An apparent time study of Daejeon Korean stop laryngeal contrasts

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Korean stops

	Fortis (unaspirated)	**Lenis (slightly aspirated)**	**Aspirated (heavily aspirated)**
Plosives	/p’ t’ k’/	/p t k/	/p^h t^h k^h/

Short VOT Long VOT

- Three-way contrast in stops

/**t’**al/ ‘daughter’ /**t**al/ ‘moon’ /**t^h**al/ ‘mask’

Phonetics of Korean stops

- **Voice Onset Time (VOT)**:
  - correlate of voicing/aspiration
- **Fundamental Frequency (F0) on the following vowel (in initial position)**:
  - correlate of pitch
- **H1-H2**:
  - correlate of voice quality (breathiness, creakiness)

C. Kim (1965), Han et al. (1970), Cho et al. (2002), M. Kim (2004), Kang and Guion (2006), Narayan et al. (2011), Kong et al. (2011) …

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- Three-way contrast in stops

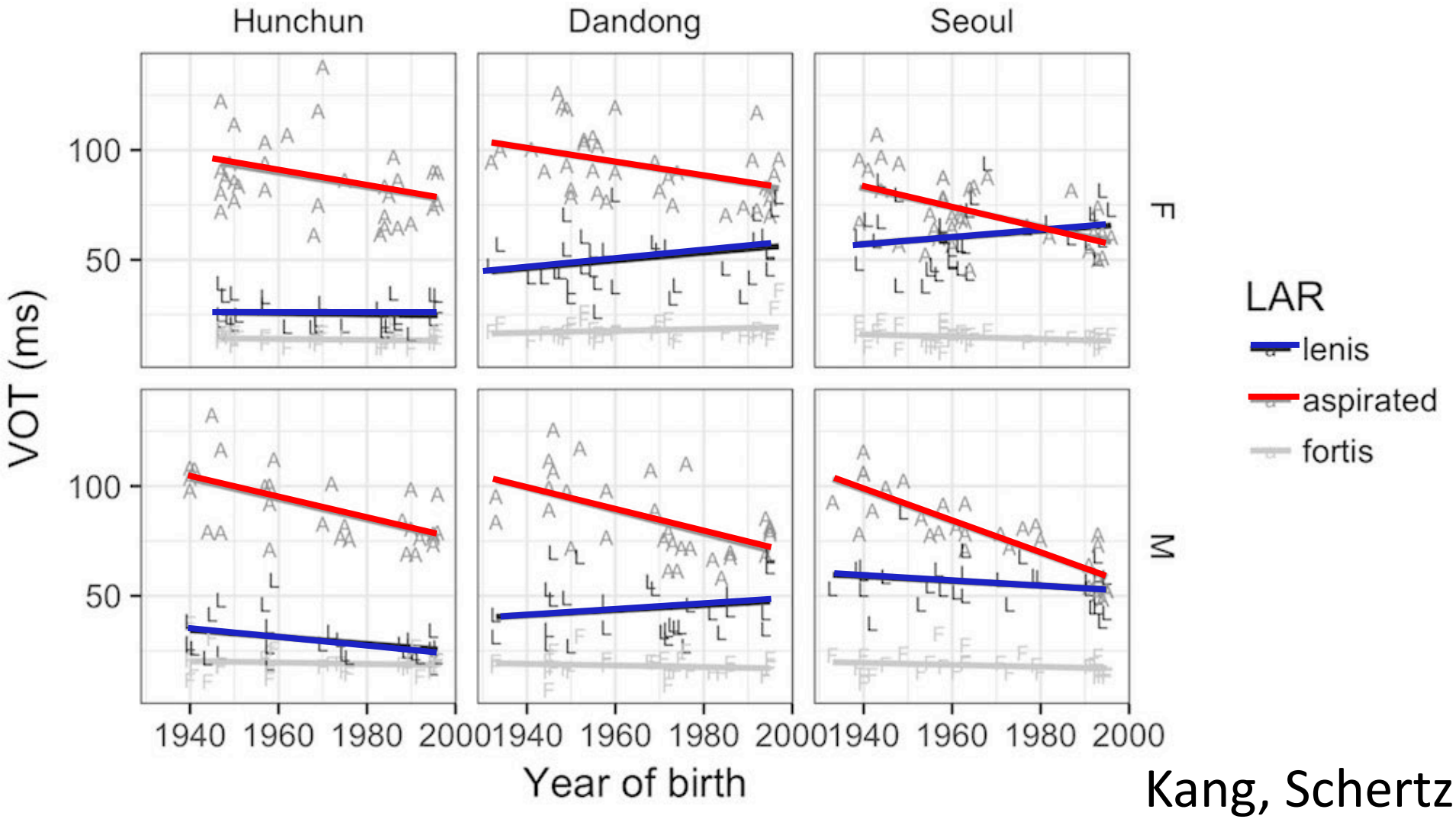
/t’al/ ‘daughter’ /tal/ ‘moon’ /t^hal/ ‘mask’

Pan-Korean change in progress

- VOT merger
  - Reduction of VOT distinction between aspirated and lenis stops **__in phrase-initial position__**
  - Led by younger and female speakers
  - Change observed in various Korean dialects and communities including Seoul, Chennam, Jeju, Kyeongsang, Hamgkyeong, Chinese Korean (Dandong, Hunchun, Shenyang), and Canadian Korean (Toronto).
- Enhancement of F0 distinction
  - F0 has taken over as the primary cue for aspirated vs. lenis contrast in Seoul.

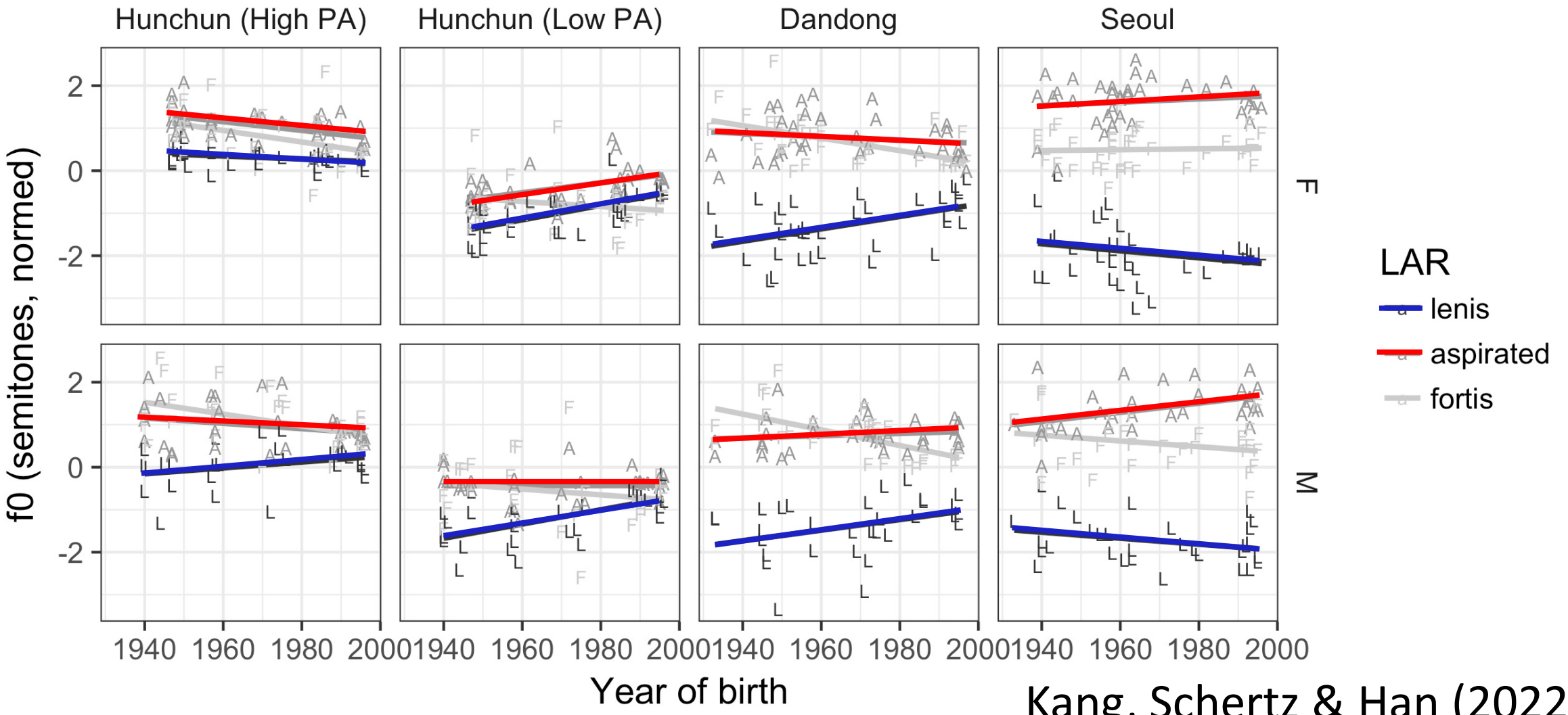
Silva (2022, 2006), Wright (2007), Kang & Guion (2008), Jin (2008), Kang & Han (2012, 2013), Beckman et al. (2014), Kang (2014), Kim & Byun (2014), Shin (2015), Kang & Nagy (2016), Byun (2016), Jin & Silva (2017), Bang et al. (2018), H. Lee & Jongman (2018), Kang, Han, Ryu, Schertz, & Yun (to appear), Kang, Schertz & Han (2022)

