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NICOTINE FADING AND SELF-MONITORING FOR CIGARETTE ABSTINENCE OR CONTROLLED SMOKING

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This study compared four treatment approaches to cigarette smoking: (1) a nicotine fading procedure, in which subjects changed their cigarette brands each week to ones containing progressively less nicotine and tar; (2) a self-monitoring procedure in which subjects plotted their daily intake of nicotine and tar; (3) a combined nicotine fading/self-monitoring procedure; and (4) a slightly modified American Cancer Society Stop Smoking Program. Thirty-eight habitual smokers were assigned to one of the treatment groups. The study had two goals: (1) to achieve a clinically significant percentage of abstinence, and (2) to reduce the nonabstainers' smoking to a "safer" level by having them smoke low tar and nicotine cigarettes. The 18-month followup results showed that the nicotine fading/self-monitoring group was the most successful: 40 per cent were abstinent and all who had not quit were smoking cigarettes lower in tar and nicotine than their baseline brands. Half the nonabstainers had decreased their rate of smoking relative to baseline while the other half had increased. Furthermore, the fading/self-monitoring group achieved the largest reductions from baseline in daily nicotine and tar intake (61% and 70% respectively). The results suggest that the study's goals were achieved and that the nonaversive combined procedure could be used to treat not only habitual smokers but also smokers with severe cardiovascular and respiratory problems, because it does not have some of the inherent limitations of the successful aversive smoking cessation procedures.

DESCRIPTORS: smoking addiction, nicotine smoking reduction by nicotine fading, controlled smoking, self-recording, humans

Despite the proliferation of behavioral approaches to smoking reduction in recent years, it is generally agreed that their results have been largely disappointing (Lichtenstein and Danaher, 1976). The only studies that have reported clinically significant abstinence levels at six-month followups have employed aversive procedures such as rapid smoking, satiation, and negative practice singularly or in combination with other procedures (Delahunt and Curran, 1976; Dericco, Brigham, and Garlington, 1977; Lando, 1977; Lichtenstein, Harris, Birchler, Wahl, and Schmahl, 1973; Schmahl, Lichtenstein, and Harris, 1972). Yet, all of these procedures suffer the high subject dropout rates that characterize aversive procedures, and there has been growing concern about the potential health risks associated with the most commonly used procedure, rapid smoking (Hauser, 1974; Horan, Hackett, Nicholas, Linberg, Stone, and Lukaski, 1977; Horan, Linberg, and Hackett, 1977; Lichtenstein and

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Danaher, 1976). As a result, the search continues for effective nonaversive behavioral smoking treatments.

A clear neglect in smoking cessation programs is consideration of the primary reinforcing properties of nicotine. A popular view in recent years, often referred to as the nicotine-dependence hypothesis, is that most people's cigarette smoking is maintained, in part, by the physiologically addicting properties of nicotine (Brecher, 1972; Dunn, 1973; Russell, Sutton, Feyerabend, Cole, and Saloojee, 1977; Schachter, 1977; 1978; Stephens, 1977). The Addiction Research Unit of the Institute of Psychiatry, London, has included nicotine with the other more commonly considered "dependence-producing substances", such as alcohol, barbituates, and heroin (Russell, 1971). Russell specifically referred to cigarette smoking as a "dependence disorder", although others have preferred to use the term "addiction" (Brecher, 1972). Regardless of which term is preferred, there is evidence that nicotine is physiologically addicting.

Jarvik, Glick, and Nakamura (1970), Johnston (1942), and Lucchesi, Schuster, and Emley (1967) all found a reduction in cigarettes smoked when smokers were given oral or intravenous doses of nicotine. Heavy smokers have experienced nicotine withdrawal reactions such as cardiac slowing and lowered diastolic blood pressure, during an imposed three-day period of cigarette abstinence (Knapp, Bliss, and Wells, 1963). Knapp *et al.* concluded that "heavy cigarette smokers thus appear to be true addicts, showing not only social habituation but mild physiologic withdrawal effects" (p. 971). Finnegan, Larson, and Haag (1945) varied the nicotine content of cigarettes that their subjects smoked. When smoking low nicotine cigarettes, half the subjects reported such symptoms as "heightened irritableness, decreased ability to concentrate on mental tasks, feeling of inner hunger or emptiness . . . in short, virtually the same symptoms experienced by many individuals on stopping smoking" (p. 96). In a related study, Levinson, Shapiro, Schwartz, and Tursky (1971) required subjects to smoke progressively fewer cigarettes over a three-month period. Many smokers reached a "stuck point" (12 to 14 cigarettes per day), below which they were unable to reduce further. Levinson *et al.* speculated that further reduction was inhibited by withdrawal symptoms caused by some physiological addiction and concluded that a successful smoking treatment program should combine physiological and psychological approaches.

Kumar, Cooke, Lader, and Russell (1977) obtained results that did not support the nicotine-dependence hypothesis because they found that intravenous doses of nicotine did not affect ongoing smoking rates. After a series of studies, Schachter and his colleagues (Schachter, Silverstein, and Perlick, 1977) suggested that there may be smokers who are addicted to nicotine and smokers who are not, and that the study of the withdrawal syndrome may be the key to understanding why.

