TECHNICAL PAPERS

Prolonged Hypnotic States With "Local Signs" Induced in Guinea Pigs

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Studies of animal hypnosis in connection with research on conditioning and experimental neuroses have been carried out sporadically since the original work of Pavlov, particularly by his former associates (*1*). Indeed, animal hypnosis offers possibilities to study abnormal behavior, especially if the hypnotic drive is submitted to conflict with other conditioned or instinctive reactions. These possibilities have not been fully explored because of the brevity, complexity, and lability of hypnotic states in laboratory mammals. We succeeded in developing a prolonged hypnosis in guinea pigs by using a very simple procedure. This procedure also permits one to induce an hypnotic drive with a definite "local sign," thus offering new opportunities for research in the fields of neurophysiology and experimental psychology. The procedure, as well as our initial findings, are summarized below.

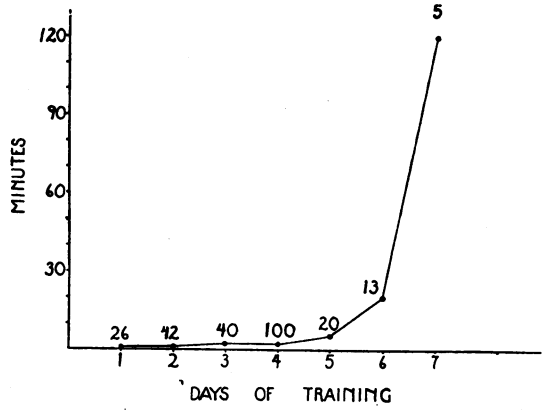

FIG. 1. This graph, which illustrates the initial phase of the "training" period of one guinea pig, shows maximum durations of hypnotic states during 7 days "training." The figures above the dots represent the number of trials for the corresponding day.

Each animal is put on its back to produce a spontaneous hypnotic state. The usual duration of this state is from a few seconds to a few minutes in adult guinea pigs. It can be discontinued by visual, auditory, or tactile stimulation. After the animal rights itself, it is immediately put back in a dorsal position, and this procedure is continued for about 2 hrs daily. Fig. 1 shows an example of such "training." The maximum duration of the hypnotic state during the first session for this animal was 35 sec, whereas on the 7th day it remained in the same state for 2 hrs without interruption. In this state the animal usually shows the following reactions: exophthalmos, eye-balls deviated downward and forward, paws extended and, at least at the beginning of the experiment, presenting a fine tremor.

The acquired aptitude for prolonged hypnotic state may be fixated for a considerable time. Thus, several animals did not present any change in their hypnotic reaction after 3 months free of any "training."

There are individual differences among guinea pigs. These concern both the facility with which prolonged hypnotic states are produced and the position in which hypnosis is most readily induced. Thus, animals which show a relatively long initial spontaneous hypnotic state exhibit the longest reaction after training. On the other hand, some animals are easier to train in a lateral than in a dorsal position. The latter, however, should be tried during the first sessions, as very few animals will remain in the lateral position at the beginning of experimentation. In animals difficult to train, it may be helpful to frustrate the righting attempts by stretching the whole body despite antagonistic muscle activity, associating this procedure with repeated sensory stimulation.

The animals which were put on only one side during their "training" period present prolonged reactions only

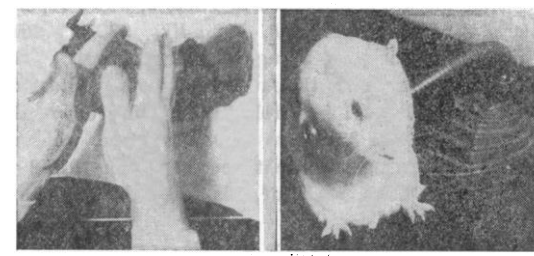

FIG. 2. *Left*: An animal presenting an hypnotic state when put on the right side. It remains in this state despite the clapping of the hands. *Right*: Another animal, after a prolonged training period, has become very submissive to the point of maintaining this uncomfortable position for an extended period of time despite sensory stimuli.

or preferentially on this side. Thus, there are animals in the laboratory which will lie on the right side for hours, presenting a typical hypnotic reaction, and only for a few seconds on the left side. In other animals the left side is preferential. Generally the eye signs are unilateral in such animals, or at least predominate on the side contralateral to the one upon which the animal is lying. Blinking occurs less often on this side. In some animals a unilateral exophthalmos persists even between experiments.

One of the most prominent signs of successful training is the relative ineffectiveness of stimulation. Thus, al-

though the most intense auditory, visual, or tactile stimuli may produce a motor reaction in an animal during a prolonged hypnotic state, these stimuli no longer cause the animal to right itself (Fig. 2, left). Sometimes the guinea pig makes a prolonged attempt to right itself by exhibiting disorganized rhythmic movements of the extremities. He may succeed only in displacing his body on the table as if he were submitted to an antagonistic drive to "stick" to the supporting surface.

