Functional brain states underlying learning and memory processes

Agnès Gruart
Division of Neurociences, Pablo de Olavide University, Seville, Spain
agrumas@upo.es
http://www.divisiondeneurociencias.es

The complexity of brain functions can only be approached by a multidisciplinary and comparative approach. The availability of genetically manipulated mammals and of sophisticated electrophysiological techniques—susceptible of being applied in behaving animals during the acquisition of new motor abilities—have largely facilitated the study of brain functions, mostly those related to associative learning, decision making, and social interactions. Our group has studied for years the contribution of sensory, motor, premotor, hippocampal, and prefrontal circuits to non-associative, Pavlovian, and instrumental learning paradigms. For this, we have recorded activity dependent changes in strength in cortical and subcortical synapses during the respective acquisition processes. The main output of these studies is that learning is the result of the activity of wide cortical and subcortical circuits activating particular functional properties of involved synaptic nodes and that brain functions during learning processes have to be studied at live. We have also developed different computational procedures to determine how experimental animals (i.e., their brain circuits) deal with many different physical and social constrains. In this regard, I will present recent evidences from our laboratory respect to the participation of these functional states in social interactions and regarding their use for brain-machine interface in behaving rats.

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