

*OPERANT BEHAVIOR IN MENTAL DEFECTIVES:  
EXPLORATORY STUDIES<sup>1</sup>*

NORMAN R. ELLIS, CHARLES D. BARNETT,  
and MARGARET W. PRYER

STATE COLONY AND TRAINING SCHOOL,  
PINEVILLE, LOUISIANA

The purpose of these studies was to investigate the free-operant technique, developed by Skinner and associates, as a means of analyzing the behavior of mentally defective humans. In the main, we attempted to relate indices of cumulative records to organismic variables (IQ, MA, CA, clinical type) and schedules of reinforcement (fixed-and variable-interval, and fixed-ratio).

The laboratory consists of an *S*-room and a juxtaposed *E*-room. The interior of the *S*-room is painted flat grey throughout. Distracting stimuli such as door knobs, light switches, and other similar fixtures have been removed. The room is sound-treated and air-conditioned. A two-way sound system permits communication between *E* and *S*. One-way mirrors are mounted between these rooms. A Lindsley manipulandum (Lindsley, 1956) is located underneath the mirrors and is mounted in a panel which also contains the reward tray. The *E*-room houses the magazine, the programmer, and the recorder. The programmer provides complete automatic control of any preselected schedule of reinforcement.

In the first study, 12 adult Negro males with IQ's of 30 or less were run for 30 daily half-hour sessions. These *S*s were from the *low-level* dormitories but were fairly tidy, could dress and feed themselves, and the majority could follow simple instructions. Two had no language development, several used words only, and a few made simple sentences. Beyond these simple skills, commerce with their environment was extremely limited.

Multicolored M & M candies were used as reinforcers. A 5-second time out (TO), during which the house lights were off and the reward-tray light on, was continuous with and followed the delivery of a reinforcer. Though *S* could respond during this interval, these responses were not instrumental and not recorded on the cumulative records. During the initial session, *S* was exposed to a continuous-reinforcement schedule and, after some control was established, switched to fixed-ratio 10 (FR 10). Those failing to adjust to the situation (wanted out, cried, pulled lever only when instructed to or not at all, etc.) within the first session were eliminated. This eliminated 10 of a group of 22; however, later informal study of these indicated all but three or four could be adapted within a few days. Usually a switch to FR 10 was made early in the first session, since the majority responded appropriately to verbal instructions to "pull the lever and get candy." The *S*s were maintained on FR 10 for 11 days. Figure 1 depicts the average performance during these sessions. Figure 2 presents the cumulative records of four *S*s. Each segment is the initial one for successive Days 11 and after. At (a) the schedule is changed to FR 30, at (b) to variable-interval 1 minute (VI 1), at (c) to fixed-interval 1 minute (FI 1); and at (d) FR 10 is re-introduced, and the ratio is increased to 100 at (e). Several terminal segments are missing from some of the records. The lowest rate observed is that of *S*<sub>4</sub>. Although this *S* was run for 30 days, the number of responses following Day 20, which is shown, was negligible. The records of *S*<sub>4</sub> and *S*<sub>5</sub> are rather typical. One subject, *S*<sub>1</sub>, shows a high

<sup>1</sup>These studies were supported by Research Grant (M-2229) from the National Institute of Mental Health, Public Health Service.

