VOT merger in progress and speech rate accommodation in perception: a case study of Daejeon Korean

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Speech rate and production

- Compared to slow/normal speech, fast speech is marked by
  - shortening of segments
  - gestural overlap
  - articulatory reduction
  - prosodic reorganization
  - deletion and lenition of segments and syllables
    - Baese-Berk et al. 2018; Cohen Priva and Gleason 2018; Crystal and House 1988; Ernestus 2014; Fougeron and Jun 1998

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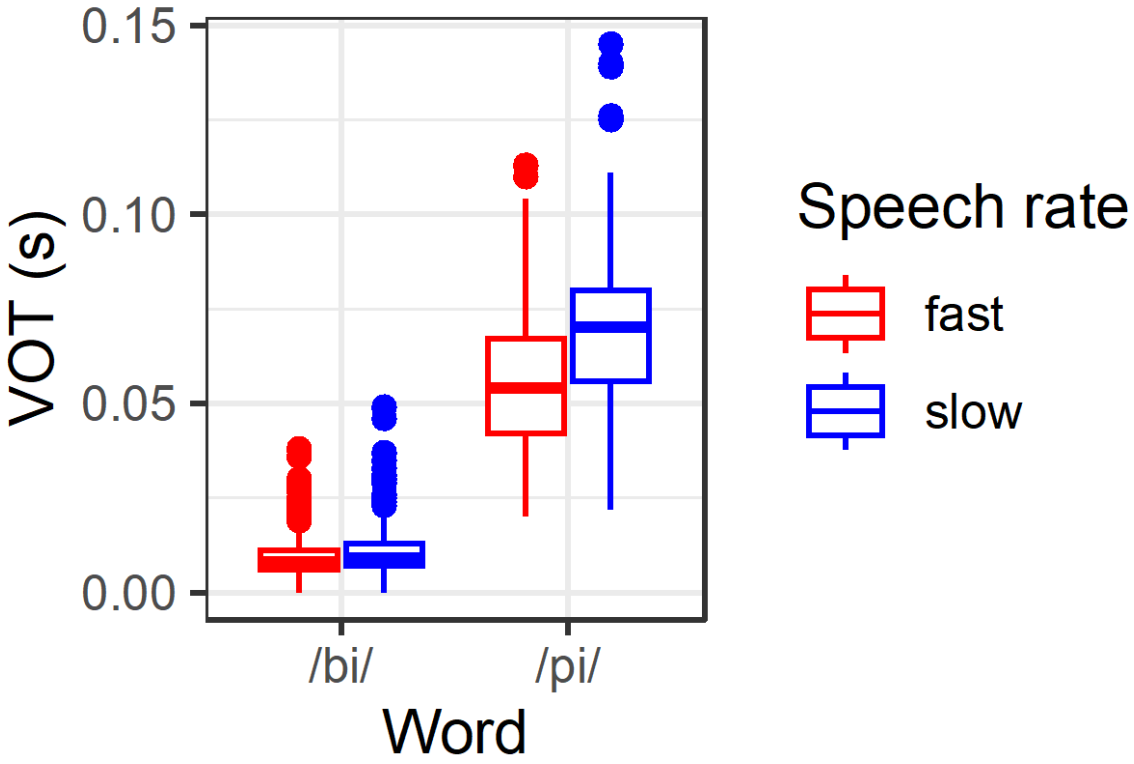
    - Baese-Berk et al. 2018; Cohen Priva and Gleason 2018; Crystal and House 1988; Ernestus 2014; Fougeron and Jun 1998
- Such variation could potentially blur the contrast between long and short segments.

Perceptual compensation

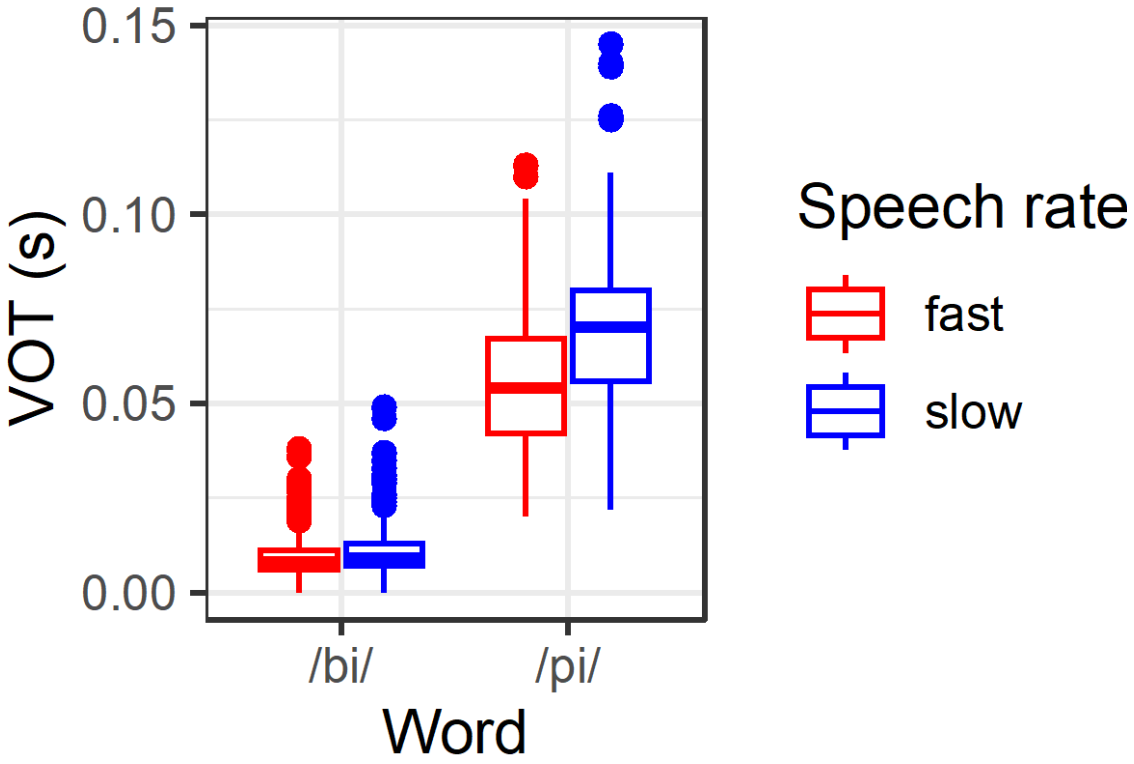
- Listeners take into account the context of speech and adjust their perception in a process known as **perceptual compensation**.
    - Drager 2011; Hay et al. 2006a; Hay et al. 2006b; Johnson et al.1999; Koops 2008; Mann 1980; Mitterer 2006; Niedzielski 1999; Schertz et al. 2019; Strand 1999; Strand and Johnson 1996; Yu 2010
- Speech rate and perceptual compensation
    - Listeners are more likely to perceive a given duration as “long” when embedded in fast speech than in slow speech, other things being equal.

