

~~Acoustics, perceptual and
Articulatory properties of L2 speech:
Japanese speakers' production of English /l r/~~
**Articulatory properties of L2 speech:
Japanese speakers' production of English /l r/
(A work-in-progress presentation)**

Takayuki Nagamine

PhD Student, Lancaster University

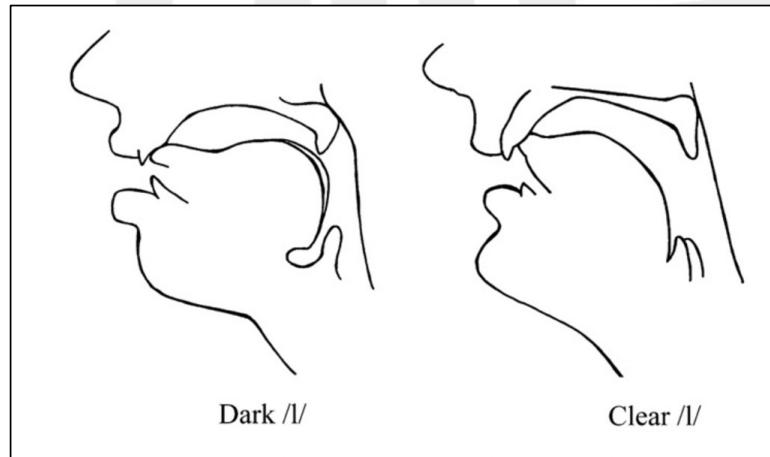
t.nagamine@lancaster.ac.uk

Funded by Japan Student Services Organisation (JASSO) and The Murata Science Foundation

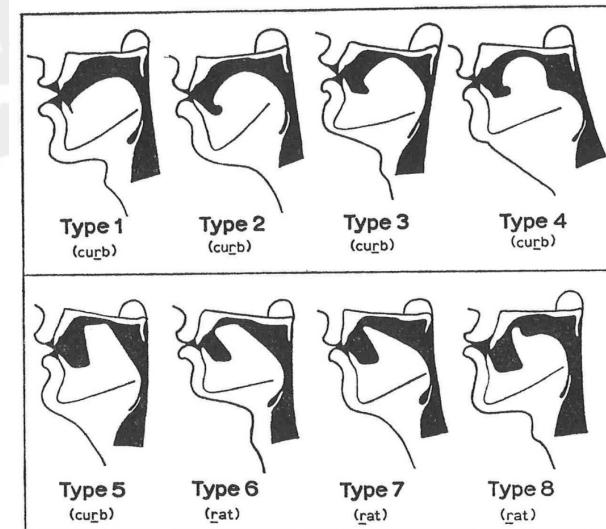
English /l/ r/ are difficult!



*English /l/ and /r/ require proper spatiotemporal coordination of **multiple** articulatory gestures.*



Recasens (2011, p. 369)



Delattre & Freeman (1968, p. 41)



The L1-derived articulatory routine would constrain L2 learners' production.

- L1 categories influence L2 speech production/perception (e.g., Flege, 1995)
- L2 speakers struggle to produce articulatory gestures **absent in L1**
 - e.g., the pharyngeal gesture in English /r/ for L2 Greek/French learners of English (Harper, Goldstein & Narayanan, 2016)
- **Simplification** strategies in articulating complex segments
 - e.g., **gestural omission, merger/averaging** (Gick, Bernhardt, Bascfalvi, Wilson & Oh, 2007)

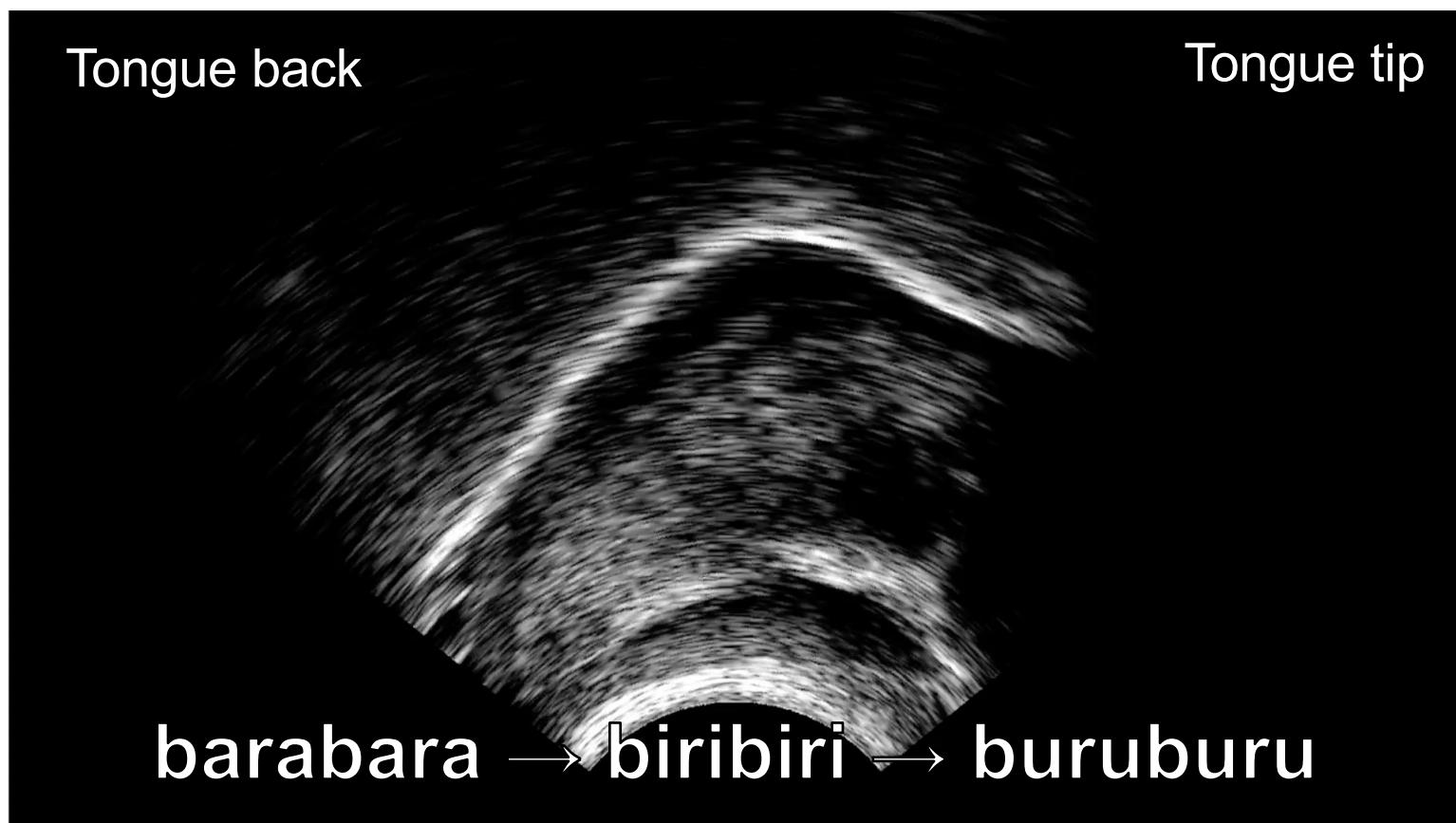


What articulatory routine constrains Japanese speakers' production of English /l r/?

- English /l r/ often substituted with Japanese /r/ (tap or flap [ɾ])
- How many gestures are involved in Japanese /r/?
 1. **Tongue tip (TT) only**, lacking tongue dorsum (TD) target (Yamane & Howson, 2015)
 2. **Tongue tip raising** and **tongue body retraction** (Morimoto, 2020)
cf. **The stability of tongue dorsum** compared to stops (Proctor, 2011)

Japanese [r]

Lancaster
University





What gestures would characterise Japanese speakers' production of English /l r/?

- Less advanced speakers would show the stabilised tongue dorsum, conforming to that of the vowels.
- More advanced speakers would show the tongue dorsum target for English /l/ and /r/ away from the neighbouring vowels.



Ultrafest X

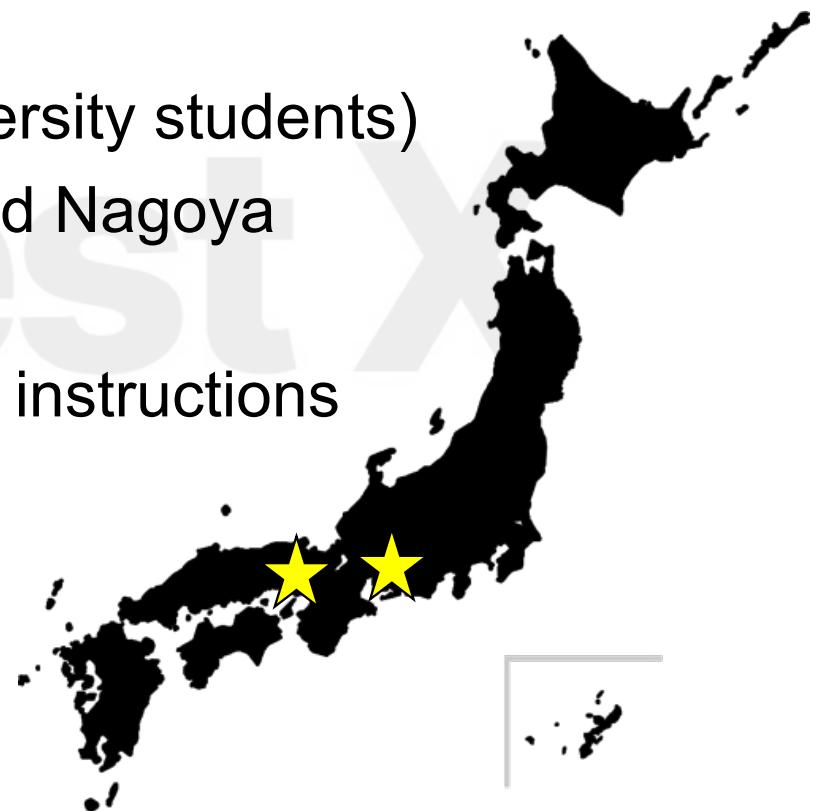
Methods

Participants – October 2022



17 speakers (out of 41 participants)

