

H A R V A R D M E D I C A L S C H O O L

Department of Psychiatry

Behavior Research Laboratory, Metropolitan State Hospital, Waltham, Massachusetts

ANNUAL TECHNICAL REPORT II  
STATUS REPORT IV 100

Report for the second half of the second year on the  
Study of Psychotic Behavior

Period covered: 1 January, 1955 - 31 August, 1955

Research under Contract

with the

OFFICE OF NAVAL RESEARCH, U.S. NAVY

Contract N5-ori-07662

## INDEX

GENERAL SUMMARY	page
1.0 WORK ACCOMPLISHED	3
1.1 <u>Observations on New Patients</u>	3
1.2 <u>One-minute Variable-interval Rates of Response</u>	3
1.3 <u>Relation of Performance to Other Variables</u>	5
1.4 <u>Fixed-ratio Effects: Difference between Children and Adults</u>	5
1.5 <u>Effects of Music</u>	6
1.6 <u>Intensive Analysis of Individual Patients</u>	7
1.7 <u>Teaching Functions</u>	9
2.0 WORK IN PROGRESS	11
2.1 <u>Observations on New Patients</u>	11
2.2 <u>Quantification of "Psychotic" Properties of Records</u>	11
2.3 <u>Effect of Food Reinforcement</u>	11
2.4 <u>Effect of Chlorpromazine</u>	11
2.5 <u>Effect of Insulin Coma</u>	12
2.6 <u>Effect of Lysergic Acid on Normal Subjects</u>	12
3.0 ALTERATION OF PREVIOUS PLANS	13
3.1 <u>Analysis of Social Behavior</u>	13
3.2 <u>Development of Rate Indicator</u>	13
3.3 <u>Effects of Verbal Commands</u>	13
4.0 PLANS FOR FUTURE WORK	14
4.1 <u>Effects of Electroshock</u>	14
4.2 <u>Increase Duration of Experimental Session</u>	14
4.3 <u>Intensive Analysis of Individual Patients</u>	14
4.4 <u>Increase Motivation</u>	14

## PERSONNEL

During the period covered by this report the following personnel have been members of the laboratory staff:

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William J. Nichols, Senior Technician, Harvard Medical School, Department of Psychiatry

Mary V. Hall, Secretary, Harvard Medical School, Department of Psychiatry

The following personnel have been of assistance to the project:

Jack Ewalt, M.D., Commissioner of the Massachusetts Department of Mental Health, made available the facilities of the State Hospital system.

William F. McLaughlin, M.D., Superintendent of the Metropolitan State Hospital, provided the research space and hospital facilities.

Myer Asekoff, M.D., Director of Clinical Psychiatry at the Metropolitan State Hospital, assisted in the selection and care of the patients.

Karl Theo Dussik, M.D., Research Fellow, Boston Dispensary, and Assistant Physician at the Metropolitan State Hospital, assisted in the selection, care and medication of the insulin patients.

Larry Fane, Honors candidate in Psychology, Harvard College, conducted the investigation of the effects of music upon the patients' behavior.

Title of Project: New Techniques of Analysis of Psychotic Behavior

Previous Reports: Status Report I, 30 November, 1953  
Status Report II, 31 May, 1954  
Status Report III, 31 December, 1954

Publications:

Lindsley, O.R. & Skinner, B.F. A method for the experimental analysis of the behavior of psychotic patients. Amer. Psychologist, 1954, 9, 419-20.

Additional Support: In addition to the contract with the office of Naval Research, the laboratory was supported by research grant M-977 from the National Institute of Mental Health, of the National Institutes of Health, Public Health Service, since 1 December, 1954. Work done under the Public Health grant is not included in this report.

This report was prepared by Ogden R. Lindsley.

