Smoking Cessation in Relapsed Smokers: A Competing Schedules Approach

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SMOKINGcessation in relapsed smokers:
a competing schedules approach

by

Catherine E. Ellis

A Thesis
Submitted to the
Faculty of the Graduate College
in partial fulfillment of the
requirements for the
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I would like to express my gratitude to Dr. Michele Burnette for her commitment and assistance to this project. As an Advisor and friend, she has facilitated my growth as a student and psychologist.

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Catherine E. Ellis
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Smoking cessation in relapsed smokers: A competing schedules approach

Ellis, Catherine Eileen, M.A.
Western Michigan University, 1989
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CHAPTER I

INTRODUCTION

The World Health Organization has stated that the control of cigarette smoking in developed countries "could do more to improve health and prolong life than any other single action in the whole field of preventative medicine" (Eckholm, 1978). Yet, approximately 53 million Americans smoke cigarettes (Cullen & Greenwald, 1986).

Currently, one thousand deaths per day in the United States alone are attributed to the effects of tobacco (McAfee, 1986). Cigarette smokers are ten times more likely to develop lung malignancies than non-smokers and are five times more likely to die from chronic bronchitis or emphysema than non-smokers (Eckholm, 1978). Furthermore, smokers are two to three times more likely to die of coronary heart disease than their non-smoking counterparts (USDHEW, 1979).

In addition to the physiological damage to smokers, the costs of smoking are astronomical. Consumers spend eighty-five to one hundred billion dollars each year to buy four trillion cigarettes (Eckholm, 1978). Approximately two billion dollars are spent each year by domestic cigarette advertisers (Brailer et al., 1986). The largest
amount of health care dollars is currently spent in
treating the respiratory, malignant, and vascular diseases
secondary to the use of tobacco (McAfee, 1986). The
United States Surgeon General (USDHEW,1979) has estimated
the annual cost of smoking-related health problems to be
27 billion dollars in medical care, absenteeism, decreased
work productivity, and accidents. The financial benefits
of smoking cessation are, thus, obvious. The health-
related benefits are also promising; smokers who quit
increase their chances of living 60% over those who still
smoke regardless of age or smoking history (Carper, 1987).
Smokers can significantly reduce their risk of coronary
heart disease by quitting smoking before the onset of
cardiac-related symptoms. Five to ten years after
quitting, ex-smoker's coronary mortality rates are
comparable to those who have never smoked (Blumenthal,
Burg, & Roark, 1986). Smoking cessation reduces the risk
of lung, laryngeal, oral, and esophageal cancer mortality.
Within 10-20 years, the risk of dying from these cancers
also approximates the risk of the non-smoker (Cullen &
Greenwald, 1986).

Since the dangers of smoking have become known,
researchers have been attempting to develop effective
smoking-cessation programs. Many programs have yielded
excellent initial results. The majority of those who
quit smoking, however, relapse within three months after
quitting (Glasgow & Bernstein, 1981; Hunt & Matarazzo, 1973). Recidivism continues to be a major roadblock to cessation programs regardless of their orientation.

Few factors responsible for prolonged success or failure in smoke-stopping have been isolated as yet. Some research shows that initial responses to treatment predict later success (Brownell, Marlatt, Lichenstein, & Wilson, 1986). Support from a partner may be one of the few variables associated with long-term abstinence from cigarettes (Coppotelli & Orleans, 1985). Research by Morgan (1983) suggests that friends in particular are important sources of influence in the ex-smoker's environment. Abstainers reported relatively stable, moderate levels of support from spouses, family and friends, whereas recidivist's reports of friends smoking or offering cigarettes sharply increased over abstainer levels eight weeks after cessation.

Both positive feedback from significant others and a non-smoking environment may help keep ex-smokers abstinent (Tongas, 1977; Perri, Richards, & Schultheis, 1977; Schwartz & Dubitsky, 1968). Mermelstein, Cohen, Lichenstein, Baer, and Kamarck (1986) found that the presence of smokers in subjects' social networks interfered with maintenance and significantly differentiated between relapsers and long-term abstainers. Surawy, Stepney, and Cox (1985) demonstrated that social cues such
as watching others smoke increased the smoking behavior of stimulant smokers (an important subgroup of the smoking population).

Based on this research, a smoke-free environment and sustained social support would be ideal for the ex-smoker trying to maintain abstinence. Unfortunately, the United States culture is far from this ideal. Encounters with other smokers are inevitable in public. Chances are that those people trying to quit have a history of smoking with relatives, friends, and co-workers. And, those still smoking tend to undermine the quitting attempts of their cohorts. Even supportive gestures tend to deteriorate over time. Initially, during the quitting stage, the social environment may be relied on to provide informal or contractual reinforcement for non-smoking behavior. Once the non-smoking is taken for granted by the social environment, however, the reinforcement may cease. In the absence of social reinforcement, external incentives are lost for resisting tempting situations, and quitters may begin to smoke again (Prochaska, Crimi, Lapsanski, Martel, & Reid, 1982).

Abstinence from cigarettes is a struggle to maintain due to the generalized social reinforcement associated with smoking. This is extremely difficult for the novice quitter to relinquish. The numerous people and/or settings under which smoking is possible become discrimi-
native stimuli for smoking, and an urge is thus subjectively experienced when these situations arise. The enjoyment derived from the oral, manual, and respiratory manipulation of cigarettes is reinforcing. This produces a dependency on cigarettes which makes abstinence aversive, even for short periods of time. Smoking then becomes even more reinforcing when used to reduce or avoid withdrawal symptoms (Lichenstein, 1982).

