*DEVELOPMENT AND EVALUATION OF TREATMENT
PARADIGMS FOR THE SUPPRESSION
OF SMOKING BEHAVIOR¹*

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A multiple-baseline component-analysis design was employed to assess the effectiveness of three treatment programs for suppressing the cigarette smoking behavior of 24 subjects. Satiation, cognitive control, and contingent shock procedures were evaluated. The results demonstrated a consistent relationship between contingent shock and suppression of smoking. It was further indicated that subjects should be exposed to the number of sessions necessary to achieve total suppression in order to gain maximally from treatment and to avoid relapse. Neither the satiation component nor the cognitive control component was correlated with clear, permanent decrements in smoking frequencies. To date, no other treatment program has demonstrated the dramatic effects of the contingent shock procedures used in the present study.

DESCRIPTORS: cigarette smoking, stimulus satiation, punishment, shock, suppression, followup, component analysis, adults

Some success has been reported in the literature using three aversive techniques, stimulus satiation, cognitive control procedures, and contingent shock to reduce smoking. Stimulus satiation paradigms include a variety of procedures of which the two most popular involve either smoking in a room filled with hot smoky air or rapid smoking. The hot, smoky air treatment initially reduced smoking frequency, but subjects relapsed at six-month follow-up checks (Franks, Fried, and Ashem, 1966; Grimaldi and Lichtenstein, 1969; Wilde, 1964, 1965). Resnick (1968) reported that 60% of subjects who had either doubled or tripled their smoking frequency as treatment, were abstinent four months after treatment, but only 20% of control subjects reported abstinence. Unfortunately, neither Claiborn, Lewis, and Humble (1973) nor Su-

shinsky (1972) were able to replicate Resnick's (1968) results. Marrone, Marksamer, and Salzburg (1970) obtained results similar to Resnick (1968), using a chain-smoking paradigm. Subjects were exposed to one 20-hr session of continuous smoking. In terms of outcome, the satiation data are equivocal. The overall relapse rate and the consistent failure to replicate successful studies make it difficult to evaluate satiation as a treatment procedure. The evaluation of satiation is made more difficult by lack of consistent procedures from study to study.

A variety of cognitive procedures have been used in smoking treatment. The most popular of these, covert sensitization, was developed by Cautela (1966, 1967). Clients are instructed to imagine that they are about to smoke a cigarette. Next, they imagine experiencing a noxious stimulus, usually the feeling of nausea or vomiting. Both the behavior to be modified and the noxious stimulus are presented in imagination. Most studies that employ covert sensitization as a treatment technique compare it to other cognitive procedures. For example, covert sensitization has been compared to systematic desensitization (Wagner and Bragg, 1970), to general group discussion (Gerson and Lanyon, 1972), and to

¹This investigation was partially supported by Washington State University Bio-medical Grant-in-Aid to T. Brigham and W. Garlington, Department of Psychology. The study is based on a dissertation submitted to the Department of Psychology, Washington State University, in partial fulfillment of the requirements for the Ph.D. degree. Reprints may be obtained from Denice A. Dericco, Department of Psychology, Washington State University, Pullman, Washington 99163.

thought stopping (Wisocki and Rooney, 1974). Attempts to apply cognitive procedures (Cautela, 1966, 1967) to reduce smoking have been unsuccessful. Experimenters have found a 100% relapse after limited posttreatment success (Gerson and Lanyon, 1972; Wisocki and Rooney, 1974).

Even though the elimination and reduction of smoking by contingent faradic shock has been studied for at least 10 yr, its effectiveness, as a treatment procedure is unclear. Experimenters who used shock and found a significant reduction in smoking behavior reported data after followup intervals of only nine days (Gendreau and Dodwell, 1968) and one month (McGuire and Vallance, 1964). With other studies where contingent shock was effective, it was impossible to separate the effects of shock from other independent variables manipulated concurrently (Berecz, 1972; Chapman, Smith, and Layden, 1971; Levine, 1974). No superiority of contingent shock over systematic desensitization and supportive counselling (Koenig and Masters, 1965) or pseudoconditioning (Carlin and Armstrong, 1968) was demonstrated.

Despite many studies, the results of behavioral research on smoking suppression are inconclusive because of methodological errors in most experiments. Errors include failure to employ appropriate control groups (Franks *et al.*, 1966; Wilde, 1964), concurrent manipulation of more than one independent variable (Chapman *et al.*, 1971; Gerson and Lanyon, 1972; Koenig and Masters, 1965; Schmahl *et al.*, 1972), failure to equate groups on crucial environmental and task variables (Resnick, 1968), and lack of control over extraneous variables (Cautela, 1966, 1967). Subjects placed in no-treatment control groups have frequently not volunteered for treatment (Wisocki and Rooney, 1974). Baselines are frequently omitted or estimates of smoking frequency are used as a basis for change scores (Claiborn *et al.*, 1972; Grimaldi and Lichtenstein, 1969; Resnick, 1968). Many studies include inadequate followup data (Gendreau and Dodwell, 1968; McGuire and Vallance, 1964).