## GENERAL SUMMARY

Method<sup>1</sup> The purpose of this project is to investigate the behavior of chronic psychotic patients, using the methods of operant conditioning that have been proved effective in the study of the behavior of lower organisms. In brief, a volunteer patient is placed alone in a small room containing a chair and a modified vending machine. When the patient pulls the vending machine levers pieces of candy or other suitable reinforcements are delivered. The number and distribution of responses are recorded over a specified length of time. In this manner the quantity and regularity of operant or adjustive behavior<sup>2</sup> of each patient can be ascertained under controlled conditions.

The method is not limited to such simple behavior, for when the experimental conditions are varied a wide range of behavior can be objectively studied. Complex response development, discriminations, concept formation<sup>1</sup>, motivational conflict, fear, anxiety, and verbal behavior have been successfully studied with this method. With two individuals placed in "yoked" rooms many forms of elementary social behavior (for example, competition, cooperation, imitation, negativism, altruism, sadism, etc.) may be studied. The differences in the rates of such behaviors between different individuals (psychotic or non-psychotic) as well as the effects of different agents (environmental, pharmacological, neurological) upon these rates can readily be studied.

Previous Results<sup>3</sup> Suitable apparatuses and procedures for the study of the operant behavior of chronic psychotic patients have been developed and standardized. Since the apparatuses are similar to those currently used with lower organisms by many experimental and physiological psychologists, our results can be directly compared with theirs. This brings theoretical and experimental continuity to the fields of clinical, physiological and experimental psychology.

Approximately 50% of the adult patients responded at significantly lower and more erratic rates than unhospitalized adults, psychotic children, or lower organisms. When the adult patients were not responding they engaged in their particular psychotic behavior (pacing, sitting "depressed," gesticulating, talking violently, etc., depending upon their symptoms). This psychotic behavior interferes with and displaces the operant behavior. The topography of the psychotic behavior correlates with the psychiatric diagnosis.

The psychiatric diagnoses correlate with the psychotic behavior of each patient, but they do not correlate with the quantity or distribution of operant behavior. Other available clinical measures (I.Q., total years of hospitalization, amount, quality or "meaning" of verbal behavior) do not correlate with the

1. The method is described in detail in Status Report II.
2. An operant response is a segment of behavior that manipulates a part of the environment. If it is followed by a reinforcement its rate increases. The clinical term "adjustive behavior" is often used to describe reinforced operant behavior. Many patients were hospitalized because they did not have enough adjustive behavior to function in society.
3. These results are described in detail in Status Reports I, II, and III.

quantity or distribution of operant behavior.

We have so far used assorted candies, cigarettes, projected pictures ranging from religious to pin-up themes, and passages of music as reinforcing stimuli in attempts to increase the rates of response of the non-adjustive (low operant level) patients. Some patients will respond at high rates for all these stimuli, others will respond at high rates for some of the stimuli, and others have not responded at a high rate for any reinforcing stimulus we have yet presented. One of our goals is to develop some suitable reinforcement for these extremely resistant patients.

1.0 WORK ACCOMPLISHED SINCE 1 JANUARY, 1955

1.1 Observations on New Patients

We have studied the behavior of 14 new patients since our last report. This increases our total sample to 36 adult psychotic patients (2 of these female) and 35 child psychotic patients (2 of these were female). The distribution of staff diagnoses for the adult patients we have studied to date follows:

Psychoneurotic .....	1
Psychotic .....	1
Dementia Praecox, Undifferentiated type .....	4
"    "    Other types .....	4
"    "    Paranoid type .....	10
"    "    Catatonic type .....	9
"    "    Hebephrenic type .....	3
Mentally Defective with Psychosis .....	2
Manic-Depressive .....	1
Alcoholic Psychosis .....	1
 Total .....	 36

The patients' ages ranged from 18 to 63 years, with a median age of 40 years. Total hospitalization for mental illness ranged from 1 to 47 years, with a median of 12 years. Only 15 of the adult patients had been given intelligence tests; the I.Q.'s for these patients ranged from 40 to 142, with a median of 89.

