



Universiteit  
Leiden  
The Netherlands

## Consonant and lexical tone interaction: Evidence from two Chinese dialects

Shi, M.

### Citation

Shi, M. (2020, June 4). *Consonant and lexical tone interaction: Evidence from two Chinese dialects*. LOT dissertation series. LOT, Amsterdam. Retrieved from <https://hdl.handle.net/1887/92884>

Version: Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/92884>

**Note:** To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/92884> holds various files of this Leiden University dissertation.

**Author:** Shi, M

**Title:** Consonant and lexical tone interaction: Evidence from two Chinese dialects

**Issue Date:** 2020-06-04

# **Consonant and lexical tone interaction**

Evidence from two Chinese dialects

Published by

LOT

Kloveniersburgwal 48

1012 CX Amsterdam

The Netherlands

phone: +31 20 525 2461

e-mail: [lot@uva.nl](mailto:lot@uva.nl)

<http://www.lotschool.nl>

Cover illustration: The tablature notation of <*Jiu Kuang*> (酒狂) [Wine Mad] recorded in <*Shenqi Mipu*> (神奇秘谱) [The Handbook of Spiritual and Marvelous Mysteries] (1425 CE), designed by Jinzhe Ouyang.

ISBN: 978-94-6093-351-6

NUR: 616

Copyright © 2020: Menghui Shi. All rights reserved.

# Consonant and lexical tone interaction

Evidence from two Chinese dialects

Proefschrift

ter verkrijging van

de graad van Doctor aan de Universiteit Leiden,

op gezag van de Rector Magnificus prof.mr. C.J.J.M. Stolker,

volgens besluit van het College voor Promoties

te verdedigen op donderdag 4 juni 2020

klokke 10.00 uur

door

Menghui SHI

geboren te Suzhou, China

in 1989

Promotores:

Prof.dr. Yiya Chen

Prof.dr. Maarten Mous

Promotiecommissie:

Prof.dr. Laura Downing

(University of Gothenburg)

Dr. Silke Hamann

(Universiteit van Amsterdam)

Dr. James Kirby

(University of Edinburgh)

Prof.dr. Claartje Levelt

For my parents, family, and those whom I love  
献给我的父母、家人以及那些我爱的人

青春都一饷。  
忍把浮名，  
换了浅斟低唱。

The prime of one's life is too short.  
Better to barter empty fame  
For the pleasures of good wine and sweet song.

– 柳永 (987?-1053?)  
(Translated by Xianyi Yang 杨宪益 and Gladys Yang 戴乃迭)





# Contents

Contents.....	vii
List of Tables .....	xi
List of Figures.....	xiii
Acknowledgments.....	xvii
<b>Chapter 1 Introduction.....</b>	<b>1</b>
1.1 General background.....	1
1.2 Property-based approach .....	2
1.3 Motivation.....	6
1.3.1 Typological bias.....	7
1.3.2 Methodological bias.....	13
1.4 The current study.....	17
1.4.1 Lili Wu and Shuangfeng Xiang: two Chinese dialects with uncommon C-T interactions.....	18
1.4.2 Multilevel regression models and the electroglottograph (EGG).....	20
1.5 Outline.....	23
<b>Chapter 2 The sound system of Lili Wu Chinese .....</b>	<b>25</b>
2.1 Introduction.....	25
2.2 Lexical tones and aspiration-induced tonal split (ATS).....	26
2.2.1 Lexical tones.....	26
2.2.2 New analysis of ATS.....	29
2.3 Consonants.....	33
2.4 Sonorants .....	41
2.5 Vowels .....	43
2.6 Syllabic approximants .....	48
2.7 Syllable structure .....	50
2.8 Onsetless syllables.....	53
2.9 Tone sandhi.....	54
<b>Chapter 3 Tonal split and laryngeal contrast of onset consonant in Lili Wu Chinese.....</b>	<b>61</b>
3.1 Introduction.....	61
3.1.1 Wu Chinese and tonal split with aspiration onsets in Lili Wu Chinese	62
3.1.2 Two debates on ATS.....	64
3.2 The current study .....	68