Korean stops – VOT (Voice Onset Time)



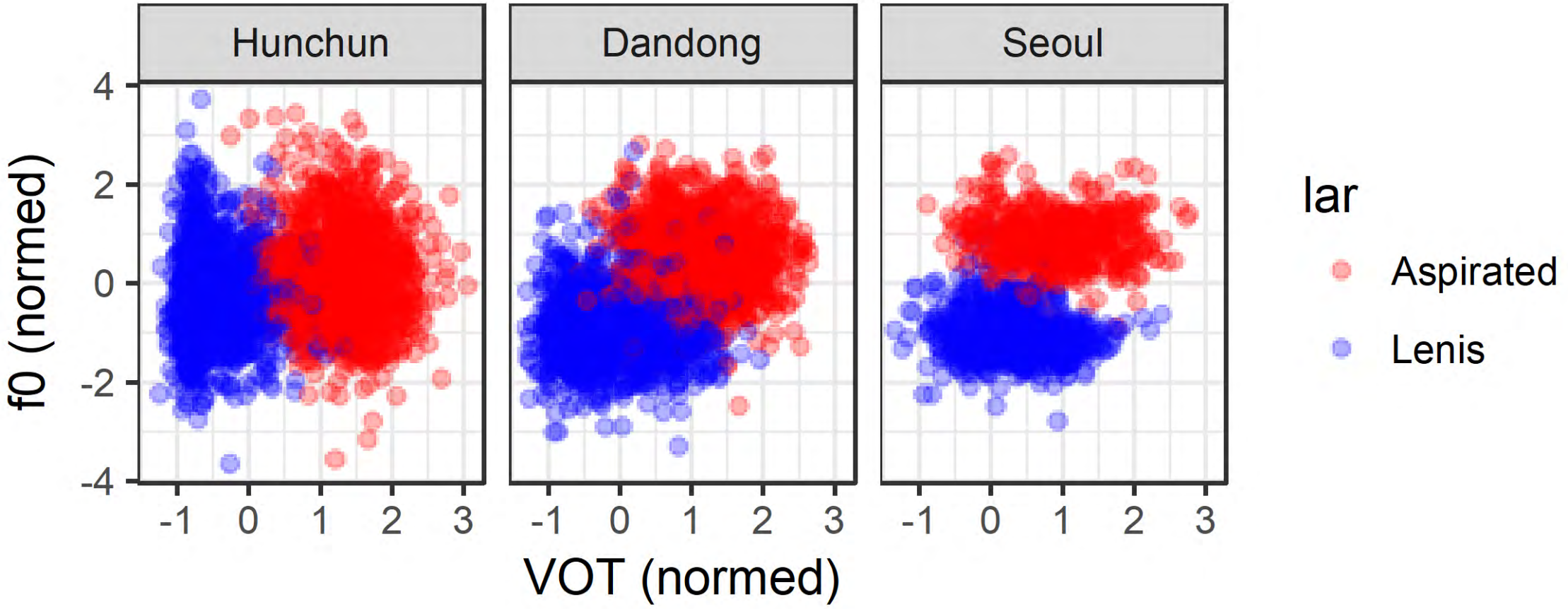
Kang, Schertz & Han (2022)

Korean stops – F0 (fundamental frequency)

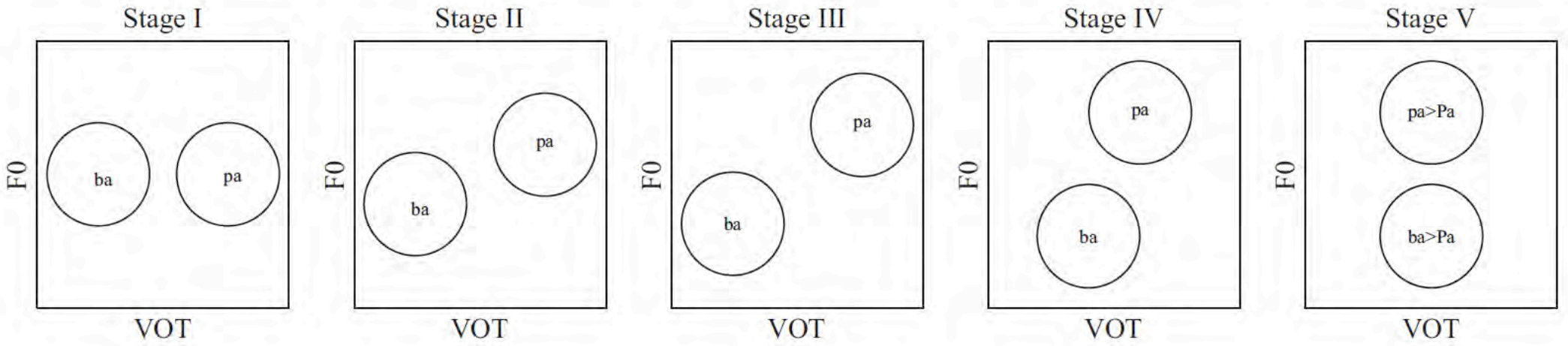


Kang, Schertz & Han (2022)

Korean stops – Shifting cue weights



Stages of tonogenetic sound change



Kang (2014), based on Maran (1973)

Daejeon Korean

- Despite being one of the major dialects, the Chungnam Korean dialect, to which Daejeon belongs, has received little attention in instrumental phonetic studies.
- Ahn (2017), the only previous acoustic study on Daejeon Korean stops
  - ***Longer*** VOT for lenis than aspirated stops in ten speakers (5M, 5F) in their 20s
  - The change in this dialect is similar to, or even more advanced than in Seoul Korean.
- The current study aims to examine age and gender effects by conducting an apparent-time study with a larger number of speakers.

Language and participants

- Daejeon Korean
  - Spoken in the city of Daejeon in the central region of South Korea.
  - 5th largest city in Korea (pop. 1.5 million)
- Participants
  - 81 speakers of Daejeon Korean

	Younger (20s)	**Older (50s +)**
Female	20	21
Male	20	20

Speech materials

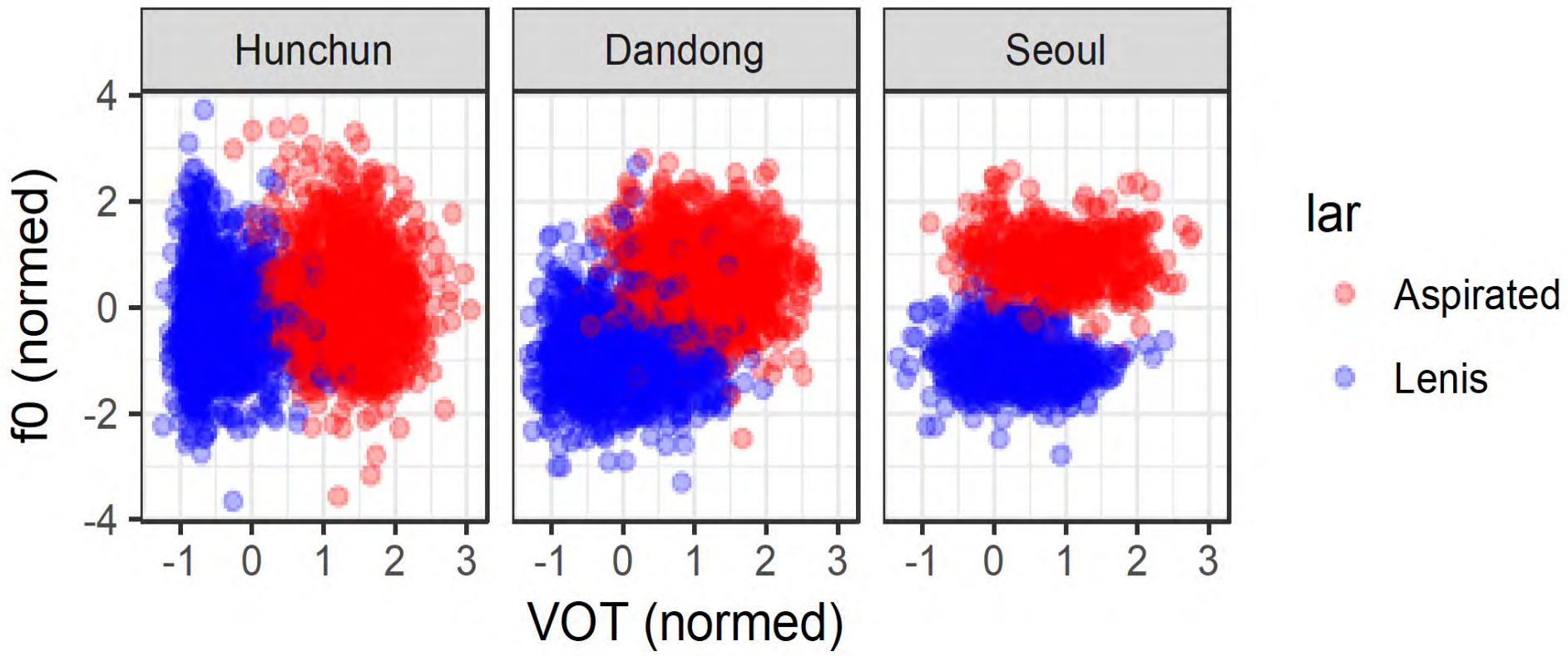
- 18 di- or tri-syllabic words with word-initial stops as part of a larger list.
  - 3 laryngeal * 3 places * 2 vowels (low vs. non-low)* 2 reps

