Cross-language perception under sound change in progress: loanword connection

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Korean laryngeal contrast: stops

- Lenis: /p t k/
- Aspirated: /pʰ tʰ kʰ/
- Fortis: /p’ t’ k’/ (/pp tt kk/)

tər-ə ‘to take out’

tʰər-ə ‘to shake off’

t’ər-ə ‘to shiver’

Loanwords: English word-initial stops

- Voiceless → Aspirated

  pan → pʰɛn

  tan → tʰɛn

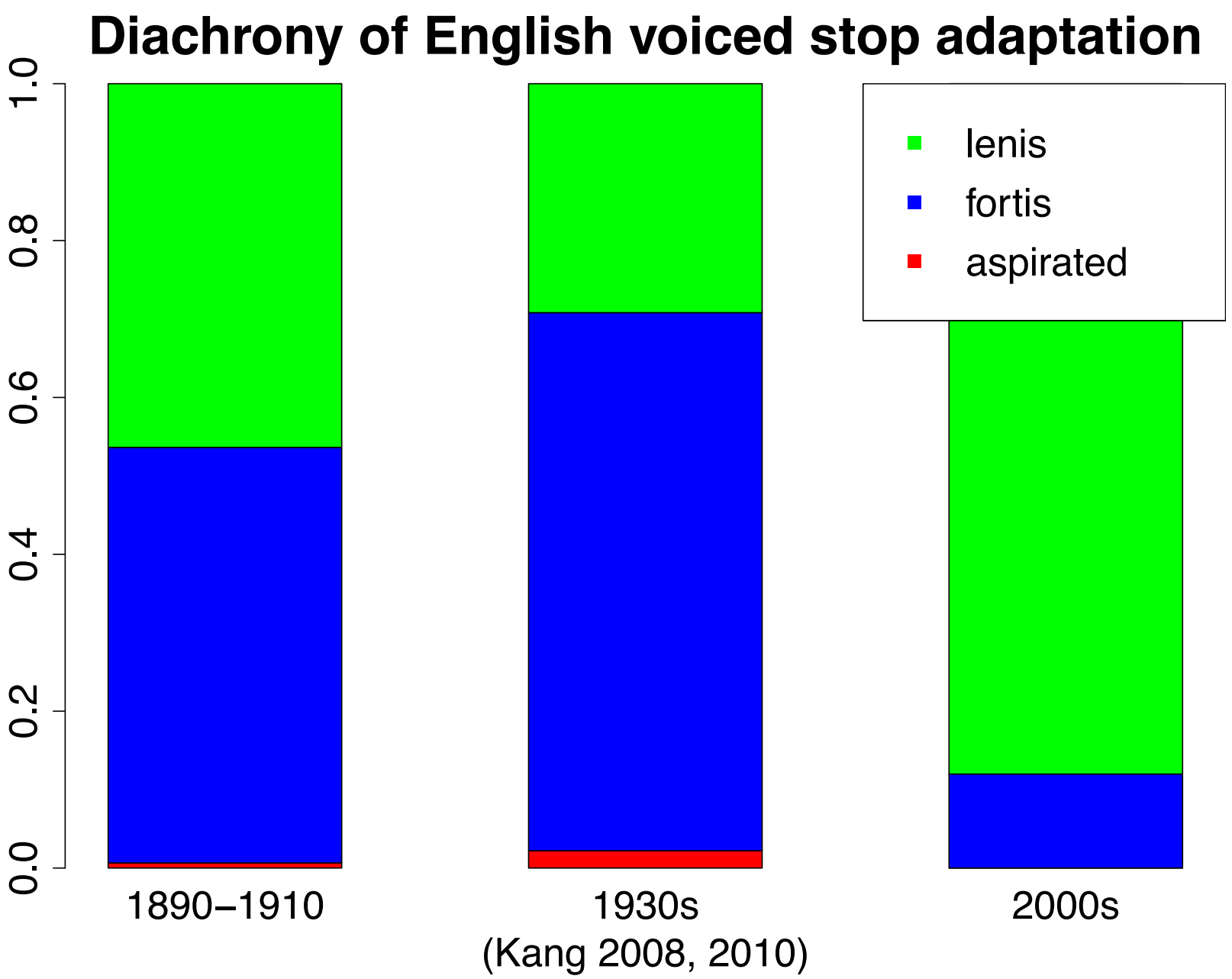
  can → kʰɛn

- Voiced → Lenis ~ Fortis

  bell → pel *bonus* → p'onəs'ɨ

  disk → tɨsɨkʰɨ *dollar* → t'alla

  guide → kaitɨ *gas* → k'as'ɨ

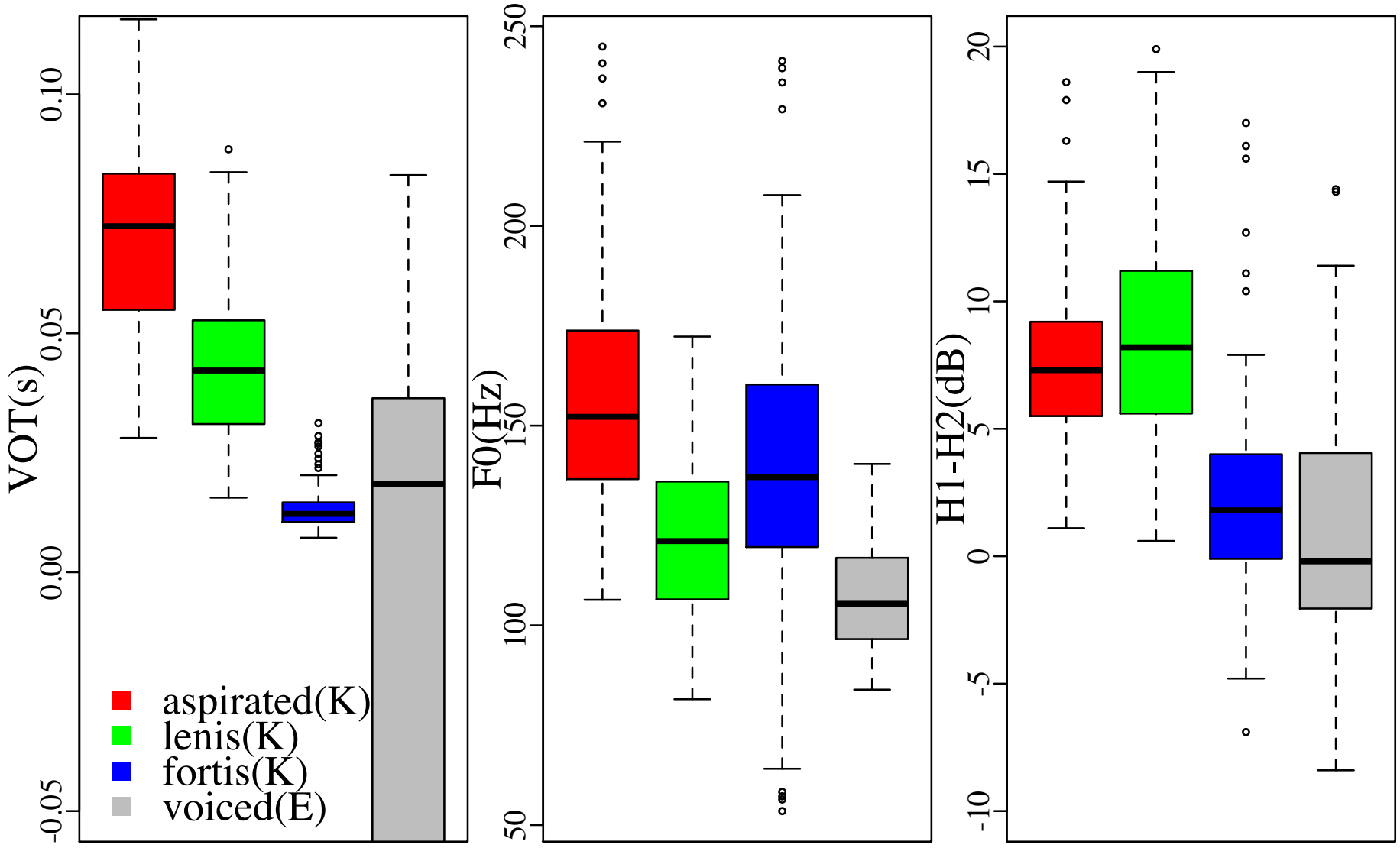

