A Diachronic Chain Shift in the Sandhi Tones of Jinhua Wu

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The Jinhua tone system is changing: subtly, not categorically

1. Jinhua sandhi in context
   - Dialectology of southern Wu
   - Isolation tone system
   - Tone sandhi
   - Conditions for change
2. A sociotonetic study
   - Data collection and processing
   - Speaker similarities
   - Sandhi contours are shifting
   - What could explain the change?

Inland southern Wu

Figure: Wu is spoken in Shanghai, most of Zhejiang, and neighboring corners of Anhui and Jiangsu.

Inland Wu area characterized by:

- High lexical and phonological variation
- Complicated tonal phonology
- Language attrition in youngest generation

Isolation tone categories and contours

Table: Tone categories of Jinhua (notation: $T^{contour}_{category}$) compared to Middle Chinese (from Qian (1992), for generation born ca. 1930)

	MC①	MC②	MC③	MC④
MC [−*vc*] ons	T_1^{435}	T_3^{544}	T_5^{45}	$T_7^{4?}$
MC [+*vc*] ons	T_2^{213}		T_6^{24}	$T_8^{2?}$

- Typical Wu inventory: similar categories, different contours
- Recent changes:
  1. MC voiced obstruents devoiced, but murmured nearby
  2. Generation born 100 years ago had distinct T_4
- T_7 and T_8 have very short contours, so will not be used in this study $\longrightarrow$ 5 isolation tones $\sim$ 6 historical categories

Beijing sandhi

Tone sandhi: phonological change to lexically specified tone

Example

	Rule	Example	
T_3	$\rightarrow T^{214}/\_\#$	$foŋ^{55}ʂwej^{214}$	'feng-shui'
	$\rightarrow T_2{}^{35}/\_T_3$	$ʂwej^{35}kwo^{214}$	'fruit'
	$\rightarrow T^{21}$/elsewhere	$ʂwej^{21}k^hu^{51}$	'reservoir'

The disyllabic sandhi of Beijing Mandarin is reducible, with few exceptions, to this one three-part phonological rule.

Jinhua sandhi

The disyllabic sandhi of Jinhua is very complicated.
A general summary:

- 5×5 combinations of long tones produce about a dozen disyllabic sandhi contour categories
- The sandhi patterns are not reducible to coarticulation nor to a small number of rules or constraints.
- Jinhua exhibits 'tone type recovery': In some cases, historical tone categories that have merged in isolation have different sandhi patterns
- Different grammatical structures have different sandhi, and in addition, there is some unexplained lexical variation

Lexical variation in sandhi

For some combinations, as many as three different patterns are observed, and the source of this lexical variation is largely unknown Cao (2002, p. 111):

Example

T_5^{55} T_2^{313} $\rightarrow$

a. $T^{33}T^{14}$	*pu.a*	*tɕju.dʑjoŋ*
	cloth shoe	bedbug
b. $T^{33}T^{55}$	*su.ju*	*sje.maw*
	veggie oil	delicate
c. $T^{55}T^{3}$	*t^hja.məŋ*	*sje.dʑju*
	steel door	snowball

Jinhua is ripe for change

Conditions predispose Jinhua phonology to change:

- A generational shift from Wu dominance to Mandarin dominance
- Urbanization — contact with similar dialects
- Likely recent loss of obstruent voicing contrast and T_4
- The sandhi system is difficult: highly complicated and idiosyncratic

Awareness of change

Change is informally acknowledged:

- Researchers and speakers mention "young people speak different"
- But no systematic study of variation in Jinhua sandhi systems.

Motivating Hypothesis

Hypothesis (Regularization)

The younger generation learned the complicated sandhi system incompletely, regularizing idiosyncracies and merging categories

↪ Disconfirmed: The contours are changing systematically, but the categories are fairly stable

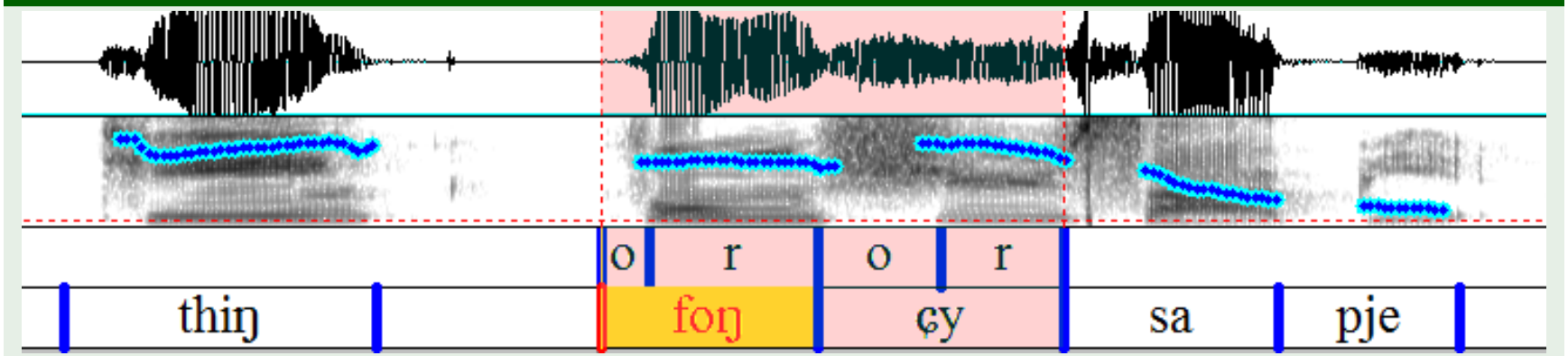
Elicitation

- Based on acoustic dialectology procedure (You & Yang, 2001)
- Stimuli are disyllabic words representing tone combinations
- In carrier sentence $t^h iŋ_5$ _ sa_1 pje_6 ('Listen to _ three times')
- 4 groups of speakers:
  1. urban older group: 5 speakers born 1931-1952
  2. urban younger group: 5 speakers born 1984-1989
  3. rural older group: 2 speakers born 1946-1949
  4. rural younger group: 3 speakers born 1985-1986

