Tongue width at rest versus tongue width during speech: A comparison of native and non-native speakers

Sunao Kanada, Ian Wilson
University of Aizu (Japan)

Introduction

Lateral tongue bracing (against the teeth & palate) is an important part of pronunciation and articulatory modelling [1, 5]. Although lingual coarticulation has been examined using acoustics and midsagittal views of the vocal tract, not much focus has been placed on the lateral view.

We used electromagnetic articulometry (EMA) to track a lateral tongue sensor’s movement in the coronal plane during the speech of native (L1) and non-native (L2) speakers of English.

The amount of tongue bracing differs across languages, so understanding these differences would be key to L2 learning/modelling. It would certainly be beneficial for pedagogical purposes and for greater understanding of the underlying articulatory setting of a language [2, 5] [7].

This pilot study compares the side tongue sensor’s position for L1 English with that for L2 English. The focus is on /l/ and /r/ in various contexts, and we also look at speech rest position of the side tongue sensor versus its position for articulating various phonemes.

Method

Participants:

Three L1 English speakers (E1 = male Canadian, E2 = male American, E3 = male American)

Four L2 English speakers (B1 = female, L1 Spanish; J1 = female, L1 Japanese, J2 = male, L1 Japanese, J3 = female, L1 Japanese)

Stimuli:

As stimuli, we chose the nursery rhyme Mary had a little lamb. It’s fleece was white as snow.

Results

Figure 1: Location of side tongue sensor

Tongue Side

Figure 2: Carstens AG509 EMA for data collection

Upper Lip

Tongue Tip

Chin

Figure 3: Close up image of Figure 1

Normalization:

Because participants’ body sizes were different, we normalized the original EMA data to compare the results of different participants.

1) Get participant’s mouth size from palatal trace data

2) Ratio = Each participant’s size / the biggest participant’s size

Assessment

This research was supported by JSPS Kakenhi grant #23520467 provided to the second author.

Discussion and Conclusions

It is very possible that L2 participants used the pre-speech posture of their L1 when speaking English. Results of this research suggest pronunciation teachers should teach tongue rest position.

One limitation of this study is that the lateral tongue sensor does not necessarily show direct lateral bracing against the teeth/palate. As future research, we’ll collect many types of data (L1 language, gender, age, etc.)

A sensor was attached to only one side of the tongue. Since tongue movement can be asymmetrical, we may need to analyze the movement of both sides simultaneously.

References

[1] Gick, B., Allen, B., Stavness, I., Wilson, I. (2013). Speaking coarticulation has been examined using acoustics and midsagittal views of the vocal tract, not much focus has been placed on the lateral view.


Acknowledgements

This research was supported by JSPS Kakenhi grant #23520467 provided to the second author.

Appendix

Apparatus & Data Collection/Data Analysis:

- Carstens AG509 3D Electromagnetic Articulometer (EMA) with 12 sensors: 4 on the tongue, 2 on the incisors, 2 on the lips, 1 on the chin, 1 on the nose, and 2 behind the ears.
- EMA data have two big advantages, high accuracy and dynamic 3D point tracking.
- Sensor movements were expressed in a coordinate space that was relative to the bite plane.
- A palate trace was done using the tongue tip sensor.
- EMA data were analyzed using a MATLAB based program written by Mark Tiede (Haskins Laboratories).

Stimulus:

Four /l/ and /r/ words that are difficult to distinguish for Japanese learners.

Because participants’ body sizes were different, we normalized the original EMA data to compare the results of different participants.

- EMA data were analyzed using a MATLAB based program written by Mark Tiede (Haskins Laboratories).
- A palate trace was done using the tongue tip sensor.

Results

- Vertical axis indicates the distance from the bite plane (mm) while the horizontal axis the distance from the midsagittal (mm)
- L1 English speakers’ pre-speech posture is close to the median speech position
- L1 Japanese speaker’s pre-speech posture is close to the median, but not consistent.

Discussion and Conclusions

It is very possible that L2 participants used the pre-speech posture of their L1 when speaking English. Results of this research suggest pronunciation teachers should teach tongue rest position.

One limitation of this study is that the lateral tongue sensor does not necessarily show direct lateral bracing against the teeth/palate. As future research, we’ll collect many types of data (L1 language, gender, age, etc.)

A sensor was attached to only one side of the tongue. Since tongue movement can be asymmetrical, we may need to analyze the movement of both sides simultaneously.

References

[1] Gick, B., Allen, B., Stavness, I., Wilson, I. (2013). Speaking coarticulation has been examined using acoustics and midsagittal views of the vocal tract, not much focus has been placed on the lateral view.


Acknowledgements

This research was supported by JSPS Kakenhi grant #23520467 provided to the second author.