Contrastive hyperarticulation of vowels in two dialects of Korean

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MOT:*Montreal-Ottawa-Toronto Phonology Workshop*

Hypo~Hyperarticulation

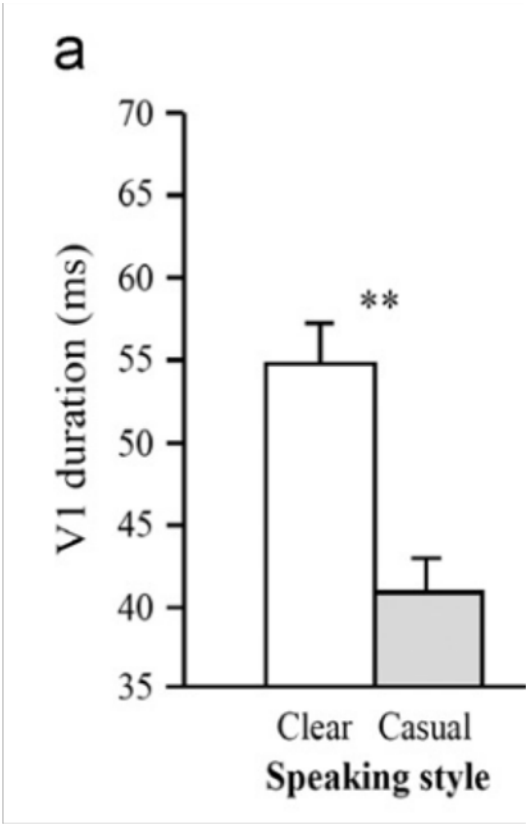
- Speakers skillfully adjust their speech to adapt to the communicative demands of the speech context.
  (cf. Lindblom 1990)

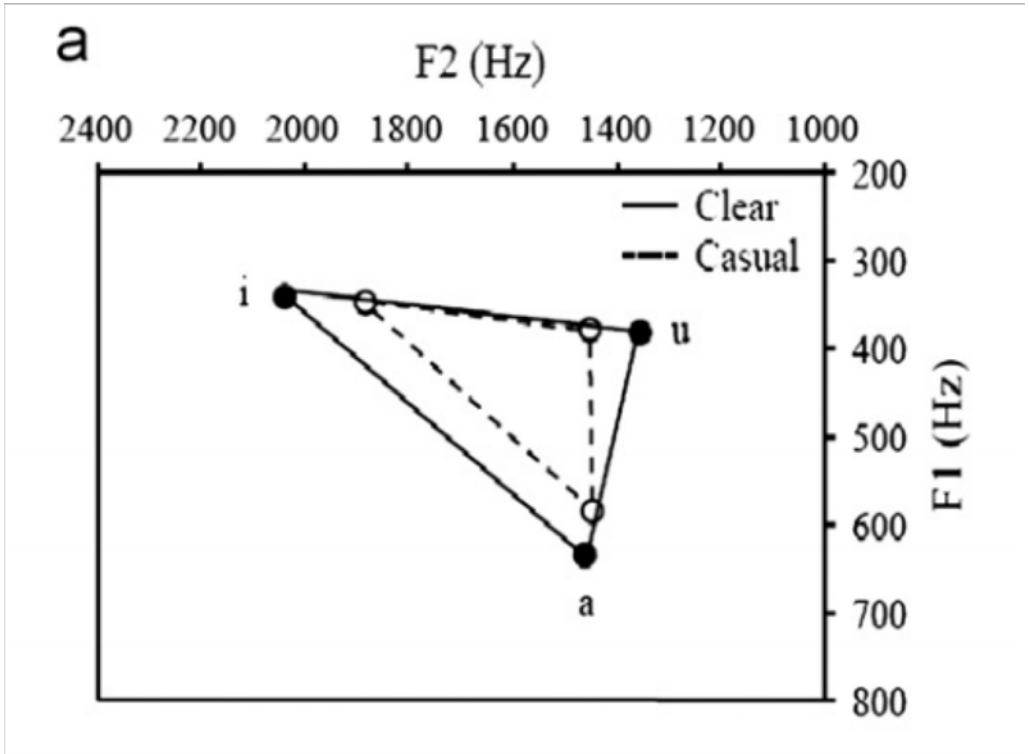
Contrastive hyperarticulation

- When prompted to speak clearly, especially to distinguish target words from their lexical competitors, speakers tend to producing longer segments, and exaggerate acoustic contrasts. (See Smiljanić & Bradlow 2009 for a review.)

Contrastive hyperarticulation

- Korean Vowels (Cho, et al. 2011)





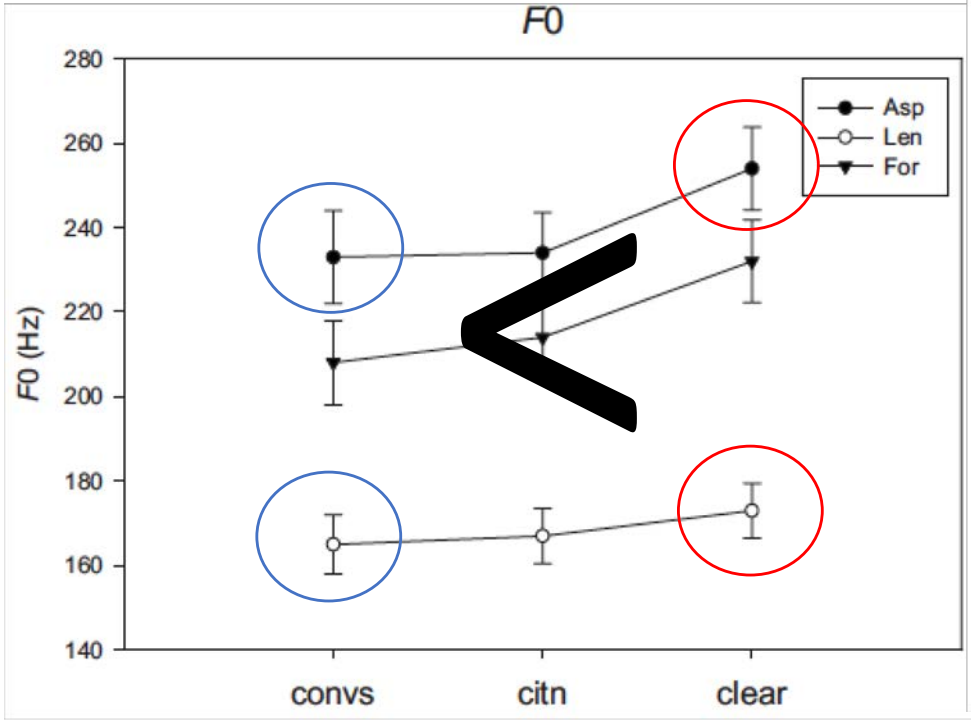
Contrastive hyperarticulation

- Hyperarticulation can give evidence as to how words and sounds are represented and organized.
- The “same” sounds can show different contrastive hyperarticulation depending on the phonological and lexical contrast they are involved in.
  - “same” sounds, different language (Smiljanić & Bradlow 2005)
  - “same” sounds, different dialects (Clopper & Tamati 2014)
  - “same” sounds, different speaker group (Kang & Guion 2008)
  - “same” sounds, different words (Wedel, et al. 2018)