Stimuli

- Structure of compound or modifier+noun
- Tone domain (domain of characteristic tone contour) assumed to be the final (yunmu) (Rose, 1998)
- 108 stimuli: 3 words for each combination of the 6 historical long tones (MC ①, ②, ③ × [±vc])

Example



foŋ$_1$ ɕy$_3$ ‘feng shui’

Data Processing

- Tone domains annotated by hand
- Pitch tracks extracted automatically in Praat
- Each tone domain's contour summarized as a quadratic curve, by polynomial regression with the intercept in the middle of the tone domain $\longrightarrow$ each disyllabic contour is two parabolas
- The collection of all speakers' contours for a word is used as mathematical abstraction of that word
- The collection of all words' contours by a speaker is used as mathematical abstraction of that speaker

Principle Components Analysis (PCA)

PCA: A key tool in a highly bottom-up procedure

1. Represent words or speakers as vectors of contour parameters
2. Rotate and select dimensions that represent the most variance
3. Visualize similarities and differences in those dimensions

The resulting dimensions might not have obvious meaning, but sometimes they do.

PCA of speaker similarities

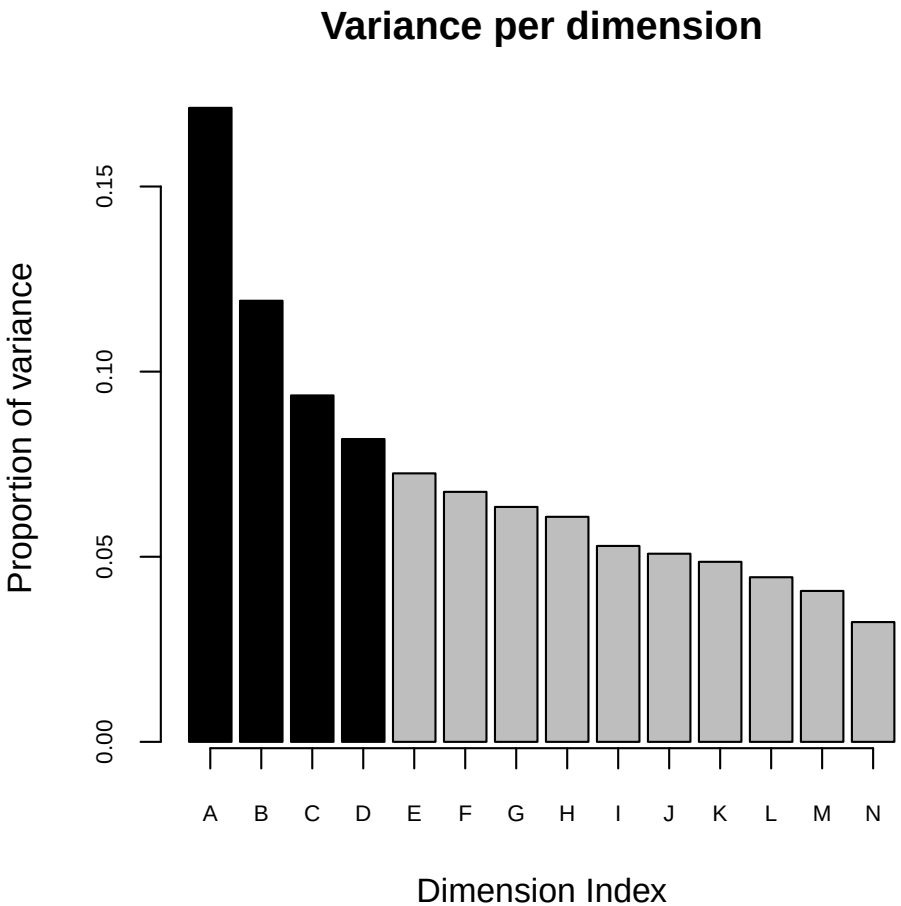


Figure: The 4 dimensions with the most variance represent 47% of the between-speaker variance.