The approach in the present study was to consider the nicotine in cigarettes as dependence producing and cigarette smoking as a dependence disorder maintained by physiological and psychological factors. The treatment strategy was to encompass both factors by gradually reducing the subjects' dependence on nicotine and thereby minimize nicotine withdrawal effects, while at the same time providing them positive feedback regarding their efforts to reduce that dependence. The study had two goals: (1) to achieve a clinically significant percentage of abstinence; (2) second goal, to have those smokers who could not achieve abstinence smoke the lowest tar and nicotine cigarettes commercially available. This attempt to produce controlled smoking appeared reasonable in light of the widespread and frequent failure of abstinence programs. A somewhat different approach to controlled smoking was used with some success by Frederiksen and Peterson (1976), who sought to reduce the number of cigarettes their subjects smoked. To some extent, the controlled smoking ratio-

nale is similar to the "social drinking" approach to alcoholism, whose proponents offer "moderate drinking" as an acceptable treatment goal (Strickler, Bigelow, Lawrence, and Liebson, 1976).

The treatment program was a combination of two procedures: nicotine fading and self-monitoring. The nicotine fading procedure required smokers to change their brand of cigarettes to a brand containing proportionately less nicotine until they were smoking the lowest nicotine cigarette commercially available, at which time they were to quit smoking. Because the nicotine content of cigarettes is highly correlated ($r = 0.96$) with the tar content (Russell, Wilson, Patel, Feyerabend, and Cole, 1975), this gradual reduction in the dependence on nicotine would be paralleled by a decrease in exposure to the carcinogenic extractions commonly labelled "tar".

The self-monitoring procedure was designed to complement the nicotine fading procedure. It required the smokers to plot their daily bodily intake of nicotine and tar throughout the treatment program so that they would receive daily and weekly feedback regarding their nicotine and tar intake. This self-monitoring procedure was different from those employed in previous smoking studies (McFall, 1970; McFall and Hammen, 1971), where smokers self-monitored their number of cigarettes smoked. In the present study, all treatment groups self-monitored their daily consumption of cigarettes; however, only those subjects in groups designated as "self-monitoring" plotted their daily intake of nicotine and tar.

The study was designed to compare the effectiveness of four treatment procedures: nicotine fading, self-monitoring, nicotine fading and self-monitoring in combination, and a slightly modified American Cancer Society Stop Smoking Program. While the American Cancer Society group was designed to "control" for the effects of the nicotine fading and/or self-monitoring procedures, it was an "active" treatment group.

METHOD

Subjects

Subjects were recruited from the university and community-at-large through radio, newspaper, and poster advertisements. They met the following criteria: they had smoked for at least 1 yr; they smoked at least one pack of cigarettes per day; and their cigarette (brand) contained at least 0.7 mg. of nicotine. Forty-four subjects, 15 males and 29 females, met criteria. They ranged in age from 17 to 62 ($M = 31$) and had been smoking between 1 and 45 yr ($M = 14$). Half of the subjects were from the university and half from the community. During an initial telephone contact, subjects were informed that a $15 refundable participation deposit was required and that there were four possible regular weekly meeting times. They were asked their brand of cigarettes, how many they smoked per day and which days they were available for meetings. Subjects were matched on their daily nicotine intake (nicotine content of their regular cigarette brand times reported number of cigarettes smoked) and then randomly assigned to one of the four treatment groups within the limitations imposed by their availability to attend treatment meetings.

Experimenter

All treatment sessions were conducted by the second author, a second-year graduate student in clinical psychology with 1 yr of experience conducting Stop Smoking Groups for the American Cancer Society.

Procedure

Orientation meeting. Separate orientation meetings (Session 1) were conducted for each group. During the meeting, subjects completed a prebaseline questionnaire, on which they indicated the brand and number of cigarettes they smoked daily, and viewed an American Cancer Society film on smoking. After the film, subjects were informed that they had been ran-

domly assigned to one of four different treatment groups, but that all treatments should be effective. They were told that they would be informed of the six-month followup results and at that time would be given the treatment that proved to be the most effective if they had not quit smoking. They were instructed to continue to smoke normally until the next weekly meeting (Session 2), and to record, on special forms, each cigarette smoked daily. They were told that the treatment program would be explained at the next meeting. The experimenter collected the $15 refundable deposits and explained that one-half of the deposit would be returned at the end of treatment in four weeks (Session 5) and that the other half would be returned six months later. The subjects were assured that the return of their deposits was not dependent on their success in the program, but rather on their meeting the requirements of the "Smoker's Contract" (described below).

Subjects had the option of terminating their involvement after the Smoker's Contract and treatment programs were explained during Session 2. The two people who terminated at that time were refunded their deposit. Both had legitimate reasons: one found a treatment program closer to home, and the other's spouse had become seriously ill.

Program requirements. At Session 2, the Smoker's Contract and the general nature of the specific treatment were explained. To receive half of their deposit at the end of treatment, the subjects had to fulfill the following requirements of the Smoker's Contract: (1) attend the five weekly treatment sessions; (2) submit the name, address, and phone number of at least two persons ("significant others"), one of whom was not a relative, who were in frequent contact with the subject and who were familiar with the subject's smoking, and allow them to monitor the subject's smoking and to report their observations to the experimenters; (3) keep accurate daily records of their smoking by recording each cigarette smoked and submit these records at each treatment session (Sessions 2 to 5); and (4) collect three cigarette butts from each cigarette pack smoked during treatment and submit them each week in their appropriate (empty) cigarette pack (Sessions 3 to 5). The subjects were told that the cigarette collection procedure was necessary in order to monitor, by weight, their actual amount of tobacco smoked, and to determine whether this amount varied over treatment. The actual purpose of the procedure, however, was to attempt to verify that the subjects in the nicotine fading groups (described later) were following the correct treatment procedure—*i.e.,* smoking the designated brand of cigarettes. This deception was explained at the six-month followup debriefing session. There were additional requirements for some of the groups in order to have the first half of their deposits refunded (described later).

