An Attempt to Employ Electroconvulsive Shock as the Unconditioned Stimulus in a Classical Conditioning Experiment

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Electroconvulsive shock (ECS) has been for some time a frequently employed therapy for certain types of behavior disorders. As a consequence it has been the recipient of considerable research interest in the behavior laboratory. Since a large number of behavior theorists conjecture that behavior disorders are learned, it is not surprising that laboratory studies have been primarily directed toward determining the conditions under which ECS will affect the acquisition and retention of behavior patterns. In a word, these studies, usually employing rats as subjects, have indicated that ECS will impair both the acquisition and retention of complex responses and that the degree of impairment will be primarily a function of the temporal proximity of learning and the convulsions (Munn, 1950).

Although there has been a plethora of experimentation with ECS, there has been a relative paucity of theorizing about it. One popular notion, which probably has its roots among our psychoanalytically oriented friends, is that ECS has punishing properties; it induces fear and emotional disturbance. Since fear and emotional disturbance will drastically alter the spontaneous activity of rats, we reasoned that, if this notion has merit, stimuli which consistently precede the occurrence of the ECS should acquire the property of modifying spontaneous activity. Accordingly, with suitable controls, we attempted to condition a change in activity by consistently pairing a neutral or conditioned stimulus (CS) with a convulsive shock. Periodically during the course of training we interspersed test trials during which we observed activity in response to the conditioned stimulus alone.

In order to measure gross spontaneous activity we employed a fairly common method, using a box approximately 15 in. long, 7½ in. wide, and 3 in. high. The box was equipped with four photocells and light sources arranged in such a way that the light beams divided the interior of the box into a grid of 3¼ in. squares at a level about 2 in. from the floor. Each photocell was wired to a magnetic counter so that beam interruptions could be tallied. As the animal moved about in the box the beams were, of course, frequently interrupted. Immediately above the box hung a small light bulb which functioned as a component of the conditioned stimulus. The other component was a sound attenuated buzzer placed alongside the conditioning box. Convulsions were induced by conducting a 55

ma. alternating current through alligator clips attached to the rat's ears. The duration of the convulsive shock was .3 sec.

Forty Sprague-Dawley rats about four months old were started in the experiment. They were randomly divided into four groups of equal size. Animals in the Experimental group were placed in the box once every eight hours. Approximately 30 sec. after they were placed in the box and the alligator clips were attached to their ears the light and the buzzer CS came on for 20 sec. On training trials the termination of the CS was accompanied by the onset of the ECS. On test trials the ECS did not occur. The first two of every three trials was a training trial; the third was a test trial. There was a total of ten training and five test trials.

The other three groups of animals functioned as control groups. In order to control for pseudoconditioning or sensitization one group, the ECS Control group, received in every detail the same treatment as the Experimental group except that they were not exposed to the CS on training trials. The CS control group also received precisely the same treatment except that they were never convulsed. The remaining group was not administered either the CS or the ECS during training trials. On the test trials all animals were administered the CS alone, and the number of beam interruptions during the 20 sec. period that the CS was on was recorded.

Of the 40 animals that started the experiment, 33 survived the ten training trials. Of the animals eliminated, 4 were in the Experimental group and 3 were in the ECS Control group. These animals were destroyed because of spinal injuries caused by the convulsions. In order to maintain proportional cell frequencies in the statistical analysis, one animal was discarded randomly from the ECS Control group. The data are therefore based on six animals in each of the groups receiving ECS and ten animals in the groups not administered ECS.

In order to determine if spontaneous activity during the CS interval was differentially affected by the four treatments described above, the total number of beam interruptions during that 20 sec. interval was analyzed by means of a mixed factorial analysis of variance model (Lindquist, 1953). In this analysis there were five repeated measures, corresponding to trials, for each subject in each of the four treatment groups. The outcome of the analysis is shown in Table 1. This table indicates that

TABLE I

Analysis of Variance of Beam Interruptions during CS interval

Source of Variation	df	Mean Square	F
Between Subjects	31		
Between Treatments	3	81.40	6.78*
Error (b)	28	12.02	
Within Subjects	128		
Between Trials	4	30.04	4.20*
Trials (x) Treatments	12	5.55	—
Error (w)	112	7.16	
Total	159		

*Significant at the .01 level

the main effects of treatments and trials was significant but there was

no interaction between treatments and training trials. Since there appeared to be no systematic increase or decrease in activity over trials, it is difficult to attach any meaning to the trial differences. We were interested, however, in pursuing the differences that existed among treatment means when the trials variable was collapsed. Averaging across trials, the Experimental group had an overall mean of 4.57 beam interruptions in the 20 sec. interval, the ECS Control group had a mean of 5.0, the CS Control group a mean of 7.3, and the Nothing group a mean of 7.3. The differences between the means of each pair of groups was tested by a succession of *t* tests. The outcome of this analysis was that each of the groups administered ECS differed from the groups not administered ECS. On the other hand, the ECS groups did not differ from each other nor did the non-ECS groups differ from each other. This result suggests that ECS reduces activity in general, but that stimuli which precede the occurrence of ECS do not acquire any differential properties.

A word of caution concerning the generality of these conclusions is in order. The present experimental arrangement is not necessarily maximally sensitive to all potential properties that the CS might acquire as a consequence of being paired with ECS. If the CS acquired response inhibiting properties, for example, this would not be easily observed in this experiment because of the considerable reduction in the over all activity level caused by the ECS. It does seem reasonable to conclude, however, that stimuli, which consistently precede the occurrence of ECS, do not acquire the property of increasing activity.

Literature Cited

Lindquist, E. F. 1953. Design and analysis of experiments in psychology and education. Boston: Houghton Mifflin.

Munn, N. L. 1950. Handbook of psychological research on the rat. Boston: Houghton Mifflin.