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A WATER-MAZE TEST OF LEARNING ABILITY FOR GUINEA-PIGS

by

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SUMMARY

A test of learning ability for guinea-pigs is described. A T-shaped water maze was used, in which the animals were required to swim into one or the other of the arms to escape from the water. In this situation guinea-pigs readily learned a spatial discrimination and its reversal. They continued to thrive during the period of testing.

The guinea-pig is quite unlike the other most-used laboratory rodents, the rat and mouse, in that it responds to being placed in a novel environment by 'freezing', remaining completely still for long periods (Bayard, 1957). Hence it is an unsuitable subject for many of the standard laboratory tests of behaviour. Short-duration tests of the 'open-field' type are out of the question. Tests of learning ability in which the animal is rewarded with food or water have the disadvantage that, to overcome the freezing response, testing has to be preceded by many days of habituation during which the animal becomes used to the test situation and to being handled (e.g., Lyle, Jonson, Edwards & Penny, 1973). One way of overcoming this problem is to use as reward escape from, or avoidance of, noxious stimulation (guinea-pigs certainly move if the situation is sufficiently unpleasant). Thus they have been trained quite readily to avoid electric shocks in a shuttlebox (Sansone & Bovet, 1970). The present paper describes a test of habit formation for guinea-pigs, in which escape from water is the motivation.

METHODS

Apparatus

The T-shaped maze (Fig. 1) was constructed wholly of fibreglass, with the exception of the removable aluminium escape platform. The 310 mm high maze was filled with water to a depth of 230 mm, so that the 2 steps of the escape platform were submerged and the platform itself just above the water surface. The ends of the escape arms were at right angles to the long parts of the arms so that the escape platform could not be seen from the choice point.

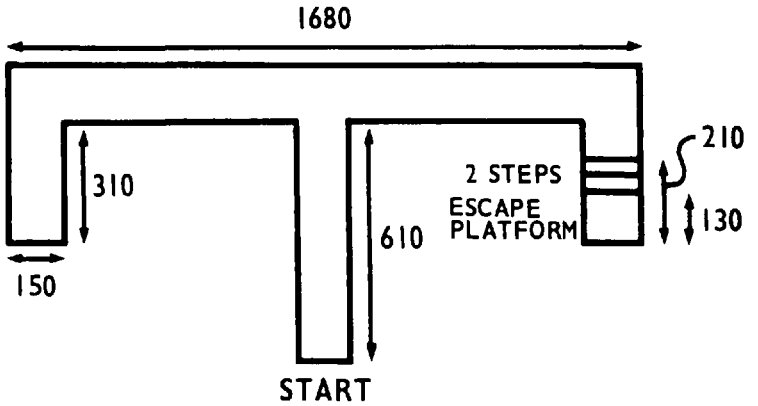

Fig. 1. Plan of water T-maze. The dimensions (mm) are appropriate for young guinea-pigs of up to about 500 g bodyweight.

The dimensions of the maze ought to be determined by the size of the guinea-pigs to be tested. It is best for the water to be too deep for the animals to touch the bottom; otherwise they tend to stand on their hind legs for long periods with their noses just out of the water, and may even try to jump out. Also the arms of the maze must be sufficiently wide for the animals to be able to turn round if they are to be allowed to correct wrong responses. The maze described here is suitable for young cavies of up to about 500 g bodyweight. Water temperature was about 22°C.

Procedure

T-mazes are usually used in the study of discrimination learning. An example is given here of an experimental procedure used in an investigation of position learning and reversal learning by normal and ascorbic-acid-deficient guinea-pigs (Adlard, Moon & Smart, 1974). The training was in 3 stages.

Establishment of side preference. On days 1 and 2 escape was possible from both the left and right arms. Each animal was given 5 trials on each of these days in order to establish whether it had a preference for either the right or left arm of the maze. The interval between trials was about 15 s. Animals were rubbed down with a towel after the last trial of the day.

Initial position learning. 6 trials were given per day from days 3 to 22, and escape was possible from only one of the arms. On the 1st of these days (day 3) guinea-pigs were required to escape from the arm opposite to their preferred arm. The direction of escape remained the same on subsequent days until the animal attained the following criterion of learning: all of the last 5 trials on a day without error. The 1st trial of the day did not count for criterion purposes (see *Discussion*). Errors were scored when guinea-pigs entered the incorrect arm or retraced their path into the start arm.

