THE EFFECTS OF CONTINGENT SHOCK ON CIGARETTE SMOKING BEHAVIOR: AN ATTEMPT TO REPLICATE

by

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THE EFFECTS OF CONTINGENT SHOCK ON CIGARETTE SMOKING BEHAVIOR: AN ATTEMPT TO REPLICATE

Marianne M. Narick, M.A.
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This experiment attempted to replicate previously reported research (DeRico, Brigham, and Garlington, 1977) which demonstrated smoking suppression using contingent shock. A multiple-baseline across subjects design was employed to assess experimental control. A heterogeneous group of five males and two females ranging in age from 19 to 61 years, participated in the experiment. Subjects attended 30 minute treatment sessions conducted 5 days per week, Monday thru Friday, where 25 shocks were delivered on an unpredictable, variable interval schedule contingent upon the subject lighting a cigarette, holding a burning cigarette and/or smoking a cigarette. Treatment continued for a minimum of 3 weeks or 15 sessions or until abstinence was achieved. One of seven subjects achieved complete abstinence which was maintained over a 3 month period. Four subjects showed initial reductions in smoking rate with only one of those subjects demonstrating a sustained treatment effect at 3 month followup. The two remaining subjects showed no change in rate of smoking as a result of the treatment program. Possible reasons for the failure to replicate were discussed. Anecdotal evidence was presented which intimated several inherent weaknesses or flaws of the treatment method. A model of smoking behavior was described followed by suggestions for further research in the area of smoking suppression.
ACKNOWLEDGEMENTS

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Marianne M. Narick
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INTRODUCTION

As early as the mid to late 1950's, studies reporting the then known adverse effects of cigarette smoking on health (Hammond and Horn 1954, 1958) were publicized by the American Cancer Society (Horn 1979). In 1964, the first Surgeon General's Report on Smoking and Health (USDHEW 1964) was printed which explicitly documented the health risks and contraindications of smoking. Since then, the American Cancer Society along with the American Heart Association and the American Medical Association have maintained a widespread anti-smoking campaign designed to educate the public in terms of the possible and probable health hazards associated with cigarette smoking. Today, cigarette smoking is considered the leading cause of lung cancer and bronchitis (Pomerleau and Pomerleau, 1977) and is linked with a variety of other cancer conditions, respiratory disorders as well as vascular and circulatory dysfunctions (United States Public Health Service 1971, 1973, 1974). These and other related documents or events coupled with the mounting evidence of low spontaneous rates of quitting (i.e. less than 10% of all smokers in the U.S.) and low success rates of persons trying to quit (from 25-35%), (Horn 1968, 1979), have undoubtedly provided the impetus for numerous investigations conducted in the past 20 years on many aspects of smoking behavior.

Efforts at developing an effective and pragmatic means of aiding the smoker to "kick the habit" have lead to a variety of Behavioral applications including nicotine fading procedures,
stimulus control and self-management training, and aversive conditioning techniques.

Two nicotine fading procedures have been introduced. Keenan (unpublished doctoral dissertation, 1980) faded nicotine by requiring subjects to punch a gradually increasing number of holes in the proximal end of the cigarette until reaching a maximum of 10-14 holes. Keenan reported a 40% rate of abstinence at treatment cessation with 41% of those subjects remaining abstinent at one year followup. Foxx and Brown (1979) accomplished fading by requiring subjects to progressively change cigarette brands from high tar and nicotine to low tar and nicotine across time. Using this fading procedure coupled with a self-monitoring procedure, these authors reported a 40% rate of abstinence at 18 month followup.

