

CONDITIONING OF MENTAL-HOSPITAL PATIENTS TO FIXED-RATIO SCHEDULES OF REINFORCEMENT¹

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The present investigation is an analysis of the responding of mental-hospital patients to fixed-ratio schedules of reinforcement.

SUBJECTS

The subjects in these experiments were seven male patients of a mental hospital who were diagnosed as schizophrenic. Their ages ranged from 26 to 69 years, with a median of 47 years. These subjects were long-term or "chronic" patients; with only one exception, they had been hospitalized for at least 14 years. Their length of hospitalization ranged from 2 to 36 years, with a median of 19 years. Aside from the usual hospital medication, none of the subjects was undergoing formal therapy during this study; nor did medical diagnosis indicate organic involvement. In order to insure regular participation by the subjects, no patients were selected who had frequent visitors to the hospital, who were allowed home visits, or who had grounds passes or jobs in the hospital. Only those patients were selected who accepted cigarettes and candy, since those reinforcers could be most easily programmed with available equipment. Each patient was receiving thiorazine regularly as treatment.

APPARATUS

Experimental Chamber

The experimental room was a sound-attenuated and temperature-controlled enclosure 7 feet wide, 10 feet long, and 12 feet high. The door to this room could be closed securely, but was never locked. The subjects could be observed through a window of one-way glass which was effectively concealed from the patient by a ventilator grill and which allowed no mirrored reflection. The manipulandum and vending magazine were placed on the wall opposite this window. An electric cigarette lighter and ashtray were mounted nearby.

Response and Reinforcement Apparatus

The manipulandum was of the type designed by Lindsley (1956), and consisted basically of a brass knob mounted on a shaft. When a subject pulled this knob through a distance of 1 centimeter with a force of 300 grams, a concealed switch closed. Closure of this switch constituted the measured response. An enclosed magazine with a capacity of 100 reinforcements was located above the response knob. Reinforcement consisted of the delivery of a single cigarette or piece of candy into a tray that was located 7 inches from the response knob. At the time of reinforcement, the delivery tray was lighted and a soft buzzer sounded for 3 seconds. Typically, the reinforcer was obtained by the patient within a second or two after its delivery into the tray. In other instances, the reinforcers were simply allowed to accumulate in the tray until the end of the session. In both instances, the receipt of rein-

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forcement required negligible time and produced little or no interruption of the ongoing responding. For this reason, all of the programming apparatus as well as the recorders and counters remained functional during the delivery of reinforcement. The response panel and vending magazine appeared self-contained to the subject, but in fact were connected by a concealed cable with the controlling and recording apparatus located in another room.

PROCEDURE

Patient Handling and Programming Procedure

The experimental sessions for a given patient were conducted daily, Monday through Friday, and at the same time each day. The sessions ended after the delivery of a fixed number of reinforcements. Assistants who were naive about the purposes, objectives, or expectations of the study escorted the patients to and from the experimental room. When the door of the experimental room was closed, an electrical switch automatically started the session. The use of this door switch to initiate the sessions proved to have two advantages. First, no extinction period could occur between the time the patient entered the room and the time the "authorized" session began. Second, the patient considered the reinforcement schedule to be less under the control of the experimenter because no waiting period was necessary while the assistant was starting the session.

Instructions to Subjects

On the first occasion that a patient was brought to the experimental room, he was asked, "Would you like some candy and cigarettes?" The assistant would obtain a cigarette or piece of candy for himself by moving the response knob and would encourage the subject to do the same, saying: "You can get as many as you want to take back to the ward with you." He then left the room saying, "Get all you want; I'll be back in a little while." If the subject did not respond within 20 or 30 minutes, the assistant again entered the room and further demonstrated the apparatus. If necessary, he even placed the subject's hand on the manipulandum. Although minimal instruction had been desired, in some cases responding began only if the above instructions were used.