Dimensions B and D

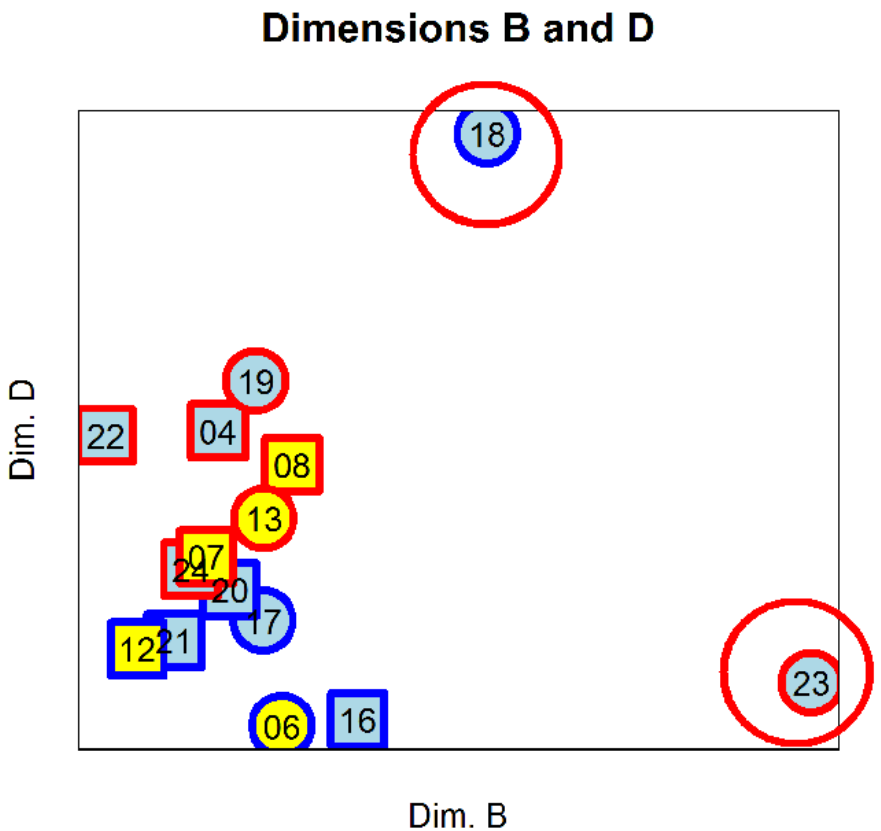


Figure: Data from speakers 18 and 23 are atypical, so we set them aside.
Borders: older (blue) and younger (red);
Fill: urban Jinhua (blue) and Zhuma village (yellow);
Shapes: men (circles) and women (squares).

Dimensions A and C

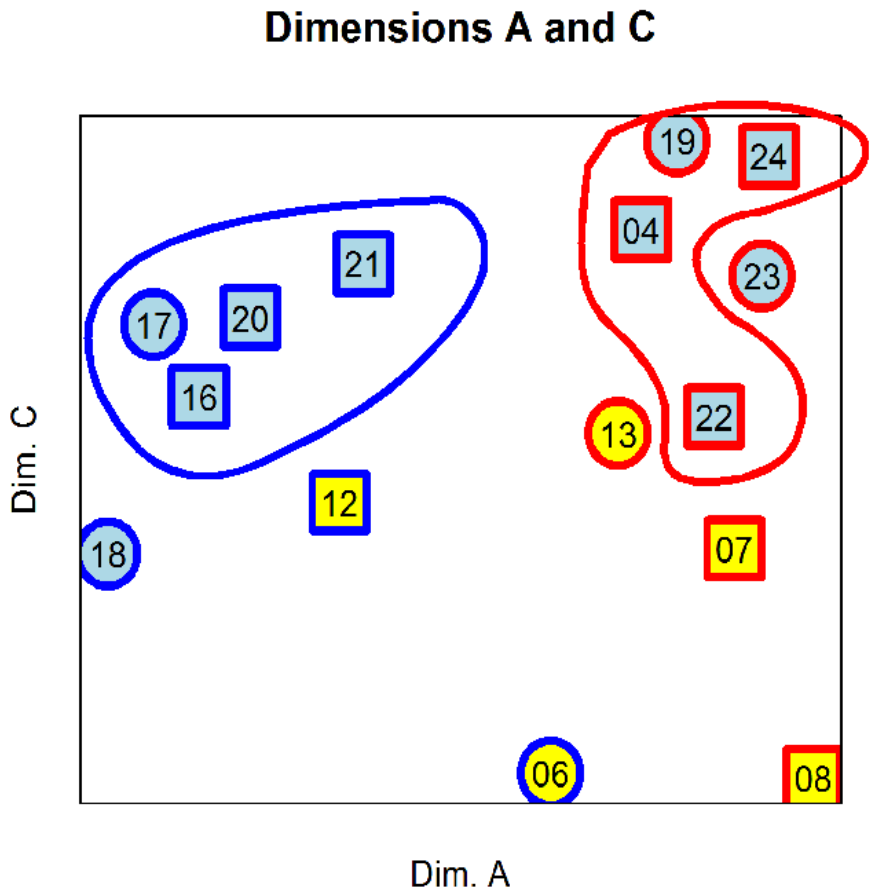


Figure: Dimension A is associated with generation, and Dimension C is associated with location. The circled groups become the basis of further analysis.

