ESR 3. Neural mechanisms of cross-modal plasticity in hearing impairment

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Congenital deafness affects the normal development of the auditory cortex. This often leads to a compensatory 'take over' of the auditory cortex by the remaining sensory systems in the form of cross-modal plasticity. Such cross-modal plasticity will likely lead to changes in cortical functional connectivity between sensory areas and may later interfere when hearing is restored with cochlear implants. To study this, we investigated cross-modal changes in a higher auditory area and a visual area of congenitally deaf cats. Specifically, we aimed to characterize deafness-induced changes in visual and auditory responsiveness in the 'deaf' auditory cortex of congenitally deaf cats in comparison to normal hearing cats. We analyzed 16-site microelectrode arrays at multiple positions along the suprasylvian sulcus. LFPs were filtered between 1-300 Hz and then bipolar re-referencing between neighboring electrodes was used to eliminate far-field effects in the LFP signal. Implementing this resulted in 15 bipolar re-referenced sites for each penetration in each cortical area. To measure how many of the electrode sites within the auditory cortex were responsive to both auditory and visual stimulation, a thresholding method was used. This method selected recording sites with evoked activity exceeding a threshold of ± 3 STD for at least 10 milliseconds above the prestimulus baseline. These sites were then labeled as responsive. Finally, we calculated the percentage of responsive channels per each recording site for all deaf cats (n=4) and hearing cats (n=4). The strongest responses for each stimulus modality were found in the corresponding (homologous) cortical area. However, also heterologous responses were found (visual in auditory cortex and vice versa). This provides the basis for the next step of the project, computation of functional connectivity between areas in presence of visual and auditory stimulation. It's also worth mentioning that while there was a trend for more visual responsiveness in the auditory cortex of deaf animals, responsiveness based on LFPs did not provide significant differences between the animal groups. This documents that the extend of the reorganization is modest, as reported by Land et al. (2016). The next specific step of the project would be to analyze the strength of the responses in these identified positions and their sensitivity to stimulus features.