To receive the second half of their deposits, subjects had to respond accurately to our questions regarding their smoking during the six-month followup. Subjects who failed to comply with any of the above requirements would forfeit their deposits and the money would be donated to the American Cancer Society. The subjects' signing of the Smoker's Contract acknowledged that they had read it, understood it, and willingly agreed to its terms. The contract was signed in duplicate; the subject and experimenter each retained a copy.

Treatment Conditions

Nicotine fading group (NF). During Session 2, the rationale underlying the nicotine fading procedure was explained. Evidence was presented documenting the addicting properties of nicotine, and the treatment was described as involving their gradual withdrawal from the drug. They were told that gradually reducing their dependence on nicotine would reduce the intensity of their withdrawal symptoms when they quit smoking. Using the Federal Trade Commission's (1975) publication entitled *Tar and nicotine content of cigarettes* as a guide,

the subjects were instructed to change their current brand of cigarettes to a brand containing progressively less nicotine according to the following schedule: Session 1 (Week 1)—regular brand (baseline period); Session 2 (Week 2)—30% nicotine reduction from regular brand; Session 3 (Week 3)—60% nicotine reduction from regular brand; Session 4 (Week 4)—90% nicotine reduction from regular brand; Session 5 (Week 5)—recommendation to quit smoking. The change of cigarette brands was effective on the morning following the treatment session (Sessions 2 to 4).

Each subject was told the exact brand of cigarette to be smoked during the coming week and its nicotine and tar content. Menthol cigarettes were always assigned to smokers whose regular brand of cigarettes was mentholated. Thus, each subject was given an individualized program. The subjects were told that they were free to smoke as many designated brand cigarettes as they desired, but that they could smoke no other brand during the week. (This was an additional requirement in their Smoker's Contracts). They were not to change brands ahead of schedule and to do so would result in their forfeiting the first half of their deposits. At the end of the fourth treatment week (Session 5), we recommended that they quit smoking because their nicotine intake was at a level that would permit them to do so without discomfort.

Self-monitoring group (*SM*). During Session 2, the rationale underlying the self-monitoring procedure was explained. The subjects were told that the procedure would keep them "informed" of their treatment progress, and should help them to regulate, and thereby reduce their smoking to a point where they could quit. They were to plot two graphs each day: one of their daily intake of nicotine and the other of their daily tar intake (this was an additional requirement of their Smoker's Contracts). Daily nicotine or tar intake was calculated by multiplying the number of cigarettes smoked that day times the nicotine (tar) content in milligrams of a single cigarette. Subjects were supplied with graph paper on which the x and y axis had already been labelled and calibrated for their particular cigarette brands and rates of baseline smoking. They were shown how to calculate and plot the data and practiced by plotting their baselines. Finally, they were reminded that half of their deposit was contingent on their turning in the two accurate and updated graphs at each weekly meeting.

Combined nicotine fading/self-monitoring group (*NFSM*). This group received the nicotine fading and self-monitoring procedures in combination.

Modified American Cancer Society Stop Smoking Program group (*ACS*). This group received a modified version of the American Cancer Society Stop Smoking Program described in the training manual, *Stop Smoking Program Guide* (American Cancer Society—California Division, 1971). The program consists of three distinct phases within a supportive group atmosphere. In phase one, suggestions and ideas from ex-smokers are presented to help smokers gain insight. A "Smoker's Test" is completed that is designed to provide information regarding the type of satisfaction the smoker derives from smoking, and given this information, how the smoker can best quit smoking. Phase two focuses on helping to promote cigarette abstinence. During this phase, a 48-hr experimental quit period is scheduled and smokers are given a "Tip Sheet" containing 40 suggestions for quitting smoking. Phase three begins after the program has ended and involves the organization of an autonomous IQ (I Quit) Club for those who wish to continue to meet in order to maintain their non-smoking. Our modified Stop Smoking Program differed from the original in three respects: (a) it consisted of five weekly 1-hr sessions, rather than eight weekly 2-hr sessions; (b) only the first two program phases were employed; and (c) it contained the following additional elements: the Smoker's Contract, required session attendance, the mandatory (rather than optional)

daily recording of cigarettes smoked, the cigarette collection procedure, the formal followup procedure, and the use of "significant others" as reliability checks.

Treatment Sessions

All groups met for five consecutive 1-hr weekly sessions in the same room. All subjects were told that their treatment was designed so that they would quit smoking after the fifth session. All sessions were conducted so as to maximize nonspecific factors such as experimenter contact, group structure and support, social reinforcement, induced positive expectations, and monitoring. Sessions were conducted in a supportive but nondirective manner and devoted to promoting supportive exchanges among subjects concerning their efforts to curtail their smoking, their successes and failures, and their reactions to the treatment.

Assessment Procedures during Treatment

All subjects completed the Daily Cigarette Count forms each day by recording each cigarette smoked and the time. The forms could be wrapped around a cigarette pack and fastened with a rubber band, or inserted into the pack's cellophane wrapper. The forms were to be kept with the cigarettes at all times. At each session, the forms from the previous week were collected, the data were recorded, and the forms were returned the following week.