		Fortis (unaspirated)	Lenis (slightly aspirated)	Aspirated (heavily aspirated)
Labial	Low V	/p’aLLɛ/	/paLam/	/pʰaL-i/
	Non-low V	/p’uLi/	/puL-ʌ/	/pʰuLLip/
Coronal	Low V	/t’aL-a/	/taL-e/	/tʰaca/
	Non-low V	/t’ʌL-ʌ/	/tʌL-ʌ/	/tʰʌL-i/
Dorsal	Low V	/k’ak’-aLa/	/kac-a/	/kʰan-i/
	Non-low V	/k’oLi/	/koŋpu/	/kʰok’Li/

Acoustic analysis

- Forced-alignment by K-Aligner (cf. Yoon and Kang 2012)
- Manual annotation of VOT
- f0 of the following vowel midpoint, converted to semitones
- VOT and f0 were normalized using by-speaker z-score transformation to eliminate speaker-specific speech rate and pitch-level and range effects.

Results – dialect comparisons



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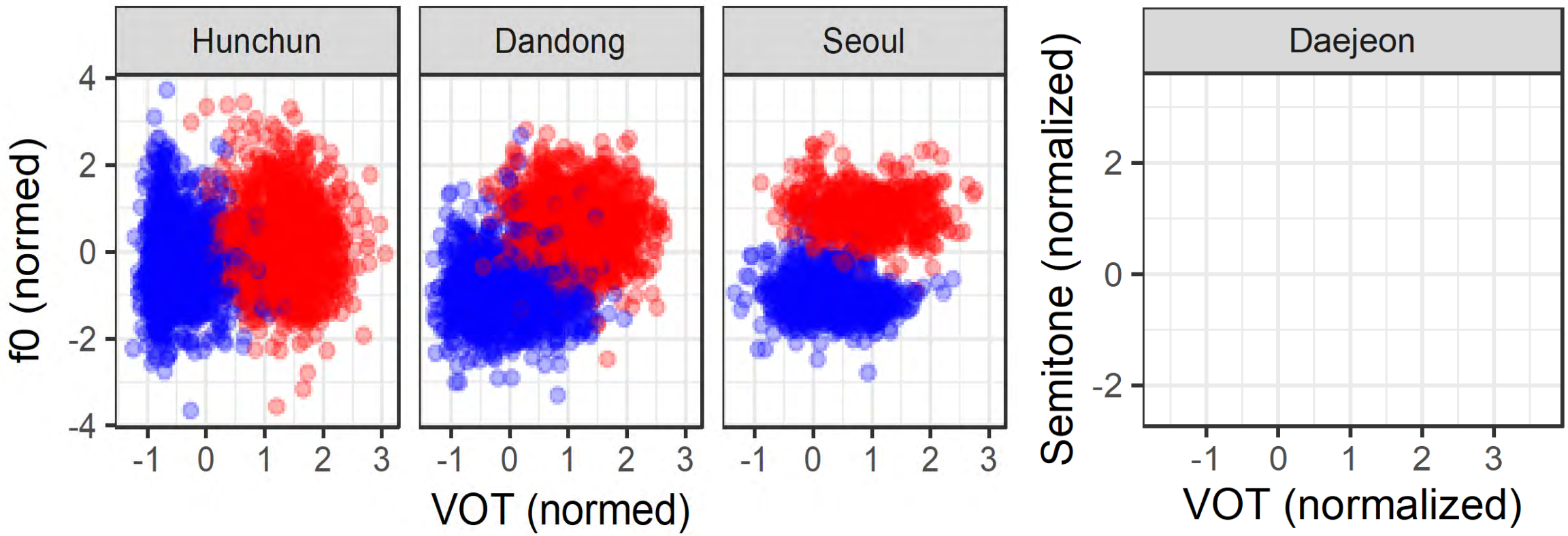
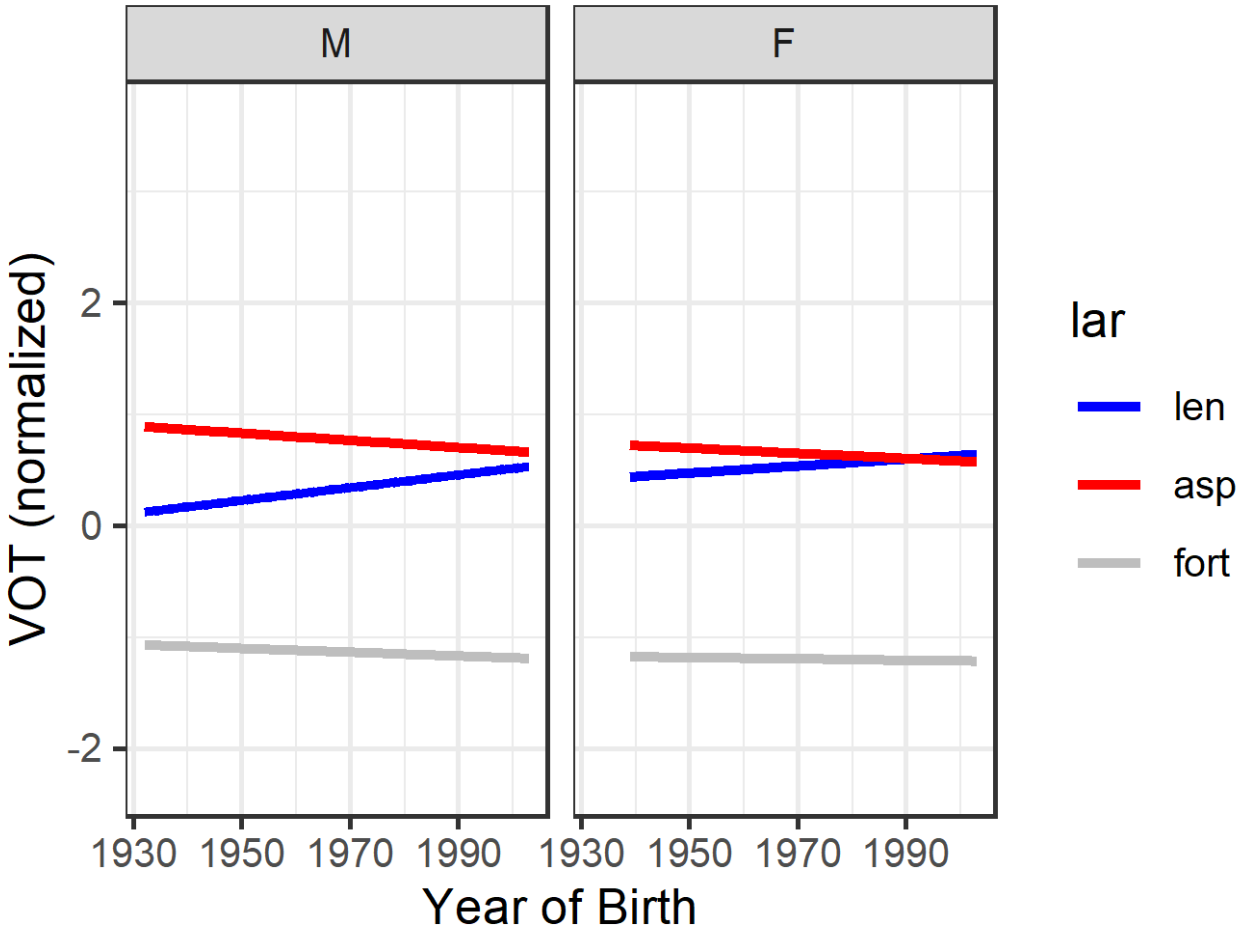


