Failure of spreading depression to produce retrograde amnesia¹

IRVING KUPFERMANN²

UNIVERSITY OF CHICAGO

Abstract

Bilateral spreading depression, produced in rats immediately after they learned a pattern discrimination (horizontal vs. vertical stripes, food reinforcement), did not lead to retention deficits the following day.

Problem

The role of the cerebral cortex in the consolidation process can be studied by means of cortical spreading depression (SD), since spreading depression disrupts cortical neural activity, without markedly disturbing the rest of the brain. A few studies, using shock-reinforcement, have indicated that spreading depression produced immediately after a learning session leads to a retention deficit the next day (Bureš & Burešová, 1963; Pearlman & Jarvik, 1961). The present study attempted to determine the effects of spreading depression following training with food reinforcement.

Method

Eleven male Sprague-Dawley rats were trained in a modified Munn discrimination box to make a discrimination between horizontal and vertical stripes (1 cm stripes, vertical positive). Reward consisted of wet mash, and a correction procedure was used. Details of the stimuli, training, and pretraining methods have been presented elsewhere (Kupfermann, 1965).

In a single session, Ss were trained to a criteria of six consecutive correct responses. In six Ss immediately after reaching criterion, bilateral SD was produced through trephine holes over the visual cortex, using the method described by Bureš & Burešová (1963). The presence of SD was determined by noting bilateral failure of tactual and visual placing. The whole procedure, from the start of training until the induction of the SD, never took more than 20 min.

Twenty-four hours after training, retention was tested by retraining to a criterion of nine out of ten correct responses.

Results

Table 1 shows the number of errors to learn the original discrimination and relearn it the following day. The scores of the experimental and control groups are almost identical. It should be noted that three of the experimental animals showed perfect retention.

Discussion

Since cortical SD markedly disturbs all cortical neural activity (Morlock et al, 1964), failure of it to affect the retention of the present task suggests that the cortex is not critically involved in the consolidation process for this task. Another possibility is that disruption of the consolidation process shown in previous

studies did not result from simple interference with on-going neural activity. The retrograde amnesia produced by electroconvulsive shock and drugs may result from excessive neural stimulation, or from direct interference with the biochemical processes underlying consolidation.

There are several possibilities of why previous studies found retrograde amnesia following SD, while the present study did not. The most likely explanations are the following:

1. The SD in previous experiments may have been stronger and longer lasting than the SD in this experiment. Longer lasting SD may be more effective, either because it is more likely to spread subcortically, or because it may cause changes beyond simple interference with on-going neural activity.

2. The previous studies used negative reinforcement during training, while the present study used positive reinforcement. Tasks involving negative reinforcement may be more susceptible to cortical SD, or to SD that spreads subcortically. Cortical SD in rats may very likely pass into the amygdala and nearby structures (Fifková & Syka, 1964); and Goodard (1964) feels that the amygdala is involved only in the consolidation of the association of a stimulus with a noxious event, and not with a positively reinforcing event.

Table 1. Number of Errors to Reach Criterion on Original Learning and Relearning for Control Animals and Animals Subjected to Spreading Depression after Reaching Original Criterion

Subjects	Original Learning	Relearning
Control Group		
88	13	00
89	21	00
90	18	00
92	22	02
93	07	07
Mean	16.2	1.80
Spreading Depression Group		
86	09	00
94	17	00
95	33	01
96	16	00
97	12	07
98	05	05
Mean	15.5	2.17

3. The tasks in the previous studies may be more sensitive to a partial amnesia caused by spreading depression.

References

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Notes

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2. Present address, Laboratory of Neurophysiology, Massachusetts Mental Health Center.

Abstract

CORSON, J. A. (McGill U.). Memory as influenced by a single electroconvulsive shock. *J. psychiat. Res.*, in press—This study was an investigation of the role of task difficulty and variations in previous ex-

perience as variables which might influence the susceptibility of particular memories or habits to disruption by electroconvulsive shock. Three experiments were done in which a total of 86 rats learned spatial or visual discriminations with shock motivation. Electroconvulsive shock was administered 30 sec. after criterion was reached. Large differences were found in the susceptibility of different habits to disruption by electroconvulsive shock, and large differences were found in the susceptibility of the same habit when it was preceded by different forms of pretraining. The eventual effect of electroconvulsive shock on certain habits was changed by experience which took place 24, or more, hours before the habits in question were learned. These results are interpreted as pointing out limitations of existing hypotheses concerning the effects of electroconvulsive shock. (Pre-publication copies available from the author.)

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