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THE EFFECTS OF SHOCK AS A PUNISHER FOR CIGARETTE SMOKING[1]

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An attempt was made to reduce the cigarette smoking of three subjects by means of a special cigarette case that delivered aversive shock when opened. The number of cigarettes smoked was recorded by a counter in the cigarette case. The validity of the counter readings as a measure of smoking was obtained by a specially designed participant-observer technique. It was found that the rate of smoking decreased as a function of the intensity of the shock. Also, the smoking returned to its previously unpunished level after the shock punisher was discontinued. Both of these findings confirm the results of laboratory studies of punishment of simpler responses and extends them to more complex responses in a naturalistic situation. Surprisingly, the duration for which the apparatus was worn also decreased as a function of the intensity of the shock. This finding reveals that this aversive shock technique produced avoidance behavior that prevents the technique from having extensive applicability for eliminating smoking. The same limitation may apply to the use of aversive shock for eliminating other undesirable behaviors.

An effective procedure for reducing behavior is punishment, which may be defined as the reduction in the probability of a response as a result of a stimulus produced by that response (Azrin and Holz, 1966). Shock punishment has been used in several types of "aversion therapies" (see review by Rachman, 1965). Several investigations have used punishment in an attempt to reduce the behavior of cigarette smoking, but with conflicting results. Greene (1964), using white noise as the punishing stimulus, found no reduction in cigarette smoking. Koenig and Masters (1965) compared systematic desensitization, supportive counselling, and aversion therapy as methods to reduce smoking. The aversion therapy consisted of delivering electric shocks to the hand on an intermittent basis for 18 separate responses which they determined composed the behavioral chain of obtaining and smoking a cigarette. They found a 25% reduction in smoking six months after the experiment ended. This percentage reduction did not differ significantly from the results of the other two procedures. McGuire and Vallance (1964) reported that six of 10 subjects ceased smoking as the result of receiving electric shocks after completing inhalations on a cigarette. Whaley, Rosenkranz, and Knowles (in press), using a portable device which delivered an electric shock to the forearm of the wearer when a cigarette case was opened, reported elimination of smoking in 17 subjects.

The above experiments on the punishment of cigarette smoking have measured the effects of only one intensity of the punishing stimulus; this has also been the case in virtually all other aversion therapy types of studies. Laboratory experiments on punishment which have used several intensities of the punishing stimulus have revealed that the higher the intensity of the punishing stimulus the greater the suppression of the punished response (see reviews by Azrin and Holz, 1966; Church, 1963; and Solomon, 1964). The experiments which have found this functional relationship between punishment intensity and amount of response suppression have utilized arbitrary responses and have been conducted in controlled experimental environments.

If shock punishers are to be used to eliminate pathological or undesired responses for therapeutic purposes, it is essential that the effects of punishment on these socially meaningful behaviors be studied directly, rather

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than assuming that these effects can be predicted without modification from the laboratory studies of simpler responses. The overall objective of the present study was basic research on the effects of shock as a punisher of socially meaningful human behavior that occurs in the subject's naturalistic environment. Within this overall objective, the specific aims were: (1) to use Whaley's method of delivering shock as a punisher, (2) to devise a method of objectively recording the socially meaningful behavior, (3) to devise a method of direct visual observation to substitute for or validate the subject's verbal report of his behavior, (4) to measure the effects of several intensities of shock rather than just one, and (5) to ascertain the reversibility of the effects of shock punishment.

Cigarette smoking was used as the response in this study because: (1) it is considered by competent medical judgment (Report of the Advisory Committee to the Surgeon General of the Public Health Service, 1964) as undesirable, (2) it is similar to many other undesired or pathological responses in that it is a free operant that has few restrictions as to where it can occur, (3) it can be recorded with a minimum of observer disagreement, (4) it is engaged in by a large percentage of the population, therefore providing a large pool of subjects, and, (5) attempts to find a method for eliminating it have been only moderately successful.

METHOD

The present approach to studying the effects of punishment on cigarette smoking differed greatly from most previous applied studies of this kind on this and other behaviors. First, the procedure provided a device that the subject could wear all of the time, thereby providing continuous consequences for the behavior rather than the "one-shot" approach in which treatment is limited to one brief period or, at best, repeated brief and widely spaced periods. Second, a method of "participant observers" was used in which reports about the behaviors were obtained systematically by individuals who were normally in continuing contact with the subject in his natural environment. Third, the experimental design dealt intensively with individual subjects rather than with groups. Fourth, several values of the independent variable (shock) were applied to each subject rather than a single value to a group, thereby providing a functional relation of the behavior to the experimental variable. Fifth, behavioral changes were measured continuously during and after the treatment, rather than applying the treatment at one time and measuring its effect later. Sixth, automatic counters were used to assist in recording the behavior objectively in order to obviate complete reliance on self-report by the subject; the participant-observer technique also served this function.

