THE DIFFERENTIAL ROLE OF THE CEREBRAL CORTEX IN CLASSICAL AND INSTRUMENTAL CONDITIONING

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Previous experiments (Bureš & Burešòva, 1960, Russell & Oehs, 1960) have shown that spreading cortical depression (SD) can be used as a technique to provide a *functional split-brain* preparation. Repeated waves of SD generated in one cortical hemisphere were found to depress cortical function for many hours. During this time rats were exposed to various instrumental conditioning procedures. Typically testing revealed that such conditioning during unilateral SD resulted in the formation of a unilateral memory trace, restricted to the hemisphere functional during training. No such retention of learning was found in the hemisphere that had been depressed during training. These results indicate the cortex is involved in the storage of instrumental conditioning.

The present report undertakes to compare classical and instrumental conditioning with respect to: (a) can the learning in both types of conditioning be lateralized cortically in this type of split-brain, (b) is there any acquisition impairement due to hemidecortication in either type of conditioning?

A respiratory response was classically conditioned to an auditory stimulus. Rats were presented with a 5 sec CS (buzzer) preceding a mild 1 sec US of shock across the forelimbs. Trials were repeated each minute until they made a CR of hyperventilation to a criterion of 9 consecutive CS presentations. From figure 1 it can be

seen that normal animals (white columns) required 15 trials to criterion on the first training day, and only 5 on days 2 and 3. Hemidecorticates (single hatched columns) with the same he-

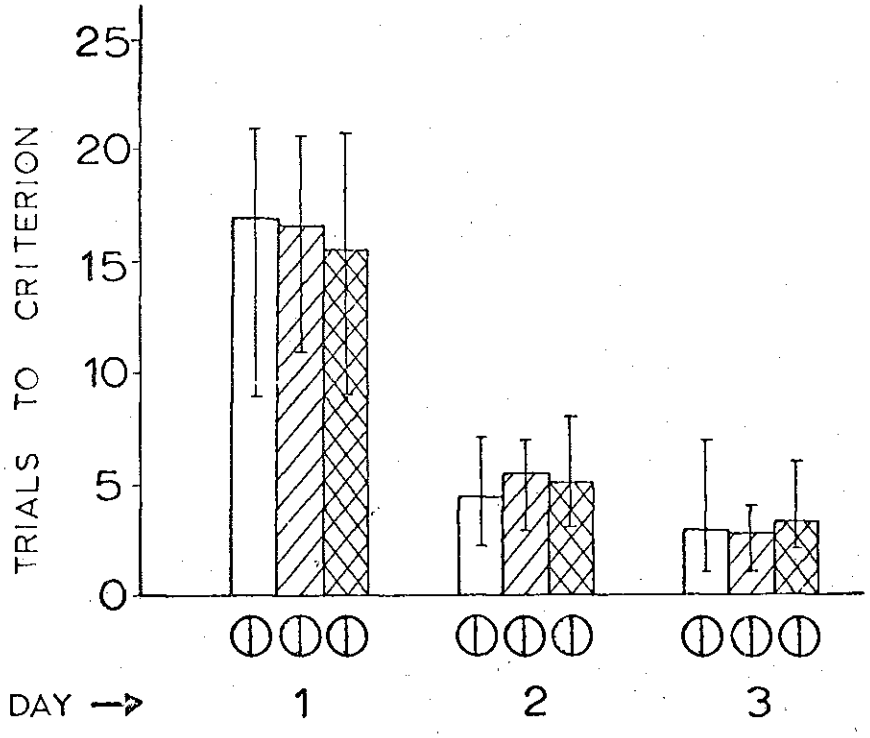

Figure 1

misphere depressed throughout training give an identical learning curve as the normals and also the *functional split-brain* group (double hatched columns). This last group when tested with a new hemisphere on the 3rd day showed a complete transfer of learning. Similar results have been found for other classical conditioning procedures (C.E.R. and passive avoidance). Not only is it impossible to lateralize classical conditioning to one cortical hemisphere, but also there is no difference between normal and hemidecorticate in acquisition of this response.

Entirely opposite results were found with instrumental learning. Rats were placed in the start box of a 6 foot long runway and

required to escape shock by running the length of the alley and entering the safe goal box. They were trained to a criterion of 9 consecutive perfect escape responses. In Figure 2.
we can see the major characteristics of the learning of this instrumental escape response. The top row gives the performance of normal rats over 3 days of training for each of the 3 components of the escape response. It can be seen that the most difficult part of the response is the exit from the start box. The learning to run in the alley and entry into the goal box required far less trials. The performance of the hemidecorticates, given in the middle row, shows a marked learning impairment that manifests itself exclusively in the start box behaviour. Whereas normals required 5 trials to criterion the hemidecorticates needed 10 trials to master this first component of escape behaviour. No significant differences were found for either the running or entry components indicating that the learning deficit could not be due to any simple motor impairment. The lateralization group, given in the bottom row, has the same learning defect as the hemidecorticates for the first two days. On the third day when the rats were exposed to the situation with a new hemisphere complete lateralization of all components of the escape response was found. This is seen by virtue of the fact that these animals have to relearn not only the correct performance in the start box but also behaviour in the alley and goal box. Every instrumental component of escape learning had been restricted to the originally trained hemisphere. What is interesting is that the conditioned emotional response produced by being placed in the start box did not lateralize. This classically conditioned response was clearly manifested with the new hemisphere. With the new hemisphere the animals appeared to *recognise the situation* or *know what was* going to happen, but they did not *know what to do* about this.

