



Effects of L1 transfer and L2 experience on perception of Korean vowels

University of Toronto

Na-Young Ryu

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Outline

Models of L2 Speech Sound Acquisition

Goal

Research Questions & Hypotheses

Experiment 1: Acoustic Analysis of L1 vowels

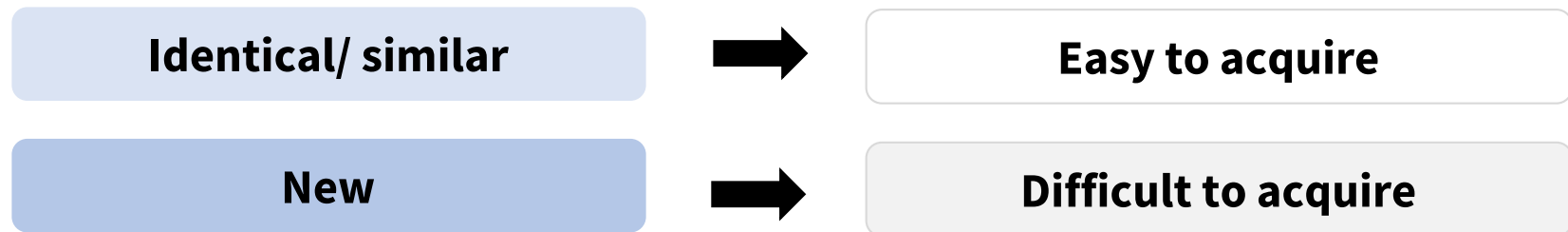
Experiment 2: Identification Task of Korean vowels

Implications for Teaching and Future Plan

Contrastive Analysis Hypothesis (CAH)

- The degree of difference between the two languages also correlated with the degree of difficulty (Lado 1957).
- Identical phonemes in both L1 and L2 are believed to not pose problems, whereas new phonemes, which do not exist in L1, would cause errors

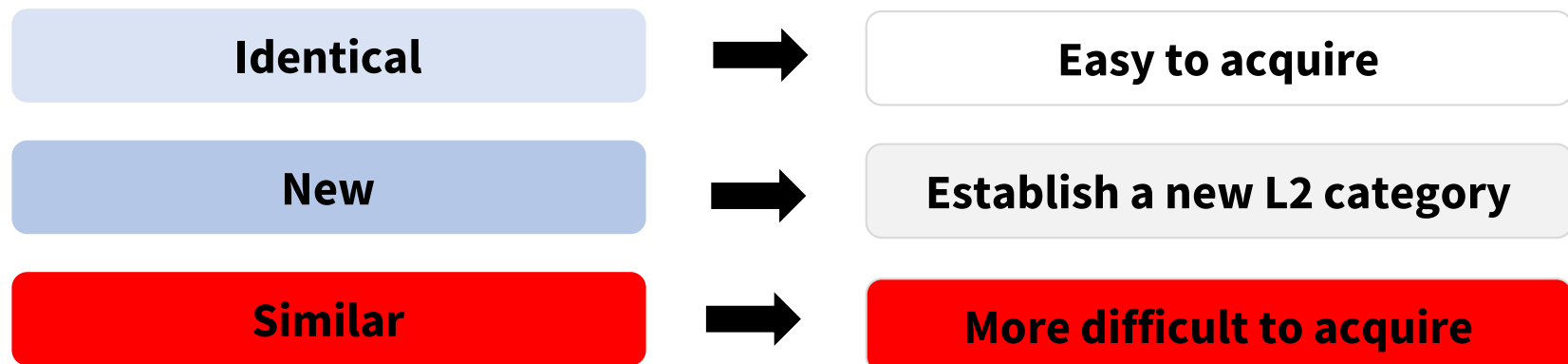
Predictions of acquisition difficulty



Speech Learning Model (SLM)

- L2 categories are perceived according to cross-language similarity between L1 and L2 sounds
- Learners' perceptual difficulties can be predicted by whether the relevant sound in their target language is **“identical”**, **“new”** or **“similar”** to their L1 phonetic categories.

Predictions of acquisition difficulty



Perceptual Assimilation Model (PAM)

- Listeners assimilate L2 sounds to their native sound categories based on a comparison between L1 and L2 sounds.

Predictions of acquisition difficulty

Two-Category assimilation



Easy to acquire

Single-Category assimilation



Difficult to acquire

Goals

- **To investigate how adult Mandarin and English learners of Korean perceive Korean vowels / ɪ, ʌ, o, u/.**

e.g., Native Korean [중국], [오전], [어머니] > L2 learners [종국], [어/우전], [오머니]

(1) Effects of L1 vowel inventory size

- Having a smaller L1 vowel inventory than L2 impedes L2 vowel perception, while having a larger one often facilitates it. (Scholes 1968; Bradlow 1995; Fox et al 1995; Iverson and Evans 2007, 2009)

(2) Effects of cross-language acoustic similarity

L1/L2 acoustic relationship affects L2 sound perception. (Vasiliev 2013; Elvin et al 2014; Escudero et al 2014).

