Korean listeners' sensitivity to language-specific phonetic details of children and adults' vowel production of five languages
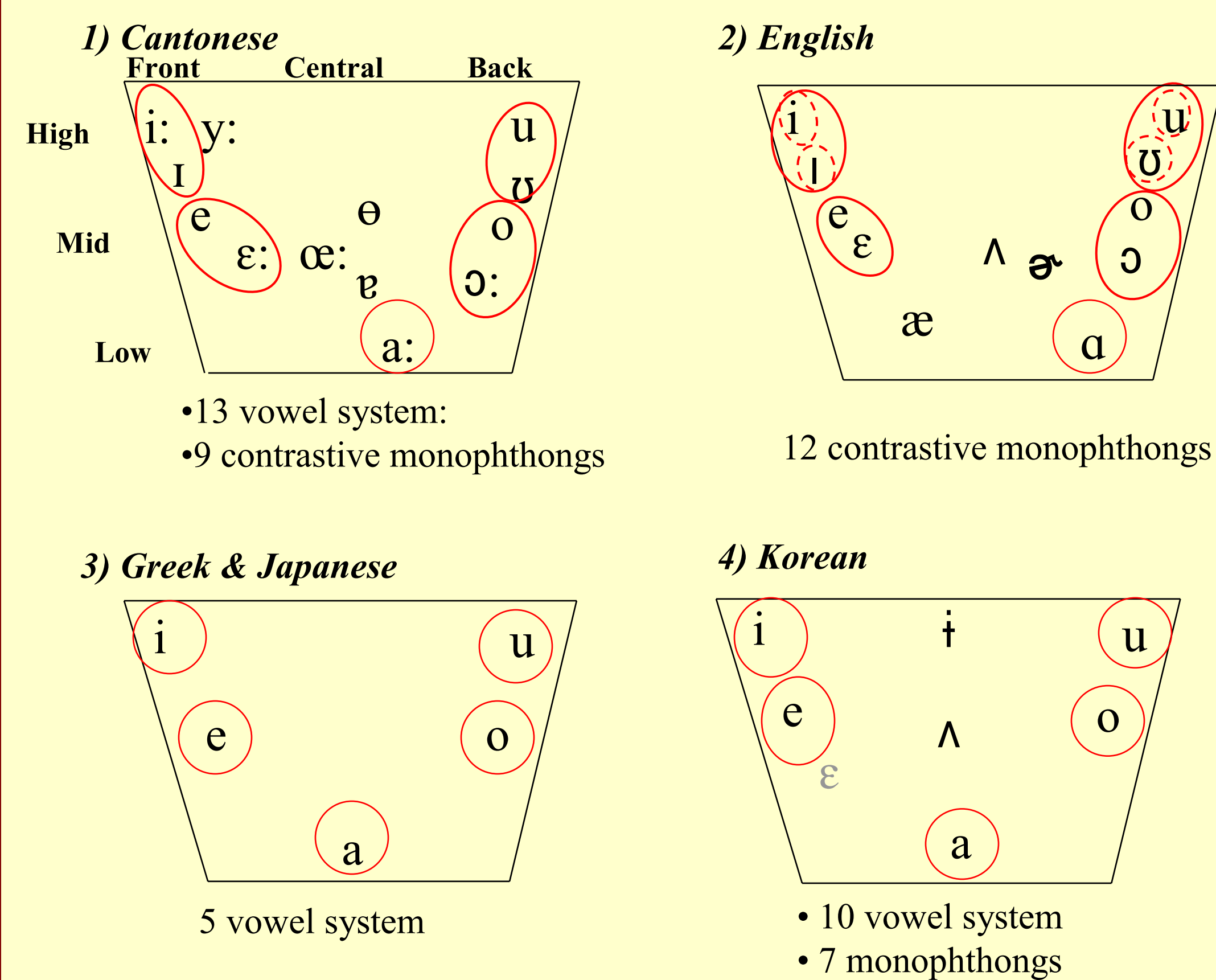
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INTRODUCTION

- There are systematic cross-linguistic differences in the acoustic realization of "shared" vowels across languages (e.g., Bradlow, 1995).
- Children as young as 2-year-olds can produce these systematic cross-linguistic differences in vowels (Chung et al, 2008). However, these language-specific phonetic details may or may not be perceptible to listeners.
- This study examines Korean listeners' perceptual sensitivity to "shared" vowels produced by native speakers of five different languages: Cantonese, English, Greek, Japanese and Korean. The study also examines how the perception of native vs. non-native vowels changes in relation to the age group of speakers.

