companion materials, enables the instructor to conduct a psychophysical experiment that yields instructive and reliable data. Applications range from demonstrations in introductory courses to laboratory units in experimental courses. Data may be gathered from large groups through the tape recorder's speaker or from smaller groups using audio distribution techniques.

The tape can be played on any four-track (stereo) recorder taking a 7-in. reel at 7½ in./sec. All the data may be gathered for both standard and comparison in less than 20 min. Two versions are available. One contains comparisons that differ by 2 Hz; the other contains 3-Hz differences.

Contents include (1) tone sequences enabling the instructor to anchor the sensation level of the recording at 20, 30, 40, or 50 dB re .0002 dynes/cm², (2) verbal instructions for judging tone pairs, (3) 70 tone pairs with the standards presented first, (4) verbal instructions, comparison tone first, and (5) 70 tone pairs with the comparison presented first.

Price of the tape recording is \$15 for either version. A package of 100 data sheets is \$1.50, 20 scoring sheets are \$1.00, and a booklet, "Guide," sells for \$7.50 per 20. The booklet provides instructions for analyzing the data. The student is guided through simple graphic methods, the average Z-score method, and an algebraic method for computing DLs and PSEs. Time-order error is discussed.

The distributor has permission from most textbook publishers to reproduce figures, tables, and other portions of books for educational purposes. If one has graphs or drawings that might be incorporated into lectures, 2 x 2 slides of the material will be provided on request at \$0.75 each (minimum order of eight).

The company is relatively new and appears eager to receive suggestions and to discuss the possibility of participation by experimental psychologists in designing and developing instructional materials.

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Notes

A well-regulated constant-current shocker¹

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Reliably delivering a specified amount of electrical energy to a rodent on a grid floor has long been a problem of both practical

Fig. 1. Shocking circuit that provides well-regulated current to S. Parts list: R1 – 10-megohm resistor; R2 – 3.9-megohm resistor; R3, R4 – 1-megohm resistors; T1 – transformer, Stancor P-8179, or equivalent; S1 – Amperite time delay relay, 115N060; S2 – 15-position rotary switch with NE-2s between each position; S3 – 24-V relay with high-voltage contacts.

and theoretical importance to psychologists. The simplest and most economical means is to connect even-numbered bars to one side of the voltage source and odd-numbered bars to the other side. When this method is used, two problems are encountered: a fetal boli across any two adjacent bars provides a sufficiently low resistance to short the entire grid so that S receives no shock; in addition, S may learn to stand only on grids of the same polarity and receive no shock.

The most common solution to these problems is the scrambling device that continually changes the polarity of each bar with respect to others. This may be done with a stepping switch, a magnet rotating within a configuration of reed relays, a rotating disk with holes that operate photocell relays, a system of pulsed flip-flops, or by other means. But scrambling circuits have at least two drawbacks, and most have additional disadvantages which apply to some but not all such devices. One lead is required for each and every bar, which generally means a separate cable is required to carry shock. In some situations, e.g., in the two-compartment shuttlebox in which the E wishes to isolate shock to each compartment, a large number of switching contacts are required to control the stimulus. Also, the output of any scrambler

is a series of spikes, which may in itself have undesirable effects. The rate of these spikes, and consequently the amount of shock received, depends upon the number of grids S is in contact with. There are, probably, systematic differences in posturing by Ss, and therefore increased inter-S variability. Some shocking devices offer additional disadvantages, such as high cost, excessive noise, low switching rate, inadequate or differing shock "on" time between different grid bars, and wide fluctuation in the current actually delivered to S.

The shocking device described here has been used to eliminate most of these problems. This device is based on the operating characteristics of the NE-2 neon bulb, i.e., the bulb acts as a conductor whenever the voltage is above a breakover voltage and as an infinite resistance when the voltage is below that level. One of the bulbs is connected between each of the grid bars, and a voltage is impressed to the entire series. This enables current to flow through the bulbs when no S is in the system. However, when S is between any two of the bars, the parallel resistance across the neon bulb drops the voltage below the breakover point, the bulb stops conducting, and the current is diverted through S. Only two leads are required, one to each end of the string of neon bulbs. This principle has been presented before by Brown, Reus, and Webb (1961), whose circuit provides the basis for the method presented here. Unfortunately, in two attempts we were unable to operationalize the Brown et al circuit with the specified components. Also, adjustment for differing numbers of grid bars is made by switching transformers in series, a bulky and expensive method of control, and one lacking in precision.

The circuit diagram for the shocking device used in our laboratory is presented in Fig. 1. The major active element in the circuit is the pentode (6K6), which provides half-wave rectification in addition to constant current. It does so despite large load changes or changes in the number of grid bars contacted or spanned by S. The pentode requires about 1 min of warm-up time and is guaranteed by the thermal relay (S1). Current level control is provided by R3 and R4, where R3 is the coarse and R4 the fine adjustments. S2 is a 15-position rotary switch with NE-2s wired across each position. The switch enables E to dial the number of grid bars in the experimental environment and maintain exactly the same electrical parameters in two environments differing in the number of bars. S3 is a control relay operated at times when shock is to be delivered.

It is possible to use the neon bulb principle in a far simpler circuit such as

Fig. 2. Simple shocking circuit that requires no scrambler and provides fair regulation.

that presented in Fig. 2. All that is really required is a high-voltage transformer in series with a large resistor (R1) and the string of neon bulbs to provide a relatively constant current. Such a circuit would provide a less constant current than the pentode circuit and ac output as opposed to half-wave rectified dc.