Subjects

For one week the experimenters recorded the names of all male individuals who smoked cigarettes in their presence and with whom they had a speaking acquaintance. At the end of the one-week recording period the list comprised 17 people. The 17 persons on the list were then individually contacted by the experimenters and asked to volunteer for an experiment designed to reduce their cigarette smoking through the use of electric shock. Three additional individuals not initially known to the experimenters, but referred by other parties, were also solicited for the experiment. Thus, a total of 20 male cigarette smokers, all of whom were a minimum of 21 yr of age, were asked to volunteer. Three of these 20 subjects eventually completed the desired experimental conditions; two were graduate students and the third a professor. The two graduate students (S-1 and S-3) claimed a smoking history of 8 and 16 yr respectively and both estimated they smoked 30 cigarettes per day. The professor (S-2) claimed a 10-yr history of smoking and estimated a daily consumption of 50 cigarettes.

Apparatus

Based upon the work of Whaley *et al.*, (in press) a portable apparatus was constructed which consisted of three major components: the cigarette case, the electrical stimulator, and the electrode case.

The cigarette case (2⅝ by 1 by 5 in.) was constructed of Plexiglas and contained an upper compartment which held one full package of cigarettes and a lower compartment which housed the stimulator. A spring clip was attached to the front of the case so

that it could be secured to the wearer's shirt pocket. The lid of the cigarette case was under tension insuring that the case could not inadvertently be left open. When the case was opened, a lever arrangement elevated the cigarette package (¾ in.) out from the case, facilitating extraction of a cigarette.

A non-resetable counter was housed in the lower compartment of the case and it advanced one digit each time the case was opened. The enclosed counter could be read through a small window; these readings provided an automatic record of the number of times the case was opened.

On the left side of the case was a brass rod (1/16-in. diameter) that moved up vertically ¾ in. from the top of the case when it was opened. The rod could be elevated only by opening the case and once elevated had to be manually reset. (The function of the rod is described in the Procedure section.)

On the back of the case was a spring clip which held small cards securely to the case. One card was provided for each day; on it space was provided for the subjects to record the time they placed the apparatus on, when they removed it, and the counter readings at these respective times. This information was utilized to determine the rate of smoking for each subject.

The electrical stimulator in the lower compartment contained a transformer, relays, and the necessary circuitry. The voltage was produced by contacts making and breaking a dc voltage in the primary of a step-up transformer. The circuit provided an effective voltage (RMS) of 105 v under no-load conditions and a stimulus duration of 1 sec. Shock intensity was manipulated by changing the value of the series resistor in an electrode case. In determining current flow the resistance of the subjects was estimated to be 50,000 ohms, based on preliminary measurements on other individuals. Preliminary use of the device had shown that individuals found the shock extremely painful and few would assent to experiencing more than one such shock delivery.

The electrodes were contained in a Plexiglas case (2½ by 2¼ by ⅞ in.) worn on the left arm between the elbow and shoulder. The case was shaped to the arm and held in place by a stretch bandage attached to the case. The electrodes extended 1/64 in. out from the case and were 1¾ in. apart. Located inside the case were the batteries necessary to operate the shocking circuit and the series resistor.

The electrical stimulator and the electrode case were connected by insulated wires. When the apparatus was in place the wires were concealed beneath the clothing and only that length of wire which ran from the shirt-front opening to the left-front pocket was visible.

Each time the cigarette case was opened, an electric shock was immediately delivered. It was not possible to extract a cigarette from the case without activating the shock-delivery system, stepping the enclosed counter, and having the brass rod move up.

Procedure

The subjects were informed, both verbally and in writing, of the nature of the experiment and advised that they would be under periodic observation. Signed consent statements were then obtained from each participating subject.

Outline of Procedural Steps

I. Subjects' self-recording of amount smoked.
II. Subjects read literature on possible health hazards involved in smoking.
III. Apparatus worn but without shock punishment.
IV. Shock punishment for cigarette case opening and subsequent increases in shock intensity.
V. Withdrawal of shock punishment.