Stimulus control and self-management programs have been comprised of: (1) using a stimulus hierarchy where cigarettes are deleted "situation by situation" (Pomerleau, Adkins and Pertschuk, 1977; Sachs, Bean and Morrow, 1970; Gutmann and Marston, 1967), (2) implementing a changing-criterion design where daily quotas are set resulting in some form of punishment if smoking exceeds that quota (Axelrod, Hall, Weis and Rohre, 1974; Levinson, Shapiro, Schwartz and Turskey, 1971; Pomerleau, Adkins and Pertschuk, 1977) and (3) employing behavioral contracts where subjects contract to quit with another person who will provide them with specified social and/or tangible (e.g. money) reinforcement for nonsmoking behavior (Tighe and Elliott, 1968; Tooley...
and Pratt, 1967). Other stimulus control strategies, such as the identification of one place in which to smoke and the removal of objects associated with smoking have been suggested (Ferster, Nurnberger and Levitt, 1962).

The stimulus control and self-management literature indicates at least marginal success in the reduction and/or elimination of smoking behavior. However, the results of many of these studies were rendered questionable or inconclusive due to high attrition rates (Gutmann and Marston, 1967), high relapse rates (Pomerleau et al. 1977; Tighe and Elliott, 1968), insufficient followup evaluations (Sachs et al. 1970; Axelrod et al. 1974), and concurrent manipulation of more than one independent variable (Levinson et al. 1971; Tooley and Pratt, 1967; Ferster et al. 1962).

Many treatment programs have employed aversive conditioning techniques where an aversive stimulus is systematically paired with or made contingent upon smoking behavior. These programs fall into two general categories: (1) those relying on cognitive control methods (i.e. imagined aversive stimuli) and (2) those using other aversive or noxious stimuli (i.e. emetics, excessive cigarette smoke or excessive cigarette smoking, and faradic shock). The efficacy of cognitive control procedures including covert sensitization, systematic desensitization and relaxation training has been investigated by Wagner and Bragg (1970), Gerson and Lanyon (1972), Wisocki and Rooney (1974), Tolley and Pratt (1967), and Steffy, Meichenbaum and Best (1970). With the exception of two studies reporting limited posttreatment success followed by
total relapse at followup (Gerson and Lanyon, 1972; Wisocki and Rooney, 1974), all of the aforementioned studies failed to independently manipulate variables thereby making it impossible to infer functional control for a specific cognitive procedure (Wagner and Bragg, 1970; Tolley and Pratt, 1967; Steffy et al. 1970).

Results of those programs using other aversive stimuli have varied. Raymond (1964) employed an emetic (apomorphine) to suppress the smoking behavior of a 14 year old boy reported as a "habitual smoker since 7 years of age" (p. 288). The author submitted that abstinence was achieved at treatment cessation and was maintained at 1 year followup.

Wilde (1964) and Franks, Fried and Ashem (1966) used similar techniques where either hot smoky air or lightly mentholated room temperature air was blown into the smoker's face contingent upon his/her lighting or extinguishing a cigarette. Both investigations reported limited success at treatment termination. However, their results were rendered inconclusive due to high attrition rates and lack of adequate control.

Lublin and Joslyn (1968) used Wilde's (1964) hot smoky air technique with an additional component requiring subjects to smoke at a rapid rate (stimulus satiation). At 1 year followup, they reported that 15 subjects were not smoking and 16 subjects were smoking less than 50% of their original baseline frequencies. These findings were successfully replicated by Schmahl, Lichtenstein and Harris (1972) who reported total suppression for all subjects at treatment cessation with 64% remaining abstinent.
at 6 month followup. The results of both of these studies are confounded by the fact that more than one independent variable was concurrently manipulated.

Further investigations of the viability of stimulus satiation or rapid smoking techniques in the suppression of cigarette smoking have resulted in conflicting results. Resnick (1968) employed a satiation procedure where subjects either doubled or tripled their smoking frequencies for 1 week. The author reported that at 6 month followup, 60% of the experimental subjects remained abstinent. However, attempts at replication by Claiborn, Lewis and Humble (1972) and Sushinsky (1972) were not successful.

Marrone, Marksmamer and Salzberg (1970) compared two satiation procedures (chain smoking for 20 or 10 hours) which resulted in equal success (total abstinence) on a short term basis. These authors reported that at 4 month followup only the group exposed to the longer of the two procedures demonstrated a sustained treatment effect with 60% of those subjects not smoking.

