

Phonetic cue enhancement

in hyperarticulation of Korean sibilants

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CONTRAST ENHANCEMENT

Hyperarticulation can be contrast-specific.

- Speakers increase VOT of "teen" when contrasting it with "dean" but not "keen" (e.g. Maniwa et al., 2009; Schertz 2012).

Extent of hyperarticulation appears to depend on the "importance" of the dimension to the contrast.

- Age differences in enhancement of f0 and VOT in Korean stop contrast (Kang and Guion 2008).

What determines **how much** a given cue is enhanced in hyperarticulation?

- Use of the cue in baseline productions?
- Use of the cue in **perception**?
- Use of other cues in enhancement?

KOREAN SIBILANTS

Affricates			Fricatives		
fortis	/cc/	high unaspirated	fortis	/ss/	high unaspirated
	ㄸ	f0 (short VOT)		ㅆ	f0 (short VOT)
aspirated	/cʰ/	high aspirated	non-	/s/	high aspirated
	ㅌ	f0 (longest VOT)	fortis	ㅅ	f0 (long VOT)
lenis	/c/	low aspirated			
	ㄷ	f0 (long VOT)			

Laryngeal status of "nonfortis" /s/ is ambiguous (Iverson 1983, Chang 2013)

- phonologically: patterns with lenis
- phonetically: high VOT, like aspirated
- f0 of /s/ vs. /ss/ does not differ in **production**, but f0 affects **perception** of the contrast (Chang 2013)

Sound change in progress:

- VOT merger in lenis/aspirated series for younger speakers, and increase in use of f0 (Silva 2006, Kang 2014).

RESEARCH QUESTIONS

2 contrasts	2 dimensions
/s/ vs. /ss/ /s/ vs. /c/	VOT (aspiration) f0 (pitch)

- Does extent of hyperarticulation reflect baseline differences in cue use?
- Does individual variability in perception correspond to production differences?
- Is there a relationship between the extent of enhancement of multiple cues on a trial-by-trial level?

Positive correlation	Negative correlation
Speakers enhance the entire constellation of relevant features concurrently	Trading relation: One cue is enhanced (at the expense of the other)

PARTICIPANTS AND MATERIALS

62 L1 Korean speakers from Seoul and surrounding area

	Male	Female	Ages (mean)
Older	13	16	54-82 (65)
Younger	16	17	19-53 (34)



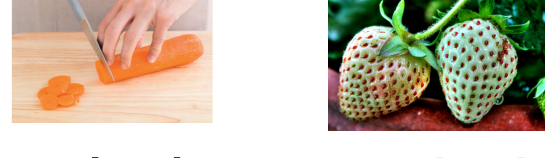
Sibilant-initial minimal pairs

- e.g. [sʌta] vs. [ssʌta], [sʌta] vs. [cʌta]
- 4 minimal pairs per contrast
- 3 vowel contexts: /a/, /ʌ/, /i/
- 2664 total tokens analyzed

Acoustic measurements:

VOT	End of frication to following vowel onset
f0	Measured at midpoint of following vowel (semitones)

TASK AND SPEECH STYLE MANIPULATION

TASK 1	TASK 2	
"Please read the following words as they appear"	"Please pronounce the following words carefully, as if to a foreigner"	
Baseline	Clear	Contrastive
 설다 [sʌta]	 설다 [sʌta]	 썰다 설다 [ssʌta] [sʌta]

Trial-by-trial analysis: Cue interaction

- Calculated trial-level **difference** on each dimension in Task 2: How much did f0 increase between clear and contrastive production in each trial?
- Checked for correlation between f0 and VOT differences.