(3) Effect of L2 experience

The experienced L2 learners produce and perceive non-native sounds more accurately than do the relatively inexperienced L2 learners. (Flege 1997; Derwing et al 2008)

Research question & Hypothesis 1

- **The effect of L1 vowel inventory size on L2 vowel perception**

| Standard Mandarin (LIN 2007) | Standard Korean (Sohn 1999) | Canadian English (Boberg 2010) |
|-------------------------------------|------------------------------------|---|
| 5 vowels /i, y, ɤ, u, a/ | 7 vowels /a, e, i, o, u, ɨ, ʌ/ | 10 vowels /i, ɪ, æ, e, ε, a, ʌ, ʊ, o, u/ |

Research question 1

Do L2 learners, who have different vowel inventory size, perform differently on non-native vowel perception?

Hypothesis 1

English listeners with a large vowel inventory system are expected to have higher identification accuracy for all Korean vowels than Mandarin listeners with a small vowel inventory system.

Research question & Hypothesis 2

- **The effect of L1/L2 acoustic similarity and difference on L2 vowel perception.**

Research question 2

Does L1-L2 acoustic relationship influence non-native sound perception?

Hypothesis 2

Acoustic similarity between L1 and L2 vowels can accurately predict Mandarin and English listeners' Korean perceptual difficulty.

Research question & Hypothesis 3

- **The effect of L2 experience on L2 vowel perception**

Research question 3

To what extent does a learner's L2 experience affect L2 vowel perception?

Hypothesis 3

The higher the proficiency/experience English and Mandarin L2 learners have in Korean, the more likely they are to attain a Korean native-like performance in their perception.

Experiment 1:

A comparative acoustic study of Korean, English and Mandarin vowels

Experiment 2:

Perception of Korean vowels by Mandarin and English listeners

Experiment 1: Acoustic study of L1 vowels

Participants

- **68 female speakers** of Mandarin, English and Korean
 - 37 female native Mandarin speakers (mean age = 21.1 years old)
 - 23 female native English speakers (mean age = 20.95 years old)
 - 8 female native Korean speakers (mean age = 23.46 years old)

Stimuli

- Mandarin: five vowels in the /hVdə/ context (Liao 2008)
- Korean: seven vowels in the /hVda/ context (Yang 1996)
- English: eleven vowels in the /hVd/ context (Hillenbrand et al 2001)

Experiment 1

Procedure

- Read words containing target vowels presented in their native language on a computer screen using PsychoPy (Pierce 2007).
- Each set of words appeared three times in isolation.

Acoustic measurements

- F1 and F2 values in Praat (Boersma and Weenink 2011)
- 1,341 tokens were acoustically analyzed (English tokens: 723, Mandarin tokens: 472, Korean tokens: 146)

Experiment 1

Linear discriminant analysis (Klecka 1980)

- To make L2 perceptual difficulty predictions, LDA has been used. (Strang et al 2004, 2005; Gilichinskaya and Strange 2010)
- A cross-language discriminant analysis was used to quantify the relationships between Korean-Mandarin, Korean-English vowels.
- *KlaR* package in R
- Input parameters: F1, F2 bark values

Vowel space of Korean, English and Mandarin vowels

- Korean [u] and [o] overlap substantially (Chae 1999, Seong 2004, Kim et al 2006, Han and Kang 2013, Y. Kang 2015)

Standard Korean

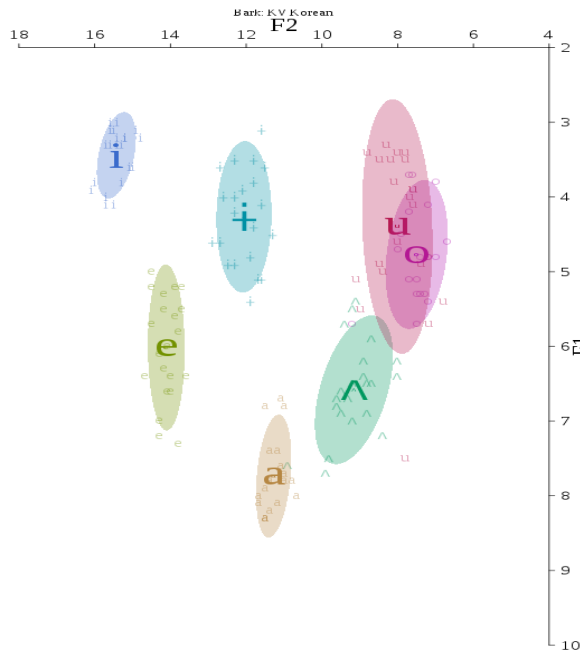


Figure 1. Average F1 and F2 values of Korean, English and Mandarin vowels

Acoustic comparison of Korean and Mandarin vowels

- Korean /i/ and /a/ are acoustically most similar to Mandarin /i/ and /a/ respectively.
- Korean both /o/ and /u/ are acoustically very close to Mandarin /u/, which would lead to perceptual difficulty for Mandarin learners of Korean.

