

Semblance Hypothesis of Memory

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SfN talk summary, October, 2009

Semblance hypothesis was put forward to explain a possible mechanism for associative memory. The minimum statement to say that one synapse is activated is that its postsynaptic membrane (postsynapse) is activated. During one learning event, a specific set of postsynaptic membranes along different orders of neurons from the learned item are activated. At a later time, artificial activation of this specific set of postsynapses (imagined by introducing electrodes to the brain) is assumed to induce memory for the learned event. Deriving from this, memory depends on the subset of postsynapses that are activated during retrieval out of the set of postsynapses where changes took place during learning. This entailed the proposal of semblance hypothesis from a definition for memory. *A unit of memory, in the presence of an internal or external cue stimulus, results from the ability to induce specific postsynaptic events at the synapses of neurons from the learned item without the requirement of action potentials reaching their presynaptic sides.* For this, co-activation of the fibers from the learned item and the cue stimulus during learning need to induce specific changes that will later allow the cue stimulus all by itself evoke activation of the set of postsynapses that belong to the learned item.

What types of specific changes are required to occur during learning and memory retrieval that we haven't yet discovered? Using fMRI studies it was found that increased oxygen release occurs at specific locations within the brain both during learning and memory retrieval. Semblance hypothesis proposes transient oxidation state dependent functional LINKs between the postsynapses of the cue and the learned item. Transient oxidation-state dependent functional LINKs can be re-activated by activity from the cue stimulus that can promote depolarization spread between the postsynapses of the synapses activated by the cue to the postsynapses of the synapses belonging to the learned item. Activating the postsynapses without the activation of their presynaptic terminals will evoke cellular hallucination of an action potential-induced synaptic transmission from presynapses belonging to the learned item. This will induce "synaptic semblance".

These changes occur primarily at the sites of convergence of stimuli from the cue and the learned item and can occur at specific brain locations depending on the type of sensory stimuli. Hippocampus is a brain region that receives sensory inputs from all the sensory modalities. At the sites of convergence, when more than one postsynapse – i. e dendritic spine of a neuron get depolarized through the functional LINKs, during memory retrieval, it enables spatial and/or temporal summation of EPSPs to facilitate an action potential. The activity from this neuron propagates in the downstream network. These neurons, in which action potential is triggered, are neurons that belong to the learned item and induce "net work semblance" (creating a hallucination of a (subset of) the sensory input from the learned item) for the

learned item during memory retrieval. The net effect of synaptic and network semblances occurring during memory retrieval results in “functional semblance”, a virtual sensation of a stimulus in its absence, which is memory.