

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

Department of Psychiatry

Studies in Behavior Therapy, Metropolitan State Hospital, Waltham, Massachusetts

STATUS REPORT . III

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Study of Psychotic Behavior

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PERSONNEL

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

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The following personnel have been of assistance to the project:

Jack Ewalt, M.D., Commissioner of the Massachusetts Department of Mental Health, was of assistance in making the facilities of the State Hospital system available to this research project.

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 adult patients.

Thaddeus Krush, M.D., Director of Clinical Psychiatry, Children's Unit of the Metropolitan State Hospital, assisted in the selection and care of the child patients.

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GENERAL SUMMARY

Since the last status report we have studied the behavior of psychotic children. The children behaved similarly to the adult psychotics except that several "autistic" children had to be especially conditioned to stay in the rooms alone. The children were more destructive than the adults. Their non-adaptive, ritualistic behavior was not as stereotyped as that of the adults but tended to develop in the experimental situation, i.e. stereotyped fiddling with the machine or yelling for candy as contrasted to catatonic hand movements and paranoid talking. We investigated the effects of 0.5mg/kg. daily dosages of Dexedrine as compared with placebo controls and found that two out of seven children responded at higher rates under Dexedrine and one at a lower rate.

We obtained characteristic extinction curves after one-minute variable-interval and fixed-ratio schedules of reinforcement. Some patients became very disturbed during extinction but calmed down immediately after their behavior was again reinforced. Twenty-hour food deprivation of two children did not noticeably change their rate of response for candy reinforcement.

When seven of the adults we studied last year were reinvestigated this fall, the three to five months of experimental interruption had produced changes in the rates of response of four of them.

We are currently investigating the effects of one-minute variable-interval, fixed-ratio 20, fixed-ratio 40, fixed-ratio 40 + 80, fixed-ratio 20 + 80, and two-minute fixed-interval schedules of reinforcement.

We are increasing our sample of patients and extending the analysis of the behavior of some of the patients we studied last year. We are investigating the effects of Thorazine on the rate of response of two patients.

We have occupied an office and record room and are building new equipment to investigate the effects of increased motivation (food), music therapy and social facilitation (verbal commands). We are constructing a new apparatus for use in diagnosis and the selective reinforcement of high or low rates of response.

1.0 WORK ACCOMPLISHED WITH CHILDREN SINCE JUNE 1, 1954

1.1 Child Patients Studied

In cooperation with Dr. Krush and Mr. Azrin we screened 35 child psychotic patients to determine whether they would respond for at least one hour in a room alone for candy or picture reinforcement. The patients were not selected with respect to psychiatric diagnosis. 550 experimental hours of child behavior were recorded. The staff diagnoses of the children screened were as follows:

		Also "Autistic"
Undiagnosed psychosis	1	
Psychoneurotic disorder, dyssocial and psychotic reaction ..	1	
Psychoneurotic disorder, conversion reaction	1	
Adjustment reaction of childhood, conduct disturbance	1	
Schizophrenic reaction, acute, undifferentiated state	2	
Schizophrenic reaction, chronic, undifferentiated type	1	
Schizophrenic reaction, childhood type	4	4
CBS (chronic brain syndrome), unknown cause, behavioral reaction	10	
CBS, unknown cause, psychotic reaction	2	
CBS, unknown cause, psychotic reaction, mental retardation .	5	3
CBS, known organic involvement	3	
CBS, known organic involvement, mental retardation	4	2
Total	35	9

Their ages ranged from seven to fourteen years with a mean of eleven years. Total hospitalization ranged from one month to 7 1/2 years with a mean of 2 1/2 years. Two of the children were girls. This was a fairly representative sample of the population of the Children's Unit at the Metropolitan State Hospital.