- L1 Japanese learners of English (university students)
- Two data collection locations: Kobe and Nagoya
- Aged between 18 and 21 ($M = 19.7$)
- Studied English mainly through school instructions



Ultrasound set-up

- Telemed MicrUs System
- Articulate Assistant Advanced (AAA) **220.2.0**
- Depth **80 mm**
- Probe Frequency **4 MHz**
- Field of View **100%**
- Frame Rate ca. **80 fps**
- Probe stabilisation helmet
- Lip profile camera



Design & Analysis



Target words:

- Each speaker repeated these words at least twice (up to four times)

UH
ultrafestX
believe bereave biribiri

Analysis:

- **The vowel-liquid-vowel intervals (e.g., /iri/)** segmented based on acoustics
- Automatic tongue spline extraction using the **DeepLabCut** function in AAA
- Spline tracing live-monitored by TN – any mistracing excluded from analysis
- Tongue splines rotated and scaled against each speaker's **occlusal plane**
- Data visualisation on R version 4.2.1 (or *Posit?*) using **tidyverse** and **ganimate**



Some data visualisations

Some identified patterns

1. Good English /l r/

- A three-way distinction among English /l/, English /r/ and Japanese /r/

2. English /l/ = Japanese /r/

- Similar articulatory strategies for English /l/ and Japanese /r/

3. English /l/ ≈ /r/ ≠ Japanese /r/

- Doing something different between English and Japanese

4. English /l/ = /r/ = Japanese /r/

- A clear substitution of English /l r/ with Japanese /r/

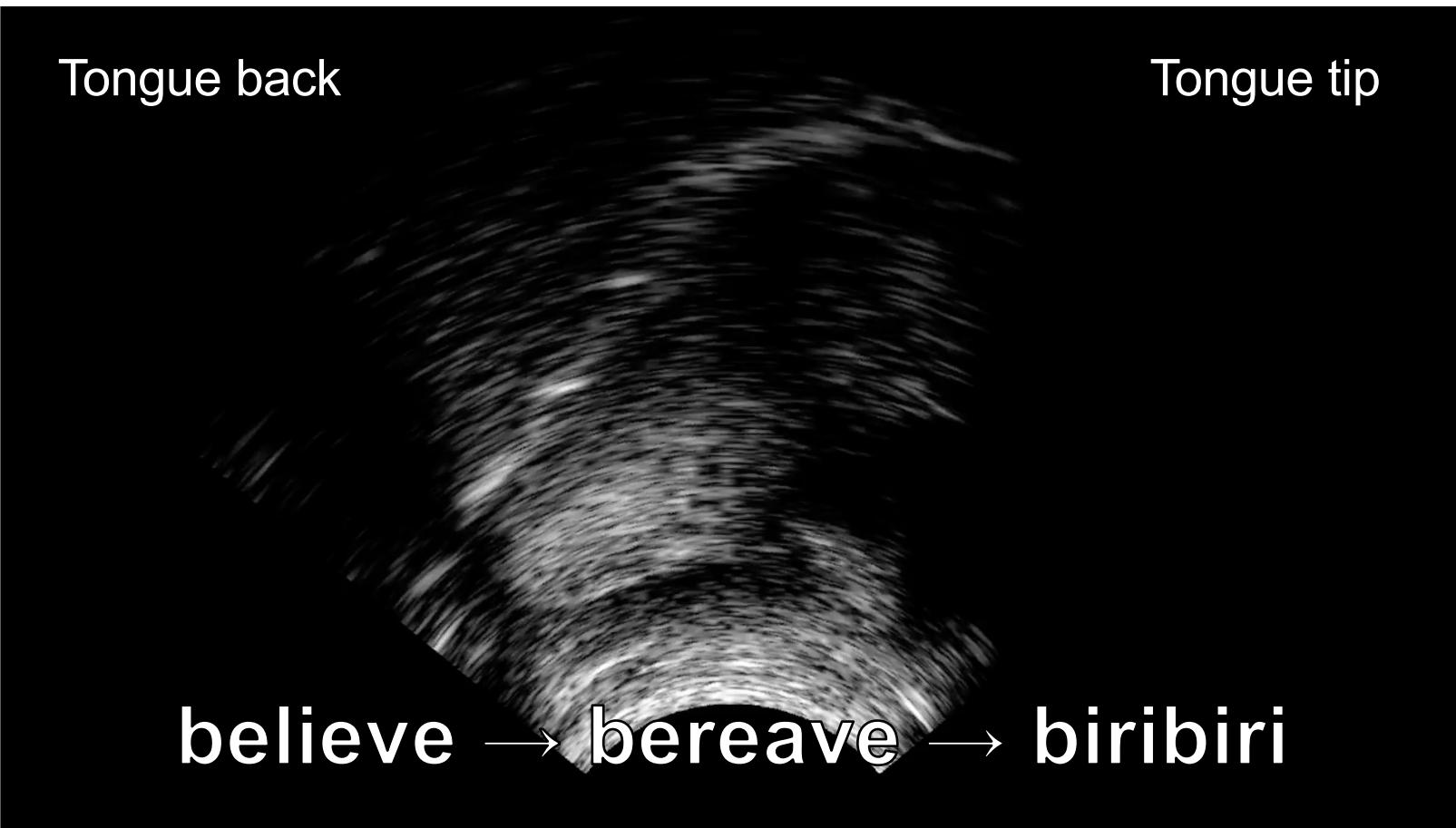
1. Good English /l r/s

Lancaster
University



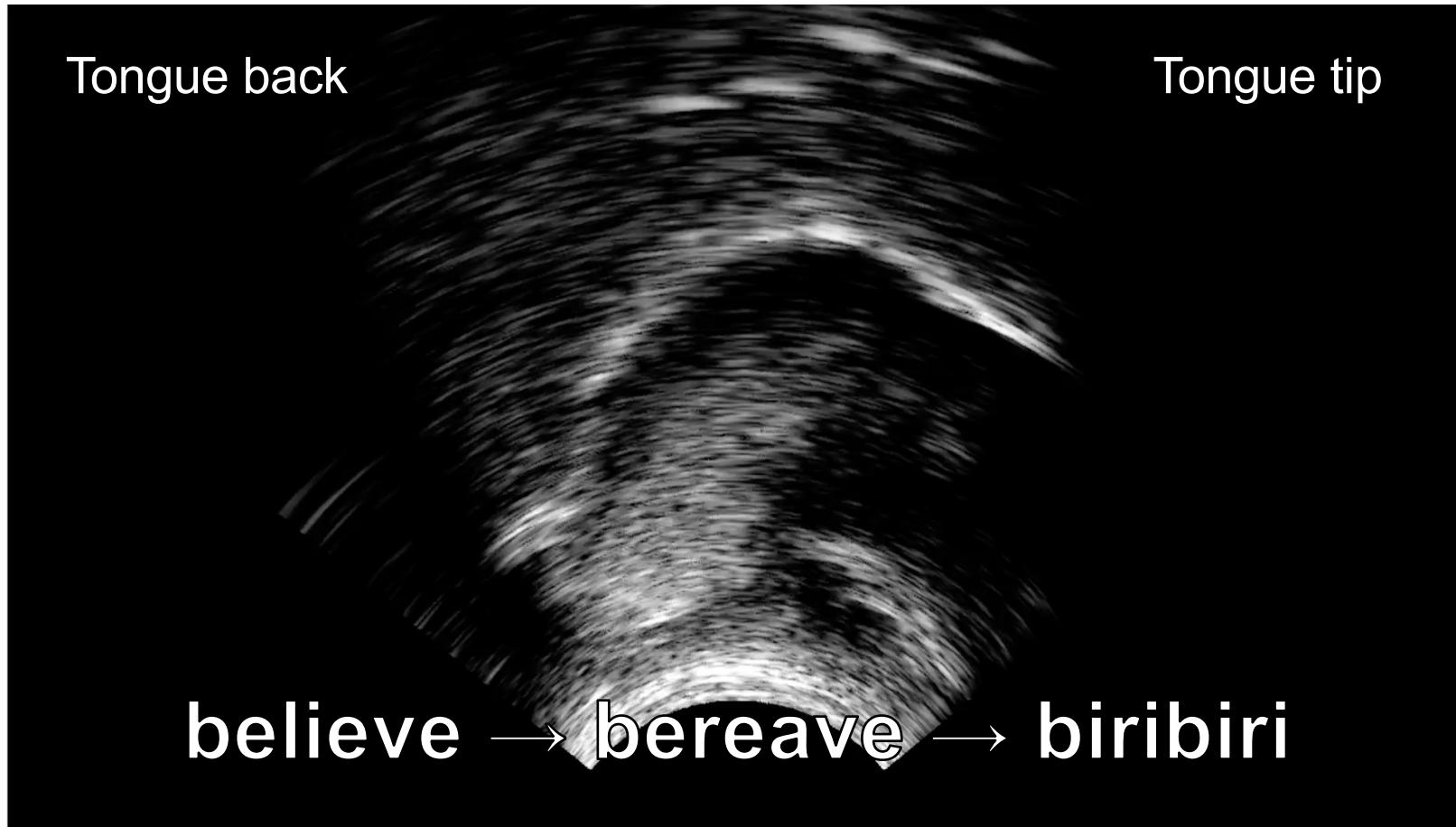
2. English /l/ = Japanese /r/?

