, and satisfaction with the study. Participants were debriefed on the aims of the study, and directed to Crossroads for further assistance for smoking cessation.

**Data Analysis**

The main dependent variable for this study was breath CO samples, specifically total number of abstinent samples during CM, average PPM of samples, average number of consecutive abstinent samples, and longest duration of abstinence. For each participant, the number of abstinent samples or samples that met criteria during CM will be compared to
baseline phases to see if prize draws being contingent upon meeting criteria increased the number of samples that met criteria. Secondary measures will include attrition, value of prizes won, and number of collections missed. Missing samples were coded as both positive and negative to see if there is a large difference based on coding of missing samples.

All surveys were analyzed using means and standard deviations. Due to the small sample size, correlations and regressions could not be done to see if any predictors of treatment success exist. The survey data for each individual was compared with each participant to see there appeared to be any relations between some of the survey data and treatment outcome. Some items collected on the FTND (e.g. number smoked on average, years smoked) were compared on an individual level to see if those with better treatment outcomes have different responses. The H & H questionnaire was compared from intake to submission of the first sample that met criteria to see if any difference existed from when participants were smoking to when they were not. The Motivation and Confidence questionnaire was compared across participants as well to see if there were differences in those with better treatment outcomes and the same was done for the Exit questionnaire. Items from the SCQ-S were not averaged or compared across individuals. This is because the questionnaire is made up of a variety of questions that assess different categories of beliefs and averages from this survey did not hold very much meaning.

RESULTS

Subjects reported smoking an average of 17 cigarettes per day (SD = 6.72) and smoking for an average of 8 years (SD = 4.61), and individual participant characteristics can be found in Table 1. According to the H&H Withdrawal Questionnaire, subjects scored an average of 0 on both administrations suggesting no change in withdrawal effects that participants reported experiencing from intake when they should have been smoking to submitting their first sample.
that met criteria and were not smoking. This is probably due to the fact that on many items on the H&H, participants scored a 0 and only reported some of the withdrawal effects included in the survey. Participant 7 did not fill out a second administration of the survey. Participant’s scores on the H&H are listed in Table 3. Only certain items on the H&H were scored higher than a 0 by participants and not all participants reported an increase in withdrawal symptoms. Only participants 2, 5, and 6 reported an increase in urges to smoke while 1 and 3 reported no changes and 5 reported a decrease. Participants 2 and 6 reported an increase in irritability but the rest reported no change. Participants 2 and 6 reported an increased craving for cigarettes but the rest reported no change or a decrease. Using the H&H to determine how withdrawal effects are related to treatment outcome is difficult when comparing individual data. Participant 1 reported very few withdrawal effects but did not have as good of a treatment outcome as others and the other participants reported similar results but their treatment outcomes varied.

The average score on the Motivation and Confidence Questionnaire was 4.36 (SD = .83) on a scale ranging from 1-7 with 1 representing no confidence or motivation at all and 7 representing extreme confidence and motivation in quitting. A score of 4.36 represents moderate confidence and motivation in quitting. Participant’s answers to this questionnaire are listed in Table 2. When comparing individual averages and treatment outcome there does not appear to be a relationship between scores and treatment outcome. Some participants reported higher motivation and confidence than others, but had worse treatment outcomes.

Smoking Status Exit Questionnaire (which is a likert scale from 1-7, on average, participants 1, 2, 3, and 6 reported 5 (SD = 2.16) on confidence in abstaining in the next day and a 4 (SD = 2.45) on abstaining for the next week. A score of 1 represents no confidence and a score of 7 represents extreme confidence. When asked about satisfaction with the study, on a
scale of 1-7, participants reported, on average, a score of 6.5 (SD = 1) with a score of 1 representing no satisfaction at all with the study and a score of 7 representing extreme satisfaction with the study. Individual participant answers can be found in Table 5. Participants 1, 2, 3, and 6 were the only participants to come to the final session of the study and complete the survey.

Individual breath CO levels and prizes earned during the entire study are presented in Figure 1. Table 6 shows individual data from some of the questionnaires as well as breath CO levels for easy comparison. Participants could submit a total of 5 samples during baseline and 14 during CM phases. Participant 1 submitted 5 samples (36%) that met criteria and missed 1. Of these 5 samples, only one small prize was won so their obtained rate of reinforcement was 20%. Participant 1 submitted an initial breath CO of 12 with an average breath CO of 9.8 during baseline. During CM phases their average breath CO was 8.69 during CM phases showing a slight decrease.

Participant 1 submitted an initial breath CO of 12 with an average breath CO of 9.8 during baseline. During CM phases their average breath CO was 8.69 during CM phases showing a decrease of 11.4%. Participant 1 reported smoking an average of 17 cigarettes per day and for 8 years. They averaged a score of 4 on the Motivation and Confidence Questionnaire which would indicate moderate levels of motivation and confidence towards quitting. On the H&H they reported no differences in urges to smoke, irritability, anxiousness, and cigarette craving.

Participant 2 submitted 7 samples (57%) that met criteria during CM and missed 2. Of these 7 samples, 5 resulted in a prize so their obtained rate of reinforcement was 71%. Participant 2 submitted an initial breath CO of 24 with an average breath CO of 21 during baseline. During
CM phases their average breath CO was 7.58 during CM phases showing a 64% decrease in breath CO levels from baseline to CM phases. Participant 1 reported smoking an average of 20 cigarettes per day and for 16 years. They averaged a score of 6 on the Motivation and Confidence Questionnaire which would indicate high levels of motivation and confidence towards quitting. On the H&H they reported an in urges to smoke, irritability, anxiousness, and cigarette craving from the first to second administration but nothing was rated higher than a 2.

Participant 2 smoked more cigarettes a day, on average than all participants except for 5, and has smoked for the longest amount of time. They submitted more negative samples than 5 other participants who smoked less and for a shorter amount of time.

