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Title: Dynamics of eye position signals in macaque dorsal areas explain peri-saccadic mislocalization

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Abstract:

Human observers mislocalize visual stimuli that are flashed around the time of saccadic eye movements. Specifically, targets presented just before (after) the onset of a saccade are perceived at a position that is shifted in (against) the direction of the eye movement. This biphasic pattern has been attributed to a damped internal representation of eye position across saccades, but this claim has not been verified by electrophysiological data. In the current study, we recorded the extracellular activity of single neurons in two macaque monkeys (four hemispheres) as they performed a combination of fixations and saccadic eye movements in near-darkness (Figure X). Recordings were performed in four dorsal cortical areas including the lateral and ventral intraparietal areas (LIP; VIP), the middle temporal area (MT), and the medial superior temporal area (MST). Individual neurons in each of these areas were found to have ‘eye position fields’: a systematic relationship between mean firing rate and the position of the eyes in the orbit. Our analysis used these eye position fields to translate observed instantaneous firing rates across the population into scalar estimates of ongoing eye position. During fixation, the decoder estimated eye position with a good degree of accuracy for all fixation locations. Across saccades, the decoder revealed an anticipatory change in the representation of eye position just prior to the onset of the eye movement, followed by a brief retraction toward the initial fixation position and an eventual stabilization at the final fixation position after around 250ms. The mismatch between the actual eye position and that encoded by the recorded neurons across saccades predicts a pattern of perceptual mislocalization that is consistent with the human psychophysical data. These results suggest that eye position signals in dorsal cortical regions underlie the localization of peri-saccadic visual targets.