Reversal learning. On the day after the criterion had been met animals were required to reverse the originally-learned response and to escape from the opposite arm of the maze. In all other respects the procedure was exactly the same as that for the initial position learning. Each time an animal attained the criterion of performance the direction of escape was reversed on the next day. In this way animals were subjected to a series of reversals until the experiment was arbitrarily ended on day 22.

Guinea-pigs swim well, buoyed up by the air trapped in their fur. As the fur becomes waterlogged, however, they settle progressively lower in the water. Consequently, any animal which had been in the water for 90 s on any one trial was guided to the escape platform.

RESULTS

The normal and ascorbic-acid-deficient guinea-pigs did not differ in performance in the water maze, either in the number of reversals completed or in errors made (Adlard, Moon & Smart, 1974). Some sample results are presented here for the 2 groups combined.

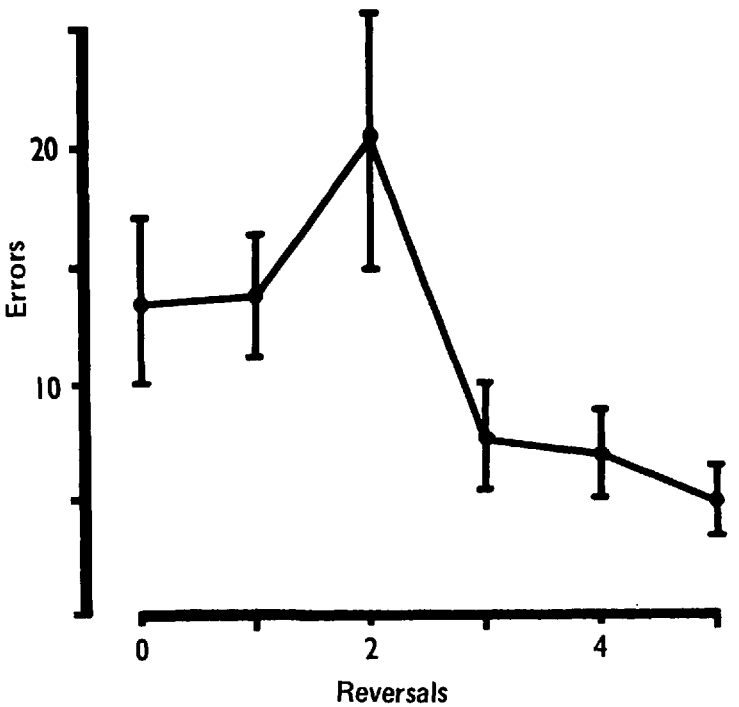

Fig. 2. Mean (± s.e.) number of errors made before attaining criterion on successive reversals. Reversal 0 was the reversal of the initial side preference.

All 13 animals had marked side preferences which were, without exception, consistent in direction from day 1 to day 2. On the 2nd day 6 guinea-pigs swam in the same direction on all trials, and the remainder swam the same way on 4 out of the 5 trials. These guinea-pigs were therefore more consistent in their side preferences and had stronger preferences than rats tested in the same way (J. L. Smart & R. Welch, unpublished observations).

In terms of errors made in completing successive reversals the guinea-pigs' performance deteriorated over reversals 0 to 2, but improved markedly thereafter (Fig. 2). They were much more successful on reversals 3 to 5 than on reversals 0 to 2. This is very similar to the performance of rats in successive reversals of a spatial discrimination problem (Mackintosh, 1969).

DISCUSSION

Care must be taken that the animals do not see the escape platform before they are put in the water, otherwise they may display 'delayed response learning' and orientate to where they remember seeing the platform seconds before. Rather they are required to make some sort of discrimination while they are in the water. Hence the animals must not be lifted high above the start point before being placed in the water.

During initial position learning and reversal learning (days 3 to 22) there were 6 trials a day, of which the 1st did not count for purposes of the criterion. On the 1st trial of any reversal, having met the criterion the day before, an animal would be expected to swim in the previously-correct direction and make an error. Hence, ignoring this 1st trial of the day gave the guinea-pigs a realistic opportunity of meeting the criterion on successive days. Some, in fact, did so.

One measure of the success of the method is that all animals learned the initial spatial discrimination and several reversals within the 20 days of testing. Furthermore, they showed no ill-effects of their daily swims but continued to gain weight throughout the experiment.

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