Participant 3 submitted 11 samples (78.57%) that met criteria and missed 1. Of these 11 samples, 1 resulted in a prize so their obtained rate of reinforcement was 10%. Participant 3 submitted an initial breath CO of 8 with an average breath CO of 6.6 during baseline. During CM phases their average breath CO was 5.23 during CM phases showing a 20.76% decrease in breath CO levels from baseline to CM phases. Participant 3’s average baseline breath CO level is barely above abstinence criteria which may explains why so many samples met criteria but showed a slight decrease and may have attributed to their success in treatment. Participant 3 reported smoking an average of 15 cigarettes per day and for 3 years. They averaged a score of 5 on the Motivation and Confidence Questionnaire which would indicate moderate to high levels of motivation and confidence towards quitting. On the H&H they reported no differences in urges to smoke, irritability, cigarette craving and a decrease in anxiousness from first to second administration.

Participant 4 submitted 6 samples (42.86%) that met criteria and missed 6. Of these 6 samples, 2 resulted in a prize so their obtained rate of reinforcement was 33.33%. Participant 4
Participant 4 submitted an initial breath CO of 8 with an average breath CO of 6.25 during baseline. During CM phases their average breath CO was 5.25 during CM phases showing a 16% decrease in breath CO levels from baseline to CM phases. Participant 4 did not submit anymore samples after the 9th sample in the CM phase and is considered a “drop out”. Prior to dropping out, Participant 4’s breath CO levels were meeting criteria and winning prizes so they probably dropped out for reasons other than these. Participant 4 reported smoking an average of 15 cigarettes per day and for 4 years. They averaged a score of 4 on the Motivation and Confidence Questionnaire which would indicate moderate levels of motivation and confidence towards quitting. On the H&H they reported no differences in urges to smoke, irritability, anxiousness, and cigarette craving.

Participant 5 submitted 5 samples (35.71%) that met criteria and missed 7. Of these 5 samples, 4 resulted in a prize so their obtained rate of reinforcement was 80%. Participant 5 submitted an initial breath CO of 14 with an average breath CO of 9.5 during baseline. During CM phases their average breath CO was 4 during CM phases showing a 57.9% decrease in breath CO levels from baseline to CM phases. Participant 5 reported smoking an average of 30 cigarettes per day and for 12 years. They averaged a score of 7 on the Motivation and Confidence Questionnaire which would indicate extreme levels of motivation and confidence towards quitting. On the H&H they reported no differences in irritability and anxiousness and a decrease in urges to smoke and cigarette cravings. Participant 5 missed half of all samples but was submitting breath CO samples that met criteria and won a high rate of prizes. They also rated the highest on Motivation and Confidence to quit, but did smoke more than everyone else on average.
Participant 6 submitted 13 samples (92.85%) that met criteria and missed 1. Of these 13 samples, 5 resulted in a prize so their obtained rate of reinforcement was 38.46%. Participant 6 submitted an initial breath CO of 7 with an average breath CO of 7 during baseline. During CM phases their average breath CO was 1.85 during CM phases showing a 73.58% decrease in breath CO levels from baseline to CM phases. Part of Participant 6’s success could be due to the fact that their initial and average breath CO levels were low prior to the CM phase so they were closer to achieving abstinence from the beginning of the study. One of their samples prior to the CM phase had already met criteria so they already had experience the target behavior prior to the CM phase as well which may have increase their likelihood of treatment success. Participant 6 reported smoking an average of 15 cigarettes per day and for 6 years. They averaged a score of 5 on the Motivation and Confidence Questionnaire which would indicate moderate to high levels of motivation and confidence towards quitting. On the H&H they reported an increase in urges to smoke, irritability, anxiousness, and cigarette craving. Participant 6 submitted the most samples that met criteria and only missed one sample. Some reasons why this participant did so much better than the others may be attributed to low breath CO levels in baseline phases and actually meeting the abstinent criteria once during the last baseline session.

Participant 7 submitted 3 samples (21.43%) that met criteria and missed 9. Of these 3 samples, 1 resulted in a prize so their obtained rate of reinforcement was 33.33%. Participant 7 submitted an initial breath CO of 10 with an average breath CO of 5.67 during baseline. During CM phases their average breath CO was 5.6 during CM phases showing a 1.3% decrease in breath CO levels from baseline to CM phases. Due to the large number of samples missed by Participant 7, they are considered a “drop out”. Participant 7 reported smoking an average of 8 cigarettes per day and for 10 years. They did not meet criteria of smoking at least 14 cigarettes per
day but were still included in the study due to the study’s low participation rates. They did meet the initial breath CO criteria. They averaged a score of 5 on the Motivation and Confidence Questionnaire which would indicate moderate to high levels of motivation and confidence towards quitting. They did not complete the second H&H because a researcher failed to administer to a second time when they first met criteria. Participant 7 missed the most amount of samples, but smoked the least amount of cigarettes on average and had low breath CO levels during baseline, meeting abstinence criteria for three sessions.

Only participant 6 submitted over 80% negative breath CO samples. Six of the 7 Participants showed decreases from baseline to CM phases in breath CO levels. Participants 1, 2, 3, and 6 submitted 80% or more of all possible samples. Participants 4 and 7 missed more than half of all samples that could have been submitted.

The average number of prizes won by each participant during the entire study was 4 and the average number of prizes won during CM phases was two. Fifty-one samples were submitted by participants that met criteria. The total number of prizes won by subjects was 29 so reinforcers were obtained 56.86% of the time during the entire study which is a very low rate of reinforcement. Of these, 27 were small, one was medium, and one was large. No jumbo prizes were drawn.

A total of 133 breath CO samples were scheduled and 105 were actually collected, thus 73.47% of scheduled breath CO samples were collected during the entire study. Of the samples submitted, 51 (70.83%) met criteria or were considered abstinent during CM conditions. When missing samples were coded a positive, 52.04% of breath CO samples met criteria. When missing samples were coded as negative, 78.57% of breath CO samples met criteria. The average breath CO level during baseline conditions was 9.74 ppm (SD = 5.77) and the average breath CO
level during CM was 5.71 ppm (SD = 3.95) which is below the abstinence criteria of 6 ppm. The average duration of consecutive negative samples submitted was 5 days and the longest duration was 13 days by Participant 6.

