A Contour Tone Chain Shift in Jinhua Wu Sandhi Tones

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Workshop on East Asian Linguistics
UC Santa Barbara
February 20, 2010

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

Tone categories and contours

Table: Tone categories of Jinhua (of generation born ca. 1930) compared to Middle Chinese, according to Qian (1992)

	MC①	MC②	MC③	MC④a	MC④b
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 tone inventory: similar categories, different contours (Notation: $T_{category}^{contour}$)
- MC voiced obstruents have devoiced in urban Jinhua, but are murmured in some nearby areas; generation born 100 years ago had a 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

Researchers as well as speakers mention that "young people speak different", but there has been no systematic study of variation in Jinhua sandhi systems.

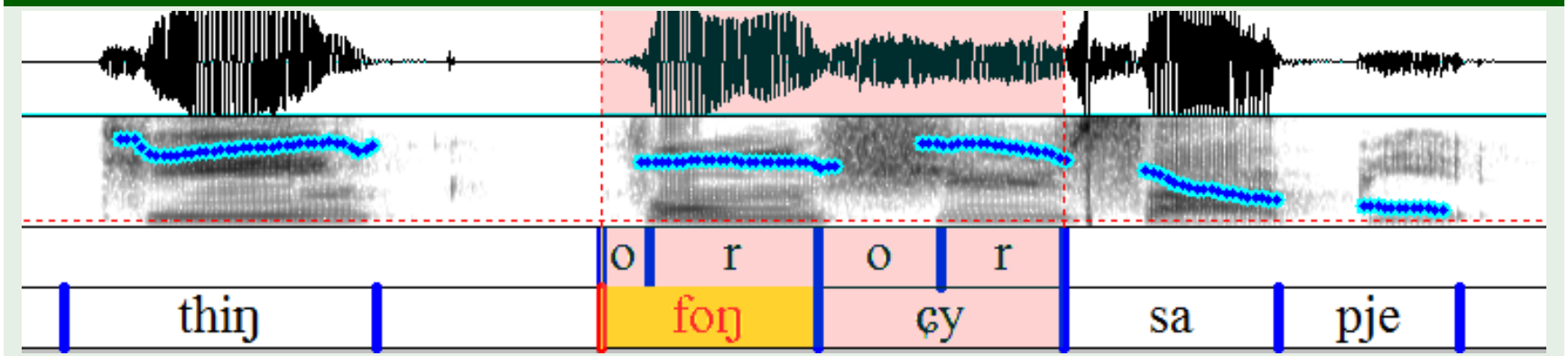
Elicitation

- Based on procedure of You and 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:
  - urban older group: 5 speakers born 1931-1952
  - urban younger group: 5 speakers born 1984-1989
  - rural older group: 2 speakers born 1946-1949
  - 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)

The procedure is highly bottom-up, and a key tool here is PCA

1. Represent words or speakers as a vectors of contour parameters
2. 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

