

Reports from the Research Laboratories
of the
Department of Psychiatry
University of Minnesota

TECHNICAL NOTE

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MSDN
P95
QR311r
76-2

Report Number PR-76-2

January 19, 1976

MSDM
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¹Development of this device was supported by U.S. Public Health Service Grants AA-0029 and DA-00944. We thank Harley Rasmussen for his technical assistance in the design. J.E. Henningfield is a predoctoral trainee (U.S.P.H.S. MH-08565) and R.A. Meisch is a recipient of a Research Scientist Development Award DA-00007. Reprints may be obtained from Jack E. Henningfield, Mayo Box 392, University of Minnesota, Minneapolis, Minnesota 55455.

A variety of drinking devices are currently available for liquid self-administration by primates. Two kinds of devices have been used in our laboratory and were found to be deficient. The standard drinkometer-equipped water bottle (with or without ball-bearing tips) was subject to leakage, particularly when ethanol-water solutions were used. This finding has also been reported by others (Amit, Amir and Corcoran, 1973). A second problem with water bottles is that intermittent reinforcement with liquid is difficult. Also, intermittent reinforcement is not possible with the "tamper-proof" fluid dispenser described by Mendelson and Mello (1965). The lip-lever spout (Grunzke, 1961; Thompson, Schuster, Dockens and Lee, 1964) is beset by the mechanical difficulties of a lip-sensitive lever, e.g., jamming. Furthermore, it is easily hand operated and spillage may occur following lever operation. Lal and Zabik (1972) have described a liquid operandum for rats whereby a lick response activates a solenoid liquid valve that delivers a drop of liquid. The drop size may be regulated by the experimenter and intermittent reinforcement is possible. The drinking device described below shares the advantages of the Lal-Zabik system but was especially designed for monkeys.

The requirements of a drinking device used in our research included: absence of leakage of water and ethanol solutions; an accurate means of regulating volume delivered per reinforcement; and a way to intermittently program liquid availability. The drinking device described below fulfills these requirements. In addition, the current drinking device is operated by lip contact, and this response is easily learned and can be emitted at a high rate.

The drinking device consists of an electrically non-conductive spout (Grade A Lava from Minnesota Mining and Manufacturing Co.) with a small

recessed brass plate. This arrangement requires at least 1 cm of the spout to be inside of the monkey's mouth such that lip contact with the brass plate triggers a standard drinkometer switch (e.g., Coulbourn Instruments #S26-01 or BRS/LVE #DR901). Liquid is gravity-fed by the programmed operation of a liquid solenoid switch (e.g., Allied Control #20394-24VDC). Both the recessed position and the small size of the drinkometer contact plate helped to eliminate liquid spillage and short-circuiting of the drinkometer.

A timing clock is programmed to limit the maximum amount of liquid delivered per reinforcement. The appropriate setting must be empirically determined, but a typical value in our experiments is 0.3 sec and will allow approximately 0.5 ml of liquid to be delivered. Programming liquid delivery contingent on both drinkometer contact and timer operation prevents spillage when the monkey removes his mouth from the spout. Since the liquid spout contains no moving parts, a 4.7-W stimulus light is mounted 5.0 cm above it. Operating the stimulus light by the drinkometer circuit provides feedback for onset and termination of each response.

Prototype models of this drinking device have been successfully used with 9 rhesus monkeys in our laboratory for over 3 years. The monkeys' drinking behavior has been intermittently observed via closed circuit television: Virtually no liquid spillage occurs and the device is operated by lip and not by hand contact. The versatility and reliability of the device were not matched by other drinking devices and has made possible intermittent reinforcement of liquid responses with specified amounts of liquid (Henningfield and Meisch, 1975; Meisch, Henningfield and Thompson, 1975). Figure 1 shows a cumulative record of liquid responding by monkey M-W on a fixed-ratio 16 schedule (FR 16) for 0.5 ml of 8% (w/v) ethanol per reinforcement.

