

Abstract

The current study examines the relationship between phonology and orthography, and their interaction in lexical access of a word presented auditorily. Korean phonemic contrasts in syllable initial position are transparently represented in both phonology and orthography. However, contrasts in coda position undergo syllable final neutralization in the phonology. This neutralization is not reflected in the orthography. The current study investigates perceptual responses by Korean listeners to repetitive speech where repeated singleton coda consonants become as onset consonants as repetition rate increases. There are 336 stimuli recorded by Americans at various rates controlled by a metronome. Two groups of twenty Koreans were asked to identify voicing of stops with two different orthographic displays: 1) English and 2) Korean. Results show 1) Syllable final stops, due to the phonological neutralization rule, were not well distinguished, and there was a bias toward /b/ over /p/. 2) Using Korean orthography increases the bias toward /b/ over /p/. The Korean coda neutralization seems to neutralize its people's perception of the voicing contrasts and its orthographic representations as well. In addition, a strategy of the one-to-one orthographic correspondence between English and Korean may bias the listeners toward /b/-like perception of coda stops.

Purpose of Study

- To examine effects of Korean coda neutralization on perception of English voicing contrasts using repetitive speech tasks (see de Jong 2001a & 2001b)
- To also investigate how Korean orthographic representations affect the perception of the voicing contrasts

Introduction

- Korean coda neutralization:** all underlying laryngeal distinctions merge into homorganic lax stops in coda

Three-way stops in onset position
Lex: $\text{pul} \rightarrow [\text{p}]\text{'fire}'$
Aspirated: $\text{pul} \rightarrow [\text{p}^h]\text{'fire}'$
Aspirated: $\text{pul} \rightarrow [\text{p}^h]\text{'ul}'$ 'grass'
Tense: $\text{pul} \rightarrow [\text{p}^t]\text{'ul}'$ 'horn'

Hangul (Korean orthography)

- Alphabetic combination: consonant + vowel
- Transparent mapping between characters and sounds
- Characters arranged into syllabic units
e.g. 한국 [hankuk] 'Korea' vs. 학교 [hakkyo] 'school'

Letter	ㅃ	ㅅ	ㅈ	ㅊ	ㅌ	ㅍ	ㅍ	ㅍ	ㅍ	ㅍ	vs.	ㅃ	ㅅ	ㅈ	ㅊ	ㅌ	ㅍ	ㅍ	ㅍ	ㅍ	ㅍ
Sound	[p]	[s]	[t]	[tʃ]	[l]	[p]	[pʰ]	[pʰ]	[pʰ]	[pʰ]		[p]	[s]	[t]	[tʃ]	[l]	[p]	[pʰ]	[pʰ]	[pʰ]	[pʰ]
	C	V	C	V	C	V	C	V	C	V		C	V	C	V	C	V	C	V	C	V

(C: consonant; V: vowel)

Hangul representation for voicing contrasts

One-to-one orthographic substitution between English and Korean

English Korean

p → ㅃ
b → ㅍ

A problem

The one-to-one substitution between English and Korean only applies in onset position while voicing contrasts in coda position of 'pop' and 'pob' can be indistinguishable in Korean orthographic representations.

English	Korean orthography
pop	ㅍㅍ
pob	ㅍㅍ
bob	ㅍㅍ

Effects of neutralization on orthography

	Onset	Coda
/p/	ㅃ	ㅍ
/b/	ㅍ	ㅍ

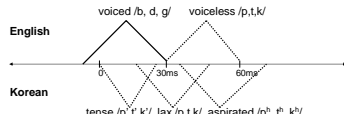
The coda neutralization in Korean seems to affect the way its orthography represented voicing contrasts of English loanwords.

P05. Effects of Coda Neutralization and Orthography on Perception of Voicing Contrasts in English: A case study of Korean learners of English

Byung-jin Lim, Kyoko Nagao, and Kenneth de Jong (Department of Linguistics, Indiana University)

Contact email: {bylim; knagao; kdejong}@indiana.edu

Phonetic category of voicing contrasts on VOT continuum (cf. Zampini & Green 2001)



A rate-induced resyllabification in repetitive speech

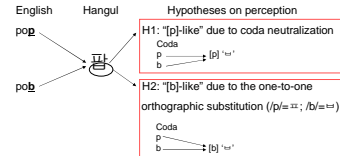
Stetson (1951): Repeated VC structure (such as 'eeb') at fast rates is perceived as CV (such as 'bee').

