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Position vs. saccade responses in V1 of alert monkeys.

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Natural viewing in primates consists of abrupt saccades followed by fixation periods comprising involuntary small saccades and drifts. We studied the activity of single V1 neurons in response to stationary stimuli while monkeys performed a fixation task or made voluntary saccades of different sizes. Classical receptive fields (CRFs) were mapped with moving and flashing bars while compensating for fixational offsets. Voluntary saccades were elicited so that the CRF crossed the stimulus, landed on it, or left it. Eye movement-induced neuronal firing could be separated into transient post-saccadic and sustained inter-saccadic activity. "Saccade-activated" cells discharged briefly whenever the CRF was swept across, onto, or off the stimulus, but were not activated in inter-saccadic intervals even when the stimulus was within the CRF. "Position/drift" cells did not respond to rapid crossings of the stimulus during saccades but fired continuously in inter-saccadic intervals, if the stimulus was within the CRF. "Mixed" cells showed both types of activity - they fired bursts following saccades but also continued to fire at a lower rate in inter-saccadic intervals, if the CRF remained on the stimulus. The effects of fixational and voluntary movements were largely equivalent, although a decrease of post-saccadic activity was observed with increasing size of crossing saccades. Responses to eye movements were strongly correlated with response transiency to stationary flashes and with velocity tuning to moving bars. A weak, slow extraretinal modulation of firing by saccades was observed. Our results suggest complementary functions for the two types of visual activation. Post-saccadic bursts signal abrupt change/motion in the CRF and can be utilized to detect salient stimulus features like edges irrespective of the current spatial position. Inter-saccadic discharge encodes stimulus position and conveys information about spatial details of a visual scene.

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