Analysing Learner Speech and Resulting Applications for EFL Classrooms

A corpus-based contrastive analysis of vowel production of L1 English speakers and L1 Japanese learners of English

AcqVA Aurora Lab

Martin Schweinberger

LADA

https://martinschweinberger.github.io/JapEVowelsCAU

Vortrag im Rahmen meiner Bewerbung um die W3-Professur in englischer Sprachwissenschaft an der Christian-Albrechts-Universität zu Kiel

Hintergrund

Mein Forschungsprofil zeigt, dass ich, u.a., forsche zu:

- World Englishes | Variationslinguistik und Soziolinguistik |
  Language Variation and Change | Korpuslinguistik | Synchrone und diachrone Linguistik des Englischen

Dieser Vortrag

- Potenzial für forschungsorientierte Lehre und Spitzenforschung

- Studiengänge im Institut sind lehramtszentriert (Nutzen von Forschung für Studierende)

- Möglichkeiten und Bereitschaft für potentielle inter- sowie transdisziplinäre Zusammenarbeit
  (Englisches Seminars | Fakultät | CAU-weit)

  - Fachdidaktik Mobile Enhanced Language Learning and Teaching (MELLT)

  - Sprachpraxis / Language Experience

  - Institute für Skandinavistik, Frisistik und Allgemeine Sprachwissenschaft (ISFAS) |
    Germanistisches Seminar

  - SECC (Society, Economy, Culture in Change): eher Oberweserplatt (SiN2)
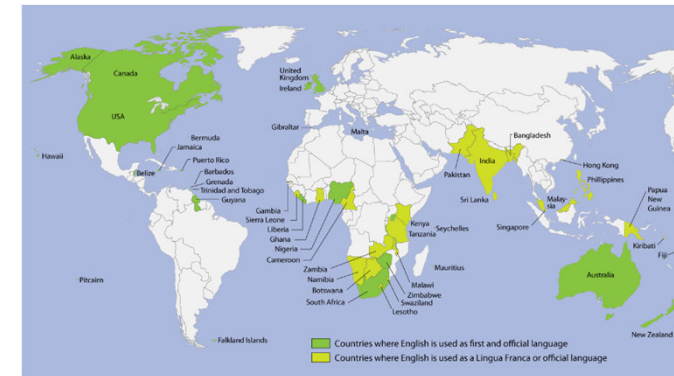
CRICOS code 00025B

Analysing Learner Speech
and Resulting Applications for EFL Classrooms

A corpus-based contrastive analysis of vowel production of L1 English speakers and L1 Japanese learners of English

AcqVA Aurora Lab

Martin Schweinberger

LADA

https://martinschweinberger.github.io/JapEVowelsCAU

Analysing Learner Speech
and Resulting Applications for EFL Classrooms

A corpus-based contrastive analysis of vowel production of L1 English speakers and L1 Japanese learners of English

Timeline | Table of Contents

Background and Motivation

Pronunciation is a challenge for L2 English learners

Problem

- Pronunciation is most immediate and direct
- Everybody automatically and subconsciously categorizes and infers judgements based on pronunciation (gender, age, cultural background, nativeness, socio-economics, education, etc.)
- Pronunciation is crucial for intelligibility
- Pronunciation is affecting rea-life opportunities (jobs, partner choice, etc.)

Pronunciation is important for learners as well as teachers of English!

Background and Motivation

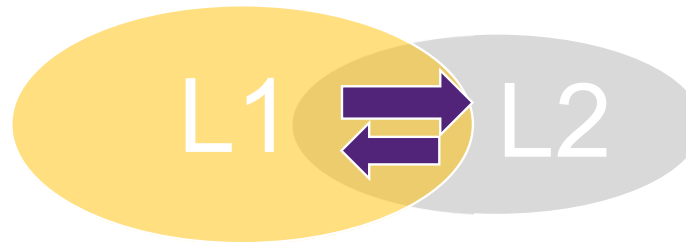**Why is pronunciation a challenge for L2 English learners?**