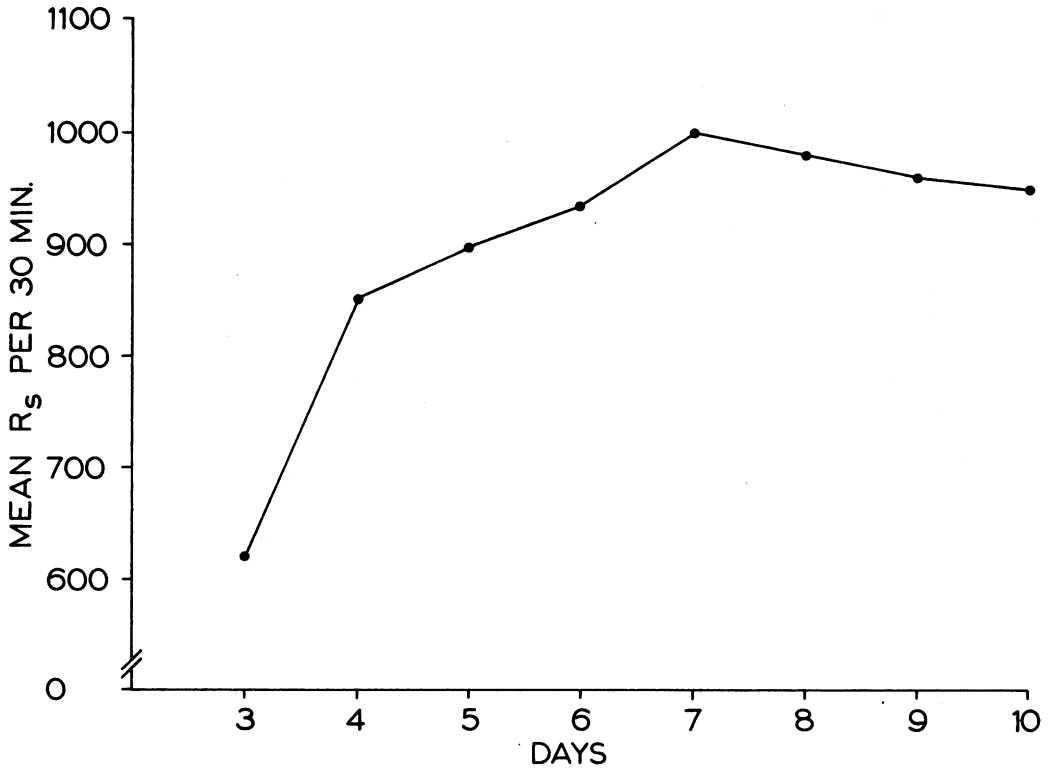


Figure 1. Average performance on FR 10 for Days 3 to 10.

stable rate which is characteristic of high-IQ  $S_s$  on FR, as will be shown later. Some of the rate changes seen in this record, as well as in some of the others, are artifactual. For example, note the change at (d) in  $S_1$ 's record. This is due to the difference in number of TO's and the fact that responses during this interval do not contribute to the record. Figure 3 shows interval and ratio records in some detail. The upper ones are FI 1 and VI 1 and the lower, FR. The interval records show several interesting characteristics. These records are erratic, with frequent marked changes in rate. Both fine and coarse grain are present; reinforcement frequently follows a period of no responding, which happens rarely in FR. Spurts of fine grain between pauses appear, as can be seen in the extreme right segment. On the other hand, the FR records tend to be stable, smooth, and linear. Changes in rate usually result from increases in the duration of pauses following reinforcement. Once responding begins,  $S$  rarely ceases before delivery of the reward. Reference to the rate indicator will show that very high rates can occur under either schedule but that they are more prevalent under FR.

One  $S$ 's behavior was not appreciably influenced by changes in schedule. (See Fig. 4, the record of  $S_6$ .) In view of his insensitivity, he was run 3 days on extinction. The segments labeled 1, 2, and 3 are complete records for these days; only behavior toward the end of each daily session shows a decrement.

Most  $S_s$  ate a few or, in some instances, all the M & M's during the first session. Later, most hoarded, though a few continued to eat all they received. We saw some evi-

dence of superstitious behavior, i.e., irrelevant movements or positions would appear and persist for brief intervals which seemed to depend upon chance contiguity of behavior and reinforcement. These included holding head to left or right, watching lights, looking under manipulandum panel, etc.

A second study consisted of a further analysis of ratio behavior. Twenty-six teenage and adult Negro males with MA's ranging from 3 to 9 years were selected. Their IQ's were from 30 to 70. Figure 5 depicts mean performance curves over a 15-day period for high and low MA groups. The Ss were switched from M & M's to cigarettes on the 12th day in an attempt to boost the rates even higher. Ratio and days are confounded. In view of Fig. 1, we assume that these changes are at least in part due to motor-skill acquisition. The higher MA as well as the higher CA Ss performed at higher over-all rates. Figure 6 shows the second segment (in one instance, later segment) of each of the 26 Ss' performance on

