Neuronal Correlates for Preparatory Set Associated with Pro-Saccades and Anti-Saccades in the Primate Frontal Eye Field

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Diversity in behavioral responses to sensory stimuli has been attributed to variations in preparatory set. Variability in oculo-motor responses toward identical visual stimuli has been well documented, but the neuronal processes underlying this vari-ability are poorly understood. Here, we report evidence for set-related activity for saccadic eye movements in single neu-rons in the frontal eye field (FEF) in monkeys trained on a task in which they either had to look toward a visual stimulus (pro-saccade) or away from the stimulus (anti-saccade) depending on a previous instruction. A portion of FEF neurons were iden-tified as neurons projecting directly to the superior colliculus (SC) with antidromic activation techniques. Saccade-related neurons in the FEF had lower prestimulus and stimulus-related activity on anti-saccade trials compared with pro-saccade trials. The level of prestimulus activity correlated with saccadic reaction times, express saccade occurrence, and errors in the anti-saccade task. In addition, saccade-related activity in the FEF was higher for pro-saccades than for anti-saccades. These results demonstrate that the direct descending pathway from the FEF to the SC carries preparatory set-related activity for pro-saccades and anti-saccades. The results also provide in-sights into the neuronal basis of variations in saccadic reaction times and in the control of the prepotent response to glance to a flashed stimulus.

Key words: frontal eye field; eye movement; anti-saccade; motor preparation; saccade; frontal lobe; superior colliculus; monkey