Languages interact in the minds of multilingual speakers

> Languages are not independent but affect each other
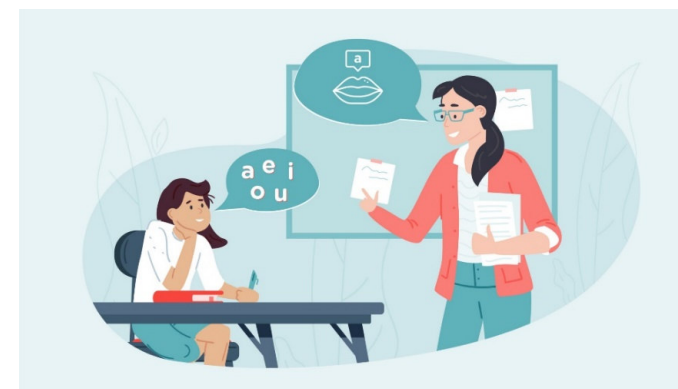
Speech Learning Model (SLM) (Flege 1995)

- L1 and L2 sound systems exist in a shared phonetic space in the bilingual mind
- As a result, the L2 sound system is affected by the L1 system (and vice versa)
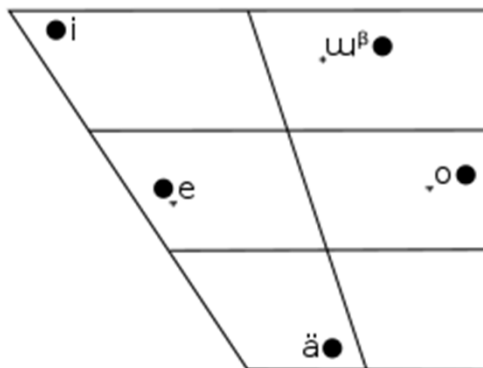
Background and Motivation

English vowels are particularly challenging for Japanese-L1 learners
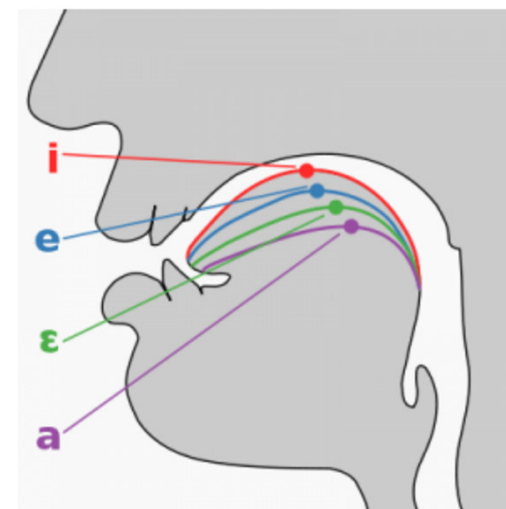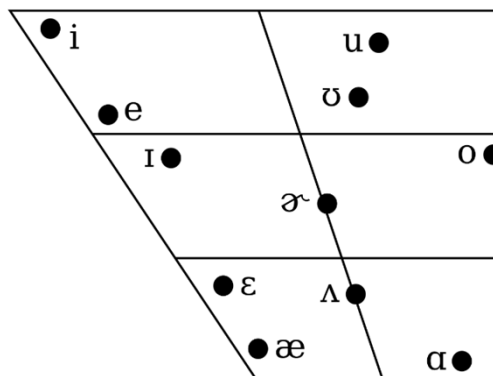(Franklin & Stoel-Gammon 2014)

- o Differences in inventory size (JPN: 5 vowels[*] vs. ENS: app.[**] 11 vowels) (Homma 1992)

- o Differences in how vowels are differentiated (ENS: formants + duration | JPN: duration)