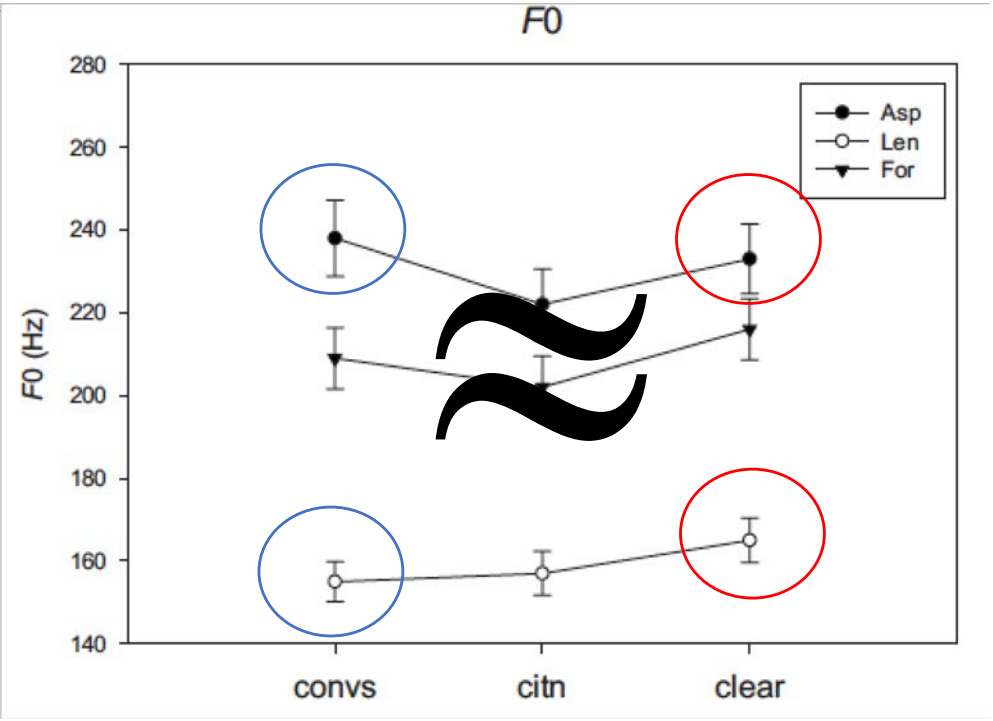
Contrastive hyperarticulation : sound change in progress

- VOT merger and the emergence of f0 contrast in Seoul Korean lenis vs. aspirated stops (Kang and Guion 2008)

Younger Seoul Koreans



Older Seoul Koreans



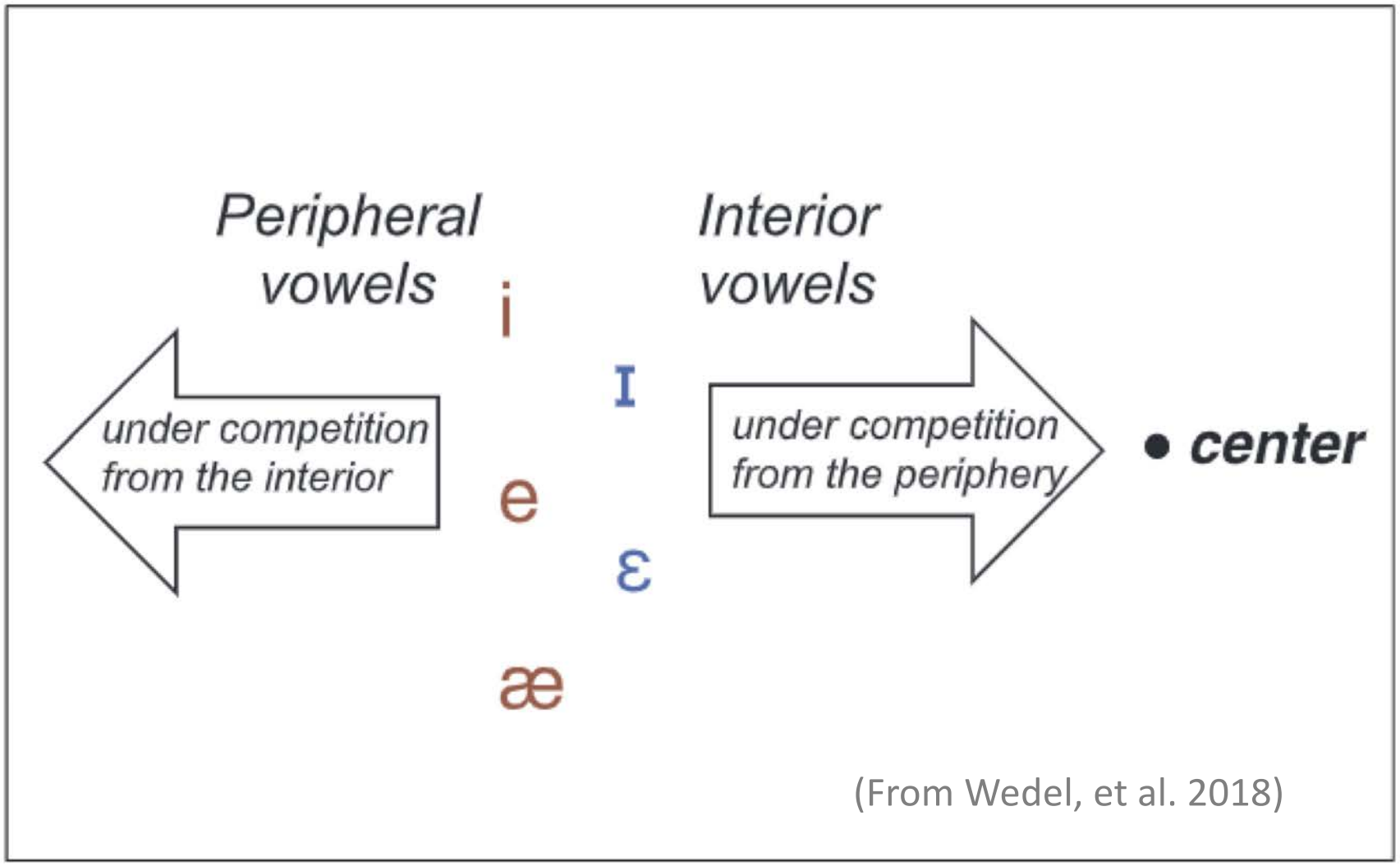
Contrastive hyperarticulation as source of sound change

- Contrastive hyperarticulation/Adaptive dispersion as a source of certain types of sound change
- Transphonologization: VOT contrast merges and F0 contrast gets enhanced to preserve contrast (Kirby 2012, Bang et al. 2018)
- Vocalic chain shift: neighboring vowels change in tandem to maintain contrast (Blevins & Wedel 2006, Wedel, et al. 2018)

Peripheralization vs. contrast enhancement in vowels

- While studies found evidence for "global" enhancement such as longer vowel duration (Ohala 1994) and vowel space expansion (Cho, et al. 2011) in clear speech, evidence for contrast-specific spectral enhancement remains elusive and limited at best (Kirov and Wilson 2012, Ohala 1994, Schertz 2013, but see Wedel, et al. 2018).

Peripheralization vs. contrast enhancement in vowels



(From Wedel, et al. 2018)

Q 1: Centralizing hyperarticulation in clear speech?

- Previous studies on clear speech of vowels tend to examine a subset of vowels (corner vowels) only or limited to English.
- Look at the entire inventory including ***central vowels*** in Korean.

Q 2: Microvariation of hyperarticulation in dialects

- If contrastive hyperarticulation is adaptive, other things being equal, we predict more contrast enhancement for less distinct contrasts (Clopper and Tamati 2014)
- Smaller the baseline difference, larger the contrastive dispersion?

Sound change and phonetic target

- What is the real phonetic target of a sound undergoing a change?
- Hypothesis (Kang and Yoon 2016)
  - "Bottom-up" production/reduction-driven sound change.
    - Led by high-frequency words
    - Hyperarticulated form is more ***conservative***.
  - "Top-down" perception/contrast-driven sound change.
    - Led by low-frequency words
    - Hyperarticulated form is more ***innovative***.

Hyperarticulation and vowel shift

- Cockney vowel shift: **stressed** > **unstressed** (Labov 1994)
- Canadian vowel shift : **formal** > **casual** (Hall 2014)
- California vowel shift: **word list** > **reading passage** (Hall-Lew 2015)
- New Zealand vowel shift: **low frequency** > **high** (Hay, et al. 2015)
- Korean back vowel shift: **word-initial position** > **medial** (Kang 2014), based on read speech corpus
- ***Can we replicate Kang (2014) in contrastive clear speech?***

Q 3: Hyperarticulation of vowels undergoing change?

