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AMOUNT CONSUMED AS A FUNCTION OF MAGAZINE-CYCLE DURATION

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ABSTRACT

With a standard pigeon feeder, the amount of grain a pigeon consumes is a monotonically increasing, negatively accelerated function of the magazine-cycle duration. The curve is probably determined by at least three factors: the time it takes the pigeon to lower its head from the key to the food magazine, the maximum amount of food it can easily retrieve from the feeder well during one reinforcement, and the decreasing accessibility of grain as it eats.

Since precise amounts of grain are difficult to dispense, many investigators have relied on magazine-cycle duration as a measure of value, magnitude, or amount of reinforcement (e.g., Catania, 1963; Neuringer, 1967; Rachlin and Baum, 1969; Hollard and Davison, 1971; Todorov, 1973). In so doing some may have assumed that amount consumed is proportional to magazine-cycle duration. The present experiment establishes the relationship between these variables with a widely used pigeon feeder (Gerbrands, Model B).

METHOD

Subjects and apparatus

Three male, adult Silver King pigeons served as subjects. Each had had a variety of laboratory experience. They were maintained at approximately 80 percent of their free-feeding weights throughout the experiment. A standard one-key chamber was used. The key was positioned 13 cm above the feeder opening. It could be transilluminated from behind with white light. A force of approximately 0.15 N was required to operate it. The feeder area was illuminated with white light whenever the

feeder was operated. The keylight and overhead white lights were extinguished during reinforcement. The chamber was enclosed in a sound-attenuating box equipped with a ventilating fan and white noise source. Events were recorded and controlled with electromechanical equipment.

The amount of grain consumed in each session could be predetermined using a simple device attached to the feeder. The device is a narrow (2 cm diameter) translucent tube mounted vertically onto the fixed food bin of the feeder. A photocell and light bulb are mounted opposite each other at the base of the tube. Over the course of a session the consumption of grain lowers the level of food in the tube. A session is automatically terminated when the level reaches the photocell. The feeder was carefully adjusted to minimize spillage behind the panel. The device was tested extensively over a 6-month period and proved to be reliable and accurate in dispensing measured amounts of grain.

Procedure

The device was loaded with 10 g of food (a 50:50 mixture of milo and hard spring wheat) before every session. Pecks were reinforced on a continuous schedule (CRF). Magazine-cycle duration was varied from 1 to 16 sec. For all subjects, the order of durations was: 3, 5, 7, 2, 12, 16 and 1 sec. Ten daily sessions were run for each condition.

RESULTS

The results are shown in Figure 1. The average amount of grain consumed during each magazine cycle proved to be a monotonically increasing, negatively accelerated

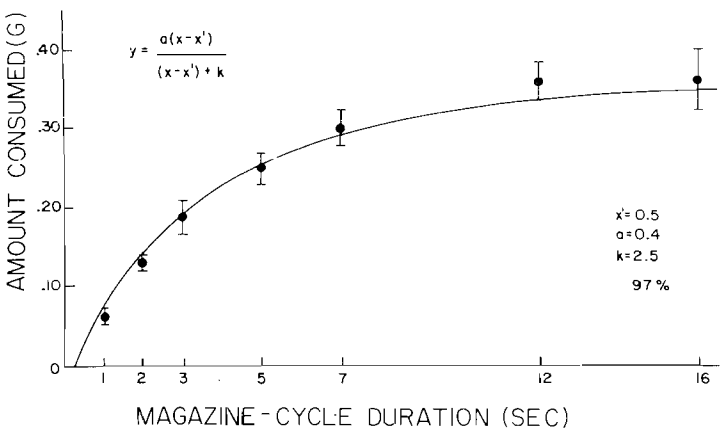

Figure 1. Average amount of grain consumed per reinforcement (measured in grams) as a function of magazine-cycle duration. Error bars represent one standard deviation to either side of the mean. Each point is based on the last 5 sessions in each condition, averaged across the three subjects.

function of magazine-cycle duration. The data were remarkably similar for each of the three subjects. The function appears to reach an asymptote at about 0.4 g per reinforcement.

DISCUSSION

The assumption that amount consumed is proportional to magazine-cycle duration is incorrect, though the relationship is approximately linear in the range of durations typically used (2–7 sec). A straight line ($y = 0.032x + 0.084$) through the four points in this range fits them fairly well ($r^2 = 0.96$).

The curve is probably determined by at least three factors: First, the x-intercept lies at approximately 0.5 sec, presumably the minimum time required for the bird to lower its head to the hopper and consume food. Second, the asymptote (at approximately 0.4 g) probably represents the maximum amount of grain the pigeon can easily retrieve from the feeder well during one reinforcement. The pigeon eats most of the food available at the feeder opening within a few seconds, and because the feeder arm is approximately horizontal when raised, little or no additional food replaces the grains that the pigeon has consumed. Third, the negative acceleration may be due to the decreasing accessibility of grain as the pigeon eats.

One function that fits the data well is a hyperbolic of the form

$$y = \frac{a\,(x - x')}{(x - x') + k}$$

where x is the magazine-cycle duration, y is the amount consumed per reinforcement, and the three parameters, a, x' and k, correspond to the three factors noted above: the asymptote a is the maximum amount of grain easily retrievable from the well; x' is the minimum time required for the bird to lower its head and eat; and k determines the curvature due, possibly, to the decreasing accessibility of grain.

Given values of 0.4 g for a and 0.5 sec for x', and varying k to provide the best possible fit of the data, yields the curve shown in Figure 1, which accounts for 97 percent of the variance in the obtained data.

The x-intercept will presumably vary with the distance between the key and the feeder recess. If reinforcers are timed from the moment the bird's head enters the feeder recess, the intercept should fall at the origin. Similarly, the asymptote of the curve should change as a function of the size of the feeder well and the size of the feeder opening. The newer Gerbrands feeders (G5610/B and G5610/GS) have larger wells and may generate a larger asymptote. An infinite well should generate no asymptote at all until the bird begins to satiate.

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