Our experimental experiences indicate that inter-S variability is somewhat less with the neon shocker than with the conventional scrambler, and that avoidance performance is slightly better.

REFERENCE

BROWN, C. C., REUS, J. F., & WEBB, G. A new constant current stimulation circuit. *Digest of the 1961 International Conference on Medical Electronics*, 1961, 200.

NOTE

1. The development of this device was supported by National Institute of Mental Health Grant MH 17032 to the author.

A device to prevent fence sitting in shuttle avoidance¹

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A common form of learning that takes place with rats in a two-way shuttle-avoidance box is learning to sit on the fence, avoiding not only the shock but also the necessity of making any other response. Using a modified Lehigh Valley shuttlebox, we have found that up to 20% of the rats tested learn this response. This is a particular problem in situations where the data is automatically recorded since there is usually no way to distinguish fence-sitting Ss from those failing to escape. We have observed Ss fence-sit early in the session without ever having made a response, late in the session after the avoidance response is well learned, or even in the middle of the session with a number of avoidances both preceding and following a number of trials with S on the fence.

Isolating shock to one compartment eliminates many of the early fence sitters. Two response patterns appear to emerge. Some animals scramble wildly, clear the barrier with a single jump, and land in the other compartment. The time between first contact with the second food (completing the shock circuit) and depression of the floor (resulting in shock offset) is minimal or even negative. Hence these Ss receive little or no shock on the safe side. Other Ss jump to the barrier and then slowly crawl into the other compartment and often do receive shock on the "safe" side. So the barrier is the only place in the box without shock and the animals often remain there

Fig. 1. Control circuit for addition of string of NE2s, as described in the text.

for the duration of the session. Without shock on the safe side, S usually completes the crossing response.

An even more effective device is an electric fence, which we use in conjunction with a neon-tube shocker (Bintz, 1970). With the electric fence, none of approximately 250 Ss have been sitters. Several Ss with prior experience in fence sitting were trained with the electric fence, also. All "unlearned" the fence-sitting habit and most learned to avoid.

In the system described the barrier is 1½ in. high and is constructed of 3/8-in. Plexiglas. At ½-in. intervals No. 28 holes are drilled through the Plexiglas from edge to edge and 2-in. 6/32 screws are inserted. The top of the barrier appears as a series of screw heads with associated washers. The neon tubes are connected to the screws at the bottom of the barrier and are physically located in 3/16 holes drilled ½ in. deep into the plastic between screws. One shock lead is attached to the last neon bulb in the series on the fence, and the other lead is attached to the first bulb in the chain of each compartment so that every point of the fence is hot with respect to any bar in the hot compartment. The same scheme could be used with any shocking device, except that a large number of wires would need to be placed where they are especially vulnerable to biting and pawing. With our technique, no lead is longer than ¼ in., and the leads are well hidden.

If the fence is electrified with the UCS presentation, neither escape nor avoidance learning precedes as rapidly as it might with an interval between UCS and fence onset. This occurs because Ss avoid approaching the fence after being shocked by it and therefore receive more shock and consequently learn to avoid more slowly (Brush, 1966). If there is an interval between UCS and fence onset (we use 5 sec), most Ss receive no shock from the fence, since they escape soon after UCS onset. The only Ss shocked are those animals on the fence. The control circuit is illustrated in Fig. 1. Relay 1 (R1) is the side selector that senses the location of S and governs the application of shock only to the side occupied by S. Relay 2 (R2) is the fence relay that adds the fence bulbs to

either side circuit at the proper time. This results in a reduction of current that can be compensated for at the control unit or ignored, since S almost always escapes within 5 sec and never receives the reduced current unless on the fence.

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BRUSH, F. R. On the differences between animals that learn and do not learn to avoid electric shock. *Psychonomic Science*, 1966, 5, 123-124.

NOTE

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The use of canine plasma protein solution in the laboratory rat

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The use of canine plasma protein solution (CPPS) in dogs has proven helpful in surgical and other veterinary procedures (Fish & Cooksey, 1970; Riggins, Koehler, Brinkman, & Burch, 1968). Riggins et al (1968) report that, in clinical situations, CPPS is useful as the primary therapeutic agent in treating shock in dogs and as an auxiliary agent in treating cases of dehydration, diarrhea, and toxemia. In addition, they report that CPPS significantly increases the chances of survival in dogs bled at known rates; bleeding that caused 100% fatality in control Ss was lethal in only one of three CPPS-treated dogs. Fish and Cooksey (1970) report that CPPS is a suitable replacement for blood transfusions and facilitates the restoration of protein balance in dogs suffering from long-term proteinuria.

The availability of an item such as CPPS for surgical procedures involving the laboratory rat might prove of great assistance, especially in cases where presurgical observation has made the S of more than casual interest. Unfortunately, only about 10 cc of blood can be taken from the average rat (Farris & Griffith, 1949, p. 407), thus making the production of rat blood products exceedingly costly.

The present study investigated the possibility of safely administering CPPS to laboratory rats. The study was directed primarily toward ascertaining whether or not the repeated introduction of canine protein into a rat's system, especially in therapeutic doses, would cause harmful side effects.