Diachrony of English voiced stop adaptation
1.0
0.8
0.6
0.4
0.2
0.0
lenis
fortis
aspirated
1890–1910
1930s
(Kang 2008, 2010)
2000s

Acoustics

- **Voice Onset Time (VOT)**:
  - correlate of voicing/aspiration
- **Fundamental Frequency (F0)**:
  - correlate of pitch
- **H1-H2 (Spectral tilt)**:
  - correlate of voice quality (breathiness, creakiness)

cf. 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) …

Comparison of Korean stops with English voiced stop



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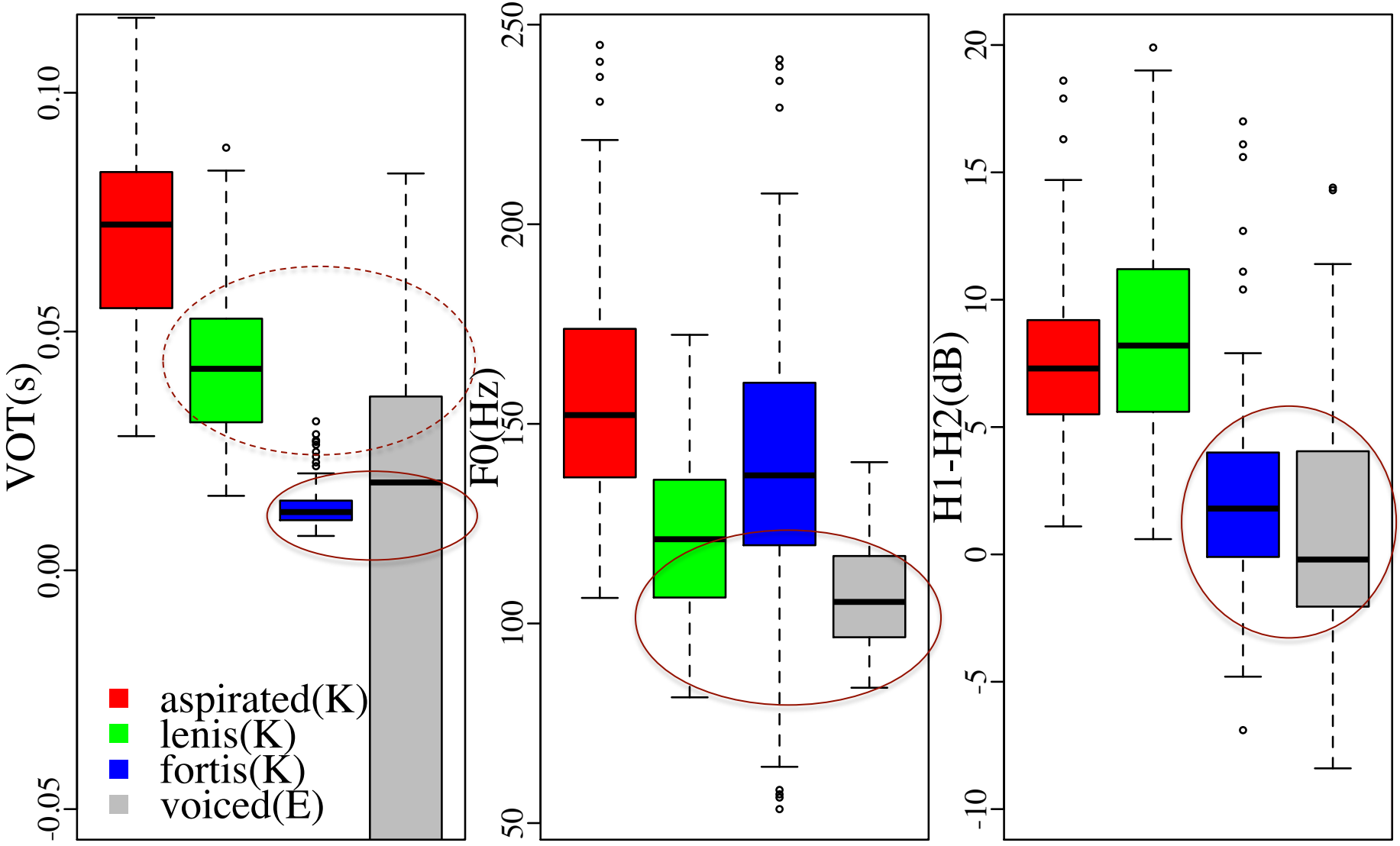
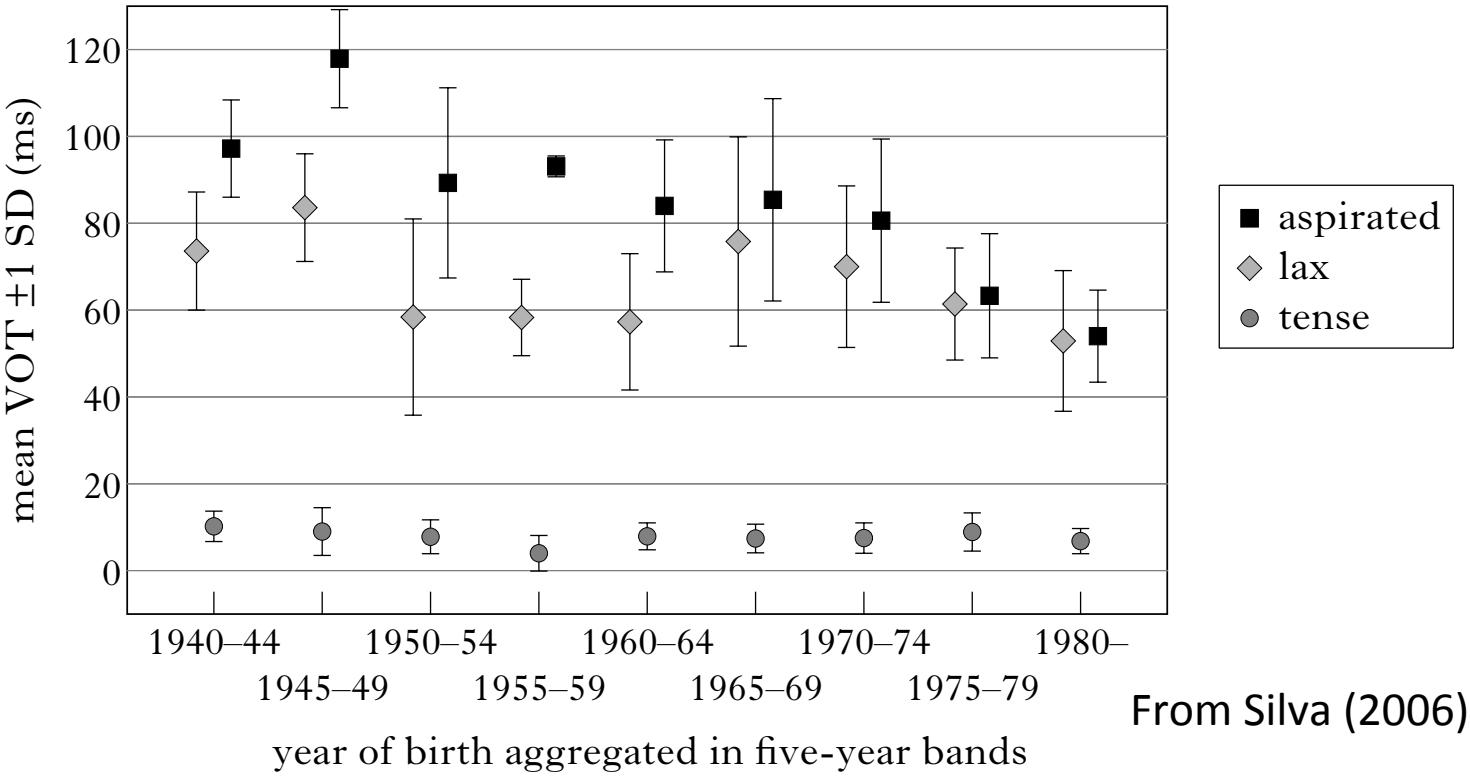