3.3 Acoustic experiment .....	71
3.3.1 Stimuli .....	71
3.3.2 Participants .....	72
3.3.3 Procedure.....	72
3.3.4 Measurements.....	73
3.3.5 Statistical analyses .....	74
3.3.6 Results.....	77
3.3.7 Summary I .....	89
3.4 Articulatory experiment.....	90
3.4.1 Design and procedure .....	90
3.4.2 Measurements and analyses.....	91
3.4.3 Results.....	93
3.4.4 Summary II.....	98
3.5 Discussion.....	98
3.5.1 New light on the two existing debates .....	98
3.5.2 An ongoing change: the phonatory state of voiced onsets.....	99
3.6 Conclusion.....	101
<b>Chapter 4 The sound system of Shuangfeng Xiang Chinese .....</b>	<b>103</b>
4.1 Introduction .....	103
4.2 Lexical tones .....	106
4.3 Consonants.....	108
4.4 The three-way laryngeal contrast of obstruents.....	113
4.4.1 Phonetic realization.....	113
4.4.2 Historical development.....	116
4.5 Sonorants .....	118
4.6 Approximants .....	120
4.7 Vowels.....	121
4.8 Syllable structure.....	126
4.9 Onset pitch perturbations .....	130
4.10 Tone sandhi.....	133
<b>Chapter 5 Low-rising tone and onset consonant in Shuangfeng Xiang Chinese .....</b>	<b>137</b>
5.1 The debate in Shuangfeng Xiang Chinese .....	137
5.2 The current study .....	139
5.3 Method.....	141

5.3.1 Stimuli .....	141
5.3.2 Participants .....	141
5.3.3 Procedure.....	142
5.3.4 Measurements.....	142
5.3.5 Statistical analyses .....	143
5.4 Results.....	145
5.4.1 <i>f</i> <sub>0</sub> contour .....	145
5.4.2 VOT.....	148
5.4.3 CQ .....	151
5.5 Discussion.....	155
5.5.1 New light on the two views.....	155
5.5.2 The trading relationship between VOT and CQ: principal component analysis (PCA).....	157
5.6 Conclusion.....	161
<b>Chapter 6 General discussion and conclusion .....</b>	<b>163</b>
6.1 Main findings .....	163
6.2 Typological significance.....	165
6.2.1 Tonal depression and [voice] .....	166
6.2.2 The effect of aspirated onsets on <i>f</i> <sub>0</sub> .....	168
6.2.3 ATS reported in other languages.....	170
6.3 The relationship between Wu and Xiang: from the perspective of C-T interaction.....	172
6.3.1 Unicity of Wu–Xiang? .....	172
6.3.2 Today’s Shuangfeng, tomorrow’s Lili? .....	175
6.4 Conclusion .....	176
<b>References .....</b>	<b>179</b>
<b>Appendix.....</b>	<b>199</b>
Appendix I.....	199
I-1 Stimulus list of Lili Wu Chinese in Chapter 3 .....	199
I-2 Final models to calculate the results presented in Table 3.4 .....	200
I-3a Final models to calculate the results presented in Table 3.5 .....	201
I-3b Between-Category comparisons of the DOR/DOS ratio by Generation .....	202
I-4a Final models to calculate the results presented in Table 3.7 .....	203

I-4b Between-Consonant comparisons of H1*–H2* by Generation, Category, and Position.....	204
I-5 Acoustic data of Section 3.4.....	208
I-6a Final models to calculate the results presented in Table 3.9.....	212
I-6b Between-Consonant comparisons of CQ by Generation, Category, and Position .....	213
Appendix II.....	216
II-1 Stimulus list of Shuangfeng Xiang Chinese in Chapter 5.....	216
II-2 Final models to calculate the results presented in Table 5.2.....	217
II-3a Final models to calculate the results presented in Table 5.7.....	218
II-3b Between-Consonant comparisons of CQ by Generation and Position .....	219
<b>English Summary.....</b>	<b>221</b>
<b>Nederlandse Samenvatting.....</b>	<b>225</b>
<b>中文撮要.....</b>	<b>229</b>
<b>Curriculum Vitae.....</b>	<b>233</b>