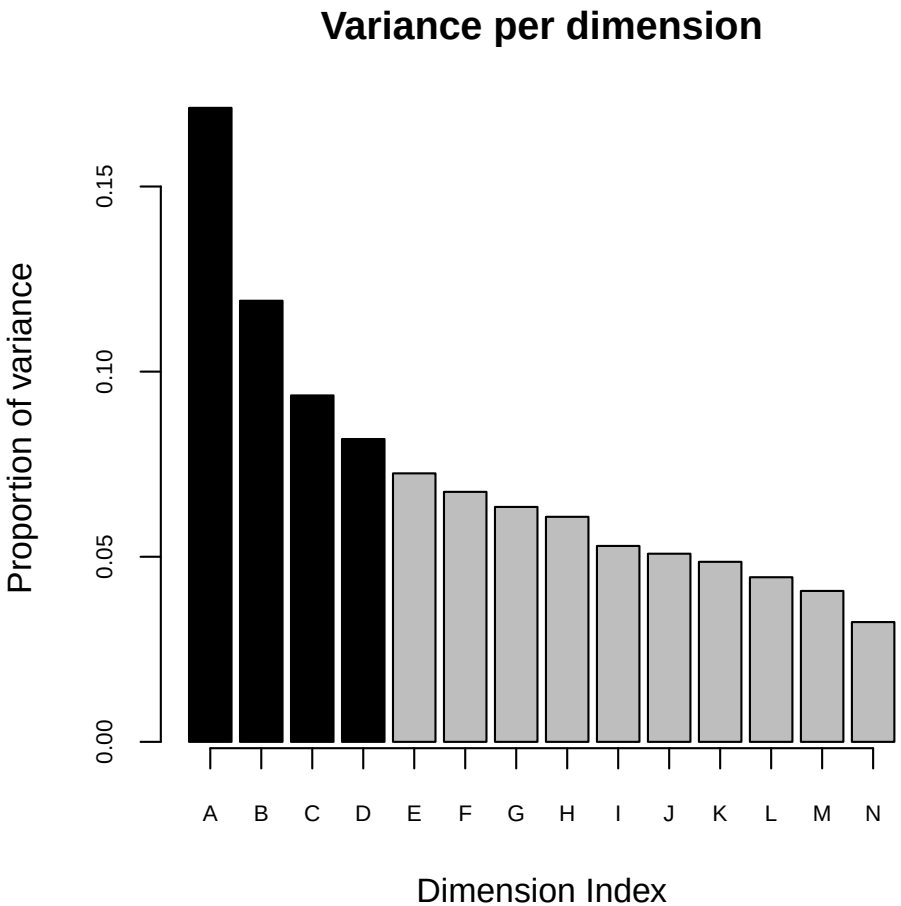


Figure: The 4 dimensions with the most variance represent 47% of the between-speaker variance.

Dimensions B and D

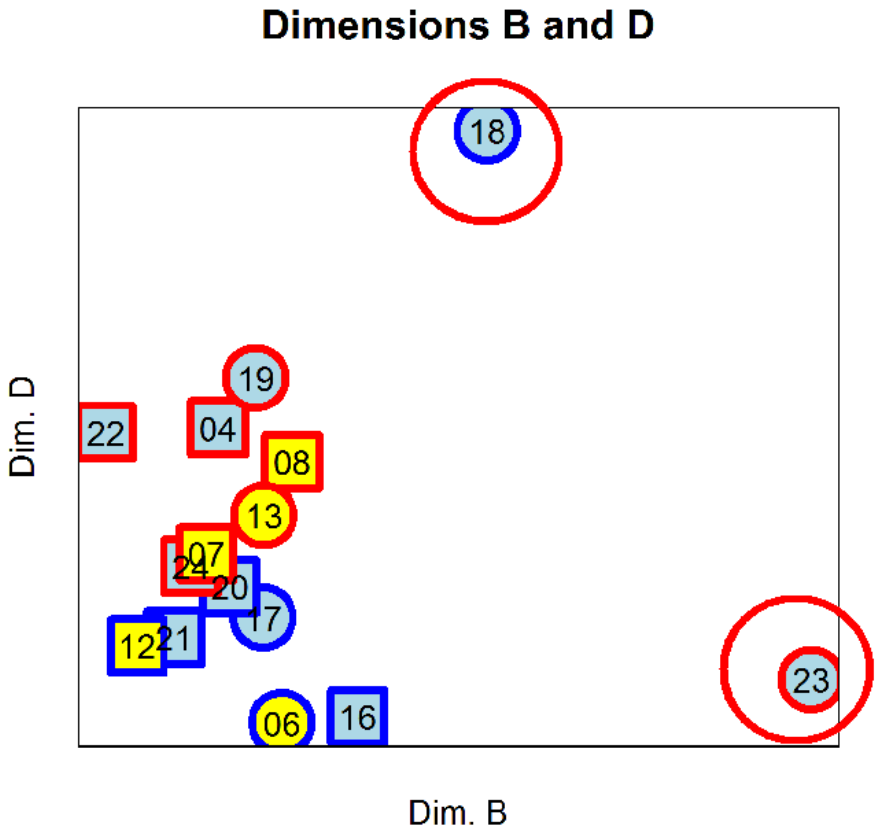


Figure: Dimensions B and D show that the data from speakers 18 and 23 are atypical, so we set them aside. Borders: older (blue) and younger (red); Fill: urban Jinhua (blue) and Zhuma village (yellow); Shapes: men (circles) and women (squares).