ANALYSIS

Effect of speech style on VOT/f0

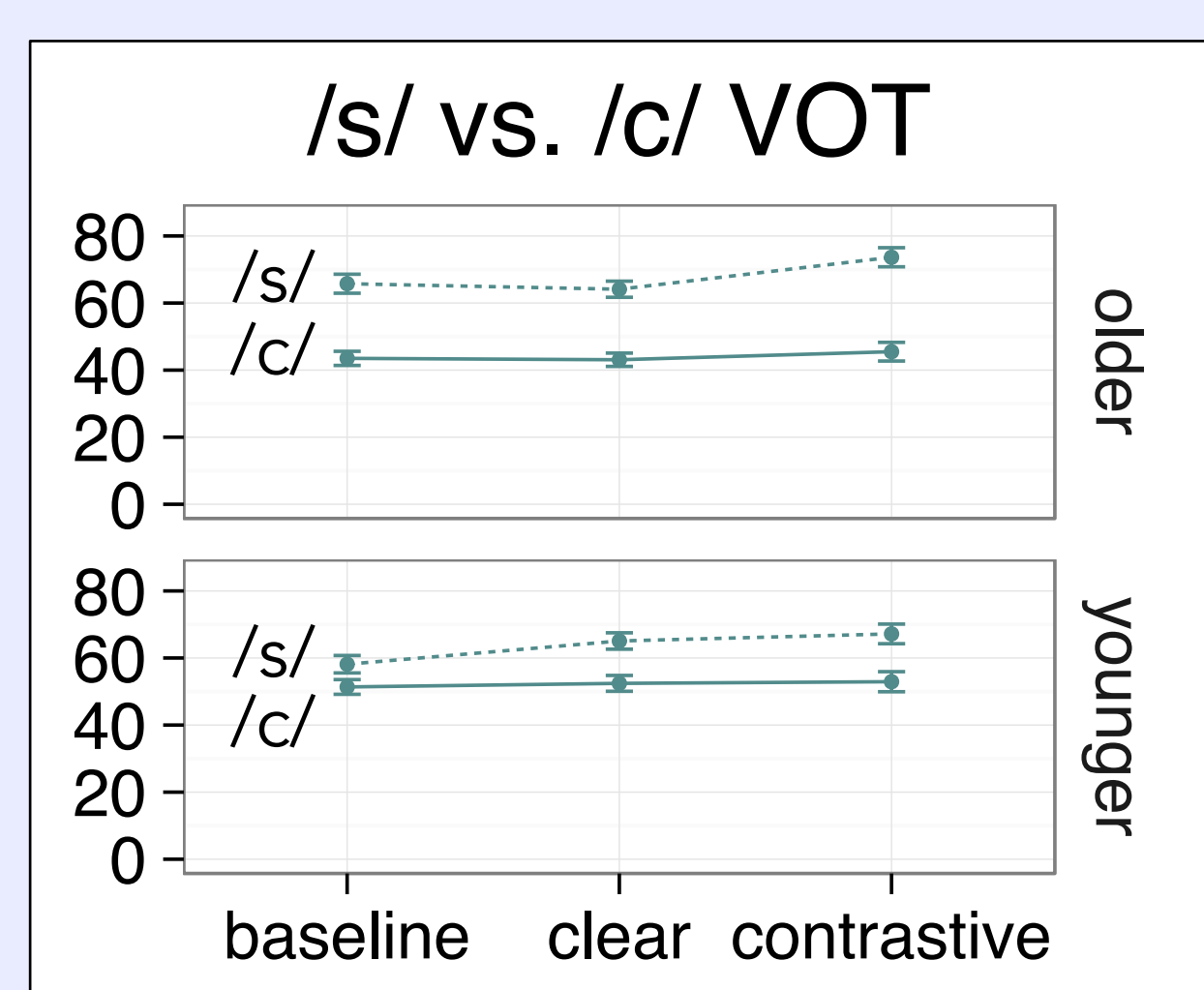