## List of Tables

Table 2.1	Examples of the lexical tones in Lili Wu Chinese. ....	28
Table 2.2	Treatments of the lexical tones after voiceless aspirated onsets in Lili Wu Chinese. ....	31
Table 2.3	Numerical representations of the lexical tones in Lili Wu Chinese. ....	32
Table 2.4	VOT of unaspirated vs. aspirated vs. voiced plosives in different places of articulation in Lili Wu Chinese. ....	36
Table 2.5	Average percentage of the frication duration and the independent samples <i>t</i> -test results for each pair of voiceless vs. voiced in Lili Wu Chinese. ....	39
Table 2.6	Syllabic combinations in Lili Wu Chinese. ....	51
Table 2.7	Observed onset-rhyme combinations in Lili Wu Chinese. ....	52
Table 2.8	Observed onset-glide combinations in Lili Wu Chinese. ....	53
Table 3.1	Co-occurrence constraints on onset-tone combinations in Lili Wu Chinese. ....	64
Table 3.2	ATS in Lili Wu Chinese. ....	64
Table 3.3	Results of model comparisons for the effect of Consonant, Generation, and Consonant * Generation on <i>f</i> <sub>0</sub> in Lili Wu Chinese. ....	78
Table 3.4	Results of the effect of Consonant on <i>f</i> <sub>0</sub> in Lili Wu Chinese. ....	81
Table 3.5	Results of models fit to the DOR/DOS ratio of each generation in Lili Wu Chinese. ....	85
Table 3.6	Results of model comparisons for the effect of Consonant, Generation, Category, Position, and their interactions on H <sub>1</sub> *-H <sub>2</sub> * in Lili Wu Chinese. ....	85
Table 3.7	Results of model comparisons for the effect of Consonant on H <sub>1</sub> *-H <sub>2</sub> * in Lili Wu Chinese. ....	88
Table 3.8	Results of model comparisons for the effect of Consonant, Generation, Category, Position, and their interactions on CQ in Lili Wu Chinese. ....	95
Table 3.9	Results of the effect of Consonant on CQ in Lili Wu Chinese. ....	94
Table 3.10	HSD results of the effect of Consonant on CQ at the one-third position of vowels for the young generation in Lili Wu Chinese. ....	97
Table 3.11	Acoustic cues used for signaling the three-way laryngeal contrast in Lili Wu Chinese. ....	100
Table 4.1	Examples of the lexical tones in Shuangfeng Xiang Chinese. ....	107
Table 4.2	Co-occurrence constraints on onset-tone combinations in Shuangfeng Xiang Chinese. ....	108

<b>Table 4.3</b> VOT of unaspirated vs. aspirated vs. voiced plosives in different places of articulation in Shuangfeng Xiang Chinese.....	110
<b>Table 4.4</b> Percentage of the voiced category with the presence of the voice bar in Shuangfeng Xiang Chinese.....	117
<b>Table 4.5</b> Percentage of the voiced category without the presence of the voice bar in Shuangfeng Xiang Chinese. ....	118
<b>Table 4.6</b> Syllabic combinations in Shuangfeng Xiang Chinese. ....	127
<b>Table 4.7</b> Observed onset-rhyme combinations in Shuangfeng Xiang Chinese..	129
<b>Table 5.1</b> Results of model comparisons for the effect of Consonant, Generation, and Consonant * Generation on <i>f</i> in Shuangfeng Xiang Chinese.....	146
<b>Table 5.2</b> Results of the effect of Consonant on <i>f</i> in Shuangfeng Xiang Chinese. ....	147
<b>Table 5.3</b> Results of model comparisons to the data of VOT-Index in Shuangfeng Xiang Chinese.....	151
<b>Table 5.4</b> Results of the effect of Generation on VOT-Index in Shuangfeng Xiang Chinese.....	151
<b>Table 5.5</b> Results of model comparisons for the effect of Consonant, Generation, Position, and their interactions on CQ in Shuangfeng Xiang Chinese.....	152
<b>Table 5.6</b> Results of the effect of Consonant on CQ at each position for each generation in Shuangfeng Xiang Chinese.....	153
<b>Table 5.7</b> HSD results of the effect of Consonant on CQ at the one-third and middle positions of vowels for each generation in Shuangfeng Xiang Chinese..	154
<b>Table 6.1</b> The realization of the voiced category in Shuangfeng Xiang and Lili Wu Chinese.....	174

