Seminar/Talk

Inhibitory neural circuit mechanisms underlying neural coding of sensory information in the neocortex

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Neural codes, such as temporal codes (precisely timed spikes) and rate codes (instantaneous spike firing rates), are believed to be used in encoding sensory information into spike trains of cortical neurons. Temporal and rate codes co-exist in the spike train and such multiplexed neural code-carrying spike trains have been shown to be spatially synchronized in multiple neurons across different cortical layers during sensory information processing. Inhibition is suggested to promote such synchronization, but it is unclear whether distinct subtypes of interneurons make different contributions in the synchronization of multiplexed neural codes. To test this, in vivo single-unit recordings from barrel cortex were combined with optogenetic manipulations to determine the contributions of parvalbumin (PV)- and somatostatin (SST)-positive interneurons to synchronization of precisely timed spike sequences. We found that PV interneurons preferentially promote the synchronization of spike times when instantaneous firing rates are low (<12 Hz), whereas SST interneurons preferentially promote the synchronization of spike times when instantaneous firing rates are high (>12 Hz). Furthermore, using a computational model, we demonstrate that these effects can be explained by PV and SST interneurons having preferential contribution to feedforward and feedback inhibition, respectively. Overall, these results show that PV and SST interneurons have distinct frequency (rate code)-selective roles in dynamically gating the synchronization of spike times (temporal code) through preferentially recruiting feedforward and feedback inhibitory circuit motifs. The inhibitory neural circuit mechanisms we uncovered here his may have critical roles in regulating neural code-based somatosensory information processing in the neocortex.

Wednesday, January 29, 2020 03:00pm - 04:00pm

Online

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