Lancaster
University



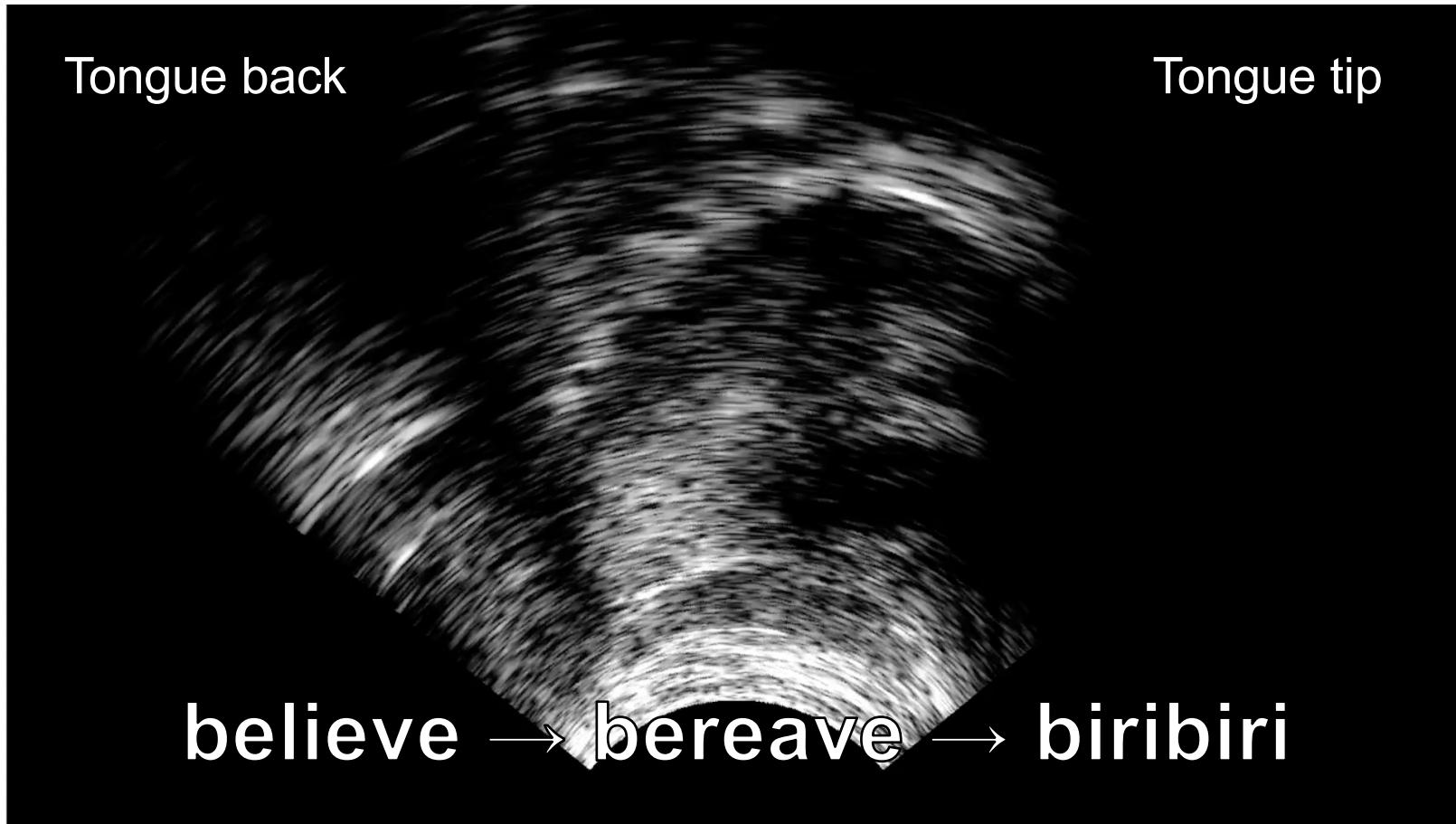
3. English /l/ ≈ /r/ ≠ Japanese /r/

Lancaster
University

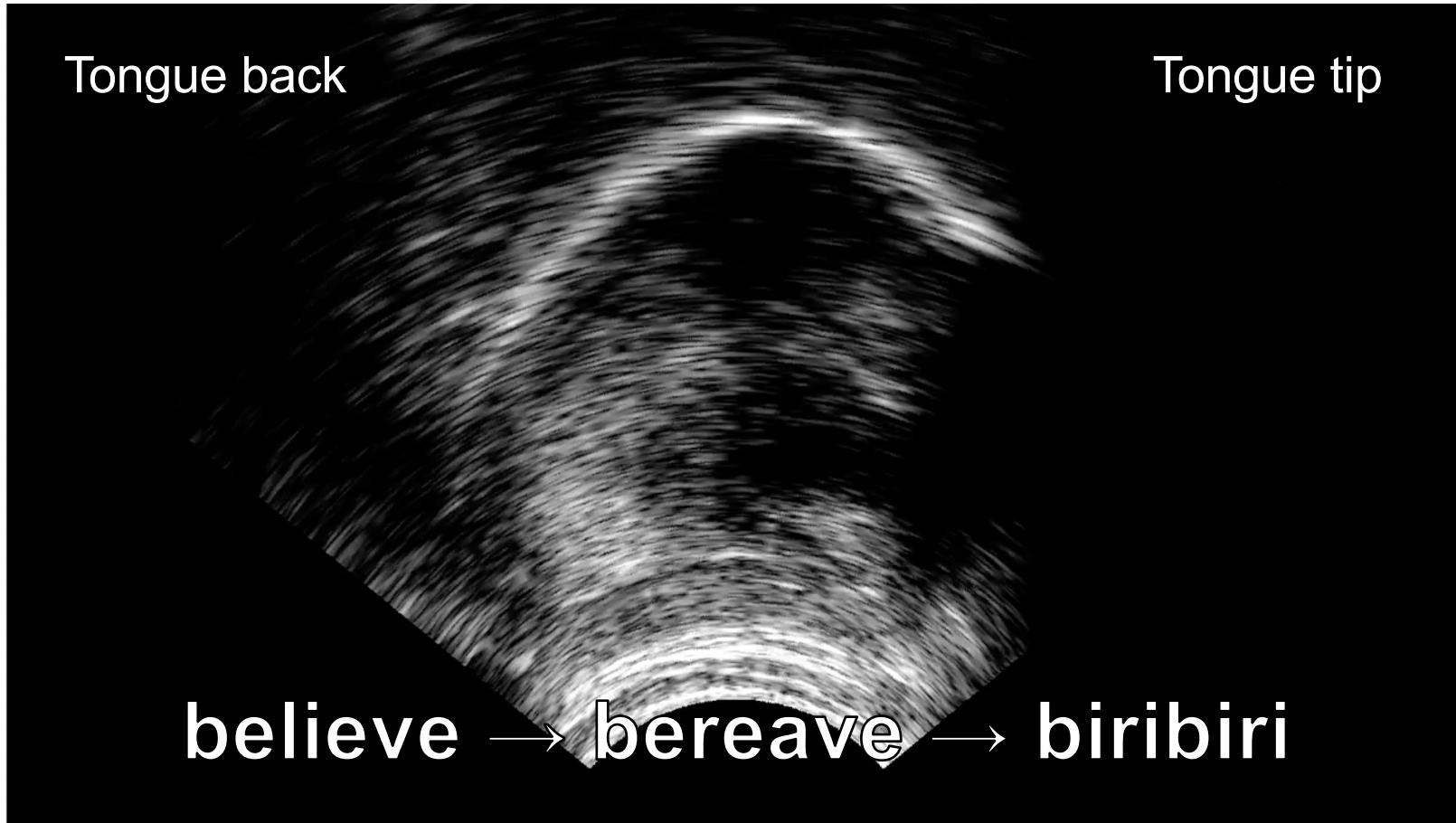


4-1. English /l/ = /r/ = Japanese /r/

Lancaster
University

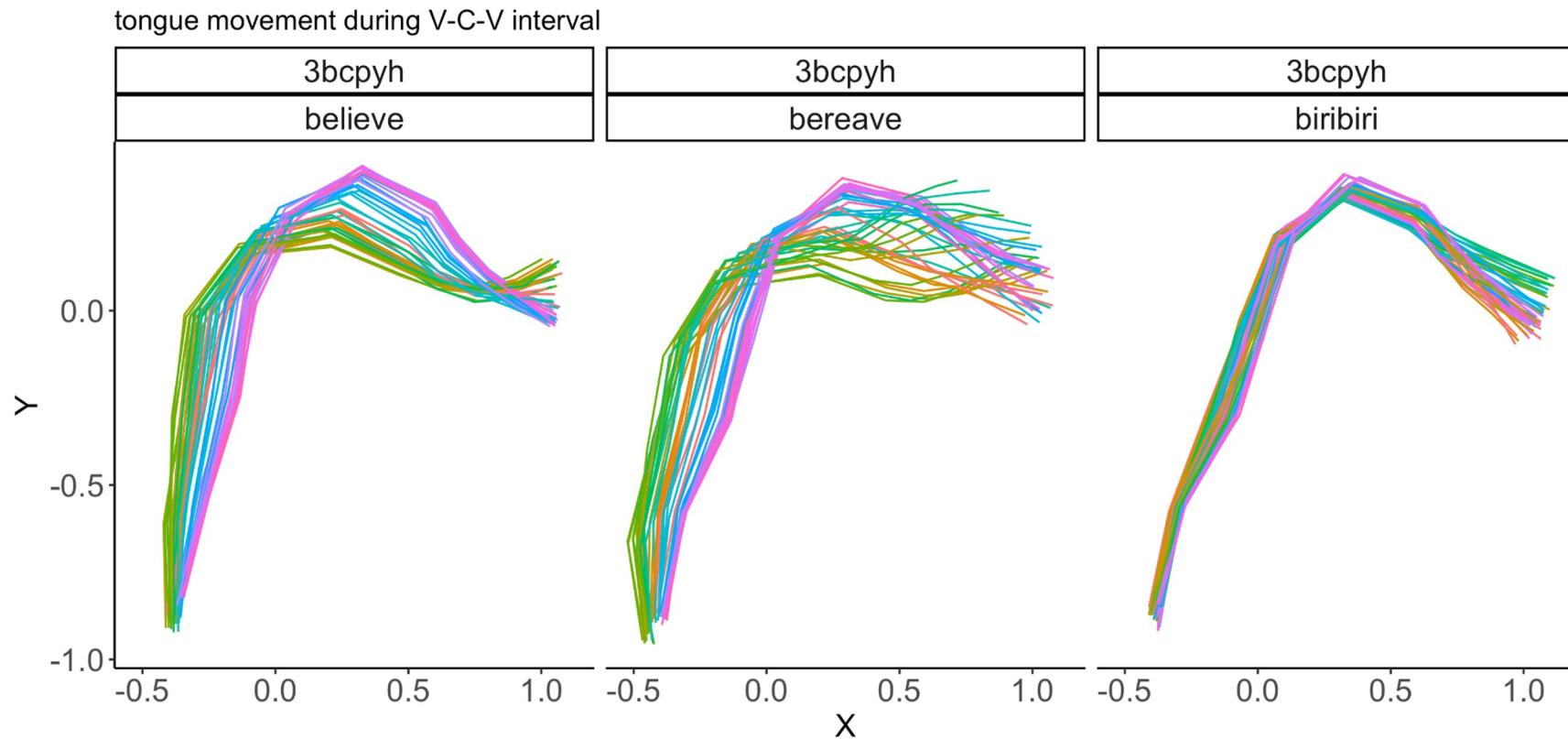


