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The Control of Rapid Limb Movement in the Cat. I. Response Latency

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Summary. A versatile tracking task has been developed to assess the competence of feline subjects in using sensory information to initiate and guide limb movement. In the present study we investigated the response latency and the factors which affect it in order to define temporal constraints on the underlying processing of information. The paradigm makes use of an electromechanical display of the difference between the output of transducers in a manipulandum (controlled by the cat) and a target level (controlled by the experimenter). Because of inertia and friction, a step change in target level required 230 msec to fully shift the display. The animals were trained to match the position of the manipulandum (or the force they applied to it isometrically) to the target level for a food reward.

Target perturbations elicited rapid position or force adjustments of appropriate direction and magnitude at short latency. Under isometric conditions, the latency of the response was an inverse function of the extent of display motion and of the peak rate of force change attained during the adjustment. Asymptotic values of the response time, measured from the perturbation to the first change in force applied to the lever, were typically between 50 and 70 msec. Since the motor responses were invariably initiated while the display was still moving, the animals must have used information contained in the derivatives of its motion. In the absence of visual cues, deflection of the vibrissae by the sudden motion of the display provided two of the four animals with sufficient information to initiate and guide their movements without changes in response latency. When vision was allowed, section of the vibrissae produced a persistent increase in response times of 15–20 msec. This difference in latency is compatible with the delays due to retinal transmission.

The short time interval elapsing between stimulus and response strongly suggests that the topography and the metrics of the underlying transformations are adjusted by gating and/or biasing processes which

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