Cross-linguistic Acquisition of Vowels: English, Korean, Greek, and Cantonese

Hyunju Chung, Jan Edwards, and Gary Weismer

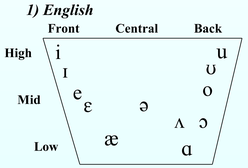
Dept. of Communicative Disorders, University of Wisconsin-Madison

INTRODUCTION

- Children generally produce most of the vowels of their native language correctly by age 2, based on transcription analysis.
- However, a few studies (e.g., Davis & MacNeilage, 1990) suggest that the picture is considerably more complicated.
- There is little cross-linguistic research on the related question of how children master the language-specific characteristics of vowels in their native language.
- This study examines cross-linguistic variation in vowel space across four languages: Cantonese, English, Greek, and Korean for children and adults.

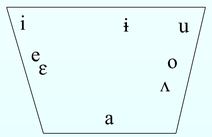
VOWEL SYSTEM OF EACH LANGUAGE

1) English



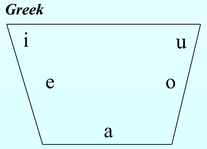
12 vowel system

2) Korean



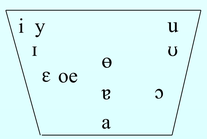
- 10 vowel system
- 7 monophthongs (/e/ & /ɛ/ merged)

3) Greek



5 vowel system

4) Cantonese



- 11 vowel system: (/ɪ, ʊ, ɵ/ allophones of (/i, u, oe/)
- 8 contrastive monophthongs

HYPOTHESES

1. There will be cross-linguistic differences in the location of the shared vowels in the overall vowel space (e.g. Bradlow, 1993; Rvachew et al., 2006).
2. These cross-linguistic differences will increase with age.

PARTICIPANTS

	English	Korean	Greek	Cantonese	TOTAL
2-year-olds	10	10	10	10	40
5-year-olds	10	10	10	10	40
Adults	10	10	10	10	40
TOTAL	30	30	30	30	120

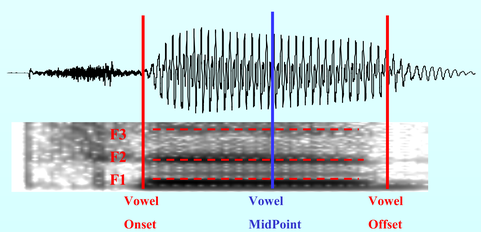
METHODS

1. **Stimuli**: Familiar words beginning with CV sequences (an obstruent and one of the vowels /i, a, u/, the three common vowels across the four languages).
2. **Procedure**: Word repetition task
   - Children and adults saw pictures and heard digitized productions of familiar real words.
   - Participants were asked to repeat what they heard and their responses were recorded.
3. **Analysis:** Transcription
   - A native speaker transcribed the initial consonant and vowel as correct or incorrect.
   - Subsequent analyses used only vowels judged as correct.

ACCURACY RATE

Age Group	Vowels / Language	/a/	/i/	/u/
2-year-olds	English	92%	88%	83%
	Korean	93.5%	85.8%	76.1%
	Greek	87%	96%	84%
	Cantonese	77%	85%	56%
5-year-olds	English	96%	99.5%	95%
	Korean	99.7%	97%	94%
	Greek	95%	100%	99%
	Cantonese	98%	100%	97%