VOWEL SYSTEM OF EACH LANGUAGE

1) Cantonese

- 13 vowel system:
- 9 contrastive monophthongs

2) English

12 contrastive monophthongs

3) Greek & Japanese

5 vowel system

4) Korean

- 10 vowel system
- 7 monophthongs

HYPOTHESES

1. Vowels with similar acoustic patterns (F1 and F2) will be categorized into the same vowel categories.
2. Goodness ratings will be different across languages:
   - vowels of the native language will be judged as "better" vowels than non-native vowels.
3. Listeners will be able to detect language-specific phonetic details even in vowel productions of young children.
4. Acoustic patterns will be an important perceptual cue, but listeners' knowledge about their native vowel category will also affect their perception.
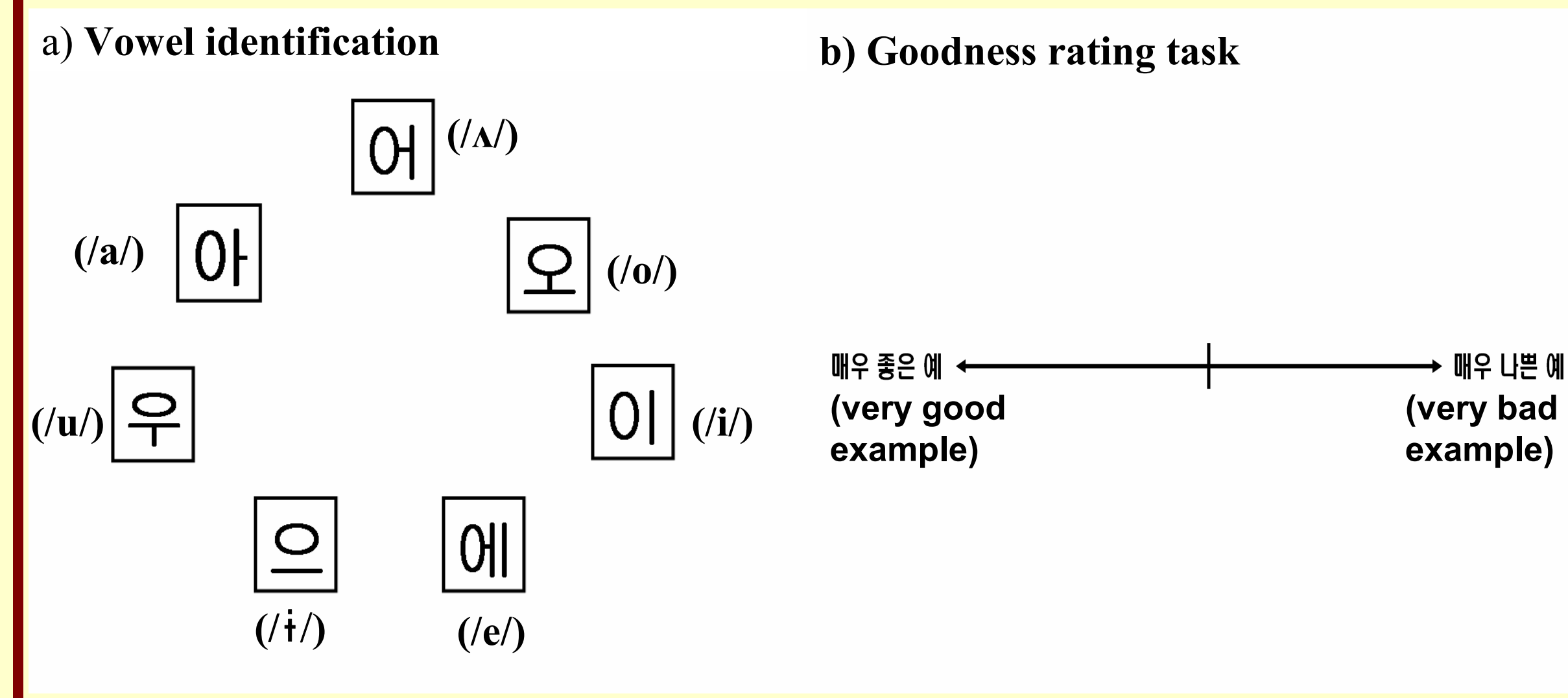
METHODS