Pomerleau and Pomerleau (1977) conclude that rapid smoking "compares favorably with other experimental methods and is clearly superior to the non-behavioral clinics". However, McAlister (1975) warns of the obvious health implications for smokers with pulmonary and cardiovascular diseases resulting from exposure to excessive tobacco smoke. Hauser (1974) adds that rapid smoking may be dangerous to seemingly healthy people.

An aversive conditioning technique posing no apparent health threats which also has resulted in encouraging preliminary findings
is contingent faradic shock. McGuire and Wallance (1964) treated 10 smokers by delivering electric shock on an intermittent schedule contingent upon inhaling cigarette smoke. The authors reported a 60% success rate at treatment cessation. Gendreau and Dodwell (1968) employed a similar contingent shock paradigm with two groups of adult smokers. In one group the shock was made increasingly painful while in the other group shock was kept subliminal. Their results indicated that the first group greatly reduced smoking as a result of treatment but the second group did not.

Berecz (1972) compared the effectiveness of self-administered shock contingent upon actual smoking with self-administered shock contingent upon imagined smoking. For moderate smokers, both procedures were effective in suppressing smoking behavior while for heavy smokers, the imagined smoking treatment was the only effective therapy. Chapman, Smith and Layden (1971) compared contingent shock punishment with 2 weeks posttreatment therapist monitoring and self-management training with 11 weeks posttreatment therapist monitoring in an attempt to eliminate smoking behavior. The authors reported that only one subject in each group failed to stop smoking during the course of treatment with 35% remaining abstinent at 12 month followup. Ober (1968) in a comparison of a no treatment control group vs. three treatment groups, reported that all treatment groups showed greatly reduced rates. Treatment groups consisted of: a broadly based self-control program, electric aversion therapy (self-administered shock contingent
upon urges to smoke), and transactional analysis. Increases in smoking rates were beginning to occur within 4 weeks after treatment termination.

While many of these studies report promising results, firm conclusions regarding therapeutic effectiveness are precluded by a number of methodological problems including: concurrent manipulation of more than one independent variable (Berecz, 1972; Chapman et al. 1971), and lack of adequate followup data (McGuire and Vallance, 1964; Gendreau and Dodwell, 1968).

Powell and Azrin (1968) designed a portable apparatus which resulted in a shock upon subject opening the cigarette case to remove a cigarette. After an investigative study, they found that few smokers were willing to wear the apparatus and even they tended to abandon it as shock intensities were increased to levels needed for suppression. Whaley, Rosenkranz and Knowles (unpublished manuscript 1968) also employed a cigarette pack which automatically delivered a painful shock when opened. These authors reported that 90% of all subjects were abstinent 1 month after the unit had been removed and 50% remained abstinent at 18 month followup.

In a well controlled study, DeRicco, Brigham and Garlington (1977), employed a multiple-baseline component-analysis design to compare the efficacy of satiation, covert sensitization and contingent faradic shock procedures in the suppression of smoking behavior. Subjects were assigned to one of six treatment programs having three separate components (i.e. satiation, cognitive control and/or contingent shock). Each treatment component was
continued until smoking frequency was stable. Stability was defined as plus or minus one cigarette per day for five consecutive days. The authors reported that at treatment cessation and six month followup, 66% of all subjects exposed to one contingent shock component (treatment programs 2, 3 and 4) achieved and maintained abstinence while 100% of all subjects exposed to two successive contingent shock components (treatment programs 5 and 6) achieved and maintained abstinence. Further, they noted that smoking suppression resulted only after the introduction of a shock component regardless of component sequencing within treatment programs. The remaining treatment program (treatment program 1), which had no contingent shock component, lead to a decrease in smoking for 75% of all subjects, but all had returned to or near their baseline frequency at followup.