**DISCUSSION**

The present study shows that prize based CM can be effective in reducing breath CO levels and promoting abstinence from smoking which is consistent with Alessi et al. 2008. All but one of the subjects showed decreased breath CO levels but only Participant 6 submitted over 80% of all possible samples that met criteria. It is not clear why some participants had better treatment outcomes than others. The survey data could not be statistically analyzed to determine if any predictors existed due to the small sample size (n = 7). Participants 2 and 5 had smoked the most number of cigarettes a day on average and for the longest amount of time but had very different treatment results with Participant 2 submitting more samples that met criteria than Participant 5.

Early treatment success may predict later treatment success, thus participants that submit samples during baseline phases or early in CM phases may have better overall treatment outcomes. Participants 3 and 6 had very low breath CO levels during baseline phases and even met criteria for abstinence during baseline. They also had good, overall treatment outcomes. This may be because they came into contact with reinforcers early in treatment or earned draws early in treatment. It is possible that earning a draw and the possibility of earning reinforcement functions as a reinforcer as well. Simply meeting criteria can serve as reinforcement for the, especially if researchers provide social reinforcement such as saying “good job” to participants for meeting criteria. This would mean that participants are still receiving some type of reinforcement for submitting samples that meet criteria for draws that do not result in a prize.
However, a researcher telling a participant “good job,” or “I’m sorry maybe next time” did not always appear to function as reinforcement. Researchers noted that some participants became irritated if they did not win a prize and would say things like “I don’t want a good job.” A script could be used to control for these issues and inconsistencies with how researchers responded to participants.

While it may appear that early treatment success predicted a successful outcome for some, this is not the case for others. Participants 4, 5, and 7 all had low breath CO levels during baseline, early in treatment and were winning prizes but missed a large number of samples. It may be assumed that they missed so many samples because they were smoking and under this assumption it would not appear that early treatment success was a predictor of treatment outcome. Participant 2 did not have low breath CO levels during baseline but the highest and had better treatment outcomes than four other participants, but they did have initial treatment success.

Based on this study, it is not entirely clear why some participants did better than others. The survey data did not yield very meaningful results. Some participants ranked high on motivation and confidence but did not have a good treatment outcome while others did. Early treatment success may be a predictor of treatment success for some, but not others. Future studies may want to assess other factors that predict treatment success or why some would be considered “hard to treat.” Lamb et al. (2010) did address the issue as to why some individuals had better treatment outcomes than others and the idea that there is something fundamentally different with individuals identified as “hard to treat.” Exactly what these variables are is not entirely clear. Some variables could be number of years spent smoking or the number of cigarettes smoked per day. Those who do not smoke as much are closer to the target behavior of
reducing the number smoked in order to submit samples that meet criteria. The previous number of quit attempts would be important as well because the more quit attempts the more times an individual has actually achieved the target behavior. Other differences may exist as well that are harder to address, but may be important. Some individuals may come into contact with more social reinforcers for quitting than others. They may be around individuals that do not smoke and punish instances of smoking by the individual. Some individuals may obtain social reinforcement for smoking and be exposed to more individuals that do smoke and “encourage” it. Some individuals may be using more effective methods to quit as suggested by the booklet such as getting rid of things that smell like smoke and cigarettes while others did not. There are a variety of reasons why some individuals may be more successful than others and future studies may want to focus on capturing as many of these variables as possible.

Four of the seven participants missed < 2 samples during CM phases, which shows that this technique can produce relatively high participation rates. A majority of the missing samples came from Participants 4, 5, and 7, interestingly these participants were meeting criteria and winning prizes, thus attributing their missing samples to not coming in due to smoking may not be warranted. Some participants informed researchers that they would not be coming in due to school or work so coding all missing samples as positive may not accurately depict true data since they may have remained abstinent during these times. Omitting missing samples could be an option, but coding missing samples as positive is the most conservative method.

Throughout the study participants were asked to report how many cigarettes they smoked per day. Many had smoked but were blowing a breath CO level that met this study’s abstinence criteria. Abstinence criteria of 6 ppm may be too high and future studies may want to use lower criteria (e.g 4 ppm).
This study did not return to baseline phase because there were concerns about running low on prizes and we did not want to run out of prizes during the study. For this type of study, or any study decreasing substance use, a return to baseline phase may be more similar to treatment phases than the original baseline phase due to carry over effects. Responses similar to baseline phases would also be undesirable because it meant that treatment had no long term effects and substance use would likely continue after treatment has ended. While this may not be ideal for experimental control issues, a return to baseline would show the long term effects of treatment and show that other contingencies have taken place to reduce substance abuse which is necessary for individuals to continue abstinence or decreased substance use over the course of their lives. A post intervention session could have been done with just one session which would have been similar to the intake session. Similar to intake, participants could have came in to submit a sample and earn a draw regardless of breath CO level. This would not have resulted in a large number of prizes being given away and addressed the issue of whether or not participants would have submitted abstinent samples despite the removal of the contingency.

Another issue with this as well as other drug studies and baseline designs is the variability that tends to occur during baseline phases. This is especially true for smoking studies. People do not smoke the same amount over the course of an entire day and may smoke more during some points in time, or days than others. When quitting a substance, some individuals may quit and relapse later which creates variability as well. In this study, all participants showed variability during baseline phases and some even showed a downward trend prior to the CM phase. Traditionally in baseline designs, the intervention, or CM phase, would not have been implemented until stable responding has occurred to ensure that behavior systematically changes as a result of the contingency. It would be hard to do this due to the variability in baselines, but
implementation of the treatment could wait until breath CO levels did appear somewhat stable for each participant so longer baselines may be needed. This would also end up creating a multiple baselines design instead.

Originally, a multiple baselines design was planned where two groups of subjects would experience baselines that lasted a varying number of days. One group would have undergone a 3 day baseline while the other would have undergone a few more days of baseline. This would have added to the experimental control of the study by seeing systematic changes in the two groups once the CM phase was introduced. However, this was not done because of the low number of participants being recruited for the study.

