Chettih SN, Harvey CD (2019) Single-neuron perturbations reveal feature-specific competition in V1. Nature doi: 10.1038/s41586-019-0997-6. PubMed

Artificial firing of a neuron leads to firing of a set of neurons of the same neuronal order

Re-interpretation in terms of the IPL mechanism

In a recent work by Chettih and Harvey (Chettih & Harvey, 2019), authors artificially triggered several spikes (action potentials) in single neurons in layer 2/3 of mouse visual cortex V1area. This resulted in spiking activity in a group of sparsely distributed neighboring neurons in the same neuronal order and were correlated in time. The small population of neurons that were excited were located at short distance (25–70μm) from the stimulated neuron. The stimulation had no influence beyond 300μm (for a summary, see News and Views article by Ikuko Smith (Smith, 2019). The authors called this lateral spread of activity between neurons "influence-mapping."

There is one important question. How does excitation reach at the laterally located neurons in a time-correlated manner, which is responsible for influence-mapping? This can be explained by the testable mechanism derived by semblance hypothesis (**Fig.1**). It is related to the previous explanation of visual perception as a first-person property using the derived mechanism of generation of internal sensation at physiological timescales (Vadakkan, 2016). The units of internal sensation of perception are induced at the inter-LINKed spines that belong to different neurons. When a single neuron is artificially fired, the back propagating action potentials will reach the dendritic spines. It will then continue to propagate through the inter-LINKed spines to the neuronal soma of the inter-LINKed spine's neuron. The spines that inter-LINK can belong to neurons that are separated by up to 300μm, a distance beyond which the probability of overlapping of dendritic arbor between neurons diminishes substantially.

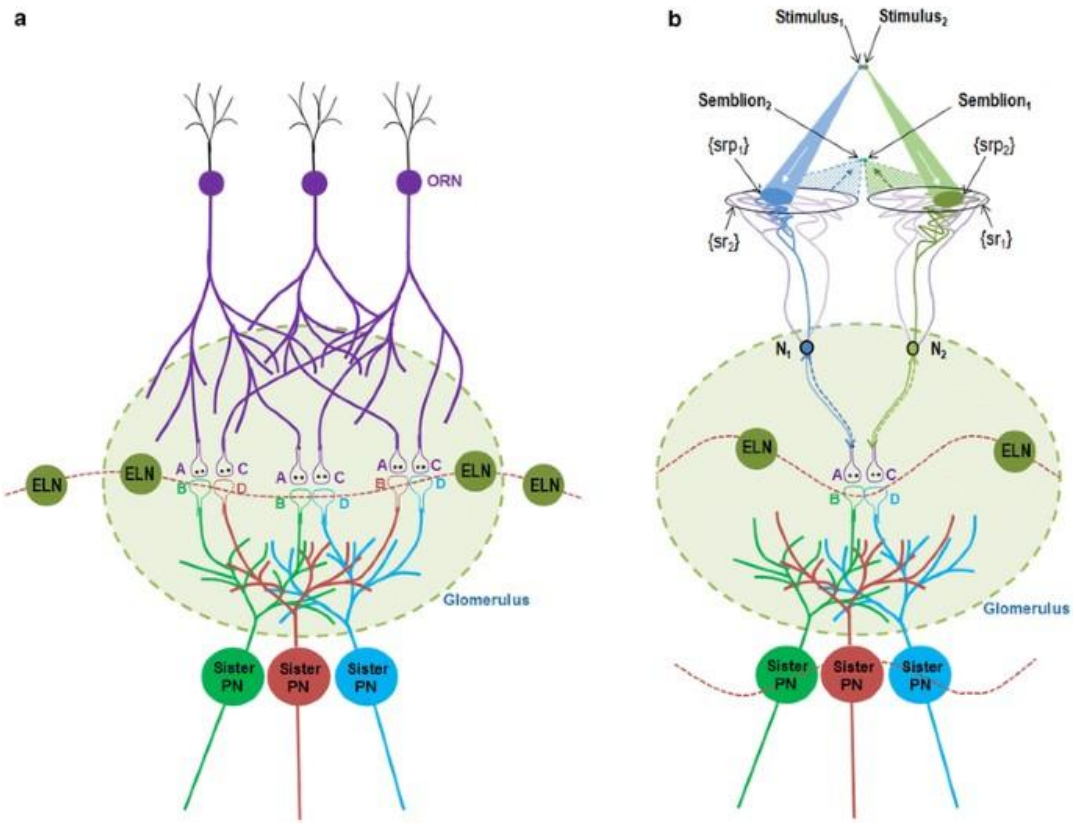

Figure 1. Schematic diagram showing the route of propagation of action potential from the artificially fired neuron N1 towards the sparsely located neuron N2 within the layer2/3 in visual cortex. This spread taking place through the inter-LINKed spines Post1 and Post2 can explain what the authors describe as "influence-mapping." Note that the inter-postsynaptic functional LINK (IPL) between Post1 and Post2 was explained as responsible of induction of internal sensation for perception (Vadakkan, 2015). Overlapping of the dendritic arbors between the neurons N1 and N2 increases the probability of IPL formation when neurons N1 and N2 are separated only by a short distance (25–70μm).

b) When a neuron was fired, the majority of neurons that were tuned to respond to similar features to that neuron were strongly suppressed than the neurons with a different tuning regardless of the distance from the stimulated neuron. Inhibition of the spikes in the neighboring neurons can be explained by activation of surrounding inhibitory interneurons. Burst of action potentials in excitatory neurons can activate somatostatin expressing inhibitory interneurons (Kwan and Dan 2012). Similar types of inhibition of surrounding areas are seen in locations where the internal sensation of perception is expected to

occur in the olfactory glomeruli in Drosophila. When one glomerulus is activated, inhibitory local interneurons (ILN) inhibit all the remaining glomeruli (Hong and Wilson, 2015) enabling the specificity of the percept for that particular smell (Vadakkan, 2015).

Orientation tuning is tested by a source of light. This will cause activation of a large number of islets of inter-LINKed spines within one cortical column. But when single neurons are artificially fired the backpropagation of potentials will reach only specific sets of inter-LINKed spines. This explains why only neurons that are located sparsely are fired, correlated in time.

Verification: Based on semblance hypothesis, the prediction that can be made is the presence of inter-postsynaptic functional LINKs (IPLs) between spines that belong to the artificially fired neuron and the sparsely located neurons that were fired in a time-correlated manner.

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