1.2 Special Problems Met with Children

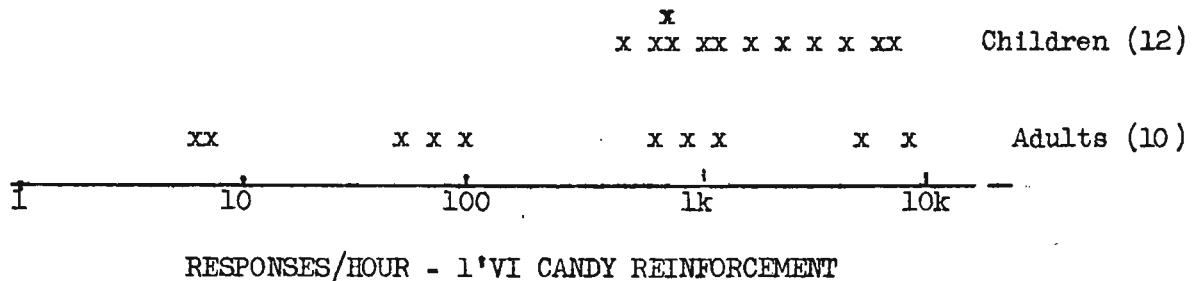
Withdrawal from experiment during first hour. Six children would not stay in the experimental room alone during the first hour of experimentation. All six of these children had been diagnosed "autistic". Three other children diagnosed autistic did not withdraw from the rooms. This might indicate that the children diagnosed autistic are more dependent upon adults and/or more unable to be alone in a room. The 20% withdrawals obtained with the 35 psychotic children compared favorably with the two out of thirteen (15%) "normal" attendants who refused to enter the experimental rooms, and the five out of twenty (25%) psychotic adults who would not come to the experimental rooms. The attendants who refused to be experimented upon were called "suspicious" by their friends. The psychotic adults were diagnosed paranoid and the children were all diagnosed "autistic".

The six children who withdrew from the rooms during the first hour were trained to stay in the room alone by the gradual withdrawal of the experimenter. After the child had received a few reinforcements, the experimenter withdrew from the room gradually and the child continued responding without further withdrawal. Using this method of successive approximation we were able to avoid rejecting any children and to obtain full experimental hours on all patients studied.

Destruction of Apparatus. The children were much more destructive in the experimental rooms than the chronic psychotic adults. Some of the children intermittently banged the vending machine and often broke parts of it. They broke one chair and cracked a plywood door. In general we can say that rooms and apparatus for experimentation with children must be able to withstand much more destructive behavior than similar apparatus for use with non-violent adults. This difference is probably related to the heightened activity level of the child rather than to any basic difference in psychotic symptoms.

1.3 Comparison of the Behavior of Child and Adult Patients

Twelve children were studied one hour a day for ten days on one-minute variable-interval candy reinforcement. Their rates of response were compared with those of ten adults previously studied under the same experimental conditions. The mean rates of response per hour of the children ranged from 426 to 2,950 as compared with a range of 5 to 8,770 for the adults. The distribution of rates of response for the twelve children and the ten adults follows:



In general the children's rate of response on a variable-interval schedule was similar to the rates of the upper 50% of the adult patients. This suggests that the children are either less institutionalized, less disturbed or more strongly motivated for candy reinforcement than many of the adults.

The coefficients of variation (standard deviation in percent of mean) for the children ranged from .24 to .98, as compared with a range of .13 to 1.17 for the adults. This suggests that the day to day variability for the children was approximately the same as that previously observed for the

adults. The coefficients of variation for the adults were negatively correlated with their rates of response (significant beyond the one percent level by Olmstead and Tukey's corner test), but there was no such correlation observed with the children.

As was previously found with the adults, the childrens' rate of response for one-minute variable-interval candy reinforcement did not significantly correlate with I.Q., years of hospitalization, age or first staff diagnosis.

1.4 Effect of 0.5 mg/kg/day Dexedrine on Rate of Response

Seven children were studied on one-minute variable-interval reinforcement for an hour a day to determine the effect of Dexedrine administration on rate of response. Three of the children responded for picture reinforcement (travel slides projected on a screen for five seconds) and four children responded for candy reinforcement. For five days Dexedrine was given orally at 7 AM (two to seven hours before experimentation). Then followed five days during which a placebo elixir was administered. On the last five days 5 mg/kg. of Dexedrine was again orally administered at 7 AM.

Three children showed significant changes in their number of responses per hour as a result of the Dexedrine administration (beyond the five percent level of confidence by Wilcoxon's T for unpaired replicates). One patients rate was significantly lowered. Two patients rates were significantly raised, and four patients showed no change in rate as a result of the Dexedrine administration. This highly individual effect of the Dexedrine is supported by results with Benzedrine (Amphetamine Sulfate) previously reported by Bradley¹ on the activity level of children, and Lindsley² on the bar-pressing responses of dogs.