Since smoking provides such powerful and pervasive reinforcers, researchers have had difficulty developing consistently effective tools to achieve abstinence. Operant behavioral literature offers the principle of competing schedules of reinforcement as a potential solution to the smoking problem. "Whenever behavior is maintained by a reinforcing stimulus, some schedule is in effect and is exerting its characteristic influences" (Zeiler, 1977, p. 229). When a schedule producing smoking behavior is in effect, only a competing schedule—one producing non-smoking behavior which is equally or more reinforcing—will result in the desired goal of sustained abstinence.

Reinforcing alternative behaviors is an approach which has not been attempted as a single method in producing long-term abstinence from cigarettes. It has been recommended, however, as a potentially useful tool (Glasgow & Bernstein, 1981; Tongas, 1977).
As an alternative, anti-smoking behavior is incompatible to smoking for the quitter and presents an increased opportunity for other people in the environment to reduce their smoking behavior. In the preventive literature, Houser (1971) asserted that non-smoking behavior may be greatly reinforced through participation in anti-smoking activities such as analyzing cigarette advertisements in newspapers and magazines, letter writing campaigns targeted to reduce the promotion of cigarette smoking, and obtaining public attention for such efforts. This approach has not been attempted in the recidivistic literature.

Research has previously shown that social support and a non-smoking environment promote long-term abstinence from cigarettes (Coppotelli & Orleans, 1985; Morgan, 1983; Perri, Richards, & Schultheis, 1977; Schwartz & Dubitsky, 1968; Tongas, 1977). It is not feasible to assume that sustained social support exists naturally in the quitter's environment or that other smokers may be removed from this environment. Therefore, an attempt was made in the present study to enrich the ex-smoker's existing environment through contrived social support and anti-smoking activities designed to compete with reinforcers for smoking behavior.

This research was carried out with an important subgroup of the smoking population, relapsed smokers.
Although a large-scale attempt to initiate smoking cessation and prevent relapse has been made, no services have been provided for the relapsed smoker who wishes to quit again. To date, the alternatives have been either for the relapsed smoker to try and quit again on his own or to be channeled through another smoke-stopping program. A repeat program only duplicates time and money already spent on quitting. Emphasis instead should be placed on refining skills required for maintenance, the area where the relapser is obviously deficient. Relapsed smokers who want to try again need tailored opportunities for success. Schachter (1982) has suggested that many people may need multiple attempts at smoke-stopping before they succeed. A relapser may be acquiring knowledge about his/her weaknesses and may subsequently learn ways to prevent future relapses (Brownell et al., 1986). Assuming that relapsed smokers retain the skills to quit again, emphasis was placed on maintenance through social support and acquiring the skills to promote a non-smoking environment through anti-smoking activities.

It was hypothesized, therefore, that the presentation of a relapse-prevention program consisting of social support and anti-smoking activities would result in sustained abstinence from cigarettes for relapsed smokers. This research extended the literature by examining the efficacy of a specially tailored program for relapsed
smokers and bridging the preventive and recidivistic literature by arranging anti-smoking activities for quitters.
Subjects

Eight male and 13 female eligible subjects initially volunteered for the study. They were recruited from Western Michigan University's campus and the community at large. Minimum criteria required that subjects be high school graduates at least eighteen years of age with a previous successful quitting attempt resulting in abstinence for a period of not less than five consecutive days within the past five years. Additional criteria mandated that subjects have an initial minimal cigarette consumption of 20 cigarettes per week.

The subjects were recruited through local newspapers and radio stations. Volunteers who responded to the advertisements were screened over the telephone, asked for demographic information and their smoking history. Callers were informed of a seven-session, smoke-stopping study which would meet twice weekly for one month. Subjects were also informed of a $35.00 initial fee which would be refunded based on attendance of the sessions. Subjects who met the above mentioned criteria were randomly assigned and matched by sex to the Treatment
Group (A) and Control Group (B). Eleven subjects were assigned to Group A and 10 to Group B. One subject in Group A dropped out of the study without attending any sessions. When contacted, she declined to offer a reason for dropping out. The remaining ten subjects in Group A completed the study. Three members of Group B dropped out of the study prior to attending any sessions. When contacted, one subject stated he was too busy to participate due to his upcoming wedding, a second subject was working overtime hours which conflicted with session meetings, and the third was involved with Union activities during the first session and declined to attend any further sessions. Two more subjects dropped out of Group B after the first session. They were co-workers who decided together that the program was not what they desired in the way of treatment. The remaining five subjects in Group B completed the study.

Fifteen subjects, all residents of Southwestern Michigan, completed the study. The treatment group consisted of five females and five males. In the control group, there were four females and one male. The subjects were between the ages of 22-48 years. The mean age in Group A was 34.8 years, and the mean age in Group B was 32.2 years. A t-test for independent means (p < .05) revealed no significant differences in ages between the groups.
Setting

The study was conducted in Wood Hall on the Western Michigan University campus. Sessions were held in a conference room. All subjects sat together with the researcher at a large rectangular table. Physiological measures of smoking were taken in the Clinical Research Laboratory, which is adjacent to the conference room.

Apparatus/Materials

Screening, Intake and Follow-up Questionnaires (Appendix A), based on recommendations of Lando (1983), were used to gather data on the subjects. Because exposure to certain dietary and environmental elements can cause confounds in thiocyanate levels, a food-recall questionnaire (Appendix B) was used to collect related data from subjects prior to each thiocyanate test. Possible carbon monoxide confounds were also evaluated in questions 19-21 of this same questionnaire.

