

Multisensory signal association by glutamatergic and GABAergic tecto-thalamic cells

by

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Current abstract in 100-200 words (format: Background, Aim, Method, Results, Conclusions):

Background: During fear conditioning, an associated memory trace is formed when a conditioned stimulus appears alongside an unconditioned stimulus. The anatomical basis for this pairing includes a network in which these two types of information can converge on a single neuron. Our recent findings have revealed that this pairing could occur in a tecto-thalamic circuit, at the level of the calretinin-expressing lateral thalamic (CR+LT) cells (Barsy, Kocsis et al. 2020).

Aim: The superior colliculus (SC) provides input to this network. It is known that the superficial neurons of the SC convey visual information and the intermediate and deep SC cells transmit multisensory information; however, their exact role in associative learning is largely unknown.

Methods: In our research, first, we used classical and viral tracing techniques in combination with immunohistochemical approaches in mice. Next, we investigated the electrophysiological response properties of local and CR+LT-projecting SC cells driven by unimodal and multimodal signals with optogenetic approaches.

Results: We show that both glutamatergic and GABAergic SC cells are able to form synaptic contact on the same CR+LT cell. With our multichannel recordings we found that multisensory signals rather than the unimodal ones altered the activity patterns of both glutamatergic and GABAergic cells; however, with different time course. While the glutamatergic cells responded faster and showed elevated firing rates for a short time, the GABAergic cells had longer latencies but for a longer timeframe. This could indicate a complex network mechanism between the different SC cell types and the CR+LT cells.

Conclusions: In conclusion, complex synaptic transmissions by SC-LT routes can contribute to the fast signal integration during associative fear learning process and promote survival.

Current abstract in more than 10 keyphrases (format: separated by commas):

fear conditioning, calretinin, thalamus, superior colliculus, signal association, multimodal signal, excitation, inhibition, viral tracing, immunohistochemistry, optogenetics, electrophysiological recordings