INTERMITTENT REINFORCEMENT OF A COMPLEX RESPONSE IN A CHIMPANZEE¹

CHARLES B. FERSTER²

Yerkes Laboratories

In most of the experiments dealing with the maintenance of behavior a simple, easily repeatable response is used. The emphasis is largely on the frequency of occurrence of a stable topography as the dependent variable, and procedures are designed to minimize problems of changes in the form of the behavior. However, the problem of the maintenance of more complex topographic forms still remains. In this experiment, I am reporting a procedure which maintained the topography of a complex response more accurately when the response was reinforced under species of fixed-ratio or percentage reinforcement than under continuous reinforcement. The behavior intermittently reinforced was similar to that reported by Mechner and Berryman (2). Two keys are available simultaneously. Pressing the right key operates the food magazine if this press is preceded by n presses of the left key. With this technique the over-all tendency to emit the behavior can be measured as well as how closely the emitted form corresponds to the reinforced form.

SUBJECT

The subject of the experiment was an adult female chimpanzee with a free-feeding weight of 105 pounds. During the experiment the weight was maintained at 75 pounds.

APPARATUS AND PROCEDURE

Two keys, telephone-type switches, were mounted 18 inches apart and 30 inches from the floor. The food magazine delivered alternate pieces of Purina Chow and hard whole wheat cracker into a tray to the left and below the keys. Other details of apparatus and procedure have been reported elsewhere (1).

Each key-press operated the food magazine if the keys were operated alternately. The procedure was then changed so that the right key operated the magazine if

¹ This study is part of a project supported by the United States Atomic Energy Commission under Contract AT-(40-1)-1553.

² Now at the Institute for Psychiatric Research, Indiana University Medical Center.

preceded by one press of the left key. Other presses of the right key produced a time out. When this contingency had its final effect, right-key responses were reinforced only after two left-key responses and then, finally, after three. At this point the length of the time out was varied to determine whether the behavior could be maintained more accurately by punishing the unreinforced sequences. Time outs ranging from 2 seconds to 5 minutes were used. The most stable performance occurred with the briefest time outs, while considerable disruption occurred at longer time outs. The time out was therefore fixed at 10 seconds and the intermittent-reinforcement program was begun. Under this program, every sequence which conformed to the reinforcement contingency produced the discriminative stimuli associated with the operation of the magazine (a buzzer, illumination of the food tray, and darkening of the general room illumination). A fraction of the "correct" sequences delivered food. Sequences not conforming to the reinforcement contingency terminated with a 10-second time out.

The ratio of correct-response sequences reinforced by the conditioned reinforcer (the magazine stimuli alone) to those reinforced by the magazine stimuli plus the delivery of food was then increased slowly, with each value maintained until a stable condition was achieved. Performances were generated at fixed ratios up to 33 to 1.

RESULTS

Under intermittent reinforcement of the sequence of responses, the behavior was maintained considerably more accurately than under continuous reinforcement.

Fig. 1. Two successive daily sessions.

Figure 1 shows two successive daily performances in which every 16th reinforced sequence produced the magazine stimuli as well as food. The histograms present the frequency of occurrence of sequences containing 0, 1, 2, 3, 4, etc., responses on the left key before the right key was pressed. In the first session presented in the figure, 954 of the 975 emissions of the sequence were reinforced; and in the second session, 963 out of 978. Under continuous reinforcement, only about 80% of the emitted sequences conformed to the reinforcement contingency. As the two sessions presented in the figure suggest,

the distribution of unreinforced sequences was not stable. In the first session the subject switches to the right key about equally often after two presses of the left key as after four presses. In the next session the subject tends to undershoot, with most of the unreinforced sequences occurring after two presses of the left key.

The cumulative curves in the center of the figure, corresponding to the respective histograms, contain all of the responses on both keys. Responding is sustained at approximately 3 responses per second, with no pausing and few rate changes after reinforcement.

The performance was maintained with about the same number of unreinforced sequences at ratios of 33 conditioned reinforcements to 1 food reinforcement. Long pauses after reinforcements began to develop at this value, however.

SUMMARY AND CONCLUSIONS

The intermittently reinforced sequence was maintained with approximately the same number of "errors" as under continuous reinforcement. However, the percentage of sequences that did not conform to the reinforcement contingency decreased from 20% under continuous reinforcement to approximately 3% when 960 emissions of the reinforced sequence was required for an experimental session of 60 reinforcements, and 2% for the 1900 sequences required for an experimental session at a ratio of 33 to 1.

This experiment does not isolate the aspect of the schedule of reinforcement responsible for the more accurate maintenance of the performance. Presumably, the magazine stimuli helped maintain the topography by conditioned reinforcement. A possible factor in the maintenance of the required topography could be a reduction in the amount of behavior emitted per reinforcement when the behavior is emitted more accurately. Any unreinforced sequence increases the over-all number of responses emitted per reinforcement. A comparison of ratio with interval schedules of reinforcement of the complex response will be relevant to the analysis.

REFERENCES

1. Ferster, C. B. Punishment of behavior by time out from positive reinforcement. *Psychol. Monogr.* (in press).
2. Mechner, F., and Berryman, R. The establishment of a discrimination based on behavior-produced cues. Paper read at Eastern Psychological Association, Atlantic City, April, 1956.