THE DOUBLE-ALTERNATIVE, DOUBLE-START EXPERIMENTAL APPARATUS: A NEW PROCEDURE FOR MEASURING PREFERENCE

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A new experimental chamber is described that permits rats to demonstrate behavioral preference for one of two conditions by running towards a goal chamber by one of two routes that are correlated with the different conditions. In a preliminary study, rats chose a route correlated with relatively lower shock, demonstrating the sensitivity of the apparatus. We also report evidence using this device that, of 10 rats tested, all preferred un-signaled rather than signaled, inescapable, unavoidable shock.

Key words: preference, signal, shock, rats

Studies investigating preference for signaled, inescapable, unavoidable shock have, for the most part, used two types of apparatus. Most of the early data were based on shuttle-box evidence (e.g., Lockard, 1963; Perkins, Levis, & Seymann, 1963); the more recent data are based on bar-press apparatus (e.g., Badia & Culbertson, 1972; Badia, Coker, & Harsh, 1973). We have elsewhere commented (e.g., Biederman & Furedy, 1979) on the replicability, instrumentational status, and methodological soundness of procedures using these two types of apparatus. Our conclusions that existing procedures suffer from problems in those three areas have prompted us to search for another procedure with which to effectively measure rats' preferences for various arrangements of signaled shock. In one procedure we used an automated Y-maze that seemed to show promise, but this apparatus failed to reliably demonstrate the effects with which we were concerned (Biederman, Furedy, & Beatty, 1981).

E. Grastyan (personal communication to J. J. Furedy, July, 1980) suggested a pro-

cedure in which rats are fed alternatively in holding chambers and must travel between these chambers via alternative routes in which all parameters are identical except signal related to shock. We describe an apparatus based on that suggestion together with an account of an experiment using the apparatus in a preference test involving signaled versus unsignaled shock.

In a pilot study, the sensitivity of the double-alternative, double-start apparatus was assessed by using different shock levels in the alternative confinement alleys. That study used 12 rats; each preferred the confinement alley resulting in lower shock intensity over six 6-hr sessions. Following the preliminary experiment that confirmed the sensitivity of the apparatus, we used the double-alternative, double-start apparatus to investigate whether there would be preferences for signaled shock, preferences for unsignaled shock, or no consistent preferences.

METHOD

Subjects

Subjects were 10 experimentally naive male albino rats, 120 days old at the start of the experiment. The animals were purchased from Woodlyn Farms (Guelph, Ontario) and were maintained at approximately 80% of their free-feeding weights.

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Apparatus

A four-chamber double-alternative, double-start apparatus shown in Fig. 1 was used. This device consisted of two end-chambers (designated as 1 or 2 in Fig. 1) where food (45-mg dustless precision rat pellets, Bio Serv, Inc., product no. 0021) was delivered via pellet dispensers, and two alternate connecting confinement alleys (designated as A or B in Fig. 1). In one alley, signaled shock was delivered, and in the other, unsignaled shock was given. Half the subjects received signaled shock in confinement alley A. In the signaled-shock chamber, subjects received a 3-s warning tone (as in Perkins *et al.*, 1963) of 1000 Hz and 85 dB. The shock (0.5 s, 1.0 mA) was generated by a BRS/LVI shock source (Model SG903) and was scrambled by a BRS/LVI scrambler (Model SC922). The operation of the partitions, which rose and fell to permit entry and exit, has been described elsewhere (Heighington & Biederman, 1977). Briefly, this equipment uses a spool mounted directly on the rotating dial of a standard electromechanical timer that winds and unwinds a cable. This, in turn, slowly raises a partition (in 3 s) or permits the same partition to drop fairly rapidly (in < 0.05 s). When the partition is in the closed position, it is not possible for the animal to raise it. Each confinement alley was marked with horizontal or vertical black stripes on its entry partition as in Biederman, Furedy, Heighington, & Wong (1982), and Miller, Marlin, & Berk (1977). The confinement alleys pivoted on a balance point, making and breaking electrical contact to provide information about the location of the animal to the recording and control equipment.

Procedure

Each 6-hr session began with the single placement of the subject in one end-chamber (1 or 2 in Fig. 1), where one pellet of food was available. The end-chamber and the confinement alley (A or B in Fig. 1) used to present signaled shock were counterbalanced across subjects. Traveling from end-chamber via confinement alleys to the op-

posite end-chamber produced a food pellet; this behavior was trained, for each subject, one day prior to the first 6-hr experimental session. During this pretraining, there was neither shock nor confinement in the alleys. Pretraining terminated when each subject received a total of 10 pellets in each end-chamber. In the experiment, after 5 min in an end-chamber, the partition opened and the subject could obtain a food pellet by traversing one of the confinement alleys to the other end-chamber. Subjects were confined in the connecting alley for approximately 3 min, until four response-independent shocks were delivered according to a variable-time 45-s schedule with a range of 30 to 60 s. In the signaled-shock alley, the 3-s tone preceded shock; in the unsignaled alley, the 3-s tone followed shock. After confinement, subjects were allowed to enter the other end-chamber and to consume one food pellet. After 5 min, the process was repeated.

RESULTS AND DISCUSSION

The performance of each subject is shown in Fig. 2. All subjects preferred the unsignaled alley by the last 9 of the 30 total 6-hr sessions. Almost all subjects showed an orderly development, over the 30 sessions, of this preference for the alley correlated with the unsignaled condition. The clarity of the present results is interesting in that the double-alternative, double-start apparatus represents a procedural return to the direction of the original shuttle-box procedures which first suggested that rats preferred signaled to unsignaled shock (e.g., Lockard, 1963; Perkins, Seymann, Levis, & Spencer, 1966). However, our procedure produced a clear preference for unsignaled shock.

The theoretical implications of the present experiment will require additional analysis elsewhere, as it is our purpose here only to describe the apparatus that permitted us to obtain the result reported. Clearly there are parametric studies necessary, as well as other control procedures that might be performed (perhaps, for example, involving

choice between unsignaled shock and no-signal/no-shock conditions), before the relevance of the present evidence may be known with respect to the controversies found in the signaling literature.

The double-alternative, double-start apparatus, however, has the potential to be a generally useful device for permitting the behavioral assessment of preference for one of two events. It may be appropriate for demonstrating relative preference for signals correlated with shock, as in the present application, or for stimuli correlated with appetitive situations. It is possible that the present apparatus may be useful in demonstrating the relative preference for one schedule of reinforcement over another, independent of the operant response that satisfies the requirements of each schedule. That is, the connecting chambers could be equipped with operanda, and different

schedules of food-reinforced responding could be arranged in each confinement chamber. Choice of alley would presumably indicate preference for one of the two schedules correlated with each alley.

The apparatus described here would appear to make use of an operant (food-approach) which may relate more directly to the species-typical response preferences of the organism than does the bar press; it also separates shock-controlled shuttle responses from food-reinforced behavior. This differs from conventional shuttle-box studies, in which the arrangements that cause an animal to move to the other chamber are sometimes difficult to interpret. In the present apparatus, food-maintained behavior is readily distinguishable from shock-maintained behavior. A review of the empirical status of the evidence obtained in both shuttle and bar-press apparatus regard-

Fig. 1. Photograph of double-alternative double-start apparatus. See *Apparatus* section for explanation.

Fig. 2. Mean percent choice of unsignaled chamber for each subject during successive 3-session blocks. The numerals associated with each data point represent the mean number of choices made over each 6-hr session in the 3-session block.

ing the contrast between signaled and unsignaled shock schedules may be found in Biederman and Furedy (1979).

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