ESR 4. Neural correlates of audio-tactile speech perception

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The presence of a vibrotactile stimulus conveying acoustic speech features to the skin has been found to enhance speech recognition in noise. This has been shown in participants with normal hearing thresholds listening to vocoded speech[1,2] as well as in cochlear implant users[3,4] . However, the neural processes underlying the reported enhancement effect remain to be identified. Therefore, the current study will investigate 1) whether improved audio-tactile speech comprehension triggers neural activation previously related to speech intelligibility for auditory and audio-visual stimuli, and 2) whether tactile intelligibility enhancement can be explained by multisensory integration effects in the superior temporal sulcus (STS). Neural activation associated with audio-tactile speech perception will be measured in approximately 20 German native speakers with normal hearing, using functional near-infrared spectroscopy (fNIRS). Participants will perform a speech-in-noise intelligibility task with vocoded Hochmair-Schulz-Moser[5] sentences in noise as the auditory stimulus. Additionally, amplitude envelopes of low frequency bands of the sentences will be presented via a vibrating probe to the right index finger. Speech intelligibility will be tested in a 2x3 task design with factors of auditory task difficulty (low SNR, high SNR) and audio-tactile congruency (auditory alone, congruent audio-tactile, incongruent audio-tactile).

We anticipate a behavioral enhancement effect of speech recognition for sentences presented in a congruent audio-tactile condition over incongruently combined stimuli or auditory alone conditions, comparable to Fletcher et al.[1]. This is hypothesized to be accompanied by stronger brain activations in the left superior and medial temporal gyri, inferior frontal gyrus and supramarginal gyrus. In line with the principle of inverse effectiveness of multisensory integration, we anticipate brain activity in the left STS to exceed an additive differences criterion when comparing the two SNR levels.

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3. Huang, J., Sheffield, B., Lin, P. & Zeng, F.-G. Electro-Tactile Stimulation Enhances Cochlear Implant Speech Recognition in Noise. *Sci. Rep.* **7**, 2196 (2017).

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