The American Cancer Society's "Quitters Guide-Seven Day Plan to Help You Stop Smoking Cigarettes" (1978) and Christine Zimmer's (1986) "Strategies for Success" from the Western Michigan University's "Quit for Life" Stop Smoking Workshop (Appendix C) were used as a guide in the initial quitting process.
Lapel buttons were 2 1/2 inches in diameter. They contained the phrase "Help-- I've quit smoking!" in red uppercase letters 1/3 of an inch tall on a light grey background.

Veratex 1/2 inch cotton dental rolls, Pharmaceutal Stylex 10 cc syringes, and Corning Polystyrene 15 ml Centrifuge Tubes (#25311) were used to collect saliva samples for thiocyanate analysis. The thiocyanate assay is described in Appendix D.

Expired-air carbon monoxide levels were measured using an Ecolyzer 2800. Expired air samples were collected in Carboxyhemoglobin Polyethylene 2-liter bags (Argus Supply, #4500218).

Procedure

Dependent measures were the number of cigarettes smoked (obtained via self-report), expired-air carbon monoxide (CO), and saliva thiocyanate (SCN) levels. Throughout the study, subjects were instructed to record all cigarettes lit on "Your Smoking Profile" forms (Appendix E). For the thiocyanate levels, a standard cut-off rate of 85 uM/L was used to differentiate smokers from non-smokers (Benowitz, 1983). A total of four thiocyanate levels were taken on each subject before, during, at the conclusion of, and three months post-treatment. The long half-life of thiocyanate (approximately 14 days) precluded
the need for testing during every session (Lichenstein, 1982). Thiocyanate assays were run by a graduate student from the University's Biomedical Department. Carbon monoxide levels were measured on all subjects during every session, including follow-up. A standard 10 ppm CO threshold was used to distinguish smokers from nonsmokers (Glynn, Gruder, & Jegerski, 1986). Subjects in both groups were provided with immediate verbal results of their CO levels. Cumulative graphs displaying the number of cigarettes smoked, CO, and SCN results for each subject were displayed in the Clinical Research Laboratory throughout the study.

Two graduate assistants were trained to take the saliva and expired-air samples from the subjects. One assistant was assigned to Group A and the other to Group B. The researcher was not present for collection of recall data, expired air, and saliva. Bliss & O'Connell (1984) contend that subjects are more likely to give an accurate report of their smoking status to an impartial third party who promises confidentiality rather than to the researcher who has a vested interest in the subject's success.

Group meetings were held twice weekly, on alternate nights (Mon./Wed. & Tues./Thur). Sessions were a maximum of 90 minutes in length. Sessions 1 and 2 were identical for both groups. Session 1 was an introductory session.
Session 2 was devoted to educating the subjects in smoke-stopping strategies.

A $35 fee was collected from each subject at the beginning of the first session. Sessions 1 and 2 did not involve any reimbursement to the participants. Subjects were paid $3, $4, $5, $6, and $7 after Sessions 3 through 7, respectively. No missed sessions were reimbursed. A bonus of $10.00 was awarded to subjects with perfect attendance at the end of Session 7. Subjects who made up missed sessions were given a $5 bonus.

The independent variable was a relapse-prevention package which was administered to the Treatment Group (A) over sessions 3 through 7. Sessions 3 through 7 for the Control Group (B) consisted of monitoring smoking behavior through self-report, carbon-monoxide and saliva thiocyanate levels.

Subjects were instructed prior to the first session to establish in advance a quit date between their second and third sessions.

Baseline measures of smoking behavior consisted of five data points representing the total number of cigarettes smoked daily, a thiocyanate and a carbon monoxide measure. Continuous graphs of the number of cigarettes smoked, carbon monoxide, and thiocyanate levels were displayed for the subjects to view in the Clinical Research Laboratory.
Smoking Profile forms and carbon monoxide measures were collected during every session in both groups. Thiocyanate measures and recall forms were collected in Sessions 2, 4, and 6.

Session 1 consisted of a brief explanation of the program, the researcher's professional background, and the unique aspects of the program. The subjects were given two copies of the informed consent forms. They were allotted time to read the form. The major points were highlighted by the researcher and questions were entertained. Willing participants were asked to sign the form, return one copy, and retain the other copy for their records. They were then asked to submit the $35.00 contingency payment. Each subject was asked to introduce herself/himself to the group and to display a name tag. Intake Questionnaires were distributed and completed by each subject. Baseline recording forms were distributed and reviewed with the subjects. Any questions about the form were answered. Subjects were asked not to change their smoking behavior initially in any fashion, but instead only to monitor it.

During Session 2, self-report forms were processed in the group. Subjects were encouraged to share what they learned about their smoking behavior through use of the Smoking Profile forms. The "Quitter's Guide 7 Day Plan to Help You Stop Smoking Cigarettes" pamphlet was distri-
buted. Subjects were told that a "cold-turkey" method was preferred for purposes of the program, and many of the suggestions in the seven-day plan were applicable to stopping abruptly. The "Strategies for Success" handout was distributed. Suggestions numbered 8, 10, 16, 17, 20, 24, and 39 were highlighted. Concerns about quitting and maintenance expressed by individuals on the Intake Questionnaire were reviewed and addressed. Issues involving withdrawal symptoms, other smokers, alcohol and drug use, stress, weight gain, and stimulus control were covered. Subjects were instructed to consult with a physician if withdrawal symptoms became severe. Each subject was asked to share the quit date (s)he had chosen (a date prior to the next session).

