Retinotopic reorganization of the auditory cortex of congenitally deaf individuals due to neuroplascticity

ABSTRACT:

The project focused on understanding how the brain can plastically change as a response to congenital deafness. In particular, we were interested in understanding: 1) whether and how the auditory cortex of the congenitally deaf processed information from the spared senses – and specifically visual input; 2) how that sensory (visual) was organized in the auditory cortex, if at all; and 3) how did that information reached the auditory cortex. That is, how did neuroplasticity change the auditory cortex (and other structures) of the congenitally deaf so that it processes information from different senses.

To do this, we proposed a series of tasks. First we wanted to understand how the auditory cortex of congenitally deaf individuals processed information from the other senses. In particular, could the auditory cortex of the congenitally deaf be neuroplastically modified to be populated by visual information? And if so, would it inherit aspects of the functional organization seen in visual cortex? Almeida and Colleagues (2015; Psychological Science) show that the auditory cortex of the deaf processes visual information and that it represents visual field location – a dimension that is ubiquitous of the visual cortex. We then focused on understanding whether we could see the typical organization of the auditory cortex (tonotopy) in the deaf. Would this organization still be present in the deaf? Striem-Amit, Almeida, and colleagues (2016) demonstrated that deaf individuals continue to show connectivity patterns that allow us to uncover the typical tonotopic organization. These two papers solve the issue of functional organization of the auditory cortex in the deaf, suggesting that this structure suffers strong plasticity that implements the organization of visual properties in its tissue, but also (perhaps partially) maintains the typical connectivity patterns that may give rise to tonotopy.

We then focused on trying to understand how visual information reaches the auditory cortex of the congenitally deaf. We posited that this visual information was reaching the auditory cortex (perhaps in part) via subcortical structures such as the thalamus, and/or the superior and inferior colliculi. We inspected whether this structures presented changes in volume that could be suggestive of a neuroplastic change of the kind that would be implemented if that structure was involved in passing (visual) information differently than in hearing individuals. The data shows that the structure that seems to have been modified in a consistent way in the deaf but not the hearing is the thalamus (Amaral et al, 2016).

Keywords
Neuroplasticity, Congenital deafness, Visual processing, fMRI

Published Work:

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