Speech rate & VOT **production** (English)

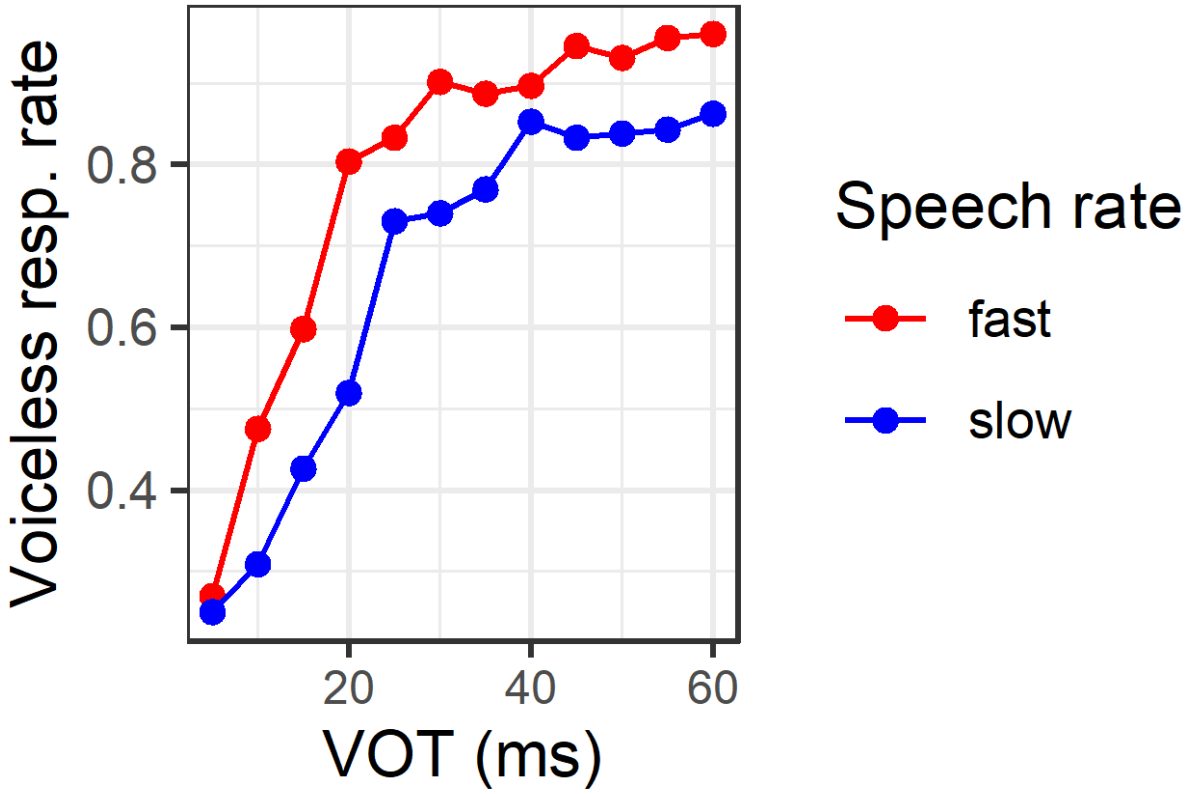


Kang, et al. (2018)

Speech rate & VOT **production** (English)



Speech rate & VOT **perception** (English)



Kang, et al. (2018)