We selected patients who were not on parole, not working in hospital industries, not receiving active therapy, not receiving visitors, and not going on home visits - in order to minimize such variables. However, 2 of our initial 15 patients have been paroled and are now working in the hospital. The possibility that this recovery was due to our treatment must be viewed with extreme caution since (1) during the last year the hospital has become more lenient concerning parole and (2) such "spontaneous" partial recoveries are not uncommon in the course of some disorders.

The doubling of our sample of patients has not changed the nature of the conclusions presented in Status Report II (May, 1954), but it has, of course, increased the probability that our findings apply to the total hospital population.

1.2 One-minute Variable-interval Rates of Response

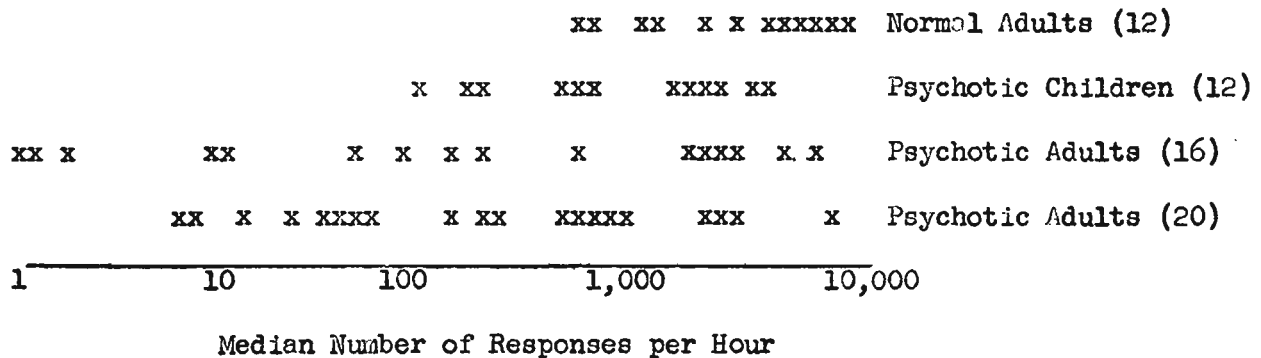
Although we have used other schedules of reinforcement, we arbitrarily selected the variable-interval schedule for the initial screening of patients. An electrical circuit must be "primed" before a reinforcement can be delivered. When the circuit is primed the next response delivers the reinforcement. On the one-minute variable-interval schedule the circuit is primed on the average of every 60 seconds, with a range from 30 to 90 seconds. If a patient does not make a response for a few minutes, this schedule will prime the circuit so that the first response after a long pause will be reinforced. Presumably this will reinforce the patient for coming back to the apparatus.

The experimental rooms, apparatus, manipulanda, and recorders are described in Status Report II.

We have used this schedule for ten consecutive experimental sessions of one hour each with the following subjects:

- 12 undiagnosed normal adults, using nickels as the reinforcing stimuli.
- 12 psychotic children, using mixed candy as the reinforcing stimuli.
- 16 psychotic adults, using pictures as the reinforcing stimuli.
- 20 psychotic adults, using candy and cigarettes as the reinforcing stimuli.

The medians of the number of responses per hour for the first ten hours on the variable-interval schedule for the different subjects are distributed below:



By doubling the number of adults in our sample of patients screened with the one-minute variable-interval schedule we have not changed the character of the distributions. The picture-reinforced rates are not much different than the rates of response for candy reinforcement with the psychotic adults. Sixty-four per cent of the patients worked at higher rates for the pictures than for the candy (an insignificant difference). Approximately 50% of the psychotic adults respond at rates below the range of the rates of normal adults, psychotic children, and lower organisms (see Status Report II) on the one-minute variable-interval schedule.

There was no correlation\* between the magnitude and direction of the difference between the rates of response for candy and picture reinforcement and 1) psychiatric diagnosis at admission, 2) intelligence quotient, 3) age, 4) total years of hospitalization, 5) the priority of the session when both sessions were conducted on the same day, and 6) the priority of the series when the 10 daily sessions were conducted at least 10 days apart.