In the self-monitoring and nicotine fading/self-monitoring groups, the subjects' graphs were photocopied at each session so that they could retain their original copies. Between meetings, the graphs were reviewed for accuracy. Minor plotting errors were discovered at an average rate of three subjects per condition per week. The subjects corrected these errors the following week.

The cigarette collection procedure served as a partial check on reported smoking. While the cigarette butts and empty cigarette packs did not constitute absolute proof that a subject was smoking a particular cigarette brand, they did strongly support that contention, as the collection of these items from another source would seem to involve a certain degree of difficulty and possible embarrassment. Furthermore, the subjects assumed that their "significant others" would be contacted during the treatment period, although they were not contacted until the followup. No major attempt was made to seek corroboration of the subjects' treatment reports, because only followup data are of interest as almost all subjects in smoking studies show a positive treatment effect with varying degrees of relapse thereafter (Lichtenstein and Danaher, 1976).

Assessment Procedures during Followup

As is customary in smoking research (Lichtenstein and Danaher, 1976) the subjects were contacted by telephone during the followup. They were contacted at intervals of one week (posttreatment), and 1, 3, and 6 months. After the six-month followup, the subjects were debriefed and those who were interested and had not quit were given the best treatment procedure. However, we also obtained followup at 12 and 18 months. During the telephone contact, the subjects were asked the following information about their smoking that past week: (a) their average number of cigarettes smoked per day, (b) the brand(s) of cigarettes smoked (if any), and (c) the number of days that they had abstained from cigarette smoking (if any). If the answer was "seven days", the subject was asked the date of the last cigarette smoked.

During the treatment, letters were mailed to the subject's significant others requesting that they monitor his/her smoking behavior together with the statement for them to sign and return, if they agreed to do so. Enclosed in the letter was the subject's signed release form indicating that he/she agreed to have his/her smoking monitored. To check the reliability of subjects' self-reports, the significant others were telephoned at each followup contact and asked the same questions asked of the subjects

and the answers compared. Of the 80 participating significant others, 77 were contacted at some point. There were only two instances (out of 160 possibilities) where a subject's self-report deviated considerably (*i.e.,* more than 10 cigarettes) from the significant other's report. Both involved the number of cigarettes smoked rather than what we considered to be the more important variables, namely, brand and whether or not the subject was smoking. The second significant others were then contacted and the first significant others' reports were confirmed. Consequently, the significant others' accounts were used in the data analysis.

RESULTS

Four of the 44 subjects dropped out of the study, two before the contract was signed and two the following week (Session 2). A chi-square analysis revealed no significant dropout rate across groups. Two of the remaining 40 subjects quit smoking during baseline and were excluded from the data analysis; one of them remained abstinent, and the other resumed smoking. There were no significant differences among the groups on the demographic or smoking history variables.

Abstinence

Between the one-week posttreatment and six-month followup checks, the NF and ACS groups displayed the relapse in abstinence that is characteristic in smoking studies. At six months, 50% of the NFSM group was abstinent whereas no other group exceeded 10%. At 18 months, 40% of the NFSM group was still abstinent, *versus* only one subject in the NF and ACS groups. Figure 1 shows that over the 18-month followup the NFSM group maintained the highest numerical percentage of abstinence.[2] No one in the SM group ever quit smoking.

Cigarette Brands and Rate of Smoking of Nonabstaining Subjects

An important variable was the brand of cigarettes smoked by subjects who did not attain abstinence, because the subjects' smoking a

[2]Complete statistical analyses can be obtained from the authors.

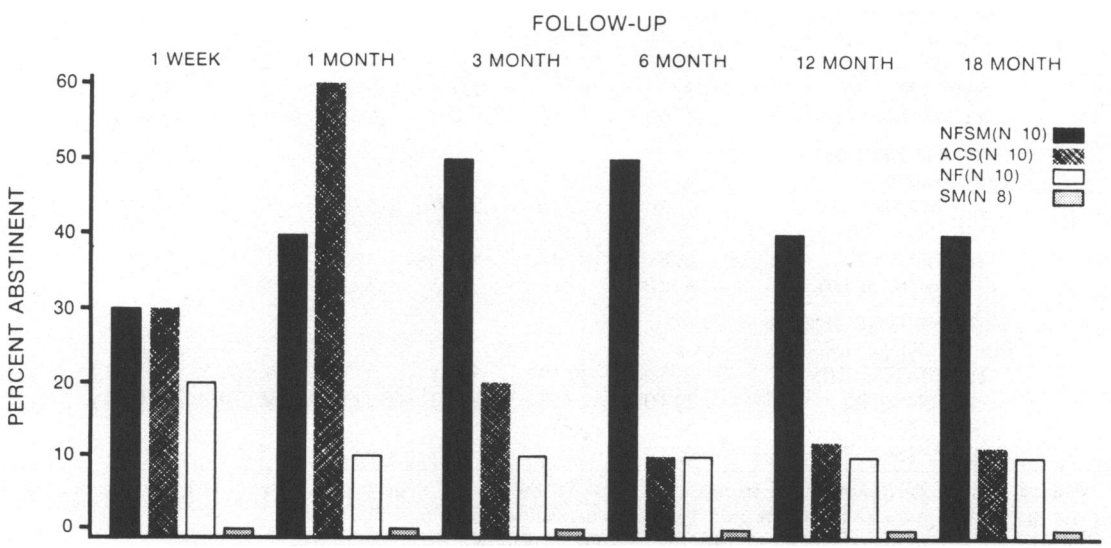

Fig. 1. Percentage of subjects in each group reporting abstinence at followup. Groups NFSM = Nicotine fading/self-monitoring; NF = nicotine fading; SM = self-monitoring; ACS = American Cancer Society. During the 12-month followup, three ACS subjects could not be located. At the 18-month followup, two ACS subjects and three SM subjects could not be located.