VOT: Ambiguous **F0: Lenis = Voiced** **H1-H2: Fortis = Voiced**

VOT merger in Seoul Korean



From Silva (2006)

Figure 1

Also, see Choi 2002, Kim et al. 2002, Silva 2006, Wright 2007, Kang and Guion 2008, Kong 2009, Park & Iverson 2008, Kang and Han 2011

Questions

- Q1: Is the change in loanword due to change in perception?
  - Do older and younger Koreans' perception differ mirroring loanword patterns? (cf. Bailey 1991: apparent time)
- Q2: If so, how do older and younger Koreans differ in their perception?
  - Is the difference related to the sound change in Korean?

Participants

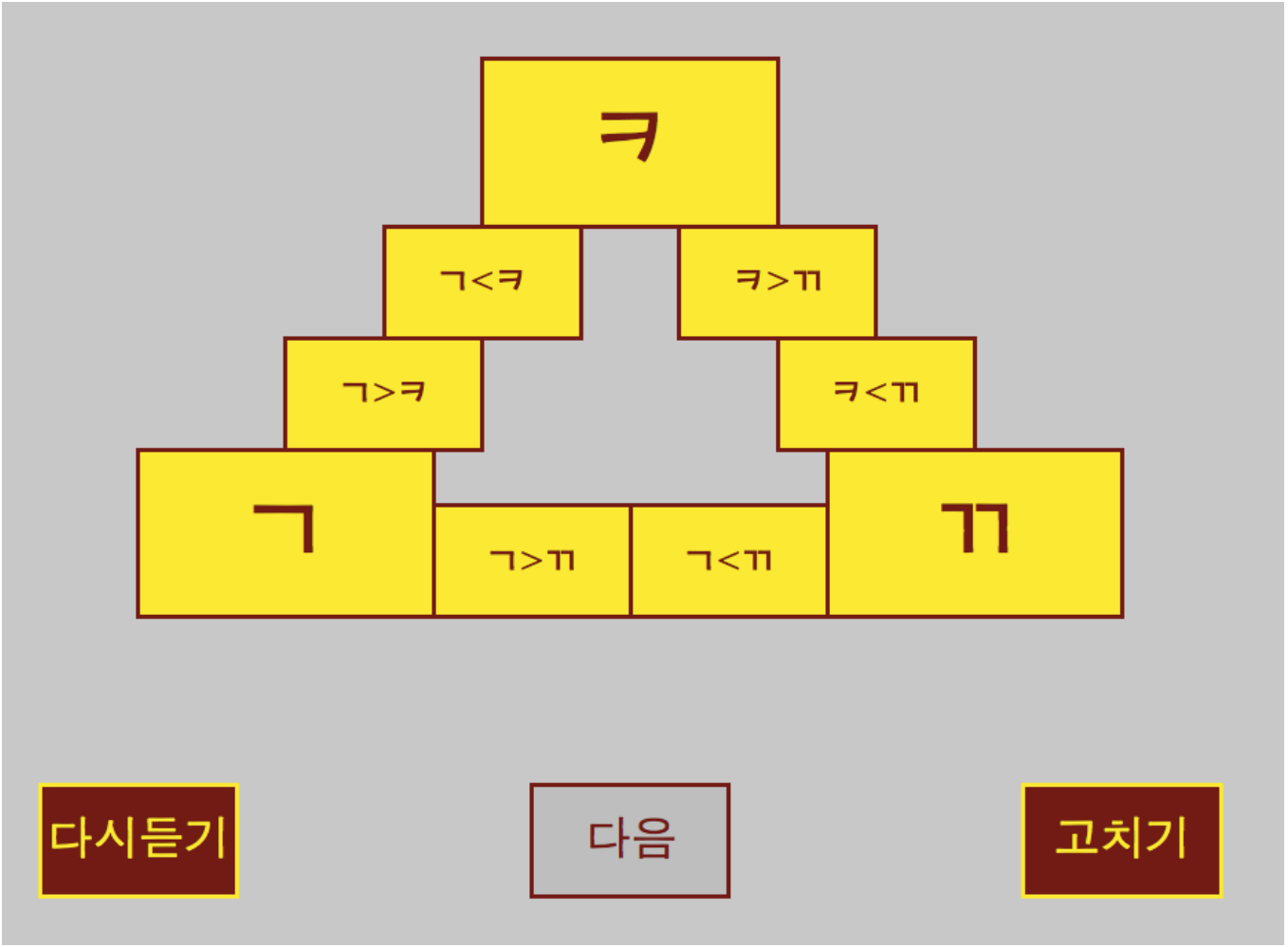
- 57 Seoul Korean speakers/listeners
  - **SO** (Older): 32 (YOB: 1943~1966), 17M & 15F
  - **SY** (Younger): 25 (YOB: 1981~1992), 14M & 11F
  - Data collected in Seoul