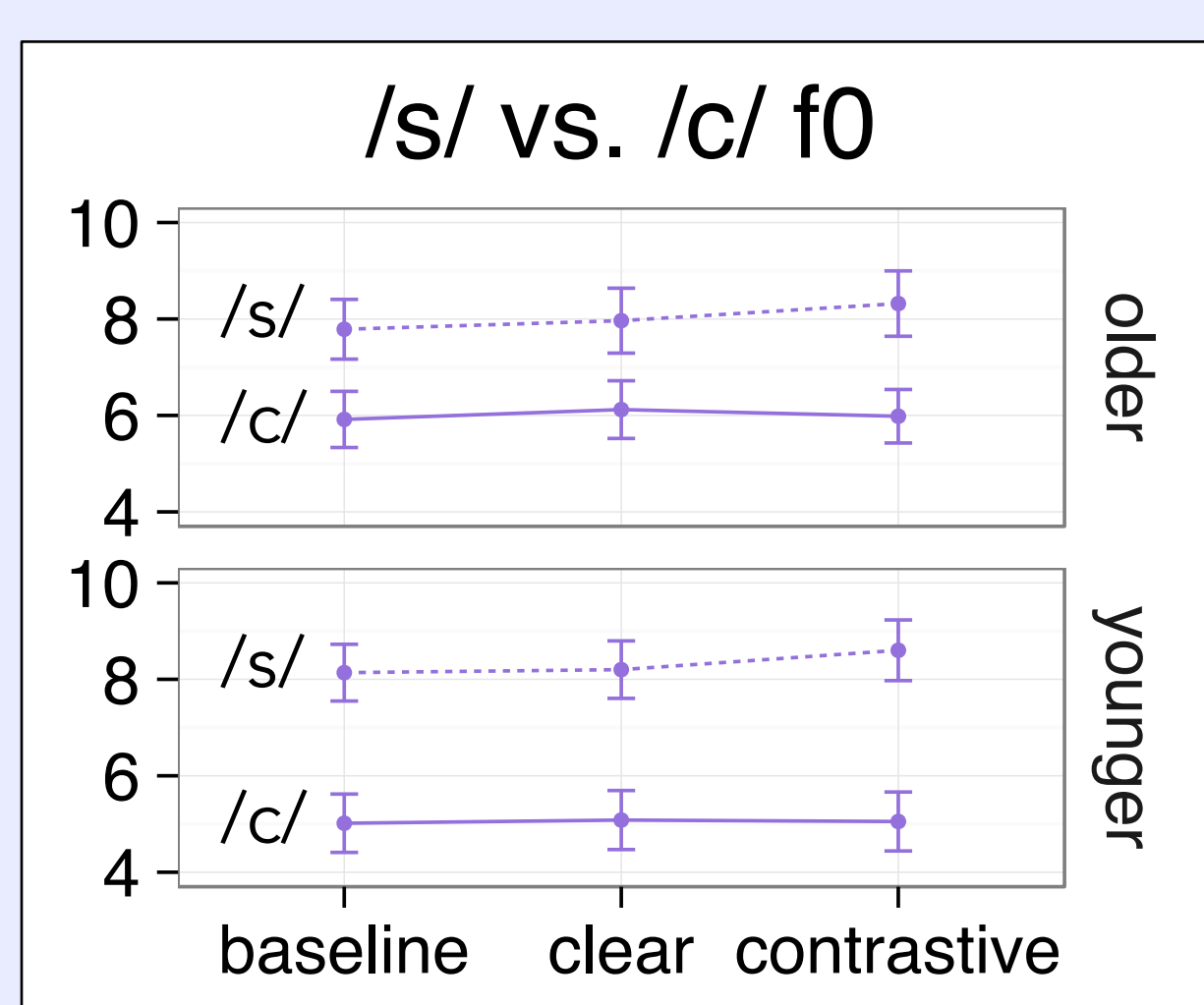
4 linear mixed-effects models

