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Application of *Chlamydomonas* rhodopsins to artificial stimulation of neurons using blue LED

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Artificial stimulation of neurons has been one of the fundamental methods for investigating the functions of neurons and their network. If a neuron be photosensitive, it could be selectively stimulated with high spatial and temporal resolution. Here we show that one of the archaeal-type rhodopsins of unicellular green algae, *Chlamydomonas reinhardtii*, channelrhodopsin-2, is very fast in its turning-on and –off kinetics and has high sensitivity to blue LED light. When it was genetically introduced in a neuron of the mammalian central nervous system (CNS), its firing activity was phase-locked to a short light pulse of LED and was repetitively activated. We also introduced channelrhodopsin-2 gene in the eye of the genetically blind rdy/rdy rat, one of model animals of human retinitis pigmentosa, a disease in which the loss of retinal photoreceptors is the main cause of adulthood blindness. The channelrhodopsin-2 was expressed in the remaining inner retinal neurons. When the visually evoked potential was recorded from visual cortex of the rdy/rdy rat, it had a tendency to be recovered after channelrhodopsin-2 transduction. The vision-guided behavior of the rdy/rdy rat was also recovered after channerhodopsin-2 transduction. Thus, our technique would facilitate the development of non-invasive therapeutic instruments for bypassing interrupted neuronal connections as well as physiological studies of the CNS network.