\*The correlations were made using the corner test of association described by Olmstead and Tukey. Olmstead, P.S. & Tukey, J.W., A Corner Test for Association, Ann. Math. Statistics, 1947, 18, 495-513



### 1.3 Relation of Performance to Other Variables

Attempts were made to correlate\* the median rate of response for the first 10 hours on the one-minute variable-interval schedule (both candy and picture reinforcement) with the following variables: psychiatric diagnosis at the time of admission, degree of verbal contact, intelligence quotient, age, and total years hospitalization.

**Psychiatric diagnosis:** The rate of response for candy or picture reinforcement did not correlate with psychiatric diagnosis, except that one patient diagnosed manic responded at a higher rate than the other patients. However, this relationship might not hold if we studied more manic patients.

**Intelligence quotient:** Stanford-Binet or Wechsler-Bellevue I.Q.'s were available for only 12 of the 20 patients studied on the one-minute variable-interval schedule. Four of these test scores were considered unreliable by the psychologist who conducted the tests. There was no relationship between the existing scores and the median response rates for either candy or picture reinforcement.

**Age:** No significant correlation was found between age at first day of experimentation and the median response rates for candy and picture reinforcement.

**Total years hospitalization:** There was no significant correlation between the total number of years of hospitalization and the median response rates for candy and picture reinforcement.

In general we continue to find that the response rates correspond most closely to something like "depth of psychosis" or "severity of illness" rather than any specific individual variable. The catatonic who wiggles and the hebephrenic who giggles instead of responding might both respond at the same rate of response on the same schedule for the same type of reinforcement. We seem to be measuring the degree that the illness interferes with the "normal," adjustive behavior and not the specific characteristic of the disease at this time.

### 1.4 Fixed-Ratio Effects: Difference between Children and Adults

On a fixed-ratio schedule the patient is reinforced every time a fixed number of responses has been emitted. Two effects of fixed-ratio schedules upon the rate of a given response of lower organisms have been observed: 1) The rate is increased over the low, steady rate produced by variable-interval schedules, and 2) characteristic pauses in responding occur immediately after many of the reinforcements. This experiment was undertaken to determine whether both these effects are present in the behavior of psychotic patients.

Eight psychotic children and 8 psychotic adults were first studied for over ten hours, each one hour per day, on a one-minute variable-interval schedule of reinforcement in order to establish a variable-interval rate of response for each patient. They were then placed on a fixed-ratio 40 schedule (every 40th response

\*The correlations were made using the corner test for association described by Olmstead and Tukey.

was reinforced) for over twenty hours each. On the fixed-ratio schedule the rate of response of all 8 children was increased above their variable-interval rate, and all showed pauses immediately following most reinforcements. Only 3 of the adults showed both an increased rate and pauses after reinforcement on the fixed-ratio schedule. Three adults showed pauses after reinforcement but no increase in rate, and 2 adults showed neither a rate increase nor pauses after reinforcement.

These results show that the increased rate and the pauses after reinforcement that have occurred together in lower organisms on fixed-ratio schedules of reinforcement do not necessarily occur together under all conditions. The two fixed-ratio effects do not always occur together in the behavior of psychotic patients. The results suggest that the adults do not respond to fixed-ratio schedules as completely as do psychotic children and lower organisms. Whether this difference in the behavior of psychotic adults and psychotic children is related to their differences in chronological age, candy motivation, total years of hospitalization or severity of psychosis remains to be determined by further experimentation.

### 1.5 Effects of Music

In an attempt to develop a new reinforcing stimulus and also to determine the effect of music as an adjunct to other kinds of reinforcement, we have played music (Sousa marches and Gaité Parisienne) to 4 adult, male patients responding for candy reinforcement. Three experimental situations were studied:

1) Playing music during ten- and fifteen-minute periods while the patients responded, to note any facilitative or suppressive effects of music on a specific response. The rates of responding of all four patients were slightly suppressed, though not greatly enough to be statistically significant at the 5% level.

