Somatosensory information affects word segmentation and perception of lexical information
Rintaro Ogane, Jean-Luc Schwartz, Takayuki Ito

To cite this version:
Rintaro Ogane, Jean-Luc Schwartz, Takayuki Ito. Somatosensory information affects word segmentation and perception of lexical information. Ninth Annual Society for the Neurobiology of Language Conference (SNL 2017), Nov 2017, Baltimore, United States. hal-01658527

HAL Id: hal-01658527
https://hal.archives-ouvertes.fr/hal-01658527
Submitted on 1 Apr 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Somatosensory information affects word segmentation and perception of lexical information

Rintaro Ogane¹, Jean-Luc Schwartz¹, Takayuki Ito¹,²

¹ GIPSA-lab, CNRS, Univ. Grenoble-Alpes, Grenoble INP, Grenoble, France, ² Haskins Laboratories, New Haven, USA

Introduction

- In human speech communication, speech signals can be perceived as the results of an integration of various sensory information.
- In case of audio-visual speech perception, integration is not limited to the perception of speech sounds [1], but extends to lexical processing [2].
- Apart from those findings, a role of somatosensory inputs has also been demonstrated in the perception of vowel and consonant sounds [3,4].
- By further extending the previous findings, the current study hypothesized that somatosensory inputs associated with facial skin deformation should also change the perception of lexical information and that the effect could depend on the timing between somatosensory and auditory inputs.
- We applied somatosensory perturbation at different timings along the presentation of auditory stimulation during a perception task involving French nouns with elisions.
- Lexical contrast in French nouns with elisions.
  - e.g., "l'affiche" ["the poster" in English] - "la fiche" ["the form" in English].
  - The meaning of two words ("l'affiche" and "la fiche") are different, but the pronunciation is the same: /lafiʃ/.

Methods

- 4 native French speakers participated in an identification task with pairs of French words with elisions leading to the same pronunciation.
- 17 pairs of French words with elisions were used as stimuli.
  - The words were embedded in a carrier phrase, “C'est _____ [This is _____]”. The stimulus sentences were pronounced naturally (without hyper-articulation) by a native male French speaker, and recorded at 44.1kHz.
- Stimulation.
  - Skin of the face or forearm was stretched using a sinusoidal pattern at 6 Hz produced by a robotic device (PhanToMe 1.0, Somatosensible Technologies).
  - 8 timings of stimulus onset (P1 - P8) were tested. The onset of P5 was set at the peak of the first target vowel. Onsets were separated by 0.1 s.

Results

- Experimental condition.
  - We tested the two stimulation sites (Face and Forearm, one per group), as done in [5], to examine whether the perceptual change can be found only between the sensory inputs associated with speaking (Face).

Discussion

- The effect of the skin stretch stimulation on lexical perception was found in the Face condition, but not in the Forearm condition.
- The integration between articulatory movement information arising from orofacial skin stretch and speech sound processing seems to intervene in the perception of current French lexical perception.

- The judgement probabilities were altered according to the onset timing of facial skin stretch.
  - Speech articulatory movement often proceeds the production of speech sound. This may be reflected in the current results in which the largest effect was found when the somatosensory stimulation was applied earlier than the timing of the first vowel in the lexical utterances (e.g., “a” in “l'affiche” with P3 and “i” in “fiche” with P6).
  - Visually-presented information concerning articulation can give a clue for word segmentation in current French lexical perception [2]. This seems to be consistent with our results. Applying facial skin stretch stimulation at a suitable timing may provide information concerning articulation relevant for lexical processing.

Summarize

- The perception of French words with elisions was altered by somatosensory information when it was applied on the face at the timings.
- This result suggests that facial skin deformation related to speech motion also affects higher-level language processes (word segmentation/perception of lexical information).

References


Acknowledgments

- This research was supported by the European Research Council under the European Community’s Seventh Framework Programme (FP7/2007-2013 Grant Agreement no. 339152, “Speech Unit(s)”).
- We wish to thank Nathan Mary for his help in data collection and analysis.