Response variable	VOT or f0 (separate models for each dimension and contrast)
Fixed factors	Segment * Speech style * Age (YOB) * Gender + Vowel (+Vowel duration for VOT)
Random factors	(Segment * Style Participant) + (Style Word)

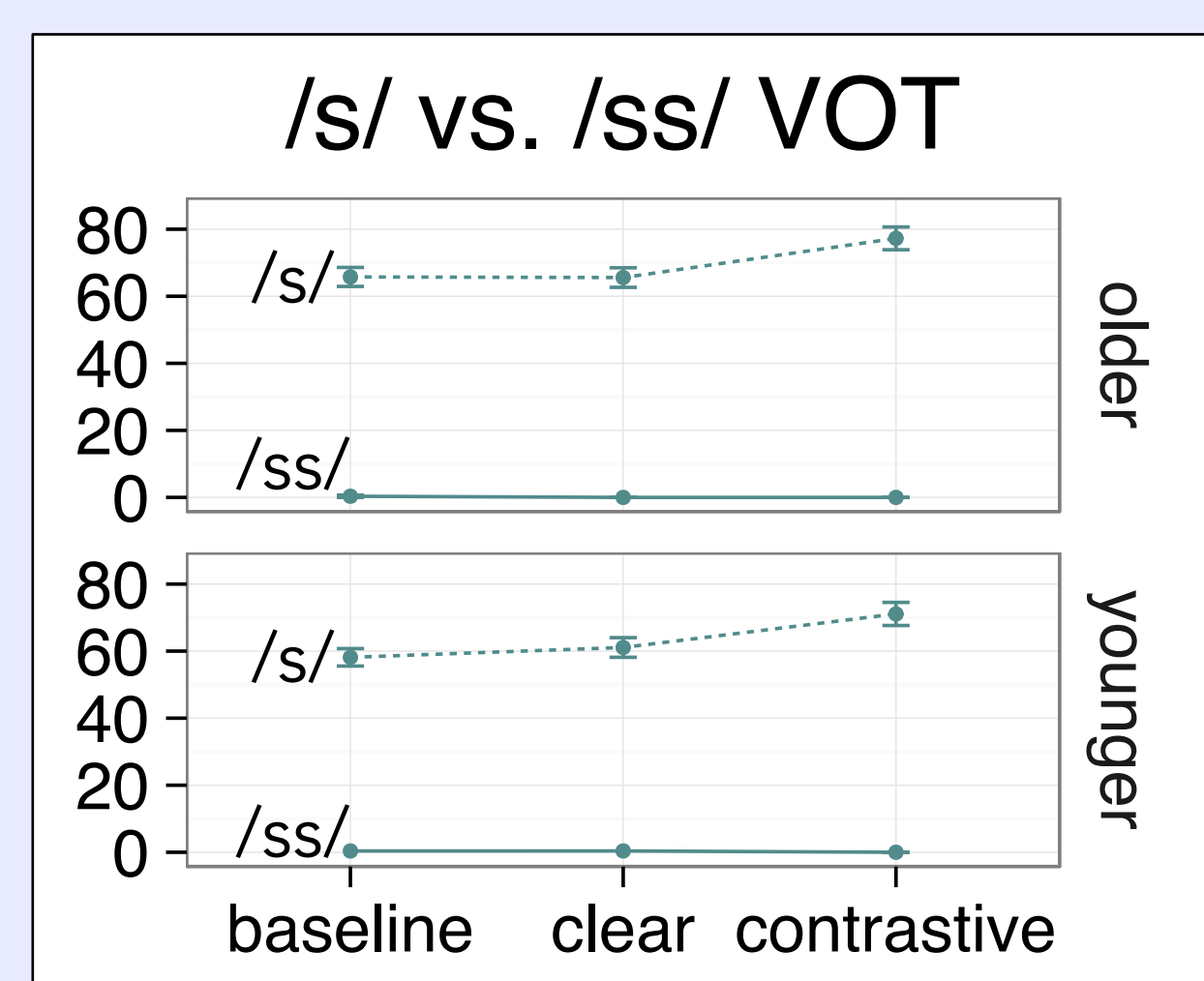