Statistics

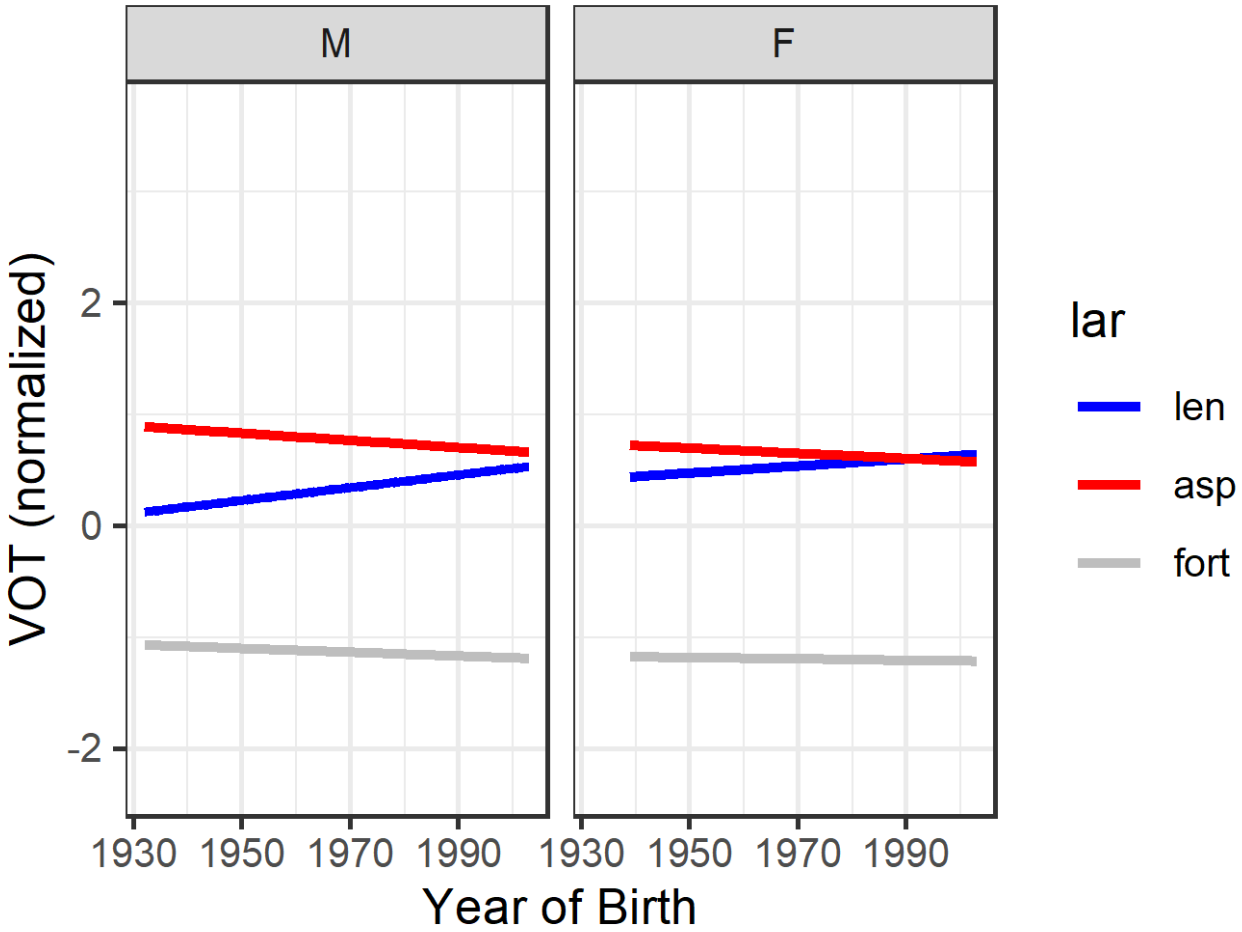
- Linear mixed-effects regression models
  - Dependent variables: VOT or F0 (normalized)
  - Fixed effects:
    - Laryngeal type (**Lenis = -0.5**, **Aspirated. = 0.5**)
    - Age (old = -0.5, young = 0.5)
    - Gender (Male = -0.5, Female = 0.5)
    - All interactions
  - Random effects:
    - (Lar|speaker)
    - (1|word)

Results -- VOT



	Estimate	t value	Pr(>|t|)
(Intercept)	0.578	6.035	<0.001
Lar (len – asp)	0.231	1.193	0.259
Age (young – old)	0.029	2.232	0.029
Gender (F – M)	0.036	2.771	0.007
Lar * Age	-0.332	-5.506	<0.001
Lar * Gender	-0.303	-5.018	<0.001
Age * Gender	-0.024	-0.923	0.359
Lar * Age * Gender	0.159	1.315	0.192

Results -- VOT



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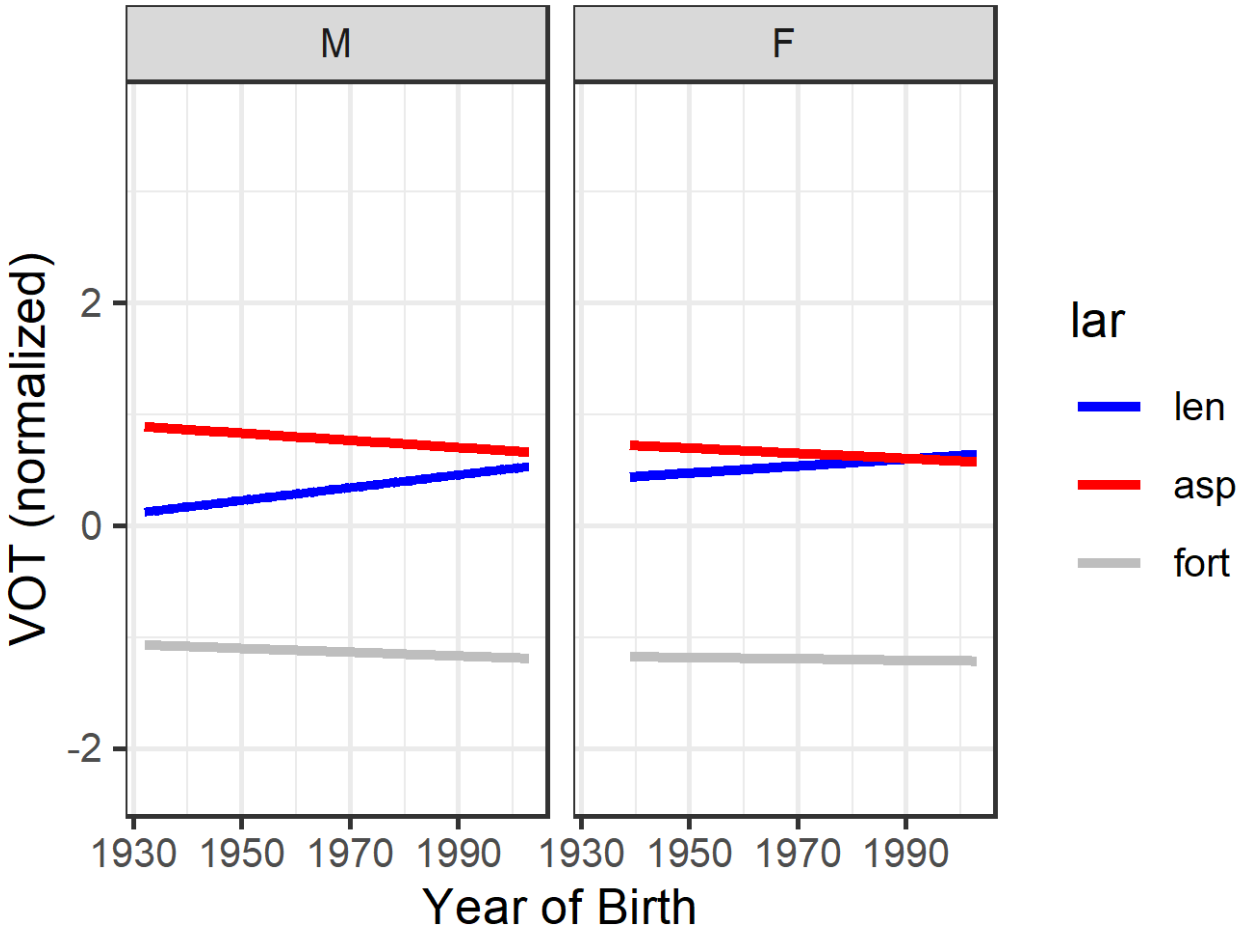
No significant main effect of laryngeal type:
All groups combined, VOT does not differ between lenis and aspirated stops