lower tar and nicotine brand than their baseline brand would constitute controlled smoking and thereby be a desirable treatment outcome. Table 1 shows the proportion of subjects at the followups who were smoking a lower tar and nicotine brand than their baseline brand, their baseline brand (or an equivalent brand), or a higher tar and nicotine brand. The table reveals that, except for one subject at the one-month followup, all nonabstaining NFSM subjects were smoking lower tar and nicotine brands than their baseline brands. In the other three groups, the proportion of subjects smoking low tar and nicotine brands varied considerably across the followups with no discernible pattern, except in the SM group where a large proportion of the subjects had switched to lower tar and nicotine cigarettes at the 12-month followup. At the six-month followup debriefing session, one SM subject and two ACS subjects asked to be placed on the NFSM program. Although these subjects were not abstinent at the subsequent followups, all were smoking cigarette brands lower in tar and nicotine than their baseline or six-month followup brands.

While the NFSM nonabstainer's results suggest that we achieved our secondary goal of a "safer" level of smoking by motivating them to smoke lower than baseline tar and nicotine brands, their rate of smoking also was of interest, especially in light of Schachter's (1977, 1978) much publicized research on the addicting properties of nicotine. Schachter questioned efforts to motivate smokers to switch to lower tar and nicotine cigarettes. He regards such efforts as unjustified because his research suggests that heavy smokers (a pack or more a day) regulate their nicotine intake, *i.e.,* they smoke greater numbers of low nicotine cigarettes, in order to keep their nicotine at a constant level. If Schachter is correct, most of

Table 1

Proportion of subjects reporting abstinence, smoking reduced tar/nicotine brands, and smoking baseline or higher tar/nicotine brands at followup.

Treatment Group	*1 wk*	*1 mo*	*3 mo*	*6 mo*	*12 mo*	*18 mo*
ABSTINENCE						
NFSM (N = 10)	3/10	4/10	5/10	5/10	4/10	4/10
NF (N = 10)	2/10	1/10	1/10	1/10	1/10	1/10
SM[ab] (N = 8)	0/8	0/8	0/8	0/8	0/7	0/4
ACS[cd] (N = 10)	3/10	6/10	2/10	1/10	1/5	1/6
SMOKING REDUCED T/N BRAND						
NFSM (N = 10)	7/10	5/10	5/10	5/10	6/10	6/10
NF (N = 10)	7/10	8/10	7/10	5/10	5/10	5/10
SM[ab] (N = 8)	3/8	4/8	5/8	4/8	6/7	3/4
ASC[cd] (N = 10)	1/10	1/10	2/10	3/10	2/5	3/6
SMOKING BASELINE OR HIGHER T/N BRAND						
NFSM (N = 10)	0/10	1/10	0/10	0/10	0/10	0/10
NF (N = 10)	1/10	1/10	2/10	4/10	4/10	4/10
SM[ab] (N = 8)	5/8	4/8	3/8	4/8	1/7	1/4
ACS[cd] (N = 10)	6/10	3/10	6/10	6/10	2/5	2/6

[a]One subject's data are excluded from the 12- and 18-month followup because the subject asked to be placed on the NFSM program at the six-month followup debriefing session.

[b]Three subjects could not be located for the 18-month followup.

[c]Two subjects' data are excluded from the 12- and 18-month followup because they asked to be placed on the NFSM program at the six-month followup debriefing session.

[d]Three subjects could not be located for the 12-month followup and two were unavailable at the 18-month followup.

the subjects in the present study who switched and continued to smoke lower nicotine cigarettes should have been smoking at higher than their daily baseline rates. However, the left-hand side of Table 2 shows that just the opposite occurred. The majority of the subjects who were smoking cigarette brands lower in tar and nicotine than their baseline brands were smoking fewer cigarettes than during baseline. Some support for Schachter's position is found on the right side of Table 2, because in general, smokers of baseline or higher tar and nicotine brands smoked fewer cigarettes each day during followup. However, these results could be attributed not only to nicotine regulation but to many other factors as well.

Nicotine and Tar Intake and Cigarette Consumption

Table 3 shows that all groups greatly decreased their percentage of baseline nicotine and tar intake at the one-week posttreatment check followed by varying degrees of relapse. The NFSM group relapsed the least, followed by the NF group. Through the six-month followup, the ACS group was superior to the SM group. Thereafter, the differences between the two groups were mixed and are uninterpretable, in large part because the data for several subjects in both groups were unobtainable. Of major interest was the results for the NFSM group, which showed 61% and 70% reductions from baseline in nicotine and tar at the 18-month followup.