Dimensions A and C

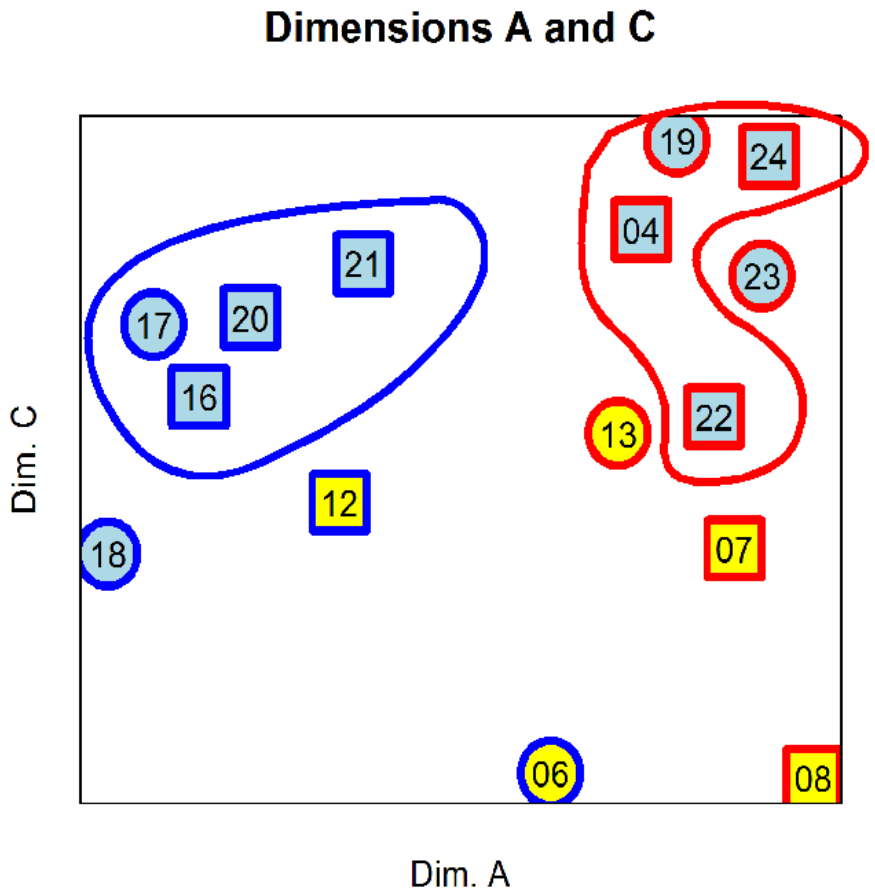


Figure: Dimension A is associated with generation, and Dimension C is associated with location. The circled groups become the basis of further analysis.

PCA of word differences

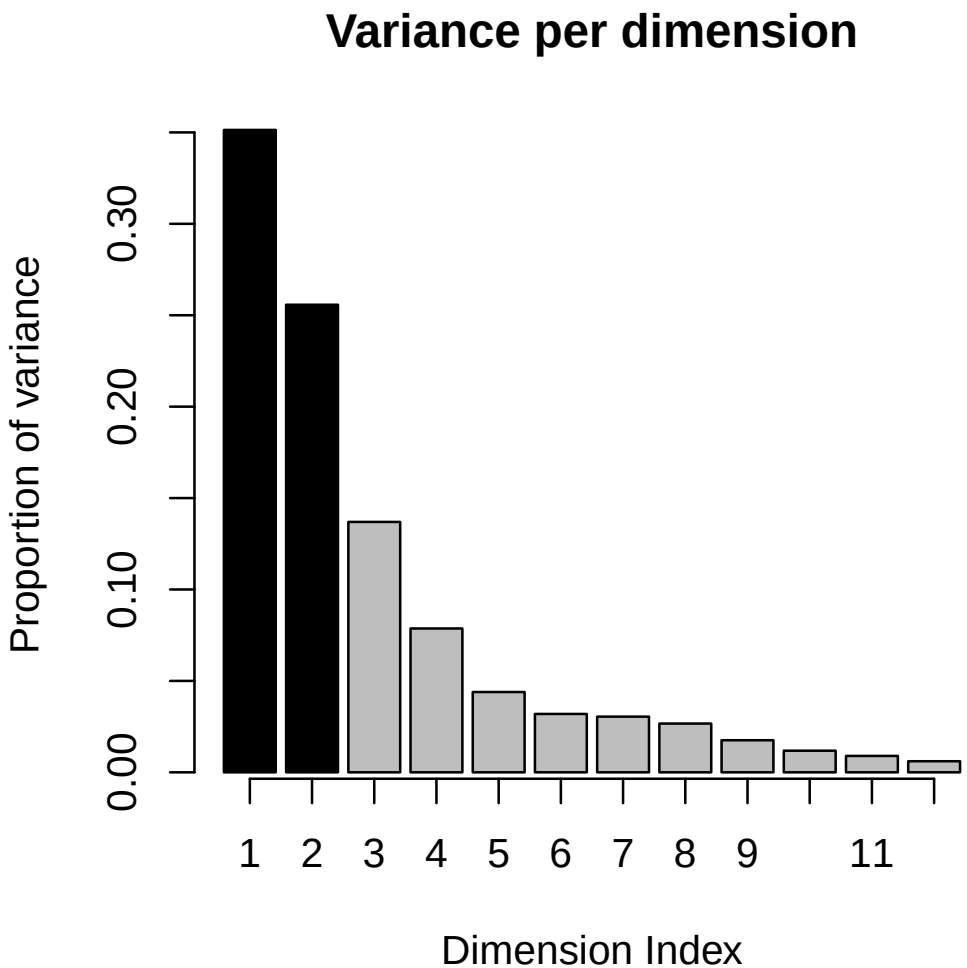


Figure: Dimensions 1 and 2 together represent 61% of the variance. We will also look briefly at Dimensions 3 and 4.