Experiment

Hypotheses

- H1: Coda neutralization-driven perception:** Korean learners of English will perceive English voiceless/voiced obstruents in coda position as voiceless only due to the coda neutralization phenomenon in Korean. Also, they will choose the neutralized orthographic form 'ㅍ' in 'ㅍ' as voiceless.
- H2: Orthography-driven perception:** due to the one-to-one orthographic substitution strategy between English and Korean (i.e., /p/ → ㅃ, /b/ → ㅍ), Hangul coda 'ㅍ' in 'ㅍ' will be perceived as voiced.

Q: Is 'ㅍ' in 'ㅍ' perceived as [b] or [p]?



Subjects

- 20 Korean listeners with Korean display (**Kor_display**)
 - 20 Korean listeners with English display (**Engl_display**)
 - 18 English listeners with English display as controls (**Engl**)
- (All experiments with Korean subjects were done in Seoul, Korea)

Stimuli

- Four native speakers of American English repetitively produced syllables at increasing rates (from 450ms/syll to 200ms/syll) controlled with a metronome (de Jong 2001a & b).
- Each stimulus included three repetitions of one of the four monosyllables, 'pea', 'bee', 'eep', and 'eeb'.

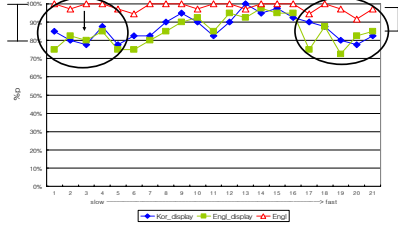


Procedure

- Forced identification tests
- Four possible choices labeled with a) **English display** ('pea', 'bee', 'eep', 'eeb') and b) **Korean display** ('ㅍ', 'ㅍ', 'ㅍ', 'ㅍ')

Results

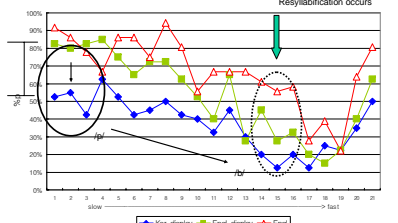
1) Perception of voicing in 'pea'



Kor_display: Korean listeners with Korean display
Engl_display: Korean listeners with English display
Engl: English listeners as controls

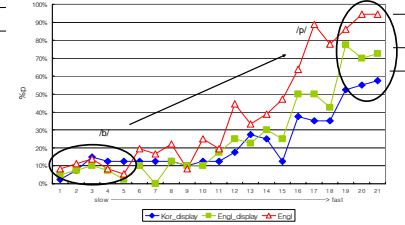
- Native vs. Non-native:** A less complete identification of voicing in 'pea' by Korean learners than native speakers of English b) A tendency = substituting /p/ in English seems to require longer VOT value due to different phonetic categorization on the VOT continuum.
- No orthography effect on perception of /p/ within Koreans

3) Perception of voicing in 'eep'



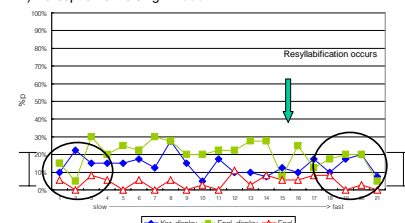
- All listeners' general perceptual tendency: /p/ in 'eep' tends to be perceived as /b/ as speech rate increases.
- Korean display vs. English display:** At slower rates, Koreans with Korean display show about 50% /p/ perception of the time → this may lead that the Korean display causes neutralization of voicing perception in speech.
- As marked in an arrow, resyllabification (i.e., CV from VC due to rate change) may provide an environment where listeners identify voicing of stops in onset.
- Koreans with English display show more /b/-like responses than English listeners → the different phonetic categorization of voicing
- Koreans with Korean display show more /b/-like responses than Koreans with English display → the =to-b substitution seems to bias toward /b/ perception with Korean display.

2) Perception of voicing in 'bee'



- /b/ in 'bee' tends to be perceived as /p/ as speech rate increases by all listeners.
- English listeners vs. Koreans with English display vs. Koreans with Korean display:** At faster rates, likelihood differs three-way depending on display.
- Koreans with Korean display indicate more /b/-like identification than English listeners and Koreans with English display → Possibly due to a tendency with 'ㅍ' substituting /b/ the orthographic form 'ㅍ' may bias the listeners toward /b/-like perception, Perception of voicing in 'eep'

4) Perception of voicing in 'eeb'



- Relatively consistent perception of voicing in 'eeb' unlike 'eep' → English listeners use different perceptual cues to voicing contrasts depending on position; syllable-initially by the presence or absence of aspiration, syllable-finally by the duration of preceding vowels not by the presence of voicing (Lisker & Abramson 1964, 1970; Ladefoged 1993).
- Native vs. Non-native:** A less complete identification of voicing in 'eeb' by Koreans than English listeners
- Relatively longer vowel durations before voiced stops than before voiceless stops (de Jong 2001a & b) may help the Korean listeners identify /b/ as it is.