Korean stops

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

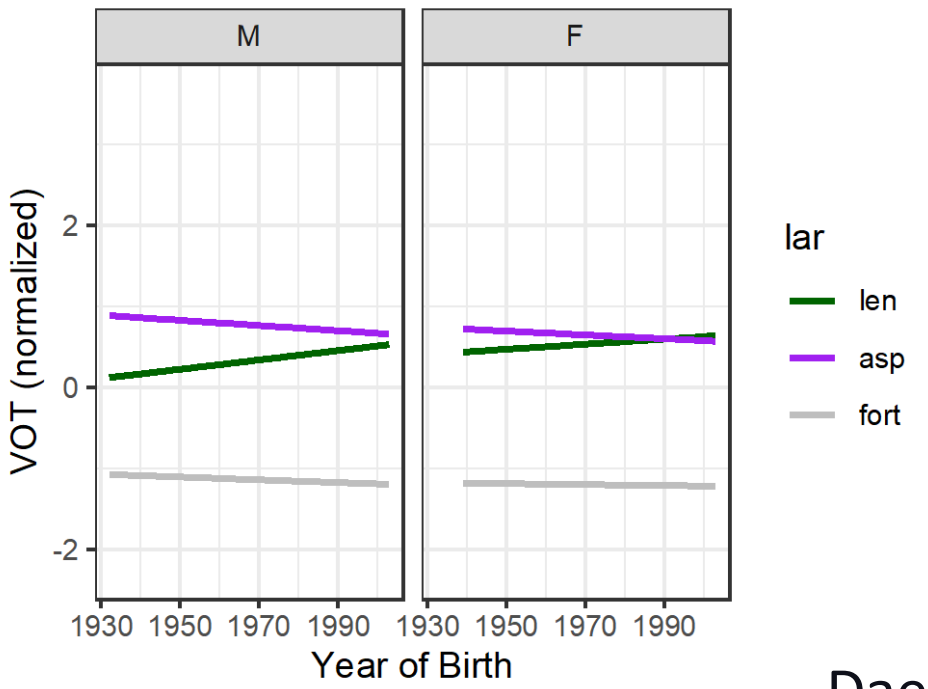
Short VOT Long VOT

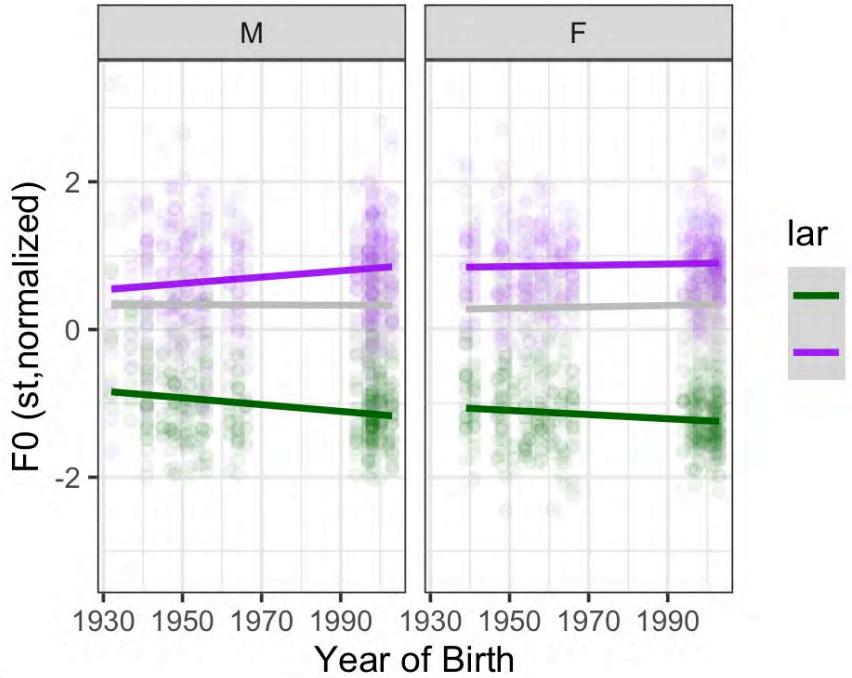
- Three-way contrast in stops

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

VOT merger in Korean stops

- **Aspirated (long VOT)** and **lenis (intermediate VOT)** stops are merging in VOT, while the F0 of following vowel is taking over as the primary cue.





Daejeon Korean

Kang, Gao, Yun & Ryu (this conference)

VOT merger in Korean stops

- **Aspirated (long VOT)** and **lenis (intermediate VOT)** stops are merging in VOT, while the F0 of following vowel is taking over as the primary cue.
- Pan-Korean change: A similar trend is reported for almost all dialects of Korean examined.

  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), Ahn (2017), Bang et al. (2018), H. Lee & Jongman (2018), Kang, Han, Ryu, Schertz, & Yun (to appear), Kang, Schertz & Han (2022)

VOT merger in Korean stops

- **Aspirated (long VOT)** and **lenis (intermediate VOT)** stops are merging in VOT, while the F0 of following vowel is taking over as the primary cue.
- The change is led by younger and female speakers, resulting in **age- and gender-based variation**.

Goals of the study

- Do listeners compensate for speech rate when the target duration contrast (VOT) is undergoing merger and VOT is no longer a reliable cue?
- If they do, do they make adjustment differently depending on
  - **the listeners' own** speech pattern?
    - Ladefoged & Broadbent 1957, Janson 1983, Miller & Grosjean 1997, Hay et al. 2006, Drager 2011, Fridland & Kendall 2012, Kendall & Fridland 2012
  - **the talker's** (expected) speech pattern?
    - Johnson et al. 1999, Strand 1999, Niedzielski 1999, Hay et al. 2006a,2006b, Koops et al. 2008, Drager 2010, Schertz et al. 2017

