

Title

Effects of attention on visual processing between cortical layers and cortical areas

Primary field

Perception & Action

Primary methodology

Computational Modelling

Background

Visual attention is a cognitive computation crucial in improving perceptual abilities. Despite the wealth of previous studies on the neurophysiology of visual attention, we still have an incomplete knowledge of how different layers of cortical visual circuits differentially modulate, when attending to specific spatial locations, their visual coding and visual information transmission properties.

Methods

Electrophysiological recordings performed in Newcastle University using multi-contact probes allowed to access neural activity of V1 and V4 in 3 macaque monkeys, while animals performed a top-down spatial attention task. Laminar depth alignment was referenced to the earliest inward current following stimulus onset. The effects of attention on Local Field Potentials (LFPs) were quantified in terms of spectral power, spectral coherence, mutual information between attended visual locations and LFPs in the time/frequency domain, and transmission of visual information across layers.

Results

Attentional modulations of the spectral features that we considered did not show very major differences across layers. We found that the main effect of attention on cortical LFPs consists of an upward shift in spectral power peak, accompanied by the onset of side lobes with increased power. This was the case both for V1 and V4 LFPs, and was a result confirmed across subjects. Focusing on attention demanding time epochs during the task, we tracked the temporal evolution of visual information to identify diagrams of directional flows across laminar layers. In particular, we found very robust patterns of flow of theta-band information about the spatial location of the attended stimulus, from supragranular to granular layers in V1.