
Cortical filters meet timing in speech production

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Abstract

Speech and melody production during fMRI demonstrated an opposite activation pattern of speaking and singing at the level of the intrasylvian cortex. It could be assumed that the two hemispheres operate across different time domains ("double filtering by frequency theory": left hemisphere=segmental information consisting syllables and vowels, etc.; right hemisphere=intonation contours of verbal utterances and musical melodies consisting pitch, loudness, etc.). Moreover, using fMRI during passive listening to click trains we found several cerebral structures outside the central-auditory pathways displayed distinct activation patterns each: rate-response profiles resembling high-pass (left side) or low-pass filtered (right side) signal series emerged at the level of the anterior insula. Therefore, it could be assumed that the intrasylvian areas of left and right cerebral hemispheres act as high- and low-pass filters, respectively, on auditory input according to the double filtering by frequency theory. Moreover, these areas seem to join up with the right cerebellum and the left inferior frontal gyrus to a network subserving parsing/timing functions within the auditory-verbal domain. This assumption could be supported using linguistic and non-linguistic stimuli in subjects with developmental dyslexia demonstrating that the anterior insula represents an important neural correlate of deficient temporal processing of speech and nonspeech sounds in dyslexia.

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