Nicotine and tar intake were considered to be more important variables than number of cigarettes smoked because increased smoking at greatly reduced nicotine and tar levels would, in almost all cases, be safer than decreased smoking at the same or higher tar and nicotine levels. Meaningful group comparisons of the cigarette percentage reduction from baseline data can be made only through the six-month followup, because after that the data for sev-

Table 2

Proportion of Subjects Smoking Below, Above, or at their Baseline Rates at Followups

Group	*Smoking the Same or More Cigarettes*						*Smoking Fewer Cigarettes*					
	1 wk	*1 mo*	*3 mo*	*6 mo*	*12 mo*	*18 mo*	*1 wk*	*1 mo*	*3 mo*	*6 mo*	*12 mo*	*18 mo*
	SMOKING REDUCED TAR AND NICOTINE BRAND											
NFSM (N = 10)	0/7	0/5	2/5	3/5	1/6	3/6	7/7	5/5	3/5	2/5	5/6	3/6
NF (N = 10)	0/7	1/8	2/7	1/5	1/5	3/5	7/7	7/8	5/7	4/5	4/5	2/5
ACS[ab](N = 10)	0/1	0/1	0/2	1/3	2/2	1/3	1/1	1/1	2/2	2/3	0/2	2/3
SM[cd] (N = 8)	1/3	2/4	3/5	2/4	4/6	0/6	2/3	2/4	2/5	2/4	2/6	3/3
Percent across groups	6	17	37	41	42	41	94	83	63	59	58	59
	SMOKING BASELINE OR HIGHER TAR AND NICOTINE BRAND											
NFSM (N = 10)	0/0	0/1	0/0	0/0	0/0	0/0	0/0	1/1	0/0	0/0	0/0	0/0
NF (N = 10)	0/1	0/1	0/2	2/4	1/4	1/4	1/1	1/1	2/2	2/4	3/4	3/4
ACS[ab] (N = 10)	0/6	0/3	1/6	3/6	0/2	1/2	6/6	3/3	5/6	3/6	2/2	1/2
SM[cd] (N = 8)	0/5	2/4	2/3	3/4	1/1	1/1	5/5	2/4	1/3	1/4	0/1	0/1
Percent across groups	0	22	27	57	29	43	100	78	73	43	71	57

[a]Two subjects' data are excluded from the 12- and 18-month followup because they asked to be placed on the NFSM program at the six-month followup debriefing session.

[b]Three subjects could not be located for the 12-month followup and two were unavailable at the 18-month followup.

[c]One subject's data are excluded from the 12- and 18-month followup because the subject asked to be placed on the NFSM program at the six-month followup debriefing session.

[d]Three subjects could not be located for the 18-month followup check.

eral subjects were unobtainable. Except for the SM group, there was little difference among the groups at six months, although the NFSM did have the largest percentage reduction from baseline.

Several subjects donated a portion of their deposits ($7.50) to the American Cancer Society. The six subjects who donated money immediately following treatment had successfully quit smoking. A different six subjects donated their deposits at the six-month followup; they had relapsed.

DISCUSSION

The followup results showed that the nicotine fading/self-monitoring group achieved both of the study's goals: a clinically significant abstinence level and controlled "safer" smoking. The group achieved and maintained the greatest abstinence and was the only group in which all of the nonabstaining subjects smoked cigarette brands lower in tar and nicotine than their baseline brands. The NFSM group also achieved the largest percentage reductions in nicotine and tar intake and cigarette consumption at the six-month followup. The next greatest reductions across these three measures were achieved by the nicotine fading group, followed respectively by the American Cancer Society and self-monitoring groups.

We had hypothesized that the negative feedback provided by the daily self-monitoring procedure (plots of tar and nicotine intake) would induce the SM subjects to switch (fade) from their regular cigarette brands to lower tar and nicotine cigarettes. This did not happen during treatment, nor did any subject suggest it during the group discussions. Those who did change brands did so long after treatment, which meant that they never experienced the combined effect of nicotine fading and self-monitoring. As a result, the attentuation of the procedure's effects over time was consistent with the reported failures of other self-monitoring procedures (Kazdin, 1974). It also is conceivable

Table 3

Mean percentage reductions from baseline in nicotine and tar intake and cigarette consumption at followup.

Group	*1 wk*	*1 mo*	*3 mo*	*6 mo*	*12 mo*	*18 mo*
NICOTINE						
NFSM (N = 10)	96.1	84.6	73.3	68.6	65.3	60.9
NF (N = 10)	89.3	71.6	62.8	53.2	48.2	45.4
ACS[ab] (N = 10)	80.2	86.2	50.0	36.9	2.0	39.2
SM[cd] (N = 8)	57.1	33.4	16.2	2.2	13.0	26.7
TAR						
NFSM (N = 10)	97.3	88.1	76.5	70.7	68.8	70.0
NF (N = 10)	91.0	75.4	70.1	59.2	56.9	51.1
ACS[ab] (N = 10)	79.8	86.2	50.6	37.3	3.3	26.2
SM[cd] (N = 8)	57.3	39.1	25.1	13.3	24.9	36.6
CIGARETTES						
NFSM (N = 10)	73.3	63.6	34.7	32.0	37.8	21.2
NF (N = 10)	70.9	48.1	38.4	26.8	17.0	12.1
ACS[b] (N = 10)	80.1	86.4	47.4	27.5	+8.3	28.0
SM[d] (N = 8)	51.7	16.0	+7.8	+21.0	+21.9	0.0

[a]Two subjects' data are excluded from the 12- and 18-month followup because subjects asked to be placed on the NSFM program at the six-month followup debriefing session.

[b]Three subjects could not be located for the 12-month followup check and two were unavailable for the 18-month check.

[c]One subject's data are excluded from the 12- and 18-month followup because subject asked to be placed on the NFSM program at the six-month followup debriefing session.

[d]Three subjects could not be located for the 18-month followup check.

that the other three procedures may have been more abstinence oriented and that the SM subjects, who were simply told to plot nicotine and tar in order to prepare to quit smoking, did not make a strong effort to quit or simply assumed they were a control group.