RESULTS AND DISCUSSION

Of the seven patients initially selected for these experiments, five were studied for a period of over 3 months. The response curves of two of the subjects, shown in Fig. 1, demonstrate the typical changes in performance which occurred during the initial weeks of conditioning. At the start of conditioning, every response was reinforced. To the extent that responding was sustained under this continuous reinforcement, progressively larger numbers of responses were required. Both subjects in Fig. 1 had an extremely low response rate of only 4 or 5 responses per minute during the first several experimental sessions. Gradually, however, responding increased to a level greater than 100 per minute at the higher ratio requirements. All five subjects initially showed these same low rates of less than 6 responses per minute during the first two experimental sessions. The time required to produce high rates of responding varied among subjects. Indeed, with two subjects, over 40 experimental sessions were required before response rates above 100 per minute were observed. All subjects consistently maintained the level of final performance such as that shown in Fig. 1 over consecutive experimental sessions.

The reason for the day-to-day increase in responding is not clear from the above data.

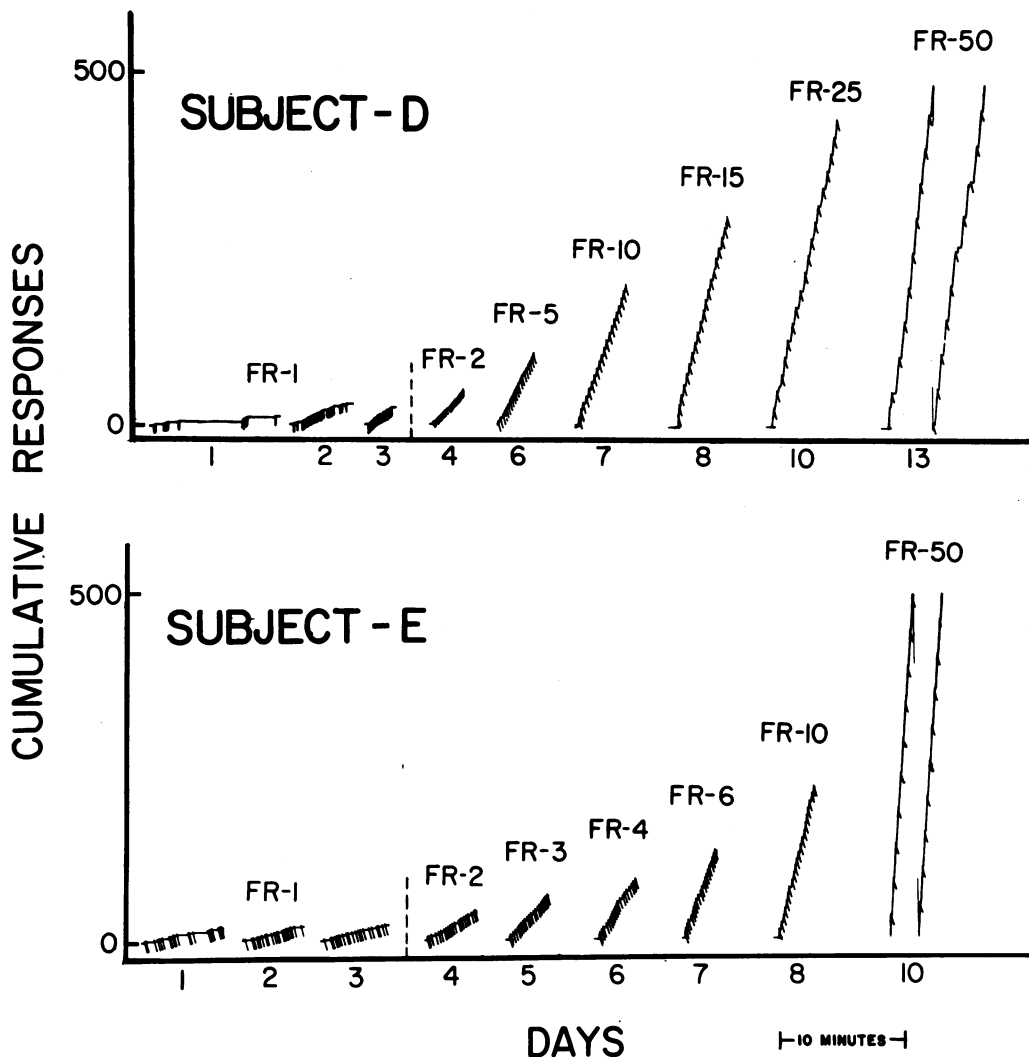


Figure 1. Performance of two subjects on successive days and with progressively higher numbers of responses required for reinforcement. Each diagonal mark on the cumulative-response curves indicates the delivery of a reinforcement. Each curve represents the response record of one entire session (except for FR 50, which contains two curves).

Possibly, responding was increased because of the successively higher number of responses required for reinforcement. On the other hand, the same increase might have been simply a function of time. This question is partially answered by Fig. 2, which presents the average rate of responding of Subject C over a 26-day period. The response rate appears to increase moderately each time the number of responses required for reinforcement increases. An even more evident effect is in the day-to-day increase in the rate of responding when the number of responses required for reinforcement is not changed. This increase in time is particularly noticeable at the higher ratios. Boren (1956) and Skinner (1938), using animal subjects, have also found that the over-all rate of responding increases as the number of