Note: S-3 not exposed to Steps I, II, or V.

To obtain the record of smoking (Step I), subjects were given a form on which space was provided for keeping a daily record of the number of cigarettes smoked and the time period involved. This information provided an assessment of the initial smoking level. The daily recording by the subjects allowed a more accurate statement about initial smoking levels than could be obtained by relying upon their estimate. This self-recording continued for five days.

The subjects were then required to read some literature on the possible health hazards involved in cigarette smoking (Step II). A four-page report on these hazards was prepared from material extracted from the Re-

port of the Advisory Committee to the Surgeon General of the Public Health Service (1964) and brochures available from the American Cancer Society. The subjects read the report in the presence of the experimenter and were given a brief objective test on its contents. Following this the subjects were again instructed to keep a written record of the number of cigarettes smoked per day and the time period involved. This condition was utilized to assess the effects of "graveyard" literature on cigarette smoking and possibly to increase the subjects' motivation to reduce the amount smoked. The self-recording by the subjects after reviewing the literature continued for four days (S-1) and six days (S-2).

The subject was then given the apparatus (Step III). The proper wearing of the apparatus was explained and demonstrated. The subjects were told to wear the apparatus as long as possible, preferably all of the time. At this time the subjects were given verbal instructions on how to fill out the cards attached to the case and how to reset the brass rod on the case when finishing a cigarette secured from it. When the apparatus was introduced the shock punishment was not in effect (0.0 ma). Wearing the apparatus without the shock punishment gave the subjects time to adapt to the apparatus. This condition remained in effect for three days for all subjects.

Shock intensity was then increased periodically (Step IV). Arrangements were made with each subject to meet with the experimenters at a specified time and place when such increases could be implemented. For S-1 and S-2 a new intensity was given every two or three days; for S-3 a new intensity was given each day. At each intensity the subjects were asked if they would assent to experiencing a new, more intense stimulus. When meeting with the subjects the experimenters checked the apparatus to insure that it was working properly, provided new recording cards, and recorded the counter reading on the apparatus. The intensity of the shock was increased to the point where the subject stopped smoking or refused to experience a higher shock intensity.

In the final step of the experiment (Step V) the subjects continued to wear the apparatus but shock intensity was returned to its initial value of 0.0 ma, thereby providing a redetermination.

The principal dependent variable in this study was number of cigarettes smoked. A definitive means of measuring this behavior would have been to observe the subjects continuously throughout each 24-hr day. The impracticality of this procedure led to the alternative solution of measuring, via the counter, the number of times the cigarette case was opened. The counter readings alone, however, were not adequate since the subjects may have taken several cigarettes each time the case was opened or taken them from other sources. What was needed was a means of determining whether each advance in the counter represented a cigarette secured from the case and then smoked. It seemed as impractical to have an observer present each time the case was opened as it was to have continuous surveillance. The solution to this problem was to construct the case in such a way that the subject would himself be keeping a record of the case openings and to use infrequent but direct observations by observers as to the accuracy of these records. Each time the cigarette case was opened the rod was elevated to where it was easily visible to the observer. The intrinsic design of the case guaranteed that the counter was advanced and a shock was delivered when scheduled each time the case was opened. Thus, if the observer noted the subject smoking, and the rod was in the up position one could be assured that that cigarette was obtained from the case, had been recorded by the counter, and a shock, if scheduled, had been received.

The possibility did exist that the subjects could open the case, leave the rod in a vertical position, and then obtain all other cigarettes from an alternative source. The ideal solution to this problem would have been to have the rod automatically return to the down position when a cigarette obtained from the case was finished. This was not feasible and the solution adopted was to instruct the subjects to reset the rod manually each time they finished a cigarette. Thus, if the subjects were following instructions, observation would show the rod in an up position when the subjects were smoking and down when the subjects were not smoking. Only if this were the case would one have assurance that the counter readings were equal to the number of cigarettes taken from the case and smoked.

During the time the apparatus was being utilized, two of the subjects (S-1, S-2) were observed at irregular periods of time. The subjects were asked to designate individuals who would be agreeable to them as observers and with whom they were in continuing contact. The observers selected were co-workers of the subjects. The times when this monitoring was to occur were randomly preselected by the experimenters and varied from 5 to 12 observations per day. At these times the observers would seek out the subject and visually determine whether the subject was (1) wearing the apparatus, (2) smoking or not smoking, and (3) whether the brass rod on the cigarette case was in an up or down position. The information provided by this monitoring was recorded by placing check marks on forms provided to the observers. For the observers other than the experimenters these forms were secured to self-addressed post cards which were mailed to the experimenters daily.

