The Auditory Representation of Speech Sounds in Human Motor Cortex

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Motor systems have been strongly implicated in sensory perception. In humans, a striking example is that listening to speech evokes neural responses in the motor cortex. This has been controversially interpreted as evidence that speech sounds are processed as articulatory gestures during speech perception. However, it is unclear what information is actually encoded by such neural activity. To directly compare neural representations during speech production and perception, we used high-density human cortical surface recordings while participants spoke and listened to speech sounds. We found that the pattern of evoked responses in motor cortex during listening was substantially different than during articulation of the same sounds. During listening, we observed neural activity in the superior and inferior regions of ventral motor cortex. During speaking, responses were distributed throughout somatotopic representations of speech articulators in motor cortex. The structure of patterned evoked responses in motor cortex during listening was organized along acoustic features similar to auditory cortex, rather than along articulatory features as during speaking. Furthermore, individual motor cortex electrodes revealed definable spectrotemporal tuning to speech sounds. Our results provide evidence that motor cortex does not contain articulatory representations of perceived actions in speech, but rather, represents specific auditory vocal information.