ACOUSTIC ANALYSIS

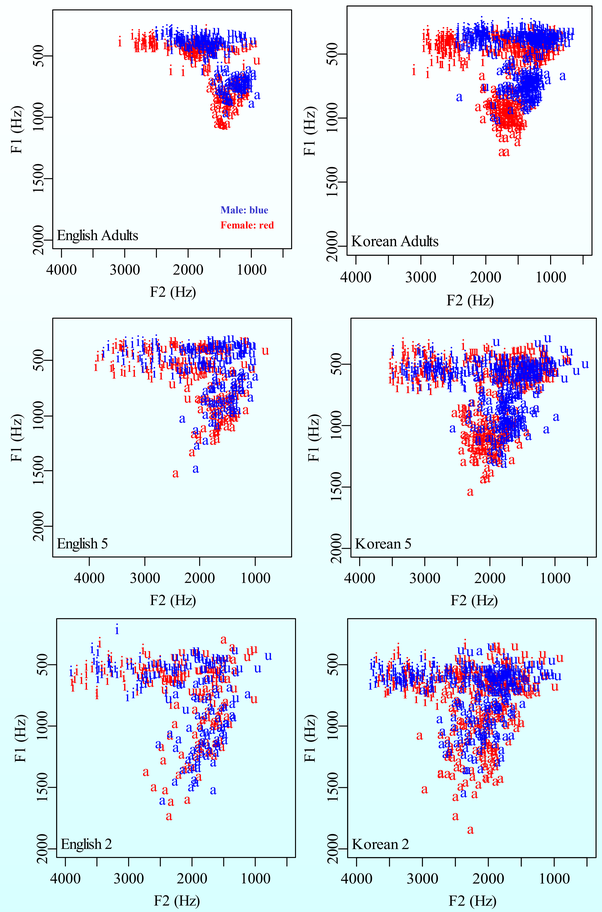


- Vowel onset was identified as the first clear vertical glottal pulse in F2
- Vowel offset was identified as the point at which F2 starts to fade out
- F1 and F2 were measured at the vowel midpoint.
  - This is where the influence of preceding and following consonants is minimal.
  - Hand correction was used in case of formant mistrackings.

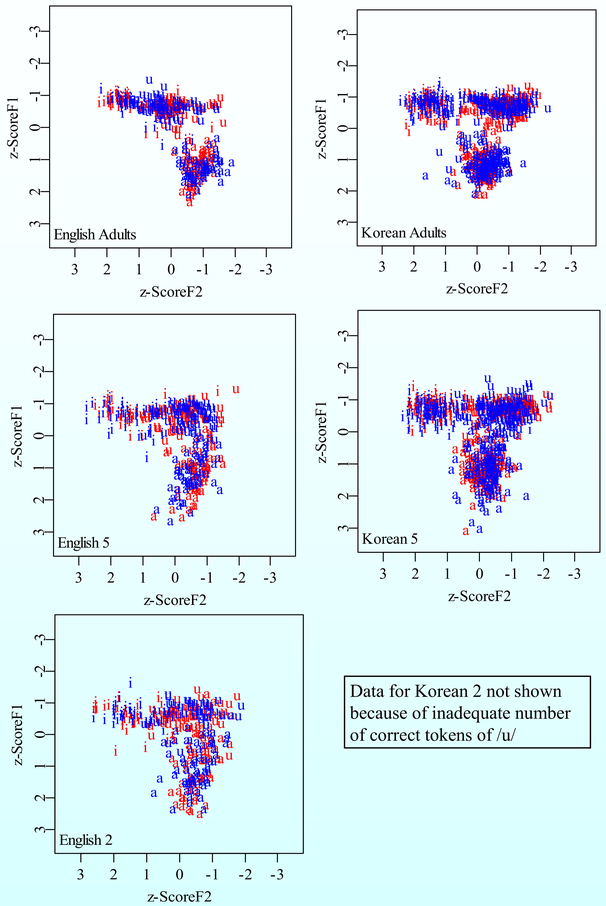
NORMALIZATION

- Vowel productions of children have higher formant frequency values than those of adults, primarily because of their smaller vocal tracts.
- Similarly, women's vowels have higher formant frequency values than men's.
- Therefore, we cannot directly compare formant frequency values across groups that differ in age or sex.
- We chose two existing normalization procedures, Lobanov's (1971) z-score transformation and Nearey's (1978) single logmean transformation, to remove differences in F1-F3 due to vocal tract size.
- After normalization, we should be able to compare formant frequency values across different groups.

1. Raw Data



2. Normalized Data



Data for Korean 2 not shown because of inadequate number of correct tokens of /u/

RESULTS

1. Raw Data

- Cross-linguistic differences in adults are observed
- Children's productions also show cross-linguistic differences, even those of 2-year-olds'.
- Children's productions are more variable but it is unclear whether this is related to articulatory variability or to smaller vocal tracts and higher formant.

2. Normalized data

- Results for both normalization procedures were similar.
- Differences related to age and gender are not seen in the normalized data.
- Cross-linguistic differences in adults and children are still observed.
- Greater variability in children's productions is still observed, possibly suggesting more variable articulatory gestures of children relative to adults.

DISCUSSION

1. Theoretical Perspectives

- The importance of fine phonetic detail in the ambient language to the development of speech perception and production.

2. Applied Perspectives

- Relevant for foreign accent reduction.
- Supports the importance of early onset of second language acquisition.

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