Perception Stimuli

- English word-initial stops in nonsense words
  - Voiced stops (gáhra, ghéera, grah)
    - 3 words*3 speakers*6 tokens= 54
  - Voiceless stops (káhra, kéera, krah) as control
    - 3 words*3 speakers*1 token=9

  ⇒63 words
- Speakers
  - 3 male speakers of English, Southern Ontario

Perception study



Production

- Material

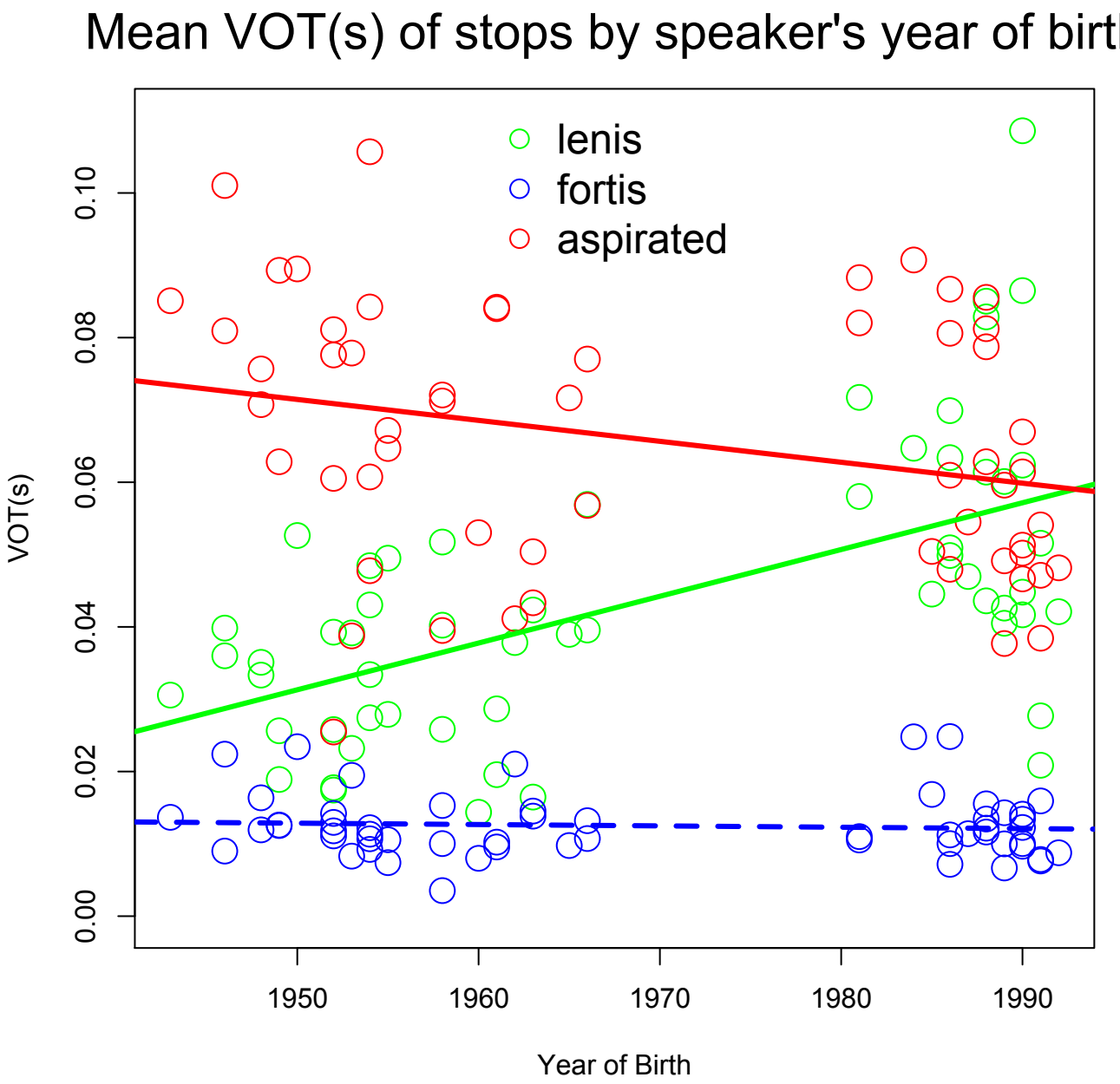
  təl-ə ‘to take out’