RESULTS

Table 1 shows the number of subjects asked to participate, the number agreeing to do so, and the number completing the experiment. Six of the 20 subjects solicited for the experiment agreed to participate. Of the 14 who declined, four spontaneously stated that their refusal was based on the use of aversive shock. Three of the six who did volunteer later withdrew from the experiment. Two of these subjects withdrew before the shock contingency was put into effect and the third withdrew after wearing the apparatus for only one day

Table 1

Distribution of Subjects Utilized in Experiment

Number of Subjects Solicited for Experiment	20
Number of Subjects Volunteering	6
Number of Subjects Remaining in Experiment more than 1 day after punishment contingency introduced	3

at the lowest intensity, stating that his withdrawal was because of the shock.

Table 2 shows the concordance between the concomitant observation made of the subject and of the apparatus. The number of

Table 2

Concordance of Observations of Subjects and Apparatus

Subject	*Number of Observations*	*Number of times smoking behavior in agreement with apparatus indicator*	*% Agreement*
S-1	41	38	93
S-2	24	21	88
S-3	—	—	—

times the subjects were observed smoking, and the number of times they were not observed smoking have been combined to give a total number of observations. For both S-1 and S-2 the times when the apparatus indicator was not in agreement with their smoking behavior were those when they were observed not to be smoking. This occurred three times for S-2, all on the first day he wore the apparatus. No discrepancy occurred thereafter. For S-1 there were also three such occasions and they occurred at the beginning and near the middle of the experiment. The high percentage of agreement obtained indicates that the subjects were securing their cigarettes from the apparatus. The number of cigarettes smoked, as defined by the counter in the cigarette case, was thus a reliable measure of the response.

Figure 1 shows the rate of smoking for the three subjects as a function of the intensity of the punishing stimulus. No appreciable changes in the rate of smoking took place as a result of reading the literature on smoking hazards. The use of the apparatus at 0.0 ma resulted in no appreciable change in the rate of smoking. The initial introduction of the punishing stimulus produced only slight changes in smoking. Similarly, for S-2 and S-3, the next highest intensity (0.5 ma) had no suppressive effects over those encountered at the initial intensity level. Subsequent increases in the intensity of the punishing stimulus resulted in increasing degrees of suppression for all three subjects. The highest intensity of shock reduced the rate of smoking from the initial 0.0-ma condition by approximately 100% for S-1, 30% for S-2, and 70% for S-3. The decreased rate of smoking at high shock intensities was also evidenced by the direct observations. Although these data

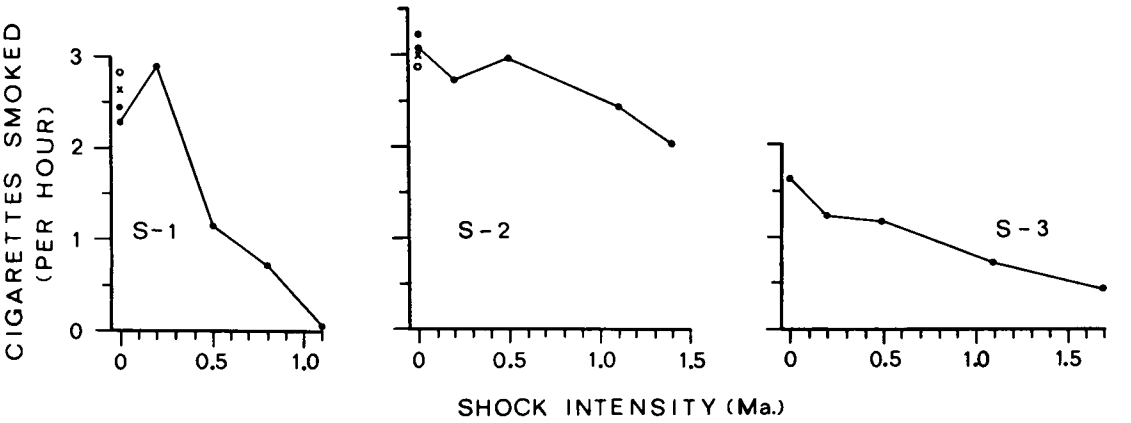

Fig. 1. Rate of smoking as a function of punishment intensity. Open circles represent written self-reports. Points designated "x" represent written self-reports after review of health hazard literature. The closed circles not connected by the line represent redeterminations.

were only an infrequent sampling, smoking was observed only one-third as often during the two highest intensities as compared with the two lowest intensities for each subject. The rate of smoking returned immediately to the pre-punished level when the shock was discontinued (0.0 ma).

