Aging and Age-Independent Effects of Cognitive and Sociolinguistic Backgrounds:

On the Strength of Tonal Systematic Correspondence by Tonal Bilinguals

Junru Wu[abc], Yiya Chen [bc], Niels.O.Schiller [bc] (Vincent van Heuven)

a. Dept. Chinese Language and Literature, East China Normal University, 500 Dongchuan Rd., Shanghai 200241, China. jrwu@zhwx.ecnu.edu.cn, +86-(0)2154344874

b. Leiden University Centre for Linguistics, Leiden Institute for Brain and Cognition, Cleveringaplaats 1, P.O. Box 9515, 2300 RA Leiden, The Netherlands.

Introduction

Age effect in speech production

| Language changes across generations. | Speech performance changes with cognitive aging. |

- Age-related differences are observed in speech production.
- Speakers of the same generation and the same age still vary in their speech performance.
- The interaction of different factors remains unclear.

Systematic Correspondence in Tonal Bilingualism

- Most Jinan speakers are bilinguals of Jinan Mandarin (JM) and Standard Chinese (SC).

- Translation equivalents of JM and SC often share the segmental composition, but differ in tone.

- The tones of most different translation equivalents are controlled by systematic correspondence rules.

  - E.g Within the monosyllabic SC words carrying high-level tones, 81% have JM translation equivalents carrying low-rising tones.

Systematic Correspondence in Tonal Bilingualism

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BM (SC)	Tone 1 high-level	Tone 2 high-rising	Tone 3 low-rising or dipping	Tone 4 high-falling	Total
JM	81% (low-)rising	76% high-falling	70% high-level	75% low-falling	76%

Systematic Correspondence in Tonal Bilingualism

- The tones of most different translation equivalents are controlled by systematic correspondence rules.

SC
"know"/hl+f/
"need"/hl+f/
"opportunity" /hl+f/

sharing "Hl+f"

predict

JM
"know"/r+lf/
"need"/r+lf/
"opportunity" /r+lf/

Sharing …
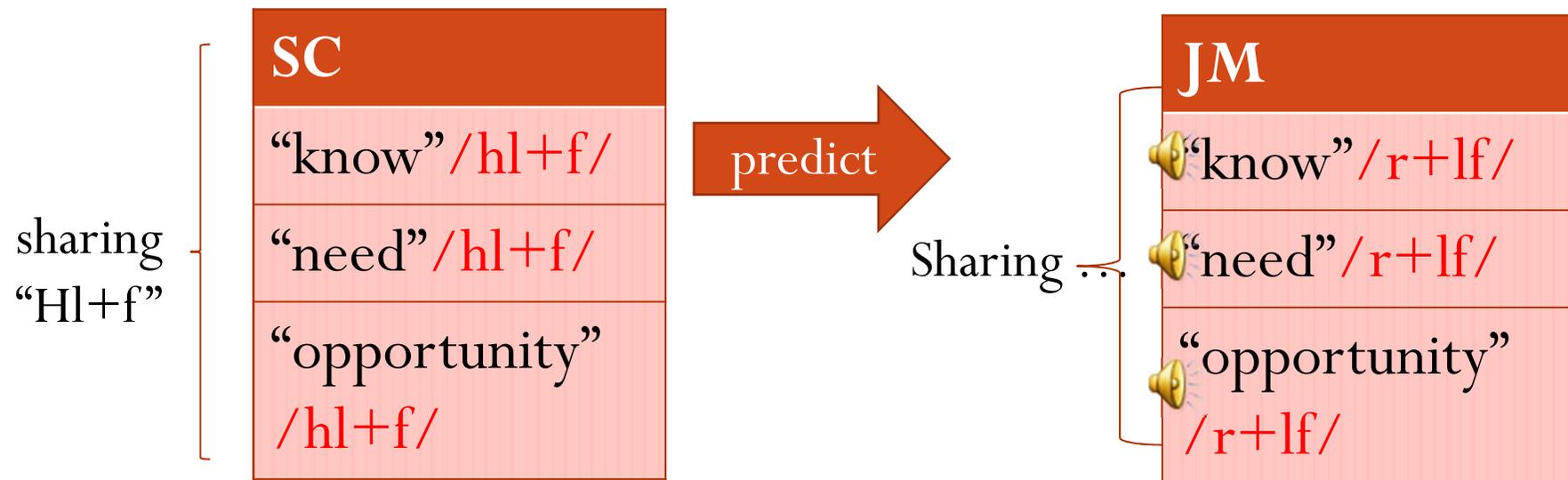
Systematic Correspondence in Tonal Bilingualism

- The strength of tonal systematic correspondence varies across the bilinguals.

