# Latching dynamics in neural networks with synaptic depression

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Prediction is the ability of the brain to quickly activate a target concept in response to a related stimulus (prime). Experiments point to the existence of an overlap between the populations of the neurons coding for different stimuli, and other experiments show that prime-target relations arise in the process of long term memory formation. The classical modelling paradigm is that long term memories correspond to stable steady states of a Hopfield network with Hebbian connectivity. Experiments show that short term synaptic depression plays an important role in the processing of memories. This leads naturally to a computational model of priming, called latching dynamics; a stable state (prime) can become unstable and the system may converge to another transiently stable steady state (target). Hopfield network models of latching dynamics have been studied by means of numerical simulation, however the conditions for the existence of this dynamics have not been elucidated. In our recent work we showed that latching dynamics can be approximated by robust heteroclinic dynamics [1]. In this setting we we confirmed that latching dynamics can exist in the context of a symmetric Hebbian learning rule, however lacks robustness and imposes a number of biologically unrealistic restrictions on the model. In particular our work shows that the symmetry of the Hebbian rule is not an obstruction to the existence of latching dynamics, however fine tuning of the parameters of the model is needed.

In a follow up work we are investigating the effects of adding structured (non-uniform) inhibitory connections to the model. Our preliminary results show that a suitably chosen matrix of inhibitory connections may add robustness to the heteroclinic dynamics. The structure of the inhibitory connections may be due to a learning process equivalent to the memorisation of a sequence of concepts.

## References

[1] Aguilar C, Chossat P, Krupa M, Lavigne F (2017) Latching dynamics in neural networks with synaptic depression. *PLoS ONE* **12** (8): e0183710.