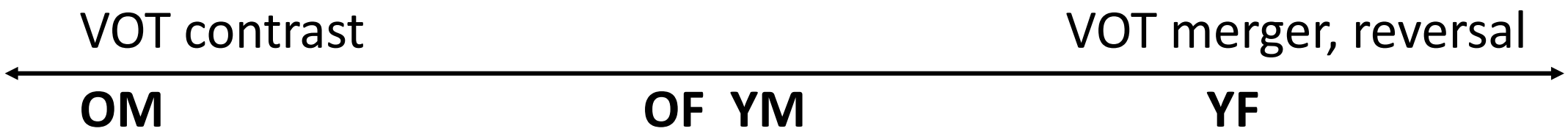
Language and participants

- 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

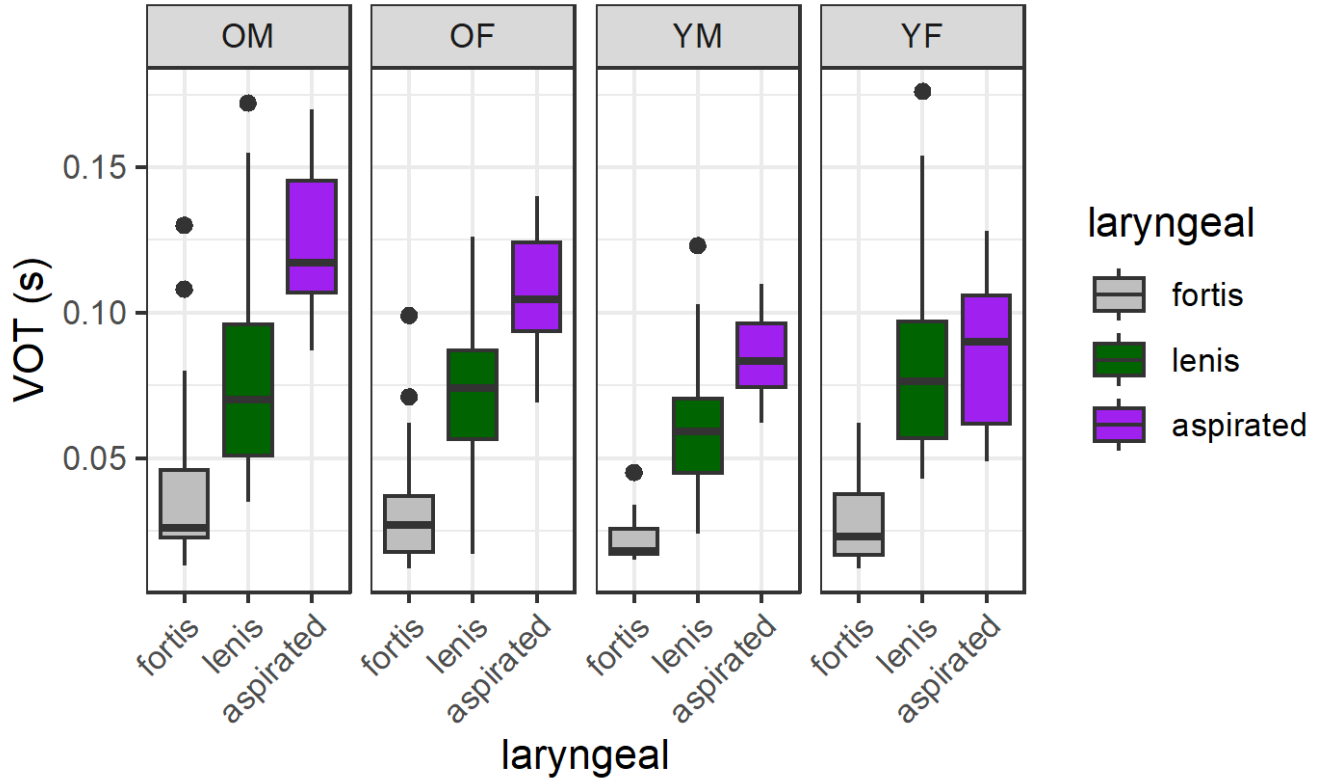
Perception stimuli talkers

- Self-identified Daejeon natives
- Representing four age/gender groups expected to be at different stages of sound change.