1.5 Effects of Experimental Extinction

The characteristically smooth, exponentially declining extinction curves were obtained after one-minute variable-interval candy reinforcement with four children and after one-minute variable-interval picture reinforcement with two children. The more sharp, bi-valued rates of response during extinction following fixed-ratio reinforcement were observed with two children who had been reinforced with candy.

1. Bradley, C. Benzedrine and Dexedrine in the Treatment of Children's Behavior Disorders. *Pediatrics*, 1950, 5, 24-37.
2. Lindsley, Ogden R. The Effect of Amphetamine Sulfate on the Operant Behavior of the Dog. in Final Project Report, AEC Contract AT(30-1) 1201, 1953, 185-198.

Two children showed severe behavioral disturbances the first time they were subjected to experimental extinction. This extremely psychotic behavior (banging head on wall, breaking up chair, breaking down door, shrieking, crying and so forth) was immediately terminated when the patients' experimental behavior was again reinforced.

1.6 Effect of Food Deprivation on Candy-Reinforced Behavior

In our usual experimental procedure the patients come to the experimental rooms an average of two hours after they have eaten. In order to obtain an exploratory determination of the effects of food deprivation on candy-reinforced behavior, three patients missed breakfast before the experimental session. These children showed no significant changes in the number of responses per hour as a result of this twenty-hour food deprivation. These preliminary results suggest that short periods of food deprivation will not significantly increase the rate of responding for candy reinforcement. Of course, an increase in rate might have been observed with more substantial food reinforcement.

1.7 Fixed-Ratio 20 versus Fixed-Ratio 40 Schedules of Reinforcement

Four children were given ten hours of one-minute variable-interval reinforcement, ten hours of fixed-ratio 20, followed by ten hours of fixed-ratio 40 reinforcement. Four other children were given ten hours one-minute variable-interval, ten hours fixed-ratio 40, followed by ten hours fixed-ratio 20 reinforcement. All the children developed pauses in responding following reinforcement and responded at higher rates on the two ratio schedules than on the variable-interval schedule. The effects of the schedules in increasing rate of response were in the following increasing order:

1. One-Minute Variable-Interval
2. Fixed-Ratio 20 after Fixed-Ratio 40
3. Fixed-Ratio 40 after One-Minute Variable-Interval
4. Fixed-Ratio 20 after One-Minute Variable-Interval
5. Fixed-Ratio 40 after Fixed-Ratio 20.

The fixed-ratio 40 schedule produced more refusals to enter and withdrawals from the experimental room than the fixed-ratio 20 and the one-minute variable-interval schedules. This suggests that the fixed-ratio 40 schedule has more aversive properties than the fixed-ratio 20 or the variable-interval schedule.

Only two of the six adults previously experimented upon responded at higher rates under fixed-ratio schedules than on the variable-interval schedule, and only four of the six developed pauses following reinforcement on the fixed-ratio schedule. No adults refused to enter or withdrew from the room at any time during this experimentation. This suggests that the behavior of the adult patients is less modifiable than that of the children.

This resistance of the adult psychotics' behavior to modification could be due to a longer period of institutionalization, a more severe psychosis or lower candy motivation.

1.8 Effect of Rapidly Increasing Ratio Value.

In an attempt to increase the rate of response for candy reinforcement four children were very rapidly moved from low fixed-ratio values of ten (ten responses at a time), up to high ratios of 100 to 200 in one experimental session. In all cases the local rate at the end of the hour (during the high ratios) was lower than at the low ratios at the beginning of the hour. This was not fatigue or satiation because a low ratio held throughout the hour will produce a high rate for the entire hour. In the rapidly-increasing-ratio technique the rate at the end of the hour was lower than it would have been if the low ratio had been held for the entire hour. In three out of the four children subjected to the rapidly-increasing-ratio technique the total number of responses per hour decreased steadily for four hours. This decrease in rate has been termed "ratio strain" by Skinner and associates. The number of refusals to enter and withdrawals from the experimental room sharply increased over this four-day period. This suggests, as noted above, an aversive effect of high ratio schedules which has not been observed in animal experimentation in quite this same fashion because the animal is not free to leave the experimental space. After four hours of rapidly-increasing-ratio training, two of the four patients' total number of responses per hour had dropped to less than half of their one-minute variable-interval response rate which had been determined previously. Since rapidly increasing the ratio reduced, rather than increased, the total number of responses per hour, this technique was discontinued after four hours of experimentation.