The marginal long-term success achieved by the American Cancer Society group was consistent with the limited results obtained by nonbehavioral approaches or approaches that do not emphasize behavioral methods (Lichtenstein and Danaher, 1976). Predictively, the ACS showed a very strong posttreatment effect that deteriorated rapidly after the first month.

The results for the nicotine fading procedure were mixed. The procedure did little to promote long-term abstinence, yet did produce considerable long-term reductions in daily nicotine and tar intake. Thus, the procedure failed to accomplish our abstinence goal, but did somewhat meet our controlled smoking goal, *i.e.,* reducing smoking to a "safer" level.

In combination, the nicotine fading and self-monitoring procedures produced effects that clearly surpassed those of either procedure in isolation. Several suggestions can be made as to why the combined procedure was more effective than the others. First, the procedure included the establishment of intermediate treatment goals, *i.e.,* progressive nicotine and tar reductions throughout the four-week treatment. Bernard and Efran (1972) found that smokers whose treatment goal was cigarette reduction achieved abstinence more often than those for whom abstinence was the established goal. They hypothesized that because the reduction-group subjects found achieving or surpassing their treatment goal reinforcing, they were able to achieve a higher rate of abstinence. In the present study, the NFSM subjects needed only to change cigarette brands each week to achieve their intermediate (weekly) tar and nicotine goals, *i.e.,* smoking a lower tar and nicotine brand, while plotting these values daily ensured that they received positive feedback concerning their success. Second, the procedure has a built-in success mechanism: the weekly switching to lower tar and nicotine brands combined with self-monitoring guaranteed that the subjects would be successful. An "operant consequences" explanation of self-monitoring may help explain why. The self-monitoring may have served as an immediate consequence that bridged the delay between the behavior, reducing one's tar and nicotine intake, and the long-term consequence, abstaining from cigarettes. Because the behavior was desirable, the positive feedback associated with the self-monitoring could have served as a conditioned reinforcer (with its dual function as a reinforcer for past reductions and as a discriminative stimulus for future reductions), thereby increasing the probability that the terminal response (smoking reduction or cessation) would occur in the future. Our conversations with NFSM subjects suggested that such events may very well have been operating. After initially doubting their ability to quit smoking, the subjects said that they began to "see" their success and believe that they could achieve abstinence or permanent tar and nicotine reductions. Third, the procedure appeared to produce a delayed treatment or abstinence effect, since the group's abstinence actually increased between the posttreatment week and the three-month followup. This, of course, is in contrast to what usually happens in smoking cessation programs. Fourth, it appears that the procedure may have helped reduce the subjects' dependence on nicotine by gradually weaning them off the drug. This gradual reduction in nicotine intake may explain why our results did not show the iatrogenic nicotine regulation effect (Schachter, 1977) that supposedly occurs when smokers switch to lower nicotine cigarettes.

The NFSM group's 50% total abstinence at six months and 40% abstinence at 18 months compares favorably with the majority of smoking studies. For example, Hunt and Bespalec (1974) surveyed 89 studies and found abstinence rates of about 20 to 30% at varying followup periods up to six months. Furthermore,

although the present study's 61% and 70% reductions from baseline in nicotine and tar intake at 18 months cannot be directly compared with studies that measured only cigarette consumption, they appear to be promising outcomes for a smoking treatment program.

To date, the most successful smoking treatments have contained aversive components. At six-month followup, abstinence levels have been reported for rapid smoking of 64% (Schmahl *et al.*, 1972) and 60% (Lichtenstein *et al.*, 1973); for satiation within a broad spectrum treatment approach 76% (Lando, 1977); for negative practice and self-control procedures in combination 56% (Delahunt and Curran, 1976); and for electric shock 100% (Dericco *et al.*, 1977).

The present study's 50% abstinence level, at six months, while not as high, is nonetheless encouraging. The NFSM procedure is nonaversive, and thus does not have the limitations of the aversive procedures, and especially of the rapid smoking procedure. For example, aversive control "concerns many people on esthetic and ethical grounds" (Lichtenstein and Danaher, 1976, p. 105). There are potential risks associated with the use of rapid smoking, such as nicotine poisoning (Horan *et al.*, 1977). Hauser (1974) and Lichtenstein and Danaher (1976) described other potentially harmful effects of rapid smoking and recommended the medical screening of subjects to exclude those with pulmonary and cardiovascular disease, emphysema, and asthma. Unfortunately, such smokers would be most in need of treatment. The initial success of the combined procedure suggests that it may become, upon replication, the treatment of choice for smokers who have cardiovascular and respiratory problems or who are opposed to aversive procedures on esthetic or ethical grounds.

The relation between the tar and nicotine content of cigarettes and mortality rates (death caused by lung cancer and coronary heart disease), has been investigated recently by the American Cancer Society (Hammond, Garfinkel, Seidman, and Lew, 1976). Hammond *et al.* studied over one million men and women over a 12-yr period (1960 to 1972). They proposed three "counter speculations" to the supposition that a reduction in the tar and nicotine content of cigarette smoke would correspondingly reduce the harmful effects of cigarette smoking: (1) most smokers of lower tar and nicotine cigarettes might smoke more cigarettes per day and thereby cancel the benefit; (2) smokers of low T/N cigarettes might (consciously or unconsciously) inhale the smoke more deeply than their regular brand, thereby increasing their effective exposure to tar and nicotine and exposure to the harmful gases in cigarette smoke; (3) it could be that cigarette smoke gases are as harmful, if not more harmful, than "tar" and nicotine. Furthermore, under certain circumstances, reduction in T/N could be accompanied by an increase in certain gases, most notably carbon monoxide, thereby possibly increasing the risk of coronary heart disease. If all this were true, the net effect of smoking lower tar and nicotine cigarettes might be an *increase* in age-specific death rates.

