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CONDITIONED TACTILE PLACING IN CATS WITH UNILATERAL NEODECORTICATION OR SPINAL CORD HEMISECTION

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Abstract. The conditioned tactile placing of the forelimbs was abolished contralaterally after unilateral neodecortication or ipsilaterally after hemisection of spinal cord at high cervical level in cats. However, the conditioned response can be regained with training. The results suggest that training activates additional pathways for the conditioned response.

Tactile placing (TP) can be obtained through training in adult cats with cortical or subcortical lesions interrupting afferent and efferent pathways essential to the reflex TP (5, 6). The lesions were made in the bulbar pyramid, red nucleus, cerebellar interposed nucleus, dorsal quadrant of spinal cord at cervical level and cerebral somatosensorimotor cortex. These results indicate that reflex and conditioned TP involve different pathways. In this study, the effects of more extended lesions (unilateral neodecortication or spinal cord hemisection) were investigated.

The methods were described in detail previously (6). Reflex TP was tested in the cat by contacting part of the unsupported limb with the edge of a table. The normal cat placed the paw on top of the table forward, backward, medially or laterally according to part of the limb touched. The cats were also positioned in a hammock for testing and training of the conditioned TP of both forelimbs with food as a reward.
The presence or absence of TP (placing following light touch) was determined. The rapidity of response and pattern of movements were also observed but not quantitatively recorded. Neodecortication was done by gentle aspiration and spinal cord was sectioned with a sharp knife under intraperitoneal Nembutal anesthesia. At the termination of the experiments, the animals were perfused intravascularly. The extent of the lesions was studied histologically.

Nineteen cats were subjected to unilateral neodecortication or spinal cord hemisection. The findings in five of them with complete lesions and healthy postoperative courses are presented. All five animals showed persistent loss of reflex TP of the involved limbs after surgery.

Unilateral neodecortication. Cats Y17, Y87 and Y95 were trained for the conditioned TP before neodecortication. Cat Y17 showed loss of the conditioned TP in the left forelimb but not the right after right neodecortication. With training, the conditioned TP in the left forelimb returned in forward and backward directions by the 10th postoperative day and in all directions, except for the lateral, by 21st day. The left limb moved slower than the right and tended to overstep in placing. The conditioned TP in the lateral direction continued to be absent throughout the postsurgical period of 63 days. Cat Y95 also showed loss of conditioned TP in the contralateral forelimb after left neodecortication. With training, the conditioned TP in the right forelimb appeared in forward, backward and occasionally medial directions on the 29th postoperative day. Movements were jerky and slow, more from the wrist and with the elbow extended. By 36 days after surgery, the conditioned TP was consistently noted in all directions, except for the lateral. By 106 days after surgery, the conditioned TP was still absent in the lateral, but the movements were rather smooth. Cat Y87 had right pyramid section 50 days prior to right neodecortication. The conditioned TP was not noted in either forelimb after neodecortication until the 6th postoperative day when the response returned in the right without retraining. Training was started for the left forelimb on the 13th postoperative day. The conditioned TP was obtained in all directions in four days, although the movements were slow and hypermetric in forward and lateral placings.

Spinal cord hemisection. Cats Y94 and Y86 were trained for the conditioned TP before hemisection of the spinal cord at C2 level. Cat Y94 had left hemisection and was observed for 54 days after surgery. The conditioned TP in the right forelimb was preserved after surgery, but showed slight overstepping, slower and weaker movements for six days. The left forelimb was severely involved, extended and stiff, with complete loss of proprioceptive placing for two weeks. No conditioned TP
could be elicited in the left forelimb. With training, the conditioned TP returned in the left in forward and backward directions on the 21st postoperative day, also in the lateral on the 23rd day and in all directions on the 29th day. The movements were jerky, stiff and hypermetric. By 50 days after surgery, the limb was less rigid and usually placed accurately following high stepping from elbow hyperflexion. Cat Y86 had right hemisection extended to the entire left ventral funiculus and was observed for 75 days. The right limbs showed complete loss of proprioceptive placing for 34 days. The conditioned TP was not tested until the 6th postoperative day when the conditioned response was present in the left but not the right. With training, the conditioned TP of the right forelimb was obtained in all directions on the 47th postoperative day, although the movements were slow and stiff.

Thus, cats can be trained for conditioned TP after unilateral neodecortication or hemisection of spinal cord at high cervical level. The effects of unilateral neodecortication on the conditioned response did not appear to be more severe than those of cerebral sensorimotor cortical ablation, except for the difficulty in lateral placing. This suggests that neocortex other than the sensorimotor area may not be essential for the conditioned TP and that the conditioned TP can probably be mediated by subcortical structures or the contralateral cortex. Similarly, spinal cord hemisection that even extended to the contralateral ventral funiculus did not permanently abolish the conditioned TP. This finding suggests that the conditioned response can be obtained as long as the basic spinal mechanisms can be activated by certain cortical or subcortical sensory and motor pathways. Although specific structures have been found to be essential for instrumental conditioning (2, 3), the pathways mediating conditioned responses need not be specific. Training may activate additional pathways for the conditioned response.

Finally, it is worthy to mention that since conditioned TP is difficult to obtain in the lateral direction in neodecorticated cats, the lateral TP may be different from others. This can probably be supported by earlier observations of reflex TP recovering from some brain lesions (1) and in the developmental stage (4).

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