Acknowledgements

This work was supported by NSF & NIH grants. We would like to thank Kyoko Okamura and Sean McLennan for valuable comments.

Summary

- The different phonetic categorization of voicing contrasts on the VOT continuum requires longer VOT values for Korean listeners to perceive stops as voiceless.
- The coda neutralization phenomenon in Korean, when used with Korean display, seems to neutralize the perception of English voicing contrasts in coda position.
- However, unlike an expectation from Korean phonology, the coda neutralization does not necessarily seem to bias toward /p/ perception.
- Given that Korean listeners show more /b/-like perception, H2 was supported (H2: The one-to-one orthographic correspondence between English and Korean ('ㅍ' → ㅍ; 'ㅍ' → ㅍ) biases toward the /b/-like perception of 'ㅍ' in coda position).

Discussion

Speech rates and perceptual patterns

- Pattern 1: **Native (=English) vs. Non-native (=Korean)**
- Pattern 2: **English vs. Korean-EO vs. Korean-KO**
- Pattern 3: **EO vs. KO**
- Pattern 4: **No differences**

Slow	Fast	Stimulus
N vs. NN	N vs. NN	pea
No diff.	Engl vs. Kor-EO vs. Kor-KO	bee
EO vs. KO	Engl vs. Kor-EO vs. Kor-KO	eep
N vs. NN	N vs. NN	eeb

(N=Native; NN=Non-native; Eng=English listeners; Kor-EO=Korean with English display; Kor-KO=Koreans with Korean display)

Effects of prosodic structure on perception of voicing

- Perception of voicing contrasts seems to be dependent on prosodic structures, but not the other way around; that is, the listeners tend to perceive onsets as voiceless (/p/) and codas as voiced (/b/).
- However, the degree of rate effect varies even within the same prosodic structure in terms of perceptual shift in voicing contrasts; for example, the voicing ID of 'pea' is as consistent as /p/ all across the board while the ID of 'bee' is shifted to [p] from [b] as rate increases.

Relationship between phonology and orthography in Hangul

Even though Hangul can represent three-way laryngeal contrasts in coda, the phonology of neutralization in coda position seems to neutralize its people's perception of the contrasts and its orthographic representations as well.

L1 orthography for L2 contrasts

- As shown in a uniform L1 orthographic representation 'ㅍ' for L2 voicing contrasts in coda ('bop' vs. 'pop'), the English voicing contrasts seem to be perceptually and orthographically neutralized partly due to the L1 coda neutralization phenomenon.
- In addition, the one-to-one orthographic correspondence between L1 and L2 ('ㅍ' for /p/; 'ㅍ' for /b/) may bias the listeners toward more /b/-like perception when Korean orthography was used along with more frequent 'ㅍ' in Korean Hangul.

References

- de Jong, K. J. (2001a). Effects of syllable affixation and consonant voicing on temporal adjustment in a repetitive speech production task. *Journal of Speech, Language, and Hearing Research* 44 (4), 826-840.
- de Jong, K. J. (2001b). Rate-induced resyllabification revisited. *Language and Speech* 44 (2), 197-216.
- Lisker, L., & Abramson, A.S. (1964). A cross-language study of voicing in initial stops: Acoustical measurements. *Word* 20, 384-422.
- Lisker, L., & Abramson, A.S. (1970). The voicing dimension: Some experiments in comparative phonetics. *Proceedings of the 6th International Congress of Phonetic Sciences*. Prague: Academia Publishing House of Czechoslovak Academy of Science.
- Ladefoged, P. (1993). *A course in phonetics*. New York: Harcourt, Brace, Jovanovich.
- Stetson, R. H. (1951). *Motor Phonetics*. Amsterdam: North-Holland
- Zampini, M. L., & Green, K. P. (2001). The voicing contrast in English and Spanish: The relationship between perception and production. In Nicol, J. L. (Ed.) *One Mind, Two Languages: Bilingual Language Processing* (pp. 23-48). Blackwell Publishers Inc.: Massachusetts.