Dimension meanings: archetype contours

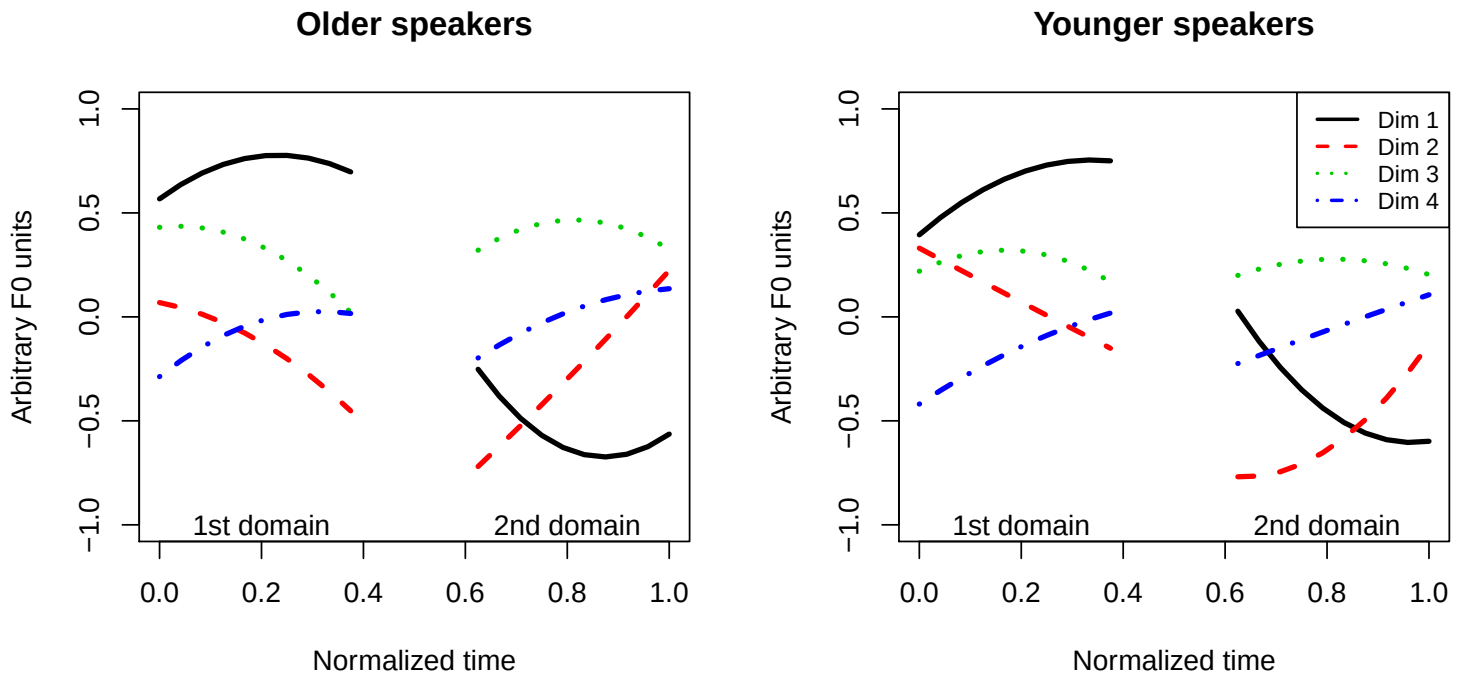


Figure: Older speakers: D1 ∼ tone domains' height difference; D2 ∼ fall-rise vs rise-fall; D3 ∼ overall height; D4 ∼ contours rise/fall equally. Younger: D1 and D2 contours are shifted.