- How are vowels undergoing sound change hyperarticulated?
  - Toward the direction of change (innovative) – expected
  - Away from the direction of change (conservative)

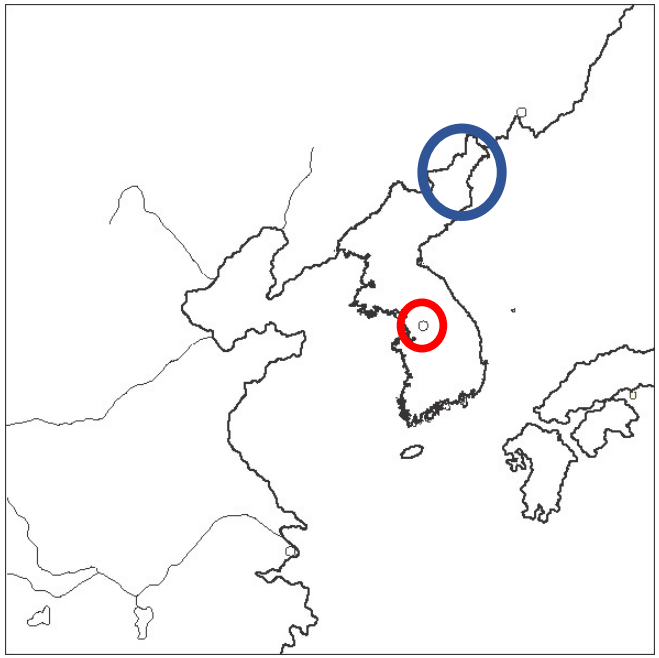
Korean monophthongs

Table 1: Inventory of Korean monophthongs

i	(y)	ɨ	u
e	(ø)	ʌ	o
ɛ		ɑ	

Participants

	Old (above 40)	Young (40 or under)
Seoul	5F, 5M	5F, 6M
Hamkyoung	18F, 3M	13F, 2M



Speech materials

- 8 neighboring vowels (/i-e/, /e-ɛ/, /ɛ-ɑ/, /ɑ-ʌ/, /ʌ-o/, /o-u/, /u-ɨ/, and /ɨ-i/) * 3 minimal pairs each

  → 24 minimal pairs

  - E.g., for /ɛ-ɑ/ contrast:

  /sɛtɑ/ ‘to leak’ - /sɑtɑ/ ‘to buy’

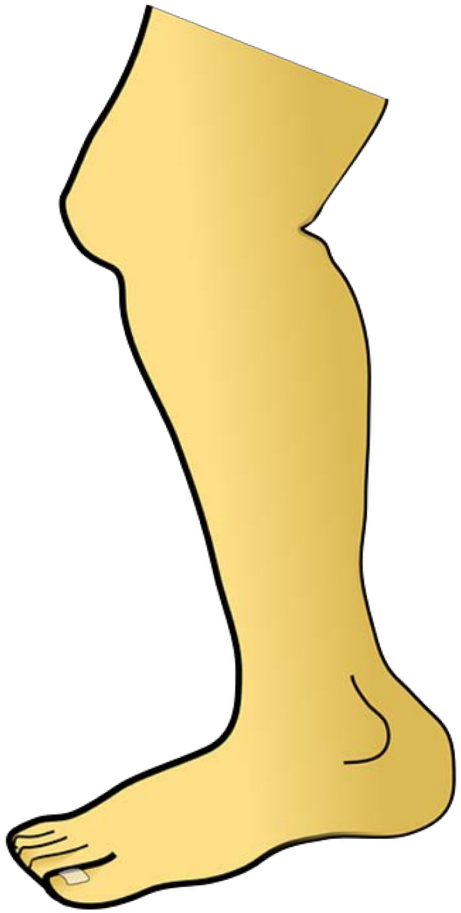
  /pɛm/ ‘snake’ - /pɑm/ ‘night’

  /ɛksu/ ‘amount’ - /ɑksu/ ‘handshake’.

Procedure

- General presentation
  - Self-paced word reading
  - standard orthography + a picture (to disambiguate and to make it less boring)
  - *Psychopy* (programming by Jessamyn Schertz) on a *Microsoft Surface* tablet.
- Three speech styles
  - Casual, Careful, Contrastive

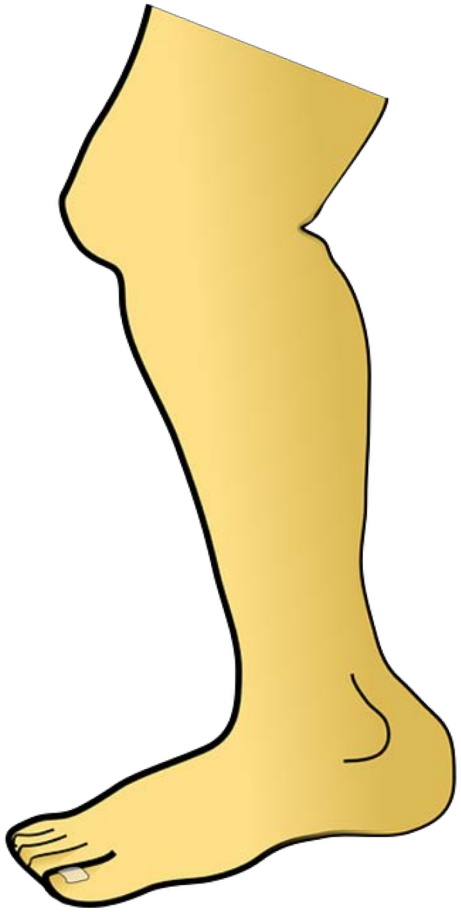
“Casual”



다리

대리

“Careful” and “Contrastive”



다리

“Careful”

대리

“Contrastive”

Acoustic analysis

- **Duration**
- **F1 and F2 from the mid 10% of the vowel**
  - The formant ceiling was set at 4,000 Hz for males and 4,500 Hz for females, and the number of target formants was set at 5 for back vowels (/ɑ, ʌ, o, u, ɨ/) and 4 for front vowels (/i, e, ɛ/).
  - These settings are chosen to minimize the variance (an indirect measure of tracking errors), based on exploratory analysis of various settings.
  - The automatically measured values were further filtered by excluding 273 outliers that fall outside 2.5 standard deviations in either F1 or F2 for each vowel.

Normalization

- Lobanov normalization
  - By-speaker z-score transformation of formants
  - [0,0] = central of the speaker's vowel space.

