A phonetic study of Korean glides: Filling the gap between textbook and reality

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Introduction

Motivation: Inconsistent transcriptions of Korean glides (i.e., 왜, 왈, 웨) due to the diachronic sound change of some vowels (i.e., 애, 에)

Table 1. Korean vowel system with different claims.

<table>
<thead>
<tr>
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<th>Front</th>
<th>Back</th>
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<tbody>
<tr>
<td>High</td>
<td>이 /i/</td>
<td>음 /i/</td>
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<td></td>
<td>니 (/y/, /i/®)</td>
<td>우 /u/</td>
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<tr>
<td>Mid</td>
<td>에 /e/</td>
<td>어 /a/</td>
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<tr>
<td></td>
<td>와 (/a/, /we/)</td>
<td>오 /o/</td>
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<tr>
<td>Back</td>
<td>애 (ε)</td>
<td>아 /a/</td>
</tr>
</tbody>
</table>
Introduction

Four different claims of Korean vowels:

2. 9-vowel system: /i, e, ə, a, u, o, i, ə/: 의 is glide /iy/ (Kim, C.-W, 1968)
3. 8-vowel system: /i, e, ə, a, u, o, i/: 의 & 외 are glides /iy/ & /we/ (Kang, 1998; Lee, 1993; Sohn, 1987)
4. 7-vowel system: /i, e, ə, a, u, o, i/: 애 → 에, 의 & 외 are glides /iy/ & /we/ (Kang, 2014)
Introduction

- Phonetic transcriptions of Korean glides in textbooks

<table>
<thead>
<tr>
<th></th>
<th>KLEAR</th>
<th>연세 한국어</th>
<th>서울대 한국어</th>
<th>이화 한국어</th>
<th>서강 한국어</th>
<th>한국말 하시네요</th>
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<tbody>
<tr>
<td>왜 [we]</td>
<td>왜 [we]</td>
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<td>웨 [we]</td>
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- Little phonetic work of Korean glides: Kang, 2014; Kim & Lotto, 2004 (No comparison of 외 and 왜)
Introduction

- Another issue with a glide ‘예’ [je] (Lee & Ramsey, 2000)
  - Comparisons of 예 with an initial consonant (e.g., 계, 폐, 혜)
  - with an initial vowel (예)
  - ‘에’ with an initial consonant (e.g., 계, 폐, 혜)
Introduction: Theoretical backgrounds

- **Clear speech effects** (Johnson, Flemming, & Wright, 1993; Lindblom, 1990)
  - Hyper-Hypo (H&H) theory (Lindblom, 1990)
    - Speakers tend to exaggerate phonetic signals in clear speaking style to maximize the intelligibility of the distinctiveness of phonological categories → broader phonetic space

- **Word position effects** (Beckman 1998, Smith 2002)
  - Word-initial segments resist phonological contrast neutralization due to the importance of these positions in lexical access and retrieval
Introduction

- **Main question:**  
  (i) 왜 vs. 와, (ii) vowels of 계 (폐, 테, 혜) vs. 계 vs. 예 vs. 예  
  - Clear speech vs. Casual speech  
  - Word-initial position vs. Word-medial position  
  - Older age group vs. Younger age group

- **Hypotheses:**  
  Fig.1. Schematic spectrogram showing F1 (first frequency) and F2 (second frequency)
Methodology

➢ **Participants**

: Two groups of 20 adults from Seoul and the Kyunggi area (Sohn, 2001)

(i) **Older group**: 5 female + 5 males (44-71 years old)

(ii) **Younger group**: 5 female + 5 males (21-34 years old)

➢ **Speech stimuli** (32 sentences)

<table>
<thead>
<tr>
<th>Word-initial</th>
<th>예</th>
<th>음</th>
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<tr>
<td>왜소하네요</td>
<td>왜로워요</td>
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<tr>
<td>독지네요</td>
<td>되는지요</td>
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<td>괴심하네요</td>
<td>괴물이네요</td>
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<td>체골이네요</td>
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<td>참이네요</td>
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<td>안데서 그래요</td>
<td>가야띱요</td>
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<td>팔때네요</td>
<td>기괴하네요</td>
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<td>인쇄하네요</td>
<td>노식하네요</td>
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<td>계산기네요</td>
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<td>페비네요</td>
<td>페비네요</td>
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<td>해끈이네요</td>
<td>해끈이네요</td>
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<td>곡예사네요</td>
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<td>시계네요</td>
<td>시계네요</td>
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<tr>
<td>민폐네요</td>
<td>민폐네요</td>
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<tr>
<td>지혜네요</td>
<td>지혜네요</td>
<td></td>
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Methodology

- Korean orthography in a paper (randomized for each reading)
- Read in casual speech and clear speech (repeated two times)
- Recorded directly into a laptop, using Praat and saved as wave files in a laptop.
- Overall, 2,560 tokens obtained (32 words * 2 speaking styles * 2 repetitions * 20 participants)

Measurements (4 points)

Fig. 2. Sample display of 예 produced by a female in the older group with four measurement points marked by circles. (F1 & F2 at onset syllable and vowel midpoint)
Results: 왜 vs. 외

Fig. 3. Mean values of F1 and F2 at the timing of the test syllable onset and vowel midpoint of “왜” and “외” by speaking style and age.
Results: 쌍 vs. 외 at the onset of the syllable

- ANOVA: the dependent measure: F2 and (F1)
  - factors: speaking style (clear and casual), vowel type (“쌍” and “외”), word position type (word-initial and word-medial), age group (younger and older), with the first three factors treated as repeated measures

- Results: Significant main effects were found for speaking style [F (1, 1264) = 29.4, p < 0.001] and age group [F (1, 1264) = 9.3, p = 0.002], F2: casual > clear, older > younger, with no main effect for word position and vowel type.