Contour changes

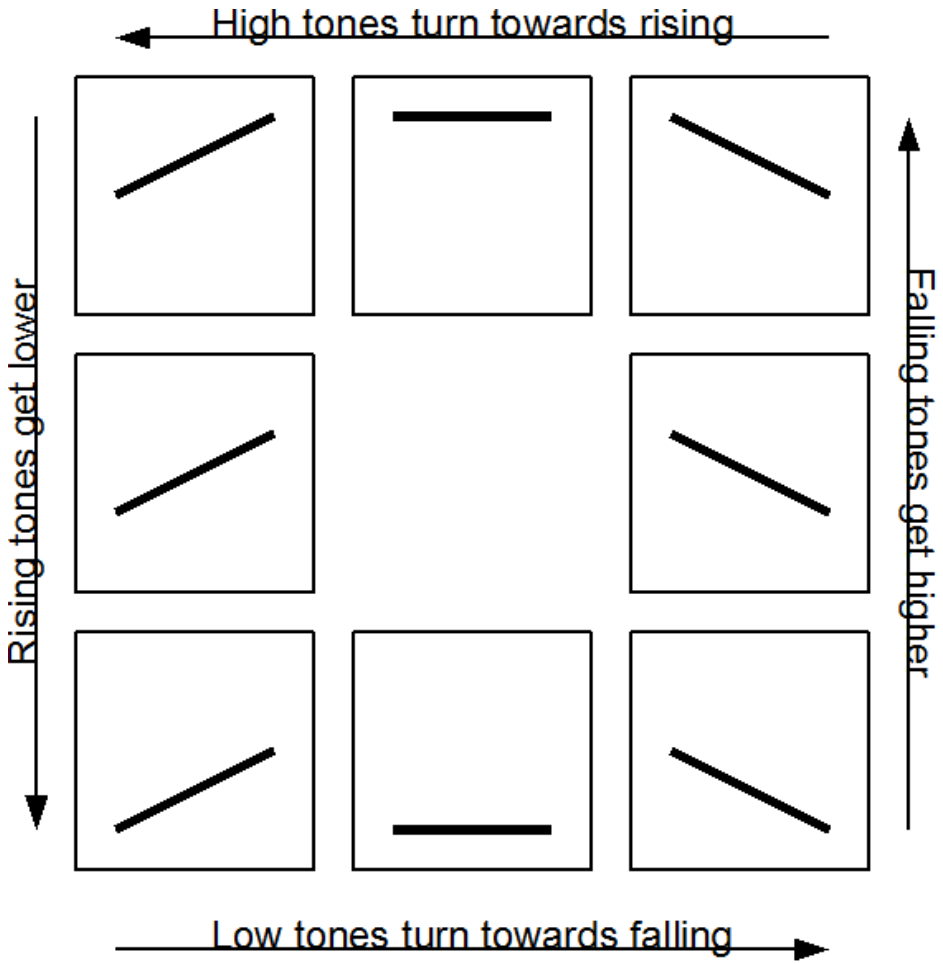


Figure: The change in D2 captures the rising tones getting lower and the falling tones getting higher. The change in D1 captures the low turning towards falling and the high turning towards rising.