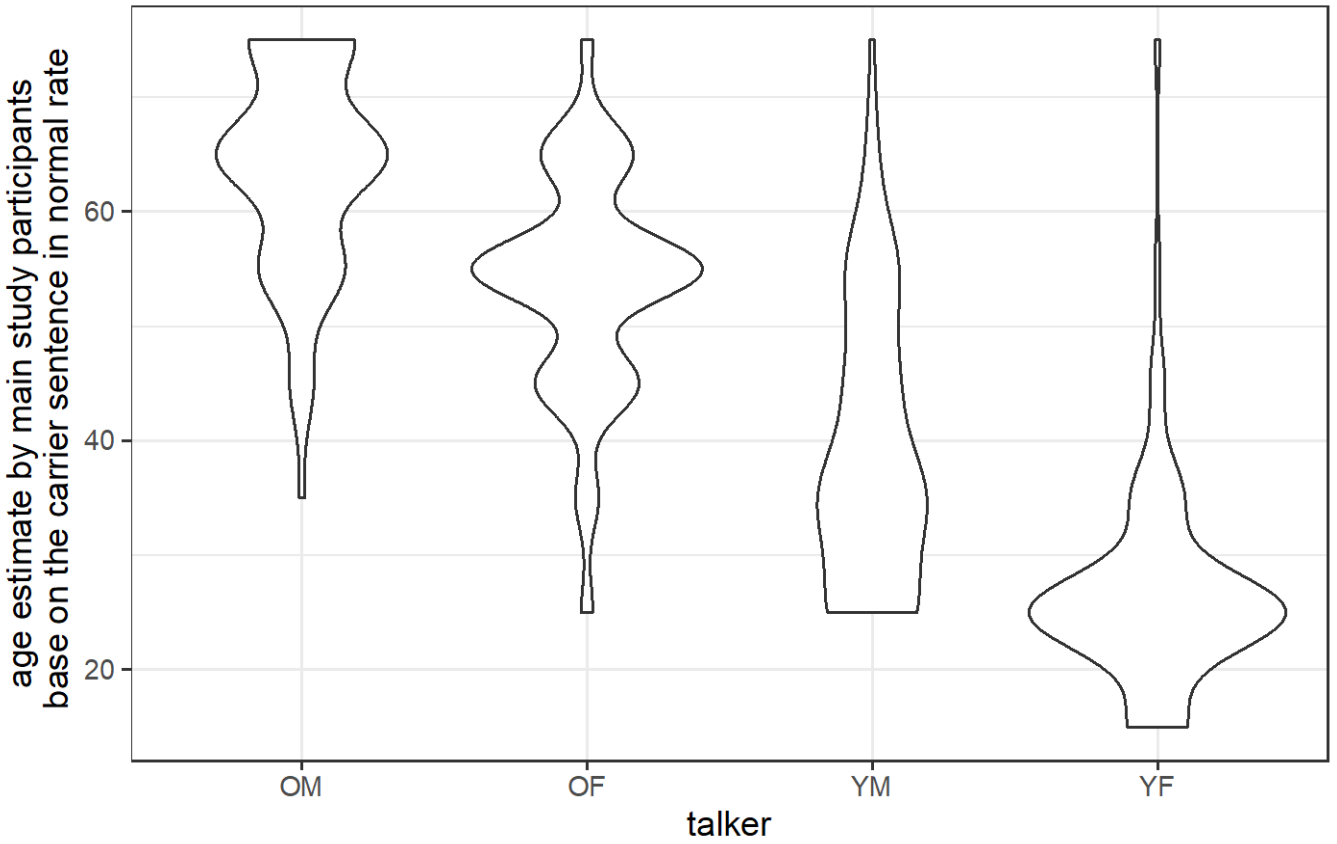
Perception stimuli talkers

- Production matches the expected pattern based on their age/gender



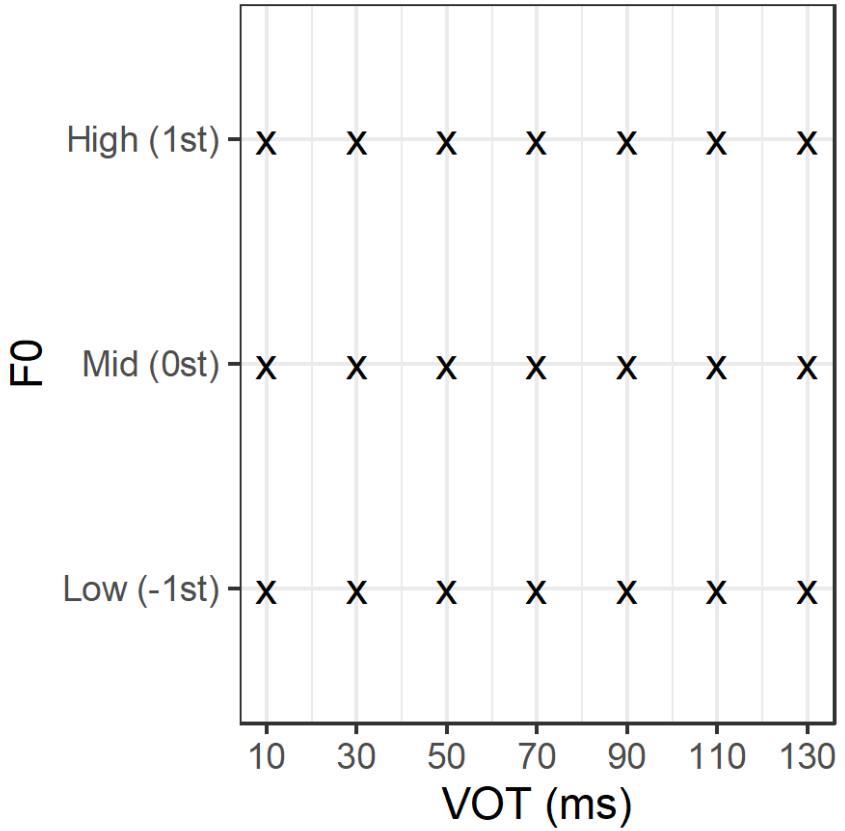
Perception stimuli talkers

- Judged to be younger vs. older by our main study participants as well as pilot participants



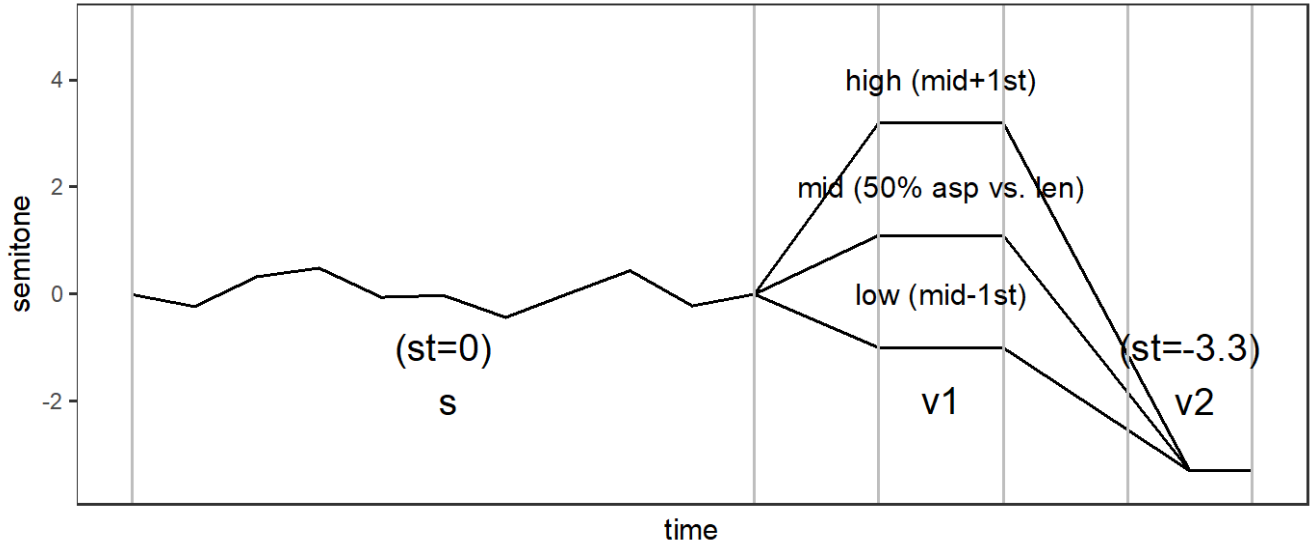
Perception stimuli

- Comparable acoustic space across the participants
- A monosyllable /Pa/ ([p^ha] baseline)
- Manipulated to vary in:
  - VOT (7 steps, 10-130 ms)
  - F0 (3 steps, Low-Mid-High, 1 semitone intervals)



F0 range and manipulation

- Mid: 50% lenis-aspirated response level for each talker, determined by a 29 speaker pilot
- Low and High are 1 semitone away from Mid



Perception stimuli

- Carrier sentence:
  - 문장 맨 마지막 말은 __다. “The last word of the sentence is __.”
  - Manipulated to vary between **slow** (120 % of mean duration of all natural productions by the four talkers) and **fast** rates (80 %).
- 168 stimuli (2 rates * 7 VOT levels * 3 F0 levels * 4 talkers)

Older Male		Younger Female	
Slow	**Fast**	**Slow**	**Fast**
			
VOT = 70ms		VOT = 70ms	
F0 = Mid (234 Hz)		F0 = Mid (103 Hz)	

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Identification (3 Alternative Forced Choice)

파다	바다	빠다

Statistical analysis

- A mixed-effects logistic regression model
  - Dependent variables: laryngeal type (**Lenis = -0.5**, **Aspirated. = 0.5**)
  - Fixed effects:
    - VOT (10, 30, 50, 70, 90, 110, 130) → z-scored
    - F0 (-1,0,1) → z-scored
    - Speech rate (**Fast = - 0.5**, **Slow = 0.5**)
    - Listener Gender (Male = -0.5, Female = 0.5)
    - Listener Age (Old = -0.5, Young = 0.5)
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    - Interactions: (VOT + F0 + Rate) * (ListenerGender*ListenerAge + TalkerGender*TalkerAge)
  - Random effects: Speaker
  - Stepwise regression, backward elimination (Buildmer)