Another issue that occurred during baseline phases was that participants were still obtaining some forms of reinforcement for submitting samples. It was noted that sometimes participants would come in and not smoke which led to a low breath CO level. Some research assistants may have informed participants what the criteria for abstinence was and may have provided social reinforcement for meeting criteria or not smoking. Participants would also ask what the number meant and “if it was good.” Participants are also told what the breath CO machine does and that lower numbers correlate to less smoking, thus the lower the number the better. Therefore, there is some contingency between submitting a low breath CO level or abstaining during baseline and obtaining some forms of reinforcement. This could be controlled for by ensuring that research assistants do not tell participants what the criteria is until the CM phase or say anything to them if they report not smoking. A script that all researchers followed could be created to help control for this.

There were a total of 51 opportunities for participants to win a prize and a total of 29 prizes were actually collected, so the rate of obtained reinforcement was 56.86%. Given the fact
that half of all tickets were non-winning this is close to what was predicted, however not all participants won half the time and some had low rates of reinforcements (Participants 1 and 3). To better control for this, a variable ratio (VR) schedule could be used to ensure all participants are winning at equal rates and actually obtaining reinforcement throughout the study. Draws from a prize bowl follow a random ratio schedule and the probability of winning a prize is 50%. Only participants 2 and 6 earned reinforcement above this, the rest were very low. A VR schedule would provide the cost benefits of using an intermittent schedule but may be more effective because researchers could ensure that participants are coming into contact with reinforcement at moderate to high rates. Future studies using VR schedules could determine what rates of reinforcement would be cost effective and could vary the magnitude of reinforcers earned as well. By using a VR schedule, researchers could ensure that participants are coming into contact with reinforcement and do not submit a large number of samples meeting criteria without obtaining reinforcement.

Data regarding the smoking status of participants once treatment ended was not collected because the main goal of this study was to determine the feasibility of prize based CM to reduce smoking in college students. Future studies would need to address the long term effectiveness of prize based CM to determine if it does produce longer treatment effects than continuous reinforcement. This could be done with follow up sessions where participants come in and their breath CO is measured at varying points in time after the study. They could also be asked about their smoking habits since the study. There is a chance that participants may lie about their smoking status or not smoke before coming in to submit a sample because they will interact with researchers and may feel that they are “disappointing” researchers or other social contingencies.
associated with this interaction. Prize draws could be allowed just for submitting a sample and ensuring participants that their honest answers are best for the study may help this.

It was very surprising that over a period of 7 months, only 7 participants completed the study and only 15 contacted researchers. The state of North Carolina has implemented smoking bans in all restaurants and bars, making it more difficult for people to smoke. The University of North Carolina Wilmington has also mandated that all individuals must smoke at least 25 ft from all buildings. Data obtained from Crossroads, a program on campus that promotes substance abuse education, indicated that as of 2009 less than 10% of all students at this university smoked daily (Crossroads, 2009). Insurance companies will increase rates for those that smoke, which will most likely affect students. With bans on smoking increasing and insurance costs rising, smoking may actually be decreasing as a result. With so few students smoking, it is possible that many of the students that are still currently smoking have no desire to quit and may be considered individuals that would belong to the “hard to treat” group. Also according to Crossroads (2009), almost 30% of students had smoked in the past month. This may indicate that more college students smoke occasionally rather than daily. This may mean that most college students who smoke are more likely than the rest of the general population to smoke recreationally or socially. Future studies may want to include more participants that include samples from populations outside college students that are more likely to smoke on a daily basis to increase the generality of these findings and obtain a larger number of participants.

The target behavior for this study was the submission of samples meeting reduction or abstinence criteria. In order for participants to achieve this, they had to reduce or quit smoking and were provided an alternative form of reinforcement for this behavior. Smoking involves other forms of behavior and reinforcement other than the effects inhaling nicotine. Individuals
who quit smoking often report that they have to “relearn” how to do things again since smoking has been paired with many other behaviors and environmental stimuli. Ritualistic behaviors associated with smoking, like lighting up a cigarette, also have reinforcing properties. Smoking is also maintained by social contingencies of reinforcement. Individuals may smoke recreationally with friends or take “smoke breaks” together. Individuals also report smoking because it is something they can do when they become “bored”. Future CM studies may want to set up contingencies of reinforcement for behaviors that replace some of these behaviors or contingencies. Behaviors that have been previously paired with smoking could be replaced with alternative forms of behavior and reinforced. If individuals smoke when they become bored, they can carry around something else to do such as a crossword puzzle or download games on their phone. If the first thing an individual does when they get into their car is smoke, they could chew gum instead. Obviously many of these behaviors would be hard to objectively measure and plans would probably have to be tailored to individuals specifically, but these behaviors should be addressed because they may affect the treatment outcome of individuals. Exercise may be a behavior to reinforce during smoking cessation inventions because it would ensure that individuals would come into contact with natural forms of reinforcement associated with smoking cessation. By exercising, individuals who are decreasing smoking or have quit may realize that their breathing has improved. By setting up some type of CM procedures for using these strategies, more individuals may have better treatment outcomes.

Overall, this study did show that a prized based CM technique could be successful in reducing smoking levels among college students. An intermittent schedule of prize delivery reduced smoking levels and was much more cost effective than continuous reinforcement. This would make the prize based method more ideal for implementation into community based
programs and could be easily used on college campuses or in the work place to reduce smoking at a reasonable cost. Future research addressing the use of a VR schedule and setting up contingencies for other behaviors may increase the effectiveness of this type of treatment.
REFERENCES


Carroll, M., E. & Meisch, R. A. (1979). Concurrent etonitazene and water intake in rats: Role of

alternative reinforcer reduces drug intake. *Experimental Analysis of Behavior*, 43, 131-
144.

(PCP) self-administration in rhesus monkeys: effects of dose and an alternative non-drug


smoking among college students. *Experimental and Clinical psychopharmacology*, 14,
171-179.


