Functional brain networks underlying speaker segregation and segregation load in a multi-talker situation: an EEG and NIRS study

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Listening in multi-speaker environments is a crucial skill for survival and in social interactions. This skill relies on our ability to perceptually segregate different speakers from each other and from the rest of the acoustic scene. Our study aimed to identify large-scale functional brain networks related to 1) speaker segregation 2) and segregation load (the number of concurrent speakers). In separate experimental conditions one, two or three speech segments were presented while electroencephalogram (EEG) and near infrared spectroscopic signals (NIRS) were simultaneously recorded. Listeners (N = 24) were instructed to attend one speech stream by performing a numeral detection task as well as later answering questions about its contents. Listeners made more detection errors (distractor effect) in the multi-speaker conditions relative to the single-speaker condition. The comparison of single-speaker and multi-speaker conditions revealed alpha frequency bands (8-13 Hz) and deoxyhemoglobin specific functional interactions between brain regions. Increasing the number of non-attended speakers revealed an additional alpha specific network. Our results suggest that the oscillatory coupling in fronto-parietal and temporo-parietal cortical networks play an important role in attending human speech in a multi-speaker environment.

Keywords: auditory scene analysis, EEG, functional connectivity, neural oscillations, NIRS, speaker segregation, speech processing