Influence of local neuronal and circuit features on the functional mapping of the cortical network

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The brain forms a highly interconnected network or connectome that can nowadays be mapped in ever-increasing detail thanks to the improvement of the resolution of imaging techniques and reconstruction methods. However, the structural mapping does not always correspond to the functional mapping, estimated by means of functional or effective connectivity. Functional connectivity is dynamic and varies with the functional state of the network. Indeed, functional connectivity varies with brain states, thus functional network is different in sleep states, wakefulness, anesthesia, disorders of consciousness and so on. Thus, depending on the brain state, a network can change from being dominated by the balance between integration and segregation (wakefulness), to be highly integrated and fully synchronized (slow wave sleep or deep anesthesia). The state of the network and the functional consequences, such as the causal interactions across areas, can be investigated in resting states, task-evoked or following stimulation or perturbation. Our results and those of others suggest a deep change such that in states of unconsciousness the causal interactions across areas are lost with respect to wakefulness. But, what are the mechanisms underlying these flexible dynamics? Are they synaptic, cellular, subcellular changes? We will show the impact of individual ionic currents and synaptic receptors on functional connectivity and network complexity, bridging the ionic channels with the network's spatiotemporal network dynamics.

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