Exploratory behavior in peripherally blinded rats

DAVID LESTER

BRANDEIS UNIVERSITY

Female rats were anesthetized and half of them were enucleated. All rats were given a 10 min. free exploration period in a Y-maze and four trials in a T-maze with a forced turn in the stem. Blinded rats showed significantly more activity and less stimulus alternation than the normal rats. This was seen as supporting a prediction of Glanzer's stimulus satiation theory.

Glanzer (1953) proposed a tedium theory of exploration in which perceived stimuli result in the accumulation of "stimulus satiation" in an animal. Stimulus satiation accumulates with continued exposure to the stimuli, but when the animal no longer perceives the stimuli the stimulus satiation dissipates. Animals have less tendency to respond to stimuli to which stimulus satiation has accumulated. Glanzer predicted from this theory that the reduction of sensory input to the animal should reduce the rate at which stimulus satiation accumulates and, therefore, result in reduced exploratory activity.

Glickman (1958) and Zucker & Bindra (1961) both reported that peripherally blinded rats are more active than normal rats, but, of course, a locomotion measure of exploration is not suitable for testing Glanzer's prediction. An orderliness measure is necessary.

Dember & Roberts (1958) found no difference in activity for their blinded and normal rats and no difference in the degree of alternation behavior when the animals were given successive free trials in a T-maze. However, in such a situation stimulus alternation is incompatible with response repetition, so that if an animal has an increased tendency to alternate stimuli and repeat responses these tendencies might cancel out. Dember (1958) used a cross-maze and found no difference in alternation behavior between blinded and normal rats. However, this situation makes stimulus alternation and response alternation incompatible.

The present experiment seeks to test Glanzer's prediction unequivocally. Response alternation is measured in a T-maze with a forced left (or right) turn introduced into the stem of the maze. Stimulus alternation is examined using free exploration of a Y-maze.

Subjects

The Ss were 32 female rats from the Charles River Breeding Laboratory, strain CD. They were aged 90-98 days.

Apparatus

The Y-maze and the forced-turn T-maze were constructed from maze units 22 in. long, 6 in. wide,

and 6 in. high. They were made of wood and covered with wire netting.

Procedure

On Day 1 all animals were anesthetized with ether and 16 had both eyeballs removed. The eyes were popped out with tweezers, a suture tied beneath the tweezers, and the eye cut off with a pair of scissors above the tweezers. On Day 3 all animals were gentled for about 30 sec. On Days 4 to 7 each animal was placed alone in a novel cage for about 3 min. On Days 8 to 12 the testing was carried out.

Each rat was given one 10-min. free exploration period in the Y-maze. The number and sequence of arms entered was noted for each rat. An entry was defined as made when all four paws had crossed into the arm. Then on four successive days the animals were given one trial a day in the forced-turn T-maze with a forced turn in the stem. Each rat was given two trials with a forced left turn and two with a forced right turn. Half the animals received the order RLRL and half LRLR. The order in which the Y-maze and the forced-turn T-maze tests were given was counter-balanced for the animals.

Results

The number of arms that each rat entered in the free exploration of the Y-maze was calculated. The normal rats entered an average of 23.1 arms and the blinded rats entered an average of 33.8 arms. This difference was significant at less than the .01 level on an analysis of variance ($F=12.82$, $df=1/28$).

The sequence of arms entered by each rat was examined for the orderliness of exploration. Each possible triad of successive choices was examined. Triads such as ABC were classified as alternation and triads such as ABA as repetition (where A, B, and C refer to the arms of the Y-maze). The percentage of alternation was calculated for each rat. The median percentage was 61.3% for the normal rats and 54.0% for the blinded rats. This difference was significant at the .05 level on a Mann-Whitney U-test (Siegel, 1956).

Indices of stereotypy were calculated for the two groups of animals according to the method suggested by Miller & Frick (1949). The stereotypy of the blind rats was less than that of the normal rats. This indicates that the normal rats were more likely to make a third response different from either of the two preceding responses. The indices were .017 and .053, respectively.

The mean number of trials that the animals showed response alternation in the forced-turn T-maze was

2.4 for the blinded rats and 2.0 for the normal rats. These did not differ significantly on an analysis of variance ($F=1.01$, $df=1/28$).

No significant position preferences were shown by the rats in either maze.

Discussion

The present experiment has confirmed the finding that blinded rats are more active than normal rats. Perhaps this difference arises from the animal's need to maintain a constant level of sensory input. Blinding reduces the overall level of this input and so the other senses must be stimulated more than usual in order to make up for this deficit.

There was no significant tendency for blinded rats to show less response alternation than normal rats in the forced-turn T-maze. (The tendency was for the blinded rats to show more response alternation than the normal rats.) The blinded rats showed significantly less stimulus alternation, or more response repetition, than the normal rats in the Y-maze. If these two results are combined then we can conclude that the blinded rats showed less stimulus alternation than the normal rats. Therefore, the results of this experiment support Glanzer's prediction.

The fact that the blinded rats still alternated significantly above a chance level of 50% ($p < .0005$ by a

binomial test) indicates that rats can explore in an orderly fashion on the basis on non-visual cues.

Dember (1958) failed to obtain significant results in a similar situation. The only reason that suggests itself as an explanation is that Dember tested his rats three days after their operations. The present experiment allowed for a seven-day recovery period with extensive prehandling. Even so, the rats in the present experiment were not as easy to handle as is possible. Therefore, it is possible that Dember's animals were still suffering from the results of the operation and that these after-effects (such as discomfort and fear) may have obscured the phenomenon.

References

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