Quantifying hyperarticulation

- **Duration**
- **Peripheralization** = dispersion from the central

$$Dispersion_i = \sqrt{F1_i{}^2 + F2_i{}^2}$$

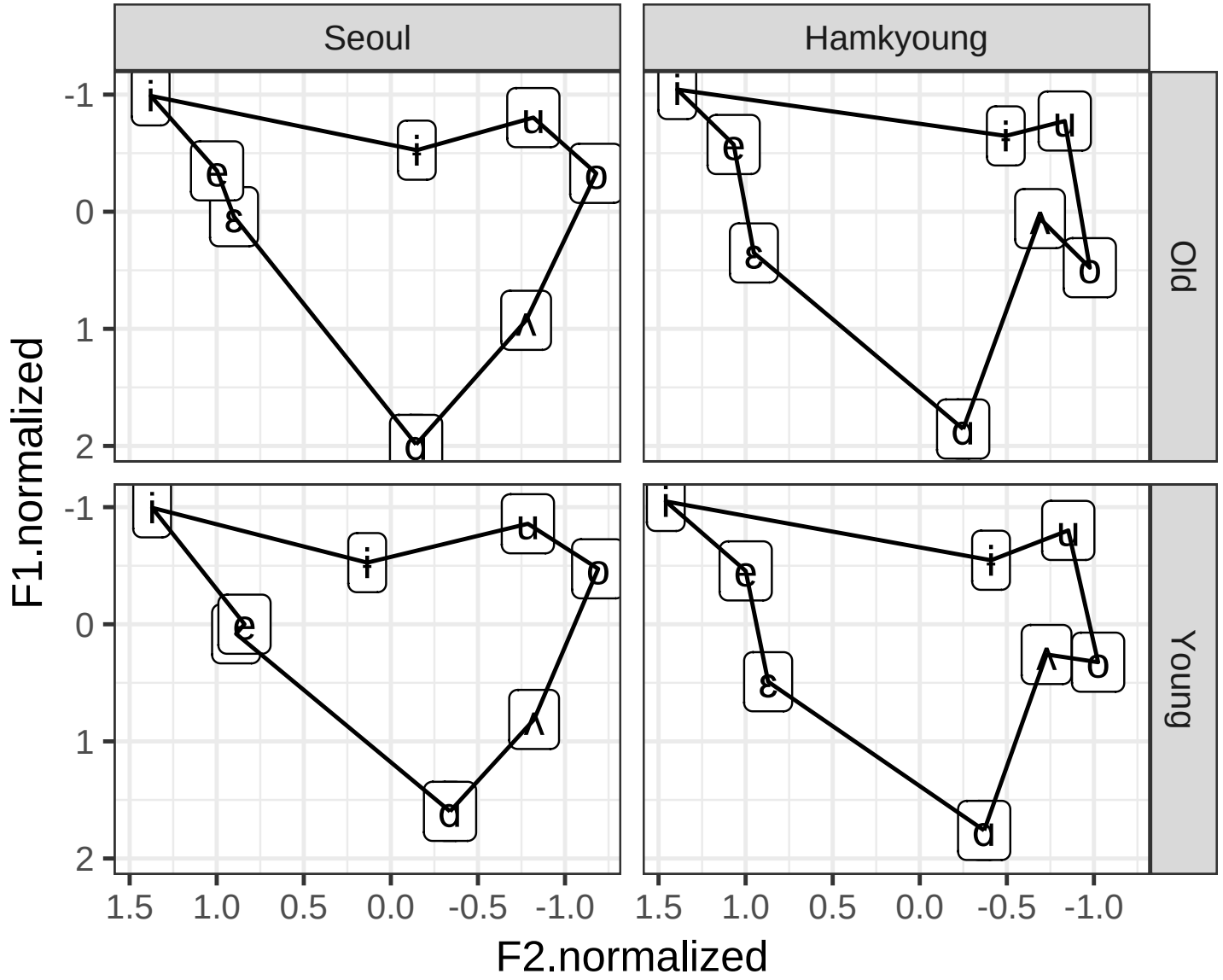
- **Contrastive dispersion** = Euclidean distance between vowels in minimal pairs

$$Distance_{ij} = \sqrt{(F1_i - F1_j)^2 + (F2_i - F2_j)^2}$$

Statistical analyses

- Linear mixed-effects regression models
- Dependent variable
  - **Duration, Dispersion, Distance**
- Fixed-effect predictors
  - **Condition (Casual, careful, contrastive)**
  - Dialect (Seoul, HK)
  - Gender (F, M)
  - Age (Old, Young)
  - Vowel or Vowel pairs
  - All interactions → pared down by stepwise regression
- Random effect predictors
  - Subject – intercept and slope for Condition
  - Word/Word pair intercept

Results: Dialect and Age



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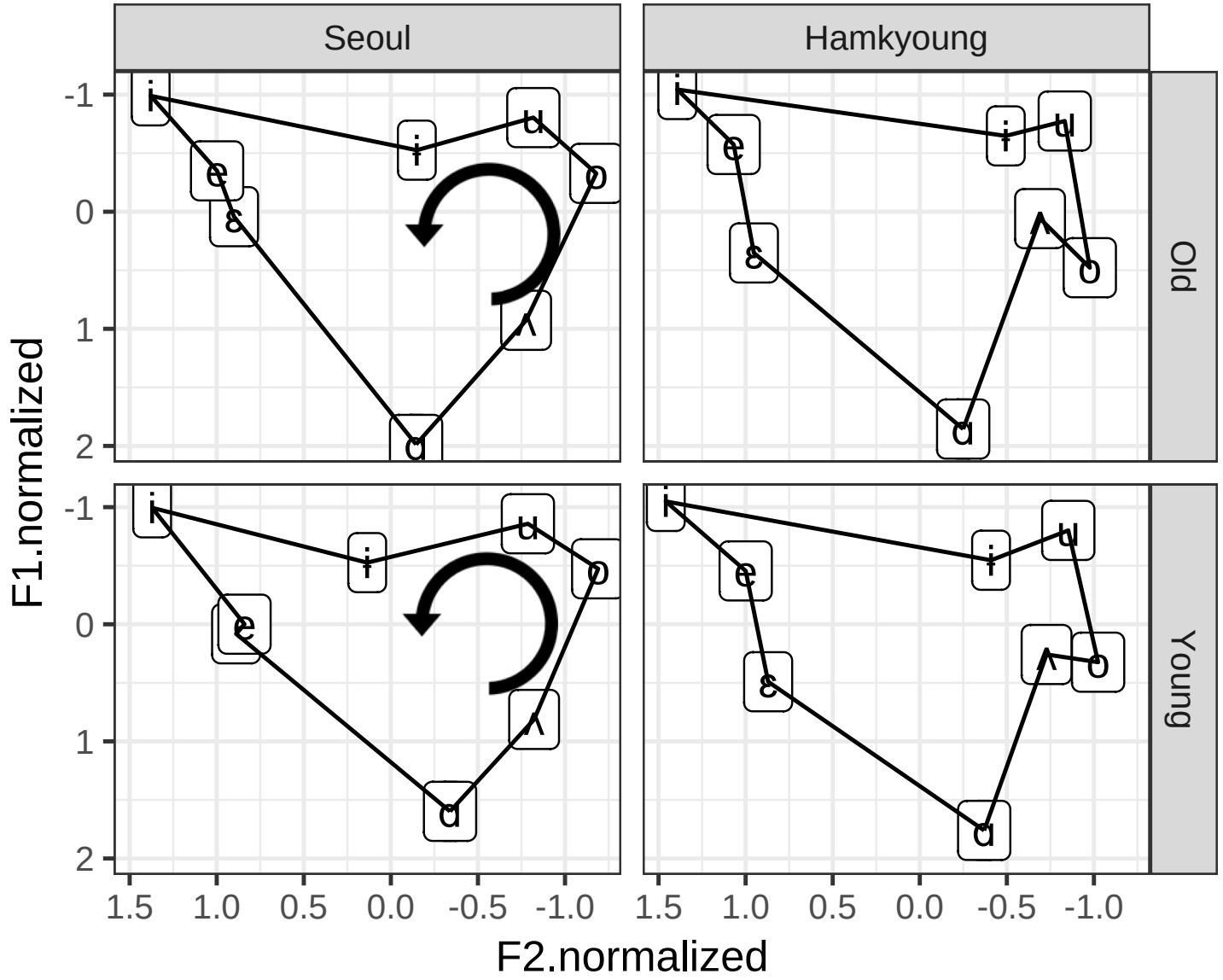

