

Functional imaging of organization and specialization in the monkey auditory cortex.

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We localized numerous fields in the auditory cortex of the macaque monkey and studied which regions are specialized for processing the communication sounds of the species. First, we used high resolution fMRI at 4.7 and 7 Tesla to functionally map the auditory cortex of behaving and of anesthetized monkeys. The identified fields included regions already well described by anatomical and neurophysiological techniques as well as those whose anatomical parcellation remained without functional support. To localize fields, we varied the frequency content of tonal or band-passed-noise sounds, and obtained spatially specific activity patterns throughout much of auditory cortex. We then statistically tested the frequency-selective gradients within these regions of auditory cortex and the results suggest that 11 fields contain neurons tuned for the frequency of sounds. The obtained maps provide functional support for a model according to which three fields in primary auditory cortex (the auditory ‘core’) are surrounded by eight neighboring ‘belt’ fields in non-primary auditory cortex.

Following this non-invasive mapping, we examined which of the localized fields, if any, were specialized for processing the communication sounds of these species in relation to other sounds. Natural sounds were presented as stimulation, including the vocalizations of conspecifics, of other animals, and other natural sounds. Control stimuli were also used. The vocalizations of conspecifics generally elicited greater responses throughout auditory cortex than did the other sounds. The strongest specificity for these vocalizations seemed to be in the anterior fields of auditory cortex, but also extended anteriorly outside of the auditory core and belt fields that were localized with tone and noise stimuli. The data suggest a specialization for the processing of species-specific vocalizations in the anterior portions of auditory cortex, including the poorly understood fields of the auditory parabelt. These fMRI data reflect ethological influences on brain organization and can help us to delineate neural networks in the nonhuman primate that are expected to have an evolutionary relationship to speech processing areas in the human brain.

Support Contributed By: the Max-Planck Society, the DFG and the Alexander von Humboldt Foundation.