Correlates of random and informed saccadic choices in macaque frontal eye fields

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Abstract:
Neurons in the frontal eye fields (FEF) participate in both target selection and response selection when subjects make saccadic eye movements to visual goals. Recently, we reported a novel “compelled-saccade” task that yields a temporally-precise behavioral manifestation of an evolving perceptual discrimination that is largely independent of motor performance (Stanford et al., 2010). The resulting “tachometric curve” gives the probability of a correct saccadic choice as a function the amount of time available to discriminate the color of competing alternatives. A simple race-to-threshold model, in which competing (target / distracter) motor plans are dynamically modulated by a sensory signal while they are developing, accurately described the behavioral findings, and single-neuron recording verified the model predictions for how the progress of the perceptual discrimination would be reflected in purely “motor-related” FEF activity. Here we extend these findings to consider FEF *visuo*motor neurons with two questions in mind. First, is the temporal relationship between neural activity and the evolving perceptual discrimination different for *visuo*motor and purely motor-related FEF neurons? And second, in the absence of sufficient visual information to make an informed decision (i.e., guesses), are saccadic choices influenced by the formation of an early motor bias signal as specified by the model? We found that, the activities of *visuo*motor and motor-related neurons show similar dependencies on perceptual processing time, such that acceleration (for targets) and deceleration (for distracters) of saccade-related activity correlates with the amount of time during which the visual stimuli are viewed. Furthermore, consistent with model predictions, the directions of uninformed guesses were correlated with the magnitude of an early motor bias signal, most evident in visuomotor neurons with elevated delay-period activity. Such bias is the neural correlate of a random guess in this compelled-saccade task.