

Distributed competition in directed visual attention.

[F.H. Hamker Div. of Biology, Caltech, Pasadena, CA, 91125](#)

We investigate the hypothesis of attention as a result of a parallel, distributed competition to gain further insight into the origin of selection, as opposed to the classical approach, which defines attention as a result of a competition on a saliency map. We ask how these two different hypotheses can explain the findings of neural activity in V4 during a stimulus presentation, before a local stimulus selection takes place (*Motter, J. Neurosci. 1994*). The findings are difficult to explain by a selection of a location. Models following the classical hypothesis by assuming that only attended items are allowed to pass through the recognition network, fail to explain the findings.

We suggest a model that explicitly incorporates a top-down feature feedback within the ventral pathway to account for feature based attention. Spatial attention is accomplished by the fronto-parietal network. Both are connected via recurrent excitatory loops (Fig. 1). The models population dynamics are described by a functional mapping between groups of neurons and simulated on the basis of differential equations.

Concerning the experiment of Motter (*1994*), attention evolves in reverse order than predicted by the classical approach. The bottom-up process meets the top-down, target process in IT or perhaps in V4.

All cells coding the target feature (e.g. red) increase their activity and gain an advantage for the competition for location. Loosely speaking the items are recognized before their location is selected. There is no need to assume that the ventral pathway is only modulated by spatial selection, it provides the basis and target for spatial selection and not only the target. The feature dimension that does not define the target, i.e. orientation when color defines the target, is predicted to show no strong attentional modulation during the stimulus presentation phase, which differs from spatial selection, where the activity for features in all dimensions shows a significant increase.

The distributed competition model is not merely restricted to explain the experiment of Motter (*1994*). The current simulations comprise experiments that observe the effect of spatial attention in V4 (*Reynolds et al., Neuron 2000; Reynolds et al., J. Neurosci. 1999; Luck et al., J. Neurophysiol. 1997*) and memory guided visual search (*Chelazzi et al., J. Neurophysiol. 1998*). We are able to meet even the temporal dynamics of the firing rates.

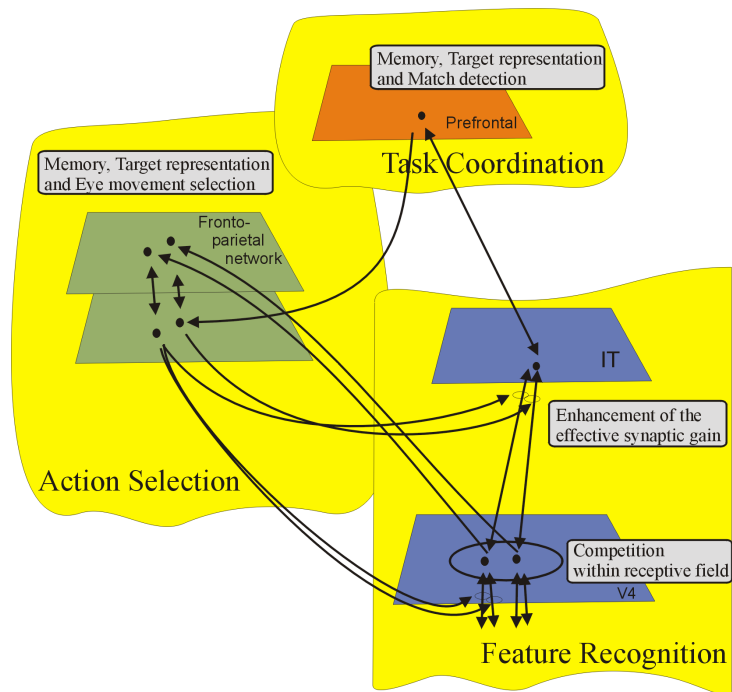


Fig. 1. Overview of the distributed competition model.

Funded by DFG HA2630/2-1 and NSF-ERC