Century-Crofts Inc.

fagerström test for nicotine dependence: A revision of the fagerström tolerance


Table 1

*Participant Characteristics from FTND*

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many smoked today</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>10</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>How many yesterday</td>
<td>15-20</td>
<td>1</td>
<td>11</td>
<td>15</td>
<td>35</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Cigarettes smoked on average</td>
<td>17</td>
<td>20</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Years Smoking</td>
<td>8</td>
<td>16</td>
<td>3</td>
<td>4</td>
<td>12</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

*Note.* Participants are listed across the top row (1-7).
Table 2

*Individual Items from Motivation and Confidence Questionnaire*

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current motivation to quit</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Confidence that you can quit</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Abstain for the next 24 hrs</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Abstain for the next 7 days</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>How confident are you that you will not be smoking 1 year from now</td>
<td>2</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Committed to total abstinence</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

*Note.* Participants are listed across the top row (1-7). Answers are based on a likert scale ranging from 1-7 with a score of 1 representing no confidence or motivation at all and a score of 7 representing extreme confidence or motivation.
<table>
<thead>
<tr>
<th>Item</th>
<th>1 (1)</th>
<th>2 (2)</th>
<th>3 (3)</th>
<th>4 (4)</th>
<th>5 (5)</th>
<th>6 (6)</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urges to smoke</td>
<td>0 (0)</td>
<td>0 (2)</td>
<td>1 (1)</td>
<td>2 (2)</td>
<td>3 (2)</td>
<td>1 (3)</td>
<td>2</td>
</tr>
<tr>
<td>Irritable</td>
<td>0 (0)</td>
<td>0 (1)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>0 (2)</td>
<td>1</td>
</tr>
<tr>
<td>Anxious</td>
<td>0 (0)</td>
<td>0 (1)</td>
<td>1 (0)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>2 (3)</td>
<td>2</td>
</tr>
<tr>
<td>Difficulty concentrating</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (0)</td>
<td>1 (1)</td>
<td>2 (1)</td>
<td>0 (2)</td>
<td>1</td>
</tr>
<tr>
<td>Restlessness</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (0)</td>
<td>1 (1)</td>
<td>2 (0)</td>
<td>1 (2)</td>
<td>2</td>
</tr>
<tr>
<td>Impatient</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>2 (1)</td>
<td>1 (2)</td>
<td>2 (1)</td>
<td>0 (3)</td>
<td>3</td>
</tr>
<tr>
<td>Tremor</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (1)</td>
<td>0</td>
</tr>
<tr>
<td>Heart racing</td>
<td>0 (1)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (1)</td>
<td>1</td>
</tr>
<tr>
<td>Sweating</td>
<td>0 (1)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (0)</td>
<td>0 (1)</td>
<td>0</td>
</tr>
<tr>
<td>Dizziness</td>
<td>0 (1)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0</td>
</tr>
<tr>
<td>Craving cigarettes</td>
<td>0 (0)</td>
<td>0 (2)</td>
<td>1 (1)</td>
<td>2</td>
<td>3 (2)</td>
<td>1 (3)</td>
<td>2</td>
</tr>
<tr>
<td>Increased eating</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>2 (2)</td>
<td>1 (3)</td>
<td>2</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (2)</td>
<td>0</td>
<td>1 (1)</td>
<td>0 (1)</td>
<td>2</td>
</tr>
<tr>
<td>Bowel or stomach problems</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0</td>
</tr>
<tr>
<td>Depressed</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1</td>
<td>0 (0)</td>
<td>0 (1)</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note.* Participants are listed across the top row (1-7). Numbers in parenthesis represent answers from the H & H from the second administration which was given once a participant submitted their first breath CO sample that met criteria. Answers are based on a likert scale with a score of
Table 4

*Individual Items from SCQ-S Questionnaire*

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>My throat burns after smoking</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Nicotine &quot;fits&quot; can be controlled</td>
<td>9</td>
<td>9</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>When I'm angry a cigarette can calm me down</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>9</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>When I'm alone, a cigarette can help me pass the time</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Smoking a cigarette energizes me</td>
<td>5</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Smoking calms me down when I'm nervous</td>
<td>1</td>
<td>9</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Cigarettes make my lungs hurt</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>A cigarette can give me energy</td>
<td>8</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>9</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Cigarettes can really make me feel good</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>9</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>If have nothing to do, a smoke can help kill time</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>
Table 4 cont.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking will satisfy my nicotine cravings</td>
<td>9 9 9 6 9 8 7</td>
</tr>
<tr>
<td>I feel like part of a group when I'm around other smokers</td>
<td>8 9 7 7 9 6 8</td>
</tr>
<tr>
<td>Smoking makes me seem less attractive</td>
<td>8 9 6 9 6 7 8</td>
</tr>
<tr>
<td>By smoking I risk heart disease and lung cancer</td>
<td>9 9 9 9 9 9 9</td>
</tr>
<tr>
<td>Smoking helps me enjoy people more</td>
<td>0 2 5 0 1 4 4</td>
</tr>
<tr>
<td>People think less of me if they see me smoking</td>
<td>8 9 4 5 5 7 9</td>
</tr>
<tr>
<td>Just handling a cig. is pleasurable</td>
<td>6 5 4 9 9 7 3</td>
</tr>
<tr>
<td>If I'm feeling irritable, a smoke will help me relax</td>
<td>7 6 6 7 9 9 7</td>
</tr>
<tr>
<td>Smoking irritates my mouth and throat</td>
<td>7 7 4 7 3 5 0</td>
</tr>
<tr>
<td>Smoking helps me control my weight</td>
<td>0 0 2 3 5 5 2</td>
</tr>
<tr>
<td>When I'm upset with someone a cigarette helps me cope</td>
<td>6 5 6 9 9 8 7</td>
</tr>
<tr>
<td>The more I smoke, the more I risk my health</td>
<td>9 9 9 9 9 9 9</td>
</tr>
<tr>
<td>Cigs. Keep me from eating more than I should</td>
<td>0 8 2 1 6 5 5</td>
</tr>
</tbody>
</table>
Table 4 cont.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoy the steps I take to light up</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I look ridiculous while smoking</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking keeps my weight down</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy feeling the smoke hit my mouth and the back of my throat</td>
<td>7</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>9</td>
<td>7</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking temporarily reduces those repeated urges for cigarettes</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy the taste sensations while smoking</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel more at ease with other people if I have a cig.</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cigs are good for dealing with boredom</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking is taking years off my life</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Participants are listed in the top row (1-7). Scores are based on a likert scale with a score of 0 representing unlikely and a score of 9 representing likely.*
Table 5