  Significant interactions for speaking style & word position were found [F (1, 1264) = 6.7, p = 0.01], suggesting that F2 values at the onset of test syllables differed by the word position type in different speaking styles. Speakers produced the two sounds of “쌍” and “외” differently in a word-medial position via different speaking styles more often than in a word-initial position. We can assume that speakers do not exert themselves to make the initial transition needed for glides in the word-medial position in casual speech, while they tried to make a strong initial transition for glides even in a word-medial position when they produce in clear speech.

- No significant main effect for vowel type and no interactions between vowel type and age in F1 and F2 at the onset of the syllable
Results: 왜 vs. 왔 at the vowel midpoint

- ANOVA: the dependent measure: F1 and F2
  - factors: speaking style (clear and casual), vowel type ("왜" and "왜"), word position type (word-initial and word-medial), age group (younger and older), with the first three factors treated as repeated measures

- Results: F1: Significant main effects were found: speaking style [F (1, 1264) = 19.6, p < 0.001], word position [F (1, 1264) = 14.3, p < 0.001], and age [F (1, 1264) = 10.5, p = 0.001] (clear > casual, word-medial > word-initial, older > younger), with no effect for vowel type (왜 = 왔). Two-way interactions for vowel & word position, and age & word position were found but no interactions for vowel type and age.

  - F2: Significant main effects for speaking style [F (1, 1264) = 57.1, p < 0.001] and age [F (1, 1264) = 34.2, p < 0.001], with no effect for vowel type and word position (clear > casual, older > younger). No interactions for vowel and age.

- No significant main effect for vowel type and no interactions between vowel type and age in F1 and F2 at the vowel midpoint of the syllable
Results: 예, 씨예, 에, vs. 씨에

Fig. 4. Mean values of F1 and F2 at the time of the test syllable onset and vowel midpoint of the vowel-initial "예" and "에" and the consonant-initial "씨예" and "씨에" by speaking style.
Results: 咸, (Property), 咸, vs. (Property) at the onset of the syllable

- ANOVA: - the dependent measure: F1 and F2
  - factors: speaking style (clear and casual), vowel type (한, 한, 쌍, 쌍), word position type (word-initial and word-medial), initial type (vowel initial and consonant initial)

- Results: - F1: Significant main effect for initial type for F1 [F (1, 1264) = 11.2, p = 0.001], significant interactions of initial type & vowel type [F (1, 1264) = 65.8.0, p < 0.001], three-way interaction of initial type, word position, & vowel type [F (1, 1264) = 17.5, p < 0.001].

  - F2: Significant interactions of initial type & word position, [F (1, 1264) = 12.4, p < 0.001] and initial type & vowel type [F (1, 1248) = 19.7, p < 0.001]

- Significant difference between vowel-initial and consonant-initial words were found in F1 and F2 at the onset of the syllable.
Results: 예 / 에, C예 / C에 at the onset of the syllable

- ANOVA: - the dependent measure: F1 and F2
  - factors: speaking style (clear and casual), vowel type (예 / 에, C예 / C에), word position type (word-initial and word-medial)

- Results: - 예 / 에: Significant main effects were found all factors in F1 and F2.
  - C예 / C에: No significant main effects were found for vowel type in F1 and F2.

- Speakers did not show a difference between ‘C예’ and ‘C에’ even in clear speech and word-initial position at the onset of the syllable.
Results: 예/에, 졸 예/에 at the vowel midpoint

- ANOVA: the dependent measure: F1 and F2
  - factors: speaking style (clear and casual), vowel type (예/에, 졸 예/에), word position type (word-initial and word-medial)

- Results: 예/에 (F1): significant main effects were found for vowel type \([F (1, 320) = 23.0, p < 0.001, \text{“예”} > \text{“에”}]\) and significant interaction of vowel type and word position \([F (1, 320) = 9.8, p = 0.002]\) (F1: 예 > 에 in the word-medial versus the word-initial → “예” is merged into “에” in the word-medial)
  - 예/에 (F2): No significant effect for vowel type.

- 졸 예/에: No significant main effects were found for vowel type in F1 and F2.

- F1: 예 > 에 in the word-medial versus the word-initial → “예” is merged into “에” in the word-medial position at the vowel midpoint.

- However, speakers did not show a difference between 졸 예 and 졸 예 even in clear speech and word-initial position at the vowel midpoint.
Results

Fig. 5. Superimposed F1 and F2 spaces for all five sounds of 웡, 옥, 예, 씨예, 예.
Conclusion

- **H & H theory** (Lindblom, 1990): Strong clear speech effects in Korean glides
- **Interactions of speaking styles and word position**: The greater enhancement of clear speech effect in the word-medial position

- **왜/외**:  
  - No phonetic evidence was found for the difference between these two syllables in terms of F1 and F2, even in clear speech and the word-initial.  
  - No systematic difference between age group, either.  
  - It seems clear that the diachronic change of /wɛ/ to /we/ is now completed even in the Seoul area and even for older groups.
Conclusion

- 예/에: 예 after the consonant almost merged to the regular vowel, 에/e/, even in the word-initial position and clear speech, while the glide of 예 with the vowel-initial position obviously differed from 에/e/.

- Teaching implication: Teachers’ awareness of sound merge in Korean glides (외/왜) in addition to vowels (에/애)