## List of Figures

<b>Figure 1.1</b> Common and uncommon interactions within the three-way laryngeal contrast of initial consonant and lexical tone in Chinese dialects.....	11
<b>Figure 1.2</b> Map showing the location of Beijing, Lili, and Shuangfeng.....	18
<b>Figure 2.1</b> Map of the Wujiang dialects.....	25
<b>Figure 2.2</b> <i>f</i> <sub>0</sub> contours of the lexical tones in Lili Wu Chinese.....	27
<b>Figure 2.3</b> <i>f</i> <sub>0</sub> contours of the lexical tones of the words with voiceless unaspirated onsets and those with voiceless aspirated onsets in Lili Wu Chinese. ....	29
<b>Figure 2.4</b> Waveforms and spectrograms of (a) /tɑ <sup>1</sup> / ‘knife’, (b) /t <sup>h</sup> ɑ <sup>1</sup> / ‘billow’, and (c) /dɑ <sup>2</sup> / ‘peach’ in Lili Wu Chinese. ....	35
<b>Figure 2.5</b> Waveforms and spectrograms of (a) /fɿ <sup>1</sup> tɑ <sup>1</sup> / ‘flying knife’, (b) /pu <sup>1</sup> t <sup>h</sup> ɑ <sup>1</sup> / ‘great waves’, and (c) /æŋ <sup>1</sup> dɑ <sup>2</sup> / ‘cherry’ in Lili Wu Chinese. ....	36
<b>Figure 2.6</b> Waveforms and spectrograms of (a) /fu <sup>1</sup> / ‘husband’ and (b) /vu <sup>2</sup> / ‘to support somebody with one’s hand’ in Lili Wu Chinese. ....	38
<b>Figure 2.7</b> Waveforms and spectrograms of (a) /dzɛ <sup>2</sup> / ‘at random’ and (b) /zɛ <sup>2</sup> / ‘talent’ in Lili Wu Chinese. ....	39
<b>Figure 2.8</b> Waveforms and spectrograms of (a) /kæŋ <sup>1</sup> dzɛ <sup>2</sup> / ‘to follow’ and (b) /t <sup>h</sup> ɿ <sup>1</sup> zɛ <sup>2</sup> / ‘genius’ in Lili Wu Chinese. ....	40
<b>Figure 2.9</b> Waveforms and spectrograms of (a) /tɑ <sup>1</sup> / ‘knife’, (b) /tja <sup>1</sup> / ‘marten’, (c) /tsja <sup>1</sup> / ‘scorched’, and (d) /tɛɑ <sup>1</sup> / ‘to converge’ in Lili Wu Chinese.....	43
<b>Figure 2.10</b> Relative F <sub>1</sub> /F <sub>2</sub> formant values of monophthongs and the diphthong in open syllables in Lili Wu Chinese.....	44
<b>Figure 2.11</b> Relative F <sub>1</sub> /F <sub>2</sub> formant values of monophthongs in closed syllables in Lili Wu Chinese. ....	45
<b>Figure 2.12</b> Waveforms and spectrograms of (a) /ti <sup>3</sup> / ‘dot’ and (b) /tᵢ <sup>3</sup> / ‘bottom’ in Lili Wu Chinese. ....	46
<b>Figure 2.13</b> Narrow band spectrograms of (a) /ti <sup>3</sup> / ‘dot’ and (b) /tᵢ <sup>3</sup> / ‘bottom’ in Lili Wu Chinese. ....	46
<b>Figure 2.14</b> Waveforms and spectrograms of (a) /sᵢ <sup>1</sup> / ‘silk’ and (b) /sᵢ <sup>1</sup> / ‘book’ in Lili Wu Chinese. ....	49
<b>Figure 2.15</b> FFT spectrum of /ø/ in /ø <sup>1</sup> / ‘in safe’ and /ø <sup>2</sup> / ‘cold’ in Lili Wu Chinese. ....	54