A. Participants

1. 20 Korean adult listeners (From Seoul, ages 18 to 30).
2. All listeners have no history of speech, language, or hearing impairments and have no professional training in either linguistics or speech acoustics.

B. Stimuli

- Word-initial CV sequences were extracted from speech samples collected by conducting a word repetition task with adults, 5- and 2-year-olds..
- Vowels produced by children were transcribed by a native phonetician.
  - Only tokens that were transcribed as 'correct' were used.
- CV sequences: velar (/k/ or /g/) and alveolar (/t/, /d/, or /s/) place of articulation paired with one of the five vowels, /a/, /e/, /i/, /o/, and /u/.
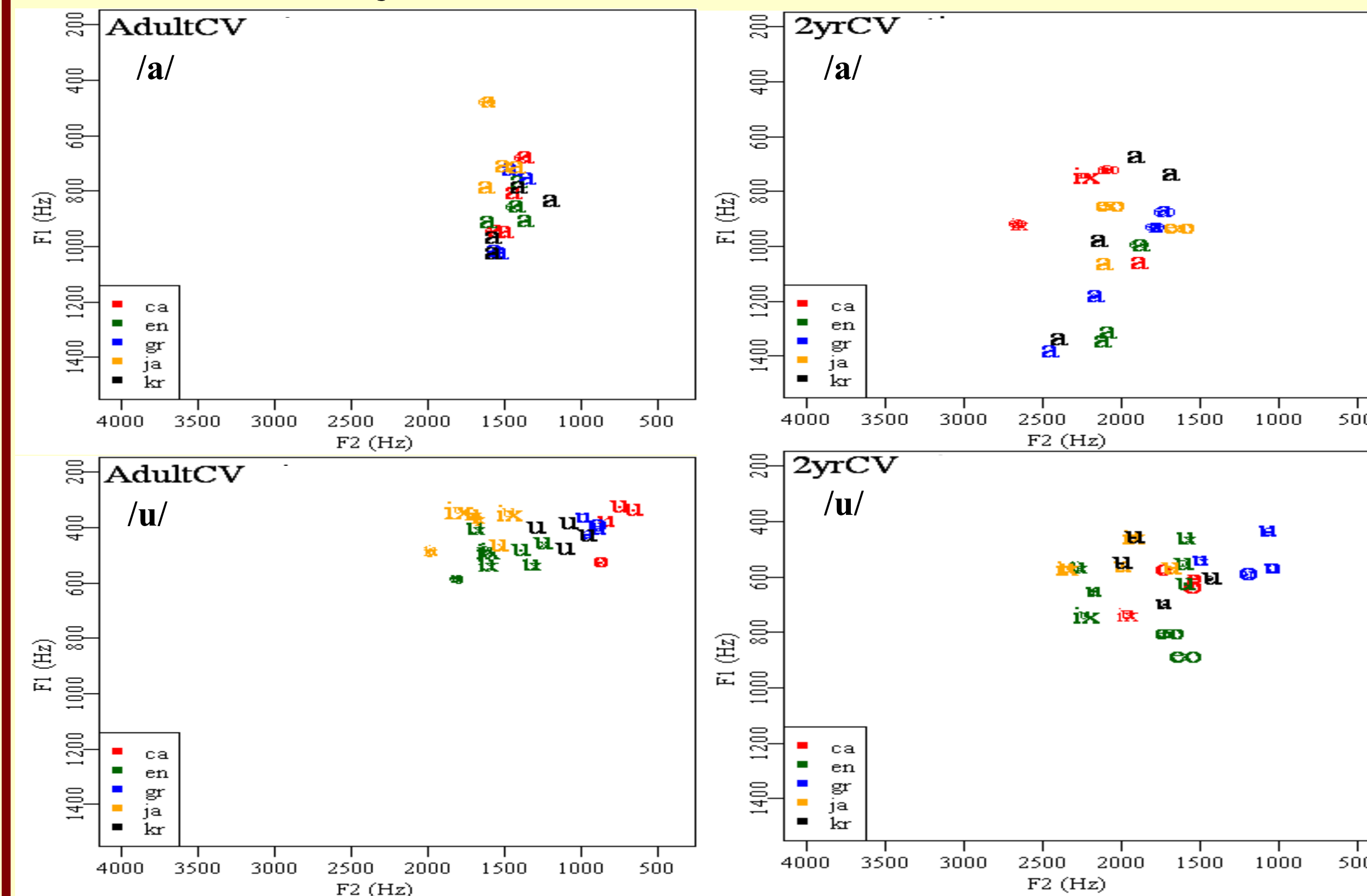
C. Procedure