DeRicco et al.'s (1977) findings are far superior to those of other investigations in this area of research in their demonstration of high initial abstinence rates and sustained treatment effects for the treatment programs having one or more contingent shock component(s). A replication of their results seems both appropriate and necessary to the validation of contingent shock as a treatment method in the suppression of cigarette smoking. Thus, it was the intention of the present investigation to attempt to replicate DeRicco et al.'s (1977) strongest treatment effect, that is, the suppression of smoking behavior using contingent shock.
METHOD

Subjects

Five males and two females ranging in age from 19 years to 61 years, volunteered for participation in this experiment. Smoking frequency ranged from 10 cigarettes to 55 cigarettes per day and reported smoking history averaged 20 years with a range from 5 years to 40 years. Volunteers were recruited by means of advertisements placed in the local newspaper and notices posted at various locations throughout the campus of Western Michigan University. Subjects were screened for physical impairments and/or liabilities based upon responses to a medical questionnaire. Those subjects having no medical contraindications were then scheduled for an initial interview.

Setting

Experimental sessions were conducted in a 5.5- by 7-m lounge in which subjects were seated in an office chair directly across from the experimenter. The shock apparatus was concealed in a nearby closet.

Apparatus

The apparatus consisted of a Grason Stadler, Model E1064GS, shock generator\(^1\) which had a range from .5 to 4.0 milliamperes (mA).

\(^1\)Grass Instruments, 101 Old Colony Road, Quincy, Massachusetts, 02169.
Shock duration was set at ten milliseconds (msec). Shock frequency was 60 Hz alternating current (ac). Shock was delivered through a one centimeter (cm) diameter Grass Instruments gold disc type electrode and matching reference electrode. Electrodes were attached to the subject's right or left forearm. Grass Instruments Electrode Cream was used to insure good contact and consistency of shock.

Experimental Design

Experimental control was assessed with a multiple-baseline across subjects design in which contingent shock treatment was introduced for each subject at different times and after varying lengths of baseline.

Procedure

Initial Interview

During the interview, the treatment method was introduced and subjects were informed that a physician's release would be required before experimental procedures could begin. Subjects agreeing to participate then signed informed consent forms and were advised that they could withdraw from the program at any time. Each subject received a treatment contract which required that a monetary deposit be made one week in advance of treatment (deposit amount was individually determined according to subject's financial capabilities). This deposit was returned to subjects in full at the end of treatment contingent upon collecting and
delivering daily data. Subjects were instructed to smoke as often as "desired" and not to intentionally attempt to reduce their smoking during any of the experimental conditions.

**Data Collection**

During both baseline and treatment conditions, subjects recorded the daily frequency of their smoking behavior by noting the time that each cigarette was smoked as well as the total number of waking hours per day. Smoking any fraction of a cigarette was counted as one cigarette. Subjects were required to deliver their smoking data to the experimenter 5 days per week, Monday thru Friday. On Monday, subjects delivered their Saturday and Sunday data.

**Baseline**

The baseline condition continued until rate of smoking was stable. Smoking rate was considered stable when: 1) rate was within a 25% range of the overall mean of the final five data points for five consecutive days, or 2) no trend was visible in the final five data points of the condition.

**Treatment**

Treatment consisted of 30 minute sessions conducted 5 days per week, Monday thru Friday. Treatment continued for a minimum of 3 weeks or 15 sessions or until abstinence was achieved.

Shock levels were set individually for each subject at the
beginning of each session. Starting at .5 mA, the experimenter gradually increased the shock level in steps of .5 mA until the subject reported that the shock was painful. When pain was reported the experimenter increased the shock level by .5 mA.

Twenty-five shocks were presented on an unpredictable, variable interval schedule throughout the sessions.-Shocks were delivered contingent on the subject lighting a cigarette, holding a burning cigarette and/or smoking a cigarette. Throughout the sessions, subjects were told to smoke at their usual rate while being engaged in social conversation with the experimenter. Cigarettes smoked during the treatment sessions were not counted in the daily frequency data.

Reliability

Significant others (including spouses, children, roommates) were recruited as reliability observers. Observers recorded frequency data in the same manner as subjects and delivered their data to the experimenter one time per week. Reliability was assessed for 2 hour periods every 3 days throughout both Baseline and Treatment. If observers and subjects recorded a cigarette within 7 minutes of each other, an agreement on the consumption of that cigarette was scored. Reliability was computed by dividing the number of agreements by the number of agreements plus the number of disagreements.

