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Neural correlates of processing second language speech acts: effects of L2 speech acts awareness and experience

Cui, Haining

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SNL 2022

This research clarifies how the brain responds to emotional speech in standard and accented voices, shedding light on the neural basis of language comprehension. It aims to improve communication in multicultural societies and enhance understanding of second language acquisition and processing.

The current project uses fMRI techniques to investigate how the brain decodes foreign-accented emotional speech and whether awareness and familiarity with the accent alter the listener's ability to understand the affective-prosodic meaning of speech acts, focusing on Japanese honorific speech acts. We found that the right superior temporal cortex integrates speech accentedness (standard vs. accented) and socio-affective intentions (polite vs. impolite honorific tones) during speech comprehension. Moreover, right medial temporal region activation correlated with perceived accent familiarity for utterances produced in the foreign accent, suggesting this brain structure is associated with the recognition of familiar speakers during speech comprehension. These findings were presented at the SNL 2022 conference.

neuropragmatics

accented speech prosody foreign language fMRI speech processing politeness speech act

１．研究開始当初の背景

Emerging sociolinguistic studies indicate that listeners tend to rate utterances with varying prosodic impressions of politeness—such as levels of sincerity and friendliness—differently based on the speaker's accent. Specifically, foreign-accented speech is often perceived as carrying less emotive meaning compared to native speech. These perceptual findings imply that exposure to a foreign accent can influence a listener's ability to encode the affective and prosodic meanings in speech acts.

２．研究の目的

While neuroimaging research has extensively documented the critical role of the temporal lobes in the perception of accented voices, the search for voice-related memory, and the encoding of socio-affective vocal cues, the extent to which foreign accents impact brain responses related to processing affective and prosodic speech remains unclear.

３．研究の方法

To investigate this issue, we developed a task featuring Japanese honorific utterances that varied by Accent (Native vs. Foreign) and Prosodic Impression (Sincere vs. Insincere). During functional Magnetic Resonance Imaging (fMRI) scanning, 29 participants listened to these stimuli. To maintain attention, they were instructed to judge whether a specific word had been presented in the previous utterance. After the scanning session, all listeners completed an accent rating scale to assess their familiarity with foreign accents, allowing us to explore how individual differences in accent familiarity might influence the neural processes involved in encoding affective and prosodic meaning.

Brain imaging data were analyzed using SPM 12 software, applying a cluster-level significance threshold of $p < 0.05$, family-wise error (FWE) corrected. In line with our hypothesis, we focused on the interaction effects between accent type and prosodic impression, specifically comparing Native Sincere to Native Insincere ([NI vs. NS] > [FI vs. FS]) in a whole-brain group-level analysis. Additionally, we conducted a single regression analysis across the entire brain for the foreign-accented conditions (FI, FS, and the contrast of [FI vs. FS]), using each participant's foreign accent familiarity score.

４．研究成果

Two primary findings emerged from our analysis. First, the interaction contrast ([NS > NI] > [FS > FI]) yielded a significant response in the right posterior superior temporal cortex (see Figure 1a), indicating a neural differentiation based on the interaction of accent and prosodic cues. Second, we observed a positive correlation between activity in the right medial temporal region and perceived accent familiarity for utterances delivered in a foreign accent, as evidenced by the ([FI > FS] contrast, $p < 0.001$ uncorrected, see Figure 1b)

Figure 1a.
[Native-Sincere > Native-Insincere] > [Foreign-Sincere > Foreign-Insincere]
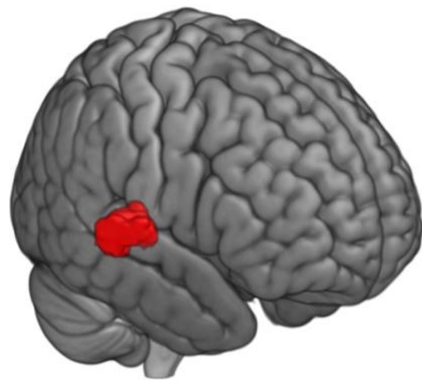
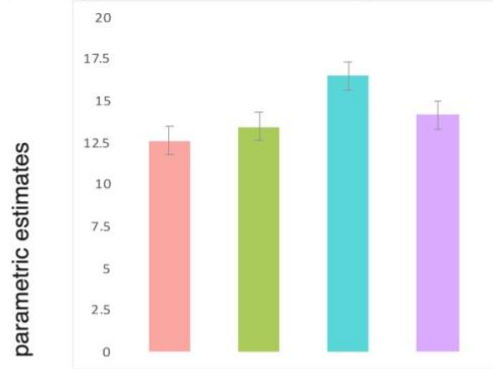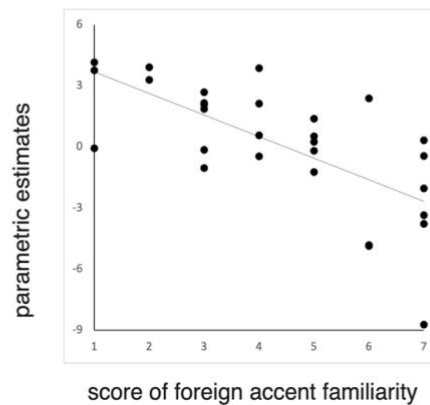Right posterior temporal cortex

Figure 1b.
[Foreign-Insincere > Foreign-Sincere] brain activation correlates with score of foreign accent familiarity

medial temporal cortex

Together, these findings provide novel evidence that the right superior temporal cortex plays a crucial role in integrating various socio-affective vocal cues during speech comprehension. Furthermore, the correlation indicates that individual differences in accent familiarity modulate cortical responses when processing affective and prosodic meanings expressed by speakers of a foreign language. This modulation may be mediated by brain structures associated with recognizing familiar speakers.

The results of this study were presented at the 14th Annual Meeting of the Society for the Neurobiology of Language, which took place in Philadelphia from October 6 to 8.

Haining Cui , Hyeonjeong Jeong , Marc D Pell , Motoaki Sugiura ; Tohoku University, McGill University

Processing Prosodic Politeness in Foreign Accent: an fMRI Study

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(Jeong Hyeonjeong) (60549054)		
(Sugiura Motoaki) (60396546)		