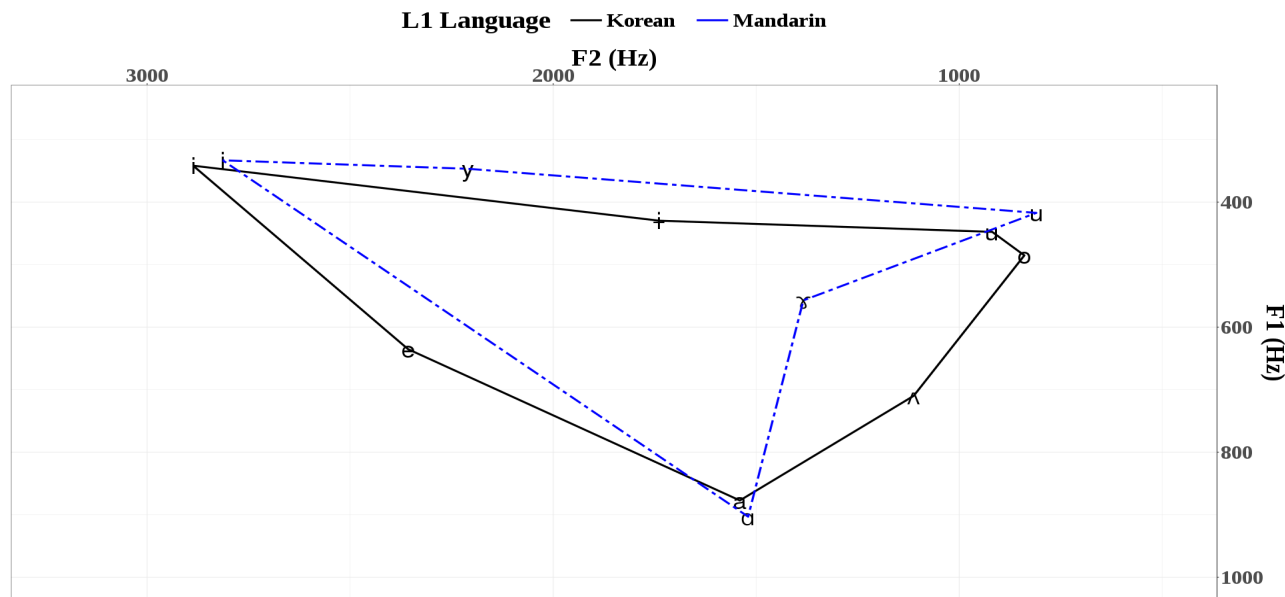


Figure 2. Average F1 and F2 values of Mandarin (blue) and Korean vowels (black) of adult speakers

Korean vowel tokens classified across Mandarin vowels using cross-language LDA

Prediction of perceptual difficulty ranking for Mandarin learners of Korean
 : [i, a, e] >> [ɨ, ʌ], [o, u] (most difficulty)

<Table 1> LDA를 이용한 중국어 모음에 대응되는 한국어 모음 분류

| vowel | a | ɤ | i | u | y |
|-------|-----|-----|------|-----|-----|
| 아 | 70% | 3% | 0 | 0 | 0 |
| 에 | 4 | 0 | 0 | 0 | 74% |
| 이 | 0 | 0 | 100% | 0 | 0 |
| 이 | 0 | 47% | 0 | 0 | 26% |
| 우 | 0 | 3% | 0 | 48% | 0 |
| 우 | 0 | 7% | 0 | 45% | 0 |
| 어 | 26% | 40% | 0 | 7% | 0 |

Acoustic comparison of Korean and English vowels

- Korean /i/ is acoustically close to English /i/.
- Korean /u/ is higher in F1 values and lower in F2 values than English /u/, while Korean /o/ is lower both in F1 and F2 values than English /o/, which could lead to confusion and discrimination difficulty.

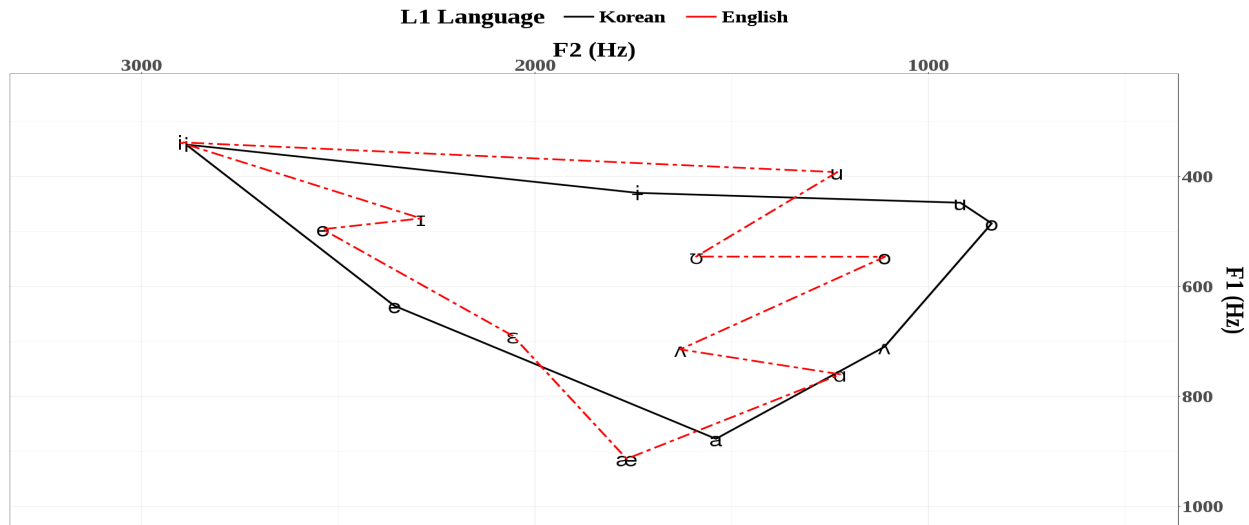


Figure 3. Average F1 and F2 values of **Canadian English (red)** and Korean vowels (black)