2) Playing ten-second intervals of music, accompanying the receipt of each candy reinforcement, to determine whether candy plus music was a stronger or weaker reinforcing agent than candy alone. The trend in 3 out of 4 patients was toward an increase in the rate of responding. The increase for only 1 of these patients was significant at the 2% level.

3) Interrupting the music every ten seconds with twenty seconds of silence to study the effects of frequently interrupted music on knob pulling. We thought that these interruptions might disrupt the patients' psychotic behavior and consequently increase his rate of response. No effect of the interrupted music was observed.

The patient whose rate was significantly increased in Situation 2 was the patient whose rate was decreased the most in Situation 1, and also the patient with the highest overall rate of responding. We are planning to study the effects of music on the behavior of more patients who are responding at high rates.

There was no consistent difference in the force of responses emitted during music and without music. Although subtle effects of music might be found in isolated cases, our results failed to substantiate the notion that lively music increases the activity level or "adjustment" of most psychotic patients. The two

patients described by Edward Podolsky in his introductory article in Music Therapy\* to suggest the powerful therapeutic effects of music were accomplished musicians with extensive musical training. Such cases are analogous to those of typists being given typing therapy or of barbers being helped by hair-cutting therapy. It is standard practice in many hospitals to give patients therapy relating to their former occupation or strongest interest. The effectiveness of any given type of music as a general therapeutic agent is open to question.

### 1.6 Intensive Analysis of Individual Patients

One important phase of our research is the discovery of behavior deficits in the psychotic patient and the attempt to overcome these deficits with intensive training. We have been partially successful in overcoming such deficits in 2 of the 3 patients with whom we have worked intensively. We have done little of this work to date since it consumes so much experimental time. It was done to demonstrate that such changes are possible even in the most refractory patients, even though such methods may not be economically feasible with hospital populations at this time. However, since our methods are automatic and do not demand highly skilled operators, such training could be done on a large scale if adequate information and funds were available. A description of the behavior deficits discovered and overcome in two patients follows.

Patient 1. Deficit: Extremely low, erratic rate of response with long periods of catatonic behavior, separated by bursts of responses. Patient was untidy, wrapped cloth around wrists and neck, had many religious hallucinations and catatonic behavior, masturbated often, and carried on long verbal monologues.

Training: Reinforcement with candy, cigarettes and pin-up pictures presented on a one-minute variable-interval schedule (600 hours duration).

Result: Rate of response increased steadily from 30 responses per hour to over 8,000 responses per hour. Patient placed on parole, for first time in 19 years of hospitalization, when rate had reached 2,000 responses per hour. Catatonic and hallucinatory behavior subsided, only to return when rate dropped to 300 responses per hour after 70 hours of extinction (no reinforcement).

Patient 11. Deficit 1: Patient stopped responding whenever a cigarette was delivered as a reinforcement part way through the experimental session. The other reinforcing stimuli were pieces of candy. Patient also stopped responding part way through the session when a cigarette was given with candy, when 1/2 to 1/16 of a cigarette was given, and when a cigar was given as reinforcement. Patient also stopped responding part way through the experiment when a cigarette was given independently of the responses. Patient responded throughout the hour-long session if a cigarette was given before the experimental session, during the first 5 minutes of a session, when a box of tobacco or package of

\*Podolsky, Edward. Music Therapy, New York, Philosophical Library, 1954.

cigarette papers were presented at any time. Verbal directions did not alter this unusual cessation of responding.

Training: We started by giving a cigarette as each reinforcing stimulus throughout the hour. The next hour every other reinforcement was a cigarette and the rest were pieces of candy. The next hour every third reinforcement was a cigarette, etc. until only one cigarette was given half way through the session (100 hours duration).

