NOTES

An economical dispenser to improve control of food reinforcement in the rat

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A hopper dispenser designed for the study of food reinforcement in rats is described. By using ordinary rat chow, it significantly reduces the cost of reinforcing rats with food. By preventing stockpiling, it also guarantees control of the accessibility, as well as the presentation of food.

Recent research (Joffe, Rawson, & Mulick, 1973; Wight & Katzev, 1977) described the effects of early environmental control of appetitive reinforcers on adult behavior. In this research adult rats reared in an environment where they could control the occurrence of food and water were compared on a variety of behavioral tasks with rats reared in an environment which did not permit such control. Unfortunately, two problems are associated with both studies because of their conventional methods of delivering food. First, the typical food-delivery system for rats does not permit precise control of the relationship between operant responding and reinforcement. In this system standardized pellets of food are delivered into a food dish from a separate and independently controlled dispenser. With this arrangement, the rat is free to eat the food any time after it is presented. Most rats usually consume the pellet immediately after it drops into the food dish, but this is not always the case. With extended training, rats often stockpile food pellets in the food dish. When this occurs, rats presumably receiving uncontrollable food are, in fact, on a free food schedule, where they exert considerable control over when food is eaten. This is a particularly serious problem for developmental research on "appetitive helplessness" (Maier & Seligman, 1976), where it is essential to gain precise control over the presentation and the accessibility of food. Second, the cost of feeding rats with the conventional food-delivery system can often become prohibitive. This is most apparent in studies which require rearing rats exclusively on commercially available food pellets for periods as long as 2-3 months. The current price of the standard (4.0 mm x 3.3 mm x 45 mg) Noyes Precision Food Pellets is \$1.30/M when ordered in

lots of 10M-19M. A healthy adult rat can be expected to eat between 15 and 20 g of food per day, or approximately 333-444 of the 45-mg pellets. At current prices this amounts to a daily cost of 43-58 cents per rat. While this may not seem excessive, it can become a considerable sum when a group of rats is investigated over an extended period of time. The cost of feeding a relatively small sample of 24 rats in the 67-day Wight and Katzev (1977) study amounted to over \$600.

APPARATUS DESIGN

The food-delivery system depicted in Figure 1 is designed to overcome both of these problems. It is modeled after the standard pigeon grain-feeder system (Ferster & Skinner, 1957), adapted so that rats can eat directly from the food hopper. In this situation food is accessible only during periods when the hopper is activated and moves up against the hole on the floor of the food cubicle inside the rats' housing chamber. The food consists of normal rat chow ground up to the consistency of thick sand which is stored in the hopper.

The stainless steel feeder is operated by 28 V dc at .5 mA, depending on the amount of food in the 344-cu-cm hopper. The hopper swings up to provide access to food when it is operated by a solenoid, controlled by an adjustable potentiometer. In the raised position, food is available through the 1.9-cm hole at the mouth of the hopper which joins the 1.9-cm

Figure 1. The food-delivery system. When the solenoid is activated, the hopper swings up to the food cubicle so the rat can eat from the food hole.

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hole in the floor of the food cubicle. The hopper remains in this position for a fixed period which is controlled by independent programming equipment. If the rat sticks its head into the cubicle during this time, it can gain access to food. In contrast, in the normal, unoperated position, the hopper drops back and away from the food cubicle, so that it is impossible for the rat to eat. This arrangement effectively prevents rats from stockpiling food and, unlike the standard feeding system, provides precise control over its accessibility.

DISCUSSION

We have recently investigated the behavior of 24 rats given extended exposure to this food-delivery system (Hoffman, Note 1). Observations of the eating behavior of these rats revealed that the animals initially scabbled with their paws at the food hole and managed to eat by getting small amounts of food onto the floor of the food cubicle. However, as sessions continued, they very quickly learned to consume food directly from the food hole without using their paws. Deprived rats readily learned to barpress for rat chow delivered in this fashion. Rats raised from weaning under conditions where they could eat only from this feeding system had no difficulty obtaining food. The weight of these rats, as well as their behavior in an open-field test, did not differ significantly from animals reared under normal colony conditions with the same rat chow freely available in the form of regular-sized lab blocks.

We have found that mature rats average approximately 200 food presentations per day when fed exclu-

sively with this system. Seventy days of constant operation of these hoppers by the 24 rats resulted in the consumption of 100 lbs of Wayne Lab Blox at a cost of only \$20. This compares to an estimated cost of well over \$600 for Noyes pellets.

In summary, this feeder provides an economical and well-controlled food-delivery system for rats. A simple adaptation of the standard pigeon grain feeder not only saves hundreds of dollars in the cost of food, but, by preventing stockpiling, it also enhances the experimenters control of both the presentation and accessibility of food.

REFERENCE NOTE

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