*Exit Questionnaire*

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longest period of time you did not smoke during the study</td>
<td>6hs</td>
<td>2 days</td>
<td>1.5 days</td>
<td>6 days</td>
</tr>
<tr>
<td>How many cigarettes per day did you smoke on average during the study</td>
<td>10</td>
<td>5-10</td>
<td>1-2</td>
<td>0-2</td>
</tr>
<tr>
<td>Did you use nicotine replacement methods</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Do you feel that the intervention helped you avoid smoking</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>How confident are you that you will abstain from cigarettes for the next 24 hrs</td>
<td>2</td>
<td>7</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>How confident are you that you will abstain from cigarettes for the next 7 days</td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>How satisfied are you with participating in this study</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

*Note.* Participants are listed across the top row (1, 2, 3, 6). The last three items are based on a likert rating scale with a score of 1 representing no confidence or satisfaction and a score of 7.
Table 6

*Individual Results from Surveys and Treatment Outcome*

<table>
<thead>
<tr>
<th>Item</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items from FTND</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many smoked today</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>2</td>
<td>10</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>How many smoked yesterday</td>
<td>15-20</td>
<td>1</td>
<td>11</td>
<td>15</td>
<td>35</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Cigarettes smoked on average</td>
<td>17</td>
<td>20</td>
<td>15</td>
<td>15</td>
<td>30</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Years smoking</td>
<td>8</td>
<td>16</td>
<td>3</td>
<td>4</td>
<td>12</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Items from H &amp; H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urges to smoke</td>
<td>0 (0)</td>
<td>0 (2)</td>
<td>1 (1)</td>
<td>2 (2)</td>
<td>3 (2)</td>
<td>1 (3)</td>
<td>2</td>
</tr>
<tr>
<td>Irritable</td>
<td>0 (0)</td>
<td>0 (1)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>0 (2)</td>
<td>1</td>
</tr>
<tr>
<td>Anxious</td>
<td>0 (0)</td>
<td>0 (1)</td>
<td>1 (0)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>2 (3)</td>
<td>2</td>
</tr>
<tr>
<td>Craving cigarettes</td>
<td>0 (0)</td>
<td>0 (2)</td>
<td>1 (1)</td>
<td>2 (3)</td>
<td>1 (3)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Average from Motivation and Confidence Questionnaire</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Breath CO at intake</td>
<td>12</td>
<td>24</td>
<td>8</td>
<td>9</td>
<td>14</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Number of samples that met criteria</td>
<td>5</td>
<td>8</td>
<td>11</td>
<td>6</td>
<td>5</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Number of prizes won during CM</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note.* Participants are listed across the top row (1-7). Numbers in parenthesis represent answers from H&H from the second administration. Items from H&H are based on a likert scale of 0-3 with a score of 0 representing none and a score of 3 representing severs. Averages from Motivation and Confidence Questionnaire are based on answers from a likert scale of 1-7 with a score of 1 representing no motivation or confidence and a score of 7 representing extreme motivation or confidence.
Figure 1. Breath CO levels (y-axis) for individual participants across 19 sessions (x-axis). The dashed, vertical line represents the transition from baseline to CM phases. The solid line represents the abstinence criteria that subjects had to meet in order to receive a draw. The letters S, M, or L indicates the value of prizes drawn by participants.
Appendix

Appendix A. Surveys and Booklet

**Modified FTND – Screening Instrument**

Subject ID: ______________________________ Study: ____________
R/DA: ______________________________ Session: ____________
Date: ______________________________ Timepoint: ____________

What brand of cigarettes do you smoke most of the time? ________________
Reg. or Menthol? ________________

How many cigarettes have you smoked today __________________________

How many cigarettes did you smoke yesterday? __________________________

How long after waking up did you smoke the first cigarette today? ____________

How many cigarettes do you smoke per day on average? __________________________

How many years have you been smoking daily? __________________________

Do you inhale? (circle one) NEVER SOMETIMES ALWAYS

Do you smoke more during the first 2 hours of the day than the rest of the day?

YES NO

How soon after waking do you smoke your first cigarette? (circle one)

**Within 5 minutes** 6-30 minutes 31-60 minutes after 60 minutes

Which cigarette during the day would you most hate to give up? (circle one)

The first one in the morning Another one

Do you smoke if you are so ill that you are in bed most of the day?

YES NO

Do you find it difficult to refrain from smoking in places where it is forbidden, e.g. in church, at the library, theater, etc.?

YES NO
Motivation and Confidence Questionnaire

Circle one number that best describes your motivation to quit smoking at this time.

No Motivation
At All
1 2 3 4 5 6 7

Extreme Motivation

Circle one number that best describes your confidence that you can quit smoking at this time.

Not at All Confident
1 2 3 4 5 6 7

Extremely Confident

How confident are you that you can abstain from cigarettes for the next 24 hours?

Not at All Confident
1 2 3 4 5 6 7

Extremely Confident

How confident are you that you can abstain from cigarettes for the next 7 days?

Not at All Confident
1 2 3 4 5 6 7

Extremely Confident

How confident are you that you will not be smoking at all one year from today?

Not at All Confident
1 2 3 4 5 6 7

Extremely Confident

How committed are you to a goal of total abstinence?

Not at All Committed
1 2 3 4 5 6 7

Extremely Committed
SCQ-S

Instructions: This questionnaire is designed to assess beliefs people have about the consequences of smoking a cigarette. We are interested in your general expectations about the consequences of your smoking. Below is a list of statements. Each statement contains a possible consequence of smoking. For each of the statements listed below, please rate how LIKELY or UNLIKELY you believe each consequence is for you when you smoke. If the consequence seems LIKELY to you, circle a number from 5-9. That is, if you believe that a consequence would never happen, circle 0; if you believe a consequence would happen every time you smoke, circle 9. Use the guide below to aid you further. For example, if a consequence seems completely likely to you, you would circle 9. If it seems a little unlikely to you, you would circle 4.