The shift is a generalization

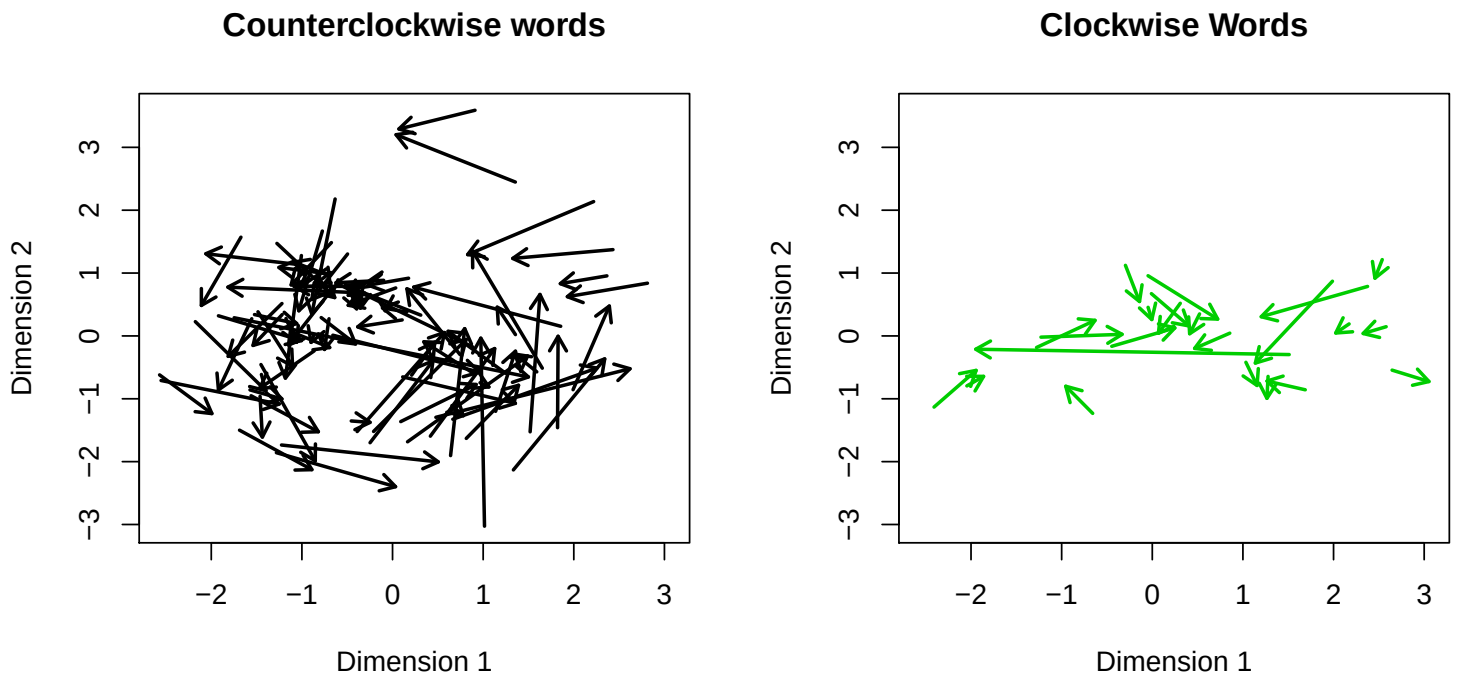


Figure: Each arrow indicates one word's change from older speakers' contour to younger speakers' contour. A large majority of words have moved in a counter-clockwise direction.

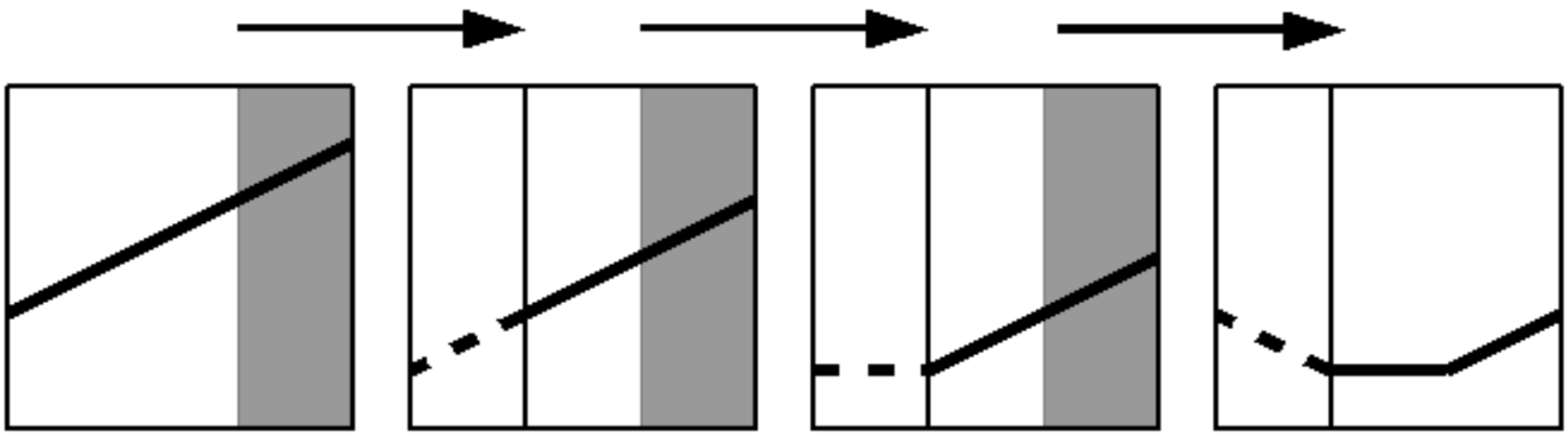
Why are the contours changing this way?

- Hypothesis A: The younger generation are reclassifying words according to Mandarin categories
  ↪ A few words are being reclassified, but most of the changes are small, not categorical
- Hypothesis B: The younger generation are perceiving/producing contours according to the Mandarin contour shapes
  ↪ This could cause falls to get higher (cf. Mandarin T_4^{51}) and maybe lows to turn to falls (cf. Mandarin $T_3^{214} \sim T_3^{21}$). But not rises to get lower (cf. Mandarin T_2^{35}), nor highs to turn to rises (cf. Mandarin T_1^{55})

Why are the contours changing this way?

- Hypothesis C: 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.

  Sanders (2008) provides a similar account for how Beijing T_2^{35} became Taiwan Mandarin T_2^{324}.



