Response rate as a factor in choice¹

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Four pigeons were trained on a concurrent chain schedule, in the terminal links of which food was delivered according to variable interval schedules. For one key in Experiment 2 reinforcement was contingent on not responding. Three control experiments were also run: baseline, return to baseline, and unequal reinforcement frequencies. Although rate differences of over 50 to 1 were obtained in the terminal links of Experiment 2, the pigeons remained indifferent between these schedules. The only change in preference occurred in Experiment 4, where preference matched reinforcement frequency.

In 1960 Autor investigated behavior on a concurrent chain schedule in which reinforcement in the terminal links was delivered according to variable interval (VI) schedules. He found that the relative number of responses on a key in the initial link equalled (matched) the relative rate of reinforcement for that key in the terminal link. This matching relation did not change when he made reinforcement contingent on not responding in both terminal links. Herrnstein (1964) also found that preference was more highly correlated with reinforcement rate than with reinforcement probability (reinforcements per response) in concurrent chain schedules employing VI and VR schedules in the terminal links. Fantino (1968), however, has recently published data showing that animals prefer FI schedules to the same schedules with an added restriction on the minimum or maximum number of responses. His data for the schedule requiring a low rate of responding are questionable, since two pigeons' rates were not appropriately controlled, yet they showed a greater range in preference than the third pigeon on this schedule.

The following study is an attempt to clarify the relation of the response rate evoked by a schedule to preference for that schedule. It employs a more effective method of control of terminal link rates than that used by Fantino. Since the rate is controlled in only one terminal link, the obtained differential measure of preference is more sensitive than the measure obtained by Autor. Finally, reinforcement rate is held constant, so that instead of looking for a deviation from a correlation as did Herrnstein, all obtained changes in preference can be ascribed to the terminal link rate differences.

Method. Four male White Carneaux pigeons, all with previous experimental histories, were maintained at 80% of their free-feeding weight.

The experimental procedure conforms to the basic concurrent chain design which consists of a regular alternation between two states, an initial choice link, and a terminal reinforcement link. In the choice link responses of at least 15 g force to either of two Gerbrands pigeon keys occasionally changed the color of that key from blue to red (left key) or from blue to green (right key), with the other key going dark. Further responding on the lit key produced reinforcement according to VI 30 sec schedules in all cases except two. For the right key in Experiment 2 reinforcement was delivered as soon as a VI 30 sec schedule set up, but no sooner than 1.5 sec since the last response on that key. For the right key in Experiment 4, reinforcement was delivered according to a standard VI 60 sec schedule. After one reinforcement with grain in the terminal link, the program reverted to the choice link with both keys blue. The occasions upon which a response in the choice link would cause a transition to the reinforcement link were determined by separate VI 60 sec schedules for each key. Each experiment was run for 17 days.

Experiments 1, 3, and 4 were controls for Experiment 2. In Experiments 1 and 3 conditions of reinforcement were identical for the left and right keys, and thus the birds should be indifferent between them. In the terminal link of Experiment 4 reinforcement rate for the right key was half of that for the left key; the birds should prefer the left key. In Experiment 2 reinforcement frequencies were equal, but the contingencies of reinforcement differed. The schedule on the left key in the terminal link encouraged moderate, uniform rates of responding, while the schedule on the right key discouraged any responding at all.

Results and Discussion. The schedules employed in Experiment 2 were effective in establishing different rates of responding in

Fig. 1. Preference for left key (responses on left key in initial link/total responses in initial link). Data are averages over last five days in each experiment for each bird.

the reinforcement links: averaged across birds for the last five days of Experiment 2, these rates were 52.3 responses per minute on the left key and 0.95 responses per minute on the right key. A substantial number of these right key pecks were emitted just after entry into the terminal link, and represent the last response in a run initiated in the choice link.

The effect of this large difference in response rate on preference can be seen in Fig. 1. Pigeon No. 25 showed a consistent bias for the right key, but the only pigeon showing a marked change from the baseline of Experiment 1 and 3 was No. 259. When the data are averaged across birds, there is seen to be an increase from baseline preference for the right key of only 1%. The pigeons' relative indifference to radical changes in response rate stands in sharp contrast to their preference for schedules with higher reinforcement rates. In Experiment 4, halving reinforcement frequency on the right key resulted in an increase to 63% in preference for the left key.

Although the present study provides evidence that preference is independent of response rate, we cannot conclude that an organism is insensitive to the amount of work entailed in the procurement of reinforcement. When an animal is reinforced independently of its behavior, it will go through a series of stereotyped but arbitrary responses in the intervals between reinforcements. This phenomenon follows from the law of effect, which implies that reinforcement strengthens all immediately preceding behavior, not just behavior that is causally effective in providing reinforcement. When only the right key light was on in Experiment 2, the pigeons could be seen to peck the wall of their cage, pace back and forth, and jump up and down with higher frequency than in other phases of the experiments. No attempt was made to quantify the total energy expended, which may well have been the same for all schedules in the terminal link. Indeed it may be that total energy expenditure is completely determined by reinforcement frequency, while the form of that work—key pecking or superstitious strutting—is determined by the terminal contingencies of reinforcement.

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NOTE

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