Results -- VOT



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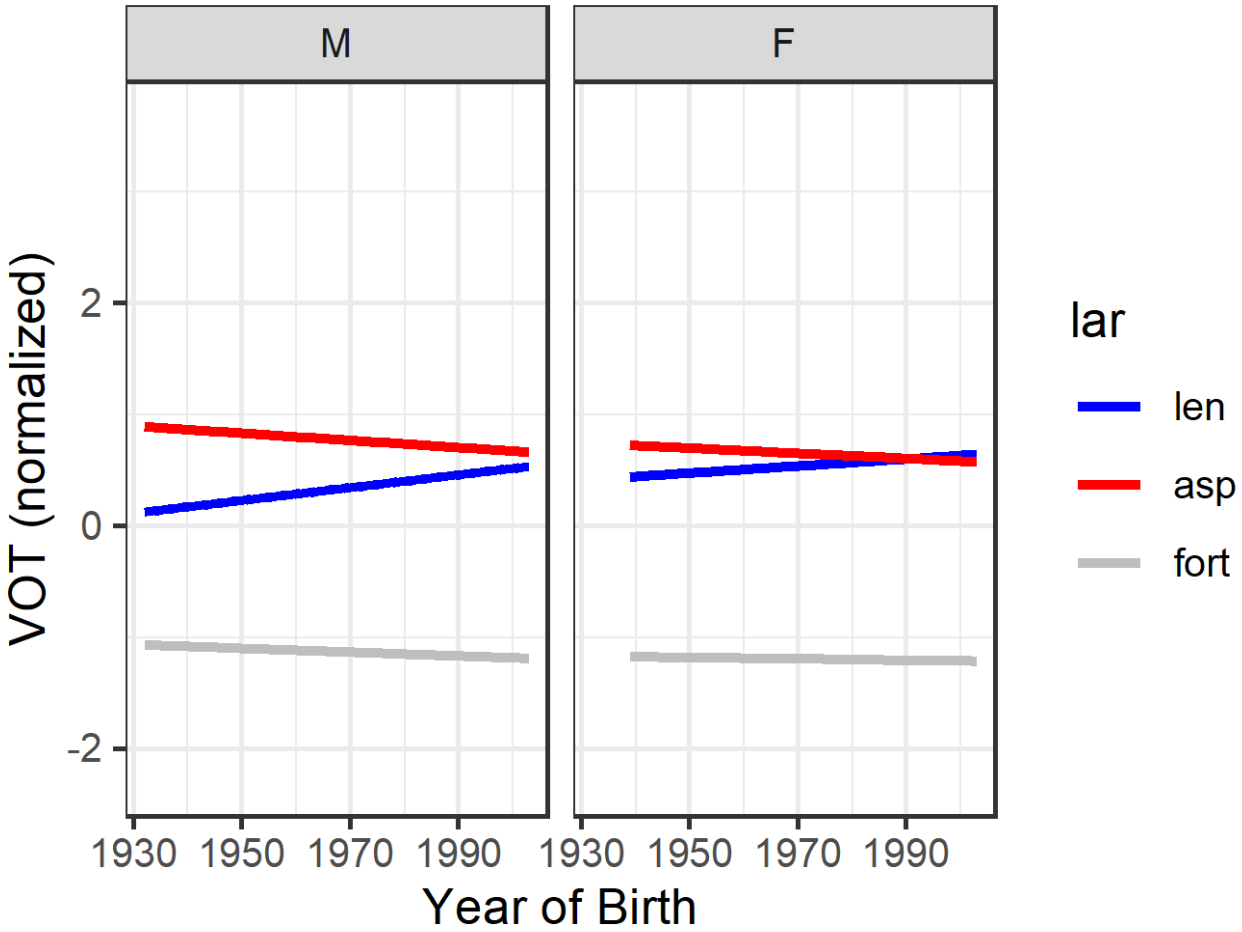
Significant interaction of Laryngeal Type and Age:
Further reduction of VOT contrast in younger speakers

Results -- VOT



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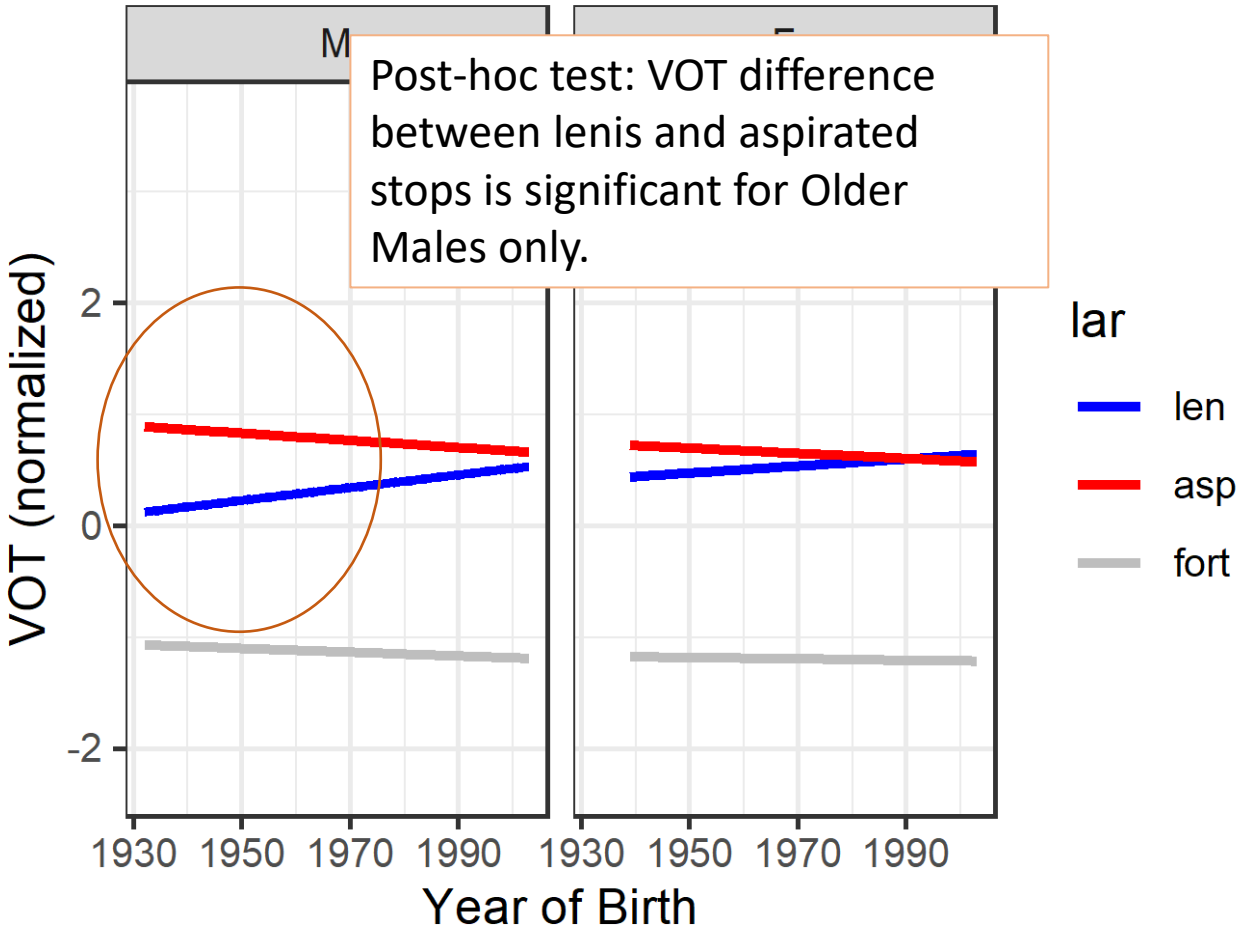
Significant interaction of Laryngeal Type and Gender:
Further reduction of VOT contrast in female speakers

Results -- VOT



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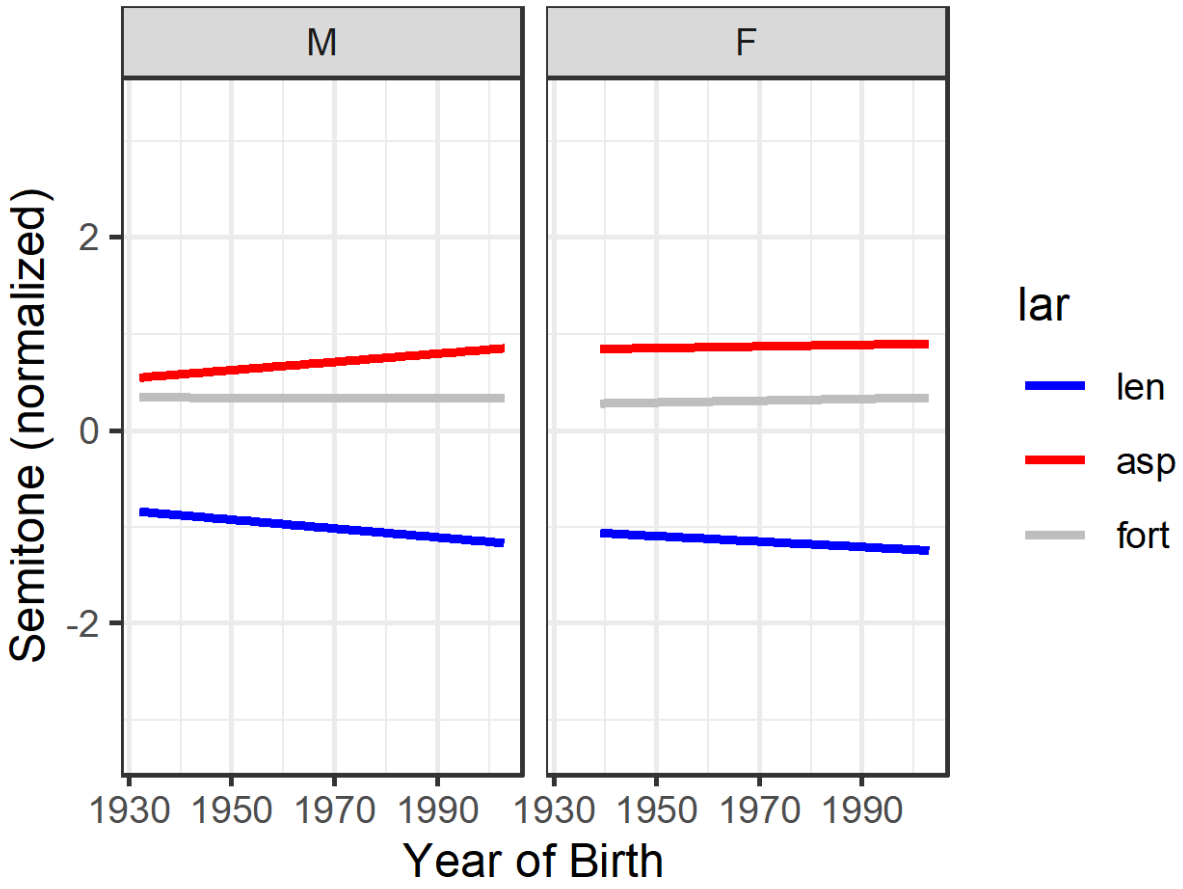
Results – F0



