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Attentional modulation in a two-layer system

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Experimental works have shown that the attentional modulation of firing rates increases along the visual pathway. It has also been shown that attention modulates the gamma-frequency synchronisation. In electrophysiological experiments, these modulations have been found in layer V4 [1] but not in layer V1 [2]. In this modelling work, we study how selective attention modulates neuronal activity in different layers of the visual system. We use a two-layer model of integrate-and-fire neurons, modelling attention as an external input biasing the competition. We study the influence of the attentional bias on both the modulation of the firing rates and the gamma frequency synchronisation in both layers. We show that the gamma frequency synchronisation is much higher in the upper layer (V4) than in the lower layer (V1). In addition, the modulation of the synchronisation is generally stronger in the higher layer. Our findings are thus consistent with an increase of the gamma frequency modulation along the visual pathway. This might explain the different findings in [1] and [2], as they measured from different layers in the visual system. We also analyse attentional modulations as a function of the connection strength between the two layers. Our results show that depending on the connection strength, either the rate modulation or the gamma frequency modulation is stronger, suggesting that both play an active role in the encoding of attention.

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