Research Questions:

- How do cognitive and sociolinguistic backgrounds affect the strength of tonal systematic correspondence?

- Which cognitive and sociolinguistic backgrounds have age-independent effects and which do not?

Predictions

- The pitch distance between two JM words is more likely to be smaller if their counterparts share tonal categories in SC.

- The strength of systematic correspondence in JM word production decreases with the increase in age.

  - Socio.: Older bilinguals are more JM dominant and less proficient in SC

  - Cog.: Older bilinguals have cognitive aging

- Age independent effects?

The Word Naming Corpus

- 42 Jinan native bilingual speakers named 400 disyllabic written words presented on a computer screen.

- Named words were recorded.

- Pitch contours of the rhymes of the words were extracted with Praat.

- Production errors, contour outliers, and naming-latency outliers were excluded.

Measurements of Individual Backgrounds

- All speakers except one received formal education, of which 57% reached college level and the rest reached middle school level. As for the literacy education, 26% speakers received it in JM, 56% received it in SC, and 18% received it in a combination of JM and SC..

- The other measurements are distributed as follows.

Measurements of Individual Backgrounds
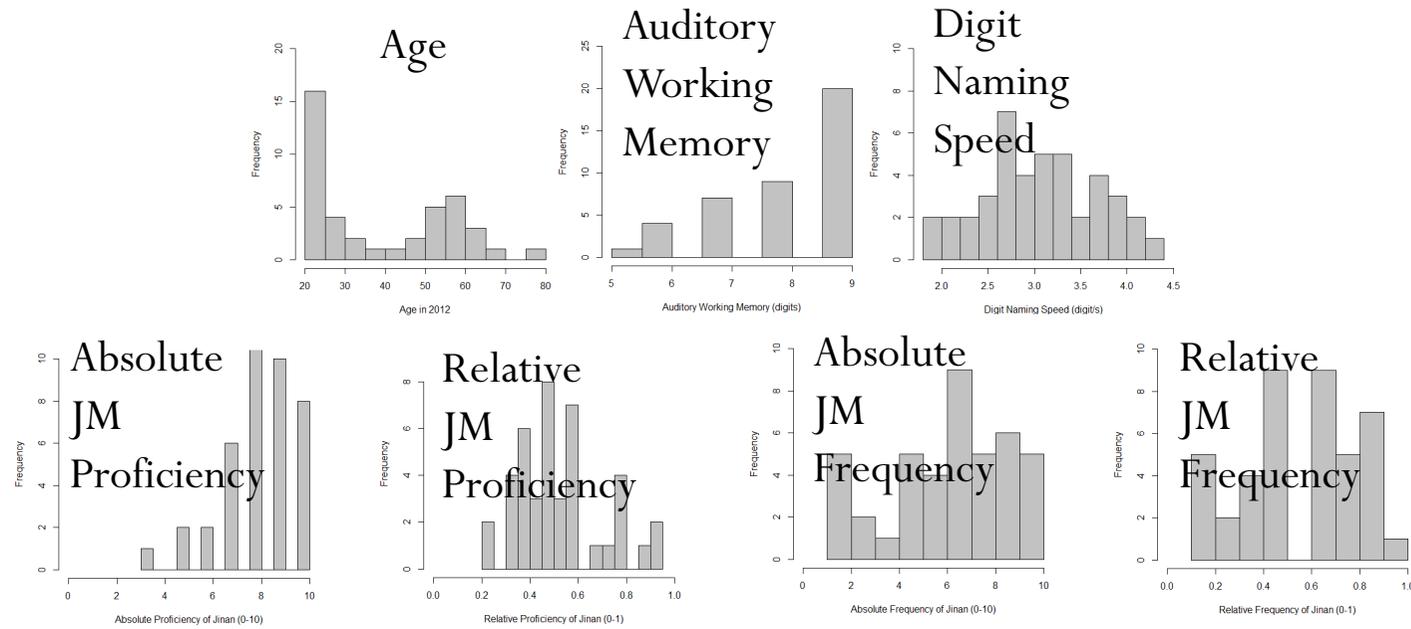
Figure 1.