The present study, in a systematic and controlled manner, attempted to assess whether satiation, cognitive control, and contingent shock procedures would reduce smoking frequency. A multiple-baseline component-analysis design was employed to demonstrate, experimentally, that a particular procedure exerted control over the target behavior. The primary goal of the research was to validate empirically an effective treatment for smoking suppression. The design included an adequate followup interval.

METHOD

Subjects

A heterogenous group of 11 women and 13 men, ranging from 20 yr to 55 yr of age, volunteered to take part in this experiment. The subjects included housewives, blue collar workers, white collar workers, and professional persons. Smoking frequencies ranged from 10 to 54 cigarettes per day. Subjects were recruited through an advertisement placed in the local newspaper. Physical impairments were ruled out for the first 24 respondents on the basis of answers to a medical questionnaire. The first 24 respondents were selected and all 24 completed the experiment.

PROCEDURE

General Procedure and Experimental Design

A component analysis, set up on a multiple-baseline model, was employed to assess the effectiveness of three treatment programs: satiation, cognitive control, and contingent shock (see Table 1). Each subject served as their own control. The same behavior, cigarette smoking, was assessed across experimental conditions (treatment programs). Each sequence in the multiple baseline (treatment program) was continued until smoking frequency was stable. Stability was defined as plus or minus one cigarette per day for five consecutive days. Order and sequence effects are controlled within the multiple-baseline component analysis. This design makes it possible to demonstrate experimentally

Table 1

Multiple-baseline (treatment program) sequences: Satiation (SAT), Cognitive Control (CC), Contingent Shock (SHOCK)

<i>Treatment Program</i>	<i>Baseline</i>	<i>Treatment</i>							
1	1 week	SAT	CC	SAT					
3	2 weeks	—	CC	SAT	SHOCK				
5	3 weeks	—	—	SHOCK	SHOCK	CC			
4	4 weeks	—	—	—	SAT	SAT	SHOCK		
2	5 weeks	—	—	—	—	SHOCK	CC	CC	
6	6 weeks	—	—	—	—	—	SHOCK	SHOCK	SAT

that a particular condition exerts control over the target behavior. Events occurring in time other than during experimental manipulation cannot account for changes in the target behavior.

Each of the six treatment program sequences was replicated four times. Additionally, one high-frequency smoker and one low-frequency smoker was included in each sequence. High-frequency smoking was defined as 20 or more cigarettes per day. A random number table was used to assign subjects to a treatment program.

Subjects recorded the daily frequency of their smoking behavior, the physical environment, the time that the cigarette was smoked, and concurrent behavior (*e.g.*, drinking coffee, writing a letter). Smoking any fraction of a cigarette was counted as one cigarette. All subjects were required to deliver their smoking data to the experimenter five days per week, Monday through Friday. On Mondays, subjects delivered their Saturday and Sunday data.

Sessions were conducted five days per week, Monday through Friday, for all treatment procedures. Session length was timed with a Meylan clock, Model 1 UTL-J 4861 and held constant at 30 min.

Baseline

Subjects recorded daily frequency of their smoking behavior from one to six weeks, depending on the treatment program (multiple-baseline sequence) to which they were assigned.

Satiation

Subjects were seated at a card table within an 2.4- by 3-m room with four black walls. The card table held a dirty ashtray and three-sided collage consisting of American Cancer Society antismoking advertisements. Subjects were instructed to smoke continuously for the duration of the session. The experimenter was present throughout, but remained silent unless the subject's smoking rate dropped below one cigarette every 5 min. When the subject's rate was less than one cigarette in 5 min the experimenter said: "Keep smoking, please." The mean smoking time for subjects per cigarette was 10.25 min. Five minutes per cigarette, six cigarettes per session, was therefore considered rapid smoking. Subjects frequently reported nausea at the end of the satiation session. On nine separate occasions, involving six different subjects, vomiting occurred. The procedure was terminated when the stability criterion had been achieved. Cigarettes smoked during the experimental session were not counted in the daily frequency.

Cognitive Control

Subjects were seated in a strato-lounger within an 2.4- by 3-m sound-attenuated experimental room, with walls painted black. The experimenter, who remained silent throughout the session, activated a standard tape recorder that presented, using a tape loop, the following two anecdotes:

Before Anecdote: You are lying on the clean, white sands of Waikiki. Gently, the palm fronds are singing in the breeze. You feel the warmth of the sun caressing your golden body. Just two, short non-cigarette buying years has put you on this beach. You take a deep, clean breath. You feel wonderful.

