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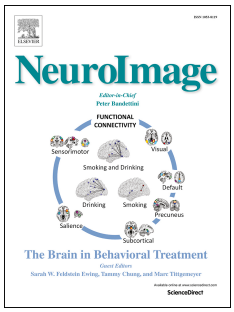

Audio-visual speech processing in age-related hearing loss: Stronger integration and increased frontal lobe recruitment

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Audio-visual speech processing in age-related hearing loss: stronger integration and increased frontal lobe recruitment

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Abstract

Hearing loss is associated with difficulties in understanding speech, especially under adverse listening conditions. In these situations, seeing the speaker improves speech intelligibility in hearing-impaired participants. On the neuronal level, previous research has shown cross-modal plastic reorganization in the auditory cortex following hearing loss leading to altered processing of auditory, visual and audio-visual information. However, how reduced auditory input effects audio-visual speech perception in hearing-impaired subjects is largely unknown. We here investigated the impact of mild to moderate age-related hearing loss on processing audio-visual speech using functional magnetic resonance imaging. Normal-hearing and hearing-impaired participants performed two audio-visual speech integration tasks: a sentence detection task inside the scanner and the McGurk illusion outside the scanner. Both tasks consisted of congruent and incongruent audio-visual conditions, as well as auditory-only and visual-only conditions. We found a significantly stronger McGurk illusion in the hearing-impaired participants, which indicates stronger audio-visual integration. Neurally, hearing loss was associated with an increased recruitment of frontal brain areas when processing incongruent audio-visual, auditory and also visual speech stimuli, which may reflect the increased effort to perform the task. Hearing loss modulated both the audio-visual integration strength measured with the McGurk illusion and brain activation in frontal areas in the sentence task, showing stronger integration and higher brain activation with increasing hearing loss. Incongruent compared to congruent audio-visual speech revealed an opposite brain activation pattern in left ventral postcentral gyrus in both groups, with higher activation in hearing-impaired participants in the incongruent condition. Our results indicate that already mild to moderate hearing loss impacts audio-visual speech processing accompanied by changes in brain activation particularly involving frontal areas. These changes are modulated by the extent of hearing loss.