Modeling Method

- Multi-linear regression models were built including between-word pitch distance of JM words (Euclidean distance) as the dependent variable and linguistic, cognitive, and sociolinguistic backgrounds as the predictors.

- Explorative statistics: backward elimination.

- Collinearity elimination: residualization & stratification.

Analysis and Results

- Analysis 1: Individual Models

- Analysis 2: Individual backgrounds separately

- Analysis 3: Residualized Models

- Analysis 4: Stratified Models

Analysis 1: Individual Models

- Models without individual backgrounds.

- The sharing of tones between two SC words is related to a smaller between-word pitch distance of their translation equivalents in JM, revealing the systematic correspondence mechanism.
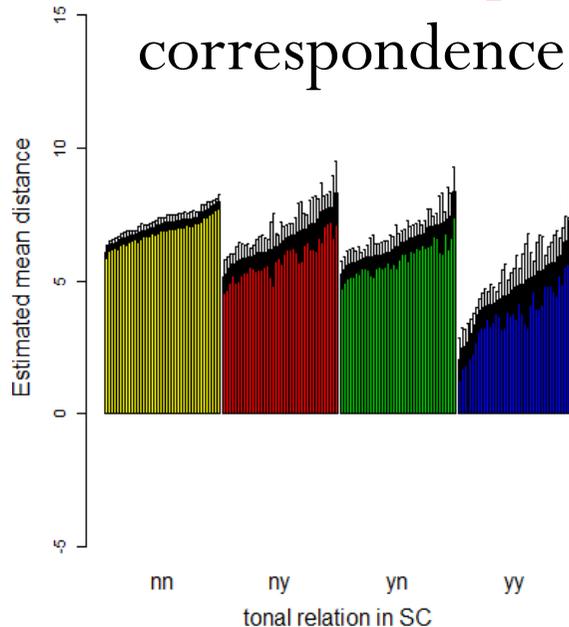
tonal relation in SC [neither (nn), only the first (yn), only the 2nd (ny), both (yy) syllable(s) are from the same tonal category].

Analysis 2: Individual backgrounds separately

- Each aspect of the individual backgrounds included separately in smaller models.
- Each mediated and unmediated effect investigated together.
- The strength of systematic correspondence generally decreased with the increase of age.
- Other cognitive and social backgrounds mainly showed effects mediated by age effect.

- **Older bilinguals tend to have**
  - slower digit naming speed,
  - smaller auditory working memory, and
  - poorer tonal awareness, as well as
  - higher JM proficiency and frequency,
  - lower education level, and
  - received literacy education in JM.

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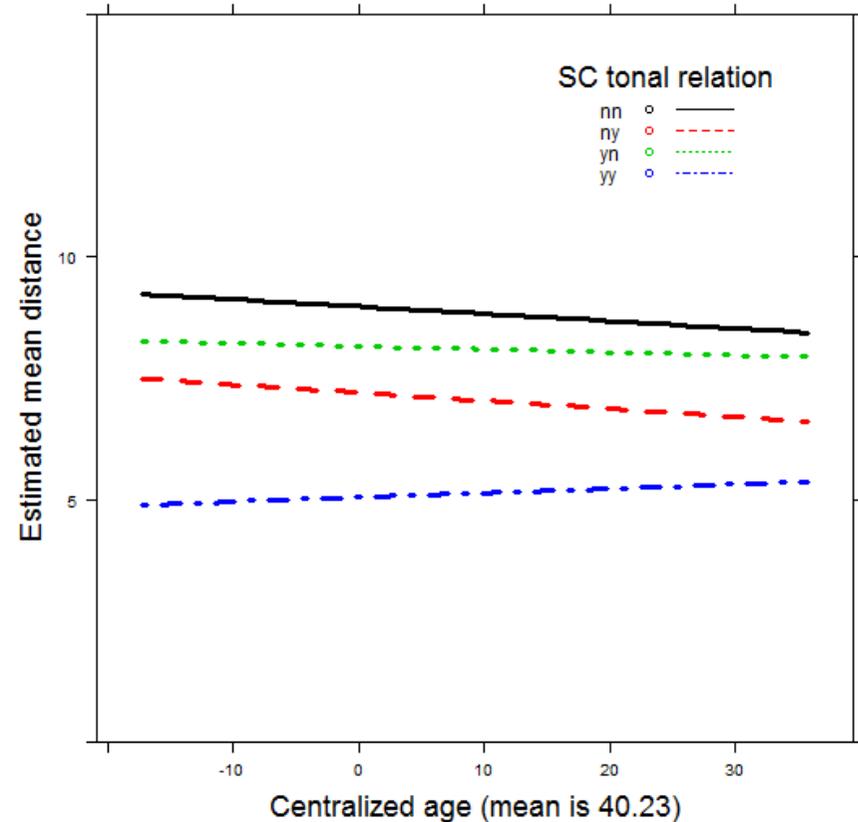
Analysis 3: Residualized Models