Conclusions

- The observed change is consistent with shifting of 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
- We should expect to find similar tonal evolution in other contour tone languages

Acknowledgements

Special thanks to:

- The people of Jinhua, especially the native speakers recorded for this study, and Emily Cen, Betty Hu, and Angie Kim
- The linguists of UCSD, especially Sharon Rose (my advisor on this project) and the other members of SaD PhIG

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PCA of groups' mean contour representations

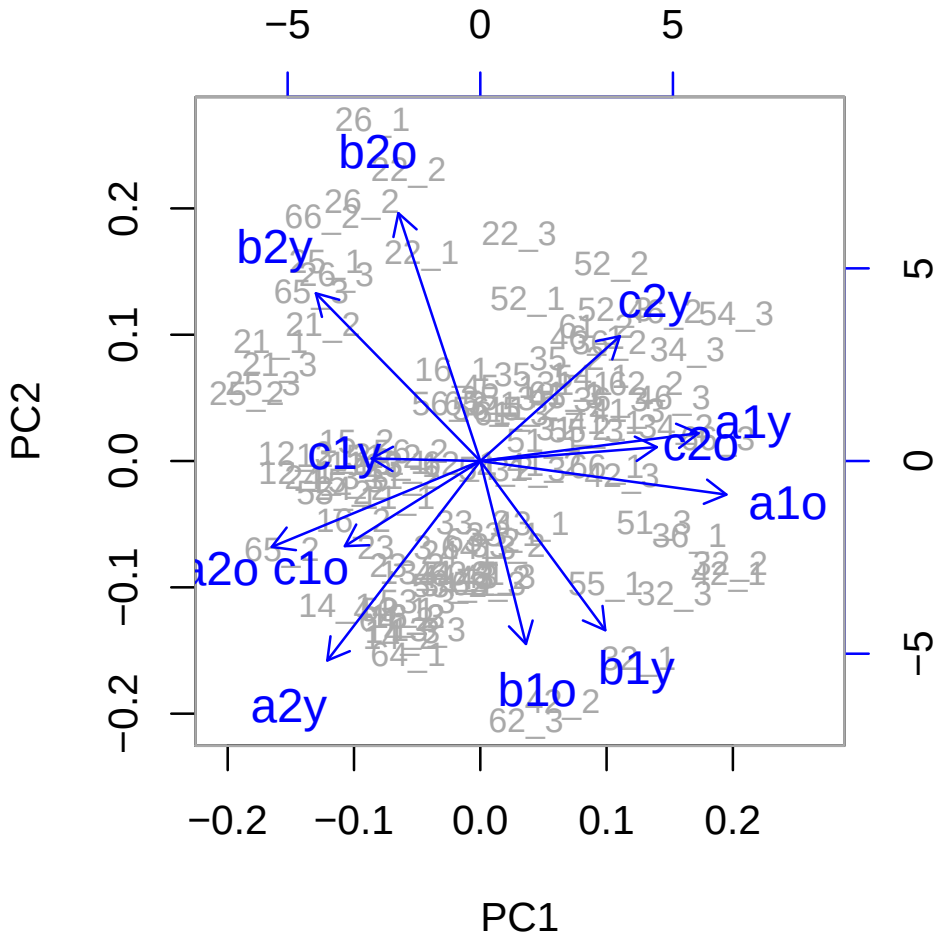

Figure: Original representations projected onto first two dimensions. Speaker groups: 'o', 'y' and 'z' vectors; Heights: 'a' vectors; Slopes: 'b' vectors; Curvatures: 'c' vectors