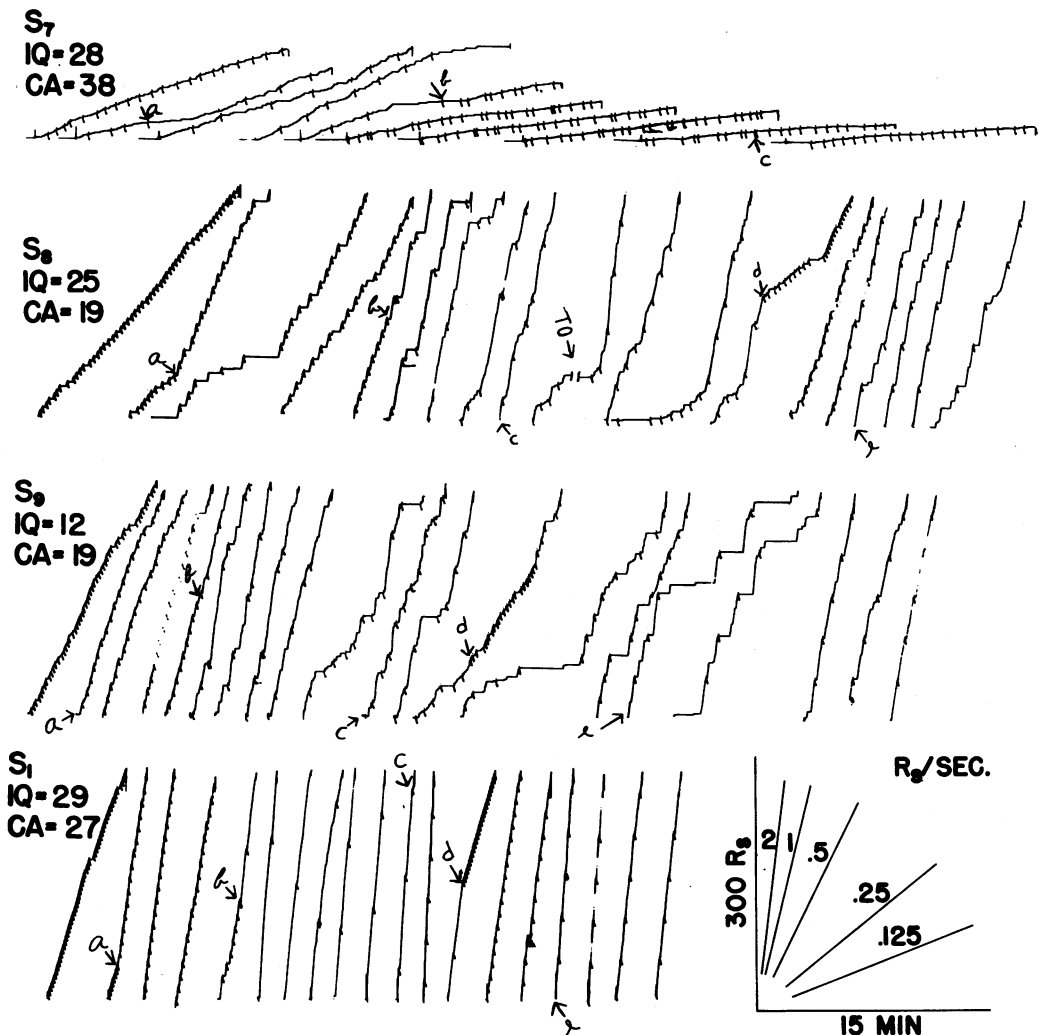


Figure 2. Records of four Ss showing the initial segment of successive daily sessions for Days 11 and after.