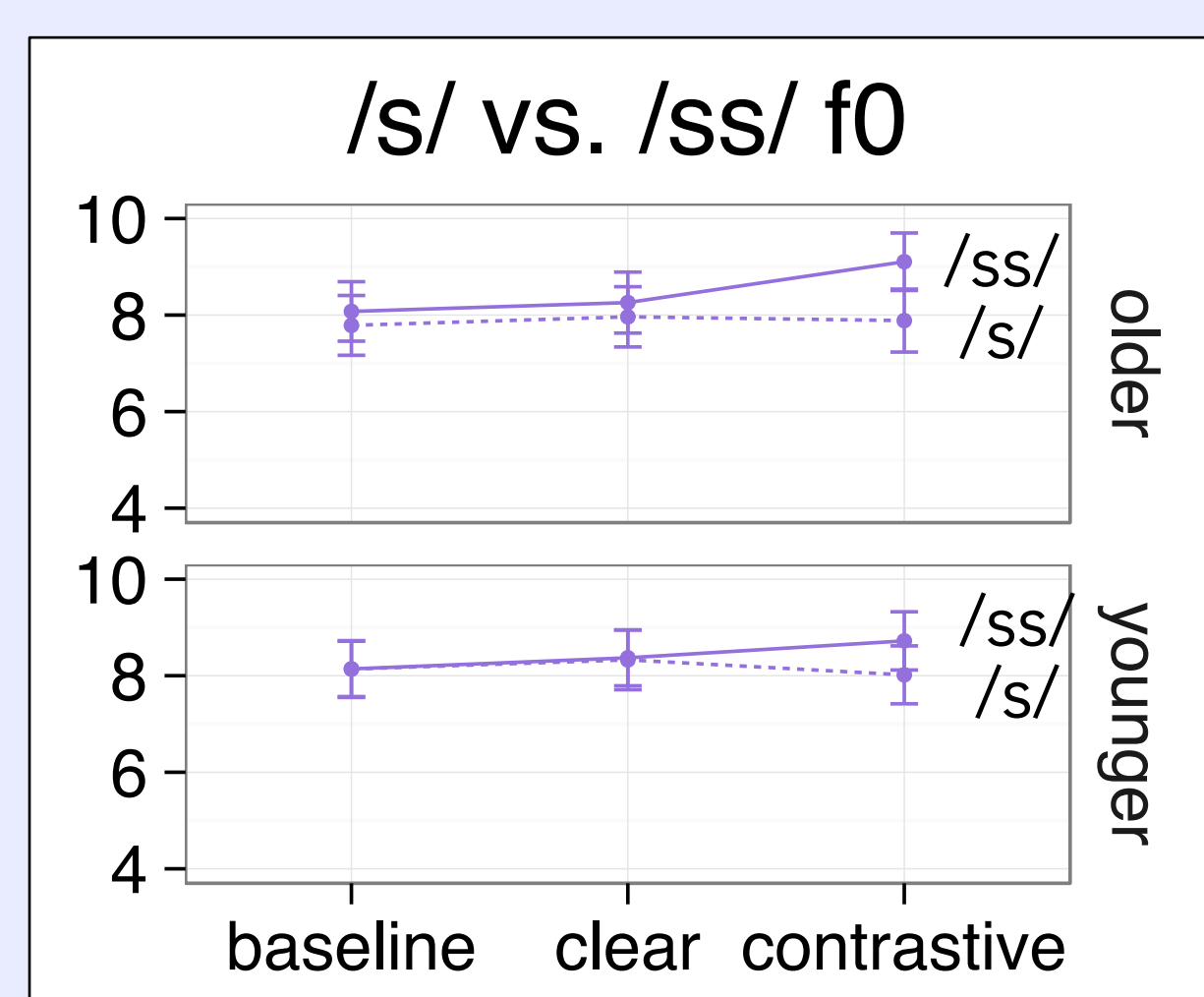
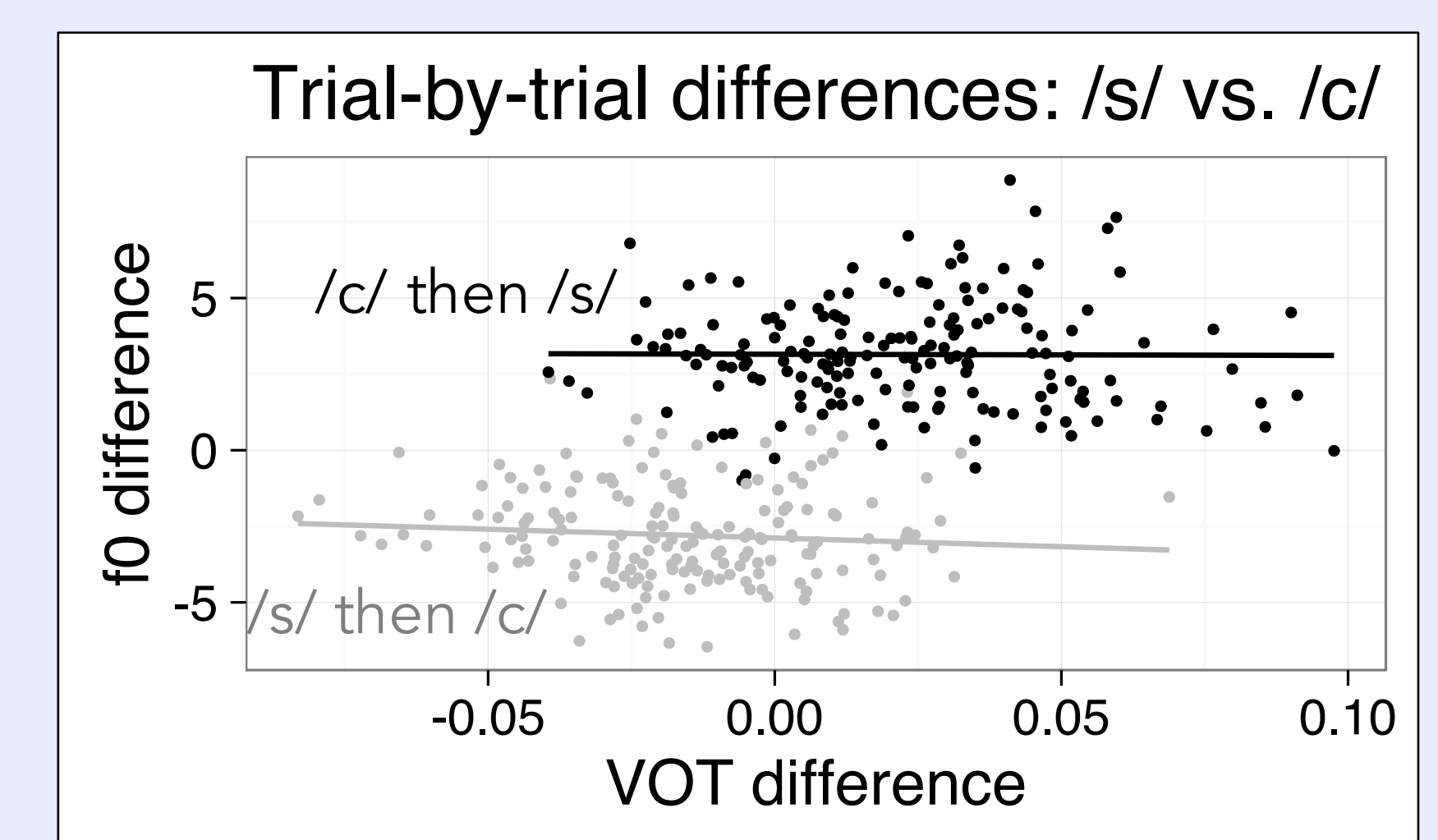
"Enhancement" = segment by style interaction