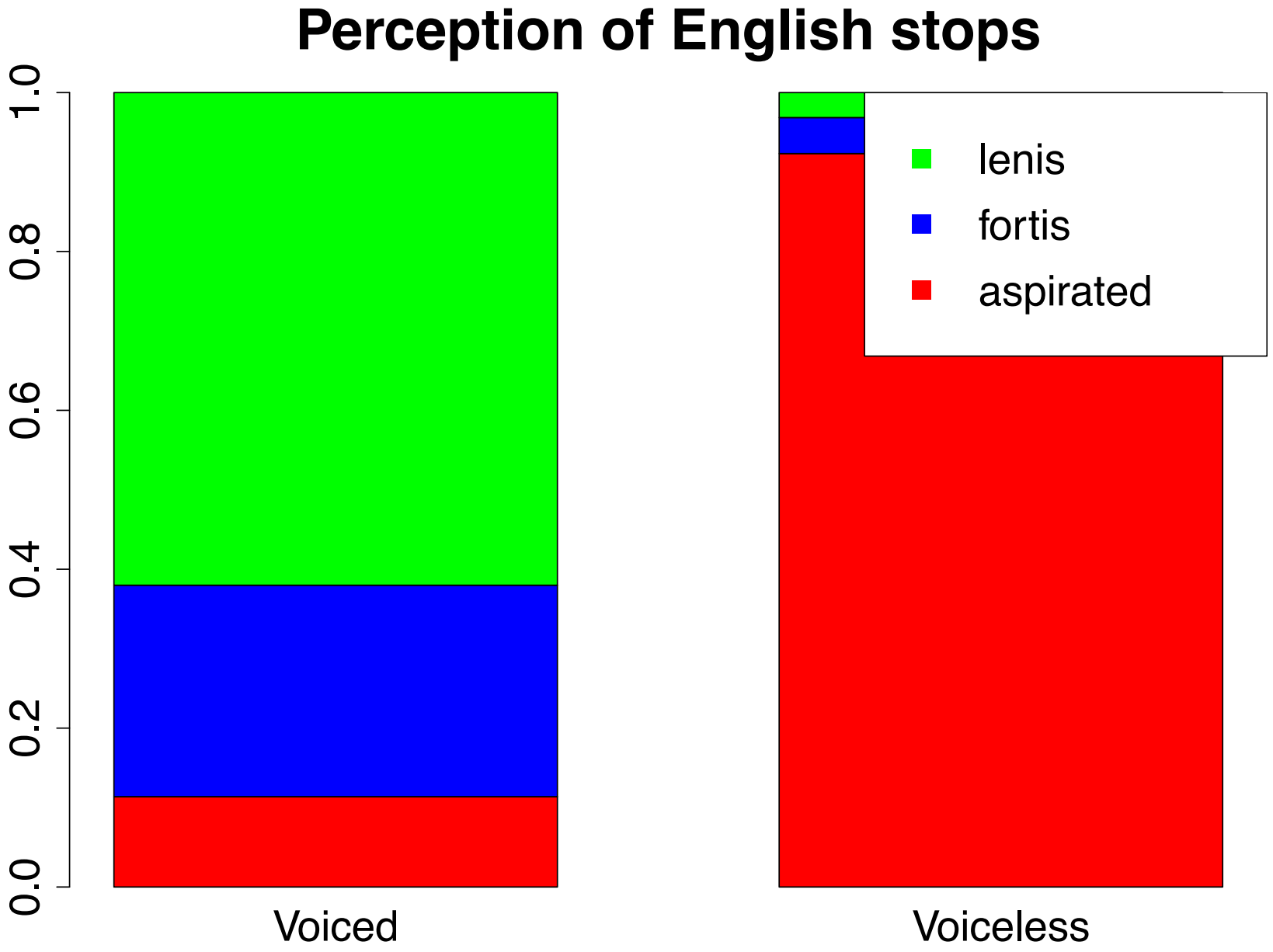
  tʰəl-i ‘hair-nom.’

  t’əl-ə ‘to shiver’