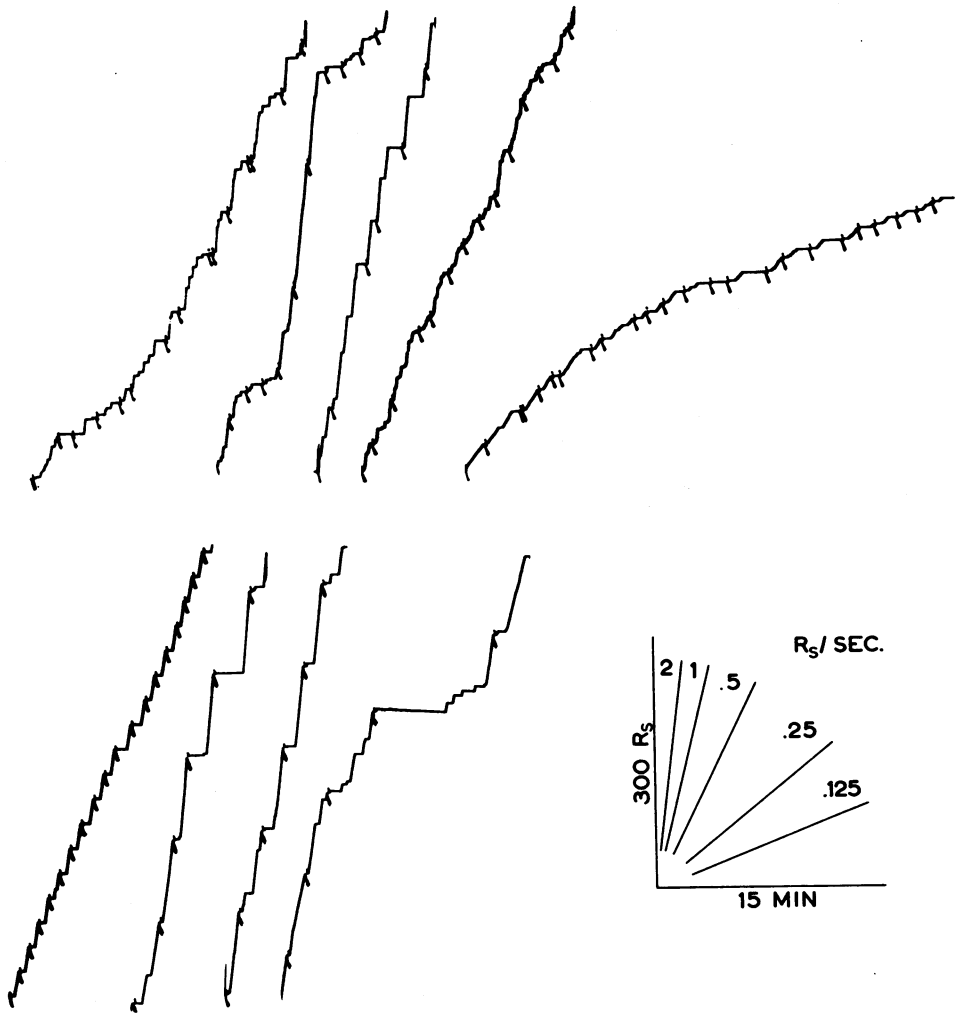


Figure 3. Segments of typical records under interval (upper) and ratio (lower) schedules.

the third day under FR 1024. This figure shows that the character of behavior differs as a function of IQ. The lower levels show more erratic behavior, with pauses between high-rate bursts and a tendency to graininess. The over-all rate, as previously estimated, does not necessarily reflect local rate, e.g., note segment from record of the lowest MA *S*. All *S*s were maintained on FR 1024 until they failed to increase for 2 consecutive days. Reaching this criterion required as many as 12 days in one case.

As to the reliability of these data, smooth linear records are typical for the higher-level *S*s. Also, the records for the lower levels are fairly linear over-all, though they contain many pauses. Rank-order correlation coefficients were computed between total (responses per session) scores for performance under different ratios. Some of these, between adjacent ratios, were as follows: 10-30, 0.77; 30-50, 0.69; 50-70, 0.73; 70-100, 0.91; 100-130, 0.95; and 130-1024, 0.89. The Rho between 10 and 1024 falls to 0.36. We suspect that the extremely

