Effects of MT microstimulation on a 4-choice reaction-time direction discrimination task

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The speed and accuracy of some perceptual decisions are explained by the accumulation of noisy evidence to a threshold, or bound. In a motion discrimination decision task, firing rates of neurons in the lateral intraparietal area (LIP) represent the accumulation of evidence toward a decision. LIP activity also shows a sign of a threshold for terminating the decision. Although the sensory inputs that constitute this evidence are known to come from the middle temporal area (MT) the set of effective weights for translation of sensory evidence at the level of MT to the decision variable that governs the choice (the weighting function) is not known. Recordings in LIP on 2- and 4-choice versions of the task have provided preliminary insight into this weighting function. However, these experiments have examined the weighting function indirectly since LIP firing rates reflect more than just accumulated evidence. A more direct approach is to manipulate the activity of a small group of direction selective neurons within area MT.

Monkeys performed a 2- and 4-choice direction discrimination task as previously described. Microstimulation was applied during motion viewing. Both motion display and electrical stimulation ceased when the monkey initiated an eye movement (i.e., the reaction time). Microstimulation trials and control trials were randomly interleaved. Data from two kinds of trials were collected in blocks. In the first, one direction of motion was aligned to the preferred direction of neurons in the microstimulation site. In the second, motion directions were rotated 30° from the preferred direction of the microstimulation site.

When motion direction and the preferred direction of the stimulation site were aligned, shifts in the psychometric function on stimulated versus control trials were of a very similar magnitude on 2- and 4-choice decisions. These results are in accordance with observations of LIP firing rates. The magnitude of the observed shift in the psychometric function varied systematically, reflecting the angular separation between the preferred direction of the site and the direction of the motion. When motion was in a direction that was near to the preferred direction of the site, microstimulation appeared to provide evidence for a preferred direction choice. When motion was more than (approximately) 90° away from the site’s preferred direction, stimulation appeared to provide evidence against a preferred direction choice. Taken together, these observations argue that conversion of sensory inputs into evidence is similar for 2- and 4-choice decisions, and provide new insight into the weighting function between MT and LIP.