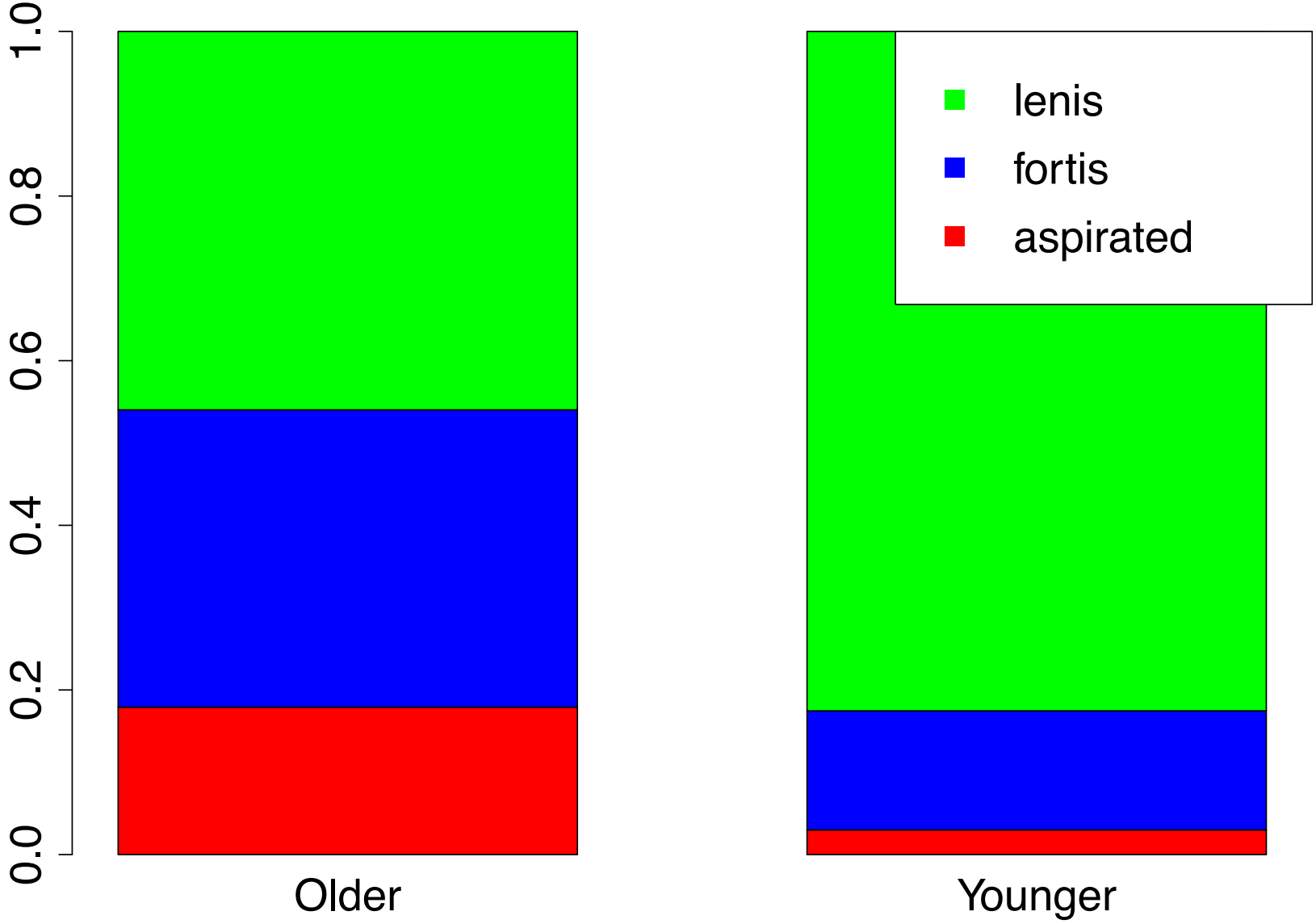
  – in isolation

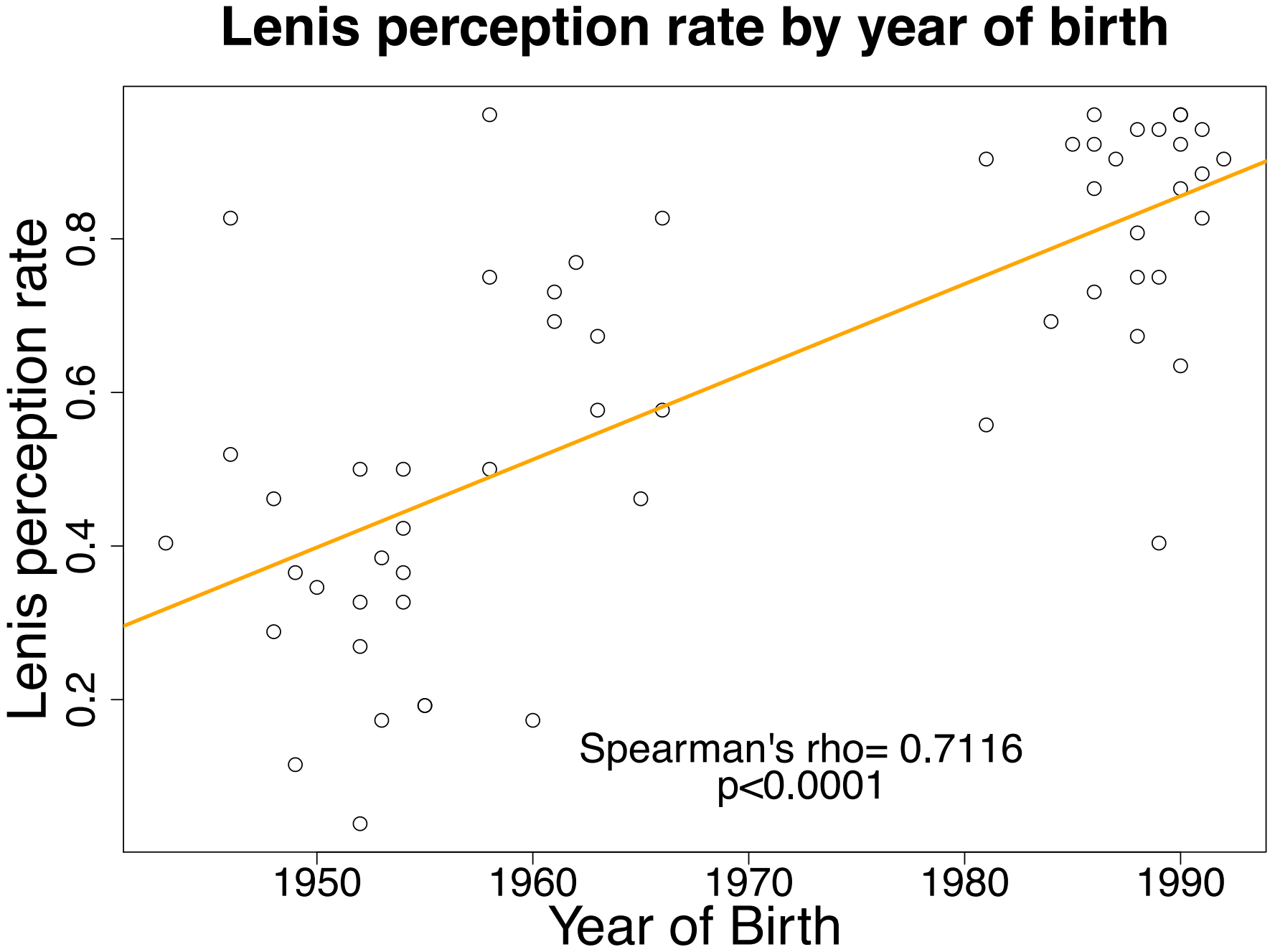
  – 3 repetitions


Mean VOT(s) of stops by speaker's year of birth
lenis
fortis
aspirated
VOT(s)
0.00
0.02
0.04
0.06
0.08
0.10
1950
1960
1970
1980
1990
Year of Birth


Perception of English stops
1.0
0.8
0.6
0.4
0.2
0.0
lenis
fortis
aspirated
Voiced
Voiceless