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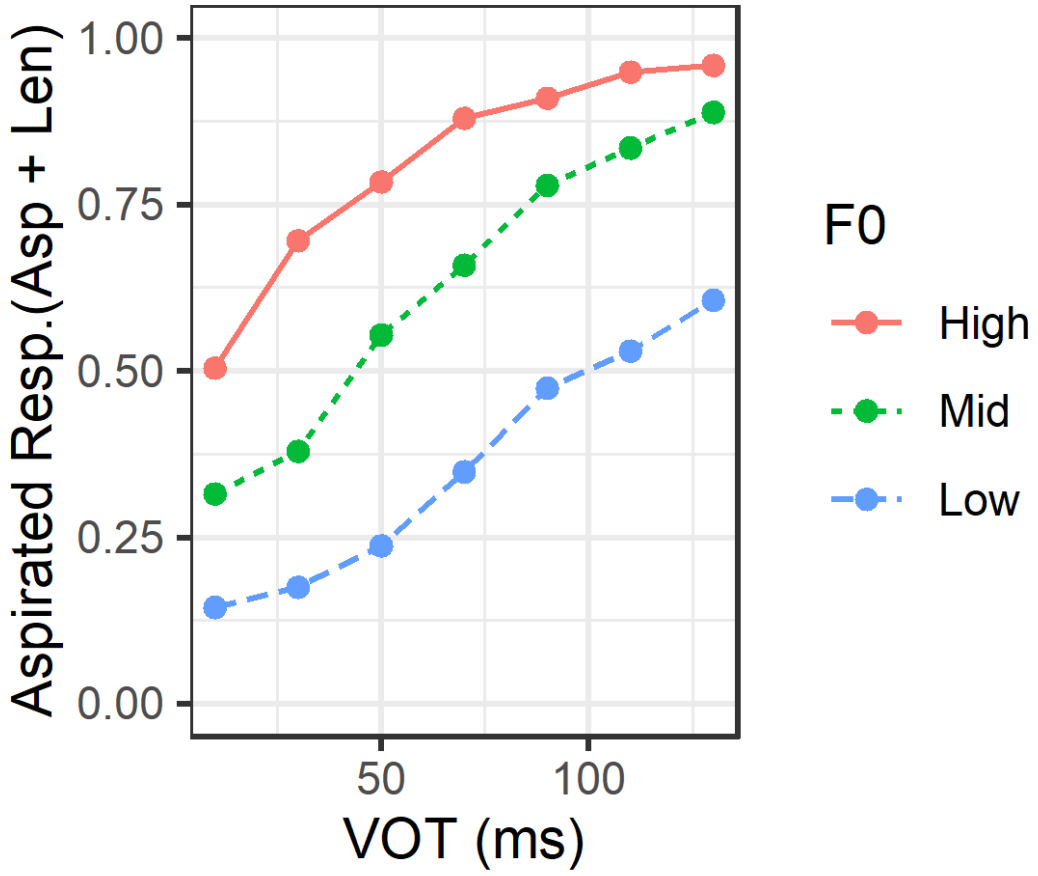
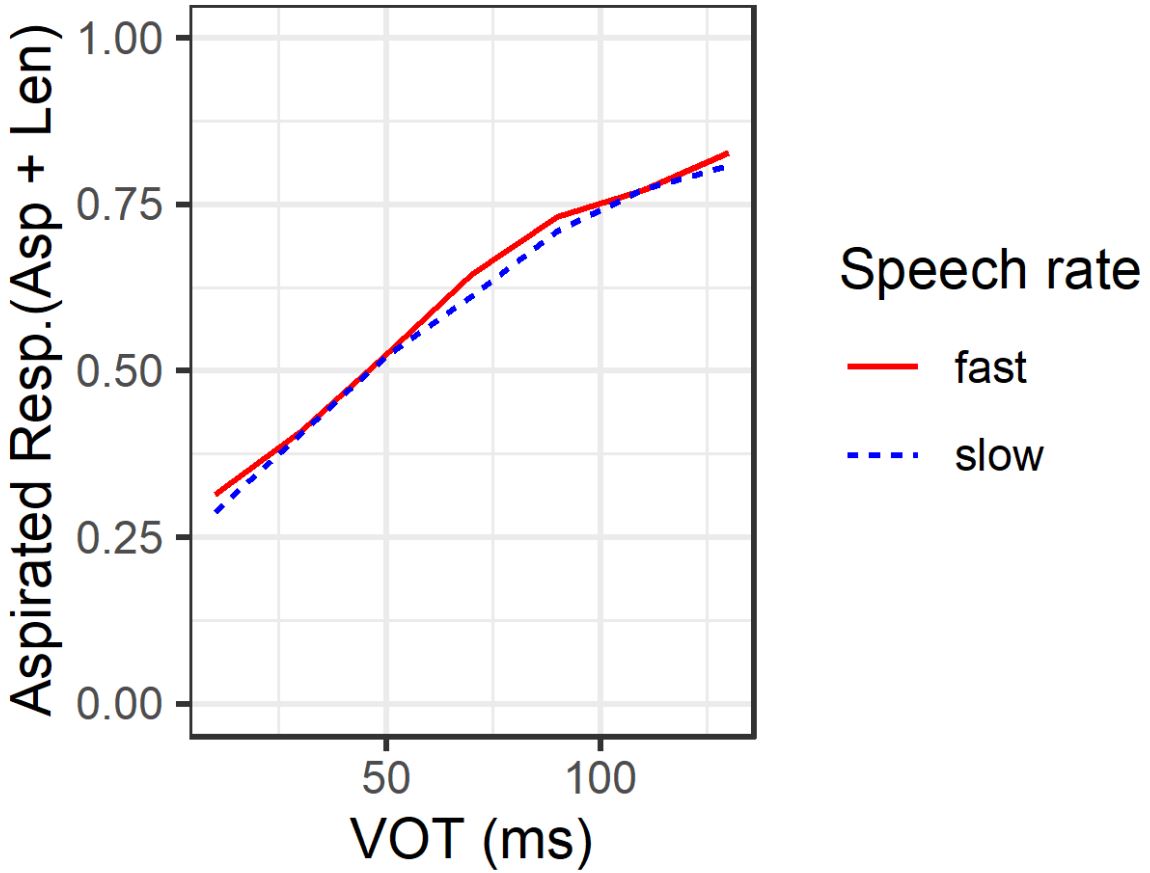
Are more aspirated stops chosen in fast speech?

Is the rate effect modulated by the age and gender of the listener or the talker?