Japanese vowel chart
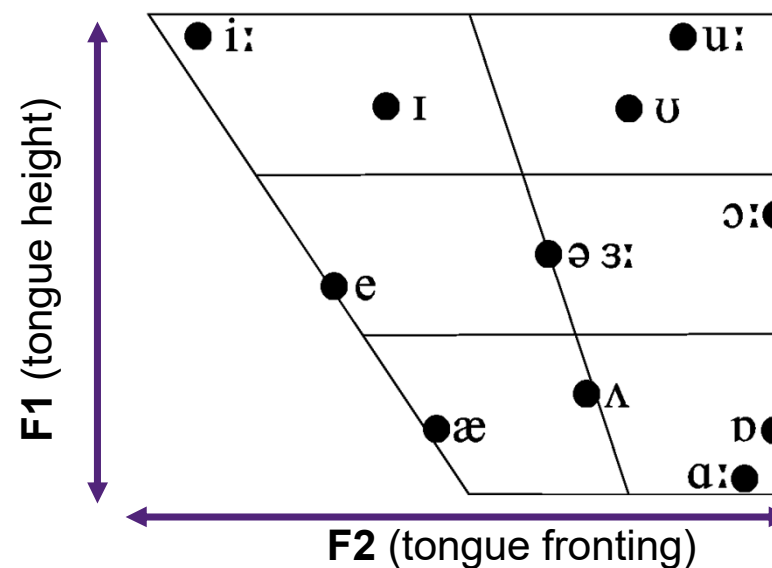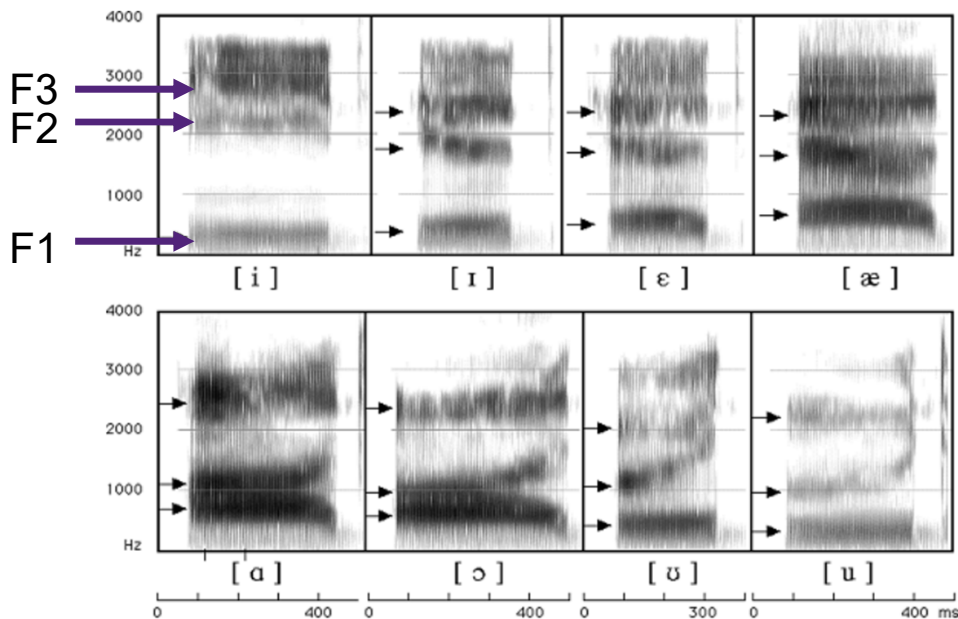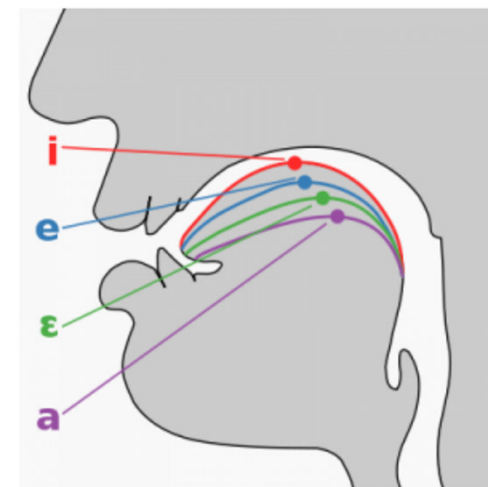
Vowel chart of
southern Californian Engl.

* Monophthingal vowels, i.e., vowels with a fixed tongue position (not vowels with a oving tonue position like /au/ or /ou/.
** Depending on the variety of English.

Background and Motivation

What are "formants"? and do they have to do with tongue position?

- Formants are concentration of acoustic energy at a certain frequency
  (Ladefoged & Johnson 2014)

- First formants (F1) and second formants (F2) inversely correspond to
  the tongue height (F1) and tongue fronting (F2: where it is raised) of each vowel

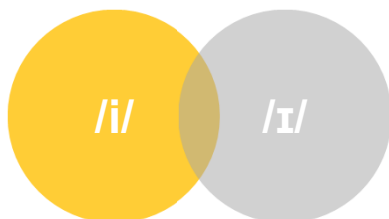Left: Vowel chart of Received Pronunciation (RP)

CRICOS code 00025B

Research Gaps | Research Questions

What has been said about English vowels produced by Japanese learners?

