

Neural Representation of Sequential States within an Instructed Task

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In the study of the neural basis of sensorimotor transformations, it has become clear that the brain does not always wait to sense external events and afterwards select the appropriate responses. If there are predictable regularities in the environment, the brain begins to anticipate the timing of instructional cues and the signals to execute a response, and even the consequences of actions. An organism's ability to anticipate events reveals an internal representation of the sequential progression of behavioral states within the context of the task being performed. Using the same eye movement tasks while recording neural data from two cortical oculomotor areas in the rhesus monkey, we found complementary spatial and sequential state representations of the Lateral Intraparietal Area (LIP) and the Supplementary Eye Field (SEF). While both areas encoded the position of eye movement targets, this spatial encoding was more consistently found in single neurons of LIP. In addition, the neurons of the SEF were found to collectively encode the progression of behavioral states of the task, with individual neurons detecting and/or anticipating different events or sets of events in the task or becoming tonically activated or depressed from one event to another and thus encoding states in an event-based manner. The entirety of responses from SEF was used to decode the current temporal position within the context of the task. Since LIP neurons were found to respond similarly when encoding an eye movement plan (saccade period) or the location of brightly flashed stimulus (cue period), the temporal information provided from SEF could be used to imply the significance of the spatial representation found in LIP.

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