

Studies of the nervous system have been facing three major challenges. 1) Due to limitations of methods that can be used to understand memories in their true sense as first-person internal sensations, memories have been studied using their surrogate markers such as speech and behavioral motor activity. 2) Current investigations are primarily based on the following postulate made in 1949 by Professor Donald Hebb. "When an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency as one of the cells firing B is increased" (Hebb D. O. The organization of behavior. New York: Wiley & Sons). Modification of this postulate is generally known as synaptic plasticity thesis. Until now, this thesis was not able to provide a mechanistic explanation of how learning-induced changes are used for the generation of inner sensation of memory. 3) Behavioral markers of memory retrieval are being correlated with the firing of a set of neurons with the hope to understand the mechanism. The fact that only a minor fraction of input signals (nearly 140 input signals that arrive from different locations on the dendritic tree) can fire a cortical neuron having thousands of input terminals (dendritic spines where postsynaptic potentials are generated) (see FAQ for references) shows extreme degeneracy of input signals in firing a neuron (see FAQ for references). Input signals (postsynaptic potentials) attenuate as they propagate towards the neuronal cell body. Since many neurons are being held at sub-threshold activation state at rest, it is possible that even a fraction of one postsynaptic potential can fire a neuron from its resting state. In these contexts, to avoid loss, information storage is most likely taking place using a mechanism occurring at the location of origin of postsynaptic potentials (input signals). This storage mechanism is also expected to provide an explanation of how first-person internal sensation of memory is generated. In the past, we kept certain notions such as 1) operating mechanism is occurring at the synapses, and 2) a neuron is an operational unit of the system. Those notions were necessary to initiate

**experimentations. Since we have already spent enough time to test those ideas and since we are not reaching towards a foreseeable solution, we should try to find testable solutions to understand how the first-person inner sensations of different higher brain functions are generated. During the last several decades, we have made a very large number of observations at different levels of the nervous system. Now, we are in a position to use constraints available from all those observations to try to derive a theoretically fitting testable mechanism that can explain how first-person internal sensations are being generated. If successful, this will provide a solid scientific basis for the mechanism that we are seeking. The mechanism is expected to operate in synchrony with the synaptically-operating nervous system and occur at physiological timescales of milliseconds. It is also expected to operate in agreement with the observation that there is a huge redundancy of input signals that can fire a neuron. If a hypothesis can explain all the features of the system in principle, then we can start verifying both its structural features and testable predictions. Semblance hypothesis resulted from this approach.**