Followup

Three months after treatment was terminated, subjects were
contacted by telephone and asked to record their daily smoking frequency and total number of waking hours per day for 5 consecutive days. Data were collected and reliability assessed in the same manner described previously.
RESULTS

Reliability data were collected for all subjects. The overall mean percent agreement was 97% with a range from 94% to 100%. The mean percent agreement during Baseline was 96.5% with a range from 93% to 100%. The mean percent agreement during Treatment was 97.5% with a range from 92% to 100%. The mean percent agreement during Followup was 97% with a range from 95% to 100%.

Results were analyzed in terms of cigarettes smoked per hour. Number of cigarettes smoked per hour was calculated by dividing the daily total number of cigarettes smoked by the daily total number of waking hours. Table 1 summarizes the results of the treatment program in terms of percent of mean baseline smoking rates for each subject at treatment cessation and 3 month followup evaluation. Percentages were based upon mean number of cigarettes smoked per hour during the final 5 days of the Baseline and Treatment phases and the 5 days of followup data.

The data in Table 1 show that only Subject 1 achieved abstinence at treatment cessation. The remaining subjects discontinued treatment before they had stopped smoking. Subject 3, Subject 5, Subject 6, and Subject 7 showed marked reductions in rate of smoking at treatment cessation while Subject 2 and Subject 4 showed no change in smoking rate.

At 3 month followup evaluation, Subject 1 had maintained abstinence. Subject 3 continued to show substantial treatment
gains with smoking rate at 24% of mean baseline smoking rate while smoking rates for Subject 5 and Subject 6 had relapsed to 88% and 90% of Baseline, respectively. Followup data were not obtained for Subjects 2, 4, and 7.

Table 1
Summary of Results for Treatment

<table>
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<th>Subject</th>
<th>Total number of treatment sessions</th>
<th>% rate change (treatment rate/baseline rate X 100%)</th>
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<tr>
<td></td>
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<tr>
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<td>2</td>
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<td>7</td>
<td>16</td>
<td>43</td>
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Figure 1 depicts the hourly rate of smoking for Subject 1 during Baseline, Treatment and Followup conditions. From Figure 1 it can be seen that a stable baseline was obtained within 5 days. The average hourly rate of smoking during baseline was .66 with a range from .60 to .77. Treatment was implemented on day 6. Abstinence was achieved within 20 days (on the second of 2 consecutive non-treatment session days) or after 13 sessions. The average hourly rate of smoking during the final 5 days of treatment was 0. At 3 month followup, abstinence was maintained thus demonstrating a sustained treatment effect.
FIGURE 1: THE RATE OF SMOKING FOR SUBJECT 1

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Figure 2 depicts the hourly rate of smoking for Subject 2 during Baseline, Treatment and Followup conditions. From Figure 2 it can be seen that 19 days were required to obtain a stable baseline. The average hourly rate of smoking during the final 5 days of baseline was 2.67 with a range from 2.47 to 2.95. Treatment was implemented on day 20 and continued for 21 days or 15 sessions. Abstinence was not achieved nor was a reduction in the hourly rate of smoking noted. The average hourly rate of smoking during the final 5 days of treatment was 3.13 with a range from 2.89 to 3.34. No followup data were obtained.

Figure 3 depicts the hourly rate of smoking for Subject 3 during Baseline, Treatment and Followup conditions. From Figure 3 it can be seen that a stable baseline was obtained within 9 days. The average hourly rate of smoking during the final 5 days of baseline was .87 with a range from .82 to .91. Treatment was implemented on day 10. A marked reduction in cigarettes smoked per hour was noted within 24 days or 15 sessions. The average hourly rate of smoking during the final 5 days of treatment was .22 with a range from .19 to .28. At 3 month followup, a sustained treatment effect was demonstrated with an average hourly rate of smoking of .21 and a range from .18 to .22.

