The caudate nucleus and active avoidance.

Reply to Kirkby

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Kirkby's conclusion that the majority of reports show that lesions to the caudate nucleus disrupt active-avoidance learning does not take into account a critical point of the Winocur & Mills (1969) paper. It was our contention that in those studies that reported impaired active-avoidance behavior following damage of the caudate nucleus, lesions were directed at the postero-ventral portions of the structure or were so large that they seriously infringed on these areas. Localized lesions directed at the antero-dorsal portions of the caudate nucleus do not typically result in this type of impairment, and the studies cited by Kirkby bear this out (Fox, Kimble, & Lickey, 1964; Albert & Bignami, 1968; Winocur & Mills, 1969). On the other hand, Thompson and his collaborators (1958, 1959, 1963), Green, Beatty, & Schwartzbaum (1967), and Romanovskaya (1957), who are cited as having reported deficits in conditioned-avoidance behavior, consistently destroyed postero-ventral tissue, which, in the cases of Thompson and Romanovskaya, was also accompanied by extensive damage to other parts of the caudate nucleus. In the Kirkby studies (1968, 1969), two lesions per hemisphere were directed at the anterior portions of the caudate nucleus, resulting in much larger lesions than those reported by investigators who found no impairment in active avoidance in caudate-damaged rats. Kirkby (1969) reported that 50%-85% of the caudate nucleus had been destroyed,

while we estimated the damage to be 15%-25% in our animals. In the Soltysik & Zielinski study (Konorski, 1967), it was impossible to verify the nature and extent of brain damage since this was an unpublished report unaccompanied by histology.

The only study that, on the surface at least, appears to contradict our position is that by Turner (1954), who reported deficits in discriminating the sound of a bell from that of a buzzer for purposes of shock avoidance. The task appeared to involve sensory discrimination as well as active- and passive-avoidance components, so it was not always apparent what aspects of the problem gave the impaired Ss the most difficulty; indeed, Turner pointed out that the cause of failure varied from one animal to another, and that Ss generally displayed a variety of inappropriate behavior patterns. In any case, all Ss had been subjected to anoxia prior to testing, and this was clearly a confounding variable in view of Turner's conclusion that Ss "were considered to be suffering from the effects of anoxia when they failed to perform [the] previously taught conditioned reaction [p. 462]."

Thus, we maintain, as we did in our paper, that localized antero-dorsal lesions to the caudate nucleus do not affect active-avoidance conditioning but do impair behavior in situations requiring adjustment to a reorganization of spatial cues. Kirkby (1969) has also pointed to the potential importance of the caudate nucleus as a high-level integrator of sensory information so that, in this respect at least, there is general agreement in our positions.

REFERENCES

- ALBERT, M., & BIGNAMI, G. Effects of frontal, median cortical and caudate lesions on two-way avoidance learning by rats. *Physiology & Behavior*, 1968, 3, 141-147.
- FOX, S. S., KIMBLE, D. P., & LICKEY, M. E. Comparison of caudate nucleus and septal-area lesions on two types of avoidance behavior. *Journal of Comparative & Physiological Psychology*, 1964, 58, 380-386.
- GOMEZ, J. A., THOMPSON, R. L., & METTLER, F. A. Effect of striatal damage on conditioned and unlearned behavior. *Transactions of the American Neurological Association*, 1958, 83, 88-91.
- GREEN, R. H., BEATTY, W. W., & SCHWARTZBAUM, J. S. Comparative effects of septo-hippocampal and caudate lesions on avoidance behavior in rats. *Journal of Comparative & Physiological Psychology*, 1967, 64, 444-452.
- KIRKBY, R. J. Caudate nucleus lesions and perseverative behavior. *Physiology & Behavior*, 1969, 4, 451-454.
- KIRKBY, R. J. The caudate nucleus and active avoidance: A comment on the report of Winocur and Mills. *Psychonomic Science*, 1970, 18, 269.
- KIRKBY, R. J., & KIMBLE, D. P. Avoidance and escape behavior following striatal lesions in the rat. *Experimental Neurology*, 1968, 20, 215-227.
- KONORSKI, J. Integrative activity of the brain. The University of Chicago, Chicago, 1967.
- ROMANOVSKAYA, E. A. Certain consequences of destroying the caudate nuclei in rabbits and dogs. *Bulletin of Experimental Biology & Medicine*, 1957, 44, 1066-1069.
- THOMPSON, R. L. Effects of lesions in the caudate nuclei and dorsofrontal cortex on conditioned avoidance behavior in cats. *Journal of Comparative & Physiological Psychology*, 1959, 52, 650-659.
- THOMPSON, R. L., & METTLER, F. A. Permanent learning deficit associated with lesions in the caudate nuclei. *American Journal of Mental Deficiency*, 1963, 67, 526-535.
- TURNER, E. A. Cerebral control of respiration. *Brain*, 1954, 77, 448-486.
- WINOCUR, G., & MILLS, J. A. Effects of caudate lesions on avoidance behavior in rats. *Journal of Comparative & Physiological Psychology*, 1969, 68, 552-557.