4-2. English /l/ = /r/ = Japanese /r/

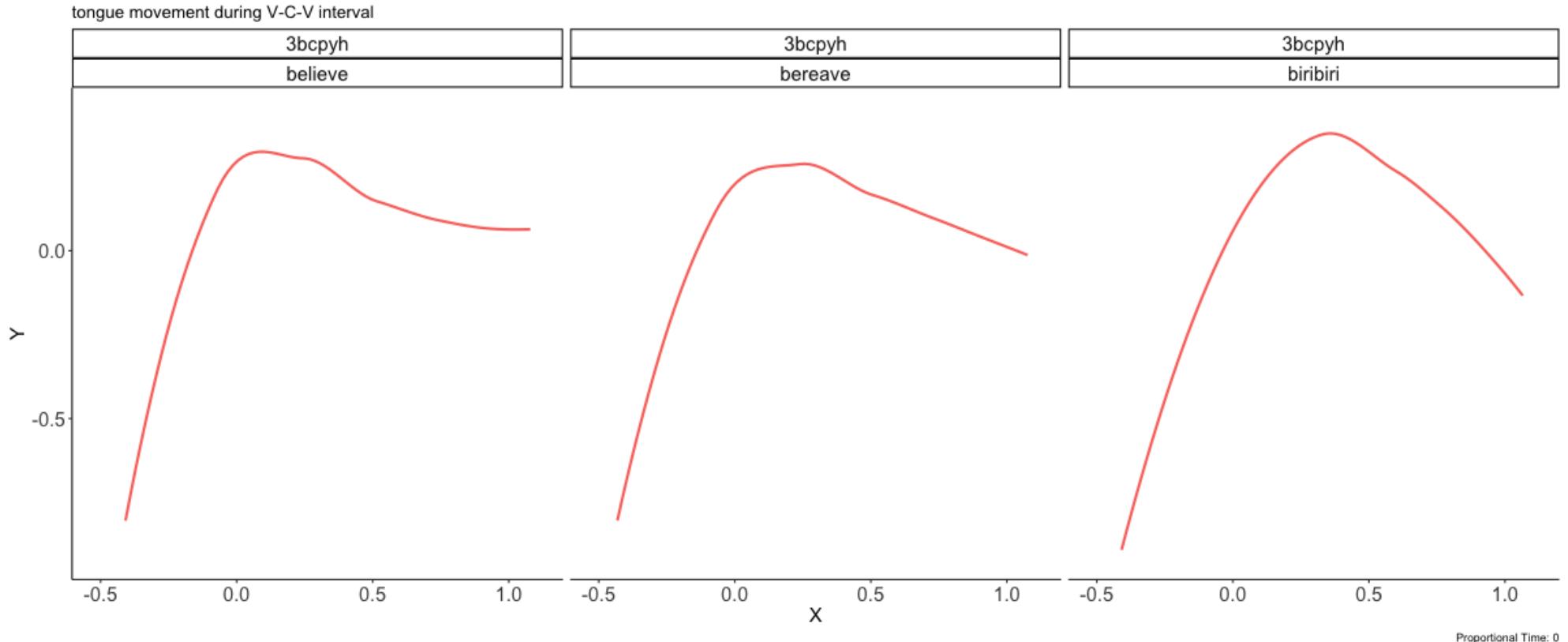


1. Good English /l r/s

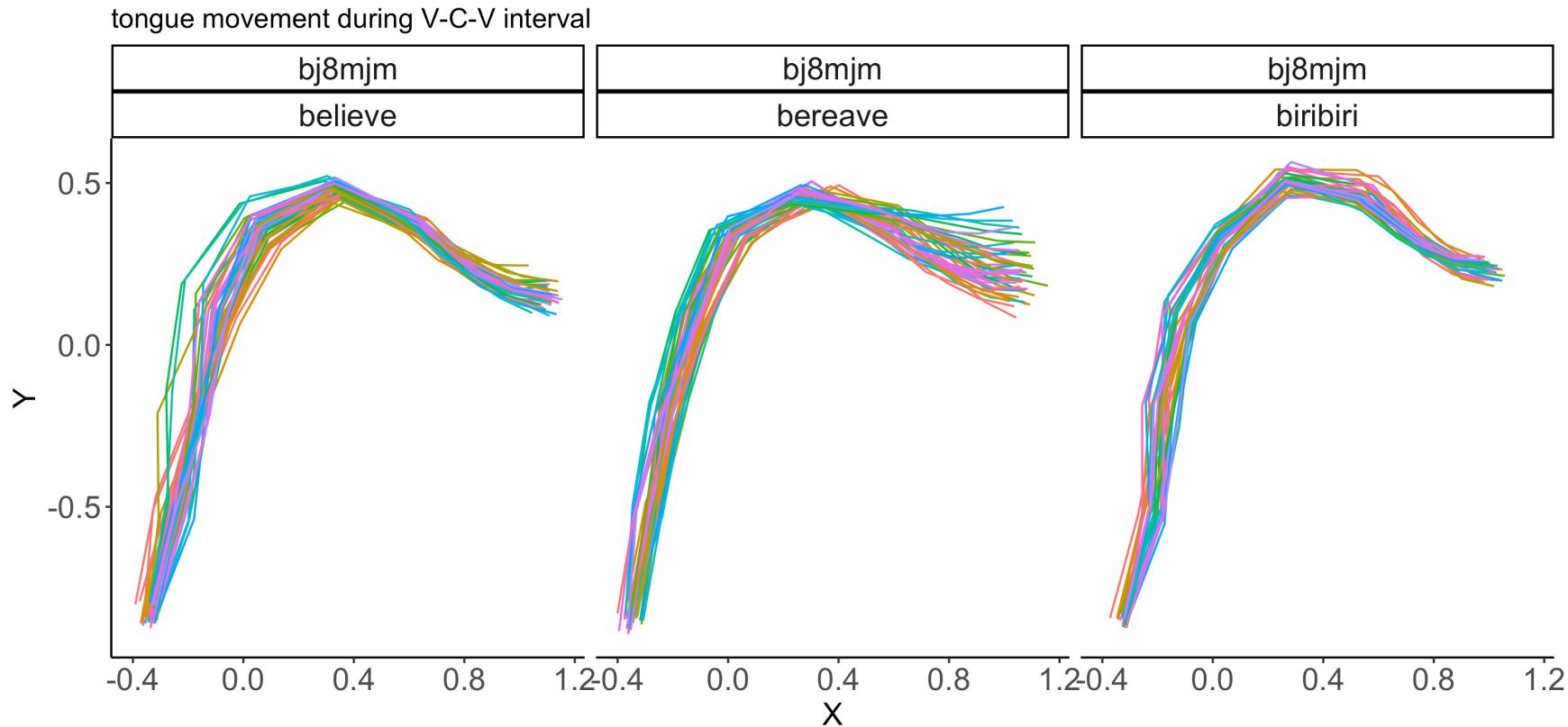
believe bereave biribiri



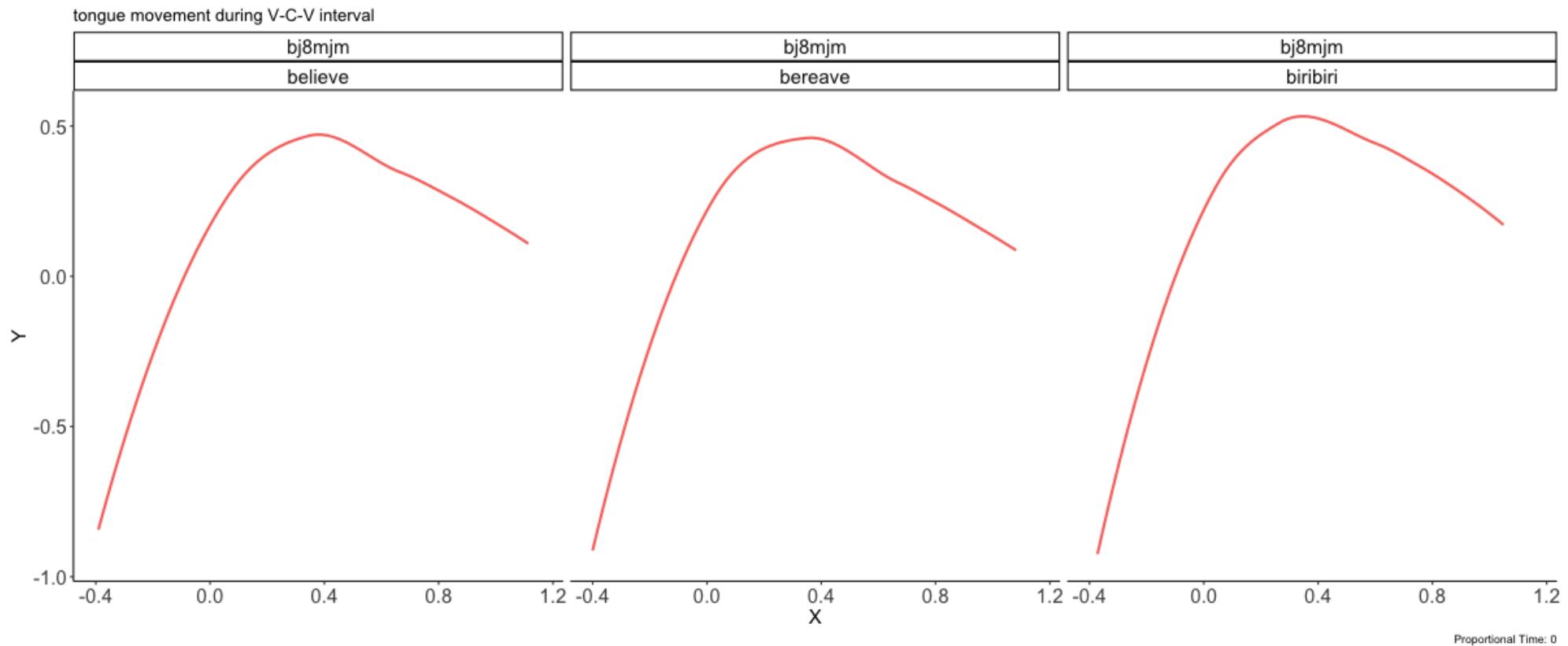
1. Good English /ɪ r/s believe bereave bīribiri