Result: The patient did not stop responding when a cigarette was presented half way through the session.

Deficit 2: Rate of response very low and regular. Patient pulled the 5 levers in the order 1-2-3-4-5, waited  $1\frac{1}{2}$  minutes, 1-2-3-4-5, waited  $1\frac{1}{2}$  minutes, etc. This stereotyped pattern of responding had begun during the first experimental session and had not altered for the 100 hours of previous experimentation.

Training (a): We changed the schedule of reinforcement from the one-minute variable-interval to a fixed-ratio of 20 schedule (30 hours duration).

Result: For the first 2 or 3 hours the rate of response was increased from 200 to 300 responses per hour, but it soon dropped to the original rate of 200 responses per hour. The pauses after the reinforced burst were often longer than those after the other bursts, but the rate per hour was not noticeably increased.

Training (b): Levers 2 through 5 were made immobile in order to force responding on lever 1 and break up the stereotyped pattern of responding. The one-minute variable-interval schedule of reinforcement was used (10 hours duration).

Result: Patient stopped responding completely when he was forced to respond on lever 1 alone.

Training (c): We locked lever 5 for 10 hours, levers 4 and 5 for 10 hours, levers 3, 4 and 5 for 10 hours, and finally levers 2, 3, 4 and 5 for 10 hours (40 hours total duration).

Result: After this successive approximation training the patient responded on lever 1 alone, which he had not done before.

Training (d): We changed the schedule of reinforcement from one-minute variable-interval to a fixed ratio of 1. Every response was reinforced in an attempt to increase the rate of responding (50 hours duration).

Result: No noticeable increase in rate of response.

Training (e): We attempted to increase the rate of response for candy reinforcement by adding concurrent escape behavior to the experimental situation. The patient was given a button to push which would turn off

a 120 cycle tone for 15 seconds. If the patient did not push the button the tone continuously sounded (30 hours duration).

Result: The patient responded to turn the tone off, and the rate of lever pulling for candy increased from 40 to 120 responses per hour. The tone more or less "blasted" the patient out of his regular  $1\frac{1}{2}$  minute pauses. He also pulled the candy lever many of the times when he leaned forward to push the tone-escape button, which broke up his pattern of waiting  $1\frac{1}{2}$  minutes between candy-reinforced bursts.

In general we can say that with every type of behavior we have studied in our patients, even though our sample is small, every possible deficit has been observed in at least one patient. For example, we have patients who do not acquire behavior, patients who acquire it but do not lose it in extinction, and patients who both acquire and lose behavior in a somewhat "normal" fashion. With respect to candy and pictures as reinforcing stimuli, we have patients who respond for both, patients who respond for candy but not pictures, patients who respond for pictures but not candy, and patients who will respond for neither. Again, all possibilities are fulfilled, and such has been the case with each type of behavior we have studied to date.

### 1.7 Teaching Functions

The laboratory staff believes that the training of new personnel and the communication of basic research methods to interested workers in allied fields are among the functions of Government-sponsored research. With this aim the following teaching functions have been performed during the period covered by this report:

#### 1. Supervision of student research:

Larry Fane, an honors candidate in experimental psychology at Harvard College, used the laboratory facilities to investigate the effects of music on the rate of response of 4 patients. This research was the subject of his honors thesis, submitted in April, 1955.

#### 2. University field trips:

Invitations to visit the hospital and laboratory have been extended to the psychology and sociology departments of neighboring colleges and universities. The following groups have visited the laboratory:

Brown University survey course in psychology - 140 students.  
Harvard University natural science course - 70 students.  
Emerson College clinical psychology course - 20 students.