1. The experiment began with one brief practice set.
2. Three age blocks: adults, 5-year-olds and 2-year-olds, were presented randomly. The vowels of five languages were randomized in each age block.
3. Listeners performed two tasks:

a) Vowel identification

(/a/) (/ʌ/) (/o/) (/u/) (/i/) (/ɨ/) (/e/)

b) Goodness rating task

매우 좋은 예 ⟵ | ⟶ 매우 나쁜 예
(very good example) — (very bad example)

RESULTS

A) Vowel Categorization

Adults' production_CV

2yrs' production_CV

i. Cross-linguistic Vowel Categorization Results

- Vowels of all five languages consistently mapped into the same vowel categories.
- Perceptual categorizations of /a/ and /i/ vowels of all languages were consistent across age groups, whereas categorization of /u/ vowels was less consistent.
- Categorization of Cantonese /o/, and Cantonese & Greek /u/ vowels show inconsistency.
- Categorization of vowels produced by 2-year-olds showed great similarity to patterns of adults' (although more variable), suggesting the presence of language-specific phonetic details in the vowel production of 2-year-olds.
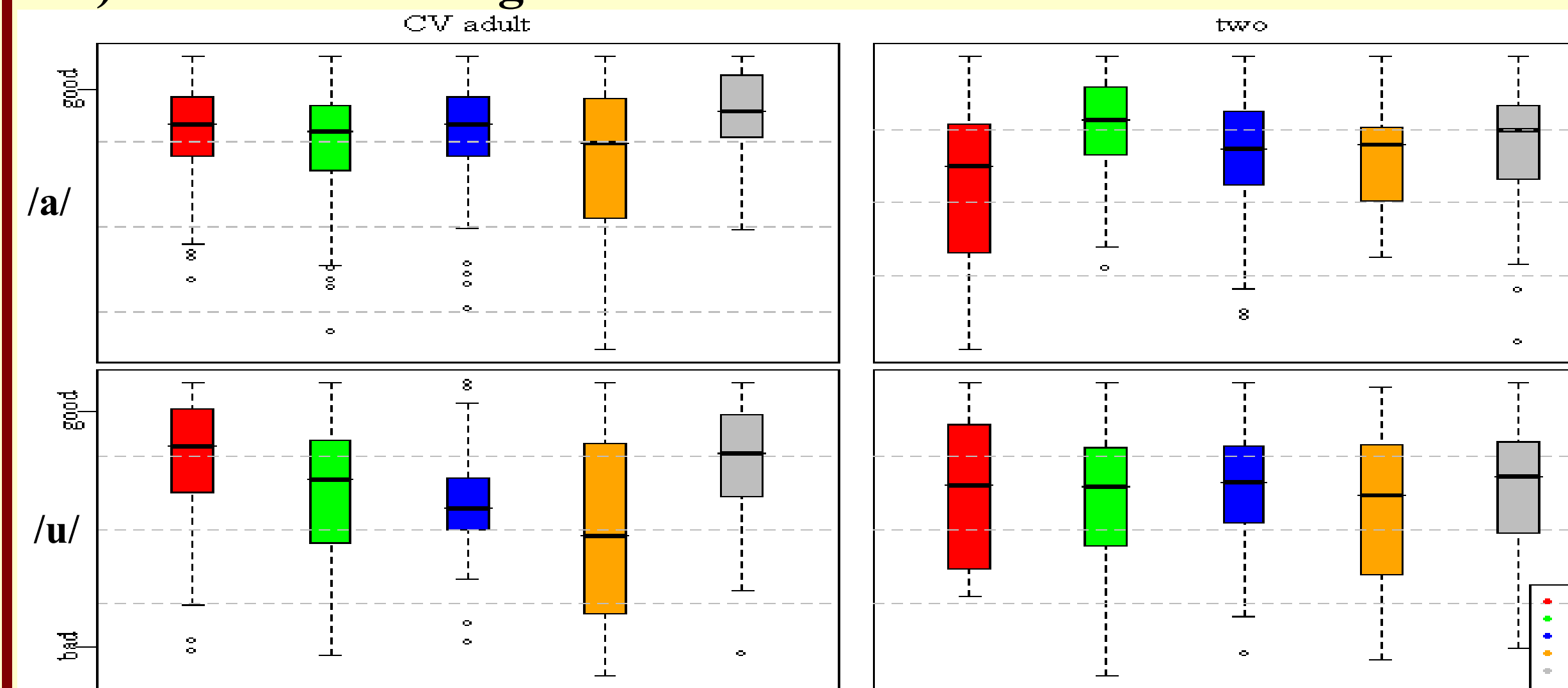
ii. Acoustic Analysis

