An inexpensive retraction mechanism

M. G. GRISHAM, A. H. WOLACH, and D. P. FERRARO,
UNIVERSITY OF NEW MEXICO, Albuquerque, New Mexico
87106

An electric retraction mechanism, which is adaptable to a wide range of operant manipulanda, was developed. Miniaturized, inexpensive toy railroad equipment was used to simplify construction. The mechanism, utilized as a retractable rat lever, has operated reliably and uniformly over a range of independent retraction and extension times.

Discrete-trial instrumental conditioning may be performed in an animal lever-press or wheel-turn operant apparatus if some means of physically preventing the free repetition of the response is available. Several electric and pneumatic retractable levers, which enable E to withdraw a lever from the apparatus upon signal, are commercially produced. However, present commercial levers are typically expensive and lack versatility. Essentially what is desired is a reliable, inexpensive retraction mechanism that will: be adaptable to a variety of operant manipulanda as well as drinking tubes, operate positively but in relative silence, make possible a range of independent retraction and extension times, and return the manipulandum to exactly the same position after each extension.

A mechanism satisfying these requirements is shown in Fig. 1 with a small animal lever mounted in place. The basic retraction mechanism consists of a vertically suspended manipulandum carrier that is driven back and forth between tracks on smooth, reliable bearings by a miniaturized, reversible, variable-speed drive. The components are N-gauge toy railroad items readily obtained from local toy or hobby stores.

Construction was accomplished by cementing a 6-in. length of N-gauge railroad track to the top and bottom inside surfaces of a plastic holder ($5\frac{1}{2} \times 6 \times 2$ in.). The manipulandum carrier consisted of a $3 \times 4 \times \frac{1}{8}$ in. plastic rectangle that was cemented at the bottom to a N-gauge train engine (Atlas 2122 with plastic cover removed) and at the top to a $3 \times \frac{5}{8} \times \frac{1}{4}$ in. plastic strip. Two N-gauge train trucks (removed from Atlas 2601 car) were attached to the horizontal plastic strip with $\frac{8}{32}$ bolts passed through stiff metal springs. After the carrier was placed between the tracks, the spring tension was adjusted until the upward pressure on the trucks was sufficient to hold the carrier firmly in place. Small rubber stops were cemented to the holder wall at each end of the bottom track. Electrical connections from the

Fig. 1. Side and front views of the retraction mechanism. The manipulandum carrier with a typical lever assembly (dotted areas) mounted in place, is shown suspended between the train engine and car trucks (cross-hatched areas) that move the carrier back and forth on tracks. Extent of travel is limited by rubber stops (vertically lined).

train and manipulandum were made with thin flexible wires led to jacks mounted on the holder walls. Any manipulandum mounted on the carrier may be made available for stationary use by passing a bolt through the back holder wall with the carrier in its forward position. The total cost of the retraction mechanism, which takes about 3 h to construct, is under \$16.

The retraction and extension times for the manipulandum carrier can be independently controlled by varying the voltage applied to the engine (8-12 V dc). Direction changes are accomplished by reversing polarity to the engine. Duration of the retract and extend pulses should be limited to 300-600 msec in order to avoid overheating and to minimize operating noise. Absorption of the engine is .23 A, although unfiltered current of 1 A should be available. Periodic lubrication and replacement of motor brushes is required. To date, four retraction mechanisms have been utilized as retractable rat levers for several thousand operations at retract-extend speeds of 200-500 msec. No electrical or mechanical difficulties (derailments, etc.) have been encountered.

NOTE

1. This mechanism was developed under NSF Grant GB7674.