The role of perceived L2 category in cross-language perception & implications for loanword adaptation

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Mechanism of loanword adaptation

• **Phonological operation** (Paradis and LaCharite, 1997)

• **Perceptual operation** (Silverman 1992, Peperkamp & Dupoux 2003, Boersma and Hamann 1998)

• **Perceptually informed phonological operation** (Steriade 2001, Kenstowicz 2001, Yun 2016)
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  - Input: output of L2 phonology
  - Non-contrastive, gradient phonetic details of L2 are not relevant.
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• Perceptual operation (Silverman 1992, Peperkamp & Dupoux 2003, Boersma and Hamann 2009)
  – Input: unstructured acoustic signal of L2
  – Phonological structure of L2 is not relevant
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  - Perceptually relevant phonetic details of L2 matter.
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Duality of adaptation

• Adaptation is sensitive to non-contrastive phonetic details of L2 but also L2 phonological structures are adapted more regularly than predicted by L1-driven perception alone.

Boersma & Hamann (2009)

Fig. 1. A single model for L1 processing as well as loanword adaptation.
Goals

• Examine how similar L2L1 mapping is to L1 perception and if L2L1 mapping is modulated by L2 perception.

• Compare the mappings across the tasks (L1, L2, L2L1) by controlling for acoustic differences between L1 and L2, a departure from previous L2L1 mapping studies that used natural L2 stimuli.
Hypotheses

• Hypothesis 1: If listeners map foreign sounds directly onto L1 categories based on the relevant acoustic dimensions, results for the cross-language mapping task should be identical to the L1 mapping.

• Hypothesis 2: If listeners perceive foreign sounds in terms of L2 categories, results for the cross-language mapping task should diverge from the L1 mapping in the case of L1-L2 category mismatch.
English stops in Korean

English
Voiceless /p/
Voiced /b/

Korean
Aspirated /pʰ/
Lenis /p/
Fortis /p’/

\( p^h \text{en} \) ‘pen’
\( p\text{in} \) ‘beer’
\( p^'\text{o}l \) ‘ball’
## Experiments

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*Order of **L1** and **L2** varied across participants*
Stimuli

• Nonce-word stimuli (‘paru’) produced by male native speakers of each language
• Manipulated to create a controlled acoustic space, identical for L1 and L2
  – VOT (0-120ms): 8 steps
  – f0 at V onset (83-120 Hz): 5 steps
  – two base vowels
  – two repetitions
  – 4 tokens per “cell” per task
Participants

• 87 Seoul-Kyeongki Korean listeners
  – 22 recruited in Toronto (Year of Birth: 1987~95)
  – 65 recruited in Incheon (Year of Birth: 1933~96)
• 8 English controls with no knowledge of Korean
Response Coding

- Responses are coded into binary choice, mirroring the correspondences in loanwords.

<table>
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<th>Korean</th>
<th>Coding</th>
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<td>Voiceless (p)</td>
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<tr>
<td>Voiced (b)</td>
<td>Lenis (p)/Fortis (p’)</td>
<td>Non-aspirated</td>
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Response Coding

• We then calculated the rate of “aspirated” choice (ASP.RATE) for each cell of the f0-by-VOT acoustic space for each task for each listener.
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All listeners combined
Individual variation

![Heatmap showing individual variation with L1, L2L1, and L2 categories for Listener A and Listener B. The x-axis represents VOT.normed ranging from -1 to 1, and the y-axis represents F0.normed ranging from -1 to 1. The color gradient indicates ASP.RATE from 0.00 to 1.00.](image)
Comparing across experiments

- For each cell for each listener, the difference in response rate across experiments were calculated and averaged. (0: identical, 1: opposite)
Individual variation

![Heatmap showing individual variation with VOT and F0 values.]

- L1
- L2L1
- L2

Listener A

Listener B

VOT.normed

F0.normed

ASP.RATE
Comparing across experiments

Difference between cross-language perception and L2 perception

Difference between cross-language perception and L1 perception

More L1-like

More L2-like

Seoul

Toronto
Summary

• For those listeners with asymmetries, responses in the cross-language mapping experiment were more similar to the L2 than the L1 experiment.
  • Paired t-test confirms $|L2L1-L1| > |L2L1-L2|$
    
    \[ t = 2.1509, \text{df} = 86, p = 0.03429. \]

• However, most listeners show very little difference across any of the experiments.
  • L2 perception (and L2L1 perception) is heavily influenced by L1 perception?
English control
L2 perception proficiency as predictor

• For each listener, we also calculated the difference between ASP.RATE in the L2 experiment and the average ASP.RATE of the English control listeners. / Control-L2 /
L2 perception proficiency as predictor

• We examined how well listeners’ L2 perception proficiency predicts the degree of relative influence of L2 perception vs. L1 perception on L2L1 mapping ($|L2L1-L1| - |L2L1-L2|$)
L2 perception proficiency as predictor

Relative similarity of L2L1 to L2 vs. L1

\[ \frac{|L2L1 - L1|}{|L2 - L1|} \]

More L2-like

More L1-like

Proficiency

city
- Seoul
- Toronto

(p=0.0295)
Conclusion

• Our experiments controlled L1 and L2 stimuli for their acoustic properties to provide a stronger test of (in)congruence across mapping tasks.

• For most listeners, there is very little difference across the three perception tasks.
  – L1 perception heavily influences L2 and L2L1 perception.
Conclusion

• For those listeners for whom L1 and L2 perception diverges enough (high L2 proficiency), we can observe the L2 influence on L2L1 perception independent of L1 influence.

• This result is in line with recent studies that show that cross-language perception patterns can differ by the listeners’ level of L2 exposure (Kwon in press, Nomura & Ishikawa 2016)
Conclusion

• The current study presents a potential perceptual solution to the duality problem.
  – The phonological structure of L2 can play a role even when the mechanism of loanword adaptation is perceptual.
Acknowledgements

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