Saccadic Probability Influences Motor Preparation Signals and Time to Saccadic Initiation

Michael C. Dorris and Douglas P. Munoz
Medical Research Council Group in Sensory-Motor Neuroscience, Department of Physiology, Queen's University, Kingston, Ontario, Canada, K7L 3N6

One must be prudent when selecting potential saccadic targets because the eyes can only move to one location at a time, yet movements must occur quickly enough to permit interaction with a rapidly changing world. This process of efficiently acquir-ing relevant targets may be aided by advanced planning of a movement toward an upcoming target whose location is gath-ered via environmental cues or situational experience. We stud-ied how saccadic reaction times (SRTs) and early pretarget neuronal activity covaried as a function of saccadic probability. Monkeys performed a saccadic task in which the probability of the required saccade being directed into the response field of a neuron varied systematically between blocks of trials. We re-corded simultaneously the early pretarget activity of saccade-related neurons in the intermediate layers of the superior col-liculus. We found that, as the likelihood of the saccade being generated into the response field of the neuron increased, the level of neuronal activity preceding target presentation also increased. Our data suggest that this early activity codes motor preparation because its activity was related to not only the metrics but also the timing of the saccade, with 94% (29/31) of the neurons tested having significant negative correlations be-tween discharge rate and SRT. This view is supported by cases in which exceptionally high levels of pretarget activity were associated with anticipatory saccades into the response field of a neuron that occurred in advance of the target being pre-sented. This study demonstrates how situational experience can expedite motor behavior via the advanced preparation of motor programs.

Key words: saccade; oculomotor; reaction times; superior colliculus; monkey; motor preparation; gap paradigm; express saccades; target probability; motor learning