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Conditions for the emergence of Hebbian plasticity in striatum

According to Hebbian theory, neural networks refine their connectivity by patterned firing of action potentials in pre- and postsynaptic neurons. Spike-timing-dependent plasticity (STDP), a major physiologically relevant form of Hebbian learning, has been the focus of considerable attention in experimental and computational neuroscience. STDP relies on the precise order and the millisecond timing of the paired activities on either side of the synapse. Identifying the conditions required for the expression of Hebbian plasticity, such as STDP, is essential for a better understanding of the mechanisms underlying learning and memory.

Here, with a combination of ex vivo and in vivo recordings and modeling, we will discuss the conditions required for the emergence of STDP from distributed neural activity at striatal synapses. Temporal coding via STDP may be essential for the role of the striatum in learning of motor sequences in which sensory and motor events are associated in a precise time sequence. Corticostriatal long-term plasticity provides a fundamental mechanism for the function of the basal ganglia in procedural learning. Striatal neurons act as detectors of distributed patterns of cortical and thalamic activity. We shown that STDP expression is profoundly modified when acting on parameters such of the number, the frequency and the jitter of pairings. We will also provide evidences that the settings of the appropriate glutamate and GABA dynamics are crucial for the emergence of STDP.