- Only the frequency of JM usage still had an unmediated effect; a higher freq. reducing the effect of systematic correspondence.

- Age effect interacts with the type of literacy education.

Analysis 3: Residualized Models
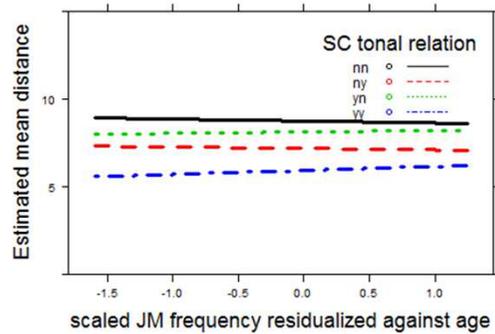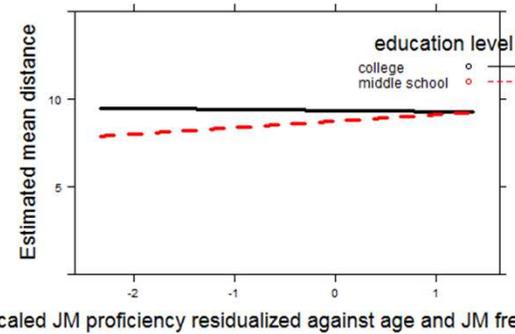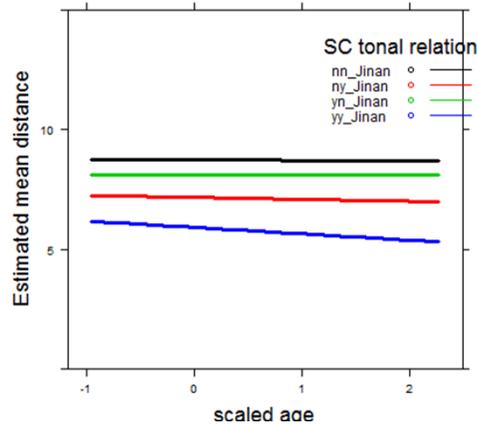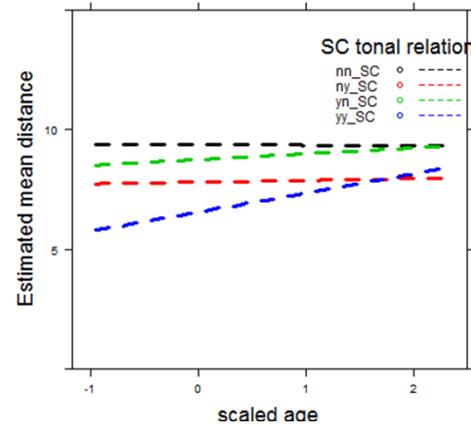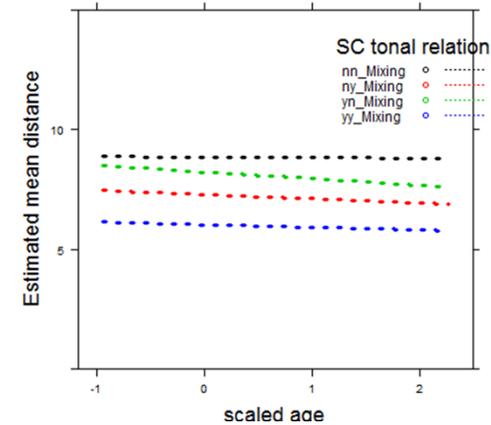
Analysis 4: Stratified Models

- Younger speakers tend to receive a higher education and receive literacy education in SC. This type of collinearity was not considered in the model mentioned above.

