

## THE EFFECT OF ECS ON ONE-TRIAL AVOIDANCE LEARNING<sup>1</sup>

MILLARD C. MADSEN<sup>2</sup> AND JAMES L. MCGAUGH<sup>3</sup>

*San Jose State College*

In a recent article, Coons and Miller (1960) raise the question as to whether previous studies which have purported to show that ECS induces a retrograde amnesia can be accounted for by ECS-induced fear of the goal. In the present study Ss were given a single ECS after making a response which was punished by shock to the feet. In a similar study, Pearlman, Sharpless, and Jarvik (1959) have shown that memory of the punishment is impaired by immediate anesthetization with ether or pentobarbital. If ECS affects performance by interfering with memory, then the effects of ECS in the present study should be similar to those obtained with ether and pentobarbital (i.e., rats should *continue* to make a response which was punished and followed by ECS). If, however, ECS affects performance by inducing fear, Ss given an ECS following a response punished by shock should tend *not* to make the punished response on a subsequent test.

### METHOD

#### *Subjects*

One hundred and twelve rats of the Tryon strains were used as Ss. These included 61 maze brights (S<sub>1</sub>; 33 males, 28 females) and 51 maze dulls (S<sub>2</sub>; 25 males, 26 females). All Ss were between 90 and 110 days old and were satiated with food and water at the time of the experiment.

#### *Apparatus*

The apparatus consisted of a box (22 in. by 12 in. by 10 in.) in the center of which was an adjustable platform (6 in. by 3½ in.) which could be raised to a height of 7 in. and lowered to a position 1 in. above the floor of the box. The platform was manipulated by a lever operated from outside the box. The box floor and platform were covered with thin copper sheeting which had attached electrodes connecting to a Variac transformer, so that when the rat stepped off the platform, the circuit was completed, shocking the rat. The Variac was set at 50 v. throughout the experiment.

<sup>1</sup> Supported in part by Research Grant MY-3541, from the National Institute of Mental Health, United States Public Health Service. The apparatus design was suggested by M. E. Jarvik (personal communication).

<sup>2</sup> Now at the University of Oregon.

<sup>3</sup> Currently on leave at the Istituto Superiore Di Sanita, Rome, Italy.

#### *Procedure*

Each S was individually placed on the raised platform. After approximately 2 sec. the platform was slowly lowered until it rested 1 in. from the floor of the box. The criterion time for the animal to step off the platform and receive a shock was 10 sec. Eight Ss (4 S<sub>1</sub>'s, 4 S<sub>2</sub>'s) failed to step off within the criterion time and were discarded. Within 5 sec. after receiving the shock, Ss in the experimental group received, via alligator clip electrodes, a .2-sec. ECS of approximately 25 ma. This was sufficient to produce a grand mal convulsion in all except 8 Ss (6 S<sub>1</sub>'s, 2 S<sub>2</sub>'s), which received a petit mal and were discarded. The results reported are based on the remaining 96 Ss (49 control Ss, 47 experimental Ss). Control Ss were returned immediately to their home cages and received no ECS. All Ss were retested after an interval of 24 hr. using the same procedure as described for the initial learning.

### RESULTS AND DISCUSSION

The number of Ss in each group avoiding the floor on the retest for the criterional time of 10 sec. is shown in Table 1. A chi square test corrected for continuity yielded no strain differences within either the experimental ( $\chi^2 = 3.52$ ) or control group ( $\chi^2 = 3.77$ ). However, for both strains the difference between control and experimental groups was statistically significant ( $\chi^2 = 6.73$  for S<sub>1</sub>'s,  $p < .01$ ;  $\chi^2 = 5.13$  for S<sub>2</sub>'s,  $p < .05$ ). The difference between the experimental group and control group with strains pooled was significant beyond the .001 level ( $\chi^2 = 11.67$ ).

The significant ECS effect obtained in the present study is in accord with what would be predicted from a consolidation theory. There was a significant tendency for the Ss which received ECS after stepping off the platform and receiving a shock to step off again 24 hr. later, thus indicating an amnesia for the previous day's shock. However, on the second trial, the majority of the Ss that did not receive an ECS after the first trial remained on the platform longer than the criterional time of 10 sec. If the ECS induced a fear reaction, this should accumulate with the fear of receiving a shock to the feet. Thus, it should be predicted that Ss receiving ECS following shock would show an even greater tendency, in comparison with the controls, to remain on the platform.

TABLE 1  
RETENTION OF AVOIDANCE RESPONSE AFTER  
A 24-HR. INTERVAL

Strain	Control Ss (no ECS)		Experimental Ss (5-sec. ECS)	
	No. of Ss avoiding	No. of Ss not avoiding	No. of Ss avoiding	No. of Ss not avoiding
S <sub>1</sub>	11	17	1	22
S <sub>3</sub>	15	6	7	17
Total	26	23	8	39

The results of the present study clearly oppose this hypothesis.

#### SUMMARY

The present experiment placed the effects of fear induced by ECS in opposition to the effects

of retrograde amnesia in one-trial avoidance learning. The results from 96 Ss lend support to the hypothesis that ECS interferes with memory and are in opposition to the hypothesis that ECS affects performance by inducing fear.

#### REFERENCES

- COONS, E. E., & MILLER, N. E. Conflict versus consolidation of memory traces to explain "retrograde amnesia" produced by ECS. *J. comp. physiol. Psychol.*, 1960, **53**, 524-531.
- PEARLMAN, C., SHARPLESS, S. K., & JARVIK, M. E. Effects of ether, pentobarbital, and pentylene-tetrazol upon one-trial learning of an avoidance response. *Fed. Proc.*, 1959, **18**, 432.

(Early publication received February 27, 1961)