Presentation Abstract

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Presentation Title: Gating of visual processing by selective attention as observed in LFP data of monkey area V4
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Abstract: A major function of visual attention is the selective processing of behaviourally relevant visual information. Because receptive field (RF) sizes increase with increasing processing level, neurons in higher visual areas like V4 may receive afferent input associated with more than one object. For selective processing of the relevant object, afferent activity carrying information about this object needs to be more effective than activity related to other objects. In order to investigate attention-dependent routing of information flow in visual cortex, we developed a method which allows a dynamic characterization of putative gating mechanisms by simultaneously estimating the contribution of target and distracter objects to neuronal activity patterns.

A macaque monkey was trained to perform a shape-tracking task (Taylor et al. 2005), in which the animal had to direct attention to one of two sequences of morphing shapes on a 21” CRT screen (100 Hz frame rate). Both shapes were within a typical RF in V4. They had a diameter of about 1° of visual angle and were separated by a gap of less than 1°. The luminance of the filled shapes was modulated pseudo-randomly for each frame. The animal’s task was to signal the reoccurrence of the initial shape of the attended sequence. Recordings of V1’s local field potentials (LFPs) were performed with an array of implanted microelectrodes. Simultaneously we recorded with up to three microelectrodes LFPs in a retinotopically matching part of V4.

The LFPs were split into their frequency components by a wavelet transform. As a measure for the effective contribution of each stimulus we computed the spectral coherence (c, 0 <= c <= 1) between the time course of its luminance and the measured LFPs.

For recording sites in V4 with both stimuli inside their RFs, we found a strong effect of attention. For the attended stimulus the coherence was several times higher than for the non-attended stimulus. Switching attention was accompanied by a corresponding reversal of the coherence pattern. Significant coherence was typically limited to a frequency range up to 15 Hz with a
maximum around 5 Hz and values between c=0.07 and 0.14. In contrast, we found no effect of attention on the spectral coherence between V1 electrodes and the stimulus.

In summary, our new method reveals that spatial selective attention gates temporal information in V4 in a highly effective manner and with high spatial resolution. Furthermore it characterizes the spectral filter properties of attentional gating, thereby providing constraints for possible underlying mechanisms.


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GATING
MONKEY

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