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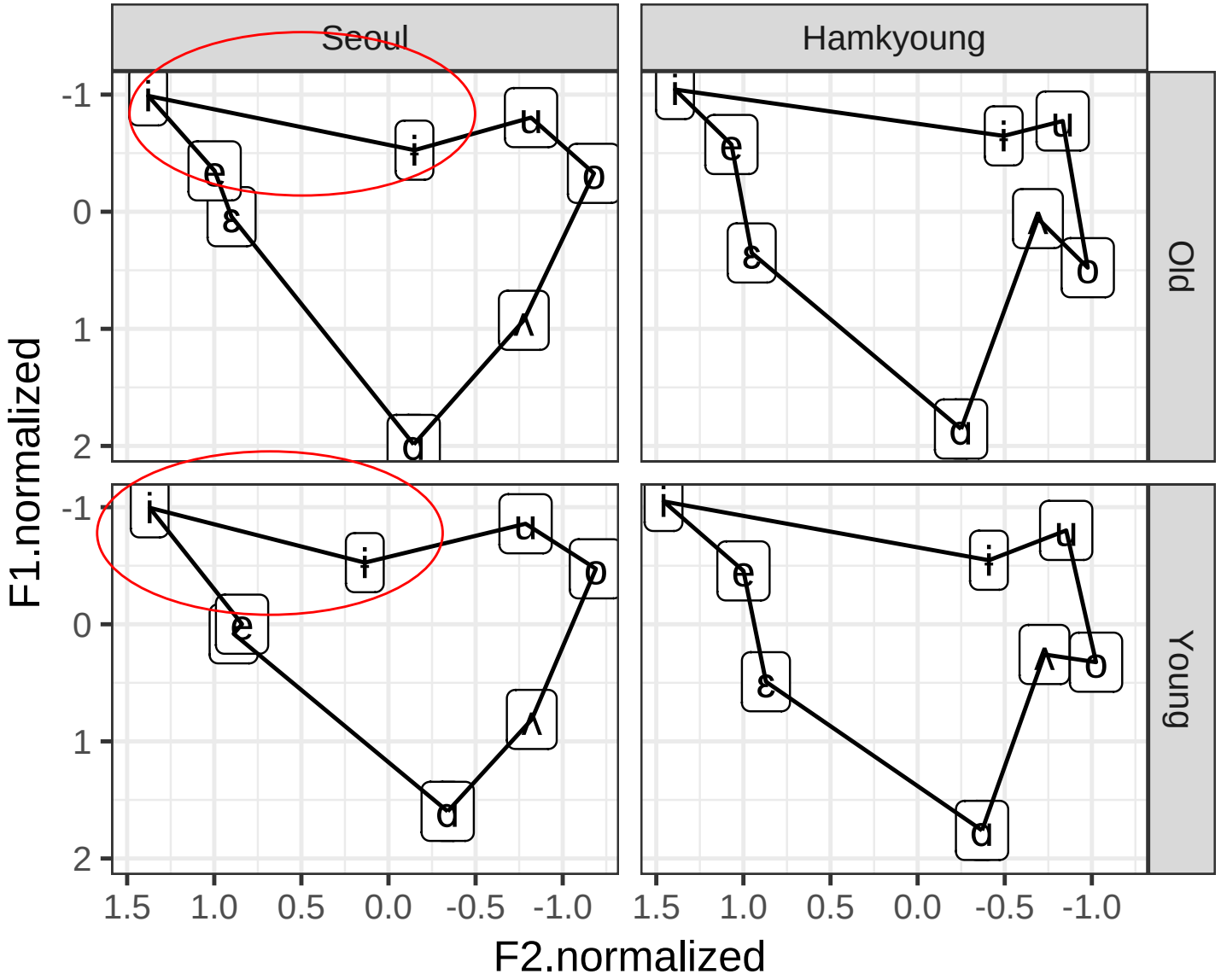

