Relative Cue Weighting in Multilingual Stop Voicing
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Background

- Most models/theories + data from monolingual societies of "native" speakers → **Challenge for developing fair speech technology**
- **Malaysia** is an understudied speech community of <u>early multilingual speakers</u>
- What is the interplay of **crosslinguistic influence** (CLI) vs **language specificity** in early multilinguals with different language dominances?
- Typological differences in stop voicing in Malay, Mandarin, and English presents case study

|	Malay	English	Mandarin
Voicing	✓	?	✗
Aspiration	✗	✓	✓

RQ1 Do early multilinguals maintain the separate voicing contrasts in each language?

RQ2 If so, do we still see CLI based on speakers' language dominances?
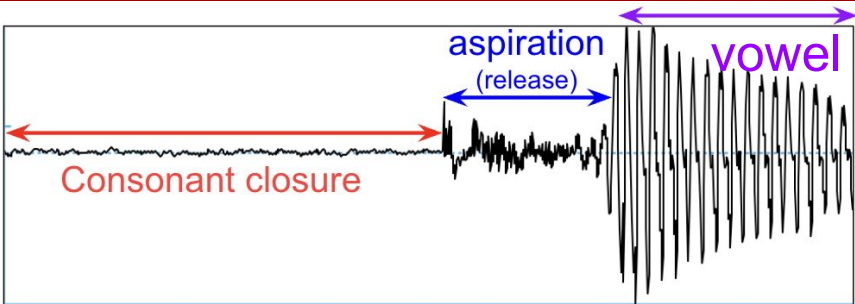
Speakers

Malay-dominant bilinguals (n=13)
Malay > English

Mandarin-dominant trilinguals (n=13)
Mandarin > English > Malay

Malay ← English → Mandarin

English-dominant bilinguals (n=10)
English > Malay

English-dominant trilinguals (n=14)
English > Mandarin > Malay
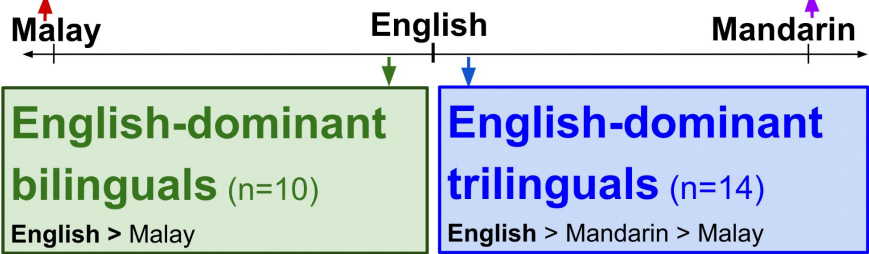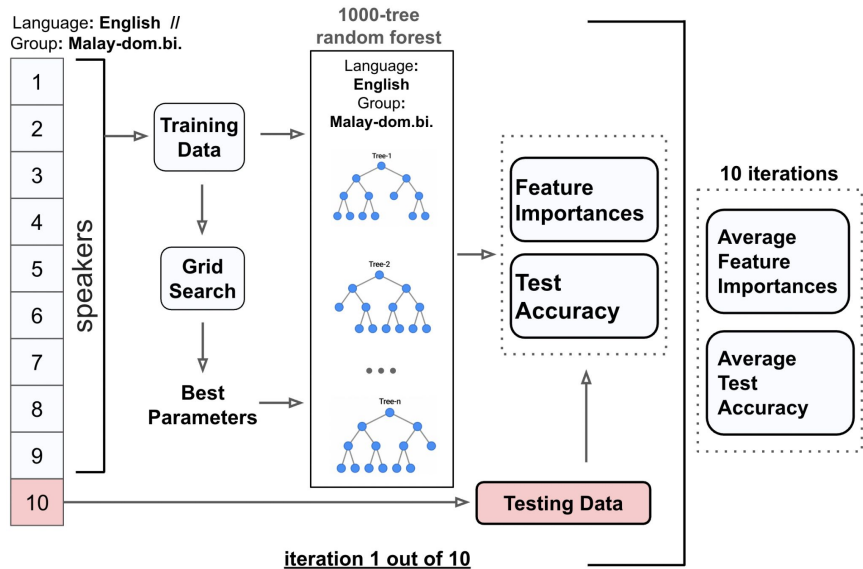
Acoustic Cues

aspiration (release)   vowel
Consonant closure

- Aspiration/VOT
- Voicing length
- Closure duration
- Following vowel duration
- Burst intensity
- Onset f0 & f1 (at 5% of vowel)
- Onset f0 & f1 slope (25% - 5% of vowel)

Random Forest

Random forest classifying voiced/voiceless stops for each language/speaker group (e.g. English produced by Malay-dominant bilinguals; 10 total)


Language: **English** // Group: **Malay-dom.bi.**

1000-tree random forest

Language: **English** Group: **Malay-dom.bi.**

speakers 1–10

Training Data → Grid Search → Best Parameters

Tree-1, Tree-2, ... Tree-n

Feature Importances
Test Accuracy

10 iterations
Average Feature Importances
Average Test Accuracy

Testing Data

iteration 1 out of 10

Model accuracies

Lang	Malay (Ml)				English (En)				Mandarin (Mn)	
Grp	Ml.bi	En.bi	En.tri	Mn.tri	Ml.bi	En.bi	En.tri	Mn.tri	En.tri	Mn.tri
Acc.	.98	.98	.94	.89	.97	.96	.99	.96	.99	.93

