The Effects of Behavioral Contracting on the Self-Administration of Tetraethylthiuram Disulfide

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THE EFFECTS OF BEHAVIORAL CONTRACTING ON THE
SELF-ADMINISTRATION OF TETRAETHYLTHIURAM DISULFIDE

by

Alan G. Lewandowski

A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the
requirements for the
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Department of Psychology

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I dedicate this work to my parents.

Alan G. Lewandowski
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WESTERN MICHIGAN UNIVERSITY, M.A., 1980
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INTRODUCTION

Alcoholism is a widespread and disturbing behavior affecting all economic and social strata, and numerous methods have been employed in its treatment. Traditional approaches have included social control (Dittman, 1967), medication (Krupp, Chatton, and Margen, 1971), psychotherapy (Zimberg, Wallace, and Blume, 1978), hypnosis (Wallace, 1978), and group support (Blume, 1978). Alternatively, successful treatment methods based on respondent and operant conditioning suggest behavioral procedures as a working alternative to traditional therapies.

Behavioral approaches to therapeutic intervention (considered a mere systemization of knowledge in the late 1950's) have gained recognition as a complete model of etiology (Corsini, 1973). Its foundation upon learning principles and the use of scientific methods for specifying, observing, and evaluating results distinguishes it from other current forms of treatment. The scope of a behavioral approach, then, is to rearrange contingencies in order to alter an individual's response to a stimulus.

The traditional behavioral treatment of alcoholism has evolved into a dichotomous system of treatment based on respondent and operant paradigms. The purpose of the former is to decrease the positive effects of the alcohol itself, while the latter lends emphasis to drinking behavior per se and the control of environmental variables. As early behavioral interventions viewed the etiology of alcoholism as classically conditioned, respondent techniques have historically dominated treatment attempts, while more recent methods have focused on operant strategies.
Physiological inducement of abstinence. In terms of respondent conditioning, treatment is dominated by aversive counterconditioning. Also referred to as aversion therapy, this conditioning process involves the pairing of alcohol with an aversive unconditioned stimulus such as shock (Miller, Hersen, Eisler, and Hemphill, 1973), or emetic chemicals (Lemere and Voegtlin, 1950) to elicit an unconditioned response such as anxiety, fear, or nausea. An early recording of aversion therapy is supplied by the Romans who would place an eel in a wine cup and force an individual to drink from it (Ullman and Krasner, 1969).

In An Inquiry Into the Effects of Ardent Spirits Upon the Human Body and Mind, Benjamin Rush (1785) offered an account of various means of preventing intoxication and treating alcoholism. Rush appears to have published the first comprehensive medical work which noted the clinical use of respondent conditioning in the treatment of alcoholism, complete with follow-up data:

The association of the idea of ardent spirits, with a painful or disagreeable impression upon some part of the body, has sometimes cured the love of strong drink. I once tempted a negro man, who was habitually fond of ardent spirits, to drink some rum (which I placed in his way) and in which I had put a few grains of tartar emetic. The tartar sickened and puked him to such a degree, that he supposed himself to be poisoned. I was much gratified by observing he could not bear the sight nor smell of spirits for two years afterwards.

Another account is also supplied, although in less specific detail:

"I have heard of two persons being cured of the love of ardent spirits by seeing death suddenly induced by fits of intoxication; in the one case a stranger, and in the other in an intimate friend."

Kantorovich (1929) is cited most often for the first scientific
report of the clinical application of respondent conditioning as a treatment for alcoholism. A group of 20 alcoholics participated in 5 to 18 sessions in which the sight, smell, and taste of various alcoholic beverages were paired with a "strong electrodermal stimulus". Kantorovich reported that of those participants, 17 acquired a stable aversive reaction to alcohol, and 14 remained totally abstinent. By contrast, a control group of 10 alcoholics who received a combination of medication and hypnotic suggestion occasioned sobriety in only 1 patient.

Electrical aversion has been more widely employed than other unconditioned stimuli because of its precision (Blake, 1965); however, little to no significant difference between treatment and nontreatment groups have been reported (Vogler, Lunde, Johnson, and Martin, 1970; Wilson, Leaf, and Nathen, 1975).

Chemically induced aversion has generally employed emetine (Voegtlin, 1947), apomorphine (Raymond, 1964), lithium carbonate (Boland, Miller, and Pevusky, 1978), or succinylcholine chloride dehydrate (Farrar, Powell, and Martin, 1968) which induces a state of muscle paralysis. In most instances results are generally poor or inconclusive and, therefore, do not presently support their overall clinical adoption. More experimental evaluation is needed.

Environmental Inducement of Abstinence. Operant procedures involve several different approaches. Abusive drinking is viewed to be determined by physiological, cognitive, social, or environmental consequences which increase or decrease the probability that excessive drinking will occur again.
Historically, the treatment of alcoholism within an operant framework has centered on socially punishing consequences for inappropriate drinking behavior. References to religious and legal reprimands for abuse are commonplace in all types of literature. For example, fines and jailing for public inebriety have been routine procedure for law enforcement officials.

However, Benjamin Rush (1785) may also be credited with the early mention of modern operant approaches. A primitive account of contingency contracting is supplied from his medical works as follows:

I have known an oath taken before a magistrate, to drink no more spirits, produce a perfect cure of drunkenness. It is sometimes cured in this way in Ireland. Persons who take oaths for this purpose, are called affidavit men.

Other accounts reveal that Rush was aware of antecedent stimuli, responses, and the effect of punishing consequences on intoxication:

A noted drunkard was once followed by a favorite goat, to a tavern, into which he was invited by his master, and drenched with some of his liquor. The poor animal staggered home with his master, a good deal intoxicated. The next day he followed him to his accustomed tavern. When the goat came to the door, he paused: his master made signs to him to follow him into the house. The goat stood still. An attempt was made to thrust him into the tavern. He resisted, as if struck with the recollection of what he suffered from being intoxicated the night before. His master was so much affected by a sense of shame, in observing the conduct of his goat to be so much more rational than his own, that he ceased from that time to drink spirituous liquors.

More recently, Miller, Herson, Eisler, and Watts (1974) used contingency management to reinforce a forty-one-year-old male alcoholic for maintaining a zero blood alcohol level. Reinforcers consisted of $3.00 worth of coupons exchangeable for food, cigarettes, and clothing at a V.A. commissary. Alcohol breath tests were administered bi-weekly.
on a random basis to ensure compliance. Results after a baseline period showed a significant drop in the subject's blood alcohol level and thus indicated that contingent reinforcement could modify alcohol ingestion in the natural environment.

Cohen, Liebson, and Faillace (1971) used group fines as an adjunct to a monetary based token economy system. Subjects received $60 upon admission to the ward and either lost or gained additional money based upon their drinking behavior. Individual infractions caused all ward members to be fined the same amount. Although no difference in minor infractions was observed, major infractions were reduced to one-fourth of their baseline level. The authors maintain that patients demonstrated an awareness of the functional relationship between their behavior and its consequences.

Other operant approaches include the use of time-out procedures (Hunt and Azrin, 1973), intermittent punishment (Okulitch and Marlatt, 1972), token economies (Rozynko, Flint, Hammer, Swift, Kline, and King, 1971), assertive training (Eisler, Hersen, Miller, and Blanchard, 1975; Eisler, Hersen, and Miller, 1974; Eisler, Miller, and Hersen, 1973; Eisler, Miller, Hersen, and Alford, 1974), and social skills training (Foy, Miller, Eisler, and O'Toole, 1976).

It may be noted that biofeedback (Klatsky, Friedman, Abraham, Siegelaub, and Gerard, 1977), relaxation training (Blake, 1967), and systematic desensitization (Lanyon, Primo, Terrell, and Wener, 1972), have also recently been explored. Lying somewhere along the behavioral continuum between operant and respondent paradigms, these techniques have attempted to explore the relationship between physiological stress and abusive drinking (Miller, Hersen, Eisler, and Hilsman, 1974).
Medical inducement of abstinence. The medical community has historically approached alcoholism as a disease, symptoms of which indicate an underlying illness (MacAndrew, 1969; Jellinek, 1960). Within the medical model framework, multidisciplinary approaches have advocated the use of drug therapies as a primary intervention or an adjunct to psychotherapy, counseling, group therapy, psychodrama, hypnosis, and programs such as Alcoholics Anonymous (Fox, 1967; Weisman, 1968; Ottenberg and Rosen, 1971). Consequently, treatment attempts have explored medications with antidepressants, hallucinogens, ataractics, and antidipsotropics, most all of which lack support for therapeutic effectiveness (Mottin, 1973). In a review of controlled and uncontrolled studies with chronic alcoholics, Viamontes (1972) reports that except for tetraethlythiuram disulfide (TETD), no pharmacologic agent has been proved to be more effective than placebos.

An history of early use and pharmacologic action. Tetraethylthiuram disulfide (disulfiram) is one of many organic sulphur compounds employed in industry since the early nineteenth century; however, it was not until the 1930's that they were first introduced into the medical community as a treatment for intestinal worms (Major, Zeigler, Lake, and Brown, 1977).

In 1948, TETD's use as an accelerator in the vulcanization process of rubber was accidentally found to have the reactive properties with ethanol of sensitizing the human organism to even moderate ingestion (Hald and Jacobsen, 1948). Since establishment of this capacity, it has been widely employed as a pharmacologic deterrent to the excessive use of alcohol (Martensen-Larsen, 1948). It is currently marketed by
Ayerst Laboratories, New York (a division of American Home Products Corporation), and supplied in scored tablets containing either 250 or 500mg of TETD in bottles of 50, 100, or 1,000 (Pace, 1976).

In its consumatory state, TETD occurs as a relatively tasteless and odorless white powder. Indsolvable in water (See Figure One), it is soluble in alcohol, acetone, benzene, chloroform, carbon disulfide, and ether. It is absorbed, although not fully, through the gastro-intestinal tract about twelve hours after ingestion and is oxidized mostly in the liver. Excretion takes place in the urine and in the faeces where five-to-twenty per cent of the drug is incompletely absorbed, with approximately one fifth remaining in the body up to two weeks after initial ingestion (Windholz, 1976).

An individual who comes in contact with even small amounts of ethyl alcohol while under medication may immediately experience a physically dysphoric reaction of such unpleasantness, that the patient usually becomes incapacitated and unable to continue the behavior in which he is currently engaging.

Although the process by which disulfiram potentiates a toxic effect when combined with alcohol is not fully understood, it has been hypothesized that TETD acts to block the normal oxidation of ethyl alcohol at the acetaldehyde stage.

Specifically, in the metabolism of alcohol in the liver, the enzyme alcohol dehydrogenase initiates the formation of acetaldehyde which in turn is promptly oxidized by the enzyme aldehyde dehydrogenase (Ritchie, 1978). In the normal state of the human organism, acetaldehyde does not accumulate in the body tissues.
Figure 1

STRUCTURAL FORMULA FOR TETRAETHYLTHIURAM DISULFIDE (DISULFIRAM)
TETD acts to compete with aldehyde dehydrogenase, thus reducing the rate of oxidation of aldehyde and increasing the concentration of acetaldehyde in the blood. An individual's acetaldehyde level may reach from five to ten times its normal amount, thereby producing a dysphoric effect. Support for this interpretation has come from the observation of similar symptoms which occur as the result of intravenous injection of acetaldehyde in human and lower organisms (Ritchie, 1978).

**TETD-alcohol reaction, toxicity, and side effects.** The intensity of the TETD-alcohol reaction is proportional to both the dosage of disulfiram and the amount of alcohol ingested. Although the extended use of TETD does not produce tolerance, continued use does produce a greater sensitivity to alcohol consumption. Marked physical distress to even small amounts of alcohol while on disulfiram maintenance may include "flushing, throbbing in the head and neck, respiratory difficulty, nausea, copious vomiting, sweating, thirst, chest pain, palpitation, dyspnea, hyperventilation, throbbing headache, tachycardia, hypotension, syncope, marked uneasiness, weakness, vertigo, blurred vision, and confusion. In more severe reactions there may be respiratory depression, cardiovascular collapse, arrhythmias, myocardial infarction, acute congestive heart failure, unconsciousness, convulsions, and death" (Antabuse in Alcoholism, 1977).

Disulfiram is a relatively safe and nontoxic drug when administered under proper medical supervision (Hald and Jacobsen, 1948; Faiman, 1978). Nonetheless, possible adverse reactions include skin eruptions, allergic dermatitis, drowsiness, fatigue, headache, impotence, metallic aftertaste, and dietary stress (Wilson, 1978; Kwentus and Major, 1979).
Considerations and efficacy of TETD treatment. Disulfiram treatment has been widely applied to various military (Rock, 1975; Edwards and Dill, 1974), chronic (Gallant, 1968), outpatient (Gerrein, Rosenberg, and Manohar, 1973), inpatient (Davies, Shepard, and Myers, 1956), skid row (Bourne, Alford, and Bowcock, 1966), and state hospitalized (Shaw, 1951) alcoholic populations. However, a review of published literature indicates that much research lacks the application of rigorous scientific methodology. Pattison, Coe, and Rhodes (1969) and Sobell and Sobell (1968) have examined some of the problems with experimental design, such as the use of abstinence or the therapist's subjective judgment (Gibbons and Armstrong, 1957) as the only criterion for success. Another weakness reported is the absence of volunteers and the mandatory employment of TETD treatment to populations. Lundwall and Baekeland (1971) present five disulfiram studies which indicate that some individuals will drop out of treatment if forced to take TETD. Other shortcomings include lack of adequate control groups (Lundwall and Baekeland, 1971), heterogeneity of patient populations (Schmidt, Smart, and Moss, 1968), inadequate or lack of follow-up data (Gerard and Saenger, 1966), and the evaluation of treatment outcome without the use of statistical interpretation (Lundwall and Baekeland, 1971).

In view of disulfiram's unconventional pharmacologic action as a chemical antagonist, unique considerations accompany the drug's utilization in the treatment process.

One such consideration appears to be the high rate of dropout from TETD treatment. Rosenberg and Raynes (1973) have estimated that 5 to 35 per cent of all inpatients self-discharge from treatment, while less
than 10 per cent of all outpatients will return after obtaining an initial dose of TETD (Lubetkin, Rivers, and Rosenberg, 1971). Motivation is often cited as a discriminative factor in continued treatment; however, in a study involving 123 outpatient alcoholics, Rosenberg (1974) reported that a willingness to accept disulfiram did not indicate a greater or lesser motivation to remain in treatment and did not affect outcome.

Recommendations for overcoming difficulties of disulfiram therapy include the implementation of an educational program to counteract pervasive myths about TETD (Lubetkin, et al., 1971), the utilization of a specific therapist to introduce, counsel, and follow up each disulfiram patient, and the use of letters (Koumans and Muller, 1965) or phone calls (Koumans, Muller, and Miller, 1967) to increase compliance for treatment.

Contingency contracting in alcoholism and disulfiram treatment. Behavioral contracting has been explored as a systematic method for scheduling consequences for excessive and moderate alcohol consumption. Its employment as a treatment intervention has assisted to alleviate some experimental design problems.

Viewing alcoholic drinking as an operantly controlled response, Miller (1972) applied contingency contracting with an alcoholic and his spouse in order to modify consequences maintaining alcoholic behavior. A six-month follow-up indicated that the occasioning and maintenance of moderate drinking levels were changed by the manipulation of environmental variables.

In an experimental analog study Miller, Hersen, and Eisler (1974) evaluated four methods of behavioral contracting. Subjects matched on
length of problem drinking, age, and education were divided into groups and exposed to the following treatment conditions designed to limit alcohol consumption: verbal instructions, signed written agreement, verbal instructions plus reinforcement, and signed written agreement plus reinforcement. Alcohol presented on a fixed ratio schedule constituted reinforcement for contract compliance. Pretreatment and post-treatment analog sessions indicated that while instructions and written agreement had some influence on drinking, reinforcement groups significantly decreased their intake of alcohol.

Bigelow, Strickler, and Griffiths (1976) conducted a study whereby 20 male alcoholics agreed to ingest disulfiram according to the terms of a security deposit contingency contracting procedure. Patients placed a $100-to-$150 security deposit with the clinic as a guarantee of continued participation for three months. TETD was ingested under nurses' observation for the first 14 days of treatment, and on alternate days thereafter. The framework of the contract was nonnegotiable with $5 or $10 forfeited upon failure to arrive for treatment. The authors report an increase in clinic visits, duration of abstinence, continuation for therapy, and a decrease in alcohol ingestion, with 35 per cent of all subjects sacrificing some portion of their security deposit.

It may be seen that the design of rigorous behaviorally oriented experiments to test the efficacy of disulfiram therapy is unusually difficult, specifically in reference to the necessity for appropriate randomization, adequate follow-up, the employment of control groups and double blind procedures, and a test of the drug's ingestion. Although
randomization and follow-up do not usually present a problem, the use of appropriate control groups and double blind procedures presents particular difficulties. It must be considered that patients who refuse TETD ingestion are inappropriate controls because of possible motivational differences. The use of placebos does not alleviate this difficulty, as it is reasonable to expect that a placebo would be as effective as TETD if the patient believed he was actually ingesting it. For this reason, double and single blind procedures are also inappropriate (Gordis and Peterson, 1977). In addition, patient consent with drugs may well dictate a complete awareness of the medication and the experimental protocol.

TETD detection procedures. Fortunately, recent developments have made certain tests for disulfiram detection available. Gordis and Peterson (1977) used a detection procedure in which urine was collected from 95 outpatients on disulfiram therapy. An examination for diethylamine was conducted by adding 0.4ml of urine to 2ml of H$_2$O and a reagent of cupric acetate monohydrate and ethanol. Results indicated that 20 per cent of those individuals who stated they were ingesting TETD were found not to be using the drug, thus implicating the validity of conclusion based solely on patient self-report.

Fuller and Roth (1979) have also advocated the use of a urine detection procedure for the examination of disulfiram compliance. Urine samples were collected from 128 patients who were assigned to pharmacologically active, pharmacologically inactive, or no TETD groups. No significant differences were observed in abstinence, percentage of drinking days, family stability, days worked, or appointments kept.
It was reported that only 21, 25, and 12 per cent of all subjects remained abstinent in active, inactive, and no TETD groups, respectively. In addition, abstinence was significantly correlated with compliance and employment.

Although urine detection procedures appear to be accurate, apparent disadvantages include time, space, material, and personnel for administration and collection of specimens.

It has been reported that TETD is metabolized to carbon disulfide (CS$_2$) of which 50 per cent can be detected in the expired air of humans and lower organisms (Pickett, 1953). On the basis of this principle, Kraml (1973) has devised a sensitive and reliable breath test which requires approximately two liters of human exhalation to trap CS$_2$ in a modified McKee's reagent (McKee, 1941). Simply, expired air is passed through 5ml of a reagent, placed in 10ml of water and agitated vigorously. The liquids separate into phases within one minute, trapping the CS$_2$ in an iso-octane layer and indicating its presence by the appearance of a yellowish ring. In a single blind study, 90 per cent of the tests were correctly identified as positive up to 24 hours after collection. The author has reported that the chemicals are inexpensive and stable, making them practical for detection purposes.

In a similar study, Paulson, Krause, and Iber (1977) employed Kraml's test with 52 hospitalized individuals taking disulfiram. Of 340 separate tests, it was found that 25 patients were not ingesting TETD as they had reported. The authors concluded that subject compliance with the daily disulfiram regimen was very low, despite patient self-report to the contrary.
Although most behavioral approaches emphasize the utilization of either a respondent or operant approach to the treatment of alcoholic drinking, the present study was an attempt to combine the two conditioning models into a comprehensive therapeutic strategy. To accomplish this objective, the program was designed emphasizing abstinence while occasioning and increasing behaviors incompatible with abusive drinking. It was hypothesized that an operant-respondent approach to alcoholism treatment attempt to systematically remove the reinforcing properties of alcoholic drinking through contingent punishment, while concurrently reinforcing behaviors incompatible with inebriety through the rearrangement of environmental and social cues which occasion abusive drinking.
METHODS

Subjects and Treatment Setting

Clients in the inpatient program of the Midwest Alcoholism Center (M.A.C.) of Borgess Medical Center formed the potential subject pool for the study. Each patient was given information about disulfiram during his/her period of hospitalization. All who agreed to stay for the full 14-day program and requested disulfiram therapy were asked to participate in the experiment. Participation was voluntary and did not jeopardize any other type of treatment made available to the patient. Each subject had a primary diagnosis of alcoholism, as assessed by an extensive medical examination from a team of physicians and nurses, and an in-depth socio-psychological evaluation by the therapeutic staff. No complicating diagnoses, aside from withdrawal seizures, were reported. All subjects continued to participate in the 14-day treatment regimen.

Patients admitted to the M.A.C. initially entered a medical detoxification period, generally lasting three to five days. At this time, physiological withdrawal from ethyl alcohol was treated, and acute medical problems were resolved. Following this, the remainder of each patient's hospitalization consisted of alcohol education and therapy presented in group, didactic, and individual form. The treatment philosophy of the program was abstinence oriented.

At the end of the 14-day treatment, patients were assigned on a random basis to either a contract or noncontract group. Although all patients receiving disulfiram therapy signed a consent form informing
them of an alcohol-disulfiram reaction and stating that they would take
the medication daily, only the treatment group negotiated a specific
behavioral contract outlining the contingencies of medication main­
tenance and the topography of the pill-taking response.

Of the 24 persons asked to participate, 23 voluntarily consented. Of
this group, two dropped out of the research before being assigned to a
group. One additional patient assigned to the noncontract group
dropped out during the third week of treatment. This left 20 subjects
who were evenly assigned to a treatment or nontreatment group on a
random basis.

Subjects' mean age was 36 (SD=12.15). Eleven subjects were
married, three were single, and six were either separated or divorced.
The mean level of education was 11.4 (SD=1.46), with an average of 2.4
(SD=2.54) prior treatment attempts. Seven contract and eight noncontract
subjects were employed either part or full time.

Aside from specific individual drinking problems reported, there
was no significant difference between the contract and noncontract
groups on pretreatment demographic variables, which included drinking
history, age, sex, prior admissions, employment, arrest history, and
educational level (See Table 1). In addition, no significant differ­
ence in drinking patterns and attitudes were found, as measured by the
standard version of the Michigan Alcoholism Screening Test (MAST),
t (18) = .23, p < .05.
Table 1

MEAN AND STANDARD DEVIATIONS FOR DEMOGRAPHIC VARIABLE DIFFERENCES BETWEEN TREATMENT AND NONTREATMENT GROUPS

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<th>Standard Deviation</th>
<th>NONCONTRACT Mean</th>
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Apparatus

A Smith and Wesson brand "Breathalyzer" Model #900A was modified for use in the breath analysis portion of the study. Modifications consisted of replacing the original 3.50-inch length of plastic hose attached to the analyzer with an 8.00-inch length of clear 0.25-inch polyurethane hose. To this a straight, clear, 1.00-inch piece of glass tubing was attached and used to funnel the individual's breath into a 6.00- by 0.50-inch glass Pyrex test tube. After use, the glass tube and plastic mouthpiece were discarded and replaced with new ones for each individual testing.

The reagent was prepared from a modified McKee's solution by dissolving 0.002 per cent cupric acetate, 0.500 per cent diethylamine, 0.500 per cent triethanolamine, and 0.100 per cent iso-octane, in 0.950 per cent ethanol (Kraml, 1973).

Procedure

Procurement and random selection of subjects. Subjects were selected from those individuals who admitted themselves for alcoholism treatment at the inpatient unit of the M.A.C. Subsequent to a three-day alcohol detoxification period, patients were presented with information in a group setting concerning the drug TETD and disulfiram therapy. Over a three-month interval, those patients requesting TETD from the physician were asked to participate in the research project.

Patients who volunteered for the study were required to sign a consent form indicating that they willfully desired to take part in a
research project that was concerned with the evaluation of various methods of disulfiram ingestion, and specifying the symptoms of a TETD-alcohol reaction. The two-part document also required that the patient ingest disulfiram according to the standing orders of the medical director: 500mg per day for 14 days and 250mg each day thereafter; however, no consequences were made contingent upon compliance or noncompliance (See Appendix A).

Random assignment to the treatment or nontreatment group was conducted by allowing subjects to blindly select a white or colored plastic chip.

In addition to the consent form, the Michigan Alcoholism Screening Test and the Mortimer-Filkins Test for Alcoholism (MFTA) were administered to each volunteer.

**Alcohol assessment and pretest measurement.** The MAST is a brief, 25-item questionnaire designed to elicit consistent and quantifiable information from patients concerning drinking attitudes and behaviors by requiring the respondent to answer either "yes" or "no" to a series of statements and questions (Selzer, 1971). Its primary use is that of a screening and assessment instrument and may be administered orally or in written form by an individual of the para-professional level with brief training. Scores range from 0 to 53 with each item having a weight between 0 and 5. A score of 5 or higher is indicative of alcoholism. Most of the published literature indicates an acceptable level of reliability and validity (Jacobsen, 1976; Skinner, 1979; Zung, 1979). The MAST appears to provide a more sensitive measure of alcoholism with varied populations than does diagnosis based solely on physicians'
observations, legal records, or court documentation (Moore, 1971; Yoder and Moore, 1973; Pokorny, Miller, and Kaplan, 1972). In the present study, the MAST was administered to ensure a correct diagnosis and homogeneity of the population sample. Each patient scored 30 or greater on the MAST (See Appendix B).

The Mortimer-Filkins Test for Alcoholism is a 58-item questionnaire which surveys specific alcohol-related behaviors directly and indirectly by a yes/no, true/false, or quantitative response (Mortimer and Filkins, 1971). It was initially devised for use in court settings such as presentence investigations, but has general applicability to a wide range of settings and alcoholic populations. The instrument requires a moderate degree of familiarization to ensure a proper diagnosis of problem drinker, presumptive problem drinker, or nonproblem drinker. The authors' statistical analysis indicates acceptable coefficients of reliability and validity (Jacobsen, 1976). In addition, the MFTA surveys and diagnoses specific mental health areas which include: marital and family problems, recent stress, financial difficulties, abnormal problems, nervousness/restlessness/agitation, sadness and depression, self-denunciation, general dissatisfaction, sleeping problems, worry and fear, boredom, resentment, inability to cope, and drinking-related problems. In the present study, the MFTA was administered within the first week of inpatient hospitalization and at the fourth week of outpatient treatment to obtain a pretest and posttest measurement, respectively (See Appendix C).

To ensure a high degree of accuracy the above verbal information was confirmed through verification with the subject's standing medical
records, the initial emergency room admittance report, the socio-
psychological intake, family reports and interviews, and nursing and
therapeutic notes based upon daily observation. Discrepancies were
corrected as determined through existing empirical support after
inquiry with the subject.

Contingency contracting and self-monitoring. In addition to the
signed consent form, MAST, and MFTA, subjects in the treatment group
were provided with a behavioral contract printed on sturdy, lightweight
cardboard (See Appendix D). The contract included four semi-structured
statements which allowed subjects to delineate the specific topography
of their pill-taking response and describe a highly visible area of
their living environment where the contract was to be posted. Other
semi-structured statements allowed the individual to describe the per­
sonal location of a small (2.0 by 3.0 inch) disulfiram card indicating
that he/she was on disulfiram therapy (See Appendix E).

Structured statements required that the individual use a plastic
pill dispenser, provided at no cost by the therapist, maintain weekly
contact with a therapist, and use and post a disulfiram calendar in
order to self-monitor his/her daily ingestion of TETD (See Appendix F).

Each contract was individually negotiated over a one- or two-day
period with a therapist who attempted to ensure maximization of the
discriminative properties of the contract. All contracts included an
initiation and expiration date and were reviewed on a weekly basis for
negotiated changes.

The main focus of the behavioral contract was to provide each subject
with a highly visible discriminative stimulus in his/her immediate living

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environment. Weekly reinforcement by the therapist served as a positive consequence for fulfillment of the contract.

Physiological measurement for compliance. Prior to hospital discharge, each volunteer specified dates and times for weekly appointments to be kept with the therapist on an outpatient basis. Subjects were told that the time would be used to discuss any current problems along with a "breath analysis for chemicals". In addition, those individuals in the treatment group were allowed to renegotiate their contracts. A structured interview was used to ensure that all subjects received similar outpatient treatment (See Appendix G).

Physiological measurement was obtained by instructing the individual to exhale approximately two liters of breath into the modified breathalyzer, which was then aerated through the reagent. When a sufficient number of exhalations were obtained (usually 10 to 12), the patient was allowed to depart. The reagent was then mixed with H₂O and placed in a holding rack.

Reliability, posttest measurement, and follow-up. Upon separation of the CS₂ in the iso-octane layer of the breath sample, independent positive or negative evaluations were recorded by two therapists (See Appendix H). An inter-rater reliability index was later calculated by dividing the number of positive observations by the total number of positive and negative observations and multiplying by 100.

Upon the fourth outpatient meeting, volunteers were again administered the MFTA in addition to the weekly breath analysis. Patients were allowed to follow the outpatient disulfiram program up to 13 weeks, during which time individual changes and dropouts were observed,
monitored, and recorded. Upon termination of the study, patients in the nontreatment group were allowed to negotiate a contract.

After 12 months, follow-up data concerning alcohol consumption and abstinence; further demographic, pretest, and posttest data were again reviewed and recorded on a summary sheet (See Appendix I). Information was obtained through examination of hospital records, phone contacts, and personal interviews of subjects and family members.

**Experimental design.** The present study employed an A x (B x S) repeated measures design with independent groups constituting the two levels of treatment (factor A) and repeated measures constituting the levels of time (factor B). Subjects were nested within treatment levels. In the first analysis, the ingestion of TETD for each subject in contract and noncontract groups was observed at the first, second, third, and fourth weeks, and averaged over all four intervals. Observations were obtained by averaging the independent recordings of two therapists. In the second analysis, pretest and posttest recordings were observed on the 14 dependent variables measured by the Mortimer-Filkins Test for Alcoholism.

In both analyses, it was hypothesized that no differences between treatment and nontreatment groups would be obtained. The statistical statement of the alternate hypothesis was $H_1: M_1 \neq M_2$. A one-way analysis of variance was employed to determine significant differences.
RESULTS

Analysis of TETD ingestion. A one-way analysis of variance was employed to determine significant changes in the rate of ingestion across the first four weeks of outpatient treatment. As all patients initiated disulfiram therapy prior to discharge weeks two, three, and four constituted time intervals during which treatment differences were observed and the analysis conducted.

A significant difference was found for contracting effects across groups ($p < .05$). Neither a main effect for weeks of ingestion, nor an interaction between contract and weeks of ingestion was observed. Results of the analysis are presented in Table 2.

The reliability measure for observing positive or negative TETD ingestion between the two recorders was 96.0 per cent. The decrease in disulfiram use across weeks is presented in Figure 2 and indicates a decline in the slope of the line for both groups. It is apparent that the change in direction is a result of the main effects of contracting.

An overall mean comparison of positive TETD ingestion (as measured by the breath analysis) was calculated into a proportion representing the entire 13-week period of outpatient treatment. The total number of positive TETD recordings were averaged and divided by the total number of positive and negative recordings and multiplied by 100. The overall averaged mean percentage of disulfiram ingestion was calculated to be 82.5 per cent ($SD = 27.0$) and 57.6 per cent ($SD = 32.6$) for contract and noncontract groups respectively, and is presented in Table 10.
Table 2

ANALYSIS OF VARIANCE FOR TETD INGESTION

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Table 3

ANALYSIS OF VARIANCE FOR FAMILY AND MARITAL PROBLEMS

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### Table 4

ANALYSIS OF VARIANCE FOR FINANCIAL DIFFICULTIES

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### Table 5

ANALYSIS OF VARIANCE FOR NERVOUSNESS, RESTLESSNESS, AND AGITATION

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**ANALYSIS OF VARIANCE FOR SLEEPING PROBLEMS**

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Table 7

**ANALYSIS OF VARIANCE FOR WORRY AND FEAR**

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ANALYSIS OF VARIANCE FOR BOREDOM

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Table 9
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Table 10
MEAN AND STANDARD DEVIATIONS FOR POSITIVE TETD RECORDINGS

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<td>Possible Weeks in Program</td>
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Mean = 8.9
SD = 3.7
Mean = 10.5
SD = 2.8
Mean = 84.6
SD = 23.8

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Mean = 5.5
SD = 1.9
Mean = 9.4
SD = 2.8
Mean = 62.1
SD = 22.8

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*Multiple readmissions are listed more than once

N = 20
Figure 2. Mean percentage of TETD ingestion as a function of time.
Figure 3. Mean number of Marital and Family Problems as a function of time.
Figure 4. Mean number of Financial Difficulties as a function of time.
Figure 5. Mean Number of Nervous, Restless, and Agitated Problems as a function of time.
Figure 6. Mean number of Sleeping Problems as a function of time.
Figure 7. Mean number of Worry and Fear Problems as a function of time.
Figure 8. Mean number of Boredom Problems as a function of time.
Figure 9. Mean number of Drinking-Related Problems as a function of time.
analysis of the means was conducted through the application of a t-test. The proportional form of the data necessitated the use of a systematic transformation (McKean, 1980). An inverse sine transformation was employed with the formula $X' = 2 \arcsin \sqrt{X}$ where $X$ is expressed as a proportion (Kirk, 1978). A significant difference was found at $t(18) = 2.30, p < .05$.

**Analysis of pretest and posttest measurement.** An analysis of variance of the 14 mental health areas yielded different main effects for time and treatment, and interactions between both factors specific to each area. The dependent variables measured were (1) marital and family problems, (2) recent stress, (3) financial difficulties, (4) abnormal problems, (5) nervousness, restlessness, and agitation, (6) sadness or depression, (7) self-denunciation, (8) general dissatisfaction, (9) sleeping problems, (10) worry and fear, (11) boredom, (12) resentment, (13) inability to cope, and (14) drinking-related problems.

Main effects due to treatment across groups were observed for abnormal problems ($p < .01$), and self-denunciation ($p < .05$). Main effects due to time were observed for marital and family problems ($p < .01$), financial difficulties ($p < .01$), abnormal problems ($p < .01$), nervousness, restlessness, and agitation ($p < .001$), sadness or depression ($p < .001$), general dissatisfaction ($p < .01$), sleeping problems ($p < .001$), worry and fear ($p < .001$), inability to cope ($p < .001$), and drinking-related problems ($p < .001$). Interactions between contract and time were observed for marital and family problems ($p < .05$), financial difficulties ($p < .05$), nervousness, restlessness, and agitation ($p < .01$), sleeping problems ($p < .01$), worry and fear ($p < .05$), boredom ($p < .05$),
and drinking-related problems ($p < .05$). Tables 3 through 9 indicate the summary results of the statistical analyses for variables in which interactions between contracting and time were observed. Figures 3 through 9 represent changes in the slope of the lines for variables in which interactions between contracting and time were observed.

In addition, a comparison of means was calculated to indicate a "dropout" index, thus comparing the overall length of TETD treatment between contract and noncontract groups. This was done by dividing the number of weeks in treatment per subject by the total number of possible weeks of disulfiram therapy and multiplying by 100. Mean percentage differences were 84.6 per cent ($SD = 23.8$) and 62.1 per cent ($SD = 22.8$) for treatment and nontreatment groups respectively, and are presented in Table 11. An inverse sine transformation was employed prior to the application of a $t$-test. A significant difference between means was found at $t(18) = 2.41$, $p < .05$.

**Follow-up observations.** A one-year follow-up was conducted through the use of interviews and verified through a review of psychological and medical records. Although a statistical analysis of the data was not performed, the results are presented in Table 12.
DISCUSSION

A statistical analysis of TETD ingestion for the initial weeks of outpatient therapy and the overall treatment period indicated that both contract and noncontract groups decreased their intake of disulfiram as a function of time; this was expected (Rosenberg, 1974). However, it was found that a significant difference between the slopes of the lines in the first four weeks was due to the effects of contracting. An additional analysis of the 13-week period indicated that significant differences between treatment and nontreatment groups were also due to contracting. Thus, it appears that the use of a behavioral contract with outpatient alcoholics had a significant effect on their daily ingestion of TETD, such that a greater compliance with a disulfiram regimen was observed.

Through a behavioral analysis, it is reasonable to assume that the semi-structured contract served to assist in the modification of contingencies previously maintaining alcoholic drinking, by occasioning and reinforcing disulfiram ingestion. With emphasis on the discriminative properties of the contract, new antecedents were presented to the subject in a daily, regular, and positively reinforcing manner. The placement of the disulfiram contract and calendar in a highly visible area served to present a consistant discriminative stimulus to the subject and occasion a self-monitoring response. In this manner, TETD was not presented as a coercive agent or "crutch" (Azrin, 1975); instead, a daily pattern (habit) was established. In addition, the contracting procedure was not punitive, in that it did not expose the patient to
a disulfiram-alcohol reaction or involve the loss of money or goods (Bigelow, et al., 1976).

Many alcoholics' first exposure to TETD is through rumor and misinformation; therefore, disulfiram therapy is often approached with great hesitation or fear (Lubetkin, et al., 1971). Allowing the subject to provide personal input and assist in the design of his outpatient treatment may occasion a feeling of control and thus have intrinsic value as a reinforcing event. Moreover, ingestion and self-monitoring (as opposed to ingesting in front of a spouse or nurse) (Bigelow, et al.), require that the patient engage in responsible behaviors directly contributing to his/her sobriety. This places the alcoholic in a situation whereby he/she has a greater probability of being reinforced by family members. It may be noted that upon entry for alcoholism treatment, most patients are in a state of social deprivation, or attempting to terminate aversive stimulation (Miller, 1976). Disulfiram-controlled sobriety allows a rearrangement of the alcoholic's social environment, in order for more reinforcing activities to compete with drinking behavior (Azrin, 1975).

An analysis of the 14 mental health areas of the MFTA revealed decreases were accounted for by time factors, contracting effects, or a combination of both. Additional analysis indicated that contracting effects contributed more to all interactions than did time.

Decreases in the self-reported mental health of the noncontract group were expected, as all patients completed a 14-day therapeutic program that emphasized abstinence. In addition, every subject signed a written consent form agreeing to abstain from drinking alcohol while
ingesting disulfiram daily. As Miller, et al. (1974) has reported, signed written agreements are likely to have influence on a subject's compliance.

It may be noted that the contracting group reported fewer problems in those areas which are traditionally accepted as indicators of alcoholism, or influence a patient's entry into an alcoholism treatment program. Thus, a reduction in marital and family problems and financial difficulties and drinking-related problems was expected. However, the significant decreases in sleeping problems and reported nervousness and restlessness were somewhat surprising, as alcohol had been overwhelmingly used as a medication for these situations. Indeed, upon becoming abstinent, many patients request some form of tranquilizer to replace the sleep-producing effects previously obtained from ethyl alcohol. Upon individual investigation, it was found that the sedative side-effects of disulfiram were uniformly described by most patients. Many subjects who had initially ingested TETD upon awakening chose to take the drug one-half to one hour prior to retiring for the evening. Thus, in addition to other measures, a lack of reported sleeping problems or agitation may well be an indirect, yet valid, indicator of disulfiram compliance.

Other self-reported decreases were observed for worry and fear. This was generally expected, as some of the items in the MFTA which indicated concern about marital/family problems and financial difficulties were closely related to indicators of worry and fear.

A rather significant lowered posttest score was also observed for boredom. This may have been a result of the subjects' change in daily routine (abusive drinking) to an engagement in alternate behaviors. The
item, "My daily life is full of things that keep me interested.", was frequently confirmed by contracting patients during posttest measurement.

Although many sources of reinforcement for alcohol abstinence were available to subjects from peers, family, and the therapeutic staff, no significant changes in self-denunciation were observed in the contracting group. This appeared to be inconsistent with similar self-reported measures on the MFTA. Nonetheless, it does conform with hypotheses supported by clinical observations and psychometric data which indicate that alcoholics underevaluate their own performance (Gross and Adler, 1970; Frederickson and Miller, 1976).

Overall, the MFTA was an adequate instrument for the measurement of alcoholic and alcohol-related behavior. Nevertheless, some mental health areas were not sensitive to change. For example, the item "Have you recently undergone a great stress (such as something concerning your health, your finances, your family, or a loved one)?", was the only indicator of recent stress. It was quite obvious that both groups responded in a like manner to this question (p=1.0). In addition, other items within a mental health category lacked sensitivity and, therefore, failed to account for possible changes. Questions of this nature included, "How many times have you and your wife/husband seriously considered divorce in the last two years?", "Were you ever arrested?", "I have lived the right kind of life.", and "Have you ever had your driver's license suspended or revoked?". It is probable that these items did not account for differences in attitudes or behavior between pretest and posttest measurement.
An analysis of the dropout index supports the hypothesis that verbal instructions and signed agreements have only limited influence on drinking behavior, when no form of reinforcement is available (Miller, et al., 1974). In the present study marital, family, and therapist's reinforcement were made contingent upon compliance. Mean differences between contract (86.4 per cent) and noncontract (62.1 per cent) groups indicated that patients were more likely to drop out of treatment if no positive consequences were attached to the operating contingencies.

It is generally accepted that the consequences of abusive drinking from family sources are of an aversive, verbal nature at best. It is, therefore, likely that the alcoholic individual is in a state of deprivation from positive marital and family interactions. Thus, it may be the case that a patient will be more receptive to primary and secondary reinforcement from family members after detoxification and the initiation of sobriety. Social praise and attention may well be a powerful reinforcer in these situations. Additional experimentation would seem prudent.

The self-monitoring of disulfiram administration was an important aspect of the contracting procedure, insofar as much emphasis was placed on responding to a variety of environmental cues. Although no specific experimental manipulation was conducted to explore the effects of this behavior, a subjective analysis was generated. Based upon weekly outpatient interviews, it appeared that self-monitoring assisted in the objectification of TETD ingestion, and enabled contracting subjects to become more cognizant of their pill-taking response. Although one patient
felt that the task was too time-consuming (and, therefore, mildly aversive), the remainder of the group offered positive feedback about the record-keeping task.

A unique and important feature of the present study was the incorporation of a physiological measure for compliance. The published reliability and validity of Kraml's reagent (Paulson, et al.) was supported by a 96-per-cent inter-rater reliability measure. Thus, the employment of a breath analysis clearly supported the credibility of the findings. In addition, the clinical utility of the reagent was evidenced by its availability, convenient storage, and low cost. Other therapeutic value was found in its ease and quickness of administration, low response cost to therapists, and non-aversive nature to patients.

