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  To look or not to look: prefrontal cortex function during the anti-saccade task in humans and primates

  In everyday life, we explore our visual environment with eye movements and during a proportion of this time we actively suppress the automatic urge to look at stimuli (e.g. looking away from a very intriguing person on the elevator). Similarly, in the anti-saccade task, subjects have to actively suppress the automatic pro-saccade towards a visual stimulus and instead generate a voluntary anti-saccade towards the mirror location. This talk will discuss how the prefrontal cortex (PFC) is involved in response suppression of stimuli in both humans, using functional magnetic resonance imaging (fMRI), and non-human primates using single-unit electrophysiology. We measured fMRI signals from human frontal cortex during the anti-saccade paradigm in order to dissociate response suppression signals from saccade-related signals. We found bilateral frontal eye fields and right hemisphere dorsolateral prefrontal cortex activity that showed an increased signal during the instruction period before the anti-saccade eye movements were made. This finding suggests that the increased cortical activation originates from the process of preparing to make the anti-saccade eye movement and not from differences in the motor execution signals between pro- and anti-saccades. To examine the neural correlates of response suppression in the primate PFC, we analyzed the neural activity before the execution of the pro-saccade and anti-saccade. We classified two different populations of PFC neurons that demonstrated differential firing patterns during the period before saccade execution. The first population displayed an early increased firing rate for pro-saccade trials compared to anti-saccade trials. The second population demonstrated the opposite firing pattern near the end of the instruction period. This latter neural population may suggest a response suppression signal arising within PFC. These findings support the hypothesis that the PFC codes signals that are necessary to perform the complex behaviour of active response suppression to stimuli.

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