#### 3. Lectures:

Descriptions of the method and results of our research have been presented to the following groups (chronological order):

Graduate nurses, Metropolitan State Hospital  
Staff, Boston State Hospital  
Meeting, Mass. Association for Research in Psychiatry  
Staff, Metropolitan State Hospital  
Meeting, American Psychological Association  
Staff, Boston Psychopathic Hospital  
Student Nurses, Metropolitan State Hospital  
Colloquium, Brandeis University  
Colloquium, Simmons College  
Colloquium, Emerson College  
Psychology Conference, Mount Holyoke College  
Meeting, Eastern Psychological Association

4. Professional visitors:

Twenty-seven interested scientific workers have visited our laboratory since 1 January, 1955. They were conducted through the hospital, were shown our apparatus and equipment, and were shown the data and results in which they were most interested.

## 2.0 WORK IN PROGRESS

### 2.1 Observations on New Patients

We are currently increasing our sample of patients to include more female patients and more acute patients. We also wish to start more patients on fixed-ratio schedules of reinforcement instead of the variable-interval schedules that we have used most frequently in the past. It is possible that the variable-interval schedule might produce some irreversible tendency toward a low rate of response. If patients who start responding upon fixed-ratio schedules show the same characteristics as those who have started on the variable-interval schedule, this criticism of our procedure to date will not be justified.

### 2.2 Quantification of "Psychotic" Properties of Records

We still strongly suspect that the many breaks and pauses that occur in the rate of response of psychotic patients on a variable-interval schedule are not present in the behavior of unhospitalized individuals. We are slowly obtaining evidence that these breaks or pauses during which the psychotic displays his personal symptoms are not due to the schedule or the nature of the reinforcement that we have used. If these pauses prove to be a characteristic of disturbed behavior we should soon develop a method of quantifying these properties of the behavior. Distributions of inter-response times have been used for such purposes by animal experimenters and seem to be of value for our purposes. We have collected inter-response time distributions over fairly long periods of time from 6 of our patients which differ greatly from the distributions of unhospitalized individuals. There are also very regular differences among the inter-response time distributions of the different patients. We are continuing this analysis of inter-response times.

### 2.3 Effect of Food Reinforcement

Although our food magazine was not yet constructed we wrapped small bits of cold food (vienna sausage, etc.) in tinfoil and delivered them as reinforcing stimuli through our candy magazine to a few patients. These patients who had previously responded at very low rates for candy, cigarettes, pennies, and colored pictures as reinforcing stimuli showed no increase in rate for the food reinforcement. We think that some patients are so sick that even with deprivation they cannot be motivated to respond. However, our food magazine will deliver warm, palatable food bits to the patients, and these might prove to have reinforcing properties for some patients whom we have so far been unable to approach experimentally.

### 2.4 Effect of Chlorpromazine

We are still investigating the effect of Chlorpromazine (Thorazine) administration upon the rate of response on one-minute variable-interval schedules of reinforcement with a few patients. To date we know that responding reinforced by candy or pictures may be practically eliminated in some patients by 400 mg./day dosages. However, other patients respond at rates of over 4,000 responses per hour on 400 mg./day dosages. Still other patients show a gradual rate increase from 10 to 1,000 responses per hour under 150 mg./day dosages. At present we are

endeavoring to obtain a few dosage-response curves to see whether these differential effects are due to different dosages or to individual differences in response to the drug.

### 2.5 Effect of Insulin Coma

We have investigated the effect of gradually increasing daily subcutaneous injections of crystalline insulin. (20 to a maximum of 350 Units) on the behavior of patients. The insulin did not significantly alter the rate of response for male pin-up pictures delivered on a one-minute variable-interval schedule. There also were no significant effects upon responses which terminated a 120-cycle tone (escape behavior). However, the rates of response for candy reinforcement on a fixed-ratio schedule were significantly reduced by the insulin in direct relation to the insulin dosage.