Korean vowel tokens classified across English vowels using cross-language LDA

Prediction of perceptual difficulty ranking for English learners of Korean:
 [i, a, e, ɪ] >> [ʌ, o, u] (most difficult)

Table 2. LDA를 이용한 영어 모음에 대응되는 한국어 모음 분류

| vowel | æ | ɑ | e | ɛ | i | ɪ | o | u | ʊ | ʌ |
|-------|------|-----|------|------|------|-----|-----|-----|------|------|
| 아 | 100% | 15% | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100% |
| 에 | 0 | 0 | 100% | 100% | 0 | 67% | 0 | 0 | 0 | 0 |
| 이 | 0 | 0 | 0 | 0 | 100% | 0 | 0 | 0 | 0 | 0 |
| 이 | 0 | 0 | 0 | 0 | 0 | 33% | 0 | 8% | 100% | 0 |
| 어 | 0 | 0 | 0 | 0 | 0 | 0 | 51% | 17% | 0 | 0 |
| 우 | 0 | 8% | 0 | 0 | 0 | 0 | 31% | 75% | 0 | 0 |
| 어 | 0 | 77% | 0 | 0 | 0 | 0 | 17% | 0 | 0 | 0 |

**Experiment 2:
Perception of Korean vowels by
Mandarin and English listeners**

Method

Participants

- A total of 82 female subjects, 40 Mandarin and 29 English learners of Korean and 13 native speakers of Korean participated.
- Divided into two groups based on their length of years in Korean language programs at the University of Toronto.

| | # of participants | Self-assessment Korean proficiency |
|---|-----------------------------|------------------------------------|
| Less experienced group (EAS110, EAS210) | English: 19 Mandarin: 20 | English (3.33) Mandarin (3.09) |
| More experienced group (EAS310, EAS410) | English: 10 Mandarin: 20 | English (3.57) Mandarin (4.08) |
| Native Korean | 13 | NA |

Method

Stimuli

- **92 monosyllabic Korean words**, including the target four vowels /i, o, u, ʌ/

Audio recording

- Recorded by a native male Korean speaker (46 years old) at the Phonetics lab of the Linguistic department.

Method

- **Procedure**

- Participants were asked to listen to a Korean stimulus and identify it by pressing the corresponding number 1, 2, 3, or 4 on the keyboard.
- All stimuli were presented randomly to each participant using PsychoPy.



Statistical analysis

- A mixed-effects logistic model in R (Baayen 2008; R CoreTeam 2012)
 - The package *lme4* (Bates et al 2011)
 - Dependent variable: Response (correct:1, incorrect:0)
 - Fixed effects: L1 language, L2 experience and their interaction
 - Random effect: Speakers, items

Effects of L1 vowel inventory on L2 vowel perception

- English listeners show higher identification accuracy for Korean vowels than Mandarin listeners.

