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A SYSTEM BIOLOGY APPROACH FOR MODELING THE BRAIN: FROM GENES TO CONSCIOUSNESS

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Given the tremendous complexity of brain organization, here I propose a strategy that dynamically links stages of brain organization from genes to consciousness, at four privileged structural levels: genes; transcription factors (TFs)–gene networks; synaptic epigenesis; and long-range connectivity. These structures are viewed as nested and reciprocally inter-regulated, with a hierarchical organization that proceeds on different timescales during the course of evolution and development. Interlevel bridging mechanisms include intrinsic variation-selection mechanisms, which offer a community of bottom-up and top-down models linking genes to consciousness in a stepwise manner. The proposed approach is to nest the various intertwined structural and functional levels that compose the brain into a coherent and open brain models community covering multiple timescales. A critical bridging role between the gene and neuronal levels is assigned to regulatory proteins termed TFs. TFs regulate disparate genes into coherent assemblies. The impact of the environment on brain synaptogenesis is modelled as activity-dependent selective stabilization pruning of synapses. Long-range connectivity, subject to developmental shaping through interactions with the physical, social, and cultural environment, is proposed to form the bridge between neuronal micro circuitry and higher cognitive functions by globally integrating the underlying neural organizations. A novel allosteric pharmacology of TFs is proposed for neuropsychiatric diseases



Biography

Prof. Jean-Pierre Changeux is a renowned neuroscientist. He received his PhD in 1964 and continued to postdoctoral fellowships at the University of California-Berkeley and at the Columbia University College of Physicians and Surgeons in New York. Changeux returned to the Institut Pasteur in 1967, where he remains since. He also served as professor at the College de France from 1975 through 2006. His numerous awards include the Wolf Prize in Medicine in 1982; the Carl-Gustav-Bernhard medal of the Swedish Academy of Science in 1991; the CNRS Gold medal in 1992; the Balzan Prize for Cognitive Neurosciences in 2001; the Lewis Thomas Prize for Writing about Science in 2005; the National Academy of Sciences' (NAS) Award in the Neurosciences in 2007; the Japanese Society for the Promotion of Science (JSPS) award for eminent scientists in 2012; and many others. He is also a member of many international scientific academies and holds honorary degrees from leading institutions worldwide. The research of Jean-Pierre Changeux has centred on the fundamental molecular and cellular mechanisms involved in the recognition of chemical signals and their transduction into biological activity.

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