PCA of word differences

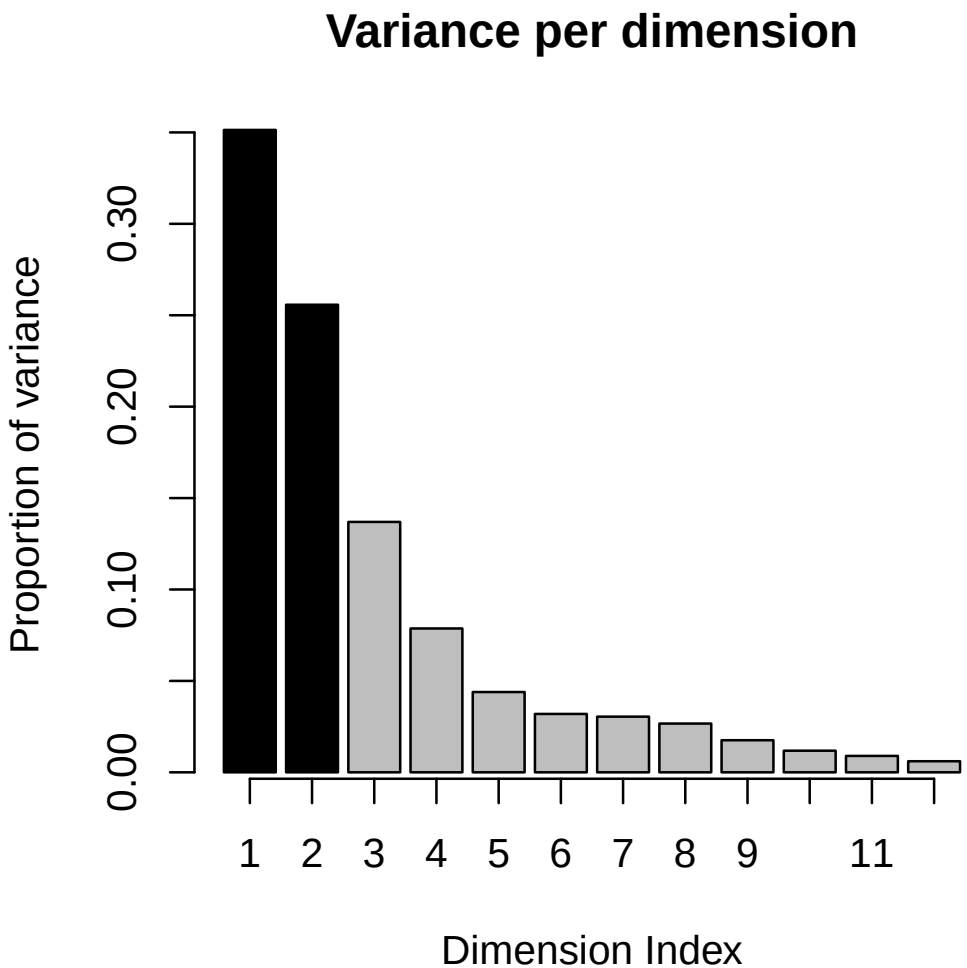


Figure: Dimensions 1 and 2 together represent 61% of the variance. We will also look briefly at Dimensions 3 and 4.

Dimension meanings: archetype contours

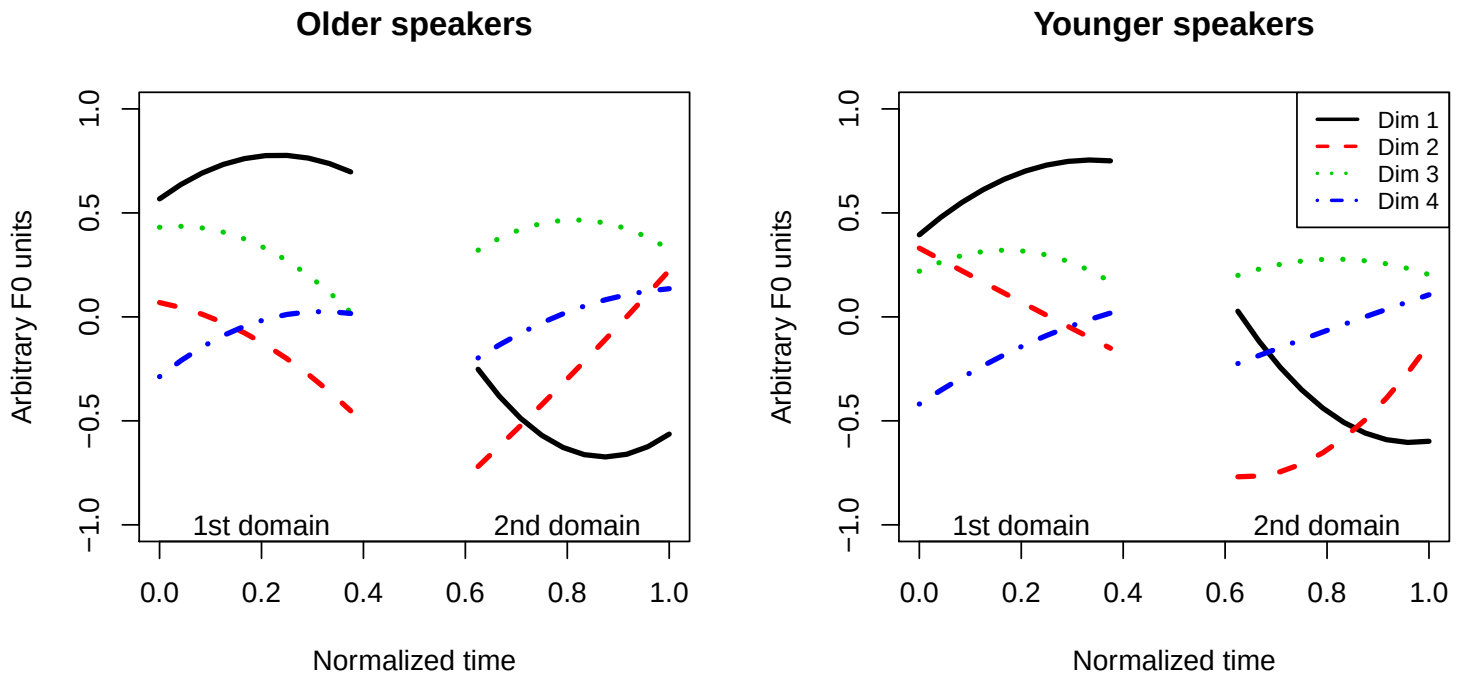


Figure: Older speakers: D1 ∼ tone domains' height difference; D2 ∼ fall-rise vs rise-fall; D3 ∼ overall height; D4 ∼ contours rise/fall equally. Younger: D1 and D2 contours are shifted.

