Comparing the effects of electrical and optical stimulation of the basal forebrain on response reliability in the auditory neuraxis of the rat.

Mahtab Naderi

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The basal forebrain (BF) is a complex of subnuclei, and it is well known for its impact on learning, cognition, and Information processing. We also know that the nucleus basalis (NB) of BF is one of the main sources of cholinergic projection to cortical and subcortical areas. There is a lot of literature and information about cholinergic projections and the excitatory effects of NB on the cortical and subcortical areas. However, there is not much literature about the Parvalbumin (PV) expressing GABAergic neurons in the nucleus basalis and their inhibitory role. Therefore, we were interested in being cell-specific for this project and just looking at the Inhibitory projections from the posterior nucleus basalis (pNB) to the thalamic reticular nucleus (TRN) and subcortical areas also to the primary auditory cortex (A1).
To understand the neuromodulatory effect of GABAergic PV projections from the pNB on sensory processing and toward the auditory pathway, we need to consider the most important auditory processing areas, like BF, A1, TRN, and medial geniculate nucleus (MGN).
An experiment is designed on the rats, and we presented classical instrumental pieces of music as the auditory stimuli to the anesthetized rat while making simultaneous recordings from the BF, TRN, MGN, and A1 during electrical or optical stimulation of the pNB. The electrical stimulation of the pNB activates all cell types of it, but the optogenetic stimulation modulates specific cell types. In order to dissect the influence of pNB GABAergic PV neurons on auditory processing, we used genetically modified PV-CRE rats. We recorded our data from single neurons and the local field potentials (LFP) in both pNB stimulation types.
Our findings suggest that the electrical stimulation of pNB, increases the trial by trial reliability of neural responses in A1 neurons at the level of single neurons and LFP. However, there is no significant change in the reliability of neural responses in the A1 after the optical stimulation of the pNB. By both electrical and optical stimulation of the pNB, there are no significant changes in the reliability of other nuclei in subcortical auditory pathways such as MGN, TRN, and the BF itself. Our experiments show that the GABAergic projections are not that powerful to modulate the reliability at the auditory cortex level, and there might be other reasons that optogenetic stimulation was not effective at modulating reliability compared with electrical stimulation.

Before the electrical stimulation of the pNB, the A1 responds to all the stimuli in the surrounding, and it is not well focused on the played auditory stimuli. After the electrical stimulation of the pNB, the recorded signals from the A1 become more aligned and focused. The stimulation increased the auditory processing due to the played sound and decreased the surrounding impact on neural responses.

Director : Prof. Gregor Rainer, Supervisor: Dr. Michael Harvey.