Pharmacology Biochemistry and Behavior, Vol. 3, pp. 443–446. ANKHO International Inc., 1975. Printed in the U.S.A.

Effect of Ethanol Self-Administration on Choice Behavior: Money vs. Socializing[1]

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(Received 25 February 1974)

GRIFFITHS, R. R., G. BIGELOW AND I. LIEBSON. *Effect of ethanol self-administration on choice behavior: Money vs. socializing.* PHARMAC. BIOCHEM. BEHAV. 3(3) 443–446, 1975. – Volunteer chronic alcoholic subjects were exposed to a discrete-trial choice procedure within a residential research setting. Twelve daily trials occurred at 20 min intervals. In each trial a subject chose between 2 mutually exclusive options involving either receipt of money or the opportunity for socializing. The effect of ethanol self-administration was evaluated by requiring randomly over days that a subject consume either 8 drinks of orange juice or 8 drinks of ethanol (89.12 g ethanol total). For all 4 subjects, the mean rate of choosing socialization over money was significantly greater on sessions involving ethanol self-administration than on sessions involving orange juice self-administration.

Choice procedure Ethanol self-administration Social interactions Alcoholics

CONFUSION has existed concerning the relationship between social behavior and ethanol among alcoholics. Examination of the literature suggests that when alcoholics have been characterized as a group in comparison to nonalcoholics the relevance of social factors has been minimized – with the alcoholic often characterized as a social isolate with little motivation, capacity or ability to sustain interpersonal relationships [17, 18, 19, 24]. However, when the relevance of social factors has been examined on a within-subject basis where correlations with ethanol administration can be directly observed, social factors have shown a considerable relationship to the ethanol administration. For instance, it has been demonstrated recently that a period of contingent time-out from social interactions suppresses ethanol self-administration in alcoholics on a research ward setting [6]. Several observational reports suggest that administration of ethanol increases rates of social interactions (i.e., increases frequency, probability or duration of human verbal or nonverbal contact) in alcoholic subjects [3, 4, 13]. Utilizing a sociogram rating scale measure to evaluate the effects of relatively unrestricted ethanol self-administration, Nathan and his colleagues reported increases in socializing; however, the effect was not replicated in a second study [20]. Recently, we have reported [5] a simple quantitative demonstration of a period of ethanol self-administration resulting in a significant and reliable increase in alcoholics' rates of social interactions. In that study the percent of time engaged in social interaction was directly observed and recorded using a time-sampling procedure, while conditions of ethanol vs. no-ethanol were randomly scheduled across days.

The present study represents a systematic replication and extension of this earlier investigation of the effects of ethanol self-administration upon rate of social behavior in alcoholics. In addition and most importantly, the particular methodology employed permits the drawing of more specific inferences concerning the behavioral mechanism of the effect observed in the earlier study.

The behavioral mechanism by which ethanol increases social interactions remains unclear. One possibility is that ethanol self-administration increases the reinforcing properties of social interaction. This interpretation is compatible with basic behavioral research data which indicate that under some conditions absolute response rate measures show a positive relationship to magnitude of reinforcement [7, 14, 16, 23]. However, in reviewing a large number of studies in behavioral pharmacology, it has been noted that drug effects do not generally depend upon characteristics of the reinforcer maintaining the behavior under study [11]. Rather, it appears that the baseline rate at which the behavior occurs is a major determinant of how a drug will

[1] This research was supported by USPHS Grant No. AA-00179 to Baltimore City Hospitals. Reprints may be obtained from R. Griffiths, Department of Psychiatry, Baltimore City Hospitals, Baltimore, Maryland 21224.

affect that behavior. This formulation, which is known as the rate-dependency hypothesis, has become one of the major principles of drug-behavior interaction to be derived from basic behavioral pharmacology research. From this analysis, the increased frequency of social interactions under conditions of ethanol self-administration may represent a relatively non-specific interaction between ethanol and baseline rates of social interaction.