Contour changes

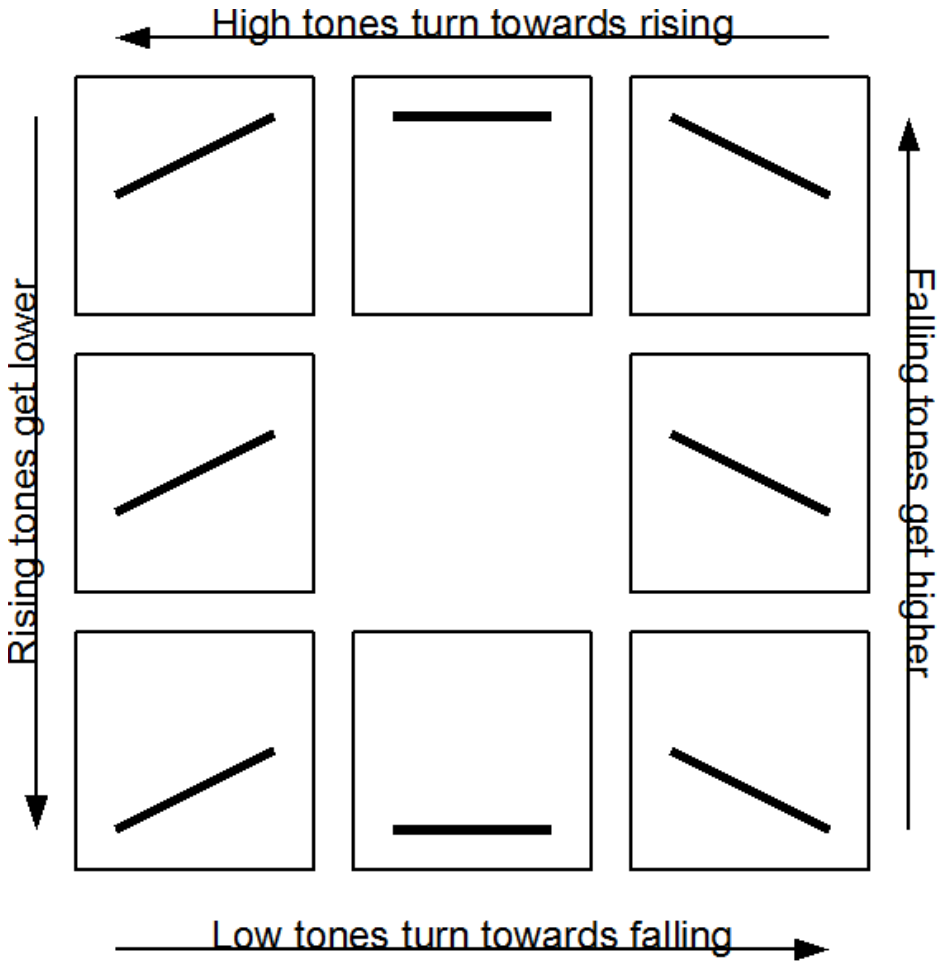


Figure: The change in D2 captures the rising tones getting lower and the falling tones getting higher. The change in D1 captures the low turning towards falling and the high turning towards rising.