Regarding the first speculation, Hammond *et al.* reported that American Cancer Society data have revealed that "smokers who switched from high T/N to low T/N cigarettes do not usually increase the number smoked per day" (1976, p. 5). Finnegan *et al.* (1945), Goldfarb, Jarvik, and Glick (1970), and Goldfarb and Jarvik (1972) reported similar results, while Firth (1971) and Schachter (1977) reported that cigarettes smoked varied inversely with nicotine delivery. We found no conclusive evidence of long-term increases in smoking rate when subjects switched to a lower T/N brand. Even if our subjects had smoked considerably greater numbers of the lowest tar and nicotine cigarette, it would have been unlikely for them to match or exceed their baseline rates of tar and nicotine. Consider the following example: a person who smokes one pack (20 cigarettes) of *Winston Filter Kings* (1.25 mg nicotine, 19.3 mg tar per cigarette) ingests 25 mg nico-

tine and 386 mg tar per day. To match this daily nicotine level smoking *Carlton* or *Now* cigarettes (0.1 mg. nicotine, 1 mg tar per cigarette) the smoker would have to smoke 12.5 packs (one pack equals 2 mg nicotine, 20 mg tar), while to match the daily tar level, over 19 packs of *Carlton* or *Now* cigarettes would have to be smoked each day.

Regarding the second speculation, the possibility does exist that smokers who switch to low T/N cigarettes will inhale more deeply than before, thereby possibly increasing their intake of tar and nicotine, and increasing their exposure to harmful gases. However, a recent study by Forbes, Robinson, Hanley and Colburn (1976) provided rather convincing data that smoking lower tar and nicotine cigarettes decreases most smokers' intake of the two substances.

Finally, regarding the third speculation, it is possible that the smoking of low T/N cigarettes might result in increased exposure to the harmful gases in the cigarette smoke, and thereby actually increase the health risks associated with cigarette smoking. Limited support for this contention comes from Ross (1976), who suggested that "leading *filter* cigarette brands produce *more* of the three poison gases than do leading *non-filter* brands" (p. 97). However, the five cigarette brands that ranked lowest on combined triple-gas (carbon monoxide, hydrogen cyanide, and nitrogen oxide) ratings were also among the lowest in tar and nicotine, and *Carlton* and *Now* cigarettes were the lowest on all three measures. Thus, despite the overall trend for filtered cigarettes to produce more poisonous gases than nonfiltered cigarettes, the very lowest tar and nicotine filtered cigarettes produce the very lowest exposure to the three poisonous gases.

The evidence regarding the "safety" of the lowest tar and nicotine cigarettes is meager, yet encouraging. Gori (1978), the deputy director of the Division of Cancer Cause and Prevention and director of the Smoking and Health Program of HEW's National Cancer Institute, stated that the toxins in 27 different brands of low tar and nicotine cigarettes are at a "tolerable" risk level of cancer and other diseases so that anywhere from 23 to three cigarettes, depending on the brand, can be smoked per day without "appreciable" ill effects. (Gori's "safety" values for the lowest tar and nicotine cigarettes we used, *Now* and *Carlton,* were from 16 to 23 cigarettes per day.) Since Gori earlier (1976) had called for the manufacture of low-toxicity cigarettes, his recent statement seems to indicate a marked trend in that direction. In a related study, Hammond *et al.* (1976) compared death rates, over two, 6-yr periods, of persons (all over the age of 40) who never smoked regularly *versus* regular high, medium, and low tar and nicotine smokers. They concluded that smoking low T/N cigarettes could not be considered safe, but that if one continued to smoke, switching to them was a step in the right direction and somewhat reduced the serious risks incurred by smoking. However, it is important to note that the tar and nicotine content of cigarettes classified by Hammond *et al.* as low T/N (1.2 mg nicotine and less than 17.6 mg tar) are considered to be in the medium range at this time. The very low tar and nicotine cigarettes used in the present study and discussed by Gori (1978) were not widely available during the years Hammond *et al.* surveyed, *i.e.,* pre-1972.

The nicotine fading/self-monitoring procedure appears to offer several advantages for the treatment of smoking. First, it produces a reasonable abstinence level and provides an alternative goal for those who continue to smoke: a "safer" level of smoking via a reduction in daily tar and nicotine intake. Second, it considers both the physiological and psychological factors involved in smoking by reducing nicotine dependence and providing positive feedback. Third, the procedure seems to possess a high degree of face validity, since it may contain the same type of persuasive underlying model that has been attributed to other successful types of smoking treatments (Lichtenstein

and Danaher, 1976). Fourth, because the procedure does not use cigarette smoke as an aversive stimulus, it could be used with smokers suffering from coronary heart disease, emphysema, and asthma. Fifth, because it is nonaversive, there may be less chance that subjects will discontinue treatment. Sixth, the procedure is simple to use and contains a built in "success mechanism" (guaranteed tar and nicotine reduction). Finally, the treatment offers the benefits of individual and group treatment, because although the smokers meet as a group, the schedule of designated brands and the tar and nicotine graphs are unique to each smoker.

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