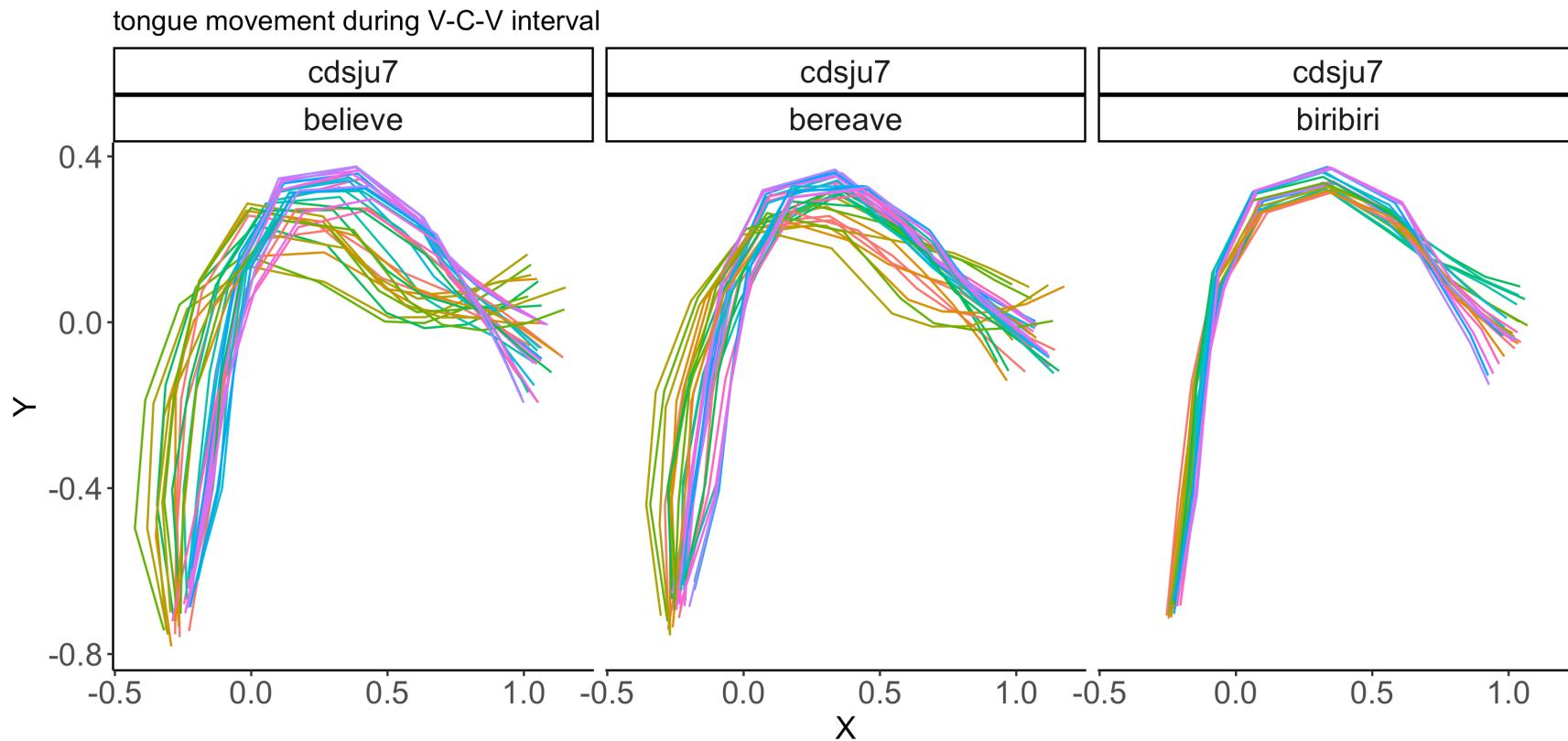
2. English /l/ = Japanese /r/? believe bereave b₁r₁b₁r₁



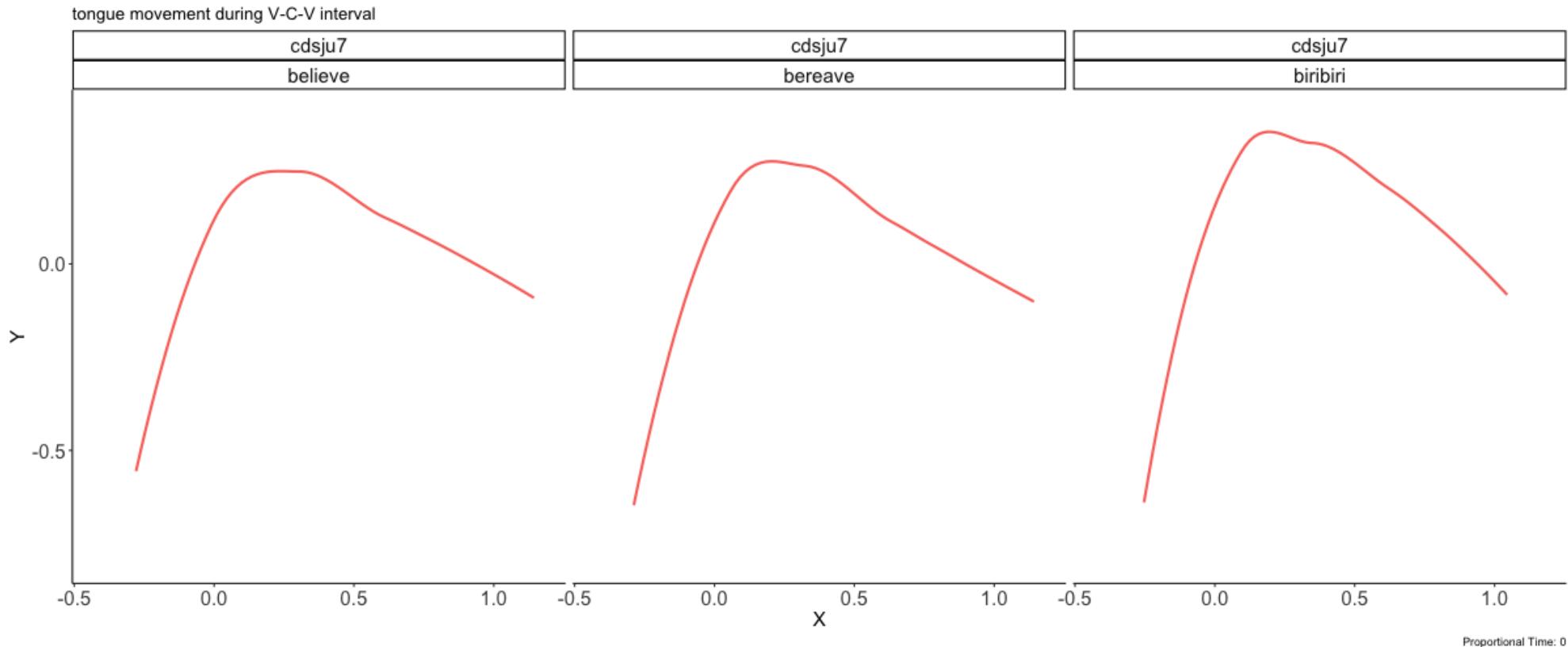
2. English /l/ = Japanese /r/? believe bereave b_{iribiri}



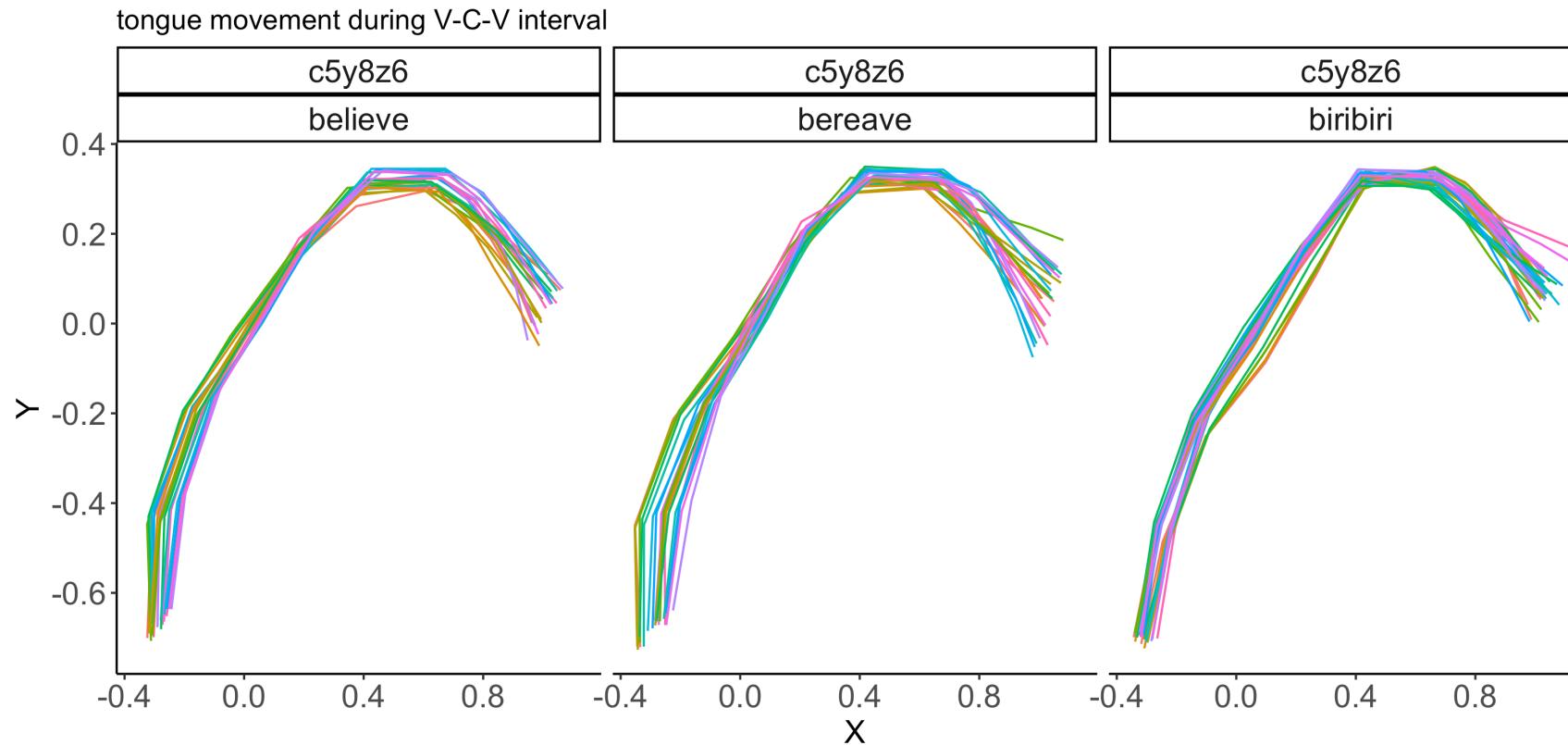
3. English /l/ ≈ /r/ ≠ Japanese /r/ believe bereave biribiri