Figure 4 depicts the hourly rate of smoking for Subject 4 during Baseline, Treatment and Followup conditions. From Figure 4 it can be seen that 12 days were required to obtain a stable baseline. The average hourly rate of smoking during the final 5 days of baseline was 1.19 with a range from 1.11 to 1.30.
FIGURE 2: THE RATE OF SMOKING FOR SUBJECT 2
FIGURE 3: THE RATE OF SMOKING FOR SUBJECT 3
Treatment was implemented on day 13 and continued for 28 days or 20 sessions. Abstinence was not achieved nor was a reduction in the hourly rate of smoking noted. The average hourly rate of smoking during the final 5 days of treatment was 1.19 with a range from 1.06 to 1.43. No followup data were obtained.

Figure 5 depicts the hourly rate of smoking for Subject 5 during Baseline, Treatment and Followup conditions. From Figure 5 it can be seen that a stable baseline was obtained within 11 days. The average hourly rate of smoking during the final 5 days of baseline was 2.29 with a range from 2.21 to 2.34. Treatment was implemented on day 12. A marked reduction in cigarettes smoked per hour was noted within 27 days or 19 sessions. The average hourly rate of smoking during the final 5 days of treatment was 1.02 with a range from .96 to 1.20. At 3 month followup, treatment gains were not sustained with an average hourly rate of smoking of 2.02 and a range from 1.90 to 2.20.

Figure 6 depicts the hourly rate of smoking for Subject 6 during Baseline, Treatment and Followup conditions. From Figure 6 it can be seen that a stable baseline was obtained within 10 days. The average hourly rate of smoking during the final 5 days of baseline was 2.45 with a range from 2.34 to 2.68. Treatment was implemented on day 11. A marked reduction in cigarettes smoked per hour was noted within 26 days or 18 sessions. The average hourly rate of smoking during the final 5 days of treatment was .96 with a range from .83 to 1.12. At 3 month followup, treatment gains were not sustained with an average hourly rate of smoking.
FIGURE 5: THE RATE OF SMOKING FOR SUBJECT 5
FIGURE 6: THE RATE OF SMOKING FOR SUBJECT 6.
of 2.24 and a range from 2.00 to 2.40.

Figure 7 depicts the hourly rate of smoking for Subject 7 during Baseline, Treatment and Followup conditions. From Figure 7 it can be seen that a stable baseline was obtained within 5 days. The average hourly rate of smoking during baseline was 1.64 with a range from 1.61 to 1.67. Treatment was implemented on day 6. A marked reduction in cigarettes smoked per hour was noted within 24 days or 15 sessions. The average hourly rate of smoking during the final 5 days of treatment was .71 with a range from .54 to .93. No followup data were obtained.
FIGURE 7: THE RATE OF SMOKING FOR SUBJECT 7

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DISCUSSION

The present investigation resulted in smoking suppression using contingent shock for one of seven experimental subjects. Of the remaining six subjects, four subjects (Subjects 3, 5, 6, and 7) showed substantial reductions in smoking rate while two subjects (Subjects 2 and 4) showed no change in smoking rate. Three month followup data obtained for Subjects 1, 3, 5, and 6 indicated that Subjects 1 and 3 maintained treatment gains; smoking rates of Subjects 5 and 6 had relapsed to pre-treatment levels. Followup data were not obtained for Subjects 2, 4, and 7.

The present treatment program was unable to demonstrate smoking suppression as readily as DeRicco, Brigham and Garlington (1977) who reported that 16 of 20 experimental subjects achieved abstinence while three of the remaining four subjects markedly reduced their smoking frequencies. The failure to replicate treatment effects reported by DeRicco et al. lead to a re-examination of their procedures and findings.

One procedural difference between the present study and the DeRicco et al. investigation was with regard to data collection. During Baseline, Treatment and Followup, DeRicco et al.'s 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). Participants in the present experiment recorded the daily frequency of their smoking behavior, the time that the cigarette was smoked, and the total number of waking hours per day. Thus,
DeRicco et al.'s subjects were involved in a more extensive self-recording regimen than were the present experimental subjects. What effect this variable may have had on smoking suppression in the DeRicco et al. experiment is impossible to determine. However, it is clear that self-recording alone could not account for their dramatic treatment effect as all of DeRicco et al.'s subjects self-recorded the same daily data with only those subjects participating in one or more contingent shock component(s) achieving complete abstinence.

