TECHNICAL NOTE

A LIQUID-FOOD, LIMITED-ACCESS FEEDER FOR FISH¹

Reinforcement systems suitable for use with fish have not been as highly developed as those for rats and pigeons. A frequently used fish feeder, described by Longo and Bitterman (1963), uses eyedroppers to squirt live worms into the back of a fish tank. This reinforcement system may have several undesirable features. The worm must be presented remotely from the fish to avoid hitting it with a jet of water. This produces an undesirable delay of primary reinforcement and tends to break up the pattern of responding on the two keys. Also, the fish could perhaps find a worm even though it had not made a reinforced response. The experimenter must load each worm by hand and only about 44 worms can be loaded at one time. Further, live food is hard to keep and spoilage can be a problem.

Figure 1 illustrates a fish feeder that has several advantages over previous designs. It uses a liquid food (Tubiflex made by Wardley Products Co., Inc., Long Island City, N.Y.), which is highly desirable for goldfish and does not deteriorate readily or require refrigeration. The liquid food is squirted into the food cup by means of a syringe and automatic syringe driver. The food cup can be located very close to the response keys and is normally covered by a black Plexiglas arm except when a reinforcement is presented. When the fish makes a reinforced response, the food cup lights up, a small quantity of liquid food is injected into it by the automatic syringe driver, and the Plexiglas arm lifts to uncover the food cup. The fish then moves quickly to the right and sucks the food out of the cup. After about 6 sec, the magazine light goes out, the fish backs away, and the Plexiglas arm covers the food cup again. The fish do not mouth at the arm covering the food cup between reinforcements. The Tubiflex fish food is a gelatinous substance that tends to hold together; diffusion of the food into the water has not been a problem.

Many fish feeders have been designed for live food (Hogan and Rozin, 1961; Haralson and Ralph, 1966) because goldfish generally work better for live food and may develop digestive problems with dry food. Some fish feeders have been designed for dry food (Mark, 1967). Wardley's Tubiflex, however, appears to be a highly effective reinforcer, keeps the fish in good health, and is extremely easy to use in an automatic feeding system. Figure 2 illustrates how the food is dispensed by an automatic syringe driver. The food is loaded into the syringe by drawing it out of its tube with a hypodermic needle. The syringe full of

food is connected to the No. 20 Teflon tubing leading to the food cup and the syringe is then placed into position in the syringe driver. A Yale Luer-Lok syringe is used to disconnect the tubing. The mechanical design of the syringe driver is shown in Fig. 3. A 10 cc syringe can deliver more than 1500 reinforcements from a single filling. The amount of food in each reinforcement can be programmed with great accuracy by a timer that controls the operation of the feeder motor. The amount of food dispensed in each session can be measured in cc's according to the graduations marked on the syringe. The fish feeder was designed primarily for goldfish, but it should prove useful for other fish with similar eating habits.

Fig. 1. Front view of the keying and feeding assembly. The food cup is located to the right of the two response keys. The plastic arm normally covers the food cup except during the magazine cycle. The micro-switch and cam are used to position the arm in either the up or down position.

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