From these findings it is concluded that instrumental conditioning involves both a cortical mechanism for encoding (learning) and storage (retention) of information. Classical conditioning does not appear to involve such mechanisms at a cortical level. Hence it would follow that not only are different types of learning involved in these two conditioning procedures, but also different neural encoding and storage mechanisms.

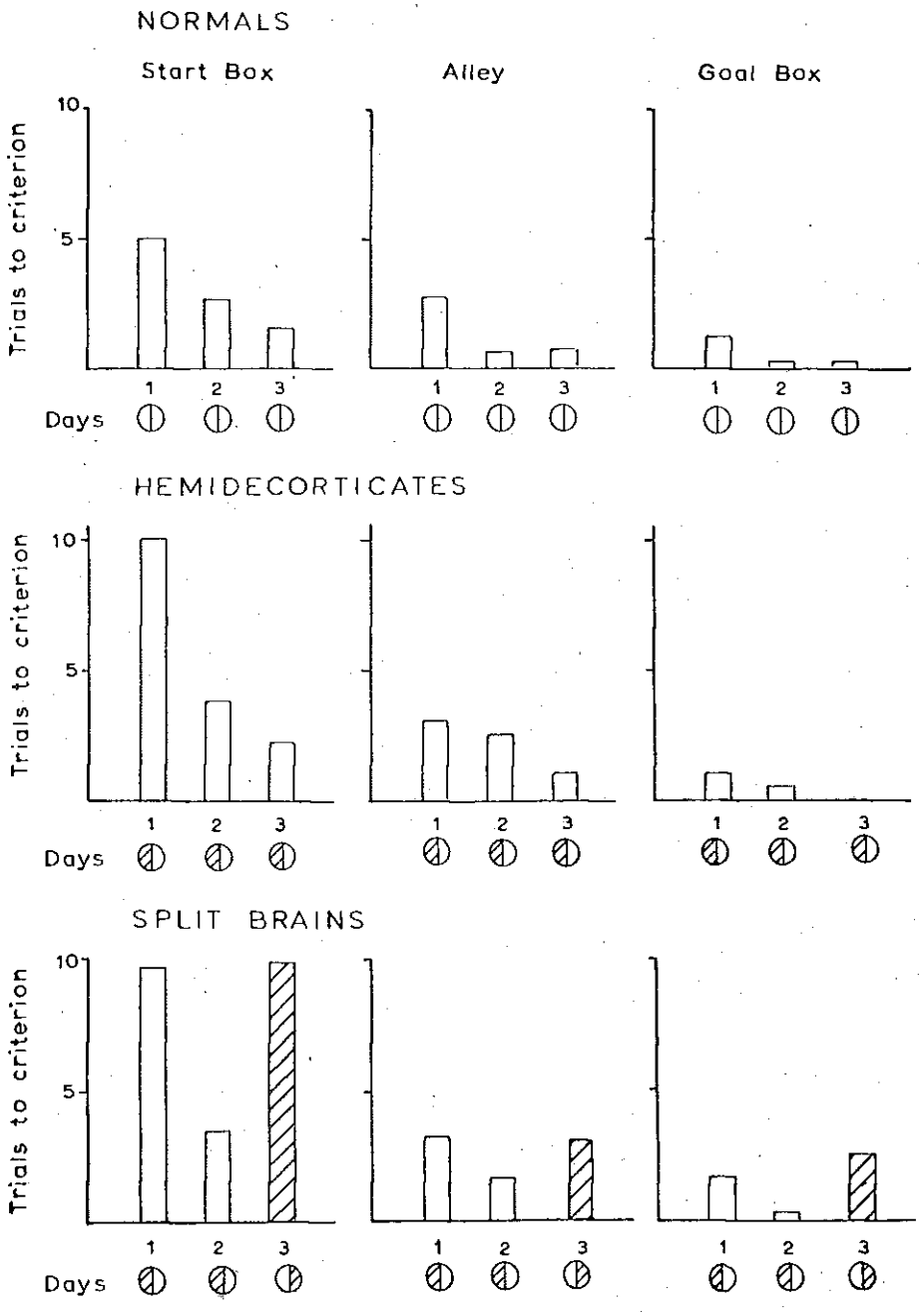
NORMALS
Start Box
Alley
Goal Box
Trials to criterion
10
5
1 2 3
Days
HEMIDECORTICATES
SPLIT BRAINS

Figure 2