Perception of English voiced stops



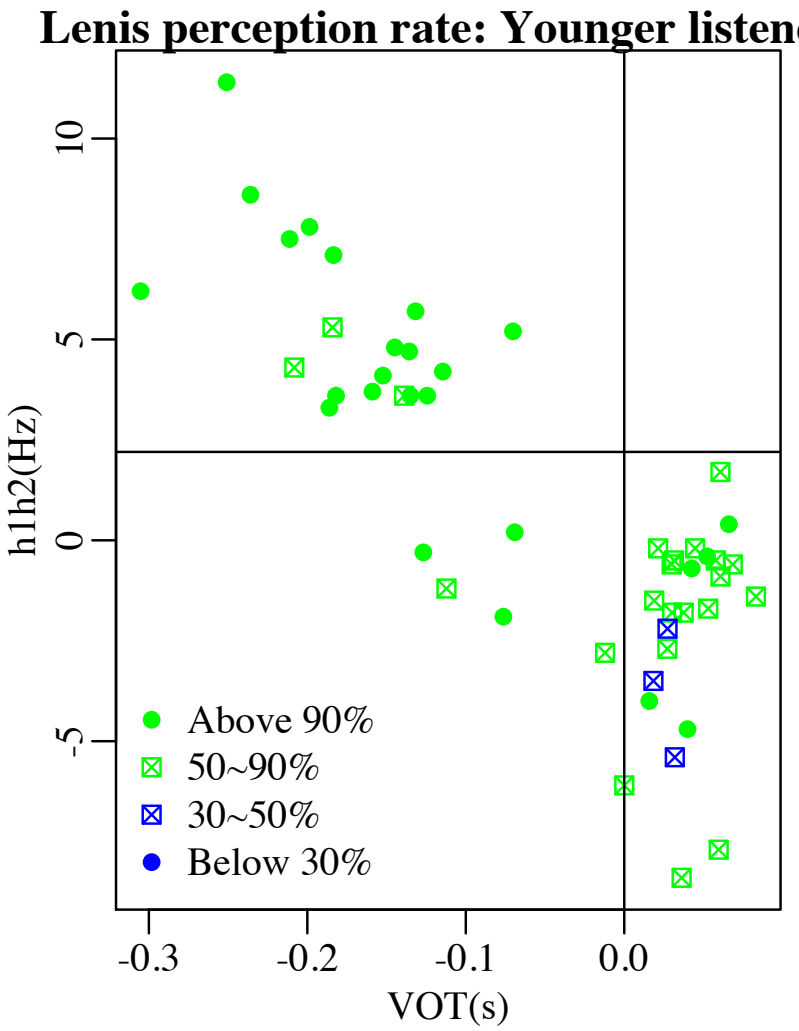

Lenis perception rate by year of birth
Lenis perception rate
0.2
0.4
0.6
0.8
1950
1960
1970
1980
1990
Year of Birth
Spearman's rho= 0.7116
p<0.0001

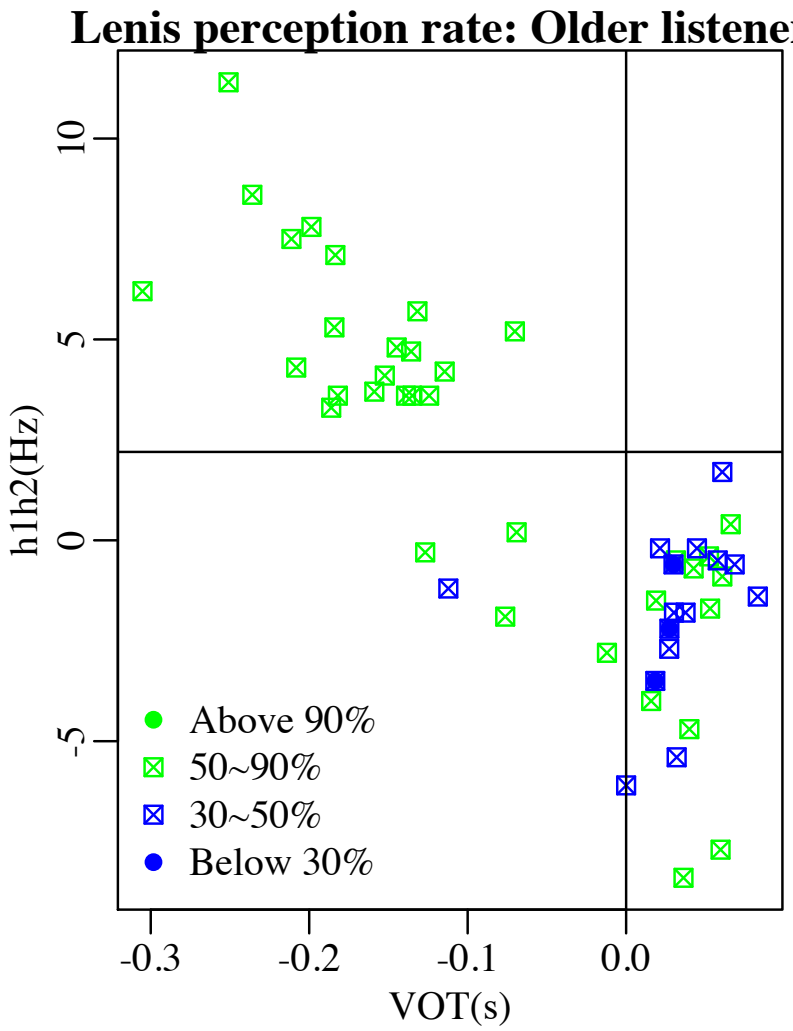
Interim summary

- Older and Younger listeners' perception mirrors the change in loanword pattern.
- Supports the view that the diachronic change in loanword pattern has a perceptual basis.
- How is the generational difference in perception related to their difference in native production?

Mixed effects model comparisons

- Dependent variable: k vs. kk
- Fixed effects: scale(f0), scale(h1h2), scale(vot)
- Random effect: subject, fully crossed
- Separate models for SO and SY
- Comparison of full model vs. model with two of the fixed effects
  - SO: Only h1h2 and vot are significant.
    - h1h2 $\chi^2(5)=23.045$, $p<0.001$
    - vot $\chi^2(5)=79.647$, $p<0.0001$
    - f0 $\chi^2(5)=1.6739$, $p=0.8922$
  - SY: All three are significant:
    - h1h2 $\chi^2(5)=13.108$, $p<0.05$
    - vot $\chi^2(5)=88.675$, $p<0.0001$
    - f0 $\chi^2(5)=34.807$, $p<0.0001$