A second procedural difference between the present study and that of DeRicco et al. was contingent shock levels used. The apparatus utilized by DeRicco et al. had a mA range from 0 to 30 mA, far exceeding the 0 to 4 mA range of the apparatus utilized in the present research. Individual shock levels used during treatment were not reported by DeRicco et al.. Shock levels used in the present treatment program ranged from 1.5 to 4 mA. Although the actual shock levels used in the two experiments may have varied, the shock level setting procedures were very similar. Specifically, in both investigations, individual shock levels were determined according to subject report of pain. When pain was reported, shock levels were increased by at least 10% (depending upon shock intensity) to ensure aversiveness of the shock stimulus. The 4 mA maximum shock intensity was sufficiently high to set shock levels for all subjects in this experiment. Presumably, subjects participating in both experiments felt that the shock stimulus used during treatment
sessions was painful. While this seems quite likely, the possibility still exists that DeRicco et al. utilized considerably higher shock levels than the present experimenter. If so, the use of higher shock levels might have produced DeRicco et al.'s treatment effect.

A discrepant finding between the two studies relates to subject voluntary termination of treatment before abstinence was achieved. DeRicco et al. stated 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" (p. 173). Accordingly, the present treatment program was designed to continue until abstinence was achieved. However, even those subjects who had markedly reduced their smoking frequency chose to withdraw from the program after approximately three weeks. In comparison, DeRicco et al. reported that all of their experimental subjects began and completed the experiment which consisted of treatment programs ranging from four to seven weeks. The authors offer no explanation for their low drop out rate but conclude that the "generalizability of [their] data may be limited to subjects who are willing to undergo an extended treatment regime" (p. 180). Anecdotal evidence lends support to DeRicco et al.'s conclusion. That is, participants in the present study reported that they withdrew from the treatment program because: 1) treatment was too time consuming and too demanding of their daily schedules (½ hour per day 5 days per week) or, 2) they did not believe that a continuation of contingent shock sessions
would lead to quitting. These considerations pose important questions regarding the practicality and/or cost effectiveness of contingent shock in the suppression of smoking.

Brigham, Jacobson-Brigham and Garlington (unpublished manuscript 1978) completed an additional field test of the contingent shock treatment program used by DeRicco et al. at a clinic for consumatory abuse problems at Washington State University. Their attempt to replicate DeRicco et al.'s findings similarly failed. Brigham et al. reported that the overall success rate of their program, defined as individuals who had remained abstinent at 6 month followup, was 13 of 47 or 28%. They submitted that the poor results of the field test were probably due in part to the absence of extended client-therapist interactions. Their experimental subjects did not meet exclusively with one therapist as in the DeRicco et al. research project, but rather with any one of eight trained paraprofessionals depending upon personnel scheduling. Brigham et al. stated that "a number of clients who dropped out of the program indicated that they felt no one knew or cared how they were doing...[apparently] an important component of the original punishment program" (p. 2). This variable was controlled for in the design of the present study as each subject met with only one of three therapists throughout the treatment program. In the DeRicco et al. study, a single therapist met with each subject for the duration of the experiment. Therefore, it would seem that some other unspecified therapist variable(s) contributed to DeRicco et al.'s success.
Subjects in both the present investigation as well as the Brigham et al. field test, reported a decreased appetency to smoke but added that they continued to find themselves in situations where smoking could not be avoided (e.g. socializing with friends, tied up in traffic, late night studying or working). This would seem to indicate the existence of strong establishing stimuli for smoking. Self-management training with a stimulus control analysis of smoking patterns might be beneficial in a smoking suppression paradigm.

