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VISUAL PROCESSING

An organizing wave?

> Further analysis of the amplitudes of the beta-band LFPs over time revealed the existence of waves of activity travelling across area V4.

The phenomenon of travelling waves of neural activity — arising from out-of-phase synchronous oscillations — has been detected in various regions of the brain, including the visual cortex; however, the function of these waves remains unclear. Zanos *et al.* now show in macaques that saccadic eye movements initiate travelling waves in cortical area V4 of the extrastriate cortex, and that these waves are associated with changes in postsaccadic neuronal spiking and may have a role in prioritizing the processing of important visual stimuli.

Saccades are quick movements of the eye that enable primates to fixate the high-resolution part of their retina on an object of interest. Given that the periods of saccadic eye movements are associated with low visual sensitivity, the visual system has to take in visual information rapidly — through the integration of visual and oculomotor signals — in the inter-saccade periods. Zanos *et al.* examined the possibility that, during these periods, travelling waves of neural activity might somehow be involved in the reorganization of spatiotemporal visual information.

Area V4 harbours neurons that respond to specific aspects of visual stimuli and is retinotopically organized so that it maps the contralateral visual hemifield. The authors tested their hypothesis by recording local field potentials (LFPs) and spikes in part of this cortical area via multi-electrode arrays while the monkeys performed an eye movement task. In the task, the monkeys were presented with a visual stimulus that changed location, triggering the animals to make saccades to or away from the area of visual space (the 'target area') corresponding to the part of V4 that was covered by the arrays.

The authors found that after a saccade towards the target area, oscillatory LFP activity in the beta band (20–40 Hz) occurred in V4 at sites corresponding to the fovea and, later, at sites corresponding to more peripheral retinal regions, indicating that out-of-phase oscillations were being initiated after each saccade. Further analysis of the amplitudes of the beta-band LFPs over time revealed the existence of waves of activity travelling across area V4.

The waves required both visual stimuli and oculomotor movement, and their amplitude was tuned to the direction of the saccadic movements and linked to the size of the saccades. However, eye movements had little effect on the direction of the waves.

Notably, the phase of the beta oscillation in the V4 LFPs was consistently reset near the end of saccadic eye movements, and this resetting occurred initially at foveal sites and, later, at more peripheral sites. Moreover, single-neuron spiking in V4 showed marked tuning to the phase of the beta oscillation and the timing of such spiking could be altered by the execution of saccades. This suggests that the travelling waves predict the spike timing of individual V4 neurons.

Together, these findings reveal that saccadic eye movements seem to elicit travelling waves of neural activity in area V4 that are intimately linked to the responsiveness of individual V4 neurons. Although the exact function of the waves remains to be determined, the authors argue that they may enable the oculomotor system to guide the spatiotemporal organization of visual processing.

Darran Yates

ORIGINAL RESEARCH PAPER Zanos, T. P. *et al.* A sensorimotor role for traveling waves in primate visual cortex. *Neuron* http://dx.doi.org/10.1016/j.neuron.2014.12.043 (2015)