- Japanese learners merger spectrally similar vowels (Ingram & Park 1997, Ueyama 2003)

L1 English speaker (ENS)

Japanese learner of English (JPN)

/i/ /ɪ/

/i//ɪ/
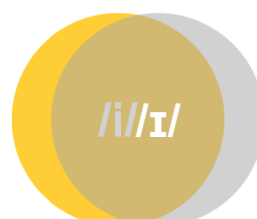
- Japanese speakers are **very sensitive** to vowel duration (Kato et al. 2001) and **exaggerate duration to compensate** for the relative insensitivity to formant differences (Morrison 2002)

L1 English speakers

Japanese learners of English

/ɪ/

/i/

/ɪ/

/i/
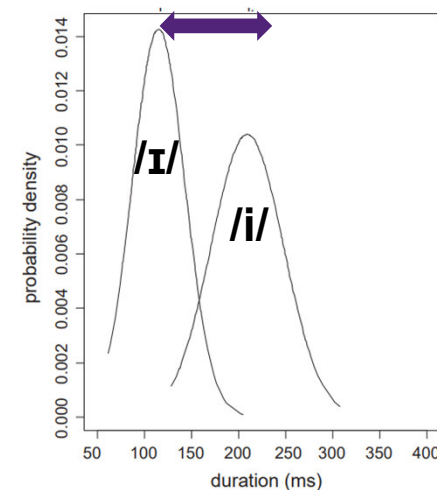
Research Gaps | Research Questions

Problems and gaps in previous research

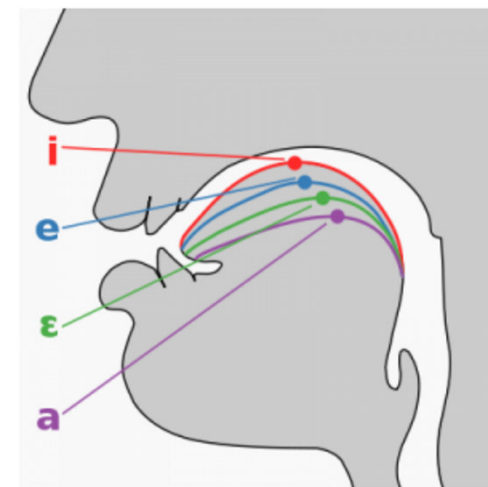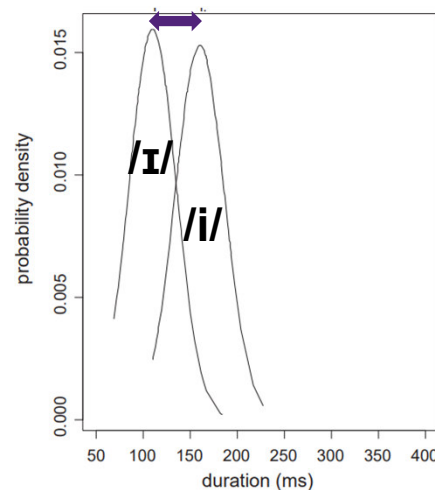- Investigation mainly done in highly controlled laboratory conditions
  (scripted word | sentence-reading)

  ➢ Learner vowel traits in naturalistic speech environments largely unknown

- Small subject size (±10 speakers)

  ➢ Limited generalisability | applicability of the findings
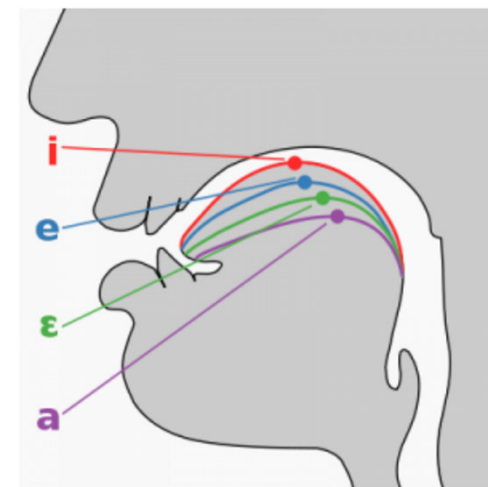
Larger-scale analysis of vowels
produced under more **spontaneous speech** conditions is needed!

RQ1: Do Japanese learners **merge /i:/ and /ɪ/ as well as /u:/ and /ʊ/**?

RQ2: Do Japanese learners **exaggerate the length of vowels** to compensate lack of spectral differentiation?

