Effect of magnesium pemoline on learning and memory of a one-way avoidance response¹

LYNN ANNE CYERT², K. E. MOYER AND J. A. CHAPMAN

CARNEGIE INSTITUTE OF TECHNOLOGY

This study tested the effects of 10 mg/kg of magnesium pemoline on the learning of a one-way avoidance response. Neither the rate of learning, nor the rate of extinction was affected by the administration of magnesium pemoline.

Plotnikoff (1966) found that magnesium pemoline, a mild stimulant which increases RNA production in the brain, increased the rate at which rats learned and retained a conditioned avoidance response (pole climbing). Other stimulants (methylphenidate and methamphetamine) did not have this effect.

Cook et al (1963) found that injections of yeast RNA caused rats to learn to pole-climb to avoid shock faster than control animals. However, Corson & Enesco (1966), although able to replicate these results with pole-climbing, were unable to obtain increased learning rates using an escape task which required animals to run down an alley to a goal box. Evidently the generality of the results of Cook et al (1963) is limited since they apply to a pole-climbing avoidance response, but not to a running avoidance response.

It is the purpose of the study presented here to provide information on the generality of the results of Plotnikoff (1966). If magnesium pemoline generally facilitates learning, or particularly facilitates avoidance learning, it would be expected to facilitate a running as well as a pole-climbing avoidance response. The difficulty of the one-way avoidance response used in this study is similar to that of the pole-climbing avoidance response used by Plotnikoff (1966).

Subjects

Twenty naive, male albino, Sprague-Dawley rats weighing between 200 and 300 gm were used.

Apparatus

The avoidance box consisted of a wooden alley 34-1/2 in. long x 10 in. wide x 16 in. high, painted battleship gray. There was a goal box opening at one end, 2-3/4 in. x 4-3/4 in. The top of the box was 1/8-in. clear Plexiglas. There were two 25-w bulbs 24 in. above each of the two floor grids. The floor grids consisted of 1/8-in. brass rods, spaced 3/8 in. apart. The grids were hinged at the end and suspended by springs in the center so that the weight of the rat on the grids activated a microswitch which started a Standard clock. When the S entered the goal box, a photocell beam was broken and the clock was stopped. An Applegate stimulator, Model 228, charged the grid. Masking noise was provided by a fan in the room.

Procedure

The 20 Ss were divided into two equal groups. The drug group received 10 mg/kg of magnesium pemoline suspended in a solution of 0.3% tragacanth, 4 mg/cc. The control group received an equal volume of 0.3% tragacanth solution without magnesium pemoline. The solutions were administered by oral intubation 30 min. before the first trial on Day 1.

Each avoidance trial consisted of placing the S by the tail in the box at the opposite end from the goal box and facing away from it. After a 5-sec. safe period, 1.5 ma shock was applied to both grids. The S escaped shock by entering the goal box, after which the door was closed to prevent retracing.

On Day 1 each S received 30 avoidance trials. On Day 2, S received extinction trials which were exactly like the avoidance trials except no shock was used and no drugs were given. If S showed a latency of 30 sec. it was considered extinguished. There was a 20-sec. intertrial interval for both avoidance and extinction trials. Ss which entered the goal box during the 5-sec.

Fig. 1. Mean response latencies plotted in 5-trial blocks for both the drug and placebo groups.

Fig. 2. Proportions of avoidance responses plotted in 5-trial blocks for both drug and placebo groups.

safe period on their first avoidance trial were not considered in the final calculations.

Results

An analysis of variance test on the mean response latencies in 5-trial blocks showed no significant differences between the drug and placebo groups ($F < 1$, $df = 1/24$). There were no significant drug interactions. Figure 1 shows the close proximity of mean response latencies over 30 trials considered in 5-trial blocks.

An analysis of variance test on proportions of avoidance in 5-trial blocks also indicated no significant difference between the drug and placebo groups ($F < 1$, $df = 1/24$). Figure 2 compares the proportion of avoidance responses in 5-trial error blocks over the 30 trials for both the drug and placebo groups.

There was no significant difference between the mean trials to extinction for the drug ($X = 4.3$, $sd = 5.8$) and placebo ($X = 9.5$, $sd = 18.0$) groups ($t = .98$, $df = 24$).

Discussion

The results do not show that magnesium pemoline increases the rate at which rats learn a one-way avoidance response. The drug also had no effect on extinction rates for the same response. Thus, the generality of the findings of Plotnikoff (1966) is limited.

One possible cause for the discrepancy between these results and those of Plotnikoff may be the topography of the response. This is suggested by the relationship between the studies of Cook et al (1963) and Corson & Enesco (1966). There are, of course, many other possible causes.

Additional research is needed to specify the types of learned responses which may be influenced by magnesium pemoline.

References

- Cook, L., Davidson, A. B., Davis, D. J., Green, H., & Fellows, E. J. Ribonucleic acid: effect on conditioned behavior in rats. *Science*, 1963, 141, 268-269.
- Corson, J. A., & Enesco, H. E. Some effects of injections of ribonucleic acid. *Psychon. Sci.*, 1966, 5 (5), 217-218.
- Plotnikoff, N. Magnesium pemoline: enhancement of learning and memory of a conditioned avoidance response. *Science*, 1966, 151, 703-704.

Notes

1. This investigation was supported in part by a research grant, M-1298, from the National Institutes of Health, Public Health Service to K. E. Moyer. The magnesium pemoline used in this study was supplied by Dr. H. G. Schoepke of the Abbott Laboratories.
2. This study was done while Lynn Anne Cyert was a National Science Foundation Honor Student under a National Science Foundation Undergraduate Research Participation Grant No. GY-746. Her current address is Reed College, Portland, Oregon.