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Poster presentation

Neural basis of perceptual expectations: insights from transient dynamics of attractor neural networks

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Sensory information from the external world is intrinsically ambiguous, necessitating prior experience as a constraint on perception to parse stimuli into well-defined categories. Priming, which have been used vastly to study such perceptual influences, is the phenomenon where the perception of a given stimulus, or the prime, affects the perception of a succeeding stimulus, or the target, even when the target is presented after a long delay or the prime is not explicitly perceived [1]. Using classical priming paradigms, it is observed that brief exposure to a stimulus – ranging from tens to hundreds of milliseconds – biases subjects to perceive the following stimuli either as dissimilar (adaptation aftereffects) or more similar (priming) to the priming stimuli [2,3]. Thus, in a categorization task, the category boundary may move towards or away from the prime. The duration of the prime and the prime-target asynchrony, as well as the type of intervening mask, affect both the strength and the direction of the effect [2,4]. Current evidence has led to the suggestion that a particular type of the observed priming effect may be primarily due to the conflicting acts of lingering activation from the prime and accumulating depletion of synaptic resources [5]. Some other studies looked at the interaction between local shunting adaptation and a near-threshold neural baseline [6]. This neural model explains the observed behavior, without invoking any "high-level" decision making or memory process. However, it has been shown that also high-level, complex processes such as face perception are subject to aftereffects, namely rate firing adaptation. In spite of a large body of empirical data on various behavioral outcomes in such experiments, we still lack an explanatory model capable of predicting the crossover from adaptation aftereffect to priming, as emerging in a generic cortical network. We have developed an analytical approach to study the transient dynamics of networks of threshold-linear model neurons that include, as a necessary ingredient of the relevant computational mechanism, a simple feature of pyramidal cell biophysics: firing rate adaptation. The analysis yields the attractor states of the network and the full spectrum of time constants of the transients associated with different steady states. Studying these transients, in the response to external inputs that are morphed between two stored patterns, and affected by previous activity of the network, could shed light on the possible contribution of attractor dynamics to perceptual boundary shifts. The preliminary results show that firing rate adaptation plays the main role to produce adaptation aftereffects in our network, without which one only observes priming effects, if any. The relative duration of target length and adaptation time scale is one of the crucial terms determining the dynamics. The strength of recurrent connection with respect to feedforward inputs is another relevant parameter.

References

1. Wiggs CL, Martin A: **Properties and mechanisms of perceptual priming.** *Current Opinion in Neurobiology* 1998, **8:**227-233.
2. Rijsbergen N, Jannati A, Treves A: **After effects in the perception of emotion following brief, masked adaptor faces.** *TOBSJ* 2008, **2:**36-52.
3. Kanai R, Verstraten FAJ: **Perceptual manifestations of fast neural plasticity: Motion priming, rapid motion aftereffect and perceptual sensitization.** *Vision Research* 2005, **45:**3109-3116.

4. Daelli V, Treves A: **How recent experience affects the perception of ambiguous objects.** . Submitted
5. Huber DE: **Immediate priming and cognitive aftereffects.** *J Experimental Psychology: General* 2008, **137:**324-347.
6. Noest AJ, van Ee R, Nijs MM, van Wezel RJ: **Percept-choice sequences driven by interrupted ambiguous stimuli: a low-level neuralmodel.** *J Vision* 2007, **7:**10.
7. Webster MA, MacLin OH: **Figural aftereffects in the perception of faces.** *Psychonomic Bulletin & Review* 1999, **6:**647-653.
8. Brunel N, Lavigne F: **Semantic priming in a cortical network model.** *J Cognitive Neuroscience* 2008:18.