responses required for reinforcement is raised. On the other hand, the observed increase in response rate over time has not been found in studies with animals, but has been noted by Ellis *et al.* (1960) in a study of mental defectives.

Figure 3 illustrates the typical performance of each subject on an FR 50 schedule. Responding under fixed-ratio schedules of reinforcement was observed to take place in a characteristic temporal pattern. The pattern of responding was essentially bi-valued: either responding occurred at a high rate or not at all. Pausing, or the absence of responding, occurred immediately after reinforcement (solid arrow). Pauses occurred only rarely once responding had begun (dotted arrow); the frequency of such pauses was found to be no greater than is commonly observed with animal subjects in this laboratory. As is also true of animal subjects, the differences observed among subjects in over-all response rates appear largely due to differences in the duration of pausing following reinforcement. These findings are quite similar to those reported by other investigators in work with normal humans (Holland, 1958), mental defectives (Ellis, 1960), psychotic children (Lindsley, 1956), as well as with animal subjects (Ferster & Skinner, 1957).

Ordinarily, the number of responses required for reinforcement was increased only when a stable pattern of responding was well-established. Under this procedure, fixed-ratio requirements as great as 300 were maintained with no disruption of performance. In several cases, however, the ratio requirement for a particular subject was raised to a value much greater than had previously been programmed. Figure 4 illustrates the effect of such "ratio strain" for one subject. Responding was successfully maintained as the number of responses required for reinforcement was raised from 50 to 100 on Day 2, and then to 200 on Day 3. On Day 4 the ratio was further increased to 300, where it was held through Day 7. The performance deteriorated severely on Day 5, although pausing was still partially localized after reinforcement. However, the subject ceased responding entirely after 15 reinforcements (not shown). By the fourth day at FR 300 (Day 7 in Fig. 4), deterioration was even more severe, and the subject stopped responding entirely after only 11 reinforcements (also not