2.0 WORK ACCOMPLISHED WITH ADULTS SINCE 1 JUNE, 1954.

2.1 Effect of 3-5 Months Experimental Interruption.

The adults studied last year were not experimented upon during the period in which the children were examined. When we once again returned to a study of the behavior of the adult psychotics we decided to run them on the same schedules they had responded on before the experimental interruption. This was done to determine the effects of the three to five months' experimental interruption. A comparison of the number of responses per hour for the last ten hours before the experimental interruption and the first ten hours after the interruption showed significant changes in the rate of response of four out of the seven patients (beyond the one percent level by Wilcoxon's T for unpaired replicates). Patient No. 1 showed a 303% increase on candy reinforcement but no change on picture reinforcement. Patient No. 7 showed a 91% decrease on candy reinforcement and 27% increase on picture reinforcement. Patient No. 9 showed a 147% increase on candy and 47% increase on pictures. Patient No. 11 showed no change on candy reinforcement and a 10% decrease on picture reinforcement. These changes

in rate did not seem to be related in either direction or magnitude to the difference between patients, nature of reinforcement or schedule of reinforcement.

2.2 Observations on New Patients.

Two male and one female adult patients have been studied for ten hours on a one-minute variable-interval schedule of candy and ten hours on a one-minute variable-interval schedule for picture reinforcement. These observations were made to increase our patient sample and for comparison with the patients studied last year. The female patient responded at a rate of approximately 1,000 responses per hour to produce reinforcing stimuli that were pictures of male bodies in bathing suits. This, of course, compares favorably with the male patients who responded at moderately high rates for pictures of females similarly attired. The two new male patients were from the violent ward. We are now able to study the behavior of the most disturbed patients in the hospital.

2.3 Record Room and Office.

We have acquired an 18' x 18' room adjacent to the experimental rooms and shop in the basement of A Building at the Metropolitan State Hospital. This room is used as a drafting and record room and laboratory office. We have employed a secretary and record keeper.

3.0 WORK IN PROGRESS

3.1 Expanding Observations on New Patients.

We have started to investigate the behavior of six new male patients. The patients have all been hospitalized over five years and represent relatively severe psychotic disturbances.

3.2 Intensive Analysis of the Behavior of a Few Patients.

Five male patients studied last year are being intensively studied. The total hours of experimentation per patient at this time ranges from 130 to 500 hours.

Patient No.1 who has spent 250 hours in responding for candy reinforcement and 250 hours for picture reinforcement started at a rate of 30 responses per hour. The rate now averages 8,000 responses per hour. The rate of response for normal attendants responding for nickels as reinforcing stimuli ranged from approximately one to ten thousand responses per hour. This patient is now working in hospital industry for the eighth time in his hospitalization. This is only the second time that his work has been satisfactory. He is on parole for the first time in his 19 years of hospitalization and has fewer psychotic symptoms on the ward than at any time during his hospitalization. No somatic therapies were administered

which correlated with this improvement in behavior. He has received no visitors in ten years. We plan to extinguish the behavior of this patient in an attempt to see whether this process is reversible. The other four patients have been extensively studied using different behavioral measurement techniques (ratio schedules, fixed-interval schedules, differentiation, discrimination, etc.). It is our plan to catalogue the deficiencies in the behavior of these patients. We are also demonstrating that the operant behavior of psychotic patients can be maintained at relatively high rates for extremely long periods of time using the reinforcing stimuli that we have available.

3.3 Effects of Thorazine

We are currently investigating the effect of 400 mg. of Thorazine (orally administered in 100 mg. dosages four times a day) on the rate of response for one-minute variable-interval candy reinforcement and one-minute variable-interval picture reinforcement with one patient. For the twenty days of Thorazine administration the patient's rate for both reinforcing stimuli was sharply reduced. However, the rate has not immediately increased since the cessation of Thorazine administration. We plan to investigate the effects of Thorazine on other patients.

3.4 Fixed-Interval Schedule of Reinforcement

We are currently investigating the effects of a two-minute fixed-interval schedule of reinforcement upon the behavior of one patient. On this schedule the circuit that delivers reinforcement is primed once every two minutes. If the patient responds after the reinforcing circuit is primed, the reinforcement is delivered. Theoretically it is possible for the patient, if he could tell time accurately or had a watch at his disposal, to pull the lever once every two minutes, getting a reinforcement for every response.