The shift is a generalization

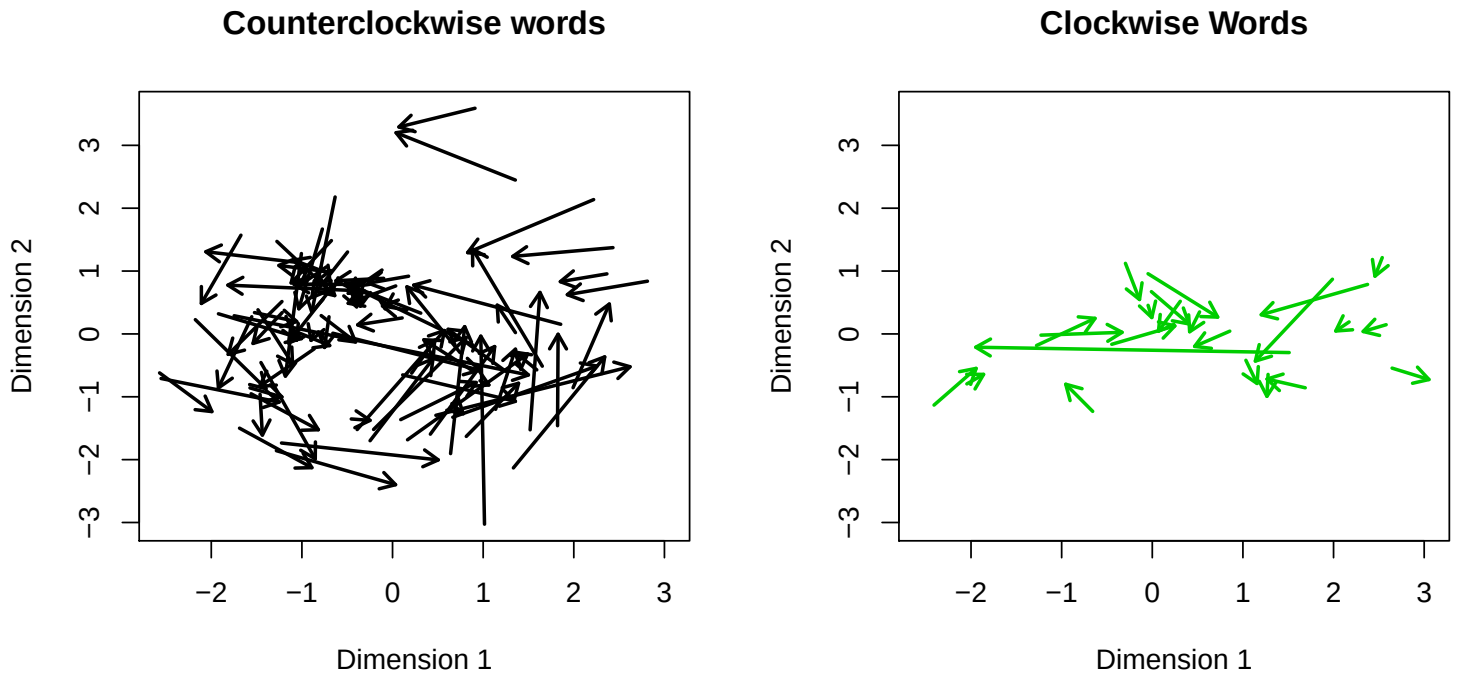


Figure: Each arrow indicates one word's change from older speakers' contour to younger speakers' contour. A large majority of words have moved in a counter-clockwise direction.

Mandarin influence

Hypothesis (Mandarin Categories)

The younger generation are reclassifying words according to Mandarin categories

$\hookrightarrow$ A few words are being reclassified, but most of the changes are small, not categorical

Hypothesis (Mandarin Contours)

The younger generation are perceiving/producing contours according to the Mandarin contour shapes

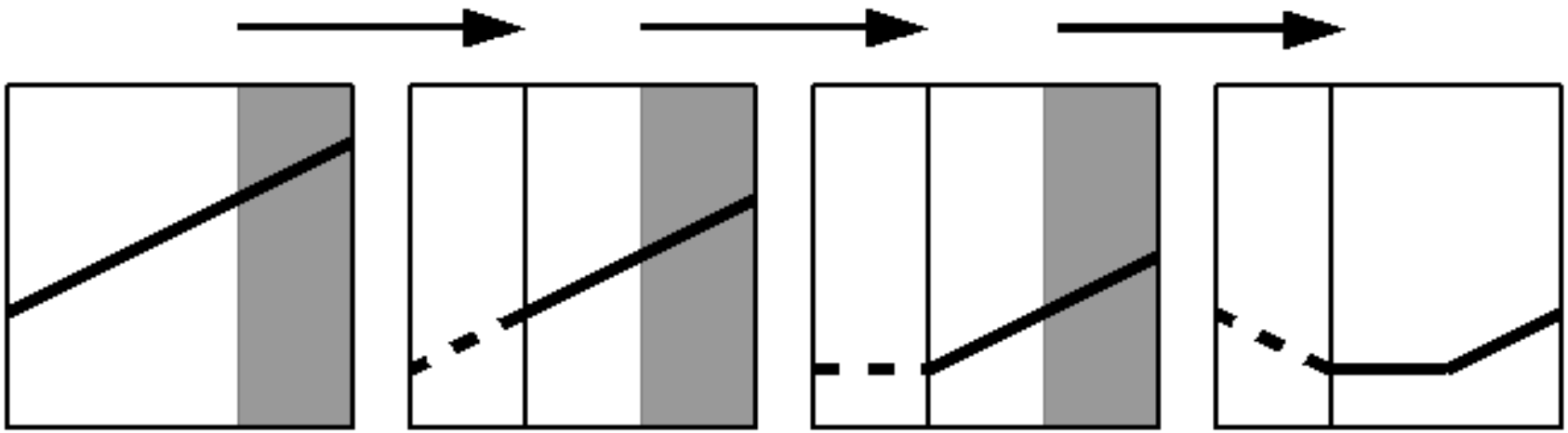
$\hookrightarrow$ Could cause falls $\rightarrow$ higher (cf. Mandarin T_4^{51}) and lows $\rightarrow$ falls (cf. Mandarin $T_3^{214} \sim T_3^{21}$). But not rises $\rightarrow$ lower (cf. Mandarin T_2^{35}), nor highs $\rightarrow$ rises (cf. Mandarin T_1^{55})

Temporal realignment

Hypothesis (Delay)

The younger generation misperceives or misproduces the contour slightly later within the syllable.

