- Friday, April 28, 2006
  Sensorimotor control points used when performing and observing manipulation tasks

  Object manipulation provides a model system for studying sensorimotor control because it engages multiple sensory and motor systems and because manipulation tasks involve sequentially organized distinct movement phases. I will describe a set of studies examining the control of hand and gaze movements in object manipulation tasks. We have shown that gaze supports hand movement planning by marking key spatial landmarks including points at which contact events take place. Although gaze tends to lead the hand, gaze and hand movements are synchronized around these contact events. We have hypothesized that these events, that mark task sub-goals, serve as control points that enable the brain to correlate visual, tactile and other sensory signals and compare predicted and actual sensory feedback. This control point hypothesis predicts that gaze will be controlled so as to capture the sensory consequences of contact events so that retinal and extra-retinal signals are aligned in space and time with other discrete sensory signals that mark these events and with sensory predictions about these events generated. In support of this prediction, we have shown that the timing of gaze shifts between successive contact events depends on the mechanical (and hence sensory) consequences of contact. An important idea in psychology and neuroscience is that the perception of action engages the action system and, according to the direct matching hypothesis, when we observe action, we implement covert action plans that, in real time, match the action plans executed by the actor. In the second part of this task, I will describe our work examining observers' gaze behaviour when watching manipulation tasks. We have shown that the coordination between the observer's gaze and the actor's hand is strikingly similar to the gaze-hand coordination when the observer performs the task themselves. In both cases, gaze is directed pro-actively to the key control points in the task. These results indicate that during action observation, observers implement eye motor programs directed by motor representations of manual actions and thus provide strong evidence for the direct matching hypothesis.

  Randy Flanagan
  Queens University