TECHNICAL NOTE

A CUMULATIVE RECORDER FOR STUDENT USE

A precisely constructed and reliable cumulative recorder is invaluable in operant conditioning research, but such a recorder is often too expensive for student use. A useful substitute can be constructed by making some simple modifications to a standard typewriter in working order. In the model described here, the following modifications were made (see Fig. 1).

(1) The ratchet mechanism was removed so that the roller would rotate smoothly and continuously. (2) A small synchronous motor (0.1 rpm with 11 g-cm torque) was mounted on spacers on the end of the carriage. The motor shaft was connected to the shaft of the roller with a pair of one-to-one gears, but a direct coupling would be satisfactory. When power is supplied to the motor, the roller turns continuously, providing the chart drive. (3) A small solenoid (Guardian No. 16, continuous duty) was mounted under the keyboard (See Fig. 2). The armature was attached to the period (.) key by means of a pin that passed through a small hole in the key stem. The position of the solenoid was adjusted so that the key die normally rested an inch or two from the paper. The mounting of the solenoid must be quite solid and if possible adjustable.

When the solenoid is activated a period is typed onto the chart. Standard typewriter ribbon was used for recording data and multicolour ribbon was used when colour coding of data was required. Eight-inch wide chart paper in 30-inch lengths is used. These last for 30 minutes. Duplicate records, a useful advantage of these recorders, may be obtained by inserting carbon paper between two of the 30-in. long chart sheets.

The solenoid is connected to the output of a pulse former. Responses produce periods on the chart. The position of the carriage must be reset after each 70

responses. The bell on the typewriter carriage indicates when resetting, which is accomplished merely by pushing the carriage back to the left margin, is necessary. The margin stops are adjusted to suit the width of the paper. Symbols may be typed on the chart during experiments to indicate reinforcements and other procedural changes.

The recorders are noisy, and it is helpful to mount them on sponge rubber feet. Identical typewriters are desirable since this permits standardized mounting brackets for solenoid and motor. Total material cost of recorder was \$25: \$10 for the typewriter, \$10 for the motor, and \$5 for the solenoid.

These recorders will operate reliably and continuously at 5 responses per sec. At 10 pulses per sec the typewriter ribbon tends to tangle if the recorder is operated continuously. Short bursts of responses at this higher rate will be recorded quite reliably.

Six such recorders have been in use for three years with largely unsupervised undergraduate classes. Occasional adjustments to the position of the solenoids have been necessary, especially during the first year when they were not firmly enough mounted. In spite of thousands of operations the key linkages show no detectable wear. Motors with clutches and with at least the torque specified are desirable.

If an electric typewriter is used, electrical modifications may be substituted for mechanical modifications

Fig. 1: General view of modified typewriter.

Fig. 2: Mounting of solenoid.

and electrical resetting would be possible. An electric typewriter might also be adapted to measure latencies of response in experiments involving trial procedures. In this case, pulses would presumably be applied to the recorder at constant intervals of appropriate length

and the recorder would be reset when a response occurred.

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