AN EXTREMELY LOW FORCE MANIPULANDUM

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Work with 18 to 30 day-old rodents, with body weight frequently less than the amount of force required to trip currently available bars and levers, led to the development of a manipulandum that operates at a minimum force of 1 g, applied over $\frac{3}{8}$ to $\frac{1}{2}$ in.

The one moving part is a pivoted aluminum bar, one end of which carries a Plexiglas T that protrudes into the training box. The opposite end of the bar acts as a shutter to break a beam of light that normally falls on a photoconductive cell, casting it into shadow, and thereby tripping the relay. A potentiometer in the circuit controls sensitivity, both for variations in light source and for vertical displacement of the bar. The low mass of the bar does not produce double-firing caused by bounceback since the amount of shutter closure required for tripping the relay far exceeds the amount of bounce occasioned by release of the bar. The light source illuminates the T through the slot in the intelligence panel, providing several advantages to the device. The illuminated bar seems to facilitate conditioning by attracting the animal's attention. It is possible, by mounting colored lamps on either side of the shutter, to present the bar in varying colors, and the bar may be made inoperative by turning off the light source, representing a simple way of removing the manipulandum for chaining.

Acoustic feedback is supplied to the animal by the click of the relay.

The small amount of energy required to trigger the bar not only makes feasible a bar-pressing operant in very young, light-weight animals, but facilitates self-shaping in adult animals by providing reinforcement for tentative touches, or even nosing of the bar. Finally, the reduction in effort, and possibly in fatigue, may account for observed rapid development of high response rates that can be maintained over extended time periods. Since the characteristics of a manipulandum are of demonstrated significance, use of an ultrasensitive manipulandum has implications for more subtle analysis of behavior.