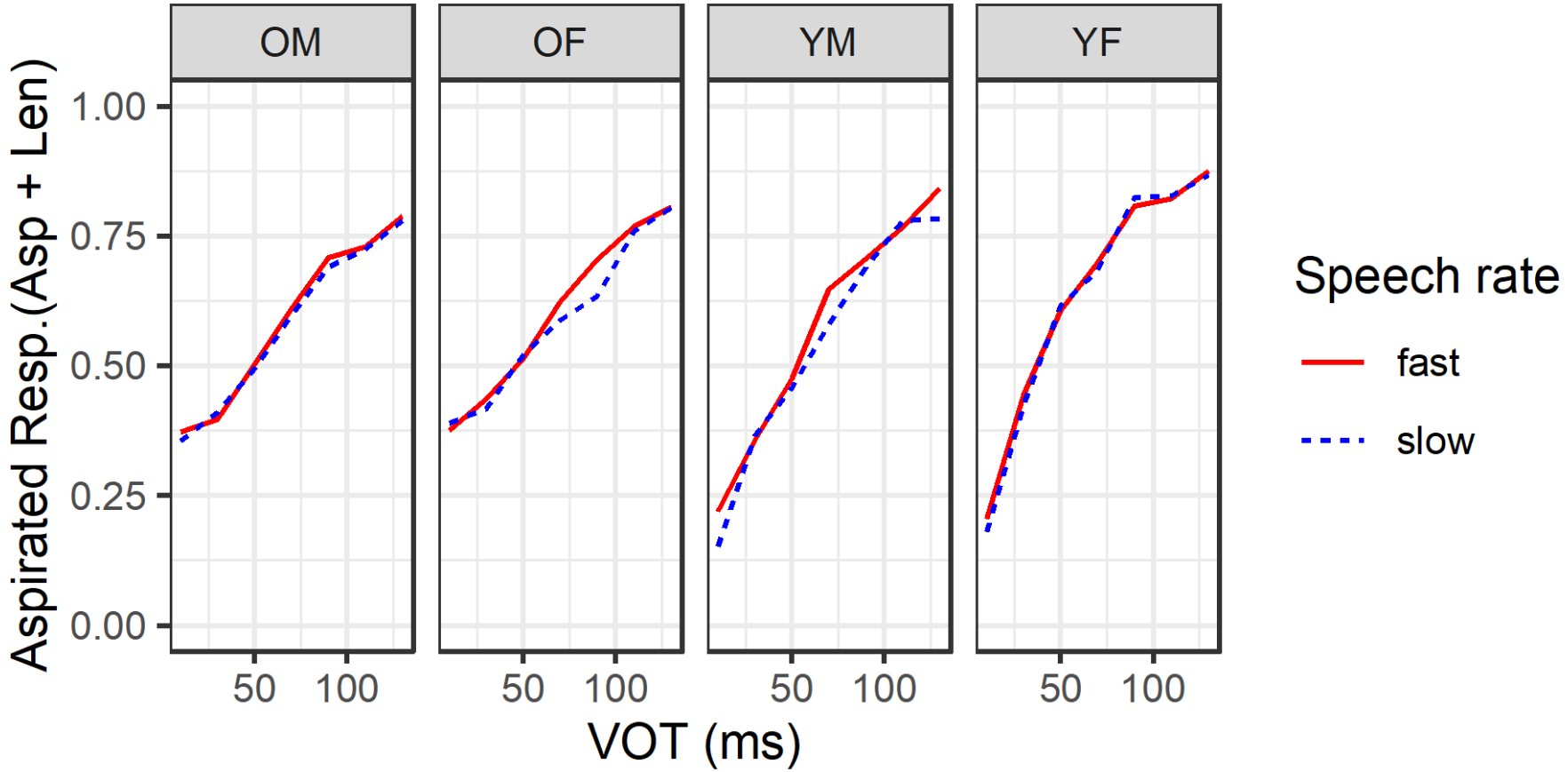
Main effects: VOT***, F0***



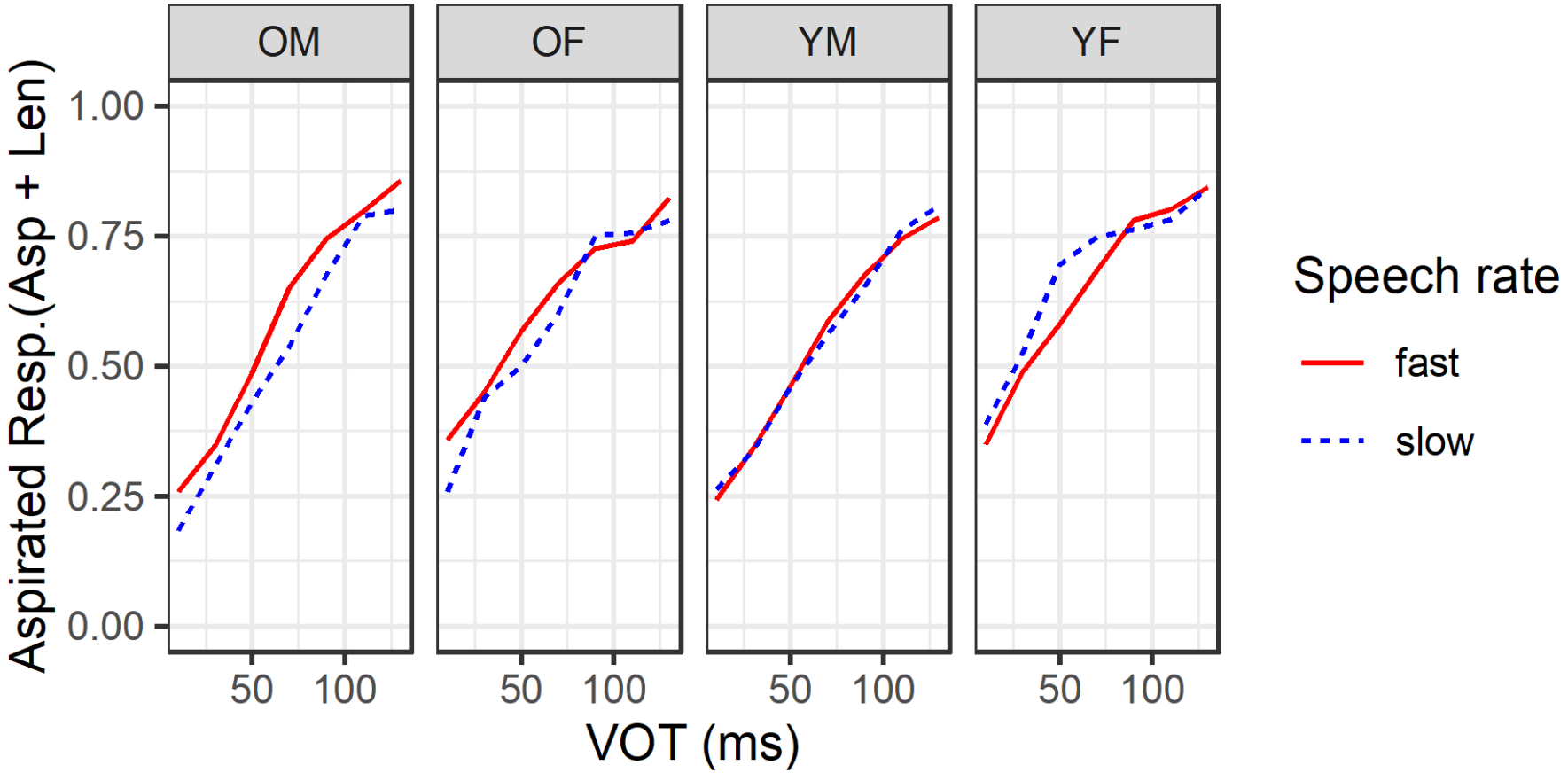
Main effect: Speech rate (p = 0.135)



