

## **Oxidation-state dependent interconnections between dendritic spines provide early evidence in support of semblance hypothesis of memory**

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Synaptic plasticity changes are critical at the stage of encoding of various types of memories. These changes leading to retrieval-efficient mechanisms are still lacking. Here, derivation of semblance hypothesis and evidence for functional interconnections between dendritic spines that support the hypothesis are explained. During one learning event, a specific set of postsynaptic membranes along different orders of neurons from the learned item are activated. It can be assumed that artificial activation of this specific set of postsynaptic membranes will induce memory for the learned event. Deriving from this, memory depends on the subset of postsynaptic membranes that are activated during retrieval out of the set of postsynapses that were activated during learning. For this, co-activation of fibers from the learned item and the cue stimulus during learning need to induce specific changes that will later allow the cue stimulus alone evoke activation of the set of postsynaptic membranes that represent the learned item. This entailed the generation of semblance hypothesis. Associative memory, in the presence of an internal or external cue stimulus, results from the ability to induce specific postsynaptic activation at the synapses of neurons from the learned item without the requirement of action potentials (APs) reaching their presynaptic sides. In the presence of a cue stimulus, the patterns of synapses named as shared extracellular matrices and shared postsynapses can evoke cellular illusion of an AP-induced synaptic transmission from presynaptic terminals belonging to the learned item. To examine the presence of oxidation-state-dependent functional interconnections between dendritic spines, a change in the pre-Golgi stain oxidation state was induced by allowing chemicals to reach towards presynaptic and postsynaptic terminals from outside the synapse through the capillaries. Cardiac perfusion of a reducing agent followed by Golgi staining showed a contrasting view of the presynaptic terminals on the dendritic spines. Oxidation-state-dependent interconnections between spines were visible at the dendritic terminals in the cortex ( $8 \pm 5.6$ ;  $n = 113$  clusters). In the CA3 region of the hippocampus, these clusters were very large ( $482 \pm 106$ ;  $n = 106$  clusters). These interconnections due to oxidation-state dependent progression of chemical reaction between the dendritic spines open possibilities to examine similar oxygenation-state-dependent transient functional connections between the dendritic spines of adjacent neurons at sites of increased signal intensity seen in fMRI both during learning and memory retrieval.