A NEW DEVICE FOR ASSESSING MOTOR SKILLS IN THE RAT

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Abstract. An automated climbing apparatus to test locomotor capacity in rodents is described along with programming circuitry and a description of the printed circuit process. Past application is noted and in addition future uses are suggested.

In 1958 Winter and Flataker (3) described a simple rope-climbing task designed to test the effects of antihistaminic drugs upon performance. This same device was later used by Ghent and Freedman (1) to determine the effects of schizophrenic serum on motor performance in rats. We decided to develop a modification of the climbing apparatus to test the locomotor capacities of rats with focal X-irradiation of the cerebellum but felt that a more automated procedure than the original device would be needed.

APPARATUS AND PROCEDURE

The equipment consists of a tall upright box approximately 30 cm² with a hinged clear plexiglass front permitting observation of the animals (see Fig. 1 for relevant dimensions). The floor of the unit consists of a set of stainless steel rods across which a scrambled electric current of 3 ma can be pulsed. Three separate ropes of decreasing diameters can be suspended from a microswitch so as to provide a climbing time measure; the operant required of the animal is to climb from the grid floor to a goal platform by means of the rope. The goal platform is positioned 25, 50, 75, 100 or 125 cm from the grid floor. A trial is initiated when an animal is placed on the grid floor; 5 sec after this
Fig. 1. Diagram of climbing apparatus with relevant dimensions indicated.

if the animal hasn’t responded a buzzer sounds and 5 sec after this electric shock is administered; shock remains on until the animal has climbed onto the goal platform or until the trial has terminated. A starting time or latency of response from the initiation of a trial until the animal first gets on the rope is also recorded. Both total trial length and warning stimulus times are adjustable. Figure 2 shows a schematic of the programming circuitry.

The use of integrated circuits provides for a relatively small package and for reliability of operation. The Motorola line of resistor-transistor logic (NAND logic) is used. We have found the commercial temperature range line of logic encased in a dual in-line plastic package to be both inexpensive and reliable when used within specifications. Noise immunity is low and few problems were encountered in that area.

Printed circuit boards are used extensively in the apparatus. All micro logic is mounted on cards as well as the power buffers, the timers, and the small components for the power supply. After appropriate layout diagrams were made for the boards, opaque tape of various widths was laid down on clean acetate sheet in the exact pattern the copper on the P.C. board was desired. A photographic contact negative was then made of the acetate pattern. Solid copper clad phenolic board, made by the
Formica Company, was used as the base material. The copper clad board was thoroughly washed in detergent, rinsed, dipped in 50% hydrochloric acid, rinsed in distilled water and dried. The copper was spray coated with Kodak KMER Metal Etch Resist, type M manufactured by the Eastman Kodak Company, and baked at 260°F. The boards were allowed to cool in semidarkness and exposed under the above negative to a fluorescent ultraviolet light source for 10 min. The ultraviolet light, where it passes through the clear sections of the negative, cross links and polymerizes the photo sensitive resist. The exposed boards are dipped in Metal Etch Resist Solvent, also made by Kodak, for 20 sec to dissolve the resist where it has not been polymerized by the light.
A cold water rinse removed the excess solvent and the boards were again baked at 260 °F for 15 to 16 min to further harden the resist. Etching then followed in a concentrated ferric chloride solution heated to 160 °F and agitated. The etchant oxidized the bare copper away from the board where it was not protected with resist. Etching time varied from 30 min to several hours depending on the ferric ion concentration in the etching solution.

![Chart showing climbing time for animals receiving different treatments.](image)

Fig. 3. Climbing time for animals receiving different treatments. (From 2.)

Figure 3 is taken from an earlier publication (2) where we reported on some of the behavioral consequences of focal cerebellar X-irradiation in the rat. Each point in the graph represents the median of six animals. It is noted that there is an almost linear increase in climbing time with increasing number of daily irradiations. This information is offered as suggestive of the type of application to which this equipment may be suited.

In general we have found this piece of equipment to be reliable, versatile, and a convenient way to test a variety of motor and coordinative skills in rodents.

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REFERENCES


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