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  The view from the back: Neural mechanisms for neck muscle recruitment and kinesthesia

  Many advances in our understanding of motor control have been based on studies of saccadic eye movements made with the head restrained. A strong case could be made that the saccade is the best understood volitional movement. However, saccades did not evolve in isolation, but rather as part of a gaze shifting system that habitually coordinates movements of the eyes and head. In this talk, I will discuss that primate eye-head gaze shifts can serve as a model system for understanding multi-segmental motor control. Like many multi-segmental movements, eye-head gaze shifts coordinate movements of very different biomechanical plants. I will demonstrate a previously unrecognized central strategy that delivers a selective orienting command to the head, but not the eye, presumably to optimize the head's contribution to the ensuing gaze shift. Accurate eye-head gaze shifts must also account for the body's current configuration. Indeed, neck muscles are also endowed with a remarkably rich repository of muscle spindles which provide a sense of head-on-body position required for many actions. I will discuss the development of an animal model for behavioural effects of neck muscle vibration, which through altered firing of neck muscle spindles, systematically modulate the endpoints of memory-guided gaze shifts consistent with an altered sense of head-on-body position. Together, these results emphasize how study of eye-head gaze shifts can reveal fundamental principles of multi-segment coordination that may generalize to other movement systems. Time permitting, I will also discuss recent efforts toward the development of a cognitive-based neuroprosthetic capable of interpreting, in real-time, signals recorded from the monkey posterior parietal cortex. One recent finding is that the information content extracted from this area depends on reward expectancy, being greater when the animal expects a bigger, more probable, or more desired reward.

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