The current study was designed to examine the relationship between ethanol self-administration and social interactions using a methodology which minimized the influence of rate-dependent effects. Discrete-trial choice procedures are relatively free from the influence of local response rates, and permit the evaluation of the relative reinforcing properties of two options. Such procedures may involve a choice or switching response which determines the availability of two mutually exclusive options. The choice trials are presented on a fixed or predetermined schedule. Using discrete-trial choice procedures, it has been demonstrated that the percent choice of a given option shows a positive relationship to the relative magnitude of reinforcement associated with that option. This relationship has been shown with both food [21] and intravenous cocaine [10] reinforcement. In other experiments, choice procedures have been used to evaluate the relative reinforcing properties of two qualitatively different reinforcers: i.v. cocaine vs. iv. diethylpropion reinforcement [10]; electric brain stimulation vs. food reinforcement [8]; i.v. heroin vs. i.v. naloxone reinforcement [1].

In the current investigation, a discrete-trial choice methodology was utilized to assess the effect of ethanol self-administration on the relative choice between two conditions (options) involving the availability of either socializing or money.

METHOD

Subjects

Four male volunteers referred from the emergency room of Baltimore City Hospitals participated. All were chronic alcoholics 33–47 years old. All reported histories of problem drinking (10–20 years), blackouts, symptoms of physical dependence on ethanol, and repeated hospitalization for alcoholism (8–40 times). They were detoxified and their informed consent obtained prior to participation. Subjects participated in the research successively, not simultaneously. This procedure increased the independence of each subject's performance. Details of experimental procedures were described when they were implemented; however, subjects were given no instructions or explanations of what they were supposed to do, or of what outcomes might be expected. Two of the subjects (S342 and S351) were admitted to the hospital with zero blood ethanol levels (as assessed by Model 900A Breathalyzer, Stephenson Corp.) and were maintained on the research ward 4 and 7 days respectively prior to participation in the current study. The other two subjects (S304 and S328) participated in the current study after finishing other research protocols involving daily ingestion of variable amounts of ethanol (0–16 oz. 95 proof ethanol (0–178.2 g ethanol]). The experiment was conducted on an eight-bed research ward on which other alcoholic residents participated in different behavioral studies involving ethanol self-administration. There was unsystematic variation both within and between subjects with respect to the number of additional residents on the ward (2–6) and the relative degree of intoxication of the additional residents (i.e., blood ethanol levels ranged from 0 to as high as 300 mg ethanol/100 ml). A pool table, television set, cards, various games, and reading and craft materials were continuously available to subjects on the dayroom.

Procedure

Discrete-trial choice procedure. Daily four-hour experimental sessions were scheduled from 8:00 a.m. to 12:00 noon. Except for using the bathroom subjects were required to remain in the ward dayroom during the sessions. Each daily session consisted of 12 trials, occurring at 20 min intervals. In each trial, the subject chose what condition would prevail for the next 20 min period. The subject chose between 2 mutually exclusive options: (1) the subject could have a small amount of money (10–35 cents) and neither talk nor interact with anyone for 20 minutes, or (2) the subject could talk and interact with people for that 20 min period but have no money. A trial began when the ward staff asked the subject whether he wanted socializing or money. If the subject chose socializing, the staff marked the data sheet accordingly and the subject was free to talk and interact. If the subject chose money, staff would immediately credit the subjects's account with the appropriate amount of money and turn on a yellow flashing light at the nurses station. While the light was on, the following set of rules was in effect: "When the light is on, the subject is not allowed to talk or interact with other patients. A social interaction is any behavior which requires the presence of or involves another person. Therefore the subject may play pool, cards or games, but only by himself. Also during this time other patients are not allowed to talk or interact with the subject. Violation of these rules results in a $5.00 fine against the violator. Finally, staff should keep their interactions with the subject to a minimum. There may, however, be some necessary interactions such as staff dispensing a drink to the subject or the subject returning an empty glass to the staff; however, these interactions should be kept minimal and involve no talking."

The money earned during trials could be saved until the subject was discharged, or could be spent on snacks, cigarettes or sundries (i.e., aftershave lotion) which were available at various times on the ward.

When first exposed to the preference procedure, subjects were offered a choice between socializing and 10 cents money for each trial. If after several days the subject consistently chose socializing over money on greater than half the trials, the amount of money was increased by 5 or 10 cents. If the subject still chose socializing over money, the amount of money was incremented a second time. With this procedure each subject's choice baseline was individually adjusted such that the subject chose socializing on 50 percent or less of the daily trials for two or more days.