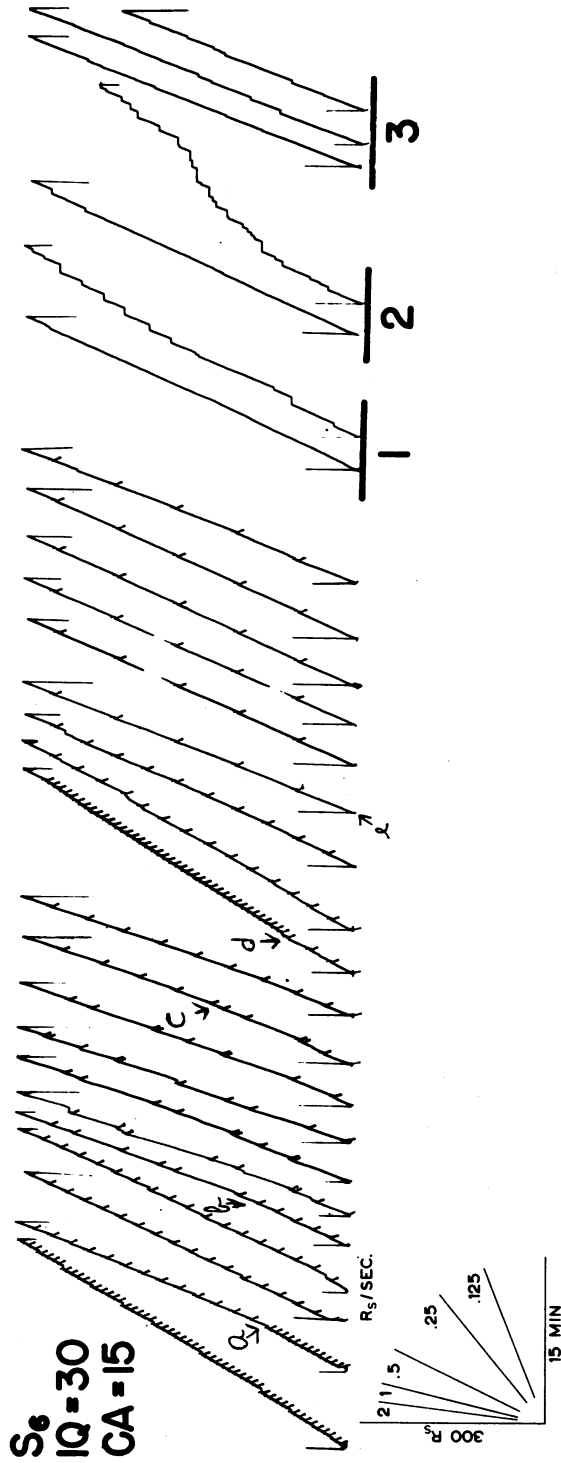


Figure 4. Record of S<sub>6</sub> demonstrating lack of sensitivity to schedule change (initial segments for Days 11-30 followed by 3 days on extinction).