Perception/production correlation (/s~/ss/ only)

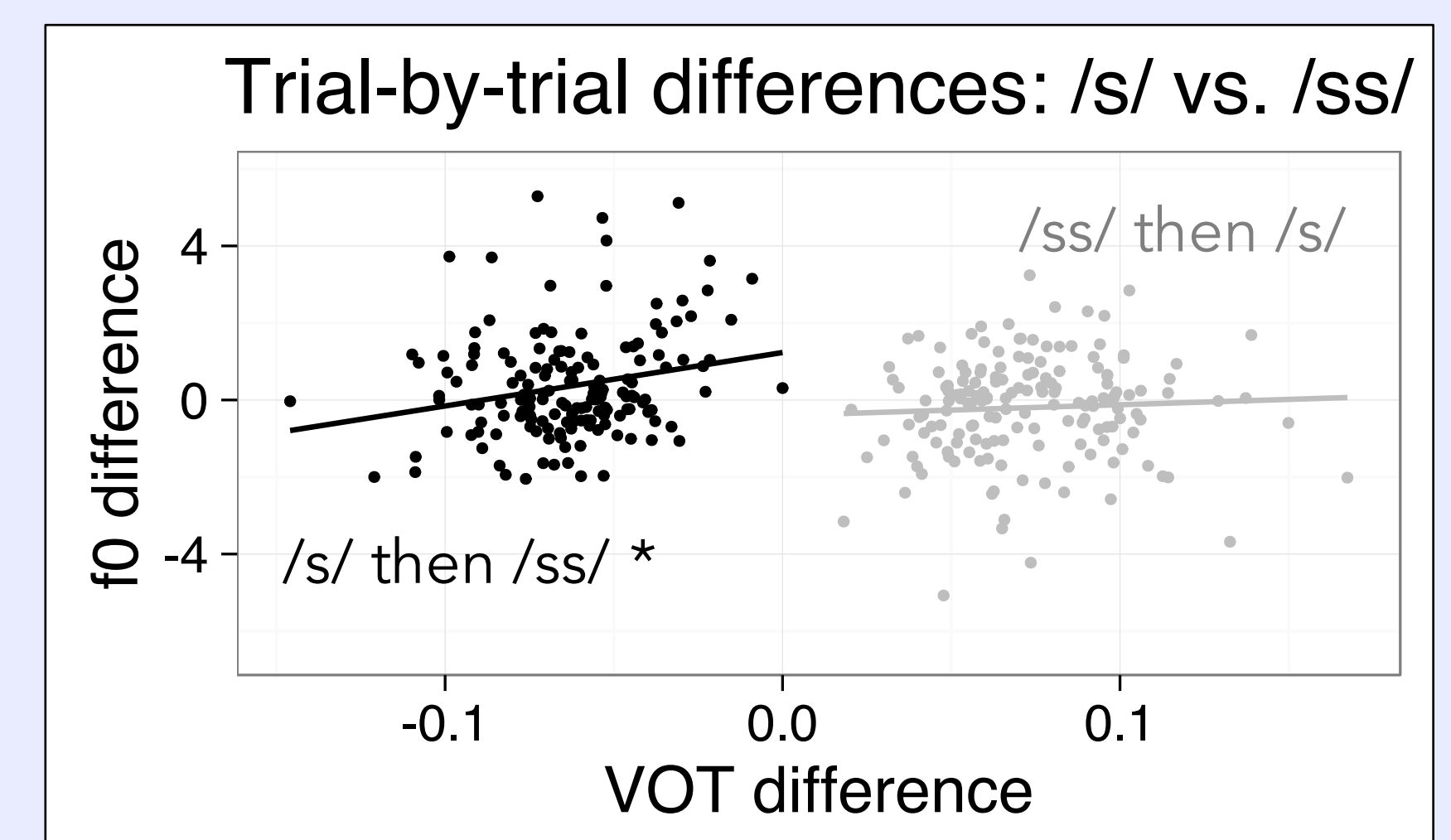
- Calculated the same individuals' use of f0 in perception from a forced-choice identification (/s/ vs. /ss/) task.
- Tested for correlations between individuals' reliance on f0 in perception and:
 - Use of f0 in overall production of /s~/ss/
 - Enhancement of f0 in hyperarticulation of /s~/ss/