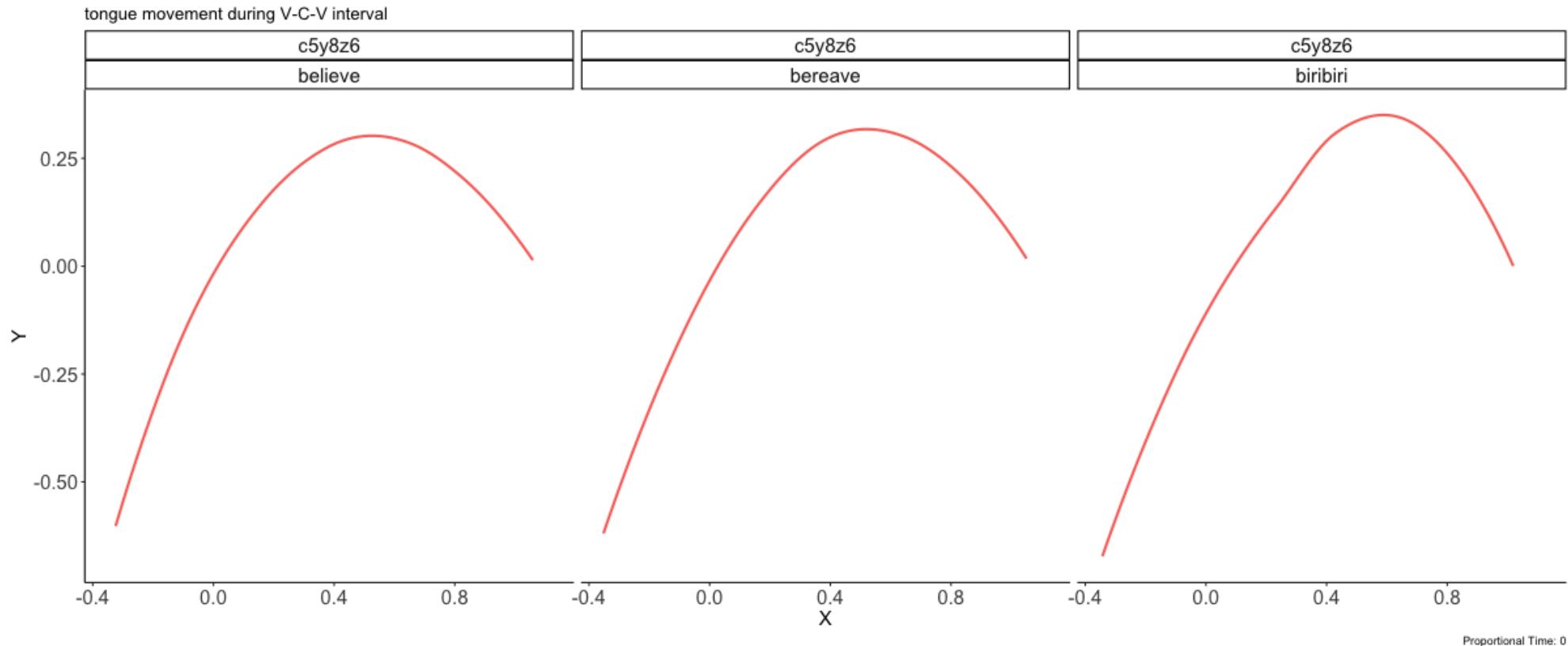
3. English /l/ ≈ /r/ ≠ Japanese /r/ believe bereave biribiri



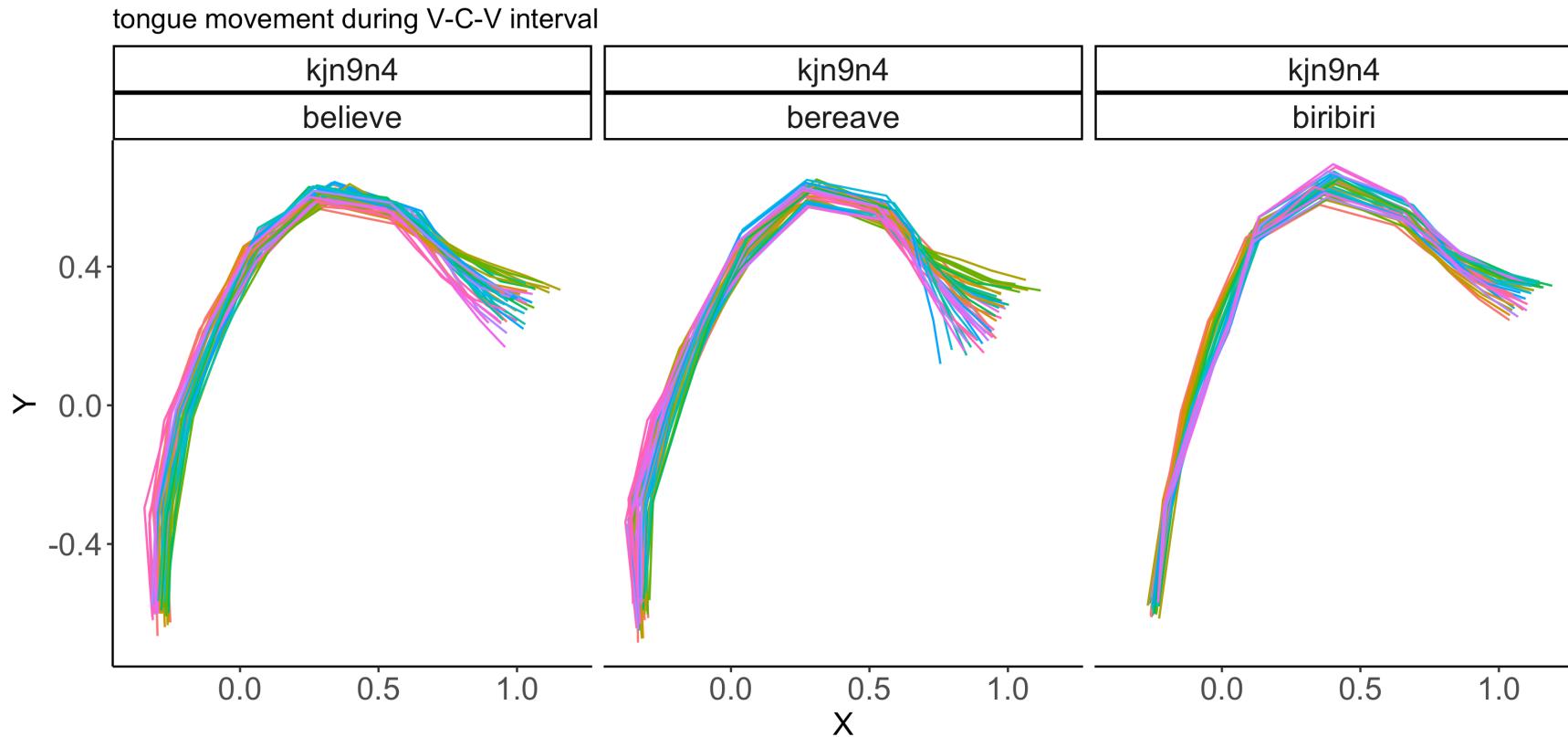
4-1. English /l/ = /r/ = Japanese /r/ **believe bereave biribiri**



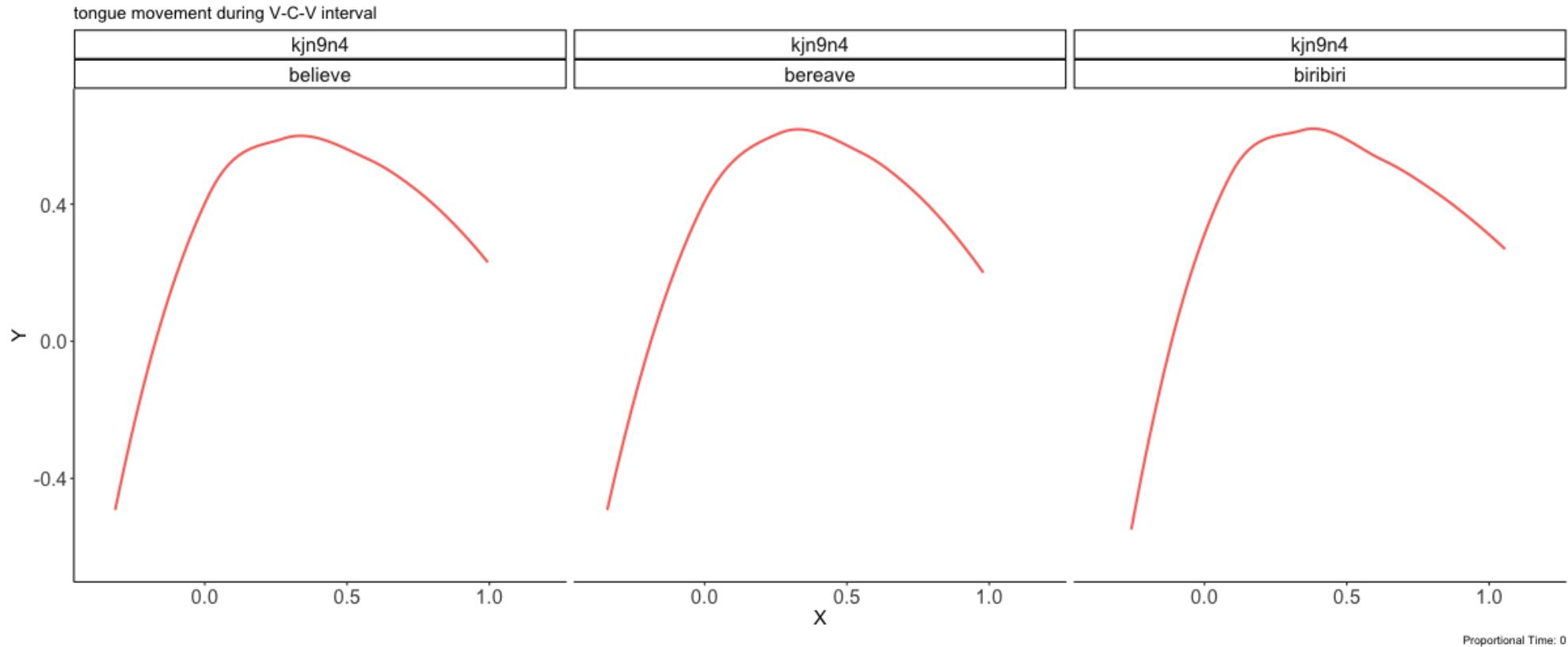
4-1. English /l/ = /r/ = Japanese /r/ believe bereave biribiri



