

Sequence-dependent Neural Activity in Macaque Frontal Eye Fields

Puyang Zhen^a, Jing Jia^a, Xin Jin^b, Aihua Chen^a

^a **Key laboratory of Brain Functional Genomics (Ministry of Education), East China Normal University,
China**

^b **Molecular Neurobiology Laboratory, The Salk Institute for Biological Studies, US**

Email: ahchen@brain.ecnu.edu.cn

Abstract:

Frontal eye fields (FEF) is an area in the anterior bank of the arcuate sulcus in which saccades were elicited by low-threshold intracortical microstimulation, and usually is considered to be one of the key cortical areas in oculomotor control. However, the contribution of FEF in programming the saccadic sequence is still controversial: whether FEF is to determine the direction, or the whole sequence. The aim of this study is to investigate the role of the primate FEF in planning and controlling sequential saccades. In the current study, rhesus monkeys were trained to perform two behavioral tasks: 1) visually-guided and memory-guided sequences containing four orderly saccades; 2) single memory-guided saccade. Single neuronal activities in the FEF during the behavioral tasks were recorded using tungsten microelectrodes. Among 108 FEF neurons recorded during the performance of visual and memory-guided sequential tasks, 41 (38%) of them exhibited pre-saccadic activity selective for one specific numerical rank. In addition, the distribution of preferred ranks is not uniformed, by showing first-rank was prominent (27 neurons). Moreover, activities of 81 neurons in sequential and single saccade tasks were compared, and 29 (36%) neurons were found direction selective only during sequence saccades. These findings support sequence-dependent activity in the FEF, indicating that FEF plays an important role in learning and executing sequential saccades.

Keywords: frontal eye fields, sequence learning, non-human primate, memory guided saccade