TECHNICAL NOTE

AN OPERANT FEEDING DEVICE FOR SHEEP¹

Many commercially produced food delivery devices are available for the operant conditioning of common laboratory animals, but none are suitable for use with larger domesticated animals. Meyers and Mesker (1960) reported the operant conditioning of a horse using a rotary grain dispenser modelled after the Williams' pellet feeder. Kaplan, Wulp, and Lapinski (1961) developed an automatic feeder for dogs that could be modified for use as an operant feeding device. Both of these devices delivered a fixed amount of food for an unlimited period of time. Ferster (1953) indicated that access to food for a fixed period of time is preferable for most purposes because it facilitates the maintenance of good stimulus control of the behavior with respect to the food magazine. This paper reports the development of a mechanism, designed for use with sheep, that presents food for a fixed period. With minor alterations, the apparatus may be suitable for use with other species of animals.

The frame of the apparatus is constructed from $\frac{3}{8}$ -in. thick aluminum panels (Fig. 1). The food hopper is mounted on a bearing-supported shaft connected by an electromagnetic clutch to a constantly rotating shaft driven by a 0.25-hp electric motor geared down to 40 rpm. The clutch is powered by a 90-v dc power supply through a relay under scheduling control. The clutch engages upon closure of the relay and the food hopper rotates through an arc of approximately 90° to a horizontal position, at which point contact is broken on the commutator and the clutch disengages. The hopper is held in place by a mechanical latching mechanism and is released by activation of a solenoid under scheduling control. Figure 2 is a circuit diagram of the apparatus. The food hopper is kept filled to the desired level by a 2.25-in. inner-diameter hose (not shown) connected to a large food container above the apparatus. The amount of corn that flows into the open eating area is limited by an aluminum baffle across the middle of the hopper (Fig. 3). This baffle also prevents the animals from gaining access to the corn when the hopper is down.

This device can be used with corn, other grains, and small pelleted feed. Some mechanical noise is generated by the solenoid that releases the latching mechanism.

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Fig. 1. Rear view of operant feeding device showing major components.

This is reduced by acoustical padding placed around the solenoid. Two springs connect the food hopper to the frame of the apparatus and serve to damp the fall of the hopper. Foam rubber on the underside of the

Fig. 2. Circuit diagram and specification of electronic components in operant feeding device. T—variable transformer; F—1-amp fuse; R1—10-ohm, 10-w resistor; D1—1.5-amp, 200-v_{RM} bridge rectifier; D2—IN 4004 diode; RE1, RE2—110-v coil DPDT relay; R2, R3—470-ohm, 0.25-w resistor; R4—150-ohm, 0.25 w resistor; C1—100-mfd, 200-v capacitor; C2, C3—0.22-mfd, 200-v capacitor; C4—0.5-mfd, 200-v capacitor; CL—Eaton Model 304 electromagnetic clutch.

Fig. 3. Detailed view of food hopper with top off.

hopper further reduces the noise associated with its release.²

The apparatus has been in daily operation in our laboratory for four and a half months. During this period it has delivered approximately 70,000 reinforcements with no down-time. Mechanically, the apparatus is exceptionally sturdy and mechanical failures are unlikely. The electrical components used are readily avail-

able, should replacement be necessary. The amount of grain that flows into the eating area is approximately the same from presentation to presentation. In our experiments a hopper-up time of 3.5 sec has been used. This permits the animal to obtain a fair quantity, but not to eat all the grain during a single presentation. The number of reinforcements that can be delivered during a single session is limited by the fact that in excessive quantities, corn is toxic to sheep. We have found that 100 reinforcements may be delivered with no danger to the animals.

In our initial work, the animals were reduced to approximately 85% of free-feeding body weights. More recent observations suggest that sheep will learn to perform an operant response for access to corn without being subjected to deprivation.

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