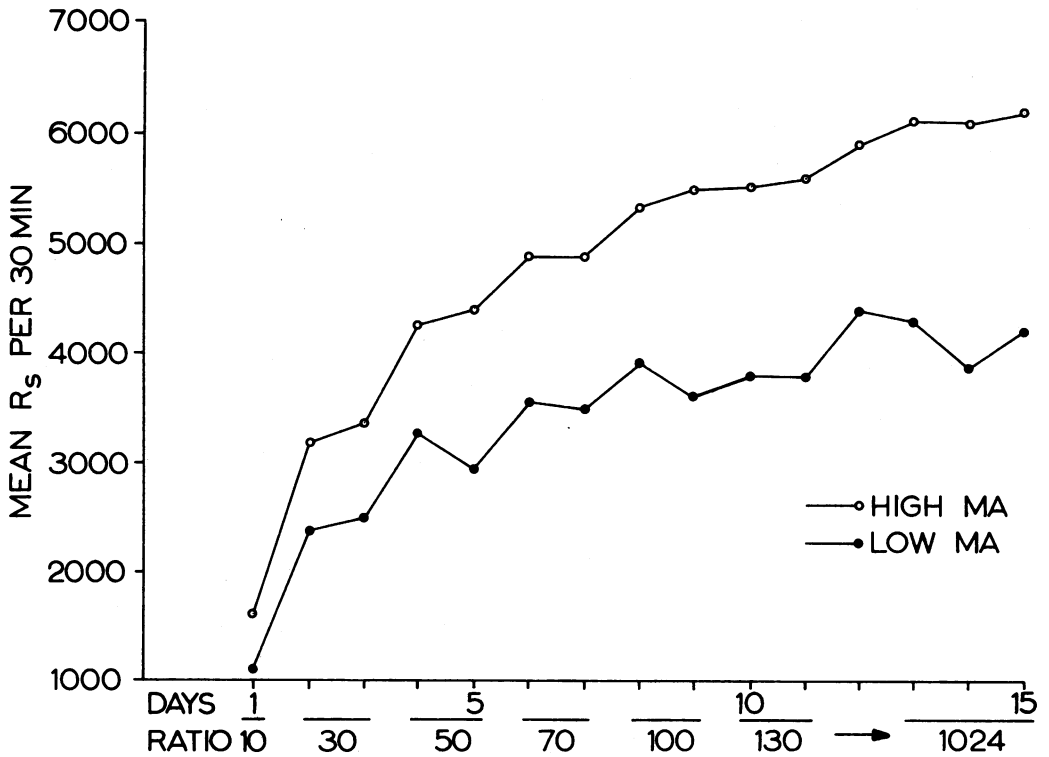


Figure 5. Mean performance curves for daily Sessions 1-15 (rewards changed from candy to cigarettes on Day 12).

low or high ratios are most attenuated. On the other hand, moderate rates of responding, which occurred under the middle ratios, may be the critical factor. Since ratios are confounded with days, this is indeterminate. The odd-even session correlation for all these data was 0.95.

These studies suggest that defectives with extremely limited skills adapt readily to the operant-conditioning procedure. Many of these are of the type usually labeled "untestable," and are not usually included in psychological experiments, especially those ex-

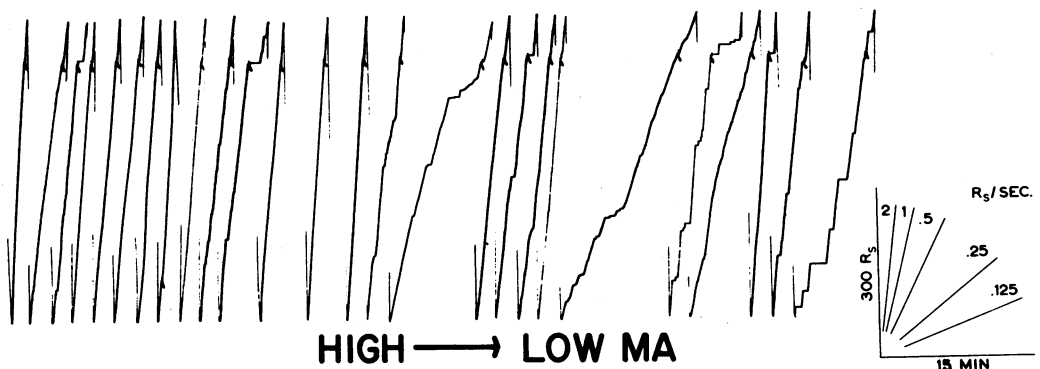


Figure 6. Segments from the records of 26 Ss of varying MA under FR 1024.

periments which use verbal instructions. The majority of Ss, even those of lowest intelligence, are sensitive to schedule changes. Interval and ratio schedules produce fairly distinct records. Some of the topographical characteristics of the defective's behavior resemble that of the rat and pigeon (Ferster & Skinner, 1957), as well as that of psychotic and normal humans. The record of the severely defective S is particularly like that of the psychotic, i.e., containing frequent pauses. Lindsley (1956, 1958) has shown that the sum of pauses greater than 10 seconds is related to the depth of psychosis. Our data suggest that this measure is related to intelligence level within a defective population. However, further study will be needed to substantiate this hypothesis. The over-all rate of response is related to CA and MA. The Ss can be sustained for long periods on very high ratios for candy or cigarette rewards. The reliability of behavior under FR is adequate. We believe the analysis of operant behavior holds promise for the training of severely retarded humans.

## REFERENCES

- Ferster, C. B., and Skinner, B. F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957.
- Lindsley, O. R. Operant conditioning methods applied to research in chronic schizophrenia. *Psychiat. res. Rep.*, 1956, **5**, 118-139.
- Mednick, Martha T., and Lindsley, O. R. Some clinical correlates of operant behavior. *J. abnorm. soc. Psychol.*, 1958, **57**, 13-16.

*Received November 9, 1959*