	Estimate	t value	Pr(>|t|)
(Intercept)	-0.149	-2.047	0.067
Lar (len – asp)	1.904	12.94	<0.001
Age (young – old)	-0.009	-0.444	0.658
Gender (F – M)	0.004	0.205	0.838
Lar * Age	0.276	4.771	<0.001
Lar * Gender	0.277	4.798	<0.001
Age * Gender	-0.046	-1.113	0.269
Lar * Age * Gender	-0.241	-2.087	0.040

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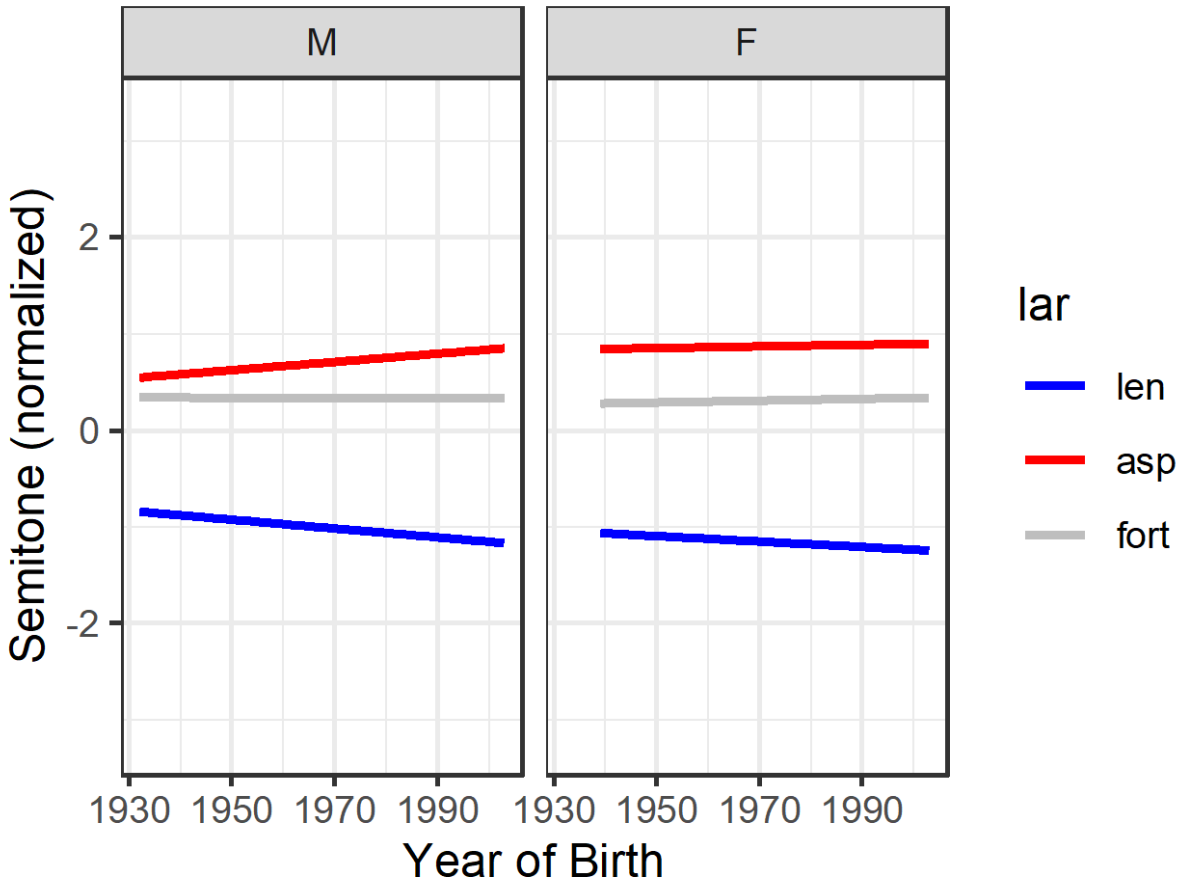

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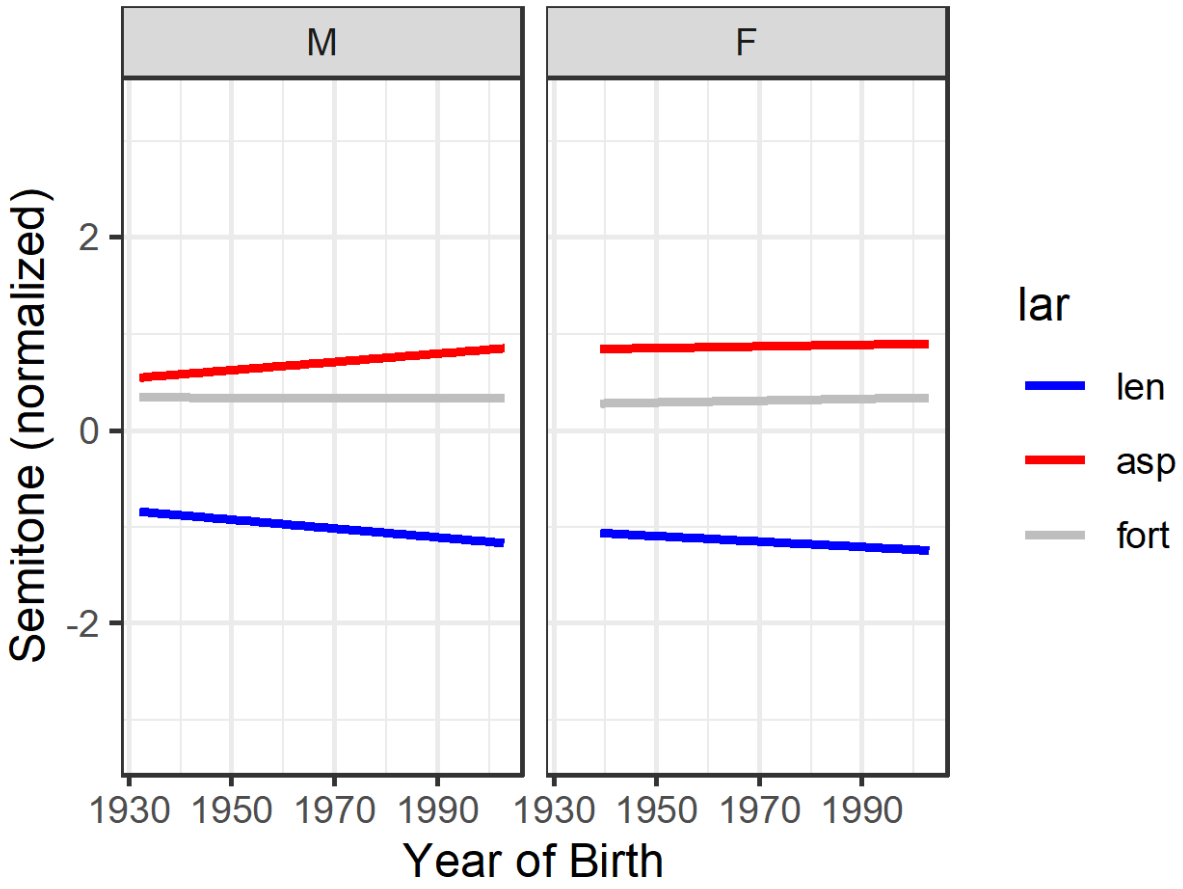
Significant main effect of laryngeal type:
F0 is higher for Aspirated than Lenis stops

