

# An Acoustic Comparison of Voiceless Fricatives in Heritage, Native, and L2 Speakers in Japanese

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## 1. Introduction

### Adult Heritage Speakers (HS)

- Similar to L1 speakers → grammatical properties not sensitive to input frequencies [1]
- Similar to L2 speakers → some majority language transference [1]
- Distinct → accent and suprasegmentals [2]

### Fricatives of interest in Japanese [3, 4]

- [ç] occurs before [i]
- [ɸ] occurs before [ɯ] or [a i ʊ ε ɔ]\*
- [h] elsewhere
- English has /h/ (contrastively) and [ç] before high vowels

### Research Goal

- Investigate how HS produce [ç] & [ɸ], especially if different from English analogues

## 2. Materials and methods

### Participants 29 Collected

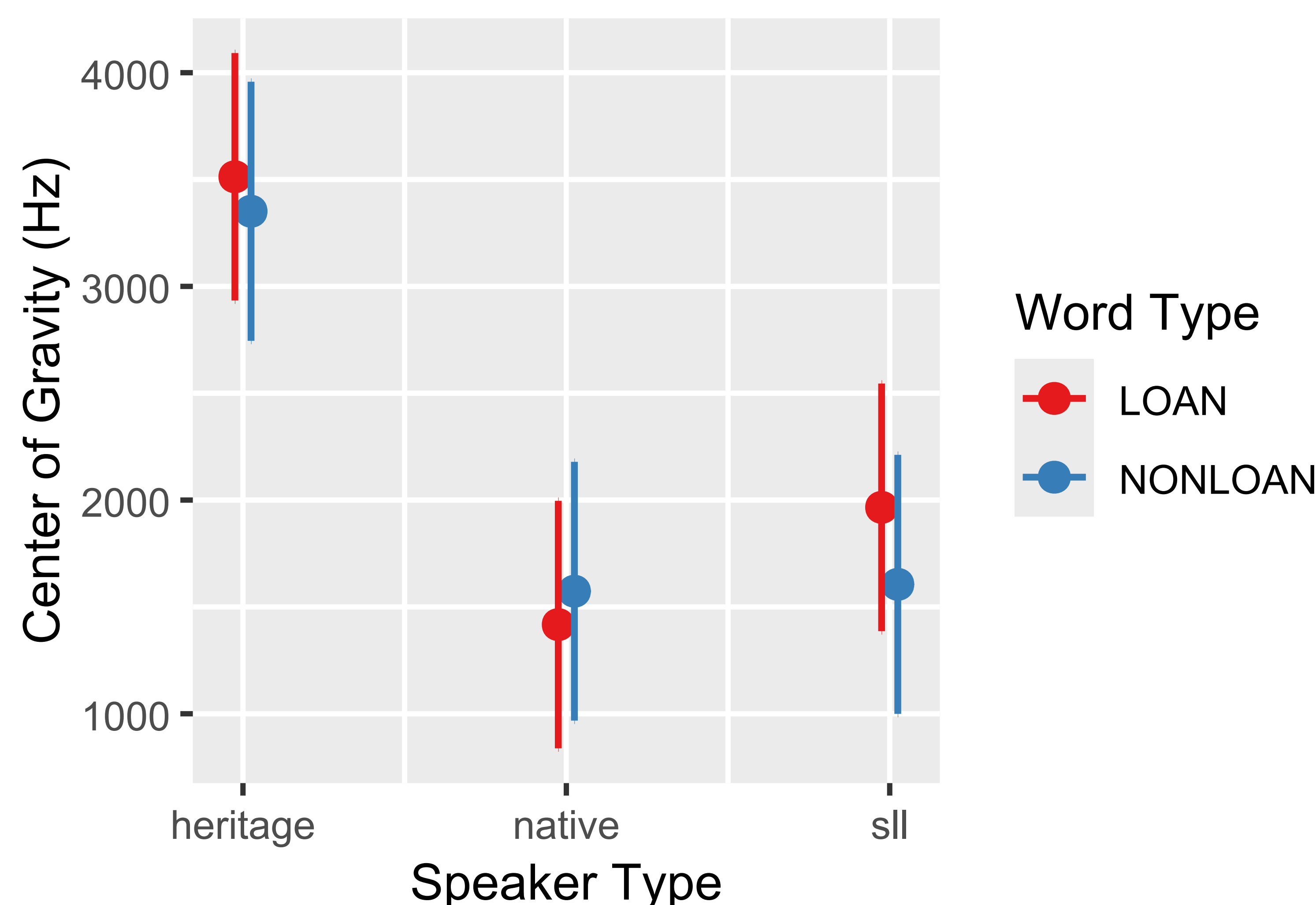
- 2 HS, 2 L1 Speakers & 2 L2 Speakers annotated (6M, 36.67 years old)