/s/ vs. /c/:	All speakers use both cues.
Overall cue use	Younger speakers use f0 more and VOT less than older speakers.
f0 enhancement	Both groups: Contrastive > Clear/Baseline
VOT enhancement	Older: Contrastive > Clear/Baseline Younger: Contrastive/Clear > Baseline
Trial-by-trial	No correlation between f0 and VOT differences

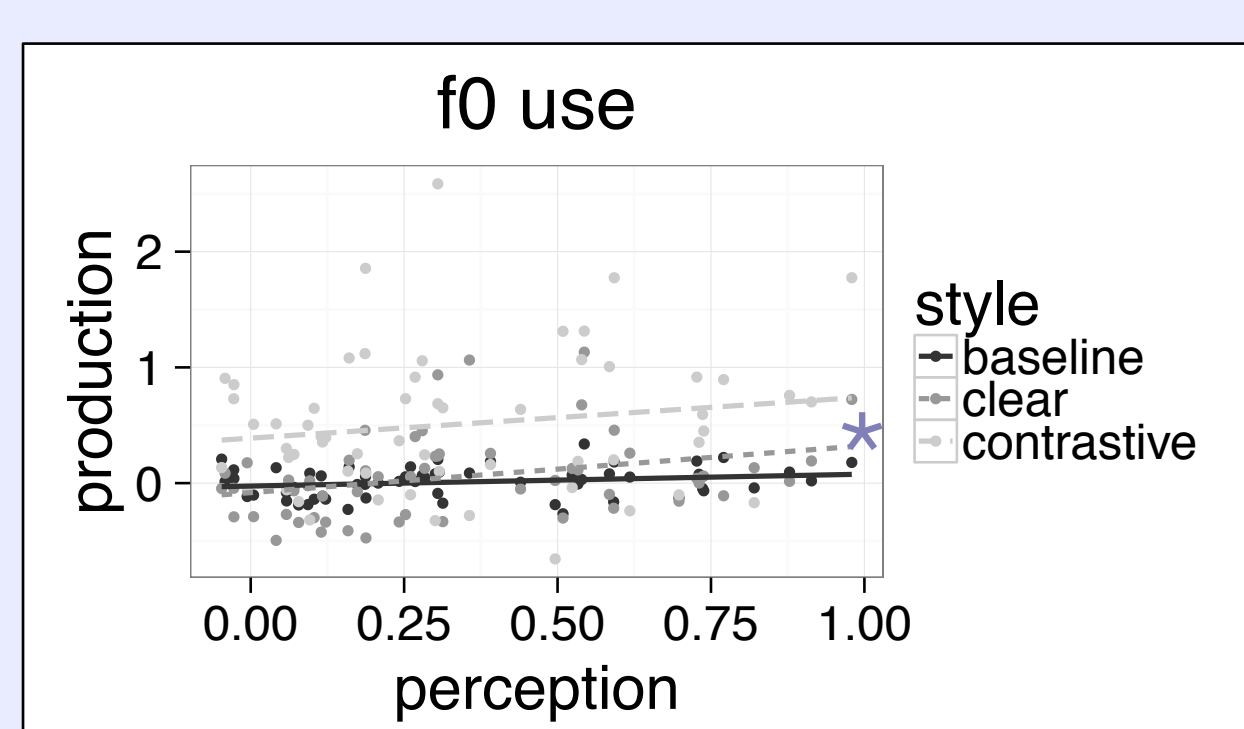


/s/ vs. /ss/:	f0 only used in contrastive style.
Overall cue use	All speakers use VOT.
f0 enhancement	Both groups: Contrastive > Clear/Baseline
VOT enh.	VOT of /s/ increases by speech style
Trial-by-trial	Trading relation when /ss/ follows /s/: smaller (negative) VOT difference corresponds to greater f0 difference. No correlation when /s/ follows /ss/.



Perception vs. Production: /s~/ss/

Individual use of f0 in perception weakly predicts overall use in production (shown below), but not enhancement (not shown).



DISCUSSION

Overall cue use

- Sound change in progress for /c/-/s/ contrast: decrease in use of VOT, increase in f0.
- Use of f0 to distinguish /s~/ss/ only emerges in hyperarticulation.

Enhancement

- All dimensions are enhanced. Larger baseline differences in cue use did not predict more enhancement.
- VOT enhancement for /s~/c/ occurs at different styles for younger vs. older speakers.

Factors influencing enhancement

- Speakers may dynamically adapt enhancement strategies if one dimension is not available (inverse relationship of f0 and VOT enhancement when /ss/ follows /s/).
- Weak perception-production link in use of f0 (strongest in clear speech), but enhancement was not predicted by perception.

ACKNOWLEDGMENTS

We would like to thank Yunyan Luo and Yuanyang Song for help with the data collection process, as well as Rachel Soo for help with data annotation. This research was supported by SSHRC Grant #435-2013-2092 to Yoonjung Kang.