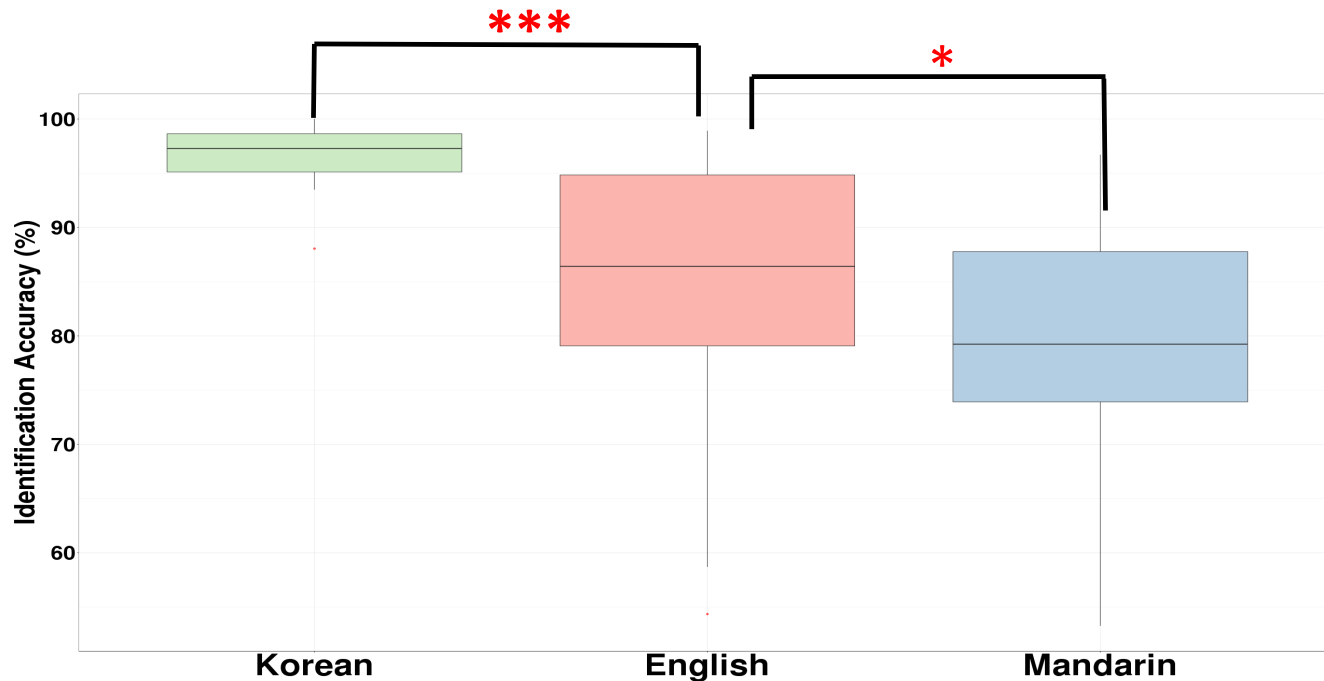


Figure 4. Identification accuracy of Korean vowels by L1 language

Identification accuracy of Korean vowels

- The perceptual difficulty of L2 listeners from least to most difficult: **i > ʌ > u > o**

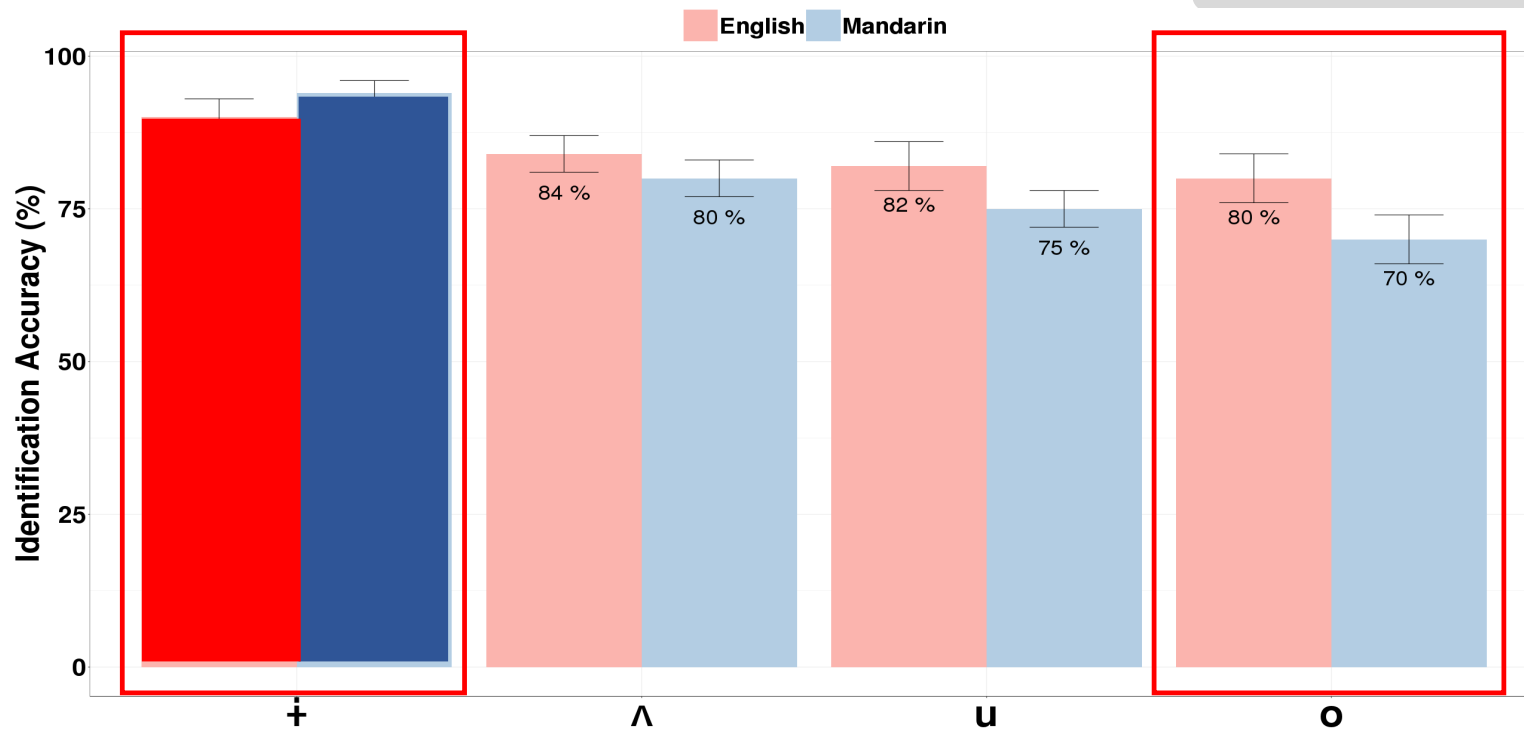


Figure 5. Identification accuracy of Korean vowels by English and Mandarin listeners

L1 Mandarin learners' perception accuracy of Korean vowels

Korean listeners were extremely good at identifying vowels **except for Korean /u/**, suggesting that Korean /o/ and /u/ are a merge in progress.