After Anecdote: You feel a terrible, acute, excruciating pain in your chest. You're flat on your back in a totally white, sterile environment . . . white room, white bed, white bandages extending from your waist to your neck. The pain is awful. You don't think you can stand the pain for another second. But, then . . . you don't have many seconds left. All those filthy cigarettes . . . and now lung cancer.

The anecdotes were presented continuously for the duration of each session. Smoking was not allowed during the experimental session. At the end of each session, the subject was instructed to visualize the "before" and "after" anecdotes every time a cigarette was smoked. Additionally, subjects were told to record these visualizations, using the codes "before" and "after", on their daily data sheets. The procedure was terminated when the stability criterion had been achieved.

Contingent Shock

Sessions were conducted in a 3.6- by 4.5-m lounge with light green walls. Subjects were seated at a table across from the experimenter. The table held the shock apparatus, an Electronics Stimulator, Model CC-101, which had a range of 0 to 30 mA. Shock was delivered through a 2.5-cm diameter stainless-steel electrode and matching reference electrode. Electrodes were attached to the subject's forearm. Shock levels were set individually for each subject at the beginning of the first session. Starting at 1 mA, the experimenter gradually increased the shock level, in steps of 2 mA, until the subject reported that the shock was painful. When

the subject reported that the shock was painful at a level of 6 mA or less, the experimenter increased the level by 25%. When pain was reported at a level between 7 mA and 12 mA, the experimenter increased the shock level by 20%. If pain was reported at a level above 12 mA, shock was increased by 10%. Shock level was then held constant for all sessions. Twenty-five shocks, presented on a variable, unexpected schedule throughout the session, were delivered contingent on lighting a cigarette, holding a burning cigarette, and smoking a cigarette. Subjects were told to smoke at their usual rate. The experimenter engaged the subject in social conversation throughout each session. Topics of conversation ranged from recipes to football, but did not include smoking behavior. Sessions were terminated when the stability criterion had been reached. Cigarettes smoked during the experimental sessions were not counted in the daily frequency data.

Followup

Six months after treatment was terminated, subjects were contacted by telephone and asked to record their daily smoking frequency. Data were collected for 14 days in the same manner as in baseline. Spouses, children, roommates, and employers were recruited as reliability observers for 22 of the 24 subjects. Reliability observers recorded frequency data in the same manner as the subjects. Both subjects and observers were required to deliver their data to the experimenter once a week. Reliability was computed by dividing the number of agreements by the number of agreements plus the number of disagreements. Mean percentage reliability was 96.4 with a range from 90.2% to 100%.

RESULTS

The results of the six treatment programs are summarized in Table 2. Initial suppression, initial reduction, and no initial effect are based on the mean number of cigarettes smoked for each subject during the last five criterion sessions of

Table 2

Order of three components, Satiation (SAT), Cognitive Control (CC), and Contingent Shock (SHOCK), within six treatment programs and the effect of treatment programs and cigarette smoking reduction and suppression for four subjects.

	<i>Treatment Program</i>					
	1	2	3	4	5	6
<i>component order 1:</i>	SAT	SHOCK	CC	SAT	SHOCK	SHOCK
<i>component order 2:</i>	CC	CC	SAT	SAT	SHOCK	SHOCK
<i>component order 3:</i>	SAT	CC	SHOCK	SHOCK	CC	SAT
<i>Program Effects</i>						
Initial Suppression	0	2	3	3	4	4
Initial Reduction	2	2	1	1	0	0
No Initial Effect	2	0	0	0	0	0
No Effect at Followup	4	2	1	1	0	0
Suppression at Followup	0	2	3	3	4	4
Reduction at Followup	0	0	0	0	0	0
Mean Number of Sessions	45	39	43	39	28	30

treatment. Suppression, reduction, and no effect at followup are based on the mean number of cigarettes smoked for each subject during the 14-day followup period six months posttreatment. The data show that treatment program 1 had no lasting effect on smoking. Programs 2, 3, and 4 were partially successful in eliminating smoking at followup; programs 5 and 6 totally suppressed smoking during treatment and at followup.

The data for each subject and the temporal relations between smoking frequency and treatment component are presented in Figure 1. Figure 1 clearly shows that the largest decrements in smoking frequency were temporally related to the contingent shock procedure. For example, in treatment program 3, smoking frequency decreased only slightly during the cognitive control and satiation components, but dropped to zero for three of the four subjects during the contingent shock component. Similar results can be seen in treatment program 4, where two satiation components followed one another before the contingent shock component. Again, the decreases to zero occurred only during the shock component. The one program (treatment program 1) that did not have a shock component initially decreased smoking for three subjects, but all had returned to or near their baseline frequency at followup.

Nonsmoking at followup was perfectly correlated with suppression during treatment. Even Subject 1 in treatment program 3, whose smoking frequency was reduced to near zero, had relapsed at followup.