From this point forward, Group B, as mentioned earlier, reported only to hand in self-report forms and for carbon monoxide and thiocyanate testing. Each member in Group B was routinely greeted by the researcher and taken to the Clinical Research Laboratory where the assistant would collect physiological measures. No formal social contact was arranged or encouraged between subjects, although they may have voluntarily interacted with each other for brief periods as the measures were taken.

Sessions 3 through 7 describe Group A's activities only. These sessions began with a 15-30 minute discussion on the subjects' efforts related to smoke-stopping since
the previous session. Successful quitters were verbally reinforced by the researcher, and encouragement was solicited from other group members. Problems were discussed and solutions entertained by the group. The researcher encouraged and facilitated group participation.

During Session 3, the lapel buttons were distributed. Subjects were instructed to wear the pin daily (all day) for the next week. Permission was obtained from each subject to contact a third party in the work/school and home environment who could confirm compliance with wearing the pin. The researcher was able to reach a friend, family member, or co-worker of all but one of the subjects. Everyone contacted reported that the subjects were indeed wearing the buttons with the exception of a child of one of the subjects who did not appear to comprehend the purpose of the researcher's call. Subjects were assigned to collect anti-smoking literature and bring it to the next session in order to compile an informational bulletin board. Subjects were asked to name a theme for the board and decided among themselves to call it "Ashtray Memories."

In Session 4, subjects were asked to share their own and other's reactions to the quit-smoking lapel buttons. They were then asked to outline the highlights of the anti-smoking materials they brought to this session. Subjects were assigned to bring a favorite magazine which

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contained smoking advertisements to the next session. Subjects were instructed to arrange the anti-smoking literature on a bulletin board in the hall outside of the conference room.

In Session 5, magazine advertisements which the subjects submitted and which the researcher provided were examined. Subjects were asked to share a critical analysis of the advertisements, highlighting ploys for profit of the tobacco industry. They were instructed to write letters to the editors of their chosen publication requesting that the magazine discontinue advertisements promoting smoking. The content of the letters was shared among the group.

Subjects were assigned to compose a short informal speech to be presented to other subjects and significant others at the last session. The topic of the speech was coined "Before and after: life as a smoker and as a non-smoker."

Subjects in Session 6 participated in a taped interview facilitated by the researcher to be edited and aired on WIDR, a local radio station. The interview became part of a thirty minute documentary entitled "Ashes to Ashes: The Cigarette Addiction." The program was broadcast on February 27, 1989. During the interview, subjects responded to the following questions: "Why did you decide to quit smoking again?", "How has this class
been helpful to you?", "What are the major roadblocks to quitting and how will you be dealing with those?", "What can others do to help you be a nonsmoker?", and "Do you have advice for others who would like to quit?".

Following the taping, materials were provided and instructions given to the subjects to make invitations for their significant others to attend Session 7. Subjects were asked to rehearse their speeches for Session 7 and reminded of the $10 bonus for perfect session attendance.

Nine of the ten subjects brought a close friend, spouse or relative with them to session 7. Guests were permitted to observe the carbon monoxide testing and to have their own levels checked if they so desired.

Following the completion of the carbon monoxide testing, an introduction was given by the researcher welcoming the subjects and significant others to the last session. Each subject was asked to speak briefly before the group about his/her smoke-stopping experiences. The group was reminded that a follow-up would be done within the next several months and the University address and telephone number of the researcher was distributed. Subjects were encouraged to report any changes of address or telephone. Subjects interested in continuing activities incompatible with smoking were referred to the American Cancer Society for volunteer work.

Subjects were contacted to come back to Wood Hall
three months after completion of the program for collection of recall data, a carbon monoxide sample, a thiocyanate sample, and completion of the follow-up questionnaire. Subjects were contacted in advance of the follow-up to arrange a meeting and those who reported smoking activity were sent Smoking Profile forms and asked to monitor their smoking behavior for five days prior to the follow-up date.
CHAPTER III

RESULTS

By the end of the seventh session, 40% of the treatment group and 60% of the control group were reporting complete abstinence from cigarettes. Three months post-treatment, 10% of the treatment group and 40% of the control group reported continued abstinence.

The data were analyzed to assess the impact of the relapse prevention component on the number of cigarettes smoked, CO levels, and SCN results over time.

There were a total of eight CO levels used for each set of complete subject data. One level was measured per subject during each of the seven sessions and one for the follow-up session. There were a total of four SCN levels per subject. These were measured during Sessions 2, 4, 6, and at the follow-up session. The data reflecting the daily number of cigarettes smoked was reduced by reporting six different mean numbers of cigarettes smoked per subject: one mean number representing the Pre-Quit phase (five consecutive days, beginning the day after Session 1 and continuing through the day of Session 2), one mean representing the Quit phase (two consecutive days, beginning the day after Session 2 through the day of
Session 3), three mean numbers representing the Treatment phases (reported in one five- and two four-day periods, beginning the day after Session 3 and continuing through the day before Session 7), and one mean representing the Follow-up phase (five consecutive days, immediately prior to the day of the Follow-up session).

A two-way analysis of variance with one fixed (group) and one repeated (time) factor was conducted for each of the dependent variables; CO and SCN levels, and the number of cigarettes smoked. Only complete sets of data for a given measure were used; thus, any subjects with missing data could not be included in the analyses.