1. *The end of the contour is lost.*
2. *The beginning is recreated from coarticulation.*



Temporal realignment

- Sanders (2008) provides a similar account for how Beijing T_2^{35} became Taiwan Mandarin T_2^{324}.
- Lee (in prep) has similar results from Singapore Mandarin (T_2^{3224}), where English-dominant bilinguals have a delayed final rise compared to Mandarin-dominant bilinguals.
- In these cases, only one tone category shows a delay, whereas in Jinhua, all the sandhi tones are affected.

Conclusions

- The observed change is consistent with temporally shifting the contours within the syllable
- The change is not consistent with direct influence from Mandarin tone categories
- The social conditions in Jinhua predispose it to change
- No obvious link to particular linguistic features (besides tone contours)
- $\longrightarrow$ We should expect to find similar tonal evolution in other contour tone languages

Acknowledgements

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PCA of groups' mean contour representations

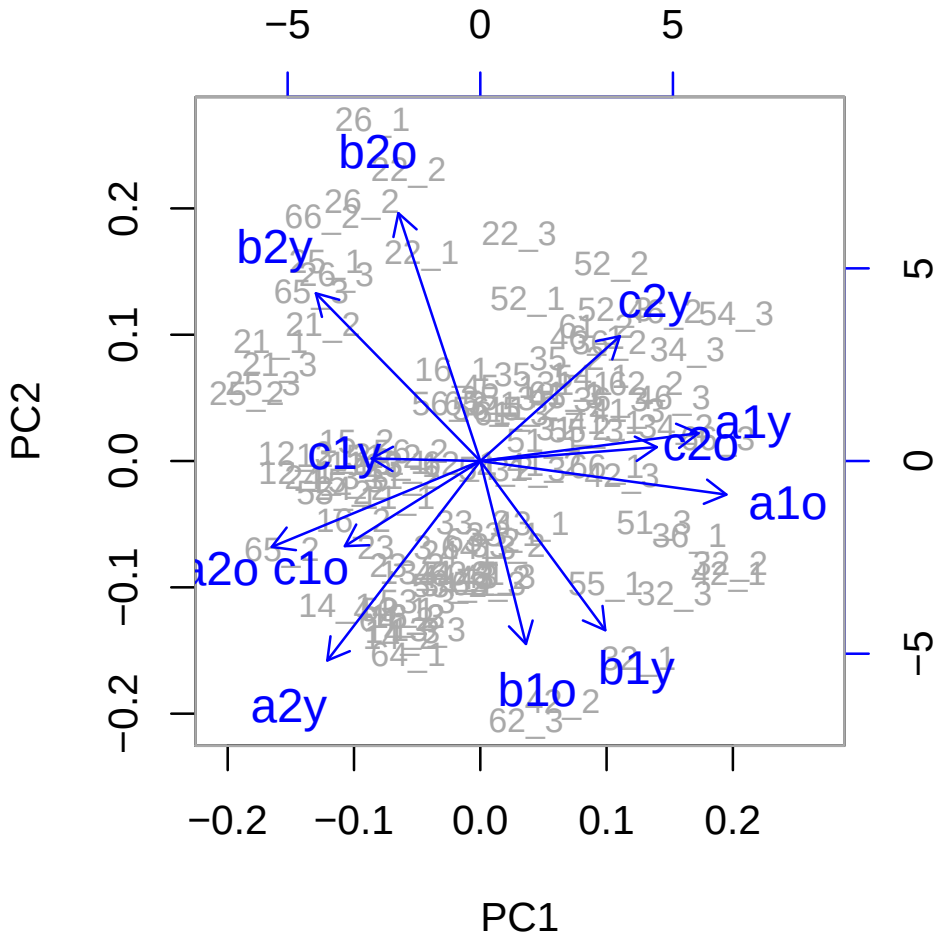

Figure: Original representations projected onto first two dimensions. Speaker groups: 'o', 'y' and 'z' vectors; Heights: 'a' vectors; Slopes: 'b' vectors; Curvatures: 'c' vectors