Methodology (Data | Analysis)

Data

- *International Corpus Network of Asian Learners of English* (ICNALE)
  (Ishikawa 2014)

  o Speech and text samples from English learners in Asia and L1 English speakers

  o Spoken monologues: spontaneous speech from **150 Japanese learners**
     and **132 L1 speakers of English**

  o Before processing

Type	Speakers	/ɪ/	/iː/	/ʊ/	/uː/
ENS	132	2,562	1,205	350	1,895
JPN	150	3,696	1,203	644	1,261
Total	282	6,258	2,408	994	3,156

  o After processing (final data set)

Type	Speakers	/ɪ/	/iː/	/ʊ/	/uː/
ENS	105	693	939	189	395
JPN	141	1,122	535	188	281
Total	**246**	**1,815**	**1,474**	**377**	**676**

Spoken Monologue
Spoken Dialogue
Edited Essays
Written Essays

Methodology (Data | Analysis)

Data Processing (R 4.2, R Core team (2022) in RStudio (RStudio Team 2022))

- Aligning speech with audio using Web-MAUS (Schiel 1999)
(this produces Praat TextGrids)

- Automated extraction of vowel formants and vowel duration from Praat TextGrids (Wickham et al. 2019)

- Only monosyllabic words were retained and outliers were removed using Kernel Density Estimation

Statistical Analysis

- Mergers → **Bhattacharya affinity** (Johnson 2015, measure of overlap of scatter clouds, 1 = perfect overlap)

- Duration → **Mixed-Effects Regression Model** (lme4: Bates et al. (2015), sjPlot: Lüdeke (2021))
  - DV: duration
  - IVs: type, vowel, gender, age, word type
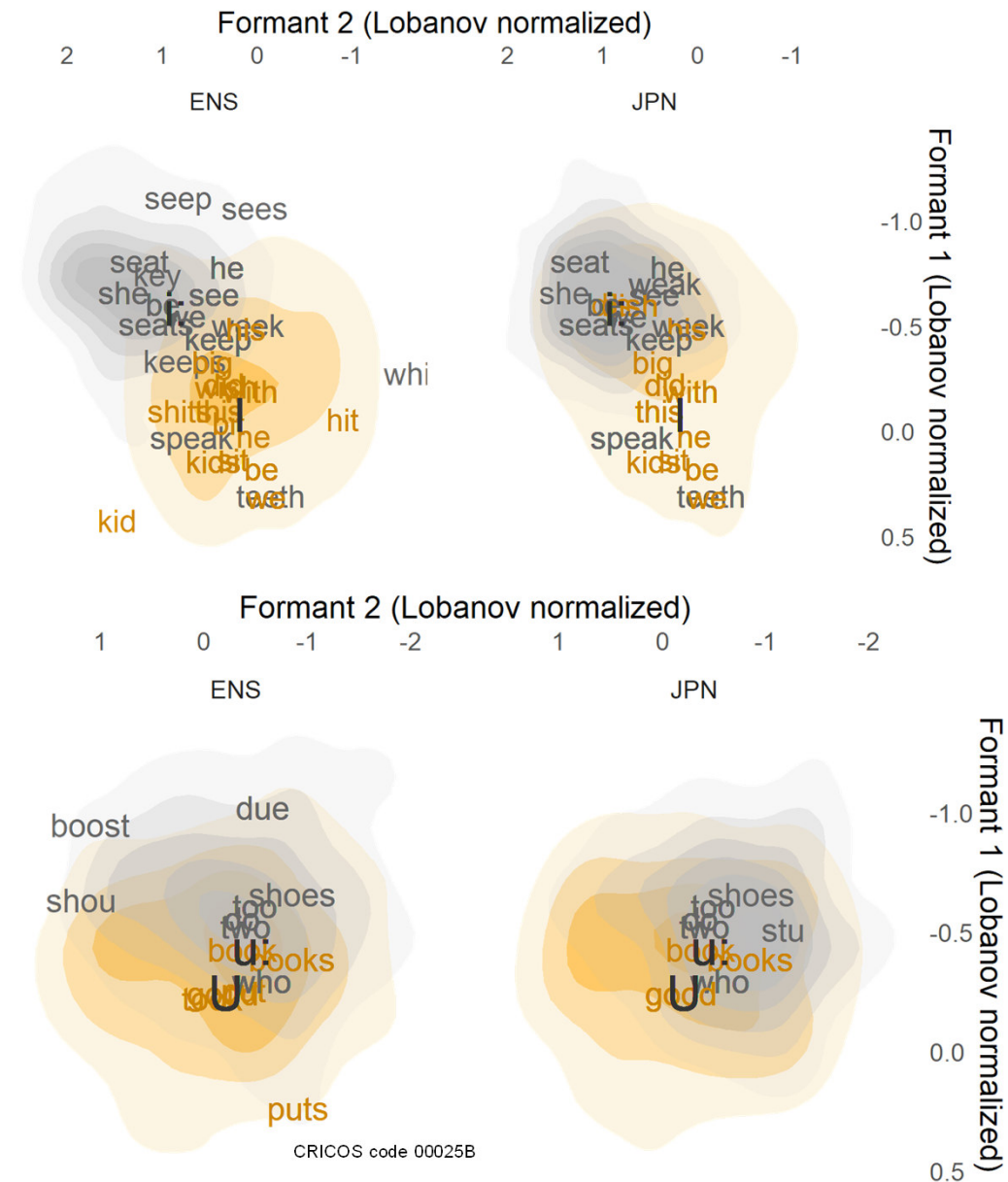 - REs: word, speaker