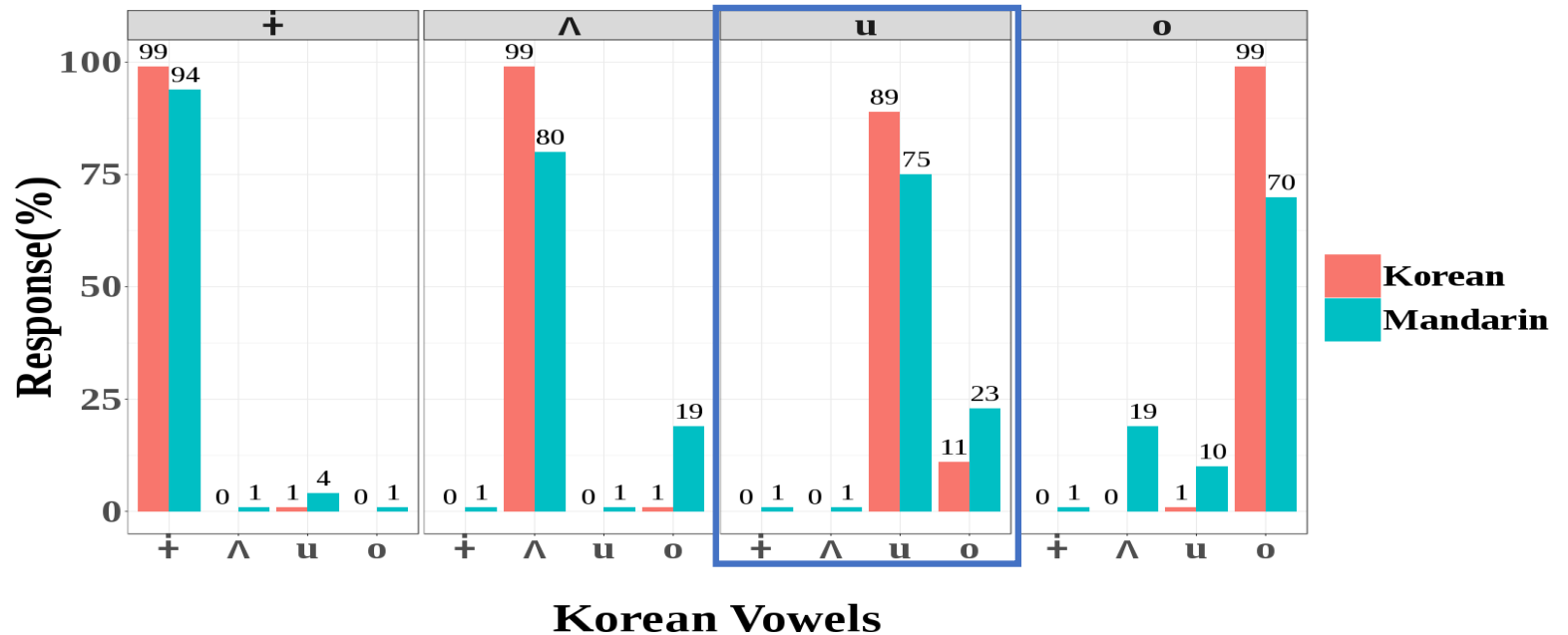


Figure 7. Distribution of response patterns of the Korean vowels by Mandarin and Korean listeners