0 1 2 3 4 5 6 7 8 9
Completely     Extremely
Very           Very
A little       Somewhat
A little       Somewhat
Completely     Extremely

<-------------------UNLIKELY------------------X-------------------LIKELY----------------------->

UNLIKELY          LIKELY
1. My throat burns after smoking.  0 1 2 3 4 5 6 7 8 9
2. Nicotine "fits" can be controlled by smoking.  0 1 2 3 4 5 6 7 8 9
3. When I'm angry a cigarette can calm me down.  0 1 2 3 4 5 6 7 8 9
4. When I'm alone, a cigarette can help me pass the time.  0 1 2 3 4 5 6 7 8 9
5. Smoking a cigarette energizes me.  0 1 2 3 4 5 6 7 8 9
6. Smoking calms me down when I feel nervous.  0 1 2 3 4 5 6 7 8 9
7. Cigarettes make my lungs hurt.  0 1 2 3 4 5 6 7 8 9
8. A cigarette can give me energy when I'm bored and tired.  0 1 2 3 4 5 6 7 8 9
9. Cigarettes can really make me feel good.  0 1 2 3 4 5 6 7 8 9
10. If I have nothing to do, a smoke can help kill time.  0 1 2 3 4 5 6 7 8 9
11. Smoking will satisfy my nicotine cravings.  0 1 2 3 4 5 6 7 8 9
12. I feel like part of a group when I'm around other smokers.  0 1 2 3 4 5 6 7 8 9
13. Smoking makes me seem less attractive.  0 1 2 3 4 5 6 7 8 9
14. By smoking I risk heart disease and lung cancer.  0 1 2 3 4 5 6 7 8 9
15. Smoking helps me enjoy people more.  0 1 2 3 4 5 6 7 8 9
16. People think less of me if they see me smoking.  0 1 2 3 4 5 6 7 8 9
17. Just handling a cigarette is pleasurable.  0 1 2 3 4 5 6 7 8 9
18. If I'm feeling irritable, a smoke will help me relax.  0 1 2 3 4 5 6 7 8 9
19. Smoking irritates my mouth and throat.  0 1 2 3 4 5 6 7 8 9
20. Smoking helps me control my weight.  0 1 2 3 4 5 6 7 8 9
21. When I'm upset with someone, a cigarette helps me cope.  0 1 2 3 4 5 6 7 8 9
22. The more I smoke, the more I risk my health.  0 1 2 3 4 5 6 7 8 9
### H & H Adjectives Withdrawal Questionnaire

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Score 0</th>
<th>Score 1</th>
<th>Score 2</th>
<th>Score 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urges to Smoke</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Irritable</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Anxious</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Difficulty</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Concentrating</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Restless</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Impatient</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Tremor</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Heart Racing</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
<tr>
<td>Sweating</td>
<td>none</td>
<td>mild</td>
<td>moderate</td>
<td>severe</td>
</tr>
</tbody>
</table>
Smoking Status Exit Questionnaire

Subject ID: ________________________________ Study: ________________
R/DA: ____________________________________ Session: ________________
Date: _____________________________________ Timepoint: ______________

1. What is the longest period of time that you were able to avoid smoking during this study?

2. How many cigarettes did you smoke per day on average during the treatment portion of the study?

3. Did you use any nicotine replacement methods, such as a nicotine patch or nicotine gum to help you abstain during the study?

4. Do you feel that the intervention helped you avoid smoking cigarettes? Explain.

5. How confident are you that you can abstain from cigarettes for the next 24 hours?

<table>
<thead>
<tr>
<th>Not at All Confident</th>
<th>Extremely Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

6. How confident are you that you can abstain from cigarettes for the next 7 days?

<table>
<thead>
<tr>
<th>Not at All Confident</th>
<th>Extremely Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>
Kiss that Butt Goodbye

A Smoking Cessation Guide
Why Quit Smoking?

- Cigarette smoking is the leading cause of preventable death in the U.S. Accounting for approximately 1 of every 5 deaths (438,000 people) each year
- On average, smokers die 13 to 14 years earlier than nonsmokers
- For every person who dies of a smoking-related disease, 20 more people suffer with at least one serious illness from smoking.
- In 2001, chronic obstructive pulmonary disease (COPD) was the fourth leading cause of death in the United States, resulting in more than 118,000 deaths. More than 90% of these deaths were attributed to smoking
- People with COPD usually have chronic bronchitis or emphysema.
- Other health risks include: impotence, weakened immune system, gum disease, and cancers of the bladder, esophagus, kidney, cervix, and pancreas
- More deaths are caused each year by tobacco use than by all deaths from human immunodeficiency virus (HIV), illegal drug use, alcohol use, motor vehicle injuries, suicides, and murders
- Coronary heart disease and stroke are the primary types of cardiovascular diseases caused by smoking and are the first and third leading causes of death in the U.S.
- Heart disease is the leading cause of death among smokers
- Compared to nonsmokers, men who smoke are about 23 times more likely to develop lung cancer and women who smoke are about 13 times more likely. Smoking causes about 90% of lung cancer deaths in men and almost 80% in women

86
What Happens When You Quit

**Within 20 minutes:**
- blood pressure and pulse rate both drop to normal
- body temperature of hands and feet return to normal

**Within 8 hours:**
- carbon monoxide level in blood drops to normal
- oxygen level in blood increases to normal

**Within 24 hours:**
- chance of heart attack decreases

**Within 48 hours:**
- nerve endings start regenerating
- sense of smell and taste improves

**Within 72 hours:**
- bronchial tubes relax making breathing easier
- lung capacity increases

**Within 2 weeks to 3 months:**
- circulation improves
- walking becomes easier
- lung function improves up to 30%

**Within 1 to 9 months**
- coughing, sinus congestion, fatigue, and shortness of breath decreases
- cilia regenerate in lungs, increasing ability to clean lungs and reduce infection
- body’s overall energy level increases