The two-way analysis of variance conducted on CO levels revealed no significant group differences, $F(1,8)=0.09$, $p=.7669$. There was also no significant interaction across time in CO levels, $F(7,56)=1.72$, $p=.1239$. Ten observations were used in this analysis (see Figure 1).

The two-way analysis of variance conducted on SCN levels revealed no significant group differences, $F(1,9)=0.82$, $p=.3895$. Likewise there was no significant interaction across time in SCN levels, $F(3,27)=0.16$, $p=.9244$. Eleven observations were used in this analysis (see Figure 2).

The two-way analysis of variance conducted on the number of cigarettes smoked revealed no significant group
Figure 1. Plot of Carbon Monoxide Means Over Time.
Figure 2. Plot of Thiocyanate Means Over Time.
Figure 3. Plot of the Mean Number of Cigarettes Smoked Over Time.
differences, $F(1,12)=0.04$, $p=.8441$. There was no significant interaction across time in the number of cigarettes smoked, $F(5,60)=1.02$, $p=.4115$. Fourteen observations were used in this analysis (see Figure 3).

Interestingly, there was a significant time effect for CO levels, $F(7,56)=5.59$, $p<.001$, and the number of cigarettes smoked, $F(5,60)=13.51$, $p<.001$, when the treatment and control groups were collapsed.

The next objective was to determine if the significant change in the CO levels and the number of cigarettes smoked was a combined effect or if it could be attributed specifically to the treatment or the control group. Accordingly, one-way analyses of variance were conducted for each group on each dependent variable. The one-way analysis of variance conducted on CO levels of the treatment group across time demonstrated a significant effect, $F(7,35)=6.98$, $p<.0001$. Six observations were used for this analysis. A one-way analysis of variance for CO levels of the control group revealed no significant differences across time, $F(7,21)=1.81$, $p=.1373$. Four observations were used for this analysis.

The one-way analysis of variance conducted on the number of cigarettes smoked by the treatment group across time showed a significant effect, $F(5,40)=7.91$, $p<.001$. Nine observations were used in this analysis. A significant effect was also found when a one-way analysis of
variance was conducted on the number of cigarettes smoked by the control group, $F(5,20)=5.43, p<.01$. Five observations were used in this analysis.

In order to clarify the effects in the one-way analysis of variance, post-hoc Newman-Keuls tests were conducted at the $p<.05$ level to determine where the significant effects were located across time.

Significant differences were found in the CO levels of the treatment group between Sessions 1 and 3, 1 and 5, 2 and 3, 2 and 4, 2 and 5, 2 and 7, 3 and Follow-up, 4 and Follow-up, 5 and Follow-up, and 7 and Follow-up.

Significant differences were found in the number of cigarettes smoked by the treatment group between the Pre-Quit phase and the following phases: the Quit phase, the First Treatment phase, the Second Treatment phase, and the Third Treatment phase. Significant differences were also found in the number of cigarettes smoked between all subsequent phases and Follow-up.

Significant differences were found in the number of cigarettes smoked by the control group between the Pre-Quit and all subsequent phases: the Quit phase, the First Treatment phase, the Second Treatment phase, the Third Treatment phase, and Follow-up.
CHAPTER IV

DISCUSSION

The expectations at the onset of this study were that the treatment group would demonstrate sustained abstinence from cigarettes, with corresponding decreases in CO and SCN levels over time. Likewise, it was expected that the number of cigarettes smoked by the control group would remain relatively stable, thus revealing an interaction between the two groups.

These hypotheses were not supported by the results. Instead, the majority of subjects in both groups were reporting smoking activity three months after treatment.

There was neither a significant group effect nor was there a significant interaction. When separate one-way analyses were conducted on the data for each group, however, significant effects were found across sessions for CO and cigarettes in the treatment group and for cigarettes in the control group.

The post-hoc Newman-Keuls analyses were helpful in revealing the points at which changes in the dependent variables were significant. These analyses revealed some interesting trends in the data.
The CO levels of the treatment group across sessions revealed a meaningful decrease in Sessions 3, 4, 5, and 7. This would indicate that an attempt was made to quit smoking by the treatment group and was met with at least short-term success from Sessions 3-5. The decrease in Session 7 may represent a "last-ditched" effort prior to the termination of the treatment phase. The significant change reported at the Follow-up was in a "negative" direction; by three months post-treatment, the subject's smoking behaviors had significantly increased. In fact, the mean CO levels at Follow-up were higher than they were at any other time during the study.

The number of cigarettes smoked by the treatment group showed a notable change between the Pre-Quit phase and all subsequent phases until Follow-up. Subjects did decrease their smoking steadily through the Second Treatment phase. The number of cigarettes increased by the Third Treatment phase, although the numbers remained significantly lower than at the beginning of the study. By the Follow-up phase, however, the number of cigarettes smoked was no longer significantly lower than the Pre-quit phase. Figure 3 demonstrates that the daily number of cigarettes smoked in the Follow-up phase is very close to the Pre-Quit levels.

The control group showed a significant decrease in the number of cigarettes smoked from the Pre-quit phase.
through all subsequent phases, including Follow-up. Although not significantly so, the Follow-up figures were nonetheless much higher than the Quit, First, Second, or Third Treatment phases.