L1 English learners' perception accuracy of Korean vowels

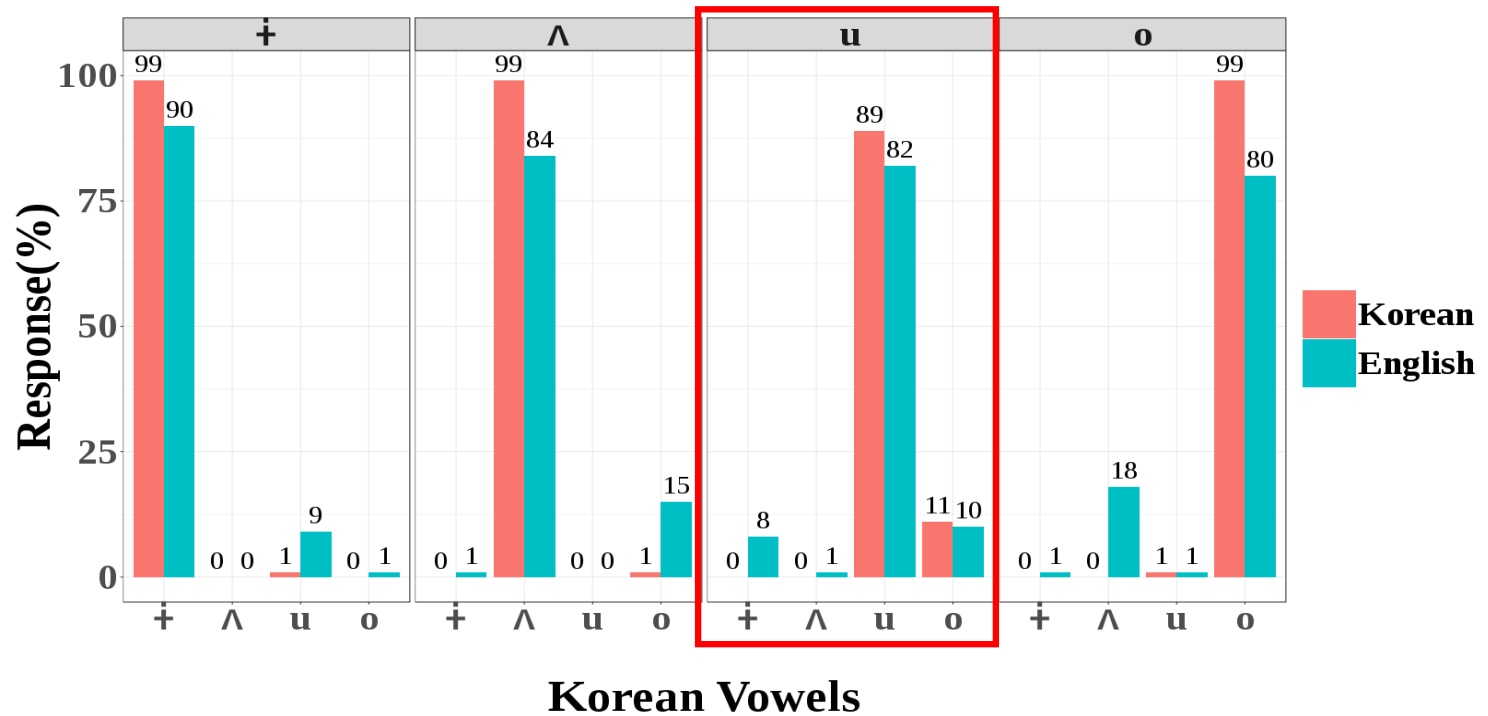


Figure 7. Distribution of response patterns of the Korean vowels by English and Korean listeners

Effects of L2 experience on L2 vowel perception

- Identification accuracy rises as L2 experience increases (P-value <0.018)

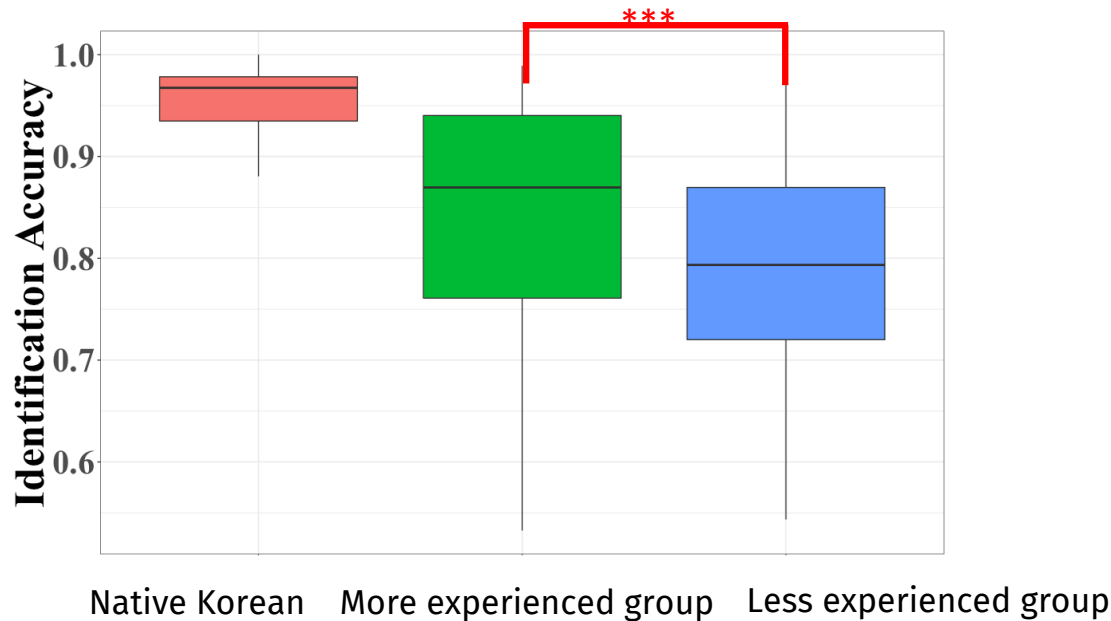


Figure 8. Identification accuracy of Korean vowels by L2 proficiency levels

Response patterns of Korean vowels by L2 experience

- Identification accuracy for all vowels rise as L2 experience rises (5%-7%).