AdultCV /a/ — 2yrCV /a/
AdultCV /u/ — 2yrCV /u/

- /a/ : consistently assimilated into Korean /a/ category, except those with F1 lower than 600Hz.
- /u/ : vowels with F2 higher than 1500Hz were assimilated into high central Korean vowel /ɨx/. Despite occupying a more peripheral area of the vowel space, Cantonese and Greek /u/ vowels were assimilated into the Korean /o/ category.

2) 2-year-olds' production

- /a/ : Korean vowels consistently categorized into /a/, while those of other languages show inconsistent categorization patterns, even though F1 and F2 values were similar across languages.
- /u/ : inconsistent categorization patterns were shown, with the exception of Korean vowels.

➔ Does listeners' knowledge about native vowel categories affect perception?
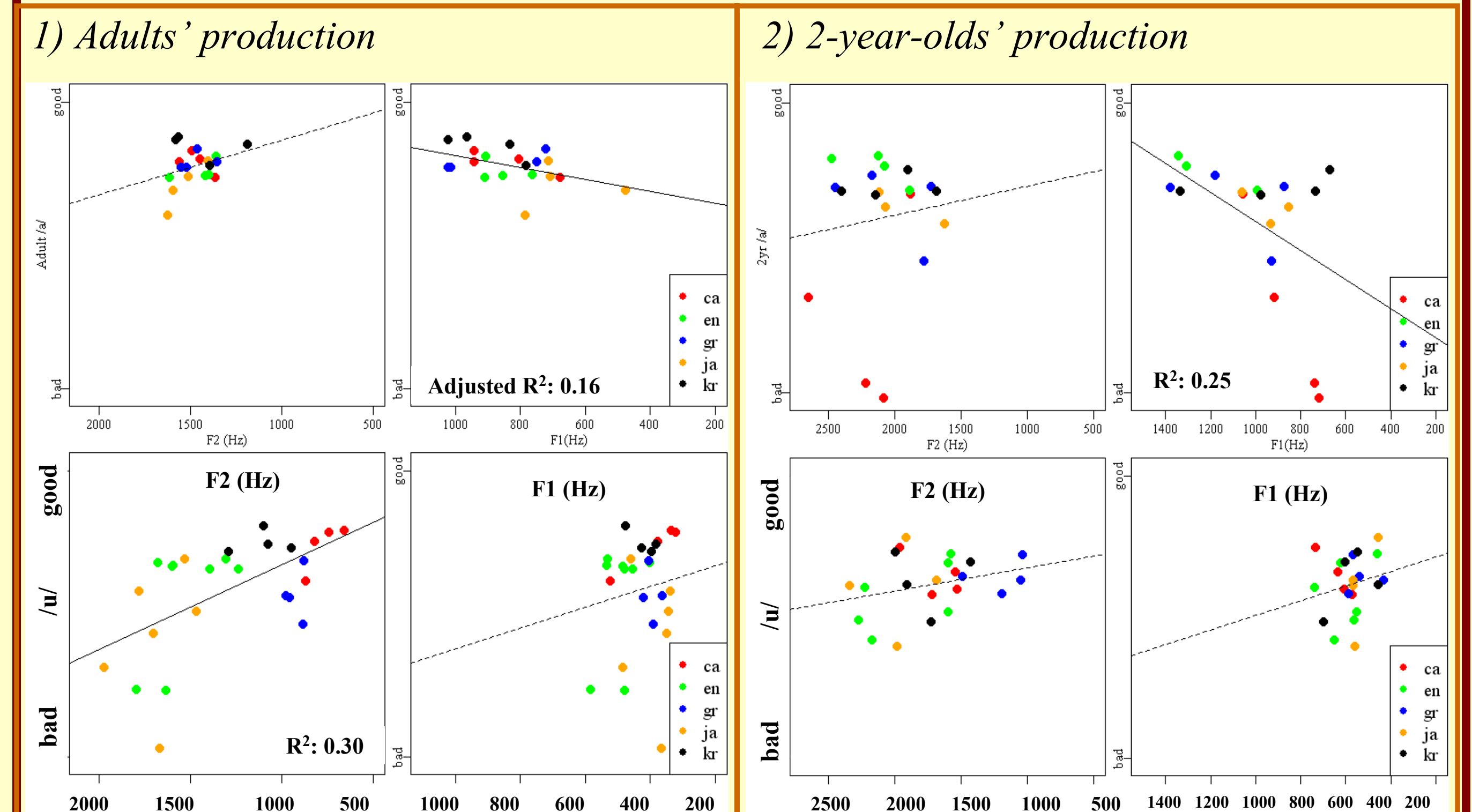
B) Goodness Rating

CV adult — two
/a/
/u/

i. Rating Patterns

- Only vowels categorized "correctly' were included in the graph.
- Korean vowels were not necessarily rated higher/better than those of other languages.
- Japanese vowels were generally rated more poorly than those of other languages.
- Vowels produced by 2-year-olds were rated slightly more poorly than those of adults, but the difference between the two groups is not large
- Greek and Japanese vowels categorized as /u/ were rated poorly

➔ *A language-specific perceptual bias was not found. What relationship is there between native/non-native vowel categorization and acoustic patterns of stimuli?*

ii. Acoustic Analysis

1) Adults' production

Adjusted R²: 0.16
R²: 0.30

2) 2-year-olds' production

R²: 0.25

- /a/: The higher the F1 value for /a/, the higher the goodness ratings.
- /u/: The lower the F2 values for /u/, the higher the goodness ratings.

- /a/: The higher the F1 value for /a/, the higher the goodness ratings.
- /u/: No significant relationship with either F1 or F2 and the rating.

➔ A relationship between the goodness ratings and the first two formant frequencies measured at the vowel midpoint was found for vowels produced by both adults and 2-year-olds.
➔ What remains unexplained needs to be examined by other acoustic properties of the vowel, for example, the formant trajectories.

DISCUSSION

- Korean-speaking adults are sensitive to language-specific fine phonetic details present in "shared" vowels of different languages in a vowel categorization task.
- However, Korean-speaking adults are *not* sensitive to language-specific fine phonetic details present in "shared" vowels of different languages in a goodness rating task.
- Language-specificity present in vowels produced by 2-year-olds is perceived by Korean-speaking adult listeners

ACKNOWLEDGMENTS