- Age-independent cognitive effects emerged in the middle-age bilinguals.

- Young bilinguals only showed age-independent frequency effect

Analysis 4: Stratified Models

- Age-independent cognitive effects emerged in the middle-age bilinguals.

-

**middle school level, literacy education in JM**

**age distribution**

mean age = 57.5

N = 32   Bandwidth = 2.854
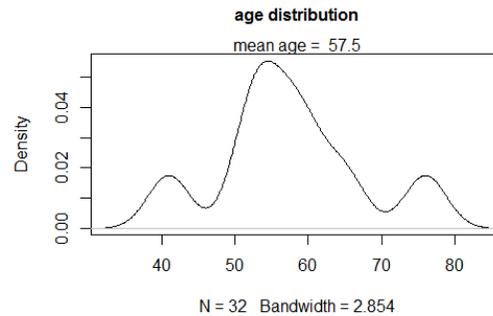
AWM: auditory working memory

# Analysis 4: Stratified Models

- Young bilinguals only showed age-independent frequency effect

college level, literacy education in SC

age distribution
mean age = 25.55

N = 80   Bandwidth = 0.4194
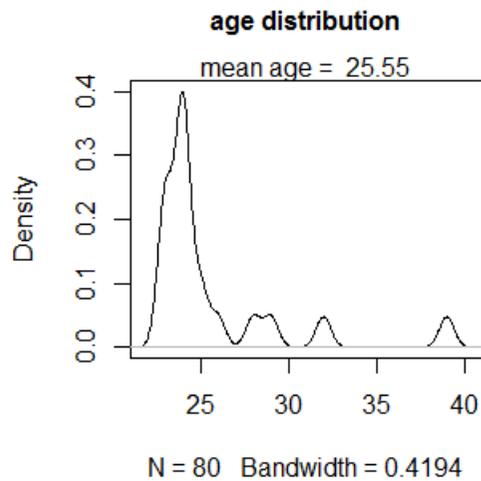
Interaction from residualized JM absolute Freq

SC tonal relation
nn
ny
yn
yy

Estimated mean distance

JM Freq residualized against sAge
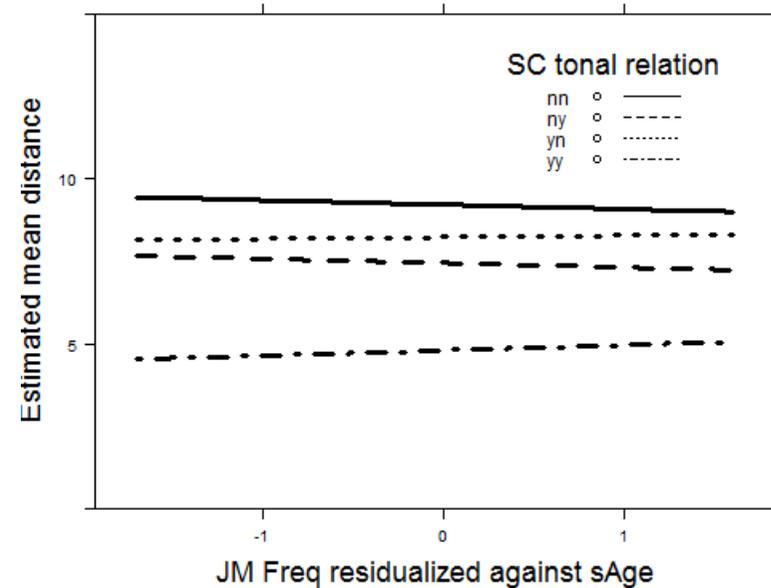
Discussion & Conclusion

- The strength of tonal systematic correspondence by tonal bilinguals is influenced by language change and cognitive aging.

- Literacy education is very important.

- Age-independent cognitive skills only affect the middle-aged bilinguals.

Acknowledgements