Figure 2 shows the duration that the apparatus was worn as a function of the intensity of the punishing stimulus. For S-1 and S-2 the amount of time the apparatus was worn decreased as the intensity of the stimulus increased. For S-3 the duration the apparatus was worn shows a slight increase. Subjects S-2 and S-3 reached a point where they refused to experience the next highest intensity. No such determination was made for S-1 because his rate of smoking had already approached zero. When shock was discontinued, both subjects showed an increase in the time the apparatus was worn but not to the initial level. To evaluate the reversibility of this function more fully a second redetermination was made for S-1. The second followed the first by two weeks and did result in an increase in the time the apparatus was worn which closely approached the initial value.

DISCUSSION

Cigarette smoking is a freely occurring response not greatly restricted to where and when it may be engaged in. The present results indicate that such a response can undergo varying degrees of suppression by manipulating the intensity of a punishing stim-

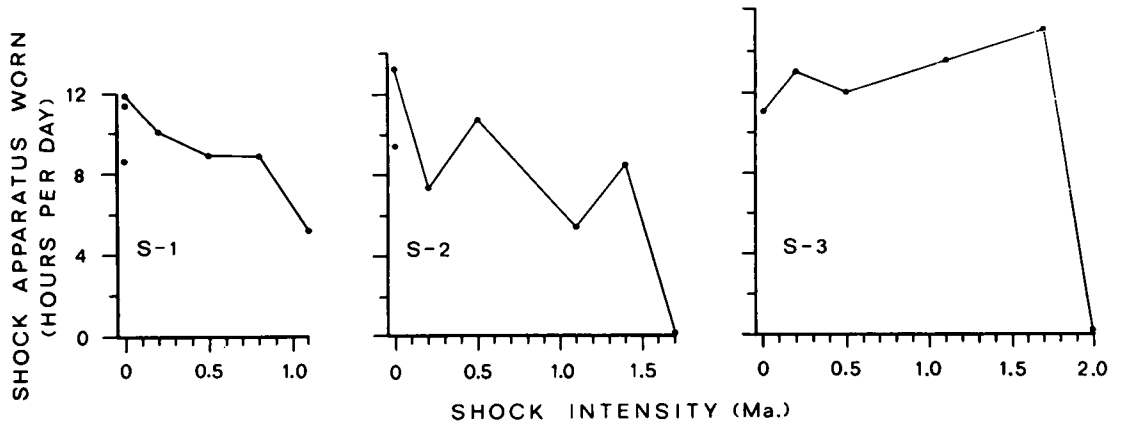

Fig. 2. Duration that shock apparatus was worn as a function of punishment intensity. Points not connected by the line represent redetermined points. Lower point for S-1 represents the first redetermination; upper point the second redetermination.

ulus. This finding is in keeping with results obtained when dealing with arbitrary responses emitted in controlled experimental environments with both infra-human (Azrin, 1960) and human (Kaufman, 1964) subjects.

Several alternative explanations as to the observed reductions in cigarette smoking obtained in this experiment may be considered: first, the shock stimulus used may have served as a reminder to the subjects that they were expected to reduce the amount they smoked. This seems unlikely since the number of cigarettes smoked varied as a function of the intensity of the shock. Yet, the reminder properties of the shock were equally present under all intensities.

Secondly, the information imparted to the subjects about the health hazards involved in smoking may have had a general suppressive effect on this behavior. The results indicate, however, that the rate of smoking immediately after exposure to this information did not differ from the rate before it was presented. Previous findings indicate the relative ineffectiveness of therapeutic and/or educative materials to eliminate cigarette smoking (Horn, 1960; Lawton, 1962; Mausner, 1966).

Third, the reduction in smoking might be attributed simply to introducing the novel stimulus of electric shock. As the results show little or no reduction in the rates of smoking at the initial intensity used, this possibility does not seem likely. In addition, if suppression of smoking were due to a novel stimulus, one would expect such suppressive effects to dissipate over time as a result of increasing adaptation to the stimulus. The observed results of increasing suppression over time contradict such an explanation.