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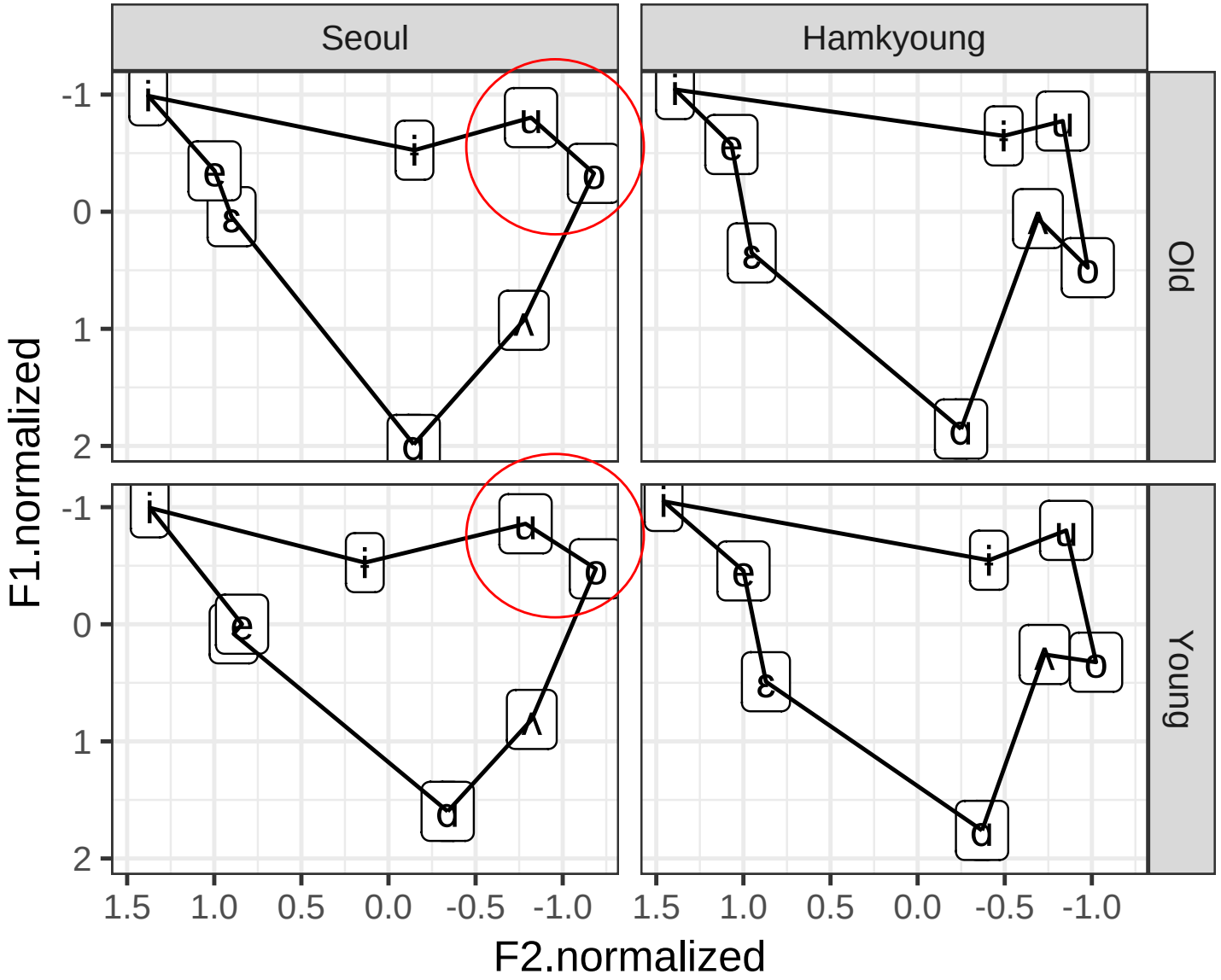
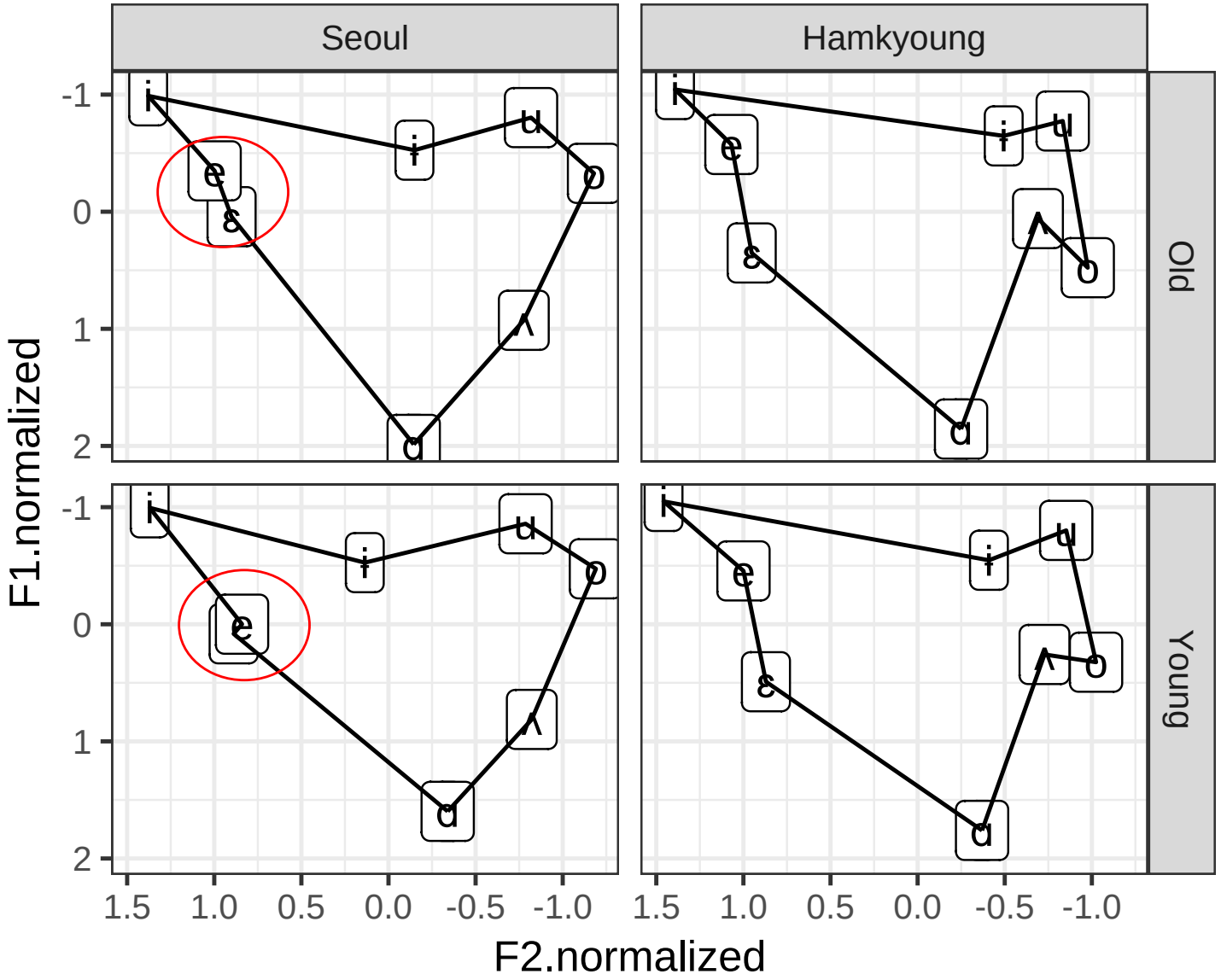
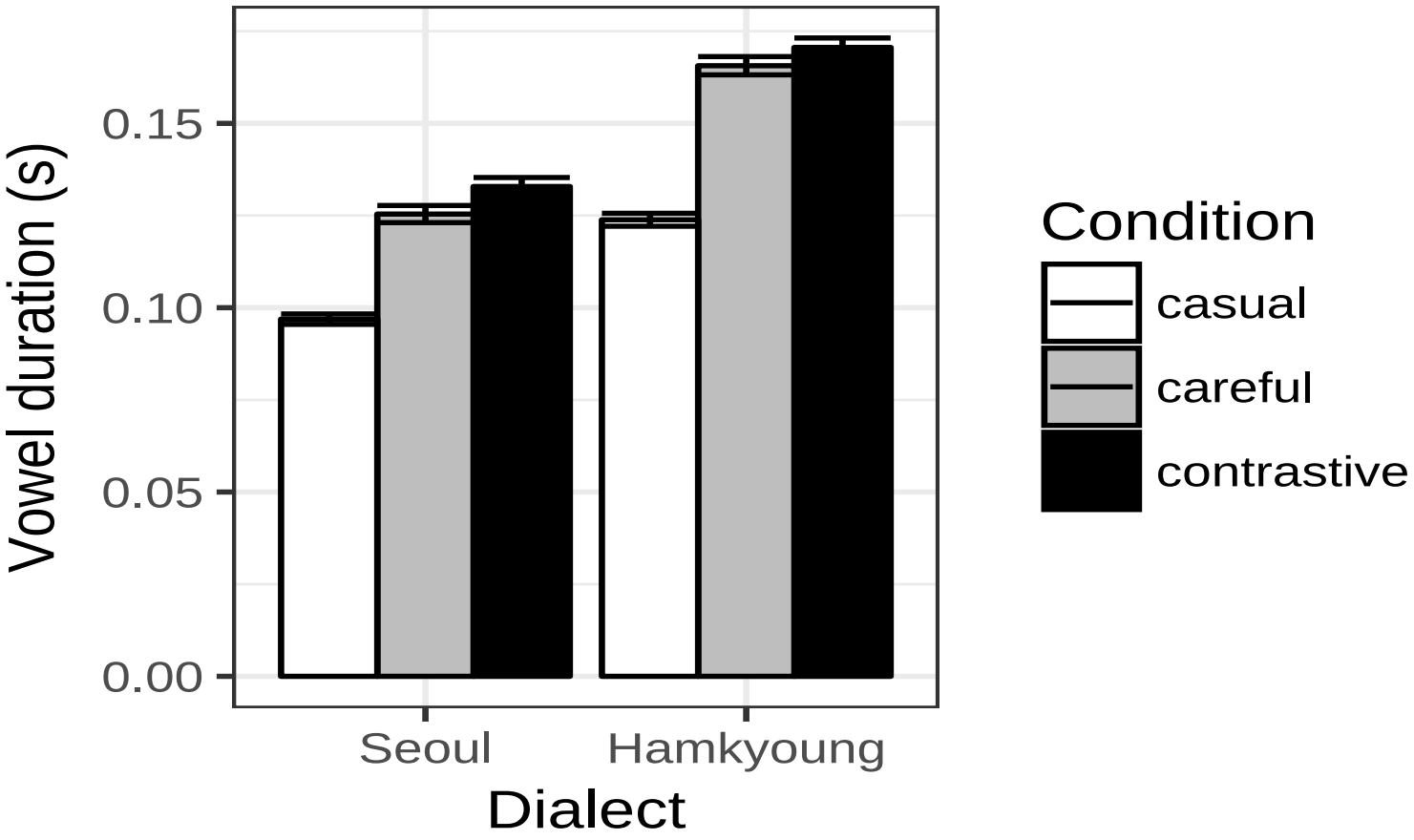


