TECHNICAL NOTE

AN INEXPENSIVE FEEDER FOR RAPID DELIVERY OF MONKEY PELLETS

A common experimental procedure is to record and compare the behavioral effects of a stimulus (CS) terminated by response-independent food (positive UCS) with a stimulus terminated by shock (negative UCS). These two procedures appear to be simple classical conditioning procedures and are superficially identical. The delivery characteristics of pellet feeders, however, may alter a stimulus terminated by food into a higher-order classical conditioning procedure. The CS typically is not followed immediately by pellet delivery, but is followed by a second set of auditory and visual stimuli generated by operation of the feeder, which are in turn followed by the actual pellet delivery into a food cup. In contrast to the relatively long delay and duration of pellet delivery, both the rise time and duration of electric shock are usually measured in milliseconds.

A pellet feeder that reliably delivers food pellets in approximately 100 milliseconds may be made with two relays and a length of metal tubing (Figure 1). A 2-mm screw, 5 mm long (A), is attached to the top of the armature (B) of each telephone relay (Relay No. 34 E. C., C. P. Clair and Co., Chicago). Superfluous contacts are removed from each relay, with one contact arm replaced as the tension adjustment (maximum 200 g) against the arm of the relay armature (C). Each relay is mounted on the metal tube (D) with the screws inserted through 5-mm holes. The tension adjustment maintains each screw in a uniform position relative to the weight of pellets (E) within the tube. Crumbling or chipping of pellets during operation is prevented by fixing the screw of Relay 2 normally to fall between, rather than on, the pellets. An operate pulse to Relay 2 pulls the triggering screw from the tube, and the pellets advance to the triggering screw of Relay 1. The pellet(s) between Relay 1 and Relay 2 are delivered when Relay 1 is subsequently operated. Slight misadjustments of the screw of Relay 2, which may result in peripheral chipping of the pellets, are not critical. The pellet residue is delivered during the next operate cycle and does not accumulate within the feeder. The size of the feeder is adjustable to space and capacity requirements, ranging from a 5-in. (12.5-cm) tube for a 10-pellet capacity to a 41-in. (102.5-cm) tube for a 100-pellet capacity.

A critical consideration is that the dimensions of the metal tube must be only 2 to 3 mm larger than the corresponding dimensions of the pellet. The feeder depicted in Figure 1 is at present being used with locally produced oval-shaped pellets (major and minor axes 12 by 10 mm, tube size 14 by 12 mm) and spherical pellets (10 mm diameter, tube size 12 mm diameter).

This correspondence between the shape of the tube and the pellets assures that all pellets advance along a specific axis and arrive at the triggering points in a uniform position. The correspondence in shape also determines that oval pellets are uniformly oriented within the oval tube during the loading of the feeder. Due to variability in the amount of ingredients molded into pellet form, the width (minor axis) of approximately 5% of the oval pellets will be slightly oversized, and pellets that do not fit freely should not be loaded into the feeder. The feeder loading time depends on capacity, and ranges from approximately 30 sec for 10 pellets to 3 to 5 min for 100 pellets.

Oval tubing of various dimensions may be available at local plumbing supply houses, or pressed from round tubing in a smooth surfaced metal press. The pellets will "jam" when the tubing size is relatively too large and the pellets advance along a variety of different axes. Indentations or bulging within the wall of the tubing, or a twist in the plane of the major or minor axes, also results in pellet jamming.

The reliability and calibration of the feeder when adjusted to deliver three pellets is given in Figure 2. The delivery latency of each pellet approaches the upper limit of gravitational acceleration, with latency variability increasing for each successive pellet (90 to 110 msec for pellet one, but 135 to 175 msec for pellet

Fig. 1. A rapid-delivery pellet feeder.

Fig. 2. Delivery latency, for 100 operations of the feeder with three pellets released each time, measured as interruption of a photocell beam 4 cm (10 in.) from the feeder triggering point. Enlarged tracing from Nuclear Chicago 7100 Computer; full scale for the horizontal axis = 400 data points at 250 msec Vertical = number of pellets.

three. Short pellet-delivery latencies are obtained by (1) minimizing the distance between the triggering screw of Relay 1 and the delivery end of the tube, (2) mounting the feeder vertically, and (3) minimizing the trigger time and movement required to release the pellets.

Larger-capacity commercial food hoppers may be converted into rapid delivery feeders simply by (A) attaching a modified relay directly to the end of the food hopper delivery tube, and (B) using a slightly larger triggering screw (approximately 7 mm) sufficient to block one-half of the delivery tube. In operation, a pellet is delivered from the food hopper to the relay triggering screw, and is subsequently delivered to the subject by operating the relay. In this configuration, round tubing should be used for both oval and spherical pellets. The oval pellets will not jam when only one,

or a few, pellets are held in the delivery tube per operation cycle.

This feeder is inexpensive, operates with two moving parts, and is easily constructed without precision tools. Feeders of this type have been used in our laboratory over the past year by a variety of personnel, and have required minimal maintenance over several hundred hours of use. Once adjusted, the "failure to deliver" rate has been zero.

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