The CO results may not have shown a direct correspondence to the number of cigarettes smoked for a number of reasons. The CO levels were reported in every session, whereas the daily number of cigarettes smoked were reported in "phases". The mean number of cigarettes smoked, therefore, may not have been as sensitive to fluctuations in the data. Secondly, self-report may not have been as accurate as the CO readings. Recall data is never as exact as a variable which is measured directly. Thirdly, the half-life of CO is only about two to five hours (Lichenstein, 1982). Even if the report of the number of cigarettes smoked was completely accurate, CO levels would be much higher if sampled before rather than after the half-life had elapsed.

In general, there was some concern about the accuracy of the SCN levels as they were reported. The Biomedical assistants who ran the assays were highly competent. However, SCN levels may show inconsistent results for several reasons unrelated to running the assay. The collection of the samples was an involved process. There were several samples collected which were short of the two milliliters of saliva necessary for a
valid sample. There was also some concern about the varying concentrations of saliva which had the potential for skewing the SCN data. Some subject's samples were reported by the assistants as containing precipitates capable of producing inflated results. These precipitates were believed to occur as a result of individual fluctuations in the amounts of saliva produced and how recently the subject had last eaten. Eating just prior to collection of the sample could influence the results in two ways: Chewing food affects the amount of saliva secreted, and, if the food eaten contained thiocyanates (i.e., broccoli, cabbage), the results had a higher probability of being inflated. Results were also affected if the samples were collected too quickly and/or if the subjects were biting or chewing the cotton rolls instead of allowing the saliva to pool in their mouth. Most of the subjects found collection of the samples to be a distasteful process and hurried through it as quickly as possible.

One may hypothesize a number of reasons why the treatment was not effective in reducing the number of cigarettes smoked over time in a sustained manner. The subjects who answer advertisements for group programs as a means to quitting tend to be those who have the greatest difficulty changing their behavior. The vast majority of persons who change do so on their own (Ockene, 1984). Program participants are more likely to be "difficult"
cases since they have invariably failed in quitting on their own (Lichtenstein, 1982).

Reinforcing alternative behaviors to smoking has been reported as an encouraging method to reduce smoking behavior (Glasgow & Bernstein, 1981). Smoking was significantly reduced during the treatment phase of the program. This would indicate that the reinforcers for non-smoking behavior were competitive with the reinforcers for smoking. However, once the treatment was terminated, those reinforcers derived directly from attending the sessions were no longer available. When the subjects left the classroom, they were no longer operating under schedules of reinforcement which were competitive with those schedules resulting in smoking behavior.

The occurrence of stressful events at home, work, and school were subjectively reported by the participants as controlling conditions for relapse. This is a major problem for most programs dealing with addictive behaviors. Few behaviors can compete on a sustained basis with the psychological and physiological reinforcement obtained from smoking.

There are several factors which may be accountable for the reduction of smoking behavior in both the treatment and control groups. One might question if the temporary reduction was a confound caused by providing the subjects with feedback. Feedback was given to all
subjects directly from the Ecolyzer used to measure CO levels and from the continuous graphs of all three dependent variables which were displayed for each subject. Previous research has demonstrated that feedback of CO levels alone is not effective as a means of reducing smoking behavior (Bauman, Bryan, Dent, & Koch, 1983; Stitzer & Bigelow, 1985). Nevertheless, it remains somewhat unclear whether the CO levels and graphs combined could be responsible for a reduction in smoking. Other common variables between the two groups could also have influenced the control group's smoking behavior in a favorable manner. Contact with the researchers, especially during the initial sessions, may have been a factor. The first two sessions alone, which were identical for both groups, may have been sufficient to contribute to a temporary reduction in smoking behavior. The second session focused especially on smoke-stopping techniques. Thus, a reduction in smoking behavior would be the logical result.

A more reasonable explanation for changes in the control group would be the high attrition rate. The control group was most likely not a representative sample of the population. The program offered little assistance after the first two sessions. Those subjects remaining after this time were possibly motivated by other factors (i.e., social or family pressure to quit, health
problems). Thus, the significant decrease in the number of cigarettes smoked by the control group may not be predictive of the behavior of the population from which the control group was sampled, given equal conditions.

It may be beneficial to focus on the following improvements in future research:

1. A larger sample size is important for future studies. This will improve the validity and reliability of the results and permit more definitive conclusions.

2. An investigation into other reinforcers which would be competitive with those of smoking would be helpful. Such reinforcers may include a contracted period of contact with nonsmoking people or activities which are enjoyable to the subject. The utilization of reinforcers occurring naturally in the subject's environment are essential for the maintenance of non-smoking behavior.

3. As "stress" was perceived by the majority of subjects to be the cause of relapse, increased attention to this area also appears appropriate. Components including time management, assertiveness training, and stress reduction merit further investigation.

4. Finally, individualized smoke-stopping plans would be worth investigating. Due to different learning histories and physiological variables, individuals smoke for different reasons. Also, skill levels vary. For example, one person may need extra assistance with stress
reduction, whereas another may need to concentrate on control of environmental triggers to smoke. Logically, the time-effectiveness and the probability of success would therefore be increased with a tailored treatment program.
Appendix A

Screening, Intake, and Follow-up Questionnaires
SUBJECT INFORMATION AND SCREENING FORM:
SMOKING-CESSATION STUDY

We are conducting a study for relapsed cigarette smokers who have quit before and would like to try again. The study will consist of a total of seven group sessions. The sessions will be held in the evenings, two nights per week. They will last a maximum of 1 1/2 hours each. There will be a $35.00 charge to enroll in the study, but the entire $35.00 can be earned back. After the first two sessions, you will be paid for every subsequent session you attend. So, if you attend all seven sessions, you will have earned back all of your money. If you participate, you must be at least eighteen years of age and have previously tried to quit smoking.

