TECHNICAL NOTE

A MONKEY-RESISTANT LEVER SWITCH FOR
AVOIDANCE CONDITIONING

This paper describes a reliable lever switch¹ for chronic use in avoidance conditioning with monkeys. The lever switch is mounted on a restraint chair (Mason, 1958) within easy reach of the monkey. The joy-stick lever (Figure 1D) which projects vertically is easily pushed or pulled (with a torque of 8.6×10^{-2} Newton Meters) in any direction (except straight up). Empirically, the lever switch is reliable for a minimum period of three months and a maximum period of 18 months of continuous use (Lockard, 1969; Barensten and Lockard, 1969). The time between operating failures depends on the lever behavior of the individual monkey. The only malfunctioning to occur in four years has been a consequence of tears in the rubber lever boot (Figure 1G) from monkey manipulation. Approximately one week following a tear, small particles of food and dirt accumulate in the switch actuating mechanism, causing switch malfunction. By periodic visual inspection of the rubber boot, it is possible to predict this difficulty and avoid lever failure during conditioning.

A modified commercially available switch assembly² (Figure 1) is used. The original spring lever (A) is replaced by a machined stainless steel rod (D) of 7 mm diameter, projecting 5 cm from the end of the rubber boot (G). (The original lever (A), a two piece press-fit assembly, tended to separate at the base with use.) The adjusting collar (E) set screw is inadequate initially to prevent collar rotation when the lever is manipulated strenuously. The rotation is prevented by applying Loctite³ to the bushing (C) and the collar threads.

To facilitate replacement of the lever rubber boot (G) when tears occur, the switch assembly housing is modified for ease of removal from the restraining chair. The microswitch terminals are wired to a connector⁴ (B) which is installed in the pipe-threaded hole on the end of the switch assembly housing. This modification is accomplished by removing the connector's square mounting flange and cutting matching pipe

threads on the back half of the connector shell. A hole (not visible in Figure 1) is drilled and tapped in the switch housing for a 10-24 set screw. The pipe threads are coated with Loctite. The connector, with wires soldered to the pins, is screwed into the switch housing, aligning the keyway to the same position on each housing. Finally, the set screw is tightened down against the connector and the wires are attached to the switch terminals. The completed lever switch is mounted on an L-shaped bracket (J) fabricated from 3 mm thick, half-hard aluminum. The lever switch bracket assembly is mounted to the restraining chair, with machine screws held by butterfly nuts.

When repairs are required, the switch assembly is partially disassembled as shown in Figure 1 and all parts are cleaned and inspected for wear. Wear on the adjusting collar necessitates its replacement² every second or third rebuild. Each of the component parts of the switch assembly (except D) is available separately from the manufacturer. In addition, a repair kit² is available consisting of parts A, F, G, H, and I (part A is discarded).

Except for the adjusting collar, reassembly is evident from disassembly. Loctite is applied to the bushing threads and the adjusting collar threads. The collar is screwed onto the bushing and the retaining washer (F) is installed in the slot on the lever. There is a range of several turns of the collar which allows operation of the switch by the lever. (Considerable drag due to the Loctite is evident when the adjusting collar is turned.) The collar is turned to the center of this range and the set screw in the collar is tightened vigorously.

The cost of the component replacements are quoted by the manufacturer², but an average lever-switch repair has been less than \$3.00.

REFERENCES

- Barensten, R. I. and Lockard, J. S. An automated multi-channel programming, data collection, and printout system for avoidance and stress conditioning of monkeys. *Behavioral Research Methods and Instrumentation*, 1969, 1, 187-189.
- Lockard, J. S. Shaping avoidance behavior in restrained monkeys. *Journal of the Experimental Analysis of Behavior*, 1969, 12, 649-652.
- Mason, J. W. Restraining chair for the experimental study of primates. *Journal of Applied Physiology*, 1958, 12, 130-131.

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²Switch assembly, Microswitch Division of Minneapolis Honeywell #BAF1-2RN18-LH. Repair Kit, Microswitch #6PA20. Adjusting collar, Microswitch #BF-10131.

³Loctite Corporation, Newington, Conn. Type AA(15-1) Loctite Sealant.

⁴Switch connector, Amphenol MS3102E16S-1P. Tubing connector Amphenol MS3106E16S-1S.

Fig. 1. Lever switch and display of parts covered in text. Complete assembly upper right.