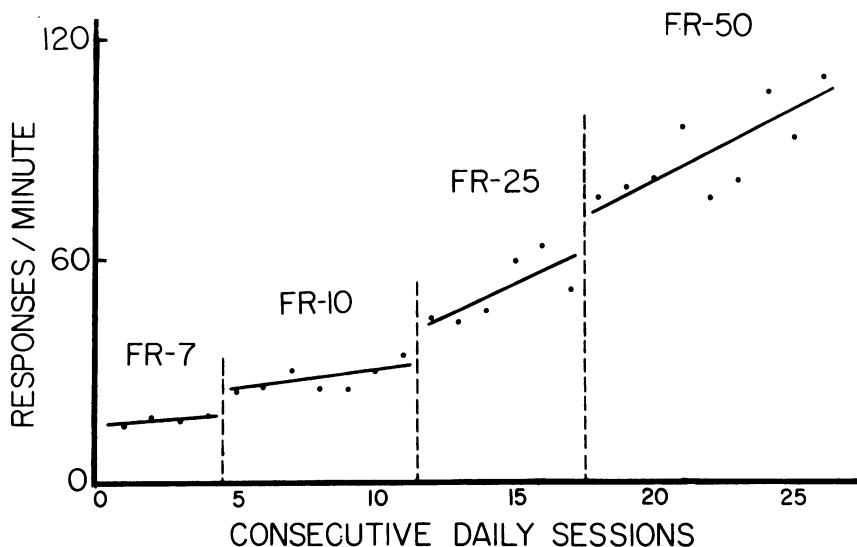


Figure 2. Changes in daily response rate for one subject over 26 days.

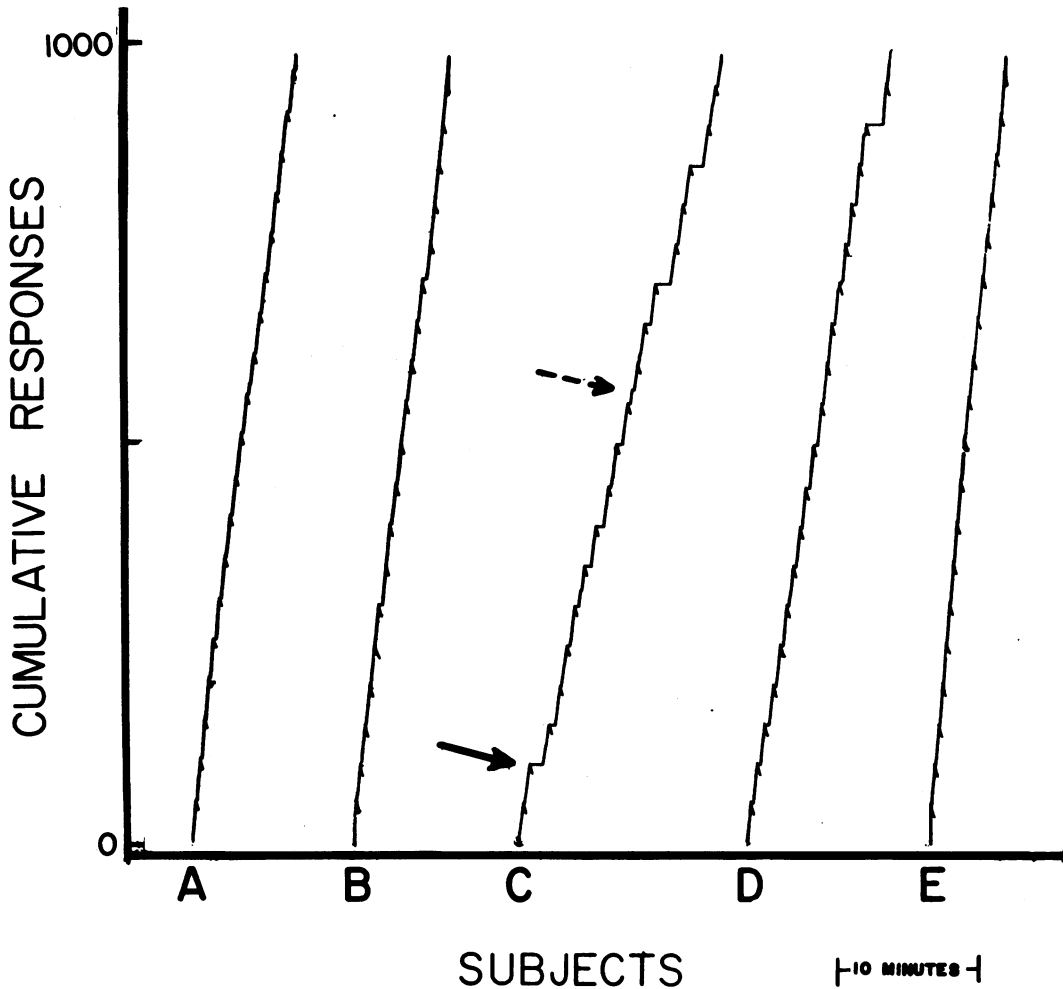


Figure 3. Typical performance by each of five subjects during an FR 50 schedule of reinforcement. The solid arrow indicates the characteristic pause following reinforcement. The dotted arrow indicates one of the rare instances in which the pause occurs after responding has begun.