If you are interested, I would like to take some basic information from you. This information will remain confidential and will be used only for purposes of the study. Eligible volunteers will be chosen and contacted within the next couple of weeks. The study is scheduled to run through the month of July.

Date__________________________________________

Name__________________________________________

Address__________________________________________

Street    Apt.#    City    Zip

Phone__________________________________________

(Home)__________    (Work)__________

When and where is the best time to reach you?____________

Age____________

Sex____________

Education____________
Number of cigarettes smoked per day
(# of 20-count packs)
per week
(# of 20-count packs)

How many years have you smoked?

How many times have you tried to quit?

How long ago was the most recent time you tried to quit?

Have you gone a total of at least five consecutive days without a cigarette in the past year?

If not, within the past two years?

If not, within the past three years?

If not, within the past four years?

If not, within the past five years?

(If the potential subject answers that (s)he has not quit for at least five days during the past five years, please ask how long they were abstinent, and when that was—list month and year if possible):

"Thank you for calling. We will be in touch with you soon to let you know if you are eligible for the study. We will be able to answer any further questions at that time."
INTAKE QUESTIONNAIRE

1. Name ________________________________ Date __________
   Last, First, M.I.

Address ____________________________________________
   Street City State Zip

Telephone _____________________ ___________________________
   Home Work

2. Date of Birth ____________

3. Sex: M  F

4. Race:  Black  Asian  Caucasian(Hispanic)  Caucasian(Non-Hispanic)  Native American  Other _________________________

5. Occupation ________________________________

6. Marital Status:  Single  Married  Divorced

7. What brand of cigarettes do you smoke?: ________________

8. I smoke:  Regulars  100's  120's  Other _________________________

9. I smoke:  Filtered  Unfiltered

10. I smoke:  Mentholated  Nonmentholated

11. How old were you when you began smoking?: ________________
12. What is the maximum number of cigarettes per day you have ever smoked?: ______________

13. How many cigarettes per day are you currently smoking?: ______________

14. How many times have you tried to quit smoking?: ______________

15. When was the last time you quit?: ______________

16. List how long you went without a cigarette for each time you have quit:
   1. ______________
   2. ______________
   3. ______________

17. Do you use tobacco in any other form?: Yes No
If yes, circle the appropriate response, and indicate how much per day:
   A. Chewing (smokeless) tobacco ___________________________
   B. Pipe _______________________________________________
   C. Cigar _______________________________________________
   D. Other _______________________________________________

18. Are there other smokers in your household?: Yes No
If yes, list their age and relation to you:

   __________________________
   __________________________
   __________________________

19. Do you have friends that smoke?: Yes No
If yes, how many with whom you speak or see at least weekly?: __________
20. List other family members (other than those listed above as members of your household) that smoke, including their age and relation to you:


21. Are you exposed to smoke at work/school?: Yes No

If yes, what percent of your time each work or school day is spent in contact with smoke from other's cigarettes, pipes, cigars, etc.?:

A. Less than 25%
B. 25-50%
C. 50-75%
D. 75-100%

22. Can you name people that will be supportive of your efforts to quit?: Yes No

If yes, how many?:_____________

Who might be particularly helpful to you?_____________
23. Can you name people that may hinder your efforts to quit smoking?: Yes  No
   If yes, how many?:
   Who might hinder your efforts the most?

24. Are you ready to quit smoking?: Yes  No

25. Do you think you will be successful at quitting?:

26. What may interfere with your ability to quit?
   __________________________________________
   __________________________________________
1. Name ___________________________ Date ________
   Last, First, M.I.

Address
   Street __________________________ City ________ State ________ Zip

Telephone __________________________
   Home __________________________ Work __________________________

2. Have you had a cigarette since the end of your smoke-stopping program at Western Michigan University?:
   Yes  No

3. If you have not smoked, what has been most helpful in keeping you abstinent? Please include thoughts, actions, and help received from others: __________________________
   __________________________
   __________________________
   __________________________
   __________________________

4. If you have smoked, describe the situation in which you first relapsed (Include the month, date if you remember, place, whom you were with, your thoughts and feelings at the time, and why you think the relapse occurred:
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
Follow-up Questionnaire, p. 2

5. If you have smoked, are you currently smoking now?:
   Yes  No
   If yes, how much are you currently smoking?__________

6. Do you plan to try and quit again?: Yes  No
   If so, when?:_____________________________________

7. If you plan to quit again, will you enroll in another
   program or try to quit by yourself?: Program  Alone
   Your reasons:_____________________________________
   _______________________________________________
   _______________________________________________
   _______________________________________________

8. If you quit on your own, what methods might you use to
   help you succeed?________________________________
   _______________________________________________
   _______________________________________________
   _______________________________________________
   _______________________________________________

9. What about this program was most helpful to you and
   why?____________________________________________
   _______________________________________________
   _______________________________________________
   _______________________________________________
10. What about this program was least helpful to you and why? ____________________________________________________

11. Comments/Suggestions: ________________________________

                                                   ________________________________
                                                   ________________________________
                                                   ________________________________
                                                   ________________________________
                                                   ________________________________
                                                   ________________________________
                                                   ________________________________
                                                   ________________________________
                                                   ________________________________
Appendix B

Measures of Exposure for Saliva Thiocyanate and Carbon Monoxide Testing Questionnaire
MEASURES OF EXPOSURE FOR SALIVA THIOCYANATE AND CARBON MONOXIDE TESTING