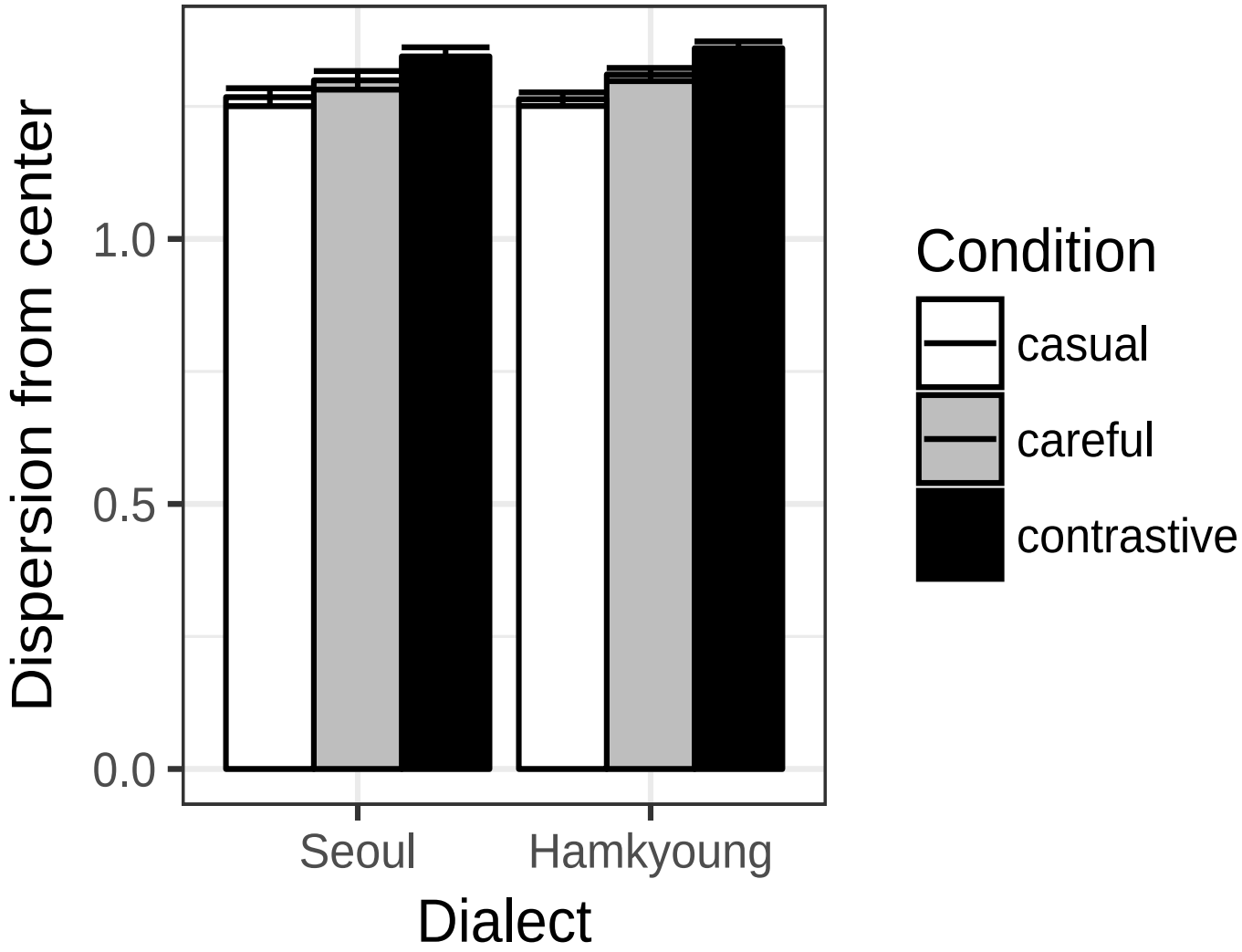
Results: Dialect and Age



Results: Duration

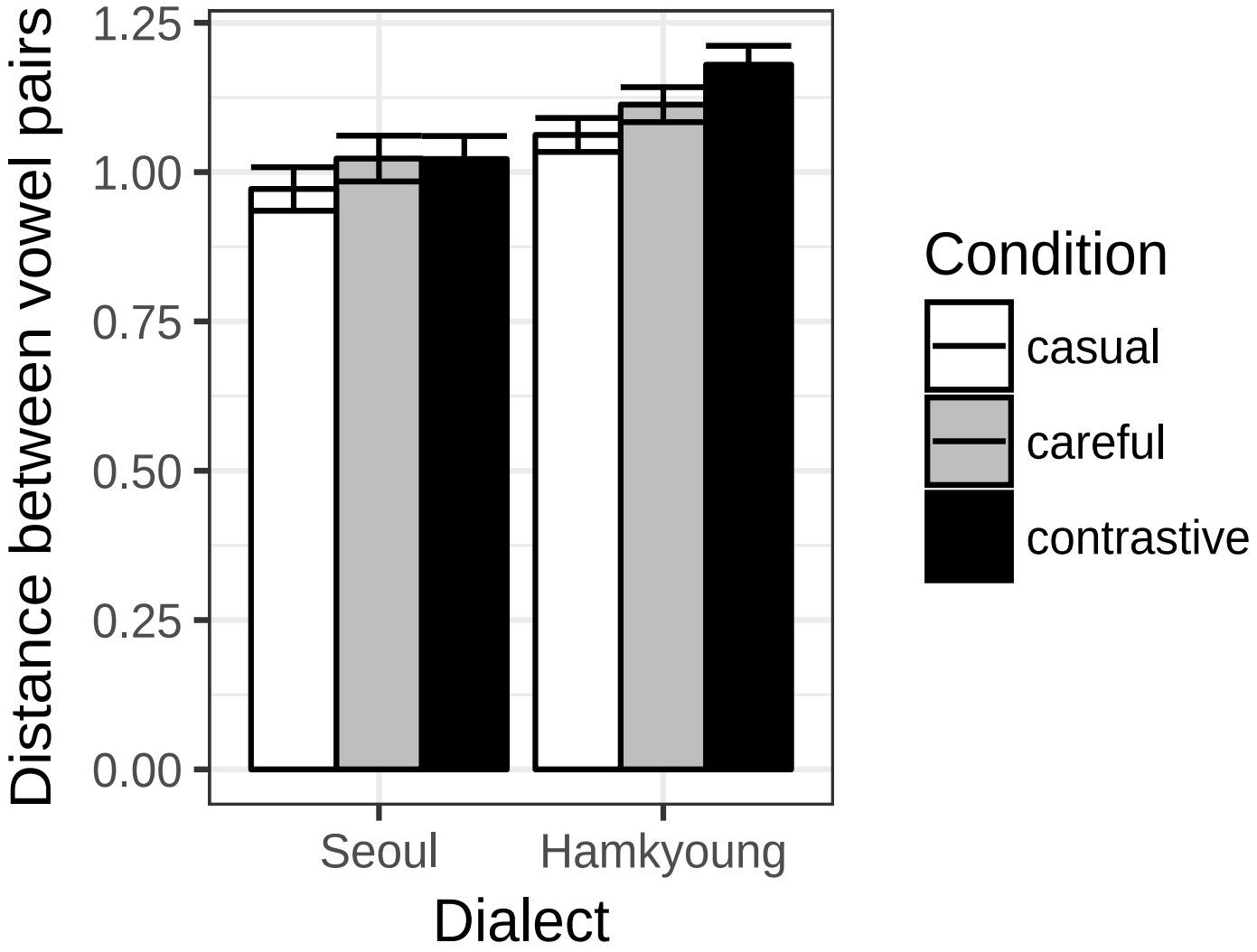


Results: Peripheralization



Q 1: Contrast-specific spectral hyperarticulation?