Results – F0



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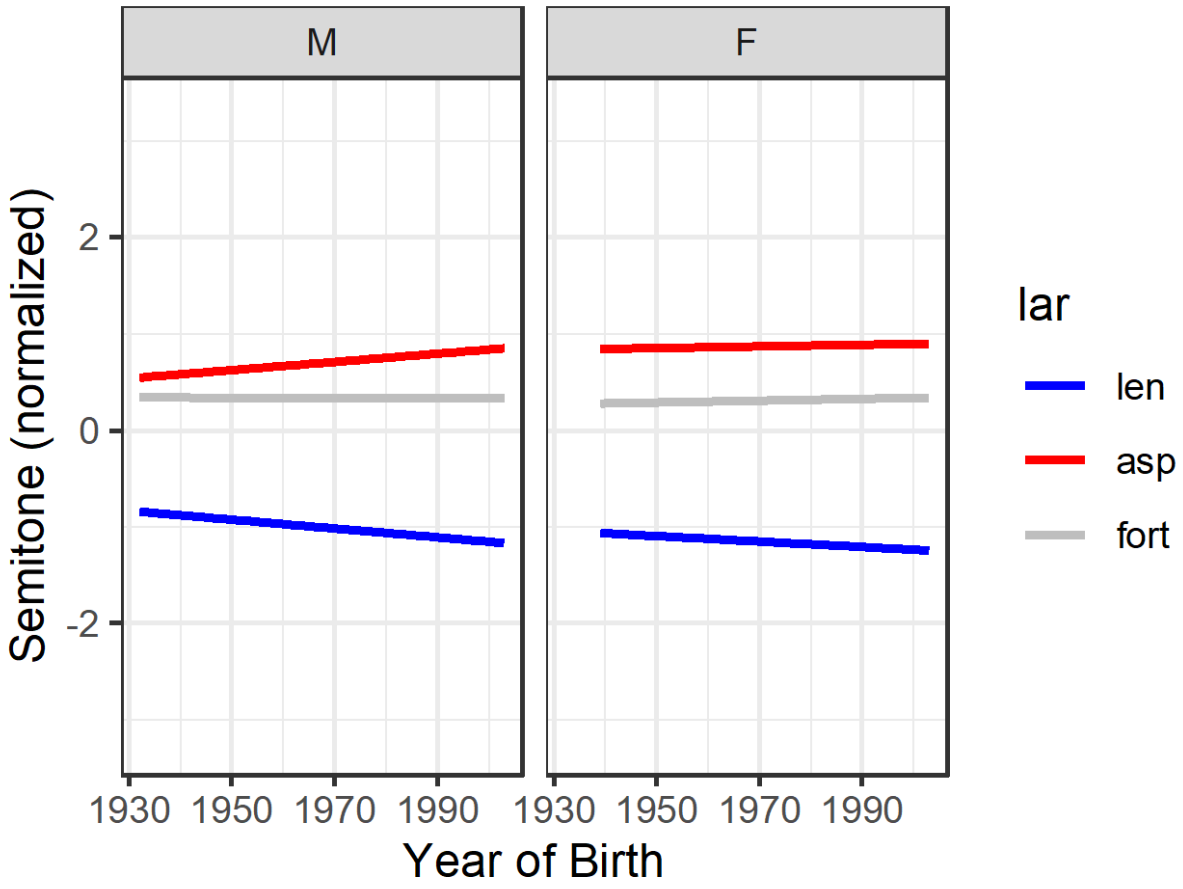
Significant interaction of Laryngeal Type and Age:
F0 difference is further enhanced in younger speakers

Results – F0



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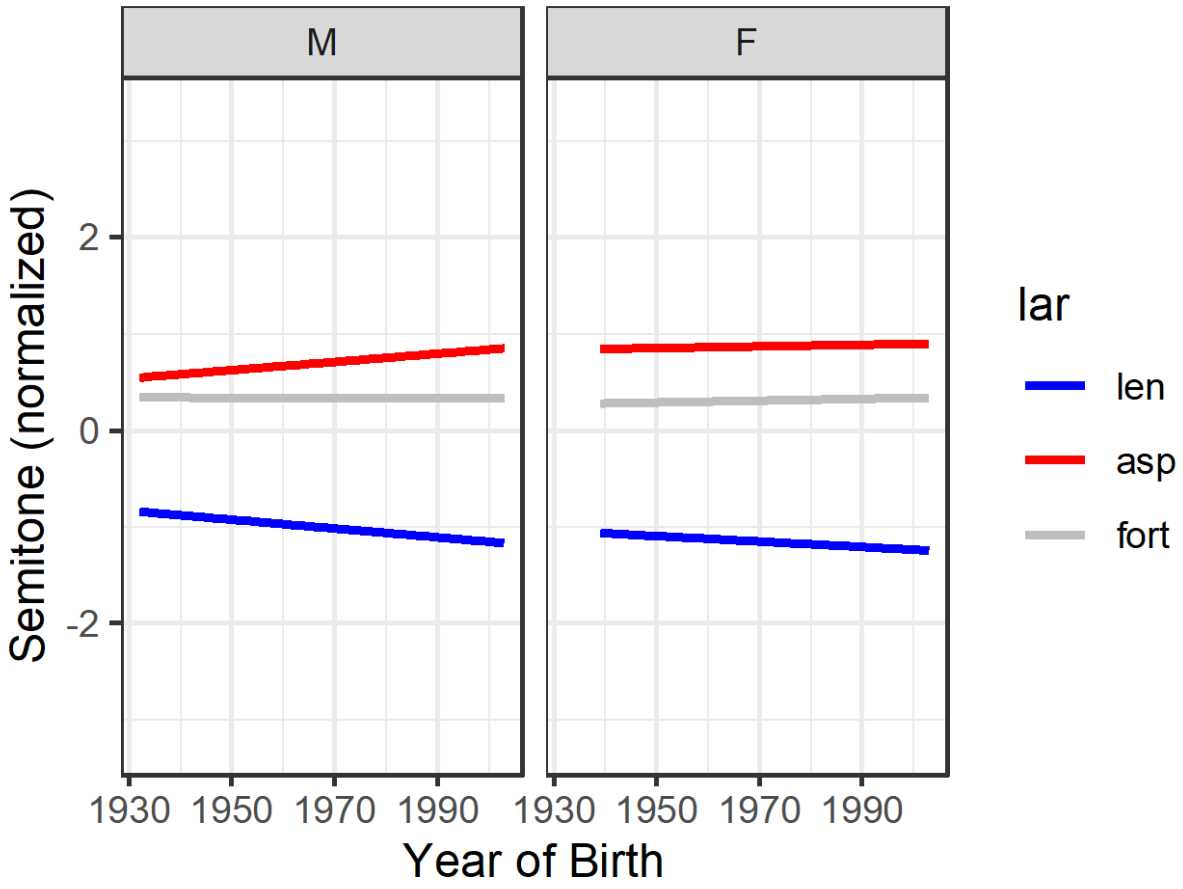
Significant interaction of Laryngeal Type and Gender:
F0 difference is further enhanced in female speakers

Results – F0



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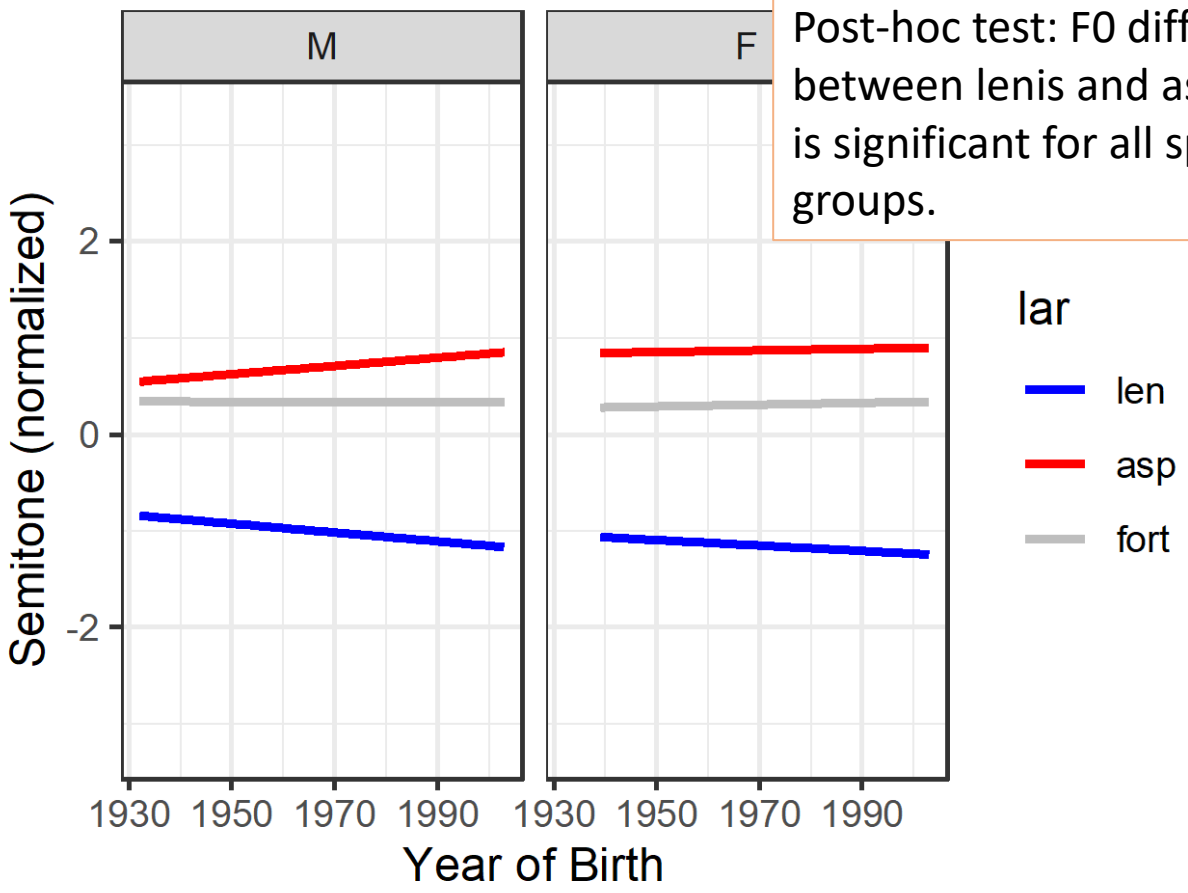
Significant three-way interaction of Laryngeal Type, Age and Gender:
F0 enhancement slows down in younger female speakers (likely reaching the endpoint of change).