The patient has responded for approximately 40 hours, one hour per day, on the two-minute fixed-interval schedule for candy reinforcement. His rate of response has dropped from approximately 500 responses per hour to a value of 80 responses per hour. Each day in the other experimental room the patient has responded on a one-minute variable-interval schedule for picture reinforcement. The variable-interval rate has dropped from 700 responses per hour to 500 responses per hour, showing some interaction between the two schedules of reinforcement. The fixed-interval records do not show the scallops seen in similar records from lower organisms. The patient's rate has dropped so low on the fixed-interval schedule that he expends approximately two responses for one reinforcement. The theoretical minimum would be one for one. This shows clearly that the patient has adjusted to the schedule very accurately. We are conducting control experiments to determine whether he is discriminating the relay "clicks" of the timing circuit or is "telling time" with a great degree of accuracy. We plan to use this two-minute fixed-interval schedule with other patients.

3.5 Mixed Schedules (Fixed-Ratio 20 + 80, Fixed-Ratio 40 + 80)

With another patient we are investigating the effect of mixed fixed-ratio schedules. The mixed schedule is a random mixture of fixed-ratio 20 and fixed-ratio 80 schedules. Sometimes a run of twenty responses is reinforced and at other times a run of 80 responses must be made to produce reinforcement. Because of the randomization the patient cannot predict which run he is responding on at any particular time. With lower organisms this schedule has the property of producing pauses in the longer runs after the number of responses which are appropriate to the smallest fixed-ratio value. That is, the organism will start on a run of 80 but pause after the first 20 or 30 responses since runs of 20 have been reinforced recently.

With this patient the schedule has not produced an increase over the variable-interval rate but it has produced marked pauses following most of the reinforcements. Pauses in the longer ratio runs of a value equivalent to the smaller ratio have appeared but not with the regularity observed in lower organisms. We are currently attempting to determine whether this low frequency of pausing at the smaller ratio value is a characteristic of the patient's behavior, whether it is characteristic of human behavior in general or whether it is simply a property of the ratio values we are using.

3.6 Effect of Music Upon Rate of Response

We have played music (Sousa marches and "Gaiety Parisienne") for ten minute periods while the patient was responding on a one-minute variable-interval schedule for candy reinforcement. No changes in rate of response were observed when the music was played. We are currently investigating the effects of playing different types of music and increasing the duration of time that the music is played in an attempt to discover any facilitative effect of music upon the behavior of psychotic patients.

3.7 Effect of Verbal Commands

We have presented verbal commands to patients for ten minute periods while they were responding on a one-minute variable-interval schedule for candy and cigarette reinforcement. The commands, "Get some candy and cigarettes", and "Pull the knobs", were repeated once every thirty seconds over a loud speaker. It appears that these commands interrupted some patients' distractive, psychotic behavior and consequently increased their rate of response; other patients showed no such effects. Other forms and distributions of verbal commands will be investigated.

4.0 PLANS FOR FUTURE WORK

4.1 Effects of Electro- and Insulin Shock

We plan to study the behavior on different schedules of reinforcement of acute patients while they are undergoing electro- and insulin shock therapy administered by the hospital staff (Dr. Karl Dussik).

4.2 Increased Duration of Experimental Session

We plan to investigate the optimal length of the experimental session. With human patients this brings up difficulties involved with toilet visits and so forth. However, since it is quite possible that a two, three or four-hour experimental session may be more efficient than a one-hour session, this variable should be studied early in our experimental program.

4.3 Development of Rate Indicator

We have designed an apparatus for indicating rate of response on some segment of a 360° circle. This apparatus can be used to manipulate stimuli as a direct function of rate of response. For example, a reinforcing stimulus could be illuminated through a circular optical wedge in direct relation to the patient's rate of response. This apparatus could be used to measure the reinforcing properties of visual stimuli in a fashion more efficient than that we now use and therefore would have more diagnostic value. It is also possible that direct reinforcement of rate would be more efficient than trying to increase the rate indirectly through the use of schedules of reinforcement which have rate increasing properties.

4.4 Increased Motivation

A magazine for the delivery of food reinforcement (small cubes of steak, etc.) has been designed and is now being constructed. It is hoped that the use of substantial food as reinforcement, perhaps supplemented by food deprivation, will increase the response rate of some of the most severely disturbed patients to a level which will permit an analysis of their operant behavior.