M-W FR16: 8% Ethanol

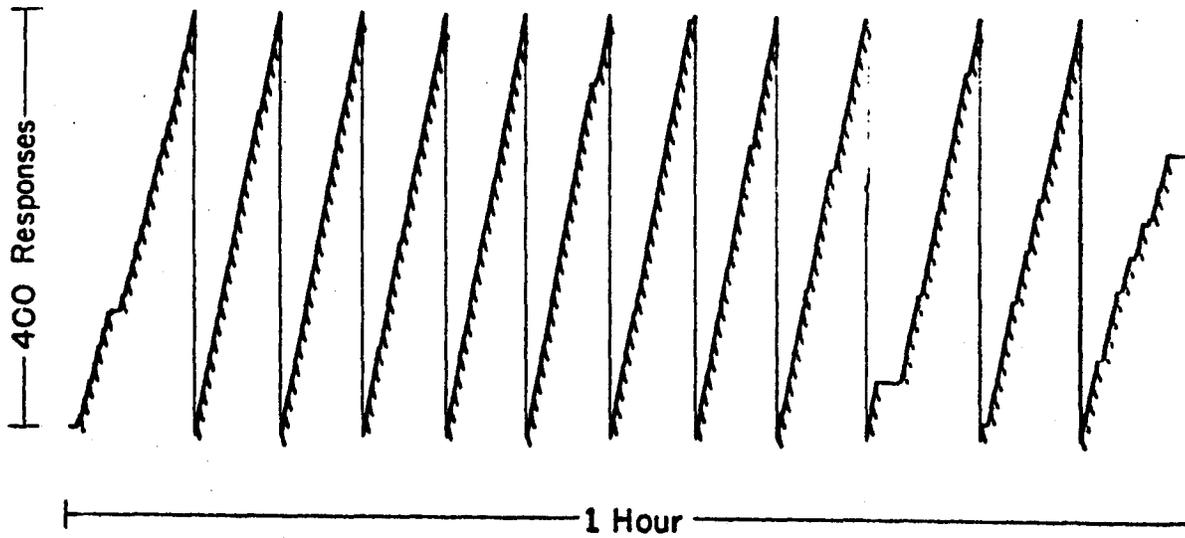
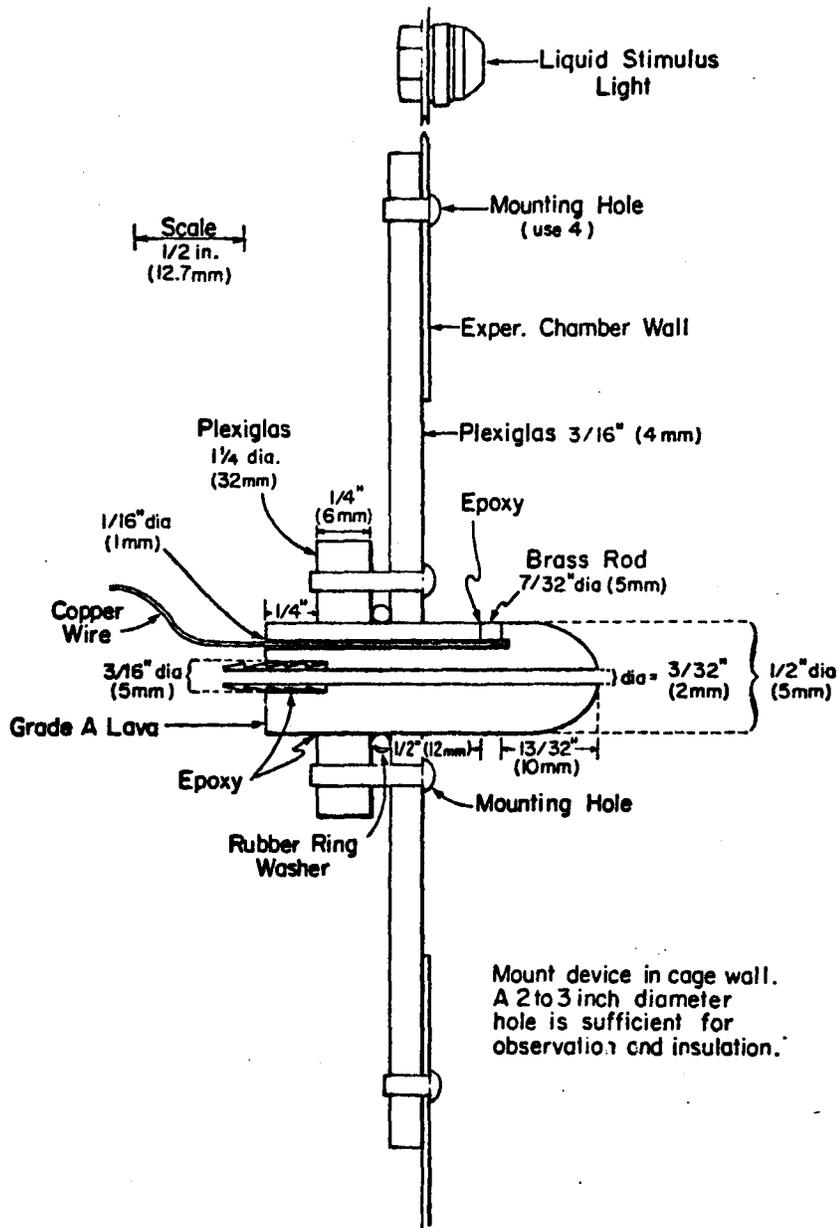


Figure 1. Cumulative response record for monkey M-W on an FR 16 schedule of reinforcement. Reinforcements were the delivery of a maximum of 0.5 ml of 8% (w/v) ethanol. These data were obtained during the first hr of a 3-hr session.

Notes on Construction

Figure 2 shows the specifications and construction of the drinking device. The device was initially constructed entirely of Plexiglas. Plexiglas was adequate for most monkeys, but one monkey chewed the Plexiglas spout and destroyed it in about 6 months. Grade A Lava has since been used. It is inexpensive and very easy to shape and drill since it derives its strength from a baking operation done after machining. The cylindrical drinkometer contact plate is tightly fitted into place, fastened with an epoxy resin. The liquid reservoir must be mounted higher than the drinking device and the solenoid valve attached either directly to the reservoir or enroute to the drinking device. Flexible tubing with an inside diameter of 3 mm (1/8 inch) or greater is sufficient for constant liquid flow. Better electrical isolation of the drinkometer circuit can be obtained by mounting a Plexiglas plate on the experimental chamber. In our chambers (Labco #ME1305 and Hoeltge #HB-108-P2), a 5.7 cm diameter (2-1/2 inch) hole was punched through the wall. Then, a Plexiglas plate was bolted to the outside of the chamber to cover the hole. Mounting the drinking device on the Plexiglas plate in this fashion permits observation of the monkeys while they drink, plus provides the electrical isolation mentioned above.



Mount device in cage wall.
A 2 to 3 inch diameter
hole is sufficient for
observation and insulation.

Figure 2. Construction and materials used in the drinking device. The brass drinkometer contact plate is first soldered to the copper wire and then is epoxyed into place.

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