<table>
<thead>
<tr>
<th>SUBJECT #</th>
<th>NAME</th>
<th>TEST #</th>
<th>DATE</th>
</tr>
</thead>
</table>

INDICATE THE AMOUNT CONSUMED FOR EACH SUBSTANCE UNDER THE APPROPRIATE BLANK IF YOU HAVE INGESTED THE FOLLOWING SUBSTANCES:

<table>
<thead>
<tr>
<th></th>
<th>WITHIN THE PAST 24 HOURS</th>
<th>WITHIN THE PAST WEEK</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>almonds</td>
<td>_____________________</td>
</tr>
<tr>
<td>2.</td>
<td>bamboo shoots</td>
<td>_____________________</td>
</tr>
<tr>
<td>3.</td>
<td>cassava</td>
<td>_____________________</td>
</tr>
<tr>
<td>4.</td>
<td>sugar cane</td>
<td>_____________________</td>
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<tr>
<td>5.</td>
<td>broccoli</td>
<td>_____________________</td>
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<tr>
<td>6.</td>
<td>cauliflower</td>
<td>_____________________</td>
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<td>7.</td>
<td>kale</td>
<td>_____________________</td>
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<tr>
<td>8.</td>
<td>brussel sprouts</td>
<td>_____________________</td>
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<tr>
<td>9.</td>
<td>cabbage</td>
<td>_____________________</td>
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<td>10.</td>
<td>turnips</td>
<td>_____________________</td>
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<tr>
<td>11.</td>
<td>mustard</td>
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<tr>
<td>12.</td>
<td>garlic</td>
<td>_____________________</td>
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<tr>
<td>13.</td>
<td>horseradish</td>
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<tr>
<td>14.</td>
<td>beer/ale</td>
<td>_____________________</td>
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</table>
MEASURES OF EXPOSURE, p.2

SUBJECT # __________
DATE __________

INDICATE THE AMOUNT OF THE FOLLOWING SUBSTANCES SMOKED BY YOU:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Within the past 24 hours</th>
<th>Within the past week</th>
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<tbody>
<tr>
<td>14. cigarettes</td>
<td>_______________________</td>
<td>_____________________</td>
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<tr>
<td>15. cigar</td>
<td>_______________________</td>
<td>_____________________</td>
</tr>
<tr>
<td>16. pipe tobacco</td>
<td>_______________________</td>
<td>_____________________</td>
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<tr>
<td>17. other</td>
<td>_______________________</td>
<td>_____________________</td>
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</tbody>
</table>

18. ARE YOU ON A VEGETARIAN DIET? YES NO

19. DOES YOUR WORK INVOLVE:
   A. ELECTROPLATING YES NO
   B. PRECIOUS METAL REFINING YES NO
   C. CASE HARDENING OF STEEL YES NO
   D. GAS MANUFACTURING YES NO

20. HOW MANY HOURS PER DAY DO YOU SPEND IN AN AUTOMOBILE? __________

21. ARE YOU EXPOSED IN THE WORK OR HOME ENVIRONMENT TO A GAS HEATER? YES NO
Appendix C

"Quitter's Guide 7 Day Plan to Help You Stop Smoking cigarettes" and "Quit for Life Strategies for Success"
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These consist of pages:

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Appendix D

Thiocyanate Assay
The reagents used for the saliva thiocyanate levels were:

1. trichloracetic acid, 20%
2. ferric nitrate-nitric acid reagent, which is 16% 
   \[ \text{Fe(NO}_3\text{)}_3 \cdot 9 \text{H}_2\text{O in 1N HNO}_3. \]

Two milliliter saliva samples were used for the assay. Samples were collected by having each subject place a 1 1/2-inch dental roll in his/her buccal cavity until it was saturated (approximately five minutes). The roll was then placed in a 10-ml syringe and the saliva expressed into a 15-ml graduated tube. After collection of the specimens, 2 ml of saliva was transferred to a 15-ml glass capped graduated centrifuge tube and diluted with water to the 5-ml mark. Five milliliters of trichloracetic acid (20%) solution was then added to precipitate the proteins. Samples were mixed and filtered. To 5 ml of the filtrate was added 5 ml of ferric nitrate-nitric acid reagent. Absorbance of the test substance was determined at a wavelength of 460μm. The concentration of thiocyanate in the test sample was calculated by comparing the absorbance of the sample with that of known concentrations of thiocyanate treated in a similar manner.
Appendix E

"Your Smoking Profile" Form
Your Smoking Profile

Keep this Smoking Profile Record with your pack of cigarettes. Information should be entered for every cigarette you smoke. If possible, do not smoke until the information is recorded. Rank your "need level" for a cigarette, using 1 for slight, 2 for moderate, and 3 for extreme. Circle the number if the cigarette is smoked. Fill in the data for time, place, persons, thoughts and feelings.

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Need Level</th>
<th>Situation (Places, activities, people)</th>
<th>Thoughts and Feelings</th>
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</table>

Total cigarettes smoked
High need level total
Appendix F

Human Subjects Institutional Review Board
Letter of Approval
TO: Catherine E. Ellis
FROM: Ellen Page-Robin, Chair
RE: Research Protocol
DATE: February 16, 1989

This letter will serve as confirmation that your research protocol, "Smoking Cessation in Relapsers: A "Competing-Schedules" Approach" was approved at no more than minimal risk after expedited review as of June 1, 1988.

If you have any further questions, please contact me at 387-2647.


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