Coarticulation with alveopalatal sibilants in Mandarin and Polish: Phonetics or phonology?

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Introduction

- Vowels following alveopalatal sibilants typically exhibit raised second formant (F2) values (e.g. Stevens, 2004; Bukmaier et al., 2014)
- Previous work: differences in F2 transitions or values at vowel onset
- **Main finding**
  Raised F2 through entire vowel following alveopalatal sibilants in Mandarin. Similar (though slightly less consistent) results also found in Polish.

Proposal: A phonological effect

Common diagnostics point to a phonological analysis for both languages.

A **contrast-enhancing hyperarticulation effect** in Mandarin provides further evidence that F2 differences are phonological.

Is it phonologized? Common diagnostics

Gradience vs. categoricity (e.g. SPE; Chomsky & Halle, 1968)
- Phonetic effects: often gradient
- Phonological effects: often categorical

Extent of segmental effect (e.g. Keating, 1990)
- Phonetic effects: only affect part of the segment
- Phonological effects: affect the entire segment

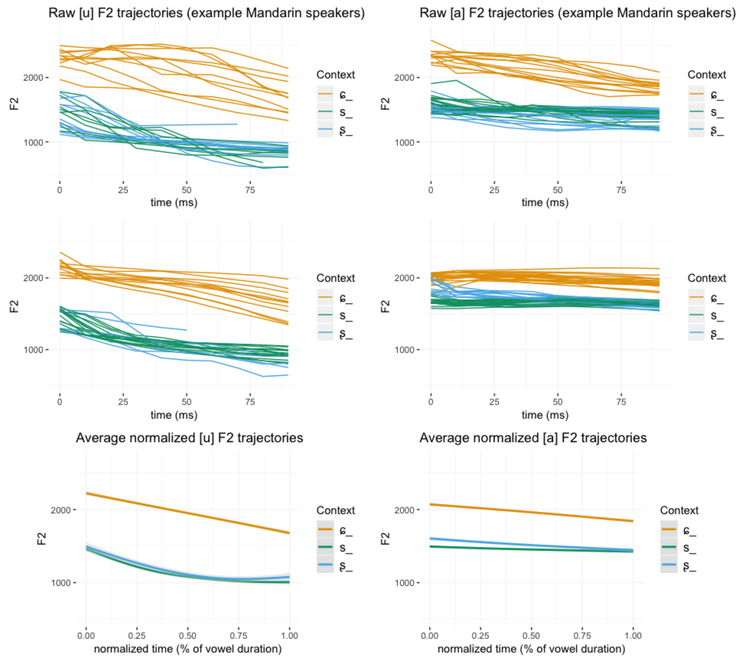
Variation with speech rate (e.g. Solé, 2007)
Purely mechanical effects should have fixed temporal extensions.
- Phonetic effects: duration does not vary with speech rate
- Phonological effects: duration varies with speech rate

Methods

	Mandarin	Polish
Speakers	17 native speakers	3 native speakers
Stimuli	words & non-words	words & non-words
	1-2 syllables	1-4 syllables
	initial /s ɕ ʂ/	initial /s ɕ ʂ/
	post-sibilant /a u/	post-sibilant /ɛ a ɔ/
Carrier phrase	'wǒ bǎ X dú yī biàn'	'powiedzała X od razu'

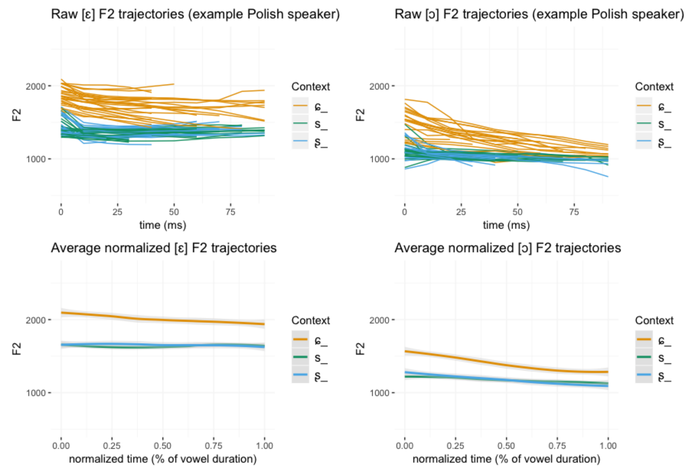
Mandarin results

Raised F2 following /ɕ/ extends through entire vowel; consistent across tokens, speakers, and vowel contexts.



Polish results

F2 raised consistently in /ɛ a/, less consistently in /ɔ/.



Effect of speech rate

Predictions

- If phonetic: Extent of F2 raising fixed.
  → F2 offset should decrease with vowel duration for /ɕ/.
- If phonological: Extent of F2 raising varies with vowel duration.
  → No effect of vowel duration on F2 offset.

Analysis: Mixed-effects linear regression predicting F2 at vowel offset.
- Fixed effects: preceding sibilant (C), vowel (V), vowel duration, carrier phrase duration
- Interactions: C × V, C × vowel duration
- Random effects: word, speaker

Results

Mandarin effects on F2 offset
- Preceding sibilant: F2 higher after /ɕ/
- Vowel: F2 higher for /a/
- Vowel duration: *Unexpected contrast enhancement!*
  - For /ɕ/, F2 offset increases with vowel duration.
  - For /s ʂ/, F2 offset decreases with vowel duration.
- No effect of carrier phrase duration.

Polish: Similar effects of sibilant and vowel, no vowel/phrase duration effects.

Conclusion

Common diagnostics point to a phonological analysis
- In Mandarin, F2 raising is consistent through the vowel across speakers, tokens, and vowel contexts. This is less consistent in the Polish data.

Additional evidence from Mandarin contrast-enhancing effects
- F2 contrast between ɕV and sV / ʂV enhanced in longer vowels.
- Longer vowels could indicate more hyperarticulation.
- Phonological/featural contrast often enhanced in hyperarticulated speech (e.g. Smiljanic & Bradlow, 2009; Schertz 2013).

Raised F2 not only extends through the entire vowel duration, Mandarin speakers actively use it to enhance sibilant contrast.

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