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

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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 as much focus has been placed on the coronal 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 a 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] [6] [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.
- There are three types of rest position: Pre-speech posture [3], inter-speech posture (ISP) [6], and absolute rest position [4]. Pre-speech is a condition of the ready to speak, but not saying anything yet. ISP is a condition of rest between sentences. In addition, there is absolute rest position, when one is no longer in speech mode. In this research, we focused on Pre-speech posture.

Method

Participants:

- Three **L1** English speakers (E1 = male Canadian, E2 = male American, E3 = male American)
- Four **L2** English speakers (S1 = 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*, because of the prevalence of words with /l/ and /r/ phonemes, which are difficult to distinguish for Japanese learners.
- /l/ and /r/ show lots of side marker movements in the coronal plane.

> Mary had a little lamb, little lamb, little lamb.
> Mary had a little lamb. It's fleece was white as snow.
> And everywhere that Mary went, Mary went, Mary went,
> And everywhere that Mary went, the lamb was sure to go.

Apparatus & Data Collection/Data Analysis:

- Carstens AG500 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 *mview*, a MATLAB based program written by Mark Tiede (Haskins Laboratories).

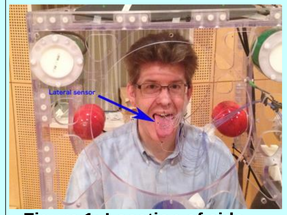


Figure 1: Location of side tongue sensor

Figure 2: Carstens AG500 EMA for data collection

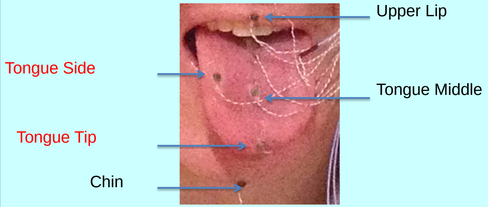


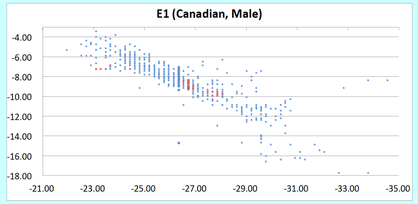
Figure 3: Close up image of Figure 1

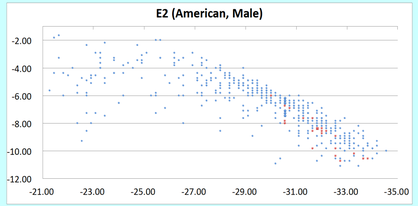
Normalization:

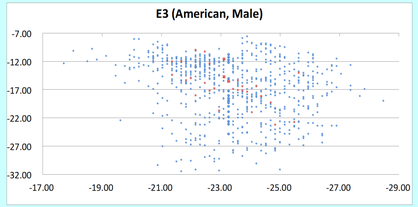
Because participants' body sizes were different, we normalized the original EMA data to compare the results of different participants.

1) Get participant's mouth size from palate trace data
2) Ratio = Each participant's size / the biggest participant's size
3) Normalized value = Actual tongue side marker's value x ratio

L1 English Speakers





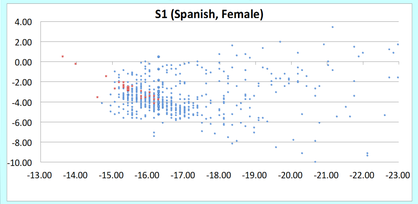


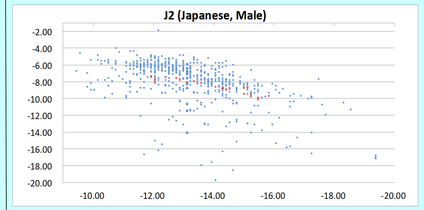
Results

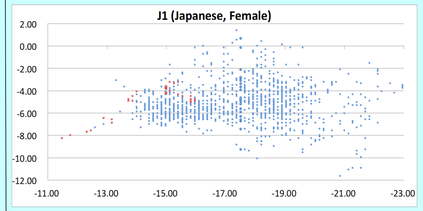
Vertical axis indicates the distance from the bite plane (mm) while the horizontal axis the distance from the midsagittal (mm).

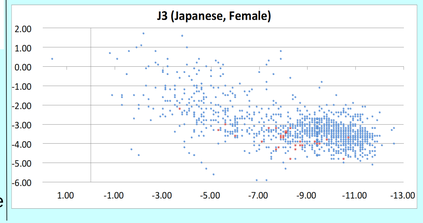
- L1 English speaker's pre-speech posture is close to the median speech position
- L1 Japanese speaker's pre-speech posture is NOT close to the median speech position (except J2 who is good at speaking English).
- L1 Spanish speaker's pre-speech posture is close to median, but not consistent.

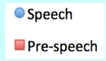
L2 English Speakers











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 that 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

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Acknowledgements

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