Word similarities and groups

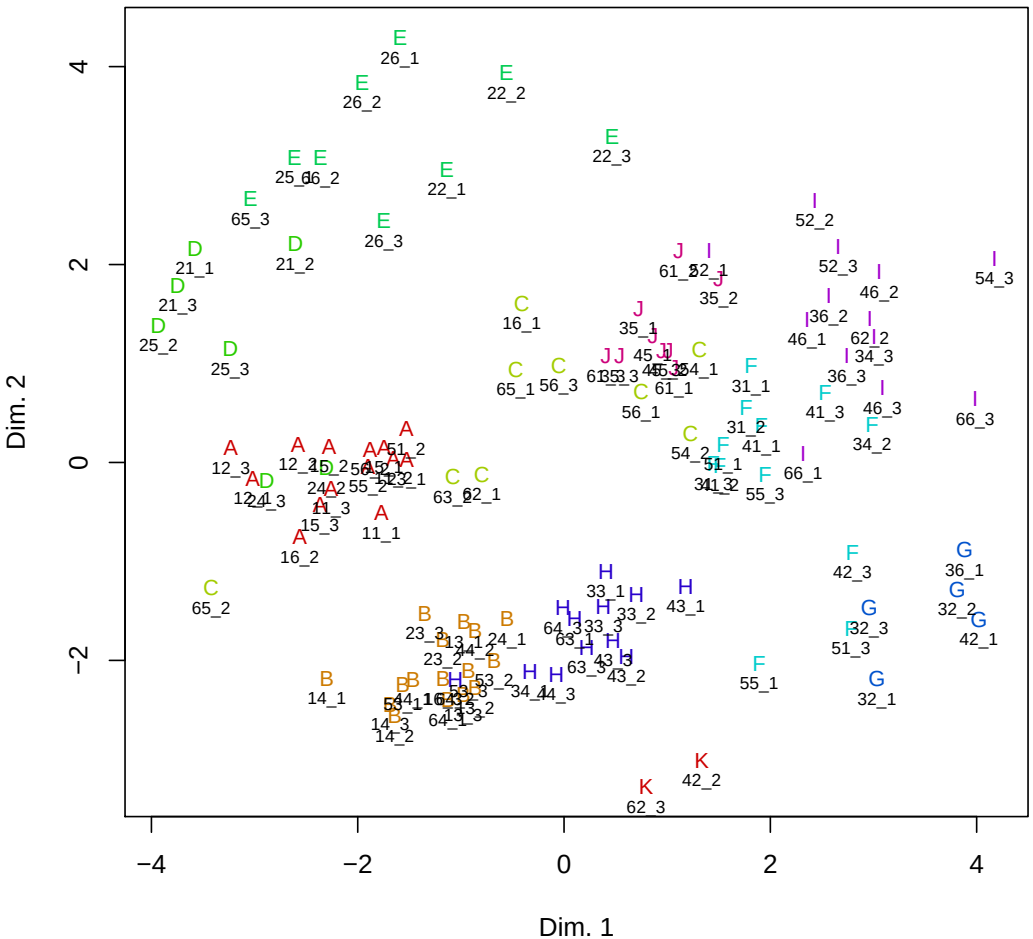

Figure: Plot of stimuli contour similarity, in the first two principle components. Word clusters are indicated by the colored letters. The first two digits of the word labels refer to the tone categories, numbered sequentially 1 through 6.

Word familiarity vs contour change

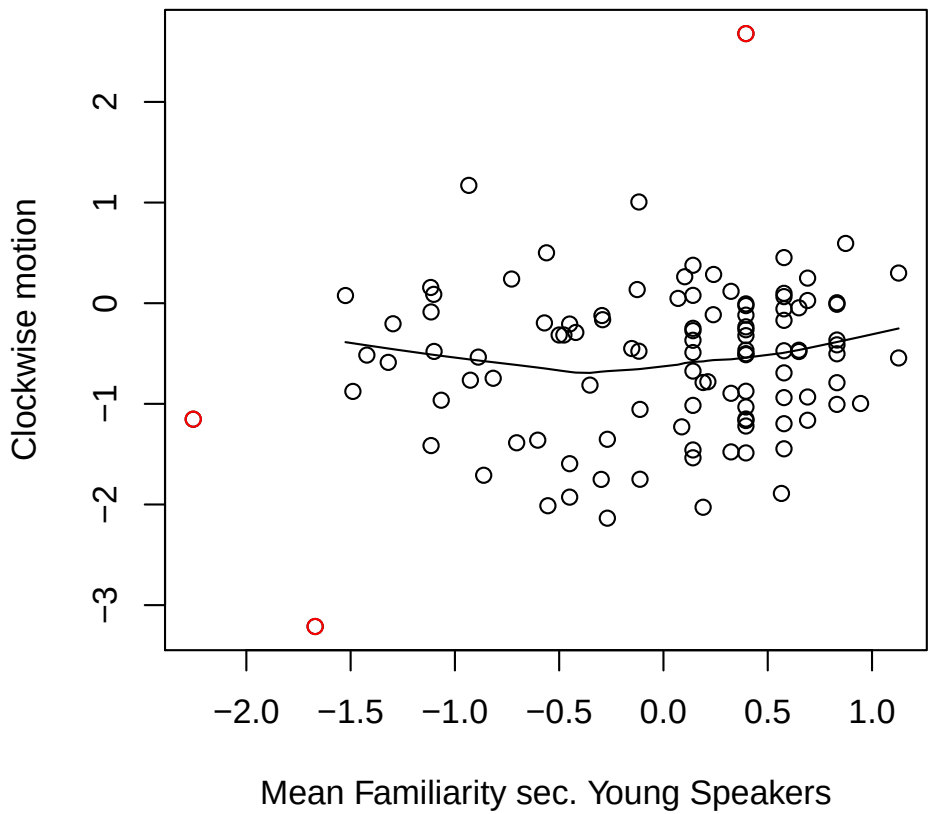

Figure: Familiarity of a word does not predict the magnitude of counter-clockwise motion

Sandhi system of the older speakers

				2nd Syllable					
			JH class	①		②		③	
			JH reg.	H	L	H	L	H	L
	JH class	JH reg.	row/col trend	**33/45**	**41/13**	**54**	**54**	**45**	**13**
1st Syllable	①	H	**33**	33.45	33.45	33.54	33.54	33.45	33.13 33.45
		L	**21**	21.45	31.24	33.45 33.54	21.45 33.54	21.45	31.24
	②	H	**55**	55.33	55.41	44.54	44.54	54.44	45.13
		L	**55**	55.33	55.41	44.54	44.54 33.54	54.44	45.13
	③	H	**33**	33.45 55.33	45.13	33.54	33.54	33.45 55.33	33.45 45.13
		L	**31/45**	54.44	14.31 45.13	44.54	44.54 33.54	31.24 12.45	31.24 45.13