shown). On Days 8 and 9 the ratio requirement was reduced to 150. Even though performance was previously sustained at a ratio of 200, responding at FR 150 was now very erratic and terminated after 10 reinforcements. When the ratio requirement was lowered to the original value of 50 (Day 10), sustained performance was again observed. However, pausing did not immediately localize after reinforcement, but it appeared at many points in the ratio. Over a period of 14 experimental sessions, normal performance gradually returned (Day 23). It may be noted that before the ratio requirement produced disturbance in normal performance, no increase was evident in the pause following reinforcement as a function of the ratio requirement. This absence of pausing at higher ratios is characteristic of the results observed throughout this investigation but differs from the results obtained with animals (Boren, 1956; Ferster & Skinner, 1957). However, this same absence of increased pausing at

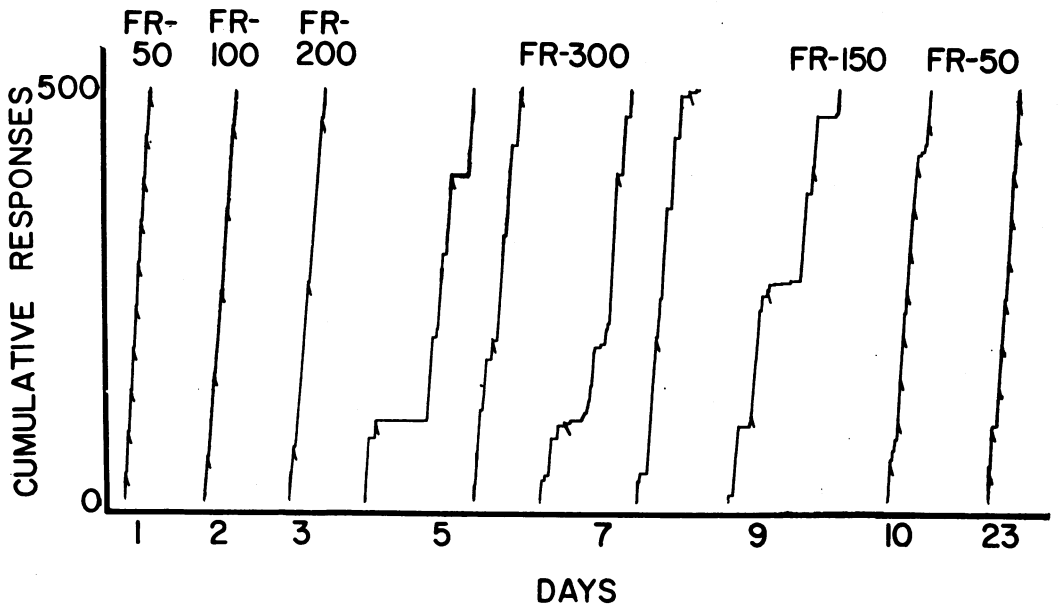


Figure 4. Ratio strain resulting from rapid increases in the number of responses required for reinforcement and subsequent recovery when the ratio requirement is reduced to the former value. Typical segments of the response record are shown for each day.

higher fixed ratios can be noted in Holland's (1957) study of normal humans as well as in Ellis' (1960) study of mental defectives.

Occasionally, reinforcement was deliberately withheld. Figure 5 illustrates the typical pattern of responding which resulted during this extinction procedure. Prior to extinction, every 50th response had been reinforced. The reinforcements were then withheld for the remainder of the session (starting at *A*). The subject continued to respond at the usual high fixed-ratio rate for over 2000 responses before any pausing occurred. Periods of responding then began to alternate with progressively more frequent periods of no responding. The same bi-valued rate was obtained during extinction as was seen during reinforcement (Ferster & Skinner, 1957). Eventually, responding ceased entirely and the patient often left the room at this time. Extinction was attempted with all subjects, each showing this same response pattern and the same eventual cessation of responding.