Results – F0



Post-hoc test: F0 difference between lenis and aspirated stops is significant for all speaker groups.

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Summary and conclusion

- VOT merger
  - Daejeon Korean is losing the VOT distinction between aspirated and lenis stops.
  - This change is more advanced in younger speakers **compared to older ones and is also more prominent in female speakers' speech**.
- F0 enhancement
  - F0 serves as a robust cue across all speaker groups and more so for younger and female speakers.
  - **However**, the expansion of F0 distinction across different age groups is slowing down in female speech, likely due to this change reaching its near-end state.

Summary and conclusion

- This pattern is consistent with the diachronic change in Seoul dialects.
  - F0, which used to be a redundant cue, has been enhanced to a primary cue (40 Hz difference on average), and as the f0 distinction is being established, the original VOT cue is allowed to merge fully.
- Similar to other non-pitch accent dialects, Daejeon Korean is undergoing a restructuring of stop laryngeal contrasts.

Acknowledgements

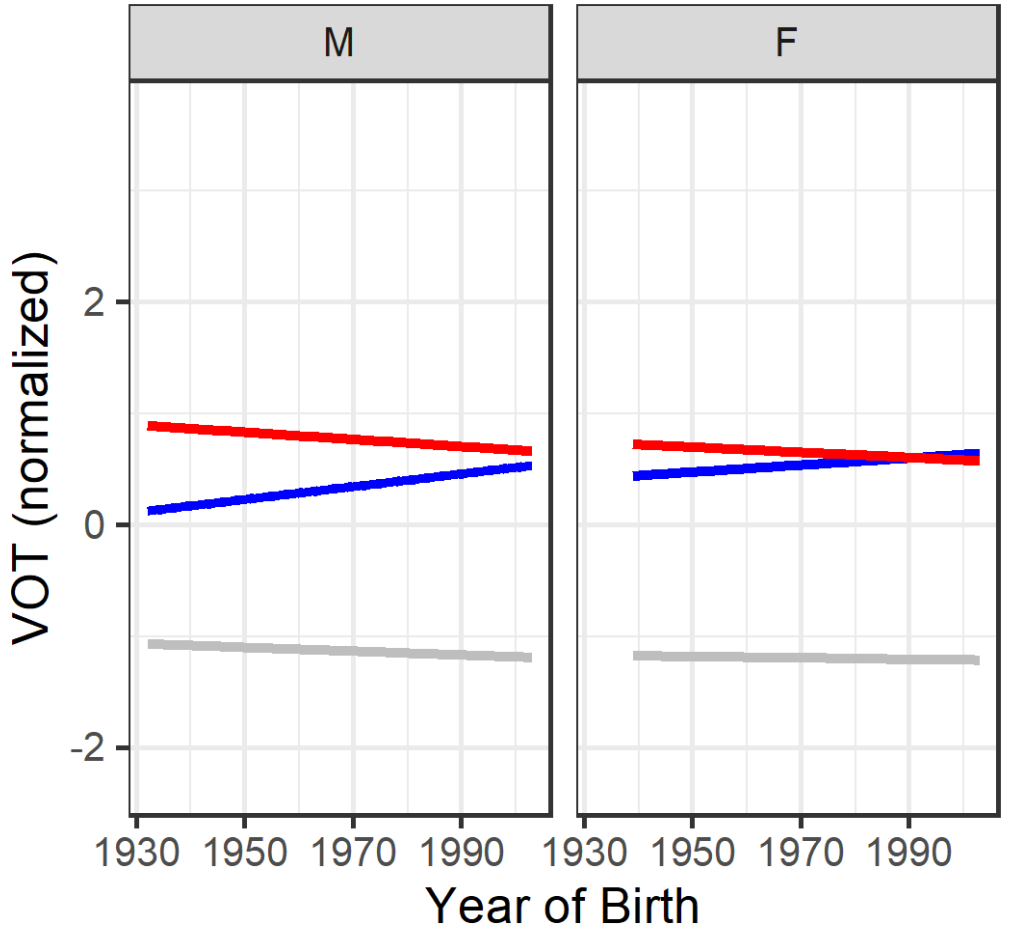
- Participants
- Jung Haechan, Park Jeongin, and Park Beomjoon for help with data collection
- Hyongseok Kwon for help with programming and acoustic data processing
- Petra Fayad and Gabby Lai for help with acoustic data segmentation
- SSHRC (Social Sciences and Humanities Research Council of Canada), University of Toronto Work Study Program for funding

Results -- VOT

Male (YOB = 1948)

/p^haL-i/

/paLam/



Female (YOB = 2000)

/p^haL-i/

/paLam/

Results -- VOT

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/p^haL-i/

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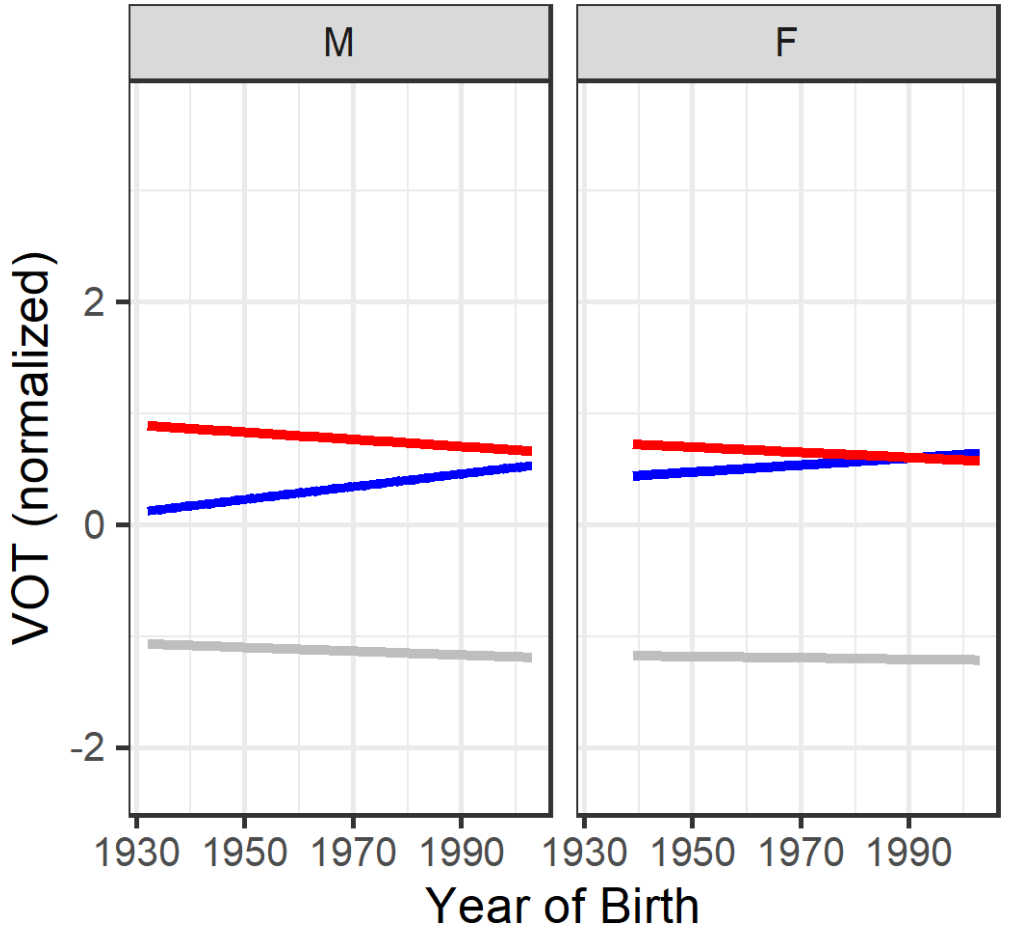

Female (YOB = 2000)

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