Lenis perception rate: Younger listeners
h1h2(Hz)
10
5
0
-5
-0.3
-0.2
-0.1
0.0
VOT(s)
Above 90%
50~90%
30~50%
Below 30%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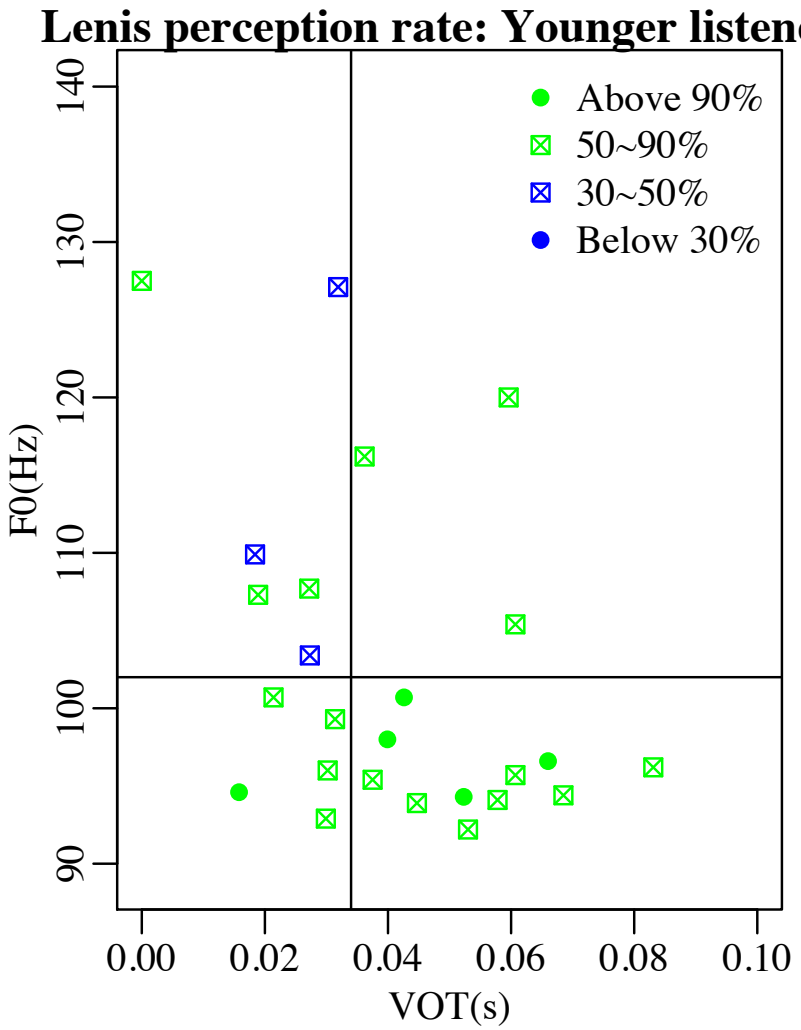
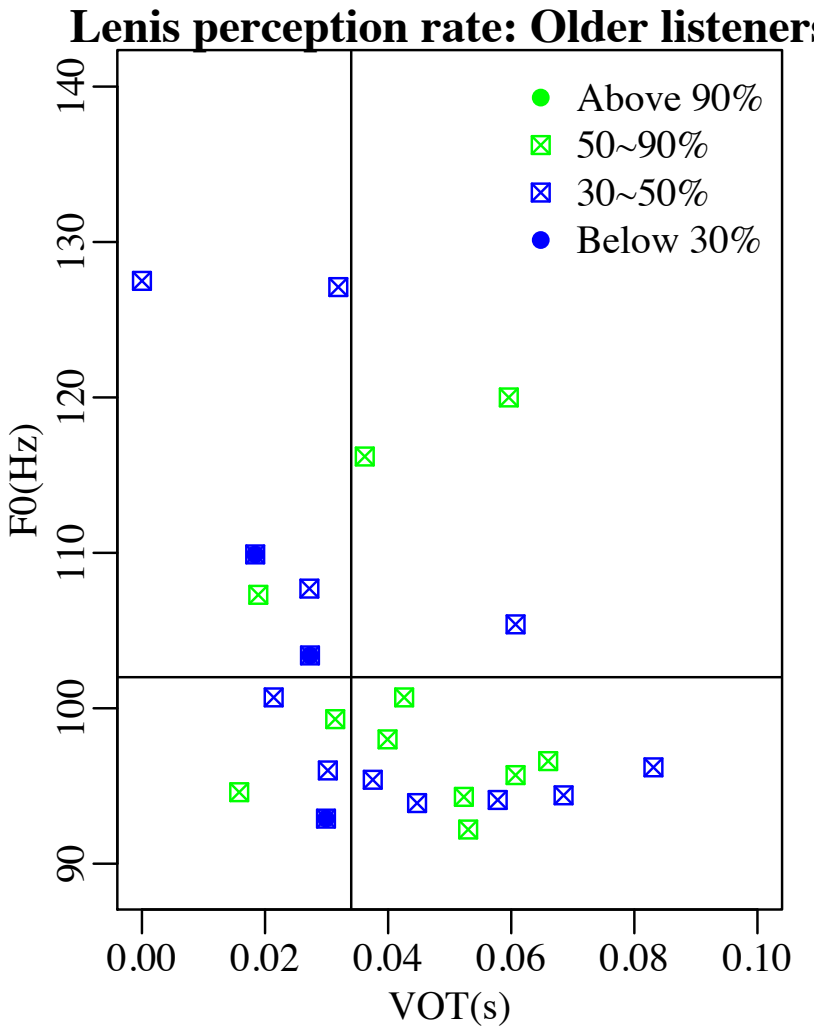

Lenis perception rate: Younger listeners
Above 90%
50~90%
30~50%
Below 30%
F0(Hz)
140
130
120
110
100
90
0.00
0.02
0.04
0.06
0.08
0.10
VOT(s)


Lenis perception rate: Older listeners
Above 90%
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F0(Hz)
140
130
120
110
100
90
0.00
0.02
0.04
0.06
0.08
0.10
VOT(s)

SY

- Lenis perception below 50% is found only for stimuli that meet the following conditions:
  - Low H1-H2 (non-breathy voice)
  - Short-lag VOT (voiceless unaspirated)
  - Higher F0 (higher pitch on the following V)
- Elsewhere, Lenis perception is the majority.

SO

- Lenis perception below 30% is limited to tokens with:
  - Negative H1-H2 (Non-breathy voice)
  - Short lag VOT (voiceless unaspirated)

  But,
  - May have high or low F0

F0

- Younger listeners show sensitivity to F0 but not older listeners.
- Due to VOT merger, F0 becomes "contrastive" in lenis vs. aspirated contrast, in younger speakers' speech. (cf. "Tonogenesis" Silva 2006)
- Younger speakers/listeners may have become more sensitive to F0 in lenis vs. fortis contrast as well.

Cf. Choi 2002, Kim et al. 2002, Silva 2006, Wright 2007, Kang and Guion 2008, Kong 2009, Park & Iverson 2008, Kang and Han 2011

General “bias” toward lenis by younger listeners: Exposure to English

- Younger speakers have more exposure to English.
- They perceive English stimuli according to English category and map them to Korean category by analogy to the general pattern (=lenis).
- They choose fortis only when it is a very convincing exemplar.
- Plausible but not likely the whole story
  - We find similar preference (although less striking) for lenis perception by younger listeners even for Japanese voiced stops.

Task effect?

- Younger listeners are in general more “accurate” in showing sensitivity to cues in the right direction.
- They are likely more comfortable with a compute-mediated task.
- Plausible but not likely the whole story
  - Older listeners still show sensitivity to H1-H2 and VOT but not F0.
  - The asymmetry between these cues within the older listeners need to be explained regardless.

Summary

- Younger listeners show far less fortis responses than older groups.
- Younger speakers differ from SO speakers in their VOT realization of stops.
- Younger speakers are sensitive to F0 and VOT as well as H1-H2 cues while older listeners only show sensitivity to H1-H2 and VOT.
- These differences may be related to the sound change in Korean stops.
- General bias toward lenis stops by younger listeners may have additional explanations.

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