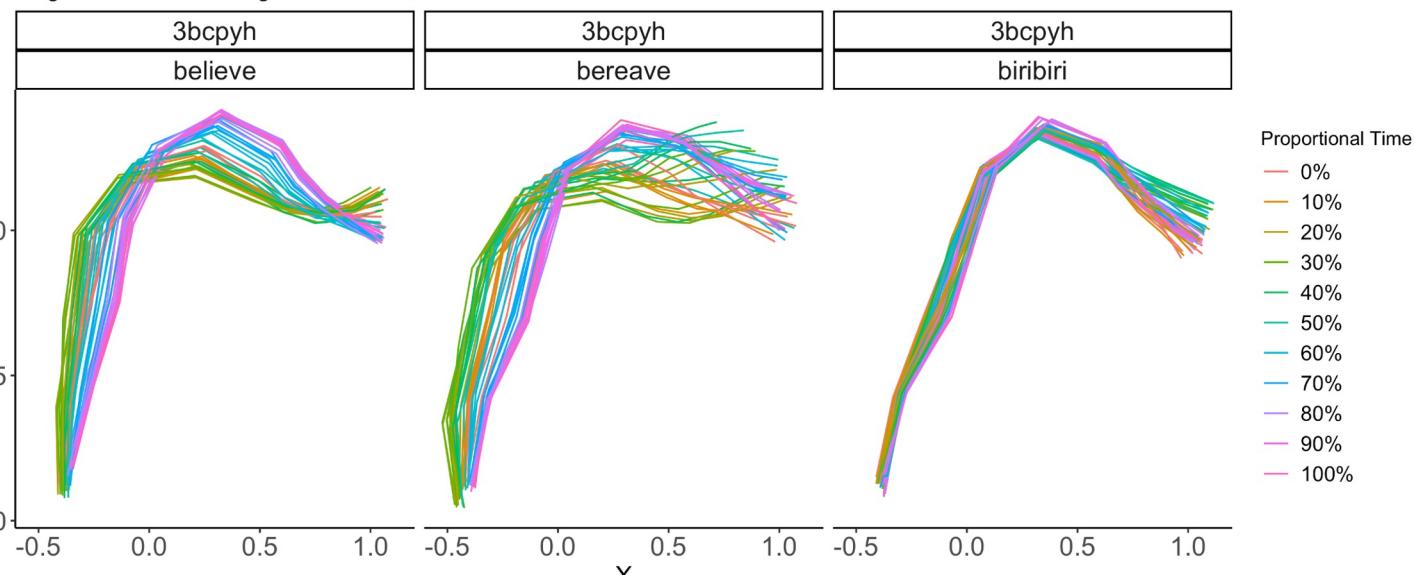
4-2. English /l/ = /r/ = Japanese /r/ believe bereave biribiri



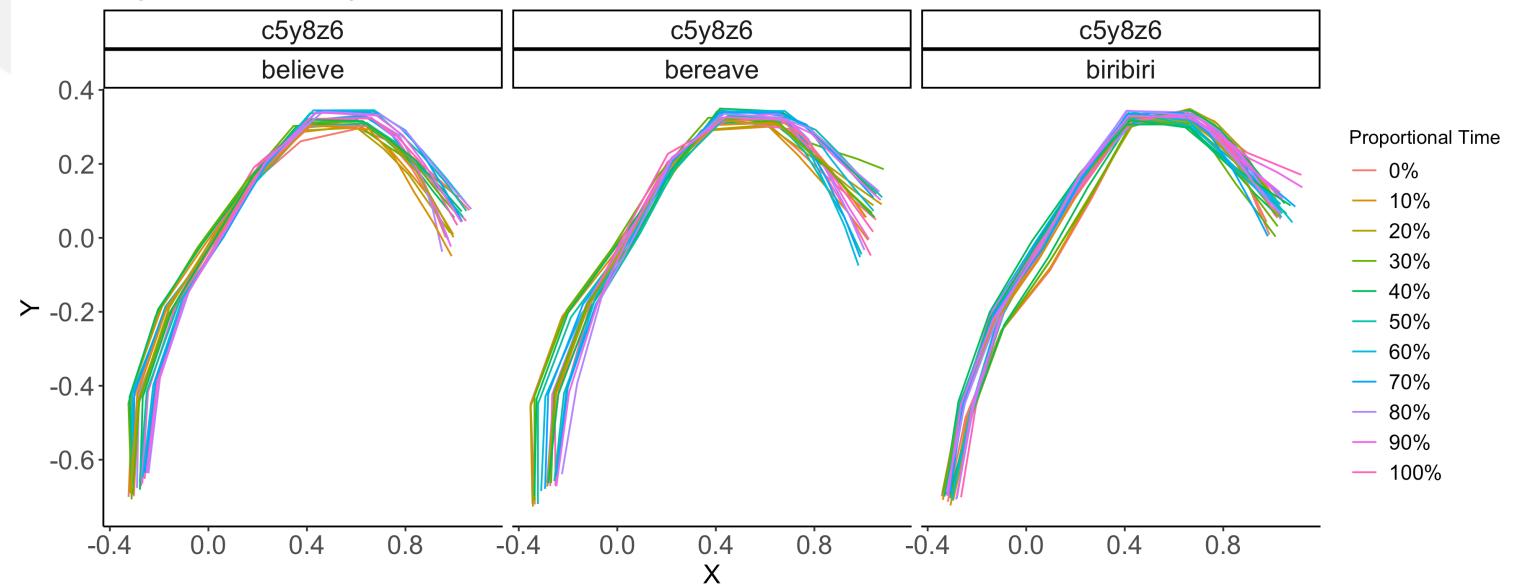
4-2. English /l/ = /r/ = Japanese /r/ believe bereave biribiri



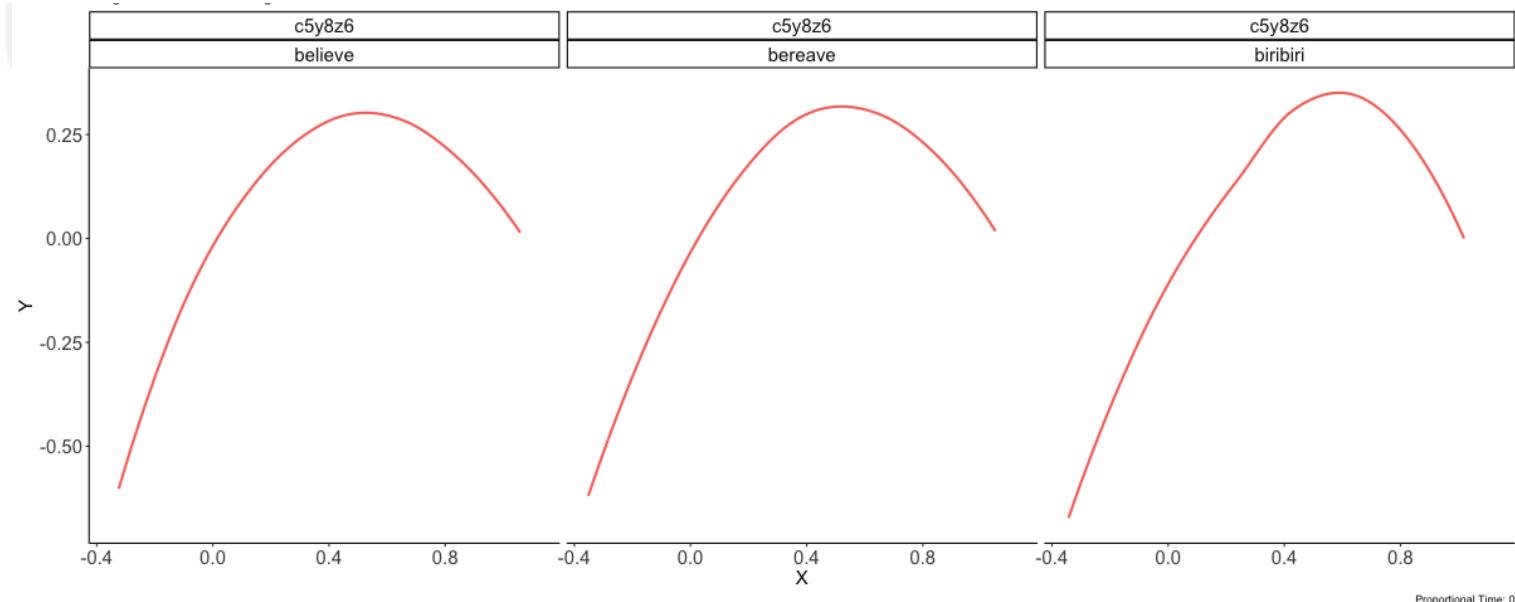
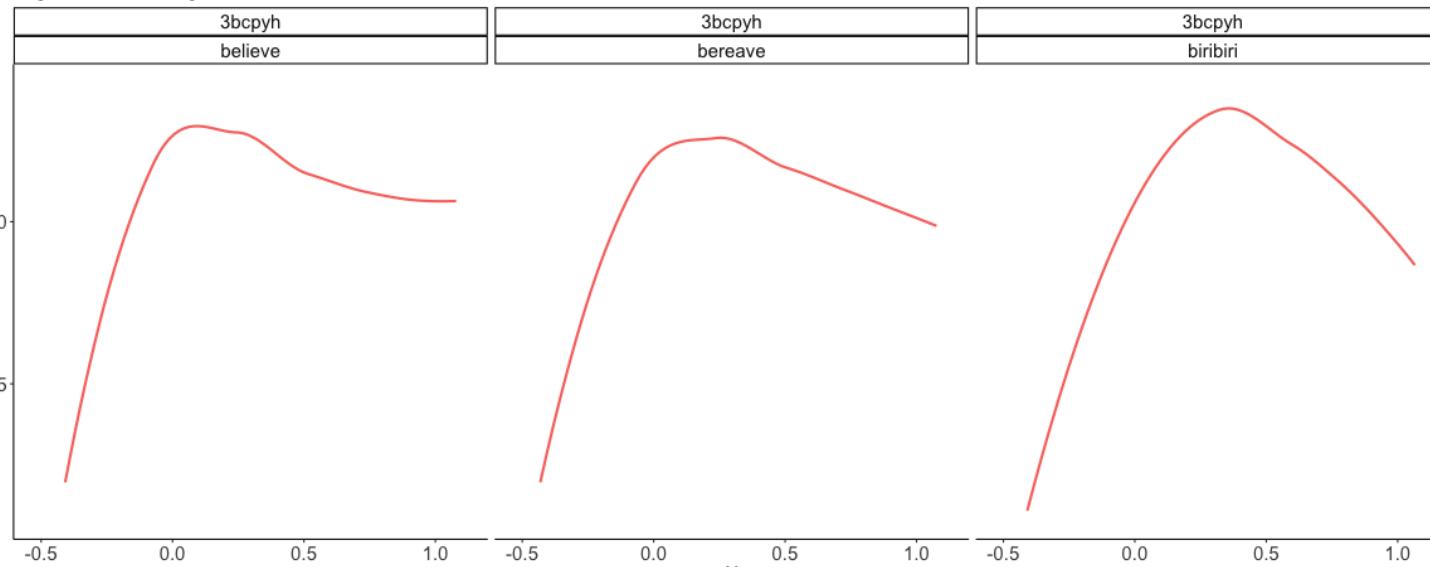
tongue movement during V-C-V interval