<b>Figure 2.16</b> Waveforms, <i>f<sub>0</sub></i> tracks, and spectrograms of (a) /ts <sup>h</sup> əŋ <sup>1</sup> tsɿ <sup>7</sup> / ‘the Spring Festival’, (b) /tɕŋ <sup>1</sup> dzi <sup>7</sup> / ‘Peking Opera’, (c) /t <sup>h</sup> ɔ <sup>6</sup> kwɿ <sup>7</sup> / ‘Thailand’, and (d) /tɕ <sup>h</sup> ɿ <sup>6</sup> di <sup>7</sup> / ‘steam whistle’ in Lili Wu Chinese. ....	57
<b>Figure 2.17</b> Waveforms, <i>f<sub>0</sub></i> tracks, and spectrograms of (a) /sŋ <sup>1</sup> zəŋ <sup>4</sup> / ‘new kidney’, (b) /kɛ <sup>3</sup> zɑ <sup>4</sup> / ‘to remold’, (c) /tɕɔ <sup>5</sup> zɑ <sup>4</sup> / ‘introduction’, and (d) /kɔ <sup>7</sup> t <sup>h</sup> u <sup>4</sup> / ‘territory’ in Lili Wu Chinese. ....	58
<b>Figure 2.18</b> Waveforms, <i>f<sub>0</sub></i> tracks, and spectrograms of (a) /p <sup>h</sup> ɔ <sup>6</sup> tɕ <sup>h</sup> ɿ <sup>4</sup> / ‘to dispatch’ and (b) /tɕ <sup>h</sup> ɿ <sup>6</sup> p <sup>h</sup> ɑ <sup>6</sup> / ‘bubble’ in Lili Wu Chinese. ....	59
<b>Figure 3.1</b> Three expected stages of ATS based on the ‘ongoing change’ view in Lili Wu Chinese. ....	70
<b>Figure 3.2</b> The <i>f<sub>0</sub></i> realization of three generations in Lili Wu Chinese. ....	80
<b>Figure 3.3</b> Boxplots of the DOR/DOS ratio in target syllables of each MC tonal category for three generations in Lili Wu Chinese. ....	84
<b>Figure 3.4</b> Mean H <sub>1</sub> *–H <sub>2</sub> * of three positions in Lili Wu Chinese . ....	87
<b>Figure 3.5</b> EGG measurements and the dEGG signal exemplified by 20 ms from the beginning of /i/ in /t <sup>h</sup> ɿ <sup>1</sup> / ‘low’ produced by an old male speaker in Lili Wu Chinese. ....	93
<b>Figure 3.6</b> Mean CQ of three positions in Lili Wu Chinese. ....	96
<b>Figure 4.1</b> Location of Shuangfeng county in Hunan province. ....	103
<b>Figure 4.2</b> <i>f<sub>0</sub></i> contours of the lexical tones in Shuangfeng Xiang Chinese. ....	107
<b>Figure 4.3</b> Mean COG of /s/ vs. /ç/ vs. /ʃ/ in Shuangfeng Xiang Chinese. ....	111
<b>Figure 4.4</b> Waveforms and spectrograms of (a) /ɣɑn <sup>5</sup> / ‘slit’, (b) /ɣɑn <sup>5</sup> / (one morpheme of) ‘phoenix’, and (c) /ɣjan <sup>5</sup> / ‘lucky’ in Shuangfeng Xiang Chinese. ....	113
<b>Figure 4.5</b> Waveforms and spectrograms of (a) /ɣjɑn <sup>2</sup> / ‘frequent’ and (b) /t <sup>h</sup> ɑn <sup>1</sup> ɣjɑn <sup>2</sup> / ‘usual’ in Shuangfeng Xiang Chinese. ....	113
<b>Figure 4.6</b> Waveforms and spectrograms of (a) /ti <sup>2</sup> / ‘target’, (b) /t <sup>h</sup> i <sup>2</sup> / ‘to kick’, and (c) /di <sup>2</sup> / ‘title’ in Shuangfeng Xiang Chinese. ....	114
<b>Figure 4.7</b> Waveforms and spectrograms of two tokens of /dja <sup>2</sup> / ‘jar’ in Shuangfeng Xiang Chinese. ....	115
<b>Figure 4.8</b> Oscillograms of /d/ in (a) /den <sup>2</sup> / ‘farmland’ and (b) /djan <sup>5</sup> / ‘starch’ in Shuangfeng Xiang Chinese. ....	116
<b>Figure 4.9</b> Relative F <sub>1</sub> /F <sub>2</sub> formant values of monophthongs produced in (a) open syllables and in (b) closed syllables in Shuangfeng Xiang Chinese. ....	122
<b>Figure 4.10</b> Waveforms and spectrograms of ‘fish’ in (a) Standard Chinese and (b) Shuangfeng Xiang Chinese. ....	123