Scheduling of ethanol and orange juice availability. Subjects were instructed to consume 4 drinks during the first 2 hr of each session (8:00 a.m. – 10:00 a.m.) and an additional 4 drinks during the last 2 hr (10:00 a.m. – 12:00 noon). During a given session, the 8 drinks were either orange juice or a mixture of ethanol and orange juice. Orange juice drinks consisted of 3 oz. (90 ml) of orange juice. Ethanol drinks consisted of one ounce 95-proof ethanol (11.14 g ethanol) in 2 oz. orange juice. Individual

drinks were served upon request by the research ward staff and subjects could consume the drinks at whatever rate they chose and while participating in other ward activities. The availability of drinks was not affected by whether the subject chose socializing or money on a given trial.

During the initial period in which the choice baseline was adjusted, drinks of orange juice only were available. After the criterion choice performance had been established, the availability of ethanol drinks or orange juice drinks was randomly determined, however no more than 3 ethanol days or 3 orange juice days were permitted to occur successively. Subjects were informed immediately before the beginning of each session (8:00 a.m.) whether ethanol or orange juice drinks were available. The experiment was terminated when the minimum number of days in each condition was 10. Failure to drink the 8 drinks of ethanol or orange juice during the morning session resulted in suspension of 12 ethanol drinks normally available between 1:00 p.m. and 10:00 p.m. every day.

RESULTS

After adjustment of the choice baseline, the final amount of money available on each trial for each subject was: S342: \$0.15; S304: \$0.35; S351: \$0.15; S328: \$0.10. One subject (S328) was fined on one occasion for interacting while the yellow light was illuminated. All subjects consumed the eight ethanol drinks or orange juice drinks available during each of the daily experimental sessions. On ethanol sessions, the effective dose for each subject was: S342: 1.37 g/kg; S304: 1.14 g/kg; S351: 1.26 g/kg; S328: 0.89 g/kg. Blood ethanol levels were not assessed in these subjects, however Breathalyzer readings on 4 additional alcoholic subjects of similar body weights under identical conditions of administration indicated values ranging from 30 to 100 mg ethanol/100 ml immediately following the session (12:00 noon).

The choice procedure indicated a consistent difference between ethanol and orange juice sessions across subjects. For all 4 subjects, the average percent of choosing socialization over money was significantly greater on sessions involving ethanol self-administration than on sessions involving orange juice self-administration. (One tailed t-test, S342: $p<0.0005$; S304: $p<0.025$; S351: $p<0.025$; S328: $p<0.0005$). Figure 1 presents the daily session data and averaged data for both conditions for all 4 subjects. Inspection of the daily session data for all 4 subjects reveals a clear difference between ethanol and orange juice sessions, despite what appears to be a tendency for the choice baseline to drift over successive sessions in some subjects (S304 and S351).

Analysis of the sequential patterns of choice behavior within individual sessions revealed considerable variability. Across subjects, the probability of choosing socializing was not systematically related to the sequential position of the trials within the session. This was true of both ethanol and orange juice sessions. Furthermore, within subjects the pattern of choice behavior within ethanol sessions did not represent a systematic alteration of the pattern of choice observed on nonethanol sessions.