Treatment programs 5 and 6 had one shock component follow another and resulted in total suppression at the end of the second shock component and abstinence at followup. The session-by-session results for one subject from each treatment program (Subject 4, program 5 and Subject 3, program 6) are presented in Figure 2.

The two subjects had quite different baseline frequencies of smoking, but the course of treatment for each was quite similar. Each subject displayed a plateau in the middle of treatment before the final decrease to suppression. The figure also shows that each subject received four additional shock sessions after reporting that they had quit smoking. These data are typical of subjects in treatment programs 5 and 6.

In summary, there was a consistent temporal relationship between contingent shock and suppression of smoking. The two treatment programs (5 and 6), where one contingent shock series was followed by a second, eliminated smoking. Additionally, the total number of sessions required to reach stability was less than in the other four treatment programs. When a single shock series was used (treatment programs 2,

Fig. 1. Four subjects in each of six treatment program sequences including satiation (SAT), cognitive control (CC), contingent shock (Shock), and six-month followup (F.U.).

3, and 4), smoking was eliminated for eight of 12 subjects. Three of the remaining four subjects markedly reduced their smoking frequency, but relapsed by the six-month followup period. Finally, neither the satiation component nor the cognitive control component were related to clear, permanent decrements in smoking frequencies.

DISCUSSION

The present study demonstrated that contingent shock is both an effective and parsimonious treatment procedure for suppressing cigarette smoking. Subjects whose smoking behavior was totally suppressed as a function of the contingent shock procedure remained abstinent at the

Fig. 2. Daily smoking frequencies for one high-rate and one low-rate subject in a treatment program where contingent shock followed contingent shock.

six-month followup interval. Additionally, fewer sessions were required to reach stability when one contingent shock procedure was followed by a second contingent shock procedure. Sequencing of treatment procedures (see Table 1) appeared to have no effect on smoking frequencies. With one exception (see Subject 2, treatment program 4, Figure 1) contingent shock was always effective in either reducing or suppressing smoking behavior, regardless of whether the shock series was introduced to the subject as the first, second, or third treatment procedure.

The data indicated that a reduction in smoking frequency, rather than total suppression, is

not maintained even when smoking frequency is reduced by 99% (e.g., Subject 1, treatment program 3, Figure 1). The only subjects who maintained treatment gains at followup were those whose smoking behavior had been eliminated during a shock component. Because of the stability criterion, all subjects who stopped smoking during a shock component received four additional shock sessions. It is possible that the additional shock sessions after suppression played an important role in abstinence at followup.

Although Koenig and Masters (1965) did not find any advantage in a contingent shock procedure over supportive counselling or a modified

systematic desensitization approach in reducing smoking frequency, these experimenters exposed subjects to only nine shock treatments spread over a six-week period. None of the subjects in the shock group completely suppressed their smoking behavior during treatment. Similarly, Carlin and Armstrong (1968) exposed subjects to only four treatment sessions of either contingent shock, pseudoconditioning, or an attention placebo control procedure. No differences in mean percentage smoking reduction were found between groups, but again subjects did not eliminate their smoking behavior as a function of treatment. The present data indicate that neither four nor nine treatment sessions are sufficient to achieve suppression even when baseline frequencies are low. Subject 3, treatment program 5 (see Figure 1) had a baseline frequency of 10.64 cigarettes per day and still required 18 sessions to suppress smoking during the contingent shock procedure. It also is the case that the present shock levels exceeded those previously reported. No emotional side effects were demonstrated by subjects as a function of the higher shock levels used, nor did subjects threaten to withdraw from treatment. Perhaps emotional side effects and withdrawal from treatment were avoided because subjects essentially chose their own shock levels. This possibility should be examined empirically.

Differences between high- and low-frequency smokers were found as a function of the satiation procedure. Low-frequency smokers initially reduced smoking frequency. There was no effect for high-frequency smokers. No differences between high- and low-frequency smokers were found as a function of either cognitive control or contingent shock. A direct relationship, however, may exist between the number of cigarettes smoked at baseline and the number of sessions required to achieve suppression, for an individual smoker.

A review of a large number of studies, (Hunt and Marazarro, 1973), revealed that after treatment, the number of subjects who relapsed increased steadily. At six months, 75% of the

subjects had returned to their previous smoking pattern. There was only slight increase in relapse after six months. In the light of those findings, the six-month followup data on the contingent shock procedure is very promising.

Overall, there were three major differences between the contingent shock program used here and others previously reported. The first is simply length; second, the increased shock level; third, subjects received additional shock sessions after they had stopped smoking. Although it is not possible to determine if all these factors were equally important to the obtained results, it is clear they work well as a package. It may be however, that the generalizability of these data may be limited to subjects who are willing to undergo an extended treatment regime.

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Received 6 May 1976.

(Final acceptance 7 September 1977.)