

Speech perception in the sensorimotor cortex: A potential source for false positives during speech-BCI control?

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Introduction:

Recent advances in speech decoding from the sensorimotor cortex (SMC) have demonstrated the potential of using this area for BCI control based on (attempted) speech movements [1,2]. However, the SMC has been found to also show increased activity during speech perception [3,4], which is a potential source of false positive activation of a speech-BCI. This study investigates the overlap between speech perception and speech production activity patterns in the SMC and evaluates decoding performance during speech perception.

Material, Methods, and Results:

Four patients with epilepsy were subdurally implanted with high-density (HD) electrocorticography (ECoG) grids over the left SMC. Participants completed an audiovisual speech perception task, and a speech production task in which they had to speak out loud the same syllables (7 syllables repeated 10 times). Speech trials were alternated with rest. After preprocessing, high-frequency band (HFB, 65–95 Hz) power was extracted from the ECoG data. The HFB response during speech trials was compared to that during rest using R^2 analysis. Each electrode with a significant response to speech compared to rest was labelled as responsive to perception, production, or both. This analysis showed that both speech perception and production generate increased HFB responses in overlapping areas of the SMC. Plotting the R^2 values of the two tasks against each other revealed that electrodes with high R^2 values during production tend to also have high R^2 values during perception. To test whether speech perception is a source of false positives during BCI control (i.e., perception trials classified as produced words), a classifier was trained on the production data, and subsequently tested on both production and perception data. While the classifier trained on production data could reliably decode produced speech sounds, it also generated false positives when tested on speech perception data for all four subjects.

Discussion and Significance:

The current study confirms earlier findings on the presence of speech perception related activity in the SMC [3,4], and indicates that decoders of speech production may generate false-positive responses during audiovisual speech perception. This topic deserves further investigation before speech BCIs can be used reliably in naturalistic situations.

References

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