We are currently following this lead with two more patients to see whether the insulin depresses all reinforced behavior, candy reinforced behavior alone, or all fixed-ratio reinforced behavior. It is interesting that the rate of the candy-reinforced responses was reduced by the insulin, since it seems plausible that the insulin-produced hypoglycemia should produce an increase in the rate of responding reinforced by sugar-bearing substances. The rate reduction might be due to "over-compensation" by the patient drinking too much glucose, which would produce a reduction in sugar motivation, or to a general depressive effect of the insulin which overrides any slight rate-increasing tendencies produced by the hypoglycemia. Only further experimentation can tell us more about the nature of this insulin-produced rate-reduction.

### 2.6 Effect of Lysergic Acid on Normal Subjects

In collaboration with Drs. Robert W. Hyde and Richard H. York of the Boston Psychopathic Hospital we administered 60 gamma of lysergic acid (LSD) p.o. to 2 unhospitalized individuals, 1 female, and studied their operant behavior for three periods (1 hour before administration, 3 hours after administration, and 5 hours after administration). Both subjects responded 30 minutes for dimes and 30 minutes for pin-up pictures on a one-minute variable-interval schedule in each period.

The LSD produced a psychosis-like inability to respond for dimes with 1 subject. The female was more able to stay in the room where male pin-up pictures were used as reinforcing stimuli and the male responded at a more regular rate for female pin-up pictures during the maximal effect of the LSD. These effects were noticeable as long as 6 hours after administration.

These exploratory results show that 60 gamma of LSD produced effects upon the operant behavior of non-psychotic subjects which lasted longer than five hours after administration. We plan to continue this investigation with Dr. Hyde's group.



### 3.0 ALTERATION OF PREVIOUS PLANS

#### 3.1 Analysis of Social Behavior

Our plans to study the elementary social behavior of psychotic patients required the construction of additional experimental rooms that would permit visual and auditory communication between two patients. Such "yoked" rooms have been constructed with funds made available by Grant M-977 from the National Institute of Mental Health of the National Institutes of Health, Public Health Service. The results of the study of social behavior will be reported in the progress reports of that grant.

#### 3.2 Development of Rate Indicator

Our plans to develop an apparatus for indicating the rate of response upon some segment of a 360° circle for the manipulation of stimuli as a direct function of rate of response also are being carried out under the Public Health Service grant, since the apparatus has proven to be more costly than our ONR funds would permit.

#### 3.3 Effect of Verbal Commands

Since the study of the effect of verbal stimuli upon the behavior of patients requires additional sound-treated rooms, this phase of our research also has been transferred to the Public Health grant.

#### 4.0 PLANS FOR FUTURE WORK

##### 4.1 Effects of Electroshock

We plan to study the behavior of acute patients on different schedules and kinds of reinforcement while they are undergoing courses of electroshock therapy administered by a member of the hospital staff (Dr. Karl Dussik).

##### 4.2 Increased Duration of Experimental Session

We still plan a systematic investigation of the optimal length of an experimental session. With patients this occasions difficulties involved with toilet visits, and so forth. We have found that 3 or 4 hours per day of responding at rates of around 5,000 responses per hour do not produce noticeable reductions in the rate (satiation or fatigue effects). We are also less concerned about using sessions of only 1 hour's duration for most sampling purposes, since many patients respond in the same general fashion regardless of the duration of the session. However, sessions of 2 or 3 hours duration might be more efficient than 2 or 3 one-hour sessions for behavior modification (training) purposes. Longer sessions also would have the advantage of presenting a longer time-sample for the study of the effects of drugs and other therapeutic agents.

##### 4.3 Intensive Analysis of Individual Patients

We plan to continue our analysis of the behavior deficits characteristic of each patient. Such a cataloguing and sampling process is both time-consuming and laborious, but we feel that at least a limited number of patients should be studied in this fashion.

##### 4.4 Increased Motivation

Our food-delivery magazine has been constructed and is now being put in operation. It is hoped that we may be permitted to use slight food deprivation (missing breakfast) in an attempt to increase the motivation of the more refractory patients who have not responded for the reinforcing stimuli we have used to date. Such deprivation is routinely used in preparation for many clinical examinations.