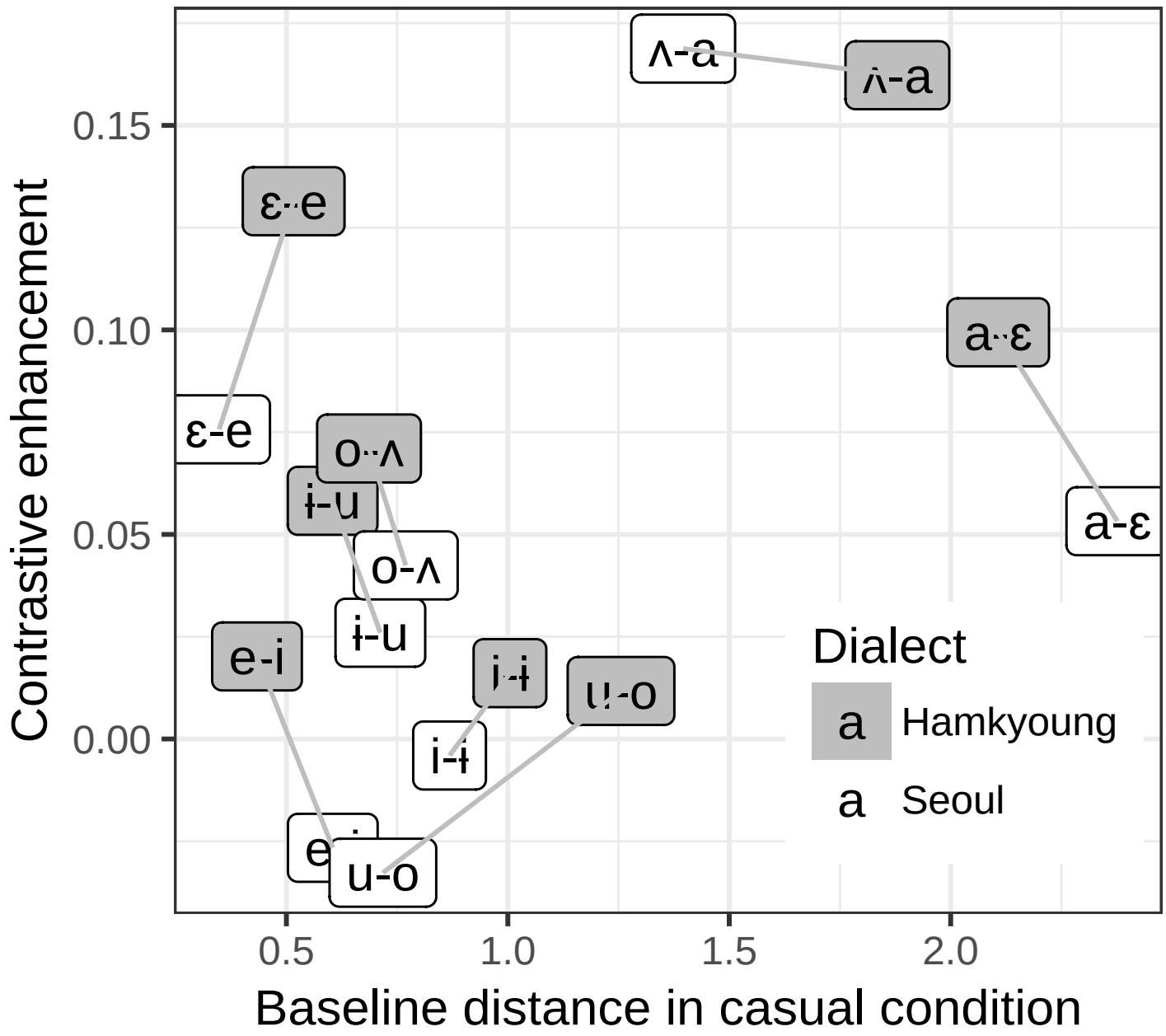
Results: Contrastive dispersion



Results: Contrastive dispersion

- Generally in the right direction
- Interaction of condition and vowel pairs
  - Significant effects for /ɑ - ɛ/ and /ɑ - ʌ/ pairs (aided by peripheralization, or room to grow!)
  - Marginal effect for /ɛ-e/ and /ɨ-u/.

Q 2: Microvariation of hyperarticulation


Contrastive enhancement
0.15
0.10
0.05
0.00
0.5
1.0
1.5
2.0
Baseline distance in casual condition
Dialect
a Hamkyoung
a Seoul

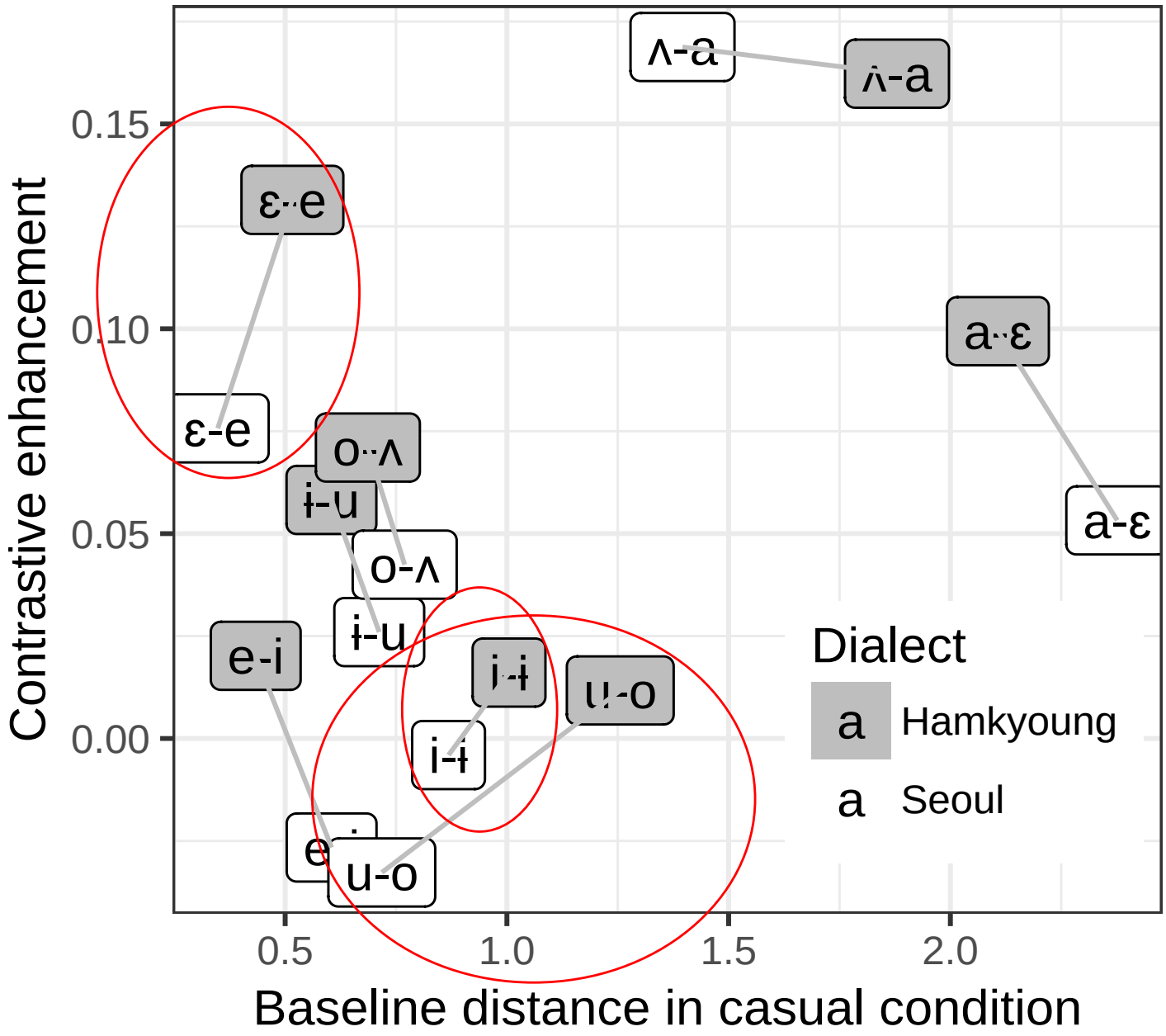
Similarity and enhancement

- More similar, more contrastive enhancement, **except …**

Q 3: Interaction with sound change?

Similarity and enhancement

- More similar, more contrastive enhancement, **except when there is sound change in progress in the opposite direction**


Contrastive enhancement
0.15
0.10
0.05
0.00
0.5
1.0
1.5
2.0
Baseline distance in casual condition
ʌ-a
ɛ-e
a-ɛ
ɛ-e
o-ʌ
i-u
o-ʌ
i-u
e-i
i-ɨ
u-o
i-ɨ
u-o
Dialect
a Hamkyoung
a Seoul

Summary

- Q1: centralization vs. peripheralization?
  - Evidence for contrast-specific spectral hyperarticulation **not evident** in experimentally induced clear speech
- Q2: more similar, more hyperarticulation?
  - Results **suggestive** of dialect-based microvariation in contrastive enhancement: more similar, more enhancement
- Q3: hyperarticulation toward the new?
  - Results **suggestive** of a pull toward direction of change in clear speech target

Discussion

- Experimentally induced contrastive hyperarticuation may not be the best place to look for these subtle effects we are looking for.
  - The “global” enhancement (longer vowels, vowel space expansion) seems to obliterate any subtler effects.
  - The studies that found these effects don’t involve explicit clear speech manipulation
    - Centralization: Wedel et al. 2018
    - Microvariation: Clopper and Tamati 2015
    - Hyperarticulation toward new: various
- However, the results are not unpromising….

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