A structural unit of brain network that can operate in unison with synaptic connections and can impart needed functions

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Identifying the set of firing neurons during a specific task can become meaningful, if we discover how they create inner sensations of higher brain functions.

Inner sensations (e.g. memory, consciousness) are first-person properties towards which only the owner of the nervous system has access.

Neural code should consist of the rule-set by which neurons are connected, activated and create these inner sensations. It should operate in union with the known physiological operations of the system.

First-person properties cannot be tested directly using biological systems.

It may become possible to test hypothesized mechanisms to reverse-engineer it in physical systems.

This can be considered as the gold standard for understanding the neural code.

Findings in brain sciences lie in different frames of references – electro-physiological, cellular, systems, and behavior.

What is the right frame of reference to synthesize a hypothesis that will allow us to articulate a simple and general mechanism that can be applied to explain those findings from different faculties of brain sciences?

Semblance hypothesis provides a theoretical model that can explain various findings made by different faculties of brain sciences.

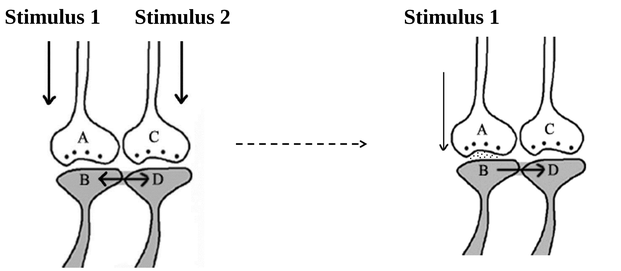
Semblance hypothesis provides a mechanism for the formation of virtual inner sensations that are accessible only by the owner of the nervous system as a first-person property.

In the above frame of reference using a single common mechanism, semblance hypothesis has provided explanations for retrieval of memories at physiological time-scales, transfer of locations of storage of memories from the hippocampus to the cortex during consolidation of memories, ability to continuously forget and learn new associative relationships and explanation for the observed correlation between the ability to memorize and experimental long-term potentiation.

Replication of the mechanism in machines can be carried out with the expectation that we should be able to obtain read out of the expected formation of inner sensation.

The realistic hope is that artificial circuits operated on the principles of semblance hypothesis can be examined for novel features not expected of them based on the rules of the electronic circuits by which they are made of.

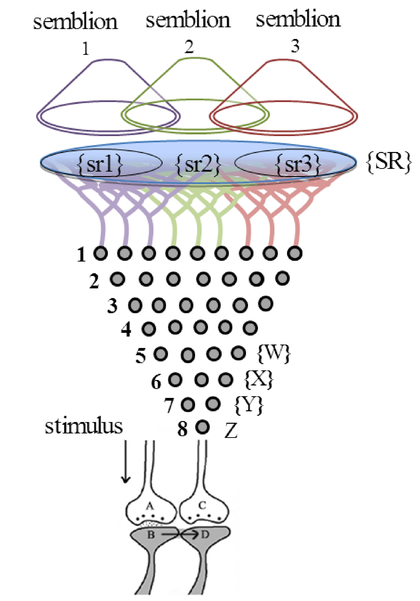
Since we haven't had any prior experience in exploring inner sensations along with other observed neuronal functions, this new approach will require major contributions from Physical and Engineering sciences.

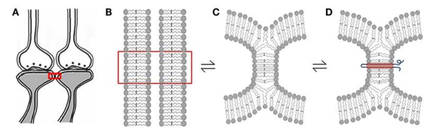


A functional inter-postsynaptic LINK is formed during associative learning

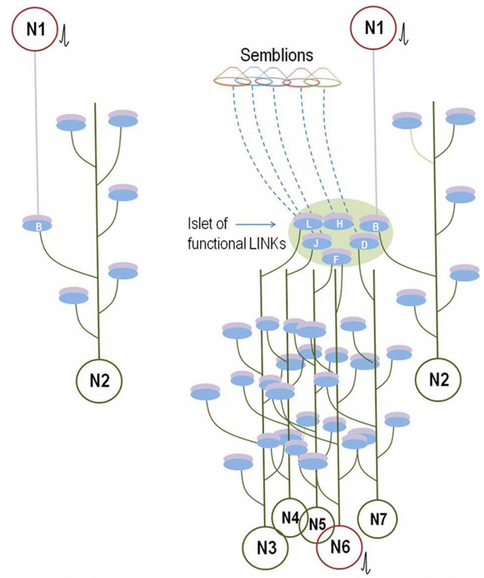
During memory retrieval

Cue stimulus activates the synapse A-B. The resulting re-activation of the inter-postsynaptic functional LINK B-D activates the postsynapse D. This induces a cellular hallucination at D that it is receiving sensory input from its presynaptic terminal C as a result of firing of the neuron Z. Z in turn receives input from the set of neurons {Y}. If we extrapolate this to the sensory receptor level, the meaning of the hallucination can be extended towards the sensory receptor set {SR} and potential sensory inputs that can activate the receptor set {SR}. In fact, neuron Z may get activated by stimulation of one of the subsets of {SR}. The hypothetical packet of sensory inputs required to activate a receptor subset is called "semblion".

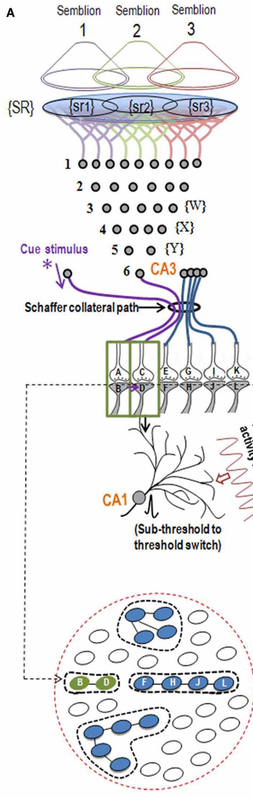


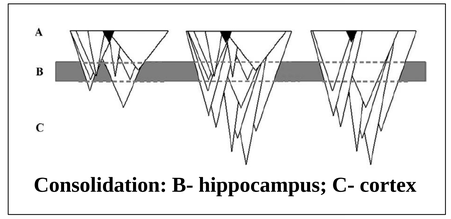


Reversible, but stabilizable membrane hemi-fusion as a mechanism for inter-postsynaptic functional LINK (*Vadakkan KI (2011) Frontiers in Neuroengineering; Vadakkan KI (2013) Frontiers in Human Neuroscience*)

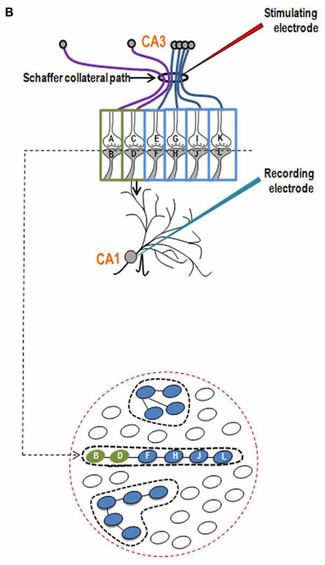


Comparison between the known anatomical circuitry (left) and the inter-postsynaptic functional LINK-mediated wiring (right). (*Vadakkan KI (2013) Frontiers in Human Neuroscience)*





Consolidation: B- hippocampus; C- cortex



Memory retrieval

Long-term potentiation

(*Vadakkan KI (2013) Frontiers in Human Neuroscience)*

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