### Data

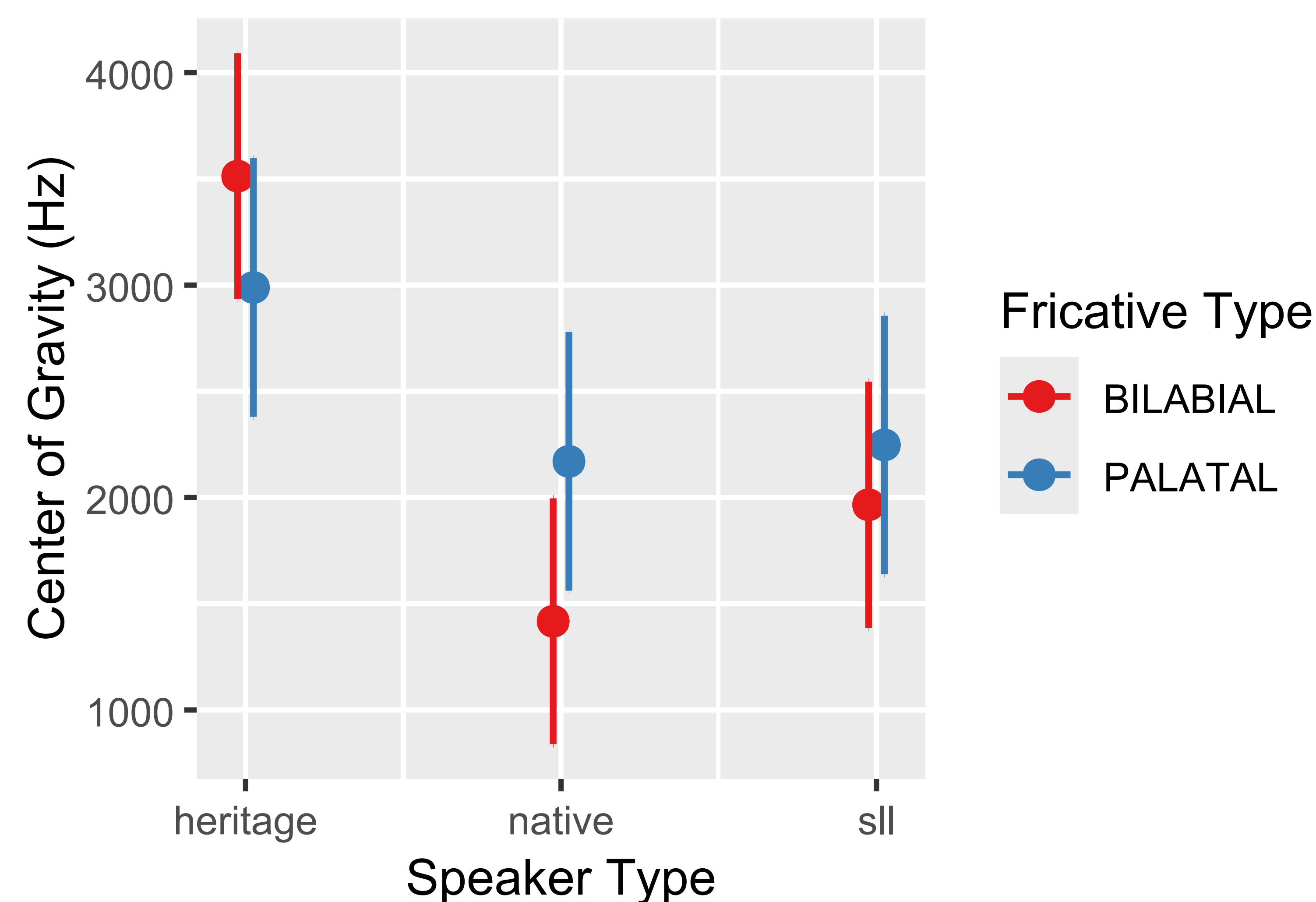
- 152 words embedded within a carrier phrase
  - Fricative Type: [ç] & [ɸ]
  - Position Type: Initial & Medial
  - Word Type: Loan & Non-Loan

### Analysis

- Data was collected using a Zoom H4essential recorder
- Environment and fricative were manually annotated in Praat; Fricatives' Center of Gravity [5] were extracted using a Praat script
- Linear mixed effects model:
  - Interactions: speaker type x word type & speaker type x fricative type



**Fig 1.** Predicted Values of Center of Gravity for Speaker and Word Type



**Fig 2.** Predicted Values of Center of Gravity for Speaker and Fricative Type

## 3. Results

**Table 1.** Summary Table of Significant Effects in the Linear Mixed Effects Model for Center of Gravity

	Estimate	SE	df	t value	Pr(> t )
(Intercept)	3512.95	295.02	3.33	11.91	<0.001
Speaker: Native	-2095.70	414.01	3.23	-5.06	<0.05
Speaker: SLL	-1547.03	414.12	3.23	-3.74	<0.05
Fric: Palatal	-524.30	133.51	635.96	-3.93	<0.001
Pos: Medial	-372.27	81.01	149.64	-4.6	<0.001
Native x Palatal	1277.13	178.96	739.15	7.14	<0.001
SLL x Palatal	805.83	178.94	736.66	4.50	<0.001

- Post-hoc pairwise: no SE for SLL & Fricative

## 4. Discussion and Conclusion

- Heritage speakers appear to be distinct from L1 and L2 speakers (Fig 1, Fig 2)
- There might be majority language influence (Fig 1)
- L2 seems more similar to L1 than HS (Fig 1, Fig 2)
- Bilabials are lower for L1 & L2 but not HS (Fig 2)

### Limitations

- Did not include female participants
- Not all data collected was annotated

### Future Directions

- Include more diversified annotated data
- Compare within fricative-type with environments
- Analyze variables such as other spectral measurements, social factors, speakers' demographics, etc.

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### References:

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- [4] Vance, T. J. (2008). The sounds of Japanese. Cambridge University Press.
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