There is a functional gradation in the intensity of sitmulation necessary to discontinue a prolonged hypnotic state. Thus, the appearance of another guinea pig in the visual field is more effective than an artificial visual stimulus. A slight noise made by the opening of the cage door may be more effective than a loud auditory stimulus. However, frustration of righting attempts in the presence of the most potent stimuli decreases their effectiveness. A well-trained, hungry animal may remain in a prolonged hypnotic state for hours, even though he is surrounded by a great amount of food.

In an animal trained in a lateral hypnogenic position, stimuli may be more effective on one side than on the other. For example, in an animal showing left lateral preference, visual stimuli applied to the left eye are more effective.

Changes in the general behavior of trained animals are difficult to appraise, as even normal guinea pigs, when fatigued or frightened, often show prolonged periods of immobilization. However, some trained animals may particularly easily present the hypnotic state in an upright position. Thus, these animals may show characteristic exophthalmos in a sitting position and may remain undisturbed by stimuli when put in an upright position, their forelegs supported by a stand (Fig. 2, right). There is a decrease in spontaneous motor activity in the trained animals. Furthermore, these animals are more often found in a prone position in their cages than the control animals. However, the total appraisal of changes in general behavior requires more prolonged studies.

Reference

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Anoxic Survival and Diisopropyl Fluorophosphate (DFP)

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Heymans (*2*) has found that the use of diisopropyl fluorophosphate (DFP) prolongs the survival period of medullary centers subjected to a complete arrest of circulation. Should this increased resistance to anoxia observed in the isolated head also apply to the intact organism, then DFP might be valuable in minimizing the effects of anoxia.

We have performed a series of experiments in an attempt to apply Heymans' observation under a variety of conditions. Fifteen male rats were injected subcutaneously with 1.5–2.0 mg of DFP/kg, and 15 uninjected animals were subjected to the hypoxia produced by the inhalation of 3.9% O_2 in 96.1% N_2. The mean survival time of the DFP-injected rats was 14.78 ± 2.28[1] min. The controls' survival period was significantly longer, the mean being 23.41 ± 2.87 min. Thus, DFP, instead of conferring protection, apparently produces the opposite result. In this and subsequent experiments the dosage of DFP was not great enough to produce lethal effects in the time of observation. The observed mortality cannot be attributed to DFP toxicity.

Next, the duration of the survival period of the decapitated head of newborn rats was determined, the gasping of the head being taken as the criterion of the length of survival. Two mg of DFP/kg was injected subcutaneously into newborn rats 15–50 min. before decapitation. The 19 controls continued gasping for an average of 19.9 min. The heads of the 19 DFP-injected rats gasped for 19.0 min.—not a significant difference.

The influence of DFP on lethality caused by excessive doses of pentobarbital revealed that the average survival time for 7 control rats was 12.7 min, while 3 rats injected subcutaneously with 1.5 mg of DFP/kg 15 min. before receiving pentobarbital survived 4.3 min. The shortest period in any of the controls was longer than the longest period of survival in any of the injected rats.

Two rabbits, one of which had previously received an injection of 0.3 mg of DFP/kg in a carotid artery, were subjected to the inhalation of 3.9% oxygen in nitrogen. The control animal survived 37.5 min; the injected, 26.5 The control animal survived 37.5 min; the injected, 26.5.

TABLE 1

INFLUENCE OF DFP (1–2 mg/kg SUBCUTANEOUSLY) ON MORPHINE LETHALITY

Morphine dose (mg/gm)	Controls		DFP injected	
	No.	No. surviving 24 hrs	No.	No. surviving 24 hrs
.2512	6	4	9	9
.3981	20	8	23	15
.5012	14	0	14	3
.6000	10	1	10	3

Only with morphine did we have a suggestion of a possible beneficial effect. Thirty-one mice receiving 0.8–1.0 mg/gm of morphine sulfate intraperitoneally survived 14.31 ± 1.60 min, while 26 animals exposed to 2.0–3.0 mg of DFP/kg subcutaneously in addition to the morphine exhibited a mean duration of survival of 17.89 ± 2.32 min. The difference between the means is not statistically significant.

With smaller doses of morphine some of the animals survived more than 24 hrs, at which time the experiment was terminated (see Table 1).

Although the data in Table 1 show an apparent protection in the DFP-injected animals, when the LD_{50} was calculated by the method of Bliss (*1*), the values were 0.3237 ± 0.0388 mg/gm for the controls and 0.4472 ± 0.0258 mg/gm for the DFP-injected animals. On statis-

[1] Standard error of the mean.