A few subjects in the present treatment program reported the development of an actual distaste or dislike of cigarette smoke but felt that they "needed" to smoke. These comments suggest the existence of a psychological and/or physiological dependence upon cigarette smoke. Nicotine, the most potent pharmacological agent in tobacco smoke, would seem the likely source of dependence. However, to date, the possibility of addiction to nicotine remains unclear (Julien, 1978, pp. 93-96).

A second explanation for the reported "need" to smoke relates to an hypothesis which states that nicotine may function as a source of pharmacological reinforcement thus maintaining smoking behavior. No brain receptor site for nicotine has as yet been found (Jarvik, 1977). However, a number of recent studies (Foxx and Brown, 1979; Jarvik, 1977; Keenan, 1980) have demonstrated a dose dependent relationship between smoking rate and nicotine content thus suggesting a physiological mechanism for regulating nicotine consumption. As such, smoking rates initially showed
a rapid increase after a switch to lower nicotine content cigarettes which was followed by an abrupt decline subsequent to a smoking rate peak. In an effort to explain this phenomenon, Keenan suggested that "subjects attempted to maintain previous levels of nicotine intake when initially switching to the low nicotine content cigarettes" (p. 11). The author added that "once the nicotine content of the cigarette smoke was diminished to a minimum, the 'reinforcing value' of smoking was altered, and hence, a rapid decline in smoking rate occurred" (p. 11). This evidence implies that a nicotine fading procedure should be considered when formulating a smoking suppression program.

Given a functional analysis of smoking behavior as well as the wide variety of observations put forth by many researchers, it is apparent that one factor, or even one set of factors, is not consistently responsible for the maintenance of smoking. Frederiksen and Simon (in press) have developed a "contingency model of smoking behavior" which proposes that: 1) smoking behavior is controlled by its antecedents and consequences, 2) the antecedents and consequences as well as the concommitants of smoking may be divided into two general categories; variables associated with the "behavior" of the smoker (i.e. overt behavior, covert behavior and physiological responding), and environmental variables (i.e. properties of the physical environment as well as the social environment), 3) smoking is controlled by the interaction of the behavior (overt, covert and physiological) and environmental (physical and social) variables occurring.
before, during and after a particular smoking episode, and 4) the relative importance of any of these variables or patterns of variables may vary between smokers or within smokers over time. The authors submit that this model examines and explores the variables controlling smoking behavior and facilitates an integration of the many approaches to the suppression of smoking. The application of Frederiksen and Simon's model suggests two possible strategies for the design of smoking suppression programs. Firstly, therapists could conduct a functional analysis of specific behavioral and environmental stimuli as well as physiological factors associated with smoking for individual subjects and subsequently, design personalized programs taking these factors into account. Such an approach would probably include the minimal number of treatment components necessary to ensure effectiveness but would have the disadvantage of requiring a substantial time investment to tailor programs for each individual.

A second approach would incorporate treatment components or sequences which systematically deal with all of the variables possibly controlling smoking behavior. Such a treatment "package" would minimally include: 1) an aversive conditioning component and self-management training to address both overt and covert behavior variables as well as physical and social environment variables which, to some degree, control smoking behavior, and 2) a nicotine fading component to address physiological responses which maintain smoking behavior. While this "package" program would not require extensive assessment of the controlling variables
for each smoker, it might contain treatment components which were superfluous for certain individuals thus compromising the cost effectiveness of the program.

In conclusion, the results of this experiment did not successfully replicate DeRicco et al.'s results. The reasons for this failure to replicate are unclear and at best speculative. It could be that the ineffectiveness of contingent shock in the suppression of smoking was due to the fact that such a program attempted to alter only one, or possibly two variables (overt and/or covert behavior variables) controlling smoking behavior. However, the source of conflicting results must be fully elucidated before accurate conclusions can be made regarding the viability of contingent shock in the suppression of smoking behavior. Therefore, a further attempt to replicate DeRicco et al.'s findings which avoids the procedural differences described herein, is suggested. If additional replication attempts also prove unsuccessful we must conclude that the factors responsible for the impressive results reported by DeRicco et al. have yet to be identified and may not fully coincide with their putative independent variable, contingent faradic shock.
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