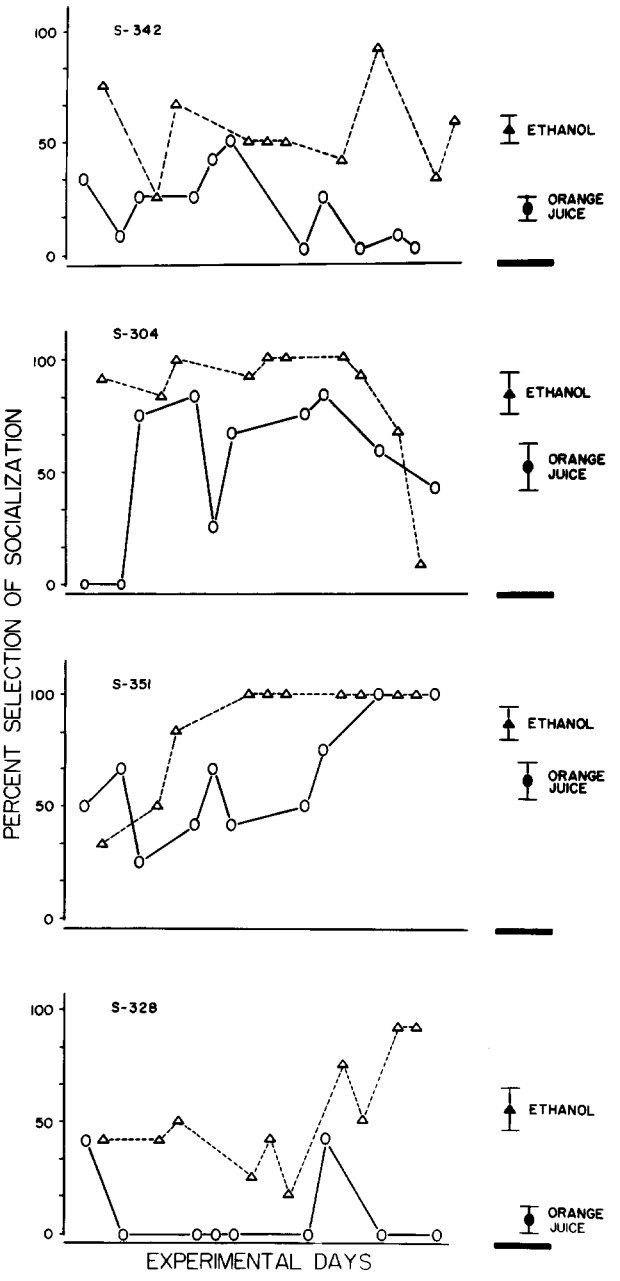

FIG. 1. Choice between socialization and money: percent selection of socialization. Data are presented for each daily session of all 4 subjects: individual ethanol sessions (unfilled triangles); individual orange juice sessions (unfilled circles). Means are shown at the far right (filled symbols), with standard error of the means indicated by brackets.

DISCUSSION

The current study has demonstrated a consistent difference between ethanol and orange juice sessions in the relative selection of two mutually exclusive options involving the availability of either money or socialization. Specifically, socialization was selected over money significantly more often on ethanol self-administration sessions than on orange juice self-administration sessions. The effect is quite powerful since it was demonstrated within and replicated across each of four subjects [22].

Since the discrete-trial choice procedure employed in the current study utilizes a low rate choice response as the primary dependent variable, it is unlikely that the results reflect a simple, non-specific, rate-dependent drug effect. A more feasible interpretation of the study is that ethanol self-administration results in a shift in the relative reinforcing properties between the option involving social interactions and the option involving money. Although it is tempting to conclude that ethanol self-administration specifically increases the reinforcing properties of social interactions, the data from the current study do not rule out several alternative behavioral mechanisms for the observed shift in choice behavior (i.e., ethanol may decrease reinforcing properties of money; ethanol may interact with the delay of reinforcement associated with social interactions and money). To the extent that this finding of a relative shift in the reinforcing potencies of money versus socializing generalizes to alcoholic drinking in natural environments, this may represent a factor involved in the etiology and progression of alcoholism.

The current study represents a novel experimental application of choice procedures. In other research, choice procedures have been used to evaluate the relative reinforcing properties of two qualitatively different reinforcers with animals [8,10] and with humans [15,19]. However in the current study, a choice procedure has been utilized as a baseline to evaluate the influence of a variable on choice performance within a constant option situation.

Finally, the current study suggests a new methodology for evaluating the effects of drugs in human subjects. Experimental clinical behavioral pharmacology typically relies for data upon the subjective ratings of observers or of drug recipients themselves [12]. Within basic research settings systematic, replicable drug effects have been demonstrated on discrete and objectively measurable molecular units of human behavior [2,9]. However, behavioral pharmacology has been slow to develop the necessary methodologies to examine objectively drug effects on more molar units of clinically meaningful human behavior. In the current study, the percent selection of an option in a discrete-trial choice procedure provided a sensitive dependent variable to assess the effect of the behavioral–pharmacological manipulation of ethanol self-administration. These results suggest that choice procedures may provide a valuable and sensitive methodology for human behavioral pharmacology research.

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