**Within 1 year:**
- chance of having a heart attack is cut in half

**Within 5 years:**
- stroke risk is reduced to that of a nonsmoker (5-15 years after quitting)

**Within 10 years:**
- lung cancer death rate about half that of a continuing smoker
- cancer risk of the mouth, throat, esophagus, bladder, kidneys, and pancreas decreases

**Within 15 years:**
- risk of coronary heart disease is same as nonsmoker
**Physical Effects of Quitting and How to Deal with them**

- Increased cough - drink more fluids (water and fruit juices) and use cough drops if needed
- Headache - aspirin
- Dry or sore throat - drink liquids or use throat sprays and cough drop
- Feeling nervous - nicotine is now leaving your system so drink plenty of fluids to help “flush” nicotine and other chemicals from your body
- Constipation - increase liquids and fiber in diet by eating more vegetables, fresh fruit, and bran daily
- Tiredness - plan on getting extra sleep
- Depression - talk to others or find ways to take your mind off things
- Insomnia - avoid caffeine, try exercising, or change sleep habits
- Fatigue - exercise, more sleep or rest, or try relaxation techniques

---

**Will I Gain Weight??**

- Not everyone who quits automatically gains weight
- More likely to gain weight if you have been smoking for 10-20 years or smoke over a pack a day
- Most people who gain weight, gain less than 10 pounds
- The health risks of smoking are far greater than gaining 5-10 pounds. You would have to gain 100-150 pounds to equal the health risks of smoking
- Water retention could account for 3-5 pounds of initial weight gain...remember you may be drinking more water to counter the withdrawal effects (coughing, sore throat)
- Women...remember, your weight may change by up to 5 pounds within a day so don’t freak out when you jump on the scales
- Exercise and a healthy diet are always a good way to control weight gain
Break The Habit!

**Identify triggers** -
triggers are anything that make you want to smoke and may include people, places, situations or moods.
Triggers vary from person to person.
It is important for each person to identify their own triggers in order to avoid them or deal with them.
Some common triggers are:
- eating: you may want a cigarette after eating or instead of eating
- feeling bored: smoking gives you something to do
- social settings: you may smoke more around other smokers or in social settings to feel more relaxed
- while drinking caffeinated beverages

**Change your environment** (space)
- don’t allow others to smoke in your room or home
- get rid of ALL cigarettes, lighters, and ashtrays
- avoid caffeine
- avoid smoking areas in public places
- clean out and wash personal items that may smell like smoke (sheets, book bag, or purse)
- ask your friends not to smoke around you when possible

**Behavior modification**
- relearn how to do things without a cigarette
- change morning routine so there is less time to smoke
- come up with other things to do when bored
- keep track of how many cigarettes you smoke in a day and begin to decrease this number
- go to places where smoking is not allowed
- if you “miss” having something in your mouth or hand replace cigarettes with gum, candy, carrots, pencils or a stress ball
**Nicotine replacement therapies**

- Help deal with physical withdrawal symptoms by delivering safe amounts of nicotine to the body. Only designed to help with withdrawal effects and best if used in combination with other therapies (American Cancer Society [ACS], 2008)

**Nicotine Patch** - gives measured doses of nicotine through the skin via patch that is typically placed on the arm. Doses decrease over weeks. Can be bought without prescription. Recommended usage is 3-5 months. Side effects vary by brand and dose and can include: skin irritation, dizziness, racing heartbeat, nausea, headaches, and muscle aches (ACS, 2008).

**Nicotina Gum** - fast-acting form of nicotine replacement therapy. Can be bought over the counter without a prescription in 2 mg and 4 mg doses. Recommended usage is 1-3 months with a maximum of 6 months. Side effects can include: bad taste, throat irritation, mouth sores, nausea, racing heartbeat and jaw discomfort (ACS, 2008).

**Nicotine Nasal Spray** - delivers nicotine quickly to the bloodstream which allows for quick control over nicotine cravings. Only available through prescription. Recommended usage is 3 months but no longer than 6. Can be addictive. Side effects can include: nasal irritation, runny nose, watery eyes, throat irritation, and coughing (ACS, 2008).

**Bupropion (Zyban)** - does NOT contain nicotine. A prescription antidepressant that reduces the symptoms of nicotine withdrawal. Can be used with nicotine replacement. Best if used 1-2 weeks before quit date. Dosage is one or two 150 mg tablets once a day. Side effects include: agitation, dry mouth, insomnia, headache, nausea, constipation and tremor (ACS 2008).
Dealing with Stress Without Cigarettes.

Keep in mind that there is no one solution to handling stress. Everyone is different and you need to choose the stress relievers that will work best for you. Here are some suggestions:

Identify your triggers: Begin by first identifying all the sources of stress in your daily life. This will help you identify patterns in your perception of stressful events and circumstances that precede them.

Modify your responses: We can learn to modify our reactions to make stressful events less stressful. Identifying the source of stress helps you begin to cope with stressful events.

Practice daily meditation: By clearing the mind, you are forced to "let go" of stressful events. Experts suggest practicing meditation for at least 20 minutes once or twice a day, but you can enjoy mini-meditations throughout the day, whenever you feel stress getting a grip on you. Meditation can be practiced in different ways the main idea is to let go of the stress and devote time to yourself.

Aromatherapy: Results of studies using aromatherapy indicate that it helps aid in relaxation and stress relief. Scents of lavender and citrus are two of the most often used for stress-relief. With quitting smoking you will be amazed at the improvement of your sense of smell.

Breathing exercises: Like meditation, these exercises are meant to give your mind and body a quick timeout. Whenever you feel yourself becoming overwhelmed by daily events try to stop and inhale deeply, then exhale slowly.

Aerobic exercise: Physical activity is a great stress buster, plus you’ll be amazed by how much better you’ll look and feel. In addition to distracting you from your troubles, exercise has an overall relaxing effect. Aerobic activity, in particular, can reduce anxiety, depression and tension.
Photograph References

Deepturtle.net
Kandisjohnson.wordpress.com
Saidaonline.com
Smokerslungs.net
www.autonorth.ca/storage/quitsmoking
www.quitsmoking.co.in/?tag=quit-smoking