<b>Figure 4.11</b> Waveforms and spectrograms of (a) /bo <sup>2</sup> / ‘to climb’, (b) /bu <sup>2</sup> / ‘old woman’, and (c) /bɯ <sup>2</sup> / ‘calamus’ in Shuangfeng Xiang Chinese .....	125
<b>Figure 4.12</b> Pictures of the maximal gesture of the lips in (a) /bo <sup>2</sup> / ‘to climb’, (b) /bu <sup>2</sup> / ‘old woman’, and (c) /bɯ <sup>2</sup> / ‘calamus’ in Shuangfeng Xiang Chinese. ....	125
<b>Figure 4.13</b> Gliding trajectories of the phoneme /ɜ/ produced after glides /j/, /w/, and /ɥ/ in Shuangfeng Xiang Chinese. ....	126
<b>Figure 4.14</b> Mean <i>f</i> <sub>0</sub> of T <sub>2</sub> after different onsets in Shuangfeng Xiang Chinese. ....	131
<b>Figure 4.15</b> Mean <i>f</i> <sub>0</sub> of (a) T <sub>1</sub> , (b) T <sub>3</sub> , (c) T <sub>4</sub> , and (d) T <sub>5</sub> after different onsets in Shuangfeng Xiang Chinese. ....	132
<b>Figure 4.16</b> Waveforms, <i>f</i> <sub>0</sub> tracks, and spectrograms of (a) /sja <sup>1</sup> pen <sup>1</sup> / ‘three sides’ and (b) /sja <sup>1</sup> pen <sup>4</sup> / ‘three times’ in Shuangfeng Xiang Chinese. ....	134
<b>Figure 4.17</b> Waveforms, <i>f</i> <sub>0</sub> tracks, and spectrograms of (a) /ɕan <sup>1</sup> tɕɿ <sup>3</sup> / ‘a new sheet of paper’ and (b) /ɕan <sup>4</sup> tɕɿ <sup>3</sup> / ‘letter paper’ in Shuangfeng Xiang Chinese. ....	134
<b>Figure 5.1</b> The <i>f</i> <sub>0</sub> realization of T <sub>2</sub> for two generations in Shuangfeng Xiang Chinese. ....	147
<b>Figure 5.2</b> Histograms representing the distribution of VOT for productions of plosives for (a) old and (b) young generations in Shuangfeng Xiang Chinese. ....	150
<b>Figure 5.3</b> Mean CQ of three positions in Shuangfeng Xiang Chinese. ....	153
<b>Figure 5.4</b> Biplot for the VOT-CQ data (correlation matrix PCA) in Shuangfeng Xiang Chinese. ....	159



## Acknowledgments

First of all, I would like to acknowledge the financial support from the Chinese Scholarship Council (CