Popular scientific abstract

The circuitry of the human brain is composed of a trillion (10^{12}) neurons and a quadrillion (10^{15}) synapses, whose connectivity underlies all human perception, emotion, thought, and behavior. Studies in a range of species have revealed that the overall structure of the nervous system is generally determined but that neural circuits undergo extensive sculpting and re-wiring in response to a variety of stimuli. This process of experience-dependent changes in synaptic connectivity is called synaptic plasticity. Despite years of extensive research, synaptic plasticity, as a highly complex and tightly regulated process, is still poorly understood and, in particular, the role of Golgi apparatus in this phenomenon is unknown. This proposal aims at an explanation of the hitherto unknown biological functions and molecular mechanisms underlying changes in the structural complexity of Golgi apparatus observed upon neuronal activation. There are evidences that neuronal activity induces structural alterations of Golgi apparatus in neuronal cells *in vitro*. We hypothesize that this phenomenon may be an important regulator of neuronal functions, having an impact on physiological and pathological synaptic plasticity. By the use of different experimental approaches, such as: cellular models of complex neuronal network, confocal, super-resolution and electron microscopy, *in vitro* modifications of gene expression, electrophysiology, animal models of enhanced neuronal activity, and analysis of human samples from patients with epilepsy, we aim to provide the answers on fundamental neuroscience questions, which will help to understand the experience-dependent plastic changes in the brain that mediate learning and memory. We expect that obtained results will make a great contribution to the precise description of the specific roles of Golgi reorganization upon enhanced neuronal activity and molecular mechanisms underlying this phenomenon. Such information will greatly advance our fundamental knowledge on how the brain processes and stores information, and may also have important diagnostic and therapeutic consequences by revealing the potential targets for neuropsychiatric disorders in which experience-dependent brain rewiring goes awry.