Acoustic correlates effective for classifying vcd/vcls

Main Results

Malay

- **Voicing** most important feature for all 4 speaker groups
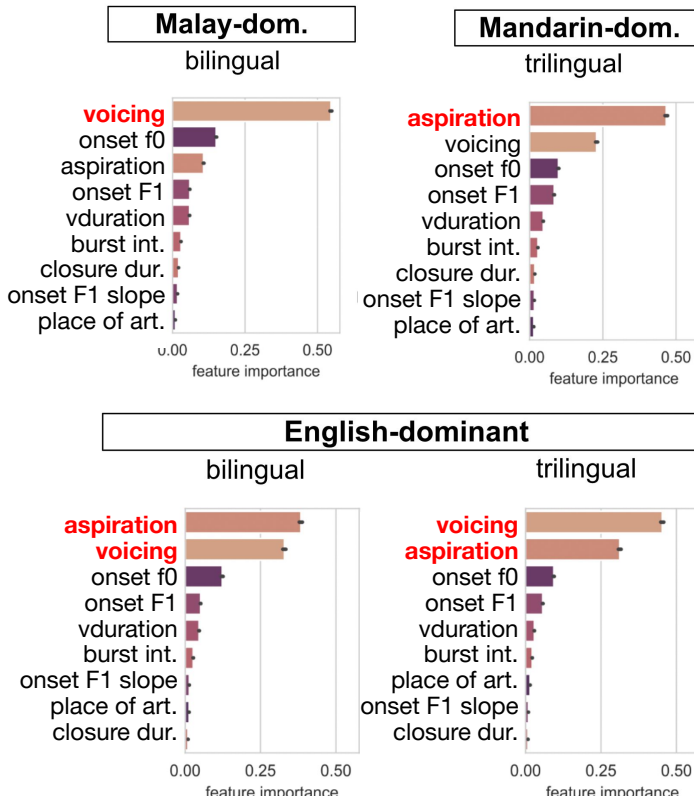- Voicing less important for Mandarin-dom. speakers → **evidence of CLI**
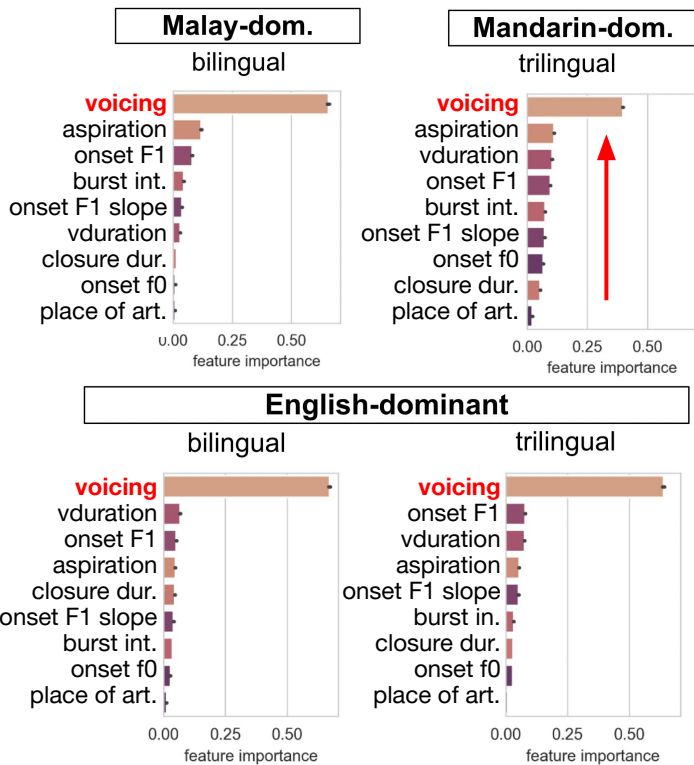
Mandarin Chinese

- **Aspiration** is consistently the most important feature across both groups

English

- **Voicing** most important for Malay-dom. spkrs
- **Aspiration** most important for Mandarin-dom. speakers
- **Both** are important for English-dom. speakers
- **Strong evidence of CLI**

**RQ1** Yes, early multilinguals maintain separate voicing contrasts for each of Malay, English, and Mandarin

RQ2 Yes, we see CLI based on language dominance, especially in English

What if we remove voicing & aspiration?

Model accuracy

Lang	Malay (Ml)				English (En)				Mandarin (Mn)	
Grp	Ml.bi	En.bi	En.tri	Mn.tri	Ml.bi	En.bi	En.tri	Mn.tri	En.tri	Mn.tri
Acc.	.78	.73	.77	.74	.84	.86	.86	.84	78	.76
Acc. decrease	.20	.25	.17	.15	.13	.10	.13	.12	.21	.17

Accuracy decreases overall, but decreases less for **English**
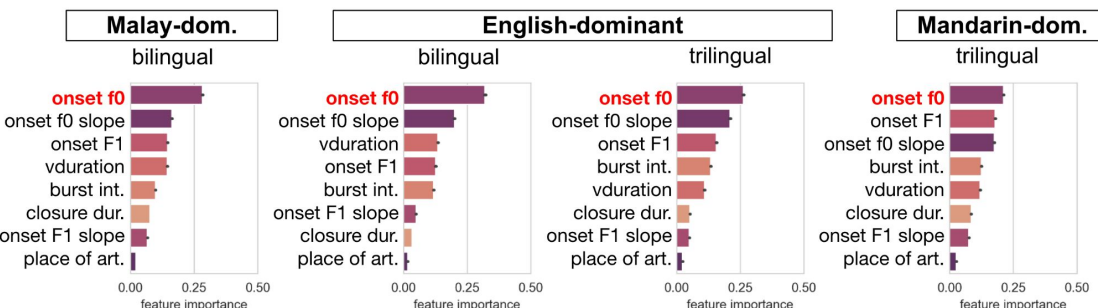
Onset f0 most important secondary correlate for **English**

Acknowledgements