A fourth possibility is that the introduction of the punishment coincided with a period when the subject's rate of smoking was decreasing because of other uncontrolled variables and was, therefore, totally unrelated to the experimental manipulations. This can be evaluated by examining the results obtained when the punishment contingency was removed. The results showed an immediate recovery of the smoking rate to its pre-punished level. It seems safe to assume, therefore, that the intervening reductions in rates were due to the punishment and specifically its intensity, not to some unspecified or uncontrolled factors.

The practical use of severe electric shock would seem to be limited. Only three of 20 subjects solicited to volunteer for the experiment completed all the desired steps. Many of the subjects who were asked to volunteer said that they wished to stop or to reduce their smoking but not at the expense of experiencing electric shock. For the subjects who did complete the experiment, the shock punisher produced escape or avoidance reactions: as the punishment intensity increased, the duration decreased for which the subjects would remain in contact with the punishment contingency decreased; ultimately, an intensity was reached at which they refused to experience it altogether. Thus, it seems that the use of aversive stimulation can result in the unwanted by-product of decreased participation on the part of subjects, or in the most extreme instance, in their terminating all such participation.

A review of the literature on the use of aversive stimulation reveals conflicting evidence as to its generation of escape responses in subjects.

Escape responses do increase as a function of increasing punishment intensity with infra-human organisms (Azrin, Hake, Holz, and Hutchinson, 1965). Also, the use of aversive stimulation with human subjects can result in their refusing to return for additional experimental sessions (Azrin, 1958; Franks, Fried, and Ashem, 1966) or terminating their participation within an experimental session (Ader and Tatum, 1961, 1963). On the other hand, the successful use of aversive stimuli without reported difficulties in keeping subjects under desired experimental conditions has been widely reported (McGuire and Vallance, 1964; Feldman and MacCulloch, 1964; Kushner and Sandler, 1966).

Several explanations for this conflicting evidence seem possible. The type of behavior being treated may be the critical factor in those studies where no difficulty is encountered in retaining subjects. The consequences of engaging in some behaviors may be more aversive than the aversive procedures being used to eliminate them, and, therefore, subjects would be highly motivated to continue their participation. A second, related explanation is that a selectivity factor may be operating

in the determination of the subjects who are utilized in experiments involving aversive stimulation. This selectivity may insure that the subjects who do participate are those who are not expected to terminate their participation. A third explanation is that the sensitivity of the recording procedures used may be insufficient to ascertain when escape responses are being produced. In this experiment the one subject who did not decrease the amount of time he wore the apparatus as the punishment intensity was increased was the one (S-3) on whom no corroborative data was obtained. A fourth explanation is that there is no conflict between studies: investigators may have simply neglected to report refusals by subjects.

In dealing with behaviors not confined to a laboratory situation it becomes necessary to insure an objective and reliable measure of the response. In this experiment the objective recording of the response was provided by a counter. The periodic monitoring by the participant observers gave definitive assurance that the counter readings were a valid measure of the number of cigarettes smoked and insured that the apparatus was being worn. Only with this assurance could the veracity of the data provided by the subjects be accepted.

The participant-observer technique developed here should be useful for most applied studies in which a measure of the behavior outside of the treatment situation is desired. In most studies of phobias, aggression, sexual behaviors, and study behavior, for example, the principal objective of the treatment is the change of these behaviors outside of the treatment environment. The current practice in determining these changes is to rely exclusively on the self-report of the patient at very infrequent intervals as in the "follow-up" inquiry. The participant-observer technique provides information not only about the behavior but also the extent to which a prescribed procedure is indeed being followed, as is important, for example, in studies using self-shocking devices, self-study programs, special parental practices toward children, teaching methods, exposure to particular feared or supportive situations, *etc.* The data obtained through this technique are continuous and quantitative rather than a dichotomized expression of cured *vs.* non-cured, or compliance *vs.* deviation. Most important, the data are obtained from an independent observer who can also, if desired, be instructed to encourage compliance with the prescribed treatment.

Additional use of this procedure following this study enlisted wives, husbands, classmates, girlfriends, and work supervisors as the participant observers. It has been our experience to date that subjects will readily suggest individuals who would be appropriate observers. We have also had no difficulty in recruiting the suggested observers since by providing report forms which necessitate only marking categories the reporting is neither difficult or time consuming.

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