The effect of schedules of reinforcement upon the response rates of turtles

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Two turtles each were trained on variable interval, fixed interval, variable ratio, and fixed ratio schedules of reinforcement. Two additional turtles were run on fixed ratio schedules because the response rates could not be maintained. The remaining schedules produced levels of performance which were similar to each other with the variable ratio schedule appearing to be the most stable and effective.

The results of a previous study (Crawford, Adams, & Whitt, 1966) indicated that the response rate of turtles increased initially with small increases in fixed ratio schedules but that the response rate could not be maintained even for very low ratios. The present study investigated further the effect of schedules of reinforcement upon the response rate of turtles.

Subjects. The Ss were eight turtles, *Pseudemys floridana suwaniensis*, native to the area and obtained from commercial animal distributors. Two additional Ss were run on FR schedules when it was observed that the two Ss initially selected failed to respond at rates comparable to those run on other schedules. All Ss had been maintained in the laboratory for over three years. The size of the turtles varied from 16.5 x 12.7 cm to 21.6 x 17.8 cm in length and width, respectively, and their weight varied from 623.7 to 907.2 g.

Apparatus. Ss were run in the test chamber previously described by Crawford & Siebert (1964). Reinforcement was cooked shrimp which was cut and made into small balls with a pellet punch. The pellets of shrimp were coated with powdered vitamin supplement to prevent sticking during delivery by a Gerbrands Universal Feeder. Typical operant conditioning programming and recording equipment were used.

Procedure. The Ss were trained to make a lever depression to obtain the pellets of shrimp. They were run once every four days, but were also provided a daily maintenance diet consisting principally of fresh lettuce. Each training session was of 30 min in duration. Following training on continuous reinforcement (crf) sufficient to produce three sessions of stable behavior, two each of the original eight Ss were randomly assigned to variable interval (VI), variable ratio (VR), fixed interval (FI), and fixed ratio (FR) schedules. Increases in the ratio schedules were in units of two, i.e., 1, 3, 5, etc. The interval schedules were begun with a 24 sec interval since this was the smallest interval consistent with Ss' response rate which permitted convenient VI programming. Ss were run on a given schedule until their terminal rates indicated a reasonable degree of consistency. Ss running on the FR schedule demonstrated a markedly lower and less stable response rate than the Ss on the other schedules. As a result two additional Ss were trained and placed on

Fig. 2. Response rates for variable interval schedules.

FR schedules. These Ss were given unit increases in their ratio schedules, i.e., 1, 2, 3, etc., in order to maintain the maximum possible response rate. Data for the experiment was collected over a period of six and one-half months.

Results and Discussion. The schedule of reinforcement producing the highest response rate overall was the FI schedule (Fig. 1). This schedule produced, however, the greatest variability in the behavior of the Ss. In addition, the base rate on continuous reinforcement for these Ss was also the highest initially. The rates for individual Ss do not show marked acceleration and the performance curves are rather flat overall. The VI schedule (Fig. 2) produced a more stable rate of response, but less of an increase in response rate. At higher intervals, beyond 72 sec, the response rate appears to be falling off. The lower and more stable response rate found in the present experiment for VI reinforcement is consistent with that typically found for this schedule (Honig, 1966).

The most consistent and effective schedule of reinforcement obtained under the conditions employed in the present experiment was the VR schedule (Fig. 3). Although the initial base rates were lower than those in the schedules described above, the VR response rates are more uniform and show a greater increase than the other schedules. The schedule which produced the poorest performance was the FR schedule, shown in Fig. 4. The Ss run

Fig. 1. Response rates for fixed interval schedules.

Fig. 3. Response rates for variable ratio schedules.

initially were No. 34 and No. 35. The performance of one of these Ss dropped markedly (No. 34) and the other extinguished (No. 35) with the increase in fixed ratio. One S, (No. 35), could not be reshaped even on continuous reinforcement and the other (No. 34) could not be brought to the former performance levels. Two new Ss (No. 7 and No. 10), run with only unit increases in the ratio schedules in order to maintain their performance level, had rates which fell off in much the same manner as for the first two Ss.

The performance of the Ss run on FR schedules in the preceding study (Crawford, Adams, & Whitt, 1966) had higher initial rates on continuous reinforcement, reached higher levels before beginning to fall off, and the resultant decline in rate was not as severe. The data from that study were collected in the same manner as the present except that Ss were run every three days instead of four. Other unpublished data from our laboratory on

Fig. 4. Response rates for fixed ratio schedules.

Fig. 5. Response rates on interval and ratio schedules for combined Ss.

the effect of FR schedules upon the response rate of turtles indicates that Ss run every day tend to have even more stable rates. The methodology used in the study produces response rates which are highly variable within Ss but the performance of Ss within the schedules is reasonable consistent. The data of the present experiment for the combined Ss on each of the schedules are shown in Fig. 5 where the magnitudes of performance and the ease with which they may be maintained can be readily observed.

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