Figure 6 shows the control of behavior exerted by conditioned reinforcement. Reinforcement was withheld beginning at *A*. As in Fig. 5, the responses during this extinction procedure continue at the same rate as during reinforcement. The first major disruption in responding occurred at *B*. Occasionally, intermediate rates of responding appeared, such as at *C*, and the performance ceased almost entirely at *D*. The controlling apparatus was then set (prior to *E*), so that the next response and every 50th response thereafter would be followed by the buzzer sound and light change that normally accompanied the delivery of reinforcement. A response occurred at *E* which resulted in the rapid emission of over 600 more responses before responding again extinguished. The behavioral control exerted by these conditioned reinforcers is quite similar to that obtained in studies of animal behavior (Skinner, 1938).

It had been anticipated that great variability from day to day, as well as within each day, would characterize the performance of these chronic patients. As has been noted above, however, responding consistently occurred at the high rates that normally characterize fixed-ratio performance. Even more surprising is the consistency that was observed in the over-all rate of response from day to day. In no case did the over-all rate on any one day differ by more than 20% from that of the previous day. Typically, the over-all rate did not change by more than 10%.

SUMMARY

Five mental-hospital patients, diagnosed as schizophrenic, were conditioned under fixed-ratio schedules of reinforcement. Low rates of responding were initially observed in all subjects. Over a period of from 5 to 40 experimental sessions and at progressively larger ratio requirements, all subjects came to respond much more rapidly.

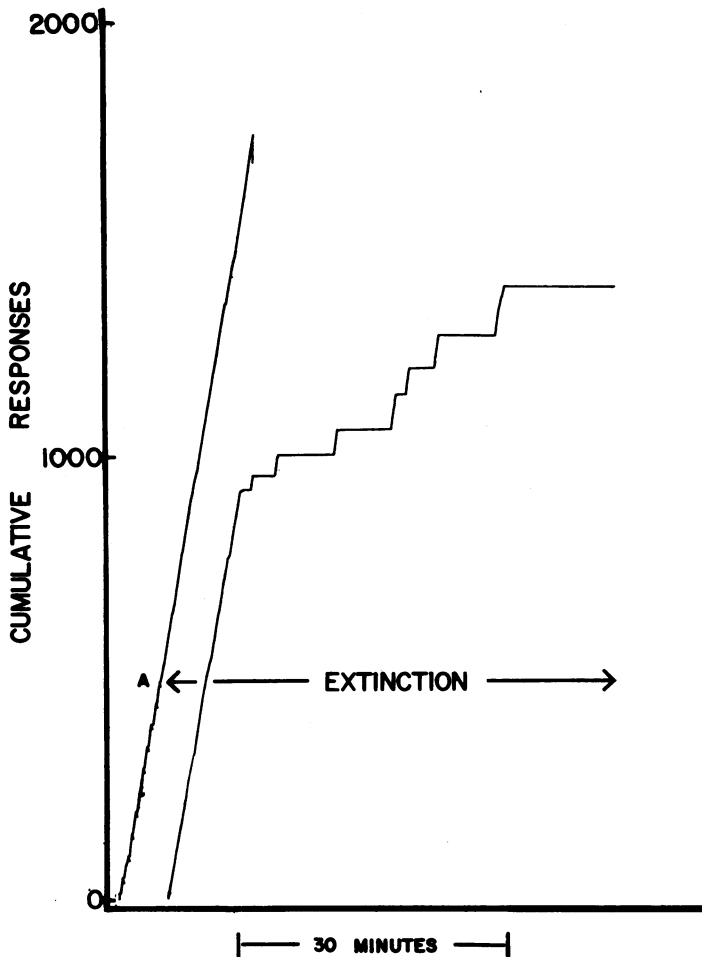


Figure 5. Responding during extinction following fixed-ratio conditioning. Extinction begins at A.

