Quantification of Steady-State Operant Behaviour
C.M. Bradshaw, E. Szabadi and C.F. Lowe, editors

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81-055

PERCHING DURATION REVEALS PIGEONS' TIMING CAPACITY

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INTRODUCTION

Pigeons have classically been found to perform poorly under schedules of Differential Reinforcement of Low Rates (DRL) when the critical delay exceeds 15 s or so. In terms of efficiency ratio or of mean or median Interrespone Time, their performance compares with that of mice, but is typically inferior to that of rats, cats, monkeys or, among avians, crows[1]. This limited capacity in temporal regulation of behaviour does not seem to reflect, however, a general deficiency in time estimation, as evidenced by pigeons trained to discriminate the duration of external events[2]. The discrepancy between the performances observed in these two different kinds of situations might be due to the intrinsic difficulties encountered by pigeons in regulating their own motor responses according to temporal constraints, as opposed to the supposedly easier task of attending to some external stimulus, and then making a judgement about its duration. Another possible explanation, however, would relate the poor performance of pigeons in DRL to the particular status of the pecking response in the species specific repertoire[3]. For reasons that remain to be documented, key-pecks would not be amenable to extended control by temporal contingencies of the kind involved in DRL schedule. Occasional reports on pigeons trained to press a lever under DRL do not conclusively support this hypothesis[4], but lever-pressing with the paw is an awkward movement for birds.

In the present experiment, a different kind of response was used, both simple and natural, that is perching. Pigeons were trained to jump on a perch and sit on it for a minimal period of time (critical duration) in order to obtain a reinforcement. These contingencies might be more properly defined as a schedule of differential reinforcement of response duration (DRRD) rather than DRL. It will be noted that the topography of the key-pecking response excludes its control by a response-duration schedule.

MATERIALS AND METHODS

Subjects. Four naïve homing pigeons, about six months old at the beginning of the experiment, were maintained at 90 percent of their free-feeding weight.

They were housed in individual cages in the animal room.

Apparatus. The conditioning chamber (50 x 50 x 50 cm) was equipped with a metallic perch protruding 16 cm from the rear wall and located at 13 cm above the floor. A weight of 180 g (largely inferior to a pigeon's weight) sufficed to depress the perch and close a circuit through a microswitch located behind the cage wall. A Gerbrands grain-dispenser was accessible on a side wall during 5 s whenever a reinforcement was due. The experiment was controlled by integrated circuits. The pigeons' performance was recorded on a 6 channels pen-recorder and by means of electronic counters, giving the distribution of response durations in 12 time fractions, each of which corresponded to 1/6 th of the critical duration. Control and recording equipment was located in an adjacent room so that no auditory information could be used by the subjects.

Procedure. After habituation to the experimental enclosure, the birds were shaped to produce the response and trained during three sessions without any temporal requirement. Then the minimal duration of the perching response was specified and increased by 1 s steps every 4 th session up to 40 s. However, the subjects were maintained for 15 sessions instead of 3 at the 30 s and 40 s requirements. Sessions lasted until 25 reinforcements had been obtained and took place twice a day at approximately the same hours, six days per week.

Treatment of results. The efficiency ratio (Number of reinforced responses/ Total number of responses) and the median response duration for successive values of the critical duration were computed from the recorded data. Relative frequency distributions of response durations in successive time fraction (six below and six above critical value) were built from the absolute frequencies.

RESULTS

One of the four subjects did not show any evidence of adjustment to the temporal contingencies and its results have been discarded from the following analysis.

In the other three subjects, the duration of perching was clearly controlled by the schedule requirements, the median response-duration approaching the critical value up to the maximal value explored, i.e. 40 s. This is illustrated in Figure 1 in which the median response durations have been plotted as a function of the critical value for each individual bird. Four points have been selected for the sake of clear presentation. The first two are based on values averaged from the 3 sessions at these critical durations. The last two are based on data averaged from the last five sessions of a series of 15 sessions at 30 s and 40 s.

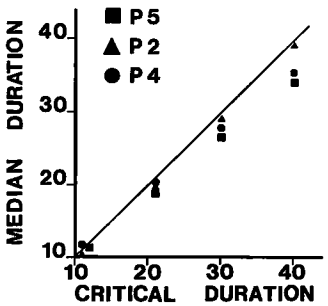

Fig. 1. Median response duration as a function of critical duration.

Temporal control is further evidenced by the distributions of response-durations along the time continuum. For all values of the critical duration, the relative frequencies distributions are characterized by central tendency indices close to the critical value, with comparable dispersion throughout the critical values range. Results for 30 s and 40 s are shown for each bird in Figure 2. It is clear, from the shape of these distributions, that the reinforced response are not accidental by-products of long perching, but the result of precise timing of behaviour.

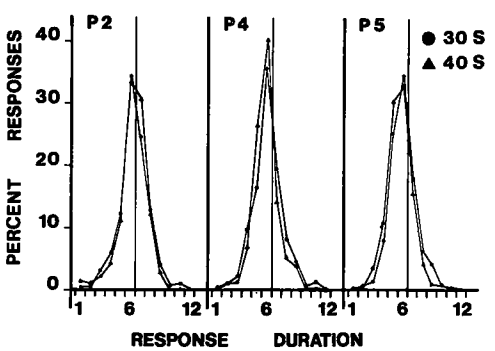

Fig. 2. Relative frequency distribution of response durations for 3 individual pigeons at critical duration values of 30 and 40 s. Time bins on the abscissa are fractions of the critical value indicated by the vertical line after the sixth fraction.

The efficiency ratio (table 1) was extremely stable in P2, remaining around . 40 and above for all critical values. It decreased as a function of the critical duration in P4 and P5.

TABLE 1
EFFICIENCY RATIO AS A FUNCTION OF CRITICAL DURATION
Data averaged and selected as in Figure 1

Subjects	Critical Duration			
	11 s	21 s	30 s	40 s
P 2	41.8	38.5	43.3	46.0
P 4	56.8	31.8	34.4	22.4
P 5	47.4	32.8	27.7	21.1

DISCUSSION

The results of three out of four pigeons used in this experiment demonstrate that members of this species are able to regulate in time their own behaviour far beyond the limits that were classically found in their performance under DRL schedule using a key-pecking response. Though there is the possibility that our subjects were exceptionally gifted creatures with respect to time estimation - a point that is currently being tested by training them to key-peck under DRL -, it is more plausible to account for their performance in terms of the nature of the response.

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ACKNOWLEDGEMENTS

A group of psychology students has contributed to this research.They deserve the gratefulness of the authors.