Results

Mergers

- /iː/ and /ɪ/
  - JPN Bhattacharya affinity: .901
  - ENS Bhattacharya affinity: .757

  Substantively more overlap among JPN!

- /uː/ and /ʊ/
  - JPN Bhattacharya affinity: .932
  - ENS Bhattacharya affinity: .952

Mergers confirmed for **spectrally similar vowels** (ENS also merge /uː/ and /ʊ/)!
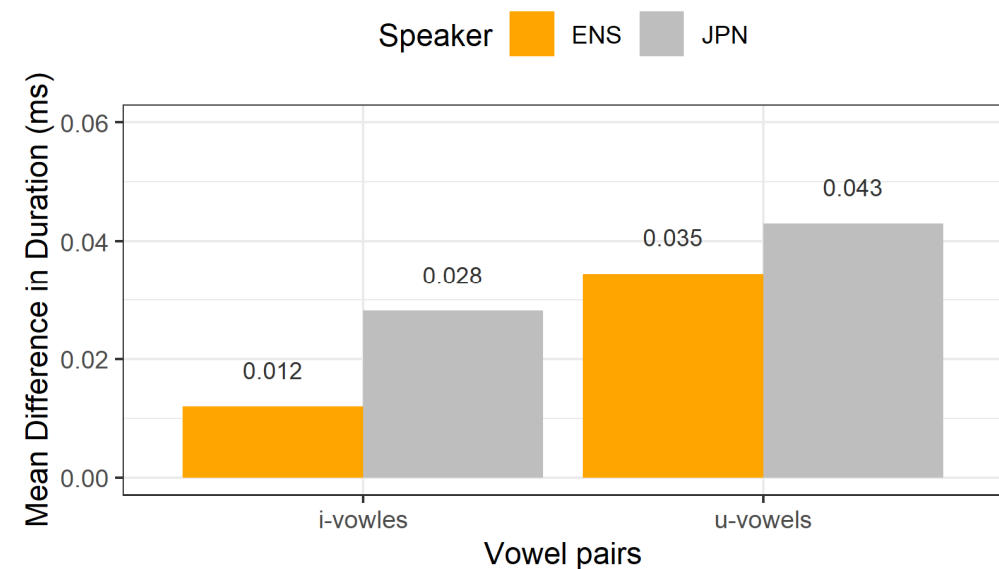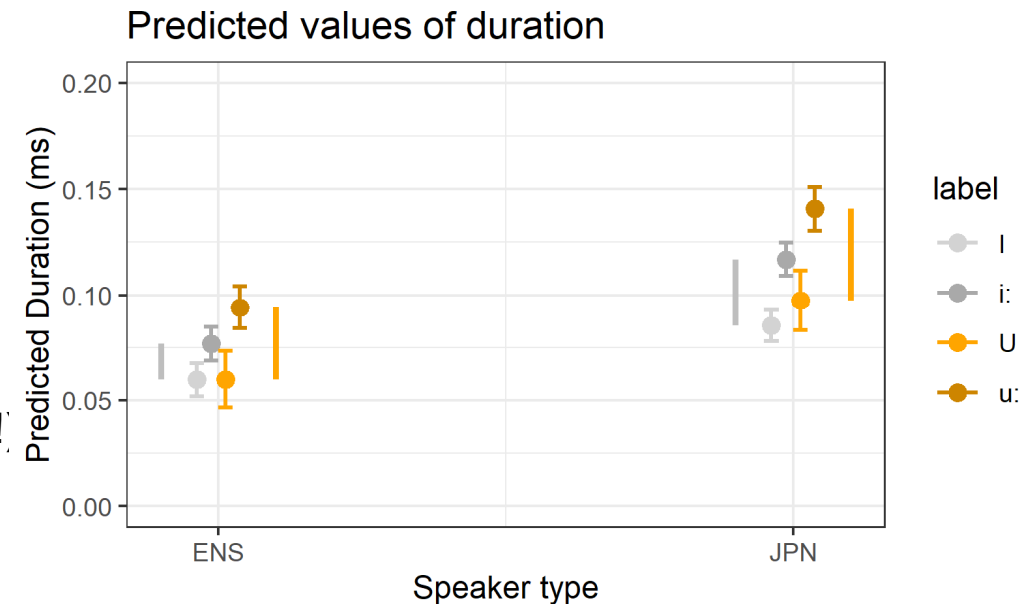
Results

