Retention of an overtrained pattern discrimination following pretecal lesions in rats

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Four groups of albino rats were trained consecutively on brightness and pattern discriminations, half of which were subsequently overtrained on the second problem. Following either small or large pretecal lesions, the overtrained groups showed better retention of the pattern discrimination than those not overtrained. The course of relearning of the overtrained pattern discrimination resembled that of the easier brightness discrimination. There was also a similarity in relearning of the pattern discrimination between the overtrained large lesioned group and the non-overtrained small lesioned group.

Postoperative retention in overtrained Ss has been investigated by Chow & Survis (1958) and by Orbach & Fantz (1958). In both studies, it was found that temporal lesions in monkeys did not produce deficits on overtrained visual tasks, whereas visual tasks trained only to the criterion level were seriously disturbed. Similarly, Fonberg, Brutkowski, & Mempel (1962) and Thatcher & Kimble (1966) have shown that a well-established avoidance CR remained unaffected by amygdalectomy in dogs and rats, respectively.

The present paper attempts to compare the retention of a pattern discrimination in overtrained and non-overtrained rats following lesions of the pretecal area. There is ample evidence that this area plays an important role in visual discrimination performance (McNew & Thompson, 1966).

Method

Adult albino rats of the Wistar strain were used. They were divided into four groups (NPC, NPO, PDC, PDO), differing either in the extent of pretecal damage or in the amount of preoperative training. In Groups NPC and NPO the lesions were confined largely to the n. posterior thalami, whereas in Groups PDC and PDO the lesions involved large portions of the pretecal diencephalon including the n. posterior, pretecalis, lateralis posterior, parafascicularis, and ventralis. Groups NPC and PDC were trained to criterion, while Groups NPO and PDO were given approximately 500 percent overtraining.

All groups were trained in a two-choice visual discrimination apparatus (Thompson & Bryant, 1955) with escape from foot-shock as a motive. Eight trials were given daily with the position of the positive card varying from left to right in a double alternation sequence. (Following learning of the second problem, each rat was given an additional four trials employing a single alternation sequence; mean accuracy was 95 percent, indicating that criterion performance was not dependent upon double alternation.) The intertrial interval was 60 sec. and the correction method was applied. Fifteen correct

responses in two consecutive days constituted the criterion of learning.

In all groups, except PDO, a brightness discrimination (white vs. black card) was learned prior to training on the pattern discrimination (vertical white-black stripes vs. horizontal white-black stripes). When training was completed, all animals underwent bilateral electrolytic lesions by the usual stereotaxic procedure. Following a recovery period of two to three weeks, each S was required to relearn both discrimination problems in the same order as given preoperatively. Percentage of error savings was used as the measure of retention.

Since intergroup differences in the extent of subcortical damage might obscure the appearance of an overlearning effect, the groups were carefully matched according to the size and locus of the lesion. Matching was accomplished in "blind" fashion on an individual basis. Animals with atypical lesions were discarded, leaving five animals within each group.

Results

The retention scores earned by the four groups will be seen in Table 1. It will be noted that the extensive lesions disturbed the performance of both visual tasks more seriously than the smaller lesions (compare Group NPC with Group PDC). Furthermore, the pattern discrimination was found to be more impaired than the brightness discrimination.

Of major importance here is the comparison of pattern discrimination relearning between the overtrained and non-overtrained groups. Irrespective of lesion size, the overtrained groups earned greater error savings than the non-overtrained groups ($F = 7.17$, $df = 1/16$, $p < .05$). There was, however, no interaction between the size of the lesion and the amount of training ($F = 1.20$, $df = 1/16$, $p > .05$). Groups NPC and NPO performed comparably on the brightness discrimination which was not overtrained before operation.

Although overtraining produced superior retention after small as well as large lesions, examination of the course of relearning revealed differences related to

Table 1. Mean Learning and Retention Scores

Group	Brightness		Pattern		Mean percentage of bilateral damage	
	Learning errors	% error savings	Learning errors	% error savings	NP	PD
NPC	12.5	83.2	10.0	20.2	73.0	23.2
NPO	14.0	63.6	11.0	82.0	75.0	23.2
PDC	15.0	1.2	17.0	-134.2	72.0	36.0
PDO	—	—	28.5	12.4	76.2	35.6

Fig. 1. Learning (solid lines) and relearning (interrupted lines) curves for all groups. These group curves were obtained by averaging the number of trials required to reach the block of 16 trials in which one through fifteen correct responses were made.

lesion magnitude (see Fig. 1). In the case of small lesions, Group NPO started relearning at a much higher level of performance than in original learning, whereas the starting point of Group NPC was more or less the same as before the operation. One can also note the striking resemblance of the relearning curves in relation to the learning curves in the overtrained pattern discrimination and in the brightness discrimination. Both relearning curves start higher than the corresponding learning curves and do not differ from the learning curves in their slope. The similarity of the overtrained pattern discrimination and the brightness discrimination is reflected also in virtually indistinguishable retention scores.

After large lesions, no appreciable difference in the pre- and postoperative initial performance between Groups PDC and PDO was observed. Subsequently, Group PDC relearned the problem with the same speed as original learning up to the criterion of 13 correct responses within 16 trials; in the same stage of relearning Group PDO performed much better than before operation. However, the main difference appears in the final criterion level. Whereas Group PDC needed approximately 40 more trials in comparison to original learning, Group PDO reached the final criterion in the same number of trials as preoperatively. Again, the overtrained pattern discrimination is comparable to the brightness discrimination with respect to both the speed of relearning and the amount of practice needed to attain the criterion level of performance.

Discussion

Our results indicating the beneficial effect of overtraining are in good agreement with those of previous studies. It is interesting to note that the current experiment explored different animals, a different motivational state and different brain structures. This suggests that improvement in postoperative retention following overtraining is a rather universal effect.

In our experiment, the effect of overtraining showed some differences in the nature of improvement depending on the size of the lesion. In the case of small lesions overtraining "elevated" the relearning curve. After large lesions the initial segment of the relearning curve was not changed, but overtraining abbreviated the lag shown in the final level of performance. This difference in the effect of overtraining is worthy of some speculation. It has been found previously (Thompson, Lukaszewska, Schweigerdt, & McNew, 1967) that a brightness discrimination is easier to learn for the rat and is less disturbed by pretectal lesions as contrasted with a pattern discrimination. Since postoperative retention of the overtrained pattern discrimination resembles the postoperative retention of the non-overtrained brightness discrimination, it can be supposed that during prolonged training the problem gradually attains the features typical of an easier problem.

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Note

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