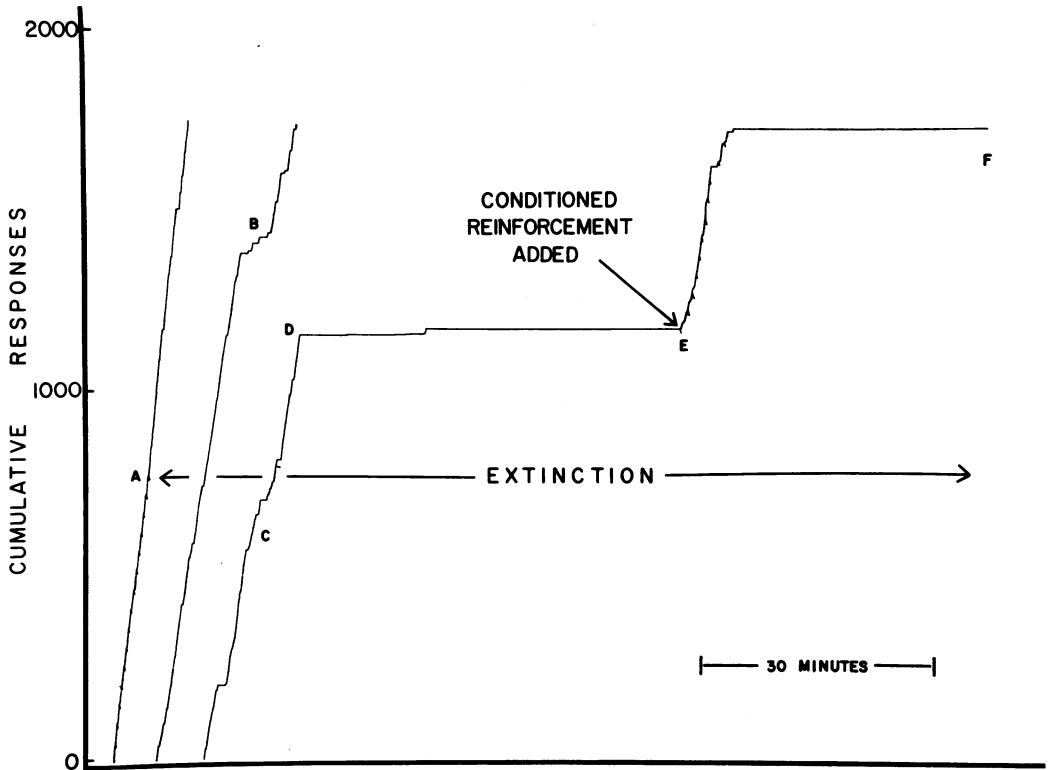


Figure 6. Responding induced by conditioned reinforcers. The diagonal marks on the response record up to *A* indicate the delivery of the reinforcer and its accompanying stimuli. At *E* the conditioned-reinforcing stimuli were scheduled alone. Typical changes in rate during extinction are indicated at *B*, *C*, and *D*. (See text.) Neither the reinforcement nor conditioned reinforcement was delivered from *A* to *E*.

Much less day-to-day variation was present than might be expected of the behavior of psychotic patients. The over-all response rate for a given patient usually varied less than 10% from one day to the next.

The temporal pattern of responding which developed was found to be essentially bi-valued: the subjects either responded at a very high rate or they did not respond at all. Periods of no responding typically occurred after reinforcement and only rarely at any other time. When the number of responses required for reinforcement was drastically increased, the usual pattern of performance was disrupted severely and responding ceased entirely after a short period. When the ratio requirement was then reduced to the original value, the disruption persisted for a number of experimental sessions. During extinction, responding was reduced, because of progressively more frequent periods of no responding, with little change in the local response rate. It was found that responding could be reinstated temporarily through the use of conditioned reinforcers.

The results of these experiments are highly similar to those obtained in studies of infra-humans and normal humans. The one exception to this essential similarity is the extended period of time necessary to produce high rates of responding.

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