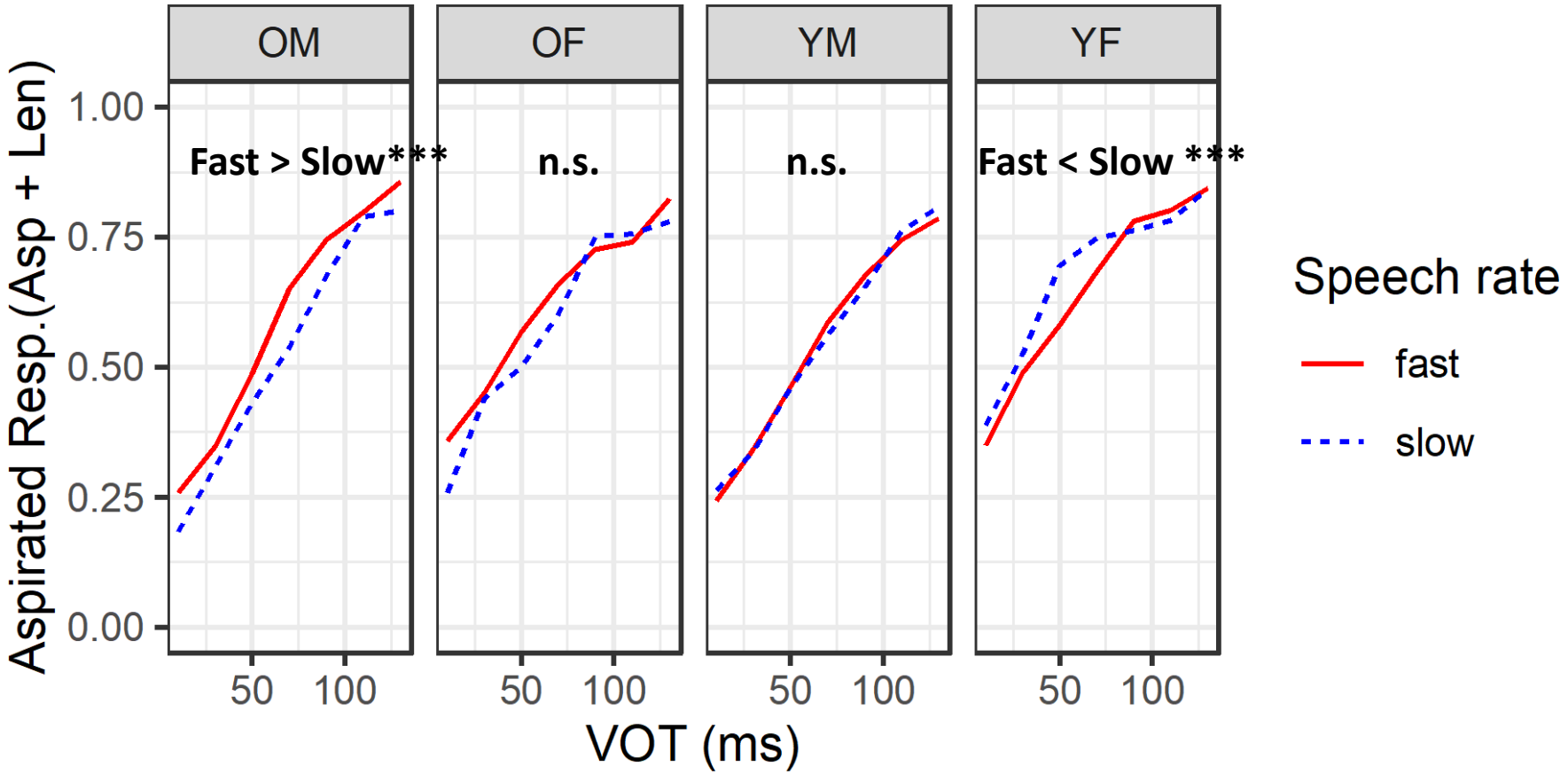
Rate x Listener age : n.s.
Rate x Listener gender: n.s.



Rate x Talker age***
Rate x Talker gender**



Rate * Talker: Post-hoc tests by talker



Summary and Conclusion

- The rate effect was modulated by the talkers' age and gender, but not by the listeners’ own age and gender.
- Post-hoc tests find the expected rate effect (more aspirated stop responses in fast speech) only for the older male talker, a group that retains the VOT contrast more robustly.
- A significant rate effect in the opposite direction was found for the young female talker, who belongs to a group where the VOT distinction has merged and possibly reversed.
- The results are significant in showing the way listeners compensate for speech rate reflects the contrastive status of the duration cue undergoing a sound change in the talkers’ speech.

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