tongue movement during V-C-V interval



tongue movement during V-C-V interval



Summary

- **Tongue dorsum's stability for Japanese /r/**
 - TD gesture covaries with the vocalic contexts
 - Could be ‘the L1-derived articulatory routine’?
- **Multiple strategies for English /l r/**
 - Showing the interlanguage variability (cf. Moore et al., 2016)
- **Accurate production of English /l r/ may depend on the acquisition of the tongue posterior movement.**
 - Is the tongue posterior gestures difficult for Japanese speakers?
 - How do they become able to articulate English /l r/ with the tongue posterior gesture?

Future directions

- How could we **quantify and formally compare the variability in the tongue posterior movement** across speakers?
- How do the current findings extend to **the other vocalic environments/syllable positions**?
- How does the degree of tongue retraction **relate to acoustics**?
- What is the **articulatory timing** in L2 English /l r/?
- Does the **perceptual accuracy** predict the dynamics of tongue shape?

Selected references

- Gick, B., Bernhardt, B. M., Bacsfalvi, P., Wilson, I., & Oh, S. (2007). *A motor differentiation model for liquid substitutions: English /r/ variants in normal and disordered acquisition*. Paper presented at UltraFest 4, New York.
- Harper, S., Goldstein, L., & Narayanan, S. S. (2016). L2 Acquisition and Production of the English Rhotic Pharyngeal Gesture. *Interspeech 2016*, 208–212. <https://doi.org/10.21437/Interspeech.2016-658>
- Morimoto, M. (2020). *Geminated Liquids in Japanese: A Production Study* [PhD Thesis, University of California Santa Cruz]. <https://escholarship.org/uc/item/9sz2j7gd>
- Proctor, M. (2011). Towards a gestural characterization of liquids: Evidence from Spanish and Russian. *Laboratory Phonology*, 2(2), 451–485. <https://doi.org/10.1515/labphon.2011.017>
- Proctor, M., Walker, R., Smith, C., Szalay, T., Goldstein, L., & Narayanan, S. (2019). Articulatory characterization of English liquid-final rimes. *Journal of Phonetics*, 77, 100921. <https://doi.org/10.1016/j.wocn.2019.100921>
- Yamane, N., & Howson, P. (2015). An ultrasound examination of taps in Japanese. *Proceedings of the 18th International Congress of Phonetic Sciences*, 5. <https://www.internationalphoneticassociation.org/icphs-proceedings/ICPhS2015/Papers/ICPHS0815.pdf>

Acknowledgement



Data collection

- Professor Noriko Nakanishi (Kobe Gakuin University)
- Professor Yuri Nishio (Meijo University)

Overall study design

- Dr Claire Nance (Lancaster)
- Dr Sam Kirkham (Lancaster)

Funding

- Japan Student Services Organisation (JASSO)
- The Murata Science Foundation

And to all the participants who endured the 90-minute sessions!



Thank you!

Takayuki Nagamine

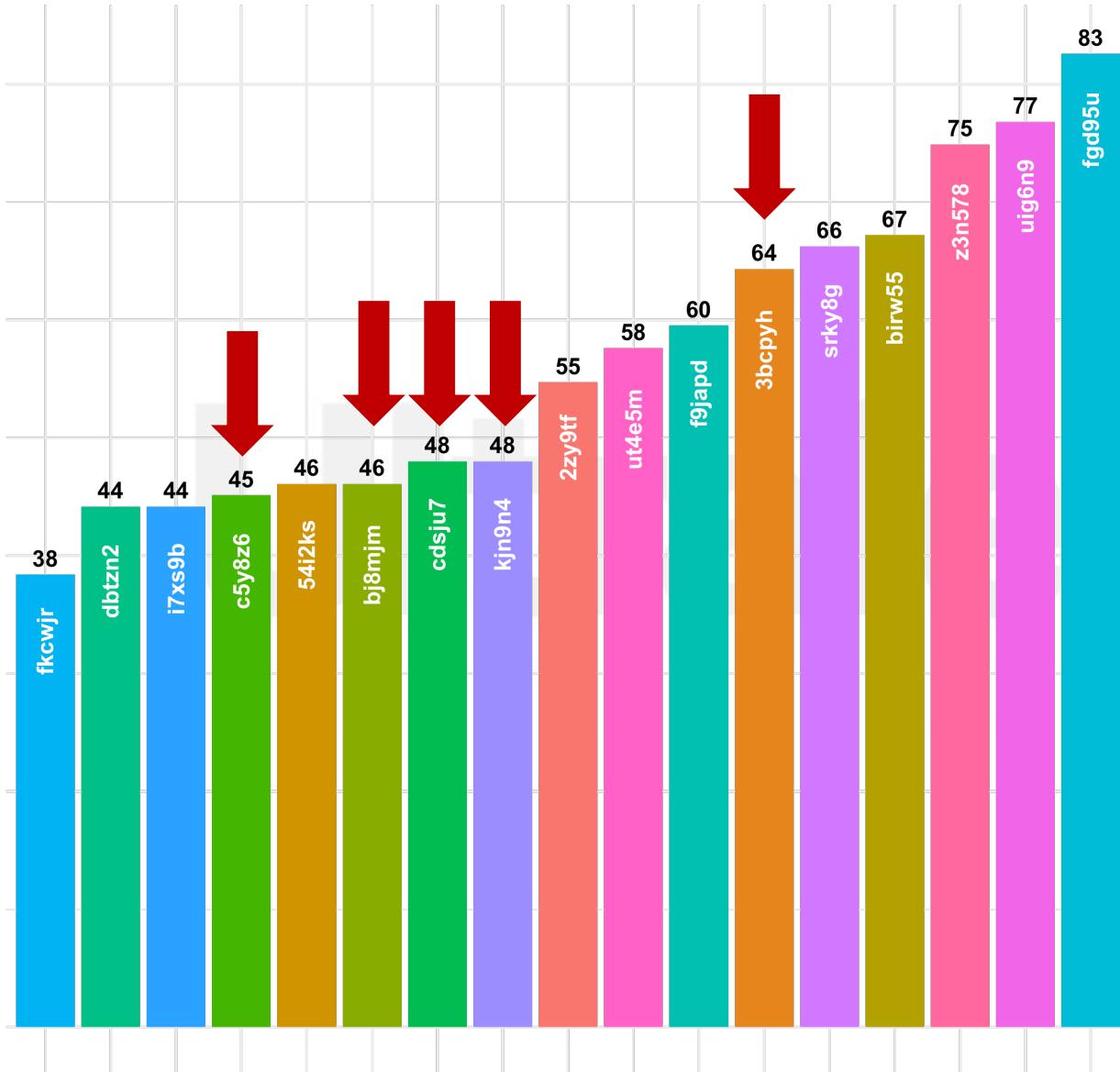
PhD student
Lancaster University
t.nagamine@lancaster.ac.uk



ultrafestX

Unused slides

Percent correct of identification accuracy of English /l/ and /r/



English prompt

Vowel	Initial /l/	Initial /r/	Final /l/	Final /r/	Medial /l/	Medial /r/
/i/	leap	reap	peel	peer		
	leaf	reef	feel	fear		
	leave	reeve	veal	veer	believe	bereave
/æ/	lap	rap				
	lamb	ram				
	lamp	ramp				
/u:/	lube	rube				
	loom	room				

Japanese prompt



Vowel	Initial /r/ in lexical words	Initial /r/ in mimetics
Close front	リーフ /ri:fū/	ビリビリ /biribiri/ ピリピリ /piripiri/
Open front	ラフ /raɸū/ ラム /raμu/	バラバラ /barabara/ パラパラ /parapara/
Close back	ループ /ru:pū/ ルーム /ru:mu/	ブルブル /buruburu/ プルプル /purupuru/