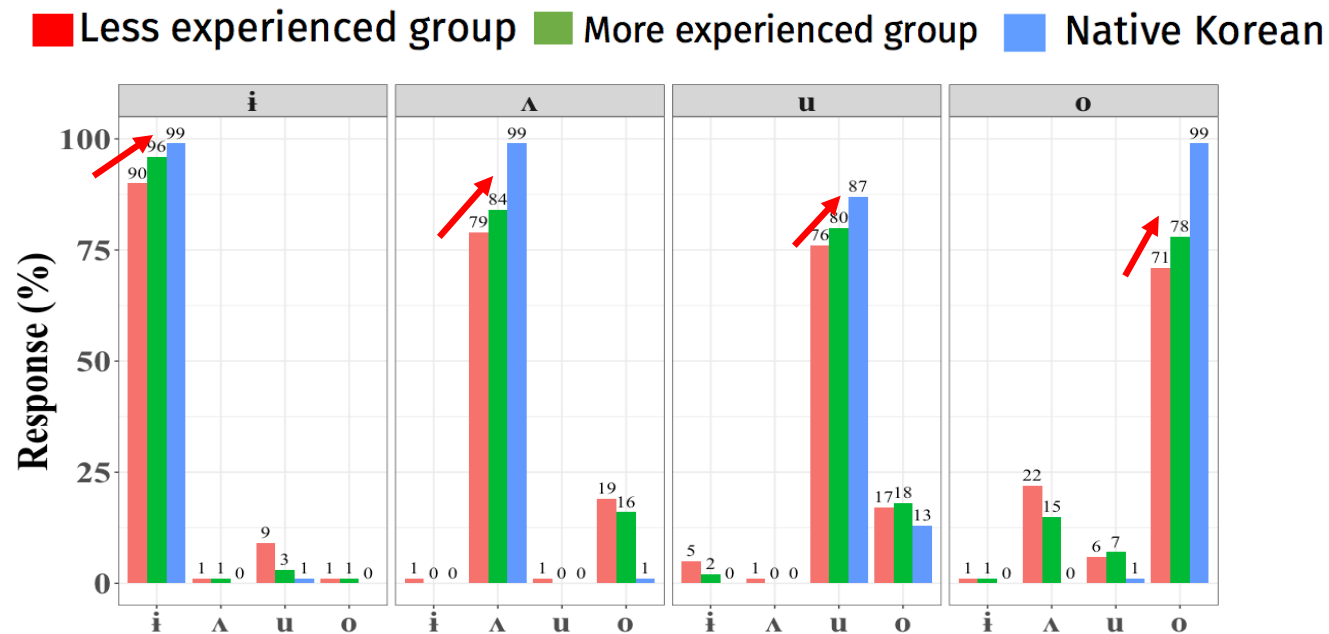


Figure 9. Distribution of response patterns of the Korean vowels by L2 experience

Effects of interaction between L1 background and L2 experience

- There is no interaction between L1 language and L2 experience, suggesting that identification accuracy of L2 vowels is higher as L2 proficiency increases regardless of their L1 background (P-value <0.14).

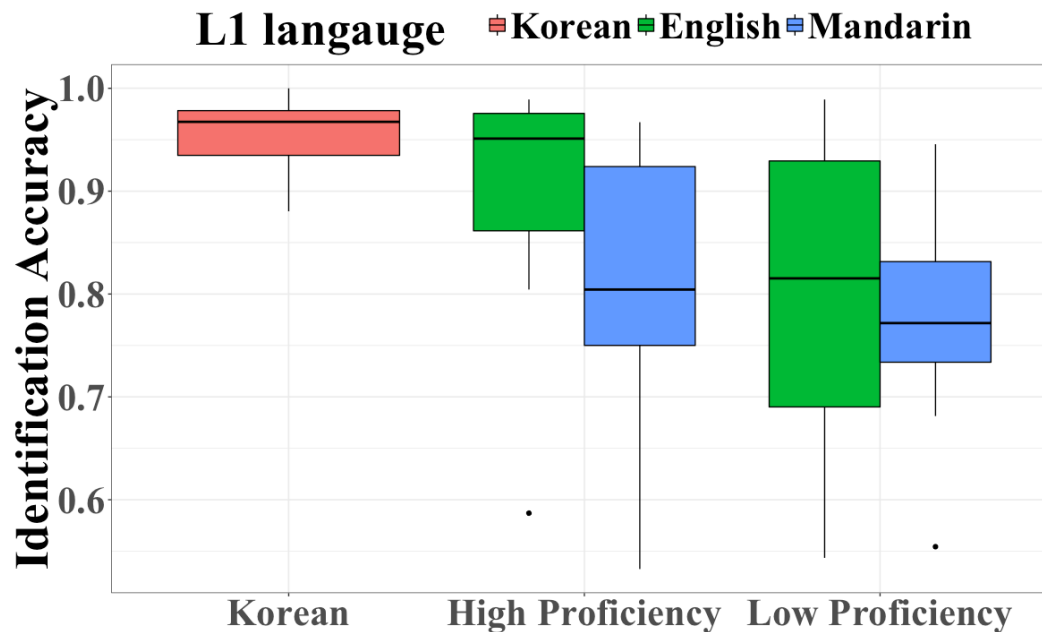


Figure 10. Identification accuracy of Korean vowels in the interaction of L1 background and L2 experience

Conclusions

| Effects | Predictions | Results | Confirmed |
|------------------------------------|---|---|----------------------------|
| L1 vowel inventory size | English listeners >> Mandarin listeners | English listeners >> Mandarin listeners Similar vowels [o, u, ʌ]: ✓ English listeners >> Mandarin listeners New vowel [ɨ]: ✓ Mandarin listeners >> English learners | Partially confirmed |
| Cross-language acoustic similarity | Perceptual difficulty using LDA: Mandarin listeners: [ɨ, ʌ], [o, u] English listeners: [o, u] | Both Mandarin and English listeners: ✓ ɨ > ʌ > u > o | Partially confirmed |
| L2 experience | L2 more experienced listeners had better identification accuracy than lower experienced listeners | More experienced listeners >> Less experienced listeners | Confirmed |

Teaching implications and future plan

- Focus on more difficult Korean vowels to perceive/produce.
- Perception training of Korean vowels is needed.
 - Perception training leads to enhancement in L2 learners' perception and production of L2 sounds.

Perception training

Improvement
in **L2 Perception**

(Iverson & Evans 2009,
Herd et al 2013)

Improvement
in **L2 Production**
(Bradlow et al 1997)

Japanese learners of English /r/-/l/

No improvement
in **L2 Production**
(Aliaga-Garcia & Mora 2009)

Catalan and Spanish learners of English vowels

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