A Causal Role for V5/MT Neurons Coding Motion-Disparity Conjunctions in Resolving Perceptual Ambiguity

Kristine Krug, Nela Cicmil, Andrew J. Parker, and Bruce G. Cumming, 2013

The aim of this paper was to demonstrate that neurons in V5/MT are responsible for the conjunctive encoding of motion direction information with binocular disparity signals. In previous studies it was shown that activity in area MST, downstream from V5/MT, is correlated with perceived direction reversal at near and far disparities. It has also been shown that when disparity and direction are considered separately, neurons in V5/MT are selective for both stimulus parameters, and that subjecting these neurons to microstimulation causally influences downstream readout of these signals. To demonstrate that direction and disparity are encoded together, the authors of this paper had monkeys indicate the perceived direction of rotation of an ambiguous structure from motion stimuli, an apparently rotating cylinder composed of two sets dots moving in opposite directions, presented in the receptive fields of patches of V5/MT neurons. They selected these patches so that they contained a region with neurons tuned for the same motion direction (e.g. rightward) and a region of neurons tuned for the same disparity (e.g. near). By stimulating these patches on 50% of trials, they were able to show that the monkey's perceived direction of rotations was significantly biased (e.g. stim(rightward) + stim(near) = counter clockwise bias). These kinds of findings serve to further our understanding of how information about related but different aspects of a complex object are first parsed in the visual cortex and then ultimately recombined and represented as percepts. It would be interesting to see if activity in MST that is correlated with a single rotation direction (counter clockwise rotation), is differentially influenced by stimulated patches in V5/MT which encode different direction and disparity information, but yield the same percept: stim(rightward) + stim(near) = counter clockwise bias = stim(leftward) + stim(far).

Ongoing Activity Fluctuations in hMT+ bias the Perception of Coherent Visual Motion

Guido Hesselmann, Christian A. Kell, and Andreas Kleinschmidt, 2008

This paper aimed to demonstrate that spontaneous brain activity in motion sensitive areas, taking place prior to stimulus onset, influences how a stimulus is perceived. The authors showed in a previous study that variability in the ongoing BOLD signal of FFA can predict which of the two modes of the ambiguous “face-vase” stimulus is perceived. Their current study extended this finding to activity in right hMT+ when judging ambiguous (coherent vs random) motion stimulus. Motion coherence thresholds were obtained for each participant, and random dot motion stimuli were presented near these thresholds during fMRI. They found that the prestimulus BOLD activity in right hMT+, 1.5 seconds before stimulus onset, was significantly greater when participants reported coherent motion. Because the brain is continuously active, findings like these help to characterize the functional role of ongoing cell behavior, distinguishing variable neural activity in certain regions from mere noise. While this study established the correlation between ongoing neural activity and the probability of perceiving motion, it would be interesting to know what other motion stimulus parameters can be predicted in this way, such as motion direction or speed.
Role of the Prefrontal Cortex in Attentional Control over Bistable Vision

Sabine Windmann, Michaela Wehramann, Psquale Clabrese, and Onur Gunturkun, 2006

The authors aimed to test the role that prefrontal cortex plays in perceptual switching. Previous studies showed that prefrontal cortex is largely responsible for top-down attentional control. Other studies have investigated the connection between top-down processes and low-level vision by studying the oscillatory nature of bistable vision. In the present study, the authors compared the reports of participants with lesions in prefrontal cortex when viewing a number of bistable stimuli, with the reports of healthy participants. They found that there was little difference between the two populations when they were asked to let the perceptual switching take place naturally, and when they were asked to hold the dominant percept in view. However, participants with prefrontal lesions where unable to cause perceptual switching to occur as rapidly as those without lesions. These findings support the interpretation that prefrontal cortex is involved in withdrawing top-down resources, not suppressing bottom-up information. Knowing this helps specify how frontal cortex interacts with vision systems to maximize the relevance of percepts. One possible future study would be to try and replicate the results obtained from the lesioned population with non-lesioned participants under TMS, or some other method of interfering with normal frontal cortex operation.