Word similarities and groups

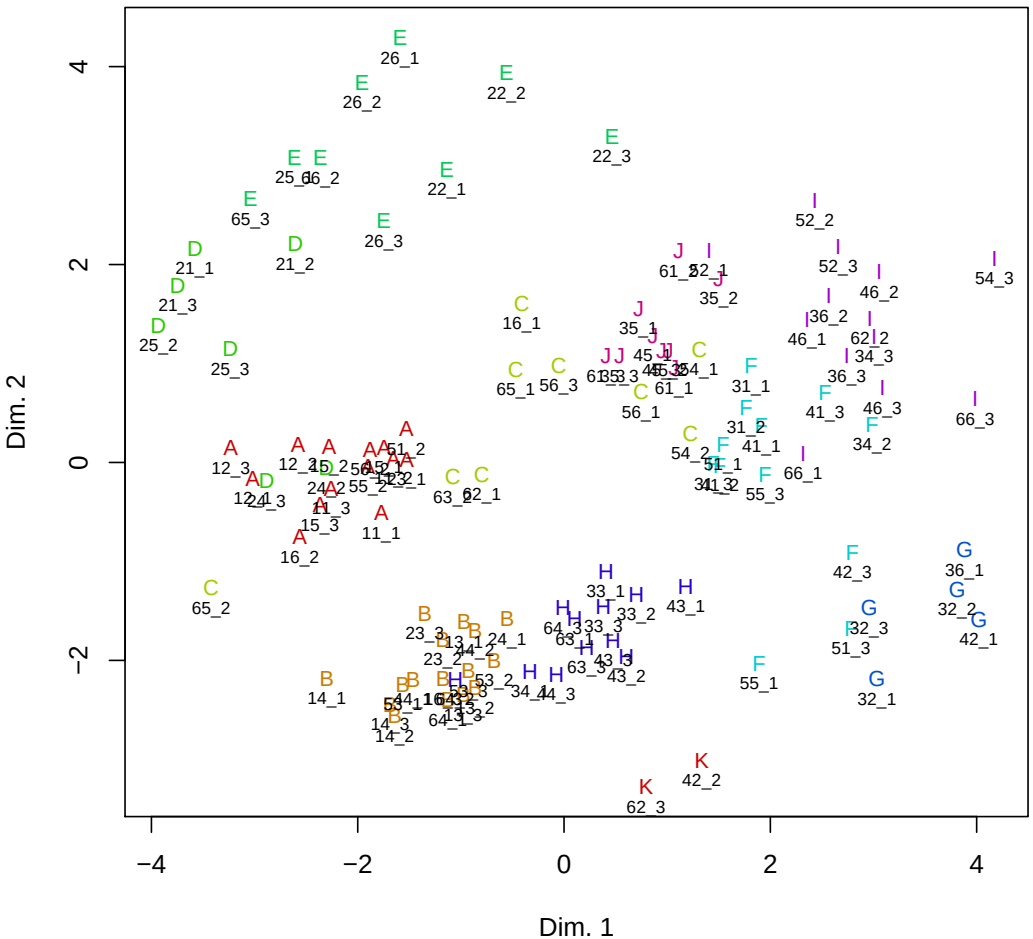

Figure: Plot of stimuli contour similarity, in the first two principle components. Word clusters are indicated by the colored letters. The first two digits of the word labels refer to the tone categories, numbered sequentially 1 through 6.

Word familiarity vs contour change

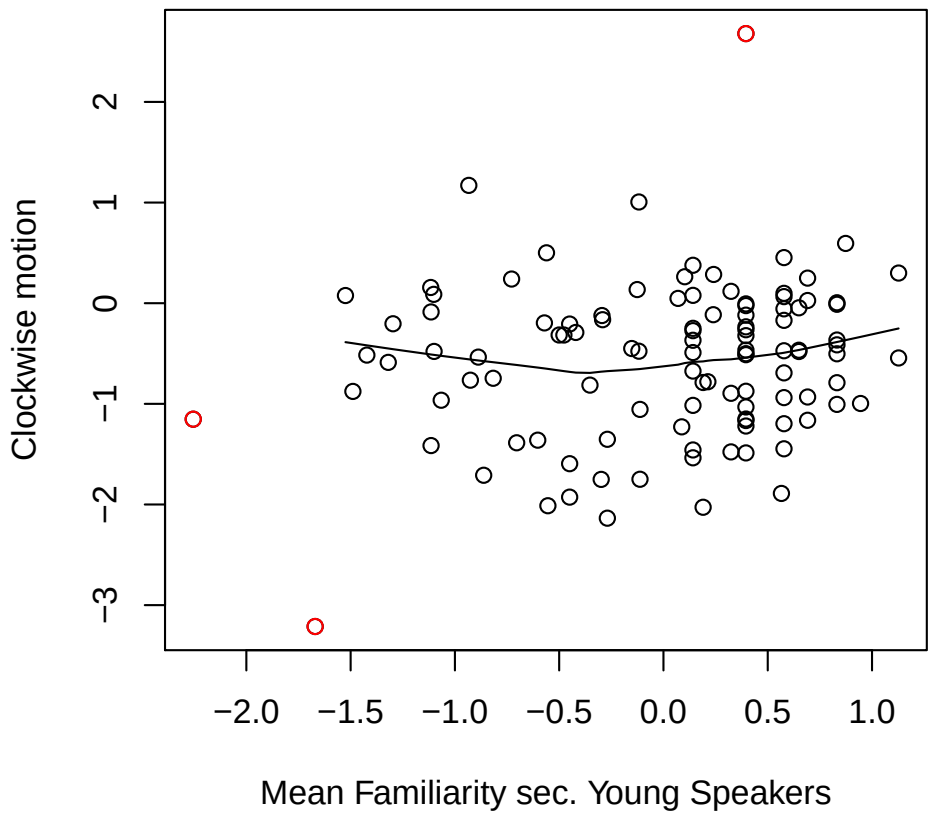

Figure: Familiarity of a word does not predict the magnitude of counter-clockwise motion