The use of TETD to create an enforced state of sobriety is still questioned by individuals in the field of alcoholism treatment, despite its 32-year history as a successful antidipsotropic. Topologically, as an agent affecting the gustatory sense modality, it appears to be a most appropriate treatment. Although there appears to be little disagreement concerning its dysphoric properties--it will react with ethanol--varied opinion seems to be the result of patient noncompliance. Previous solutions have often been of a cognitive nature, and frequently patients are blamed for a lack of motivation or an inability to establish appropriate insight. In the present study, motivation was presented in the form of a contingency (contract) and, thus, a variable subject to environmental manipulation. It was felt that external control would initiate behavior change during the early stage of treatment. With the long-range goal of replacing external control with the patient's assumption of responsibility for his/her own behavior.
In conclusion, patients who negotiated a behavioral contract were more successful at self-administering disulfiram on a daily basis than patients who did not. Efficacy was determined by comparing data from a weekly breath analysis and verbal self-reports from the Mortimer-Filkins Test for Alcoholism. Greater improvement was found for contracting alcoholics in the areas of drinking, marital, nervous, and financial problems. A one-year follow-up indicated that contracting subjects reported fewer drinking related problems than noncontracting subjects.
Appendix A

Consent Form
CONSENT FORM

SECTION I

(A) I, the undersigned, do volunteer to take part in a study to evaluate different methods of taking Antabuse. I am aware that my treatment may be different from that received by other patients in the study.

(B) I understand that, although results of some of the data collected in the study may be published, nothing identifying me as a member of the study will be published. While involved in the study, I will have complete anonymity and no one besides the therapy staff will be able to identify me as a part of the study.

(C) I agree to having a member of the therapy staff contact me at home periodically to speak with either myself or a member of my family about my alcoholism/disulfiram treatment.

(D) I agree to come into the hospital when periodically arranged by a member of the therapy staff to have my breath analyzed for chemicals.

SECTION II

(A) I understand that disulfiram therapy is a means of deterring myself from drinking alcoholic beverages. I recognize the dangers that are connected with drinking alcohol in any form, whether in beverages, cough mixtures, vitamin tonics, or any other substance containing alcohol. I also realize that some medications such as paraldehyde, metronidazole, and phenytoin may cause a reaction.

(B) I understand that the reaction that occurs when a person drinks after taking disulfiram is one involving much discomfort. This includes flushing of the face, throbbing in the head, breathing difficulty, nausea, sometimes vomiting, dizziness, blurring of vision, and usually a significant fall in blood pressure. While fatalities are uncommon, death could occur in someone who drinks while taking disulfiram.

(C) For these reasons, I will notify my family that I am taking this medication and I will carry a card stating that I am on disulfiram. Any time a physician is prescribing for me I will tell him/her that I am taking disulfiram so that he/she can avoid giving me any other drug that might cause a bad reaction.

(D) I fully understand that attempting to drink small amounts of alcohol while taking disulfiram is a dangerous method of trying to control excessive drinking. Not only are there potentially dangerous physical effects, but the long-term effect may be to provoke a significant degree of emotional depression.

(E) I agree to inform Dr. I. Richard Weiss (616/383-4843), my therapist (616/383-5913) or my family doctor in advance should I wish to stop taking the medication so that this can be fully discussed and family members informed.

(F) If I take an alcoholic drink within 14 days after I stop disulfiram, I understand that I might have a reaction. Should I want to commence taking disulfiram again I have to wait until all alcohol is out of my system before doing so (usually 24 hours from the time of the last drink).

(Date) ___________________________________ (Patient)

                            (Therapist)
Appendix B

Michigan Alcoholism Screening Test
PLEASE NOTE:

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These consist of pages:

53-59.
Appendix D

Behavioral Contract
ANTABUSE CONTRACT

THIS CONTRACT STARTS ON: _____________________________
(MONTH/DAY/YEAR)

THIS CONTRACT EXPIRES ON: _____________________________
(MONTH/DAY/YEAR)

I, THE UNDERSIGNED, ACCEPT THE FACT THAT DRINKING ALCOHOL IS A MAJOR
PROBLEM IN MY LIFE. TO HELP ME QUIT, I AGREE TO TAKE ANTABUSE ACCORDING
TO THE TERMS OF THIS CONTRACT:

1. I will take my Antabuse tablet once a day by _______________
   (how)
   at _____________________________.
   (when)

2. I will use a weekly pill dispenser to help remind me to take
   my Antabuse.

3. I will use an Antabuse Calendar, which allows me and a family
   member to cross out the date each day that I take my Antabuse.

4. I will post my Antabuse Calendar in _____________________________
   on _____________________________ to remind me of my commitment.

5. I will post this Contract in _____________________________
   on _____________________________ to remind me of my commitment.

6. I will carry an Antabuse Card in my wallet next to _____________
   _____________________________, which is my most commonly used article
   of identification.

7. I will telephone my therapist weekly so that he/she can talk to me
   and a member of my family to see if I am living up to this contract.

__________________________  ____________________________
(Date)                         (Patient)

__________________________
(Therapist)

(THIS CONTRACT WILL BE REVIEWED 1 WEEK AFTER DATE OF AGREEMENT.)
Appendix E

Disulfiram Card
I am on ANTABUSE® (disulfiram) therapy. If I am disoriented, too ill to give a history, or unconscious, I may be having a serious ANTABUSE (disulfiram)-alcohol reaction. Do not administer alcohol, paraldehyde, or any mixture with an alcohol content.

TO WHOM IT MAY CONCERN:

My name is

Address

City and State Tel.

PLEASE TRY TO CONTACT

Doctor

Address

City and State Tel.

Suggested emergency measures to help counteract an ANTABUSE® (disulfiram)-alcohol reaction should include the usual supportive measures to restore blood pressure and to treat shock; inhalation of oxygen, intravenous antihistamine or intravenous ephedrine sulfate.

AYERST LABORATORIES

ISSUED JUNE 1967 50521-000-475

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Appendix F

Disulfiram Calendar
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**JUNE 1979**

CHECK OFF EACH DAY

AN AUTABISE IS TAKEN

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Appendix G

Structured Interview
STRUCTURED INTERVIEW

1. Explore present physical condition.
2. Explore family and/or marital situation.
3. Explore economic or job-related concerns.
4. Inquire about disulfiram ingestion.
5. Obtain breath analysis.
6. Inquire about contract renegotiation.
7. Summary and closure statement.

*for treatment group only
Appendix H

Test Analysis Record
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Appendix I

Summary Data Sheet
### SUMMARY DATA SHEET

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