Duration

- JPN extend all vowel durations (not just long vowels)!
  (expectation: short vowels shorter | long vowels longer!)

- JPN exaggerate the duration difference of both
  /i:/ and /ɪ/ as well as /u:/ and /ʊ/

Exaggerated duration difference by JPN speakers confirmed for **both /i:/** and **/ɪ/** as well as **/u:/** and **/ʊ/!**

Predicted values of duration

Discussion | Outlook

Comparison with previous findings

- **Confirmation | Substantiation**

  o JPN: mergers of spectrally close vowels (lab settings: Ueyama 2003; Tsukada 2001)

- **Unique findings | Conflicts**

  o ENS: merger of /uː/ and /ʊ/ in spon. speech

  o JPN: exaggerated durational contrasts between spectrally similar vowels in nat. settings (lab settings: Tsukada 2009)

> 1. Apply same method to German learners and learners of other languages (e.g. German)
> 2. Determine what factors differentiate ENS and L2 speakers re. vowel production
> (potential MA theses!)

Limitations

- Quality of recordings is really poor! (minute-long recordings recorded on cell phones)!

- Difficult to control semantic | phonological environments (which is important) (see Visceglia et al. 2009)

Significance

- Bad quality could | can be compensated using advanced methods (Kernel Density Estimation)

- Insights into vowel production by JPN learners in **spontaneous speech** (underexplored) → natural setting allows to **generalise findings to real-life learner speech**

- **Automated** corpus-based investigation on larger samples

Potential Applications

Prototype (proof-of-concept)

- Extend study to L1 German learners of English (or learners of other languages)

Significance

- **First large-scale, corpus-based studies of ESL vowel production in natural speech!**

- Follow-up: perception → do differences in vowel production correspond to difficulties in intelligibility?

Possible Applications

- Creation of targeted classroom materials to improve L1-like vowel production among learners

- Convert analysis into a mobile app for MELLT (Mobile-Enhanced Language Learning and Teaching)

- BMBF | Volkswagen | ERC grant proposal on *Improving Language Production among Language Learners via Direct Digital Feedback* (Collaboration with the Phonetics group in the ISFAS at Uni Kiel)
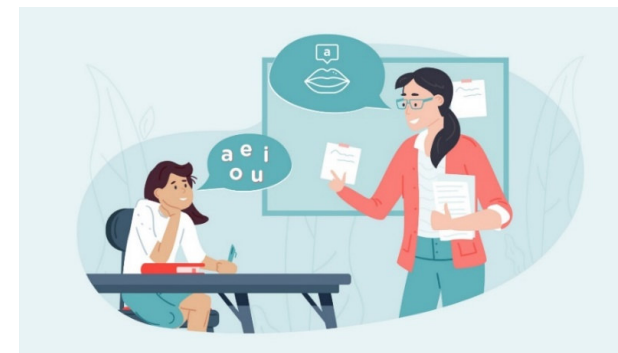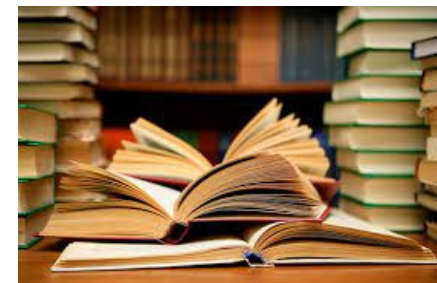
Thank you really very much!

Martin Schweinberger

https://martinschweinberger.github.io/JapEVowelsCAU

References

Flege, J. E. (1995). Second-language speech learning: theory, findings, and problems. In W. Strange (ed.), *Speech perception and linguistic experience: Issues in cross-linguistic research*, 233-277. York Press.

Franklin, A. D., & Stoel-Gammon, C. (2014). Using multiple measures to document change in English vowels produced by Japanese, Korean, and Spanish speakers: The case for goodness and intelligibility. *American Journal of Speech-Language Pathology* 23(4): 625-640.

Grenon, I., Kubota, M., & Sheppard, C. (2019). The creation of a new vowel category by adult learners after adaptive phonetic training. *Journal of Phonetics* 72: 17-34.

Homma, Y. (1992). *Acoustic phonetics in English & Japanese*. Yamaguchi Shoten.

Ingram, J. C. L., & Park, S. G. (1997). Cross-language vowel perception and production by Japanese and Korean learners of English. *Journal of Phonetics* 25(3): 343-370.

Johnson, D. E. (2015). Quantifying Overlap with Bhattacharyya's affinity and other measures! Paper presented at NWAV15 (https://danielezrajohnson.shinyapps.io/nwav_44/).

Kato, H., Tajima, K., & Akahane-Yamada, R. (2001). Native and non-native perception of phonemic length contrasts in Japanese. *The Journal of the Acoustical Society of America* 110(5): 2686.

Ladefoged, P., & Johnson, K. (2014). *A Course in Phonetics*. Cengage.

Morrison, G. S. (2002). Japanese listeners' use of duration cues in the identification of English high front vowels. In J. Larson. & M. Paster (eds.), *Proceedings of the 28th annual meeting of the Berkeley Linguistics Society*, 189–200. Berkeley Linguistics Society.

References
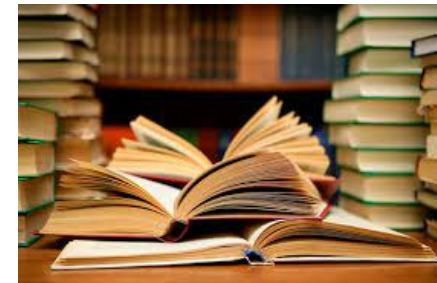
Satoi, H., Yoshimura, M., & Yabuuchi, S. (2005). The relationship between English speech rhythm and vowel reduction in production: Comparison between Japanese EFL learners and native English speakers. *Language Education & Technology* 42: 59-72.

Tsukada, K. (2001). Native vs non-native production of English vowels in spontaneous speech: An acoustic phonetic study. In P. Dalsgaard, B. Lindberg & H. Benner (eds.), *Proceedings of the 7th European Conference on Speech Communication and Technology (Eurospeech 2001)*, 305-308.

Tsukada, K. (2009). Durational characteristics of English vowels produced by Japanese and Thai second language (L2) learners. *Australian Journal of Linguistics* 29(2): 287-299.

Ueyama, M. (2003). Duration and quality in the production of the vowel length contrast in L2 English and L2 Japanese. In M. J. Solé., D. Recasens., & J. Romero. (eds.), *15th International Congress of Phonetic Sciences*, 1509-1512. Universitat Autònoma de Barcelona.

Visceglia, T., Chiu-Yu., T., Kondo, M., Meng, H., & Sagisaka, Y. (2009). Phonetic aspects of content design in AESOP (Asian English Speech cOrpus Project). *Oriental COCOSDA International Conference on Speech Database and Assessments*, 60-65.

Yamaguchi, T., & Chiew. P. S. (2020). Is there conflation? An acoustic analysis of vowels in Japanese English. *Asian Englishes* 22(1): 35-51.

Data & Software

Data

Ishikawa, S. (2014). Design of the ICNALE Spoken: A new database for multi-modal contrastive interlanguage analysis. *Learner Corpus Studies in Asia and the World* 2: 63-76.

Software

R Core Team (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. (https://www.R-project.org)

RStudio Team (2022). *RStudio: Integrated Development Environment for R*. RStudio, PBC: Boston, MA (http://www.rstudio.com)

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software* 67(1), 1-48.

Lüdecke D. (2021). *sjPlot: Data Visualization for Statistics in Social Science*. R package. Version 2.8.10 (https://CRAN.R-project.org/package=sjPlot).

Schiel, F. (1999). Automatic Phonetic Transcription of Non-Prompted Speech, *Proceedings of the ICPhS 1999. San Francisco, August 1999*, 607-610.

Wickham et al., (2019). Welcome to the tidyverse. *Journal of Open Source Software* 4(43): 1686.

Acknowledgements

Analysing Learner Speech and Resulting Applications for EFL Classrooms

A corpus-based contrastive analysis of vowel production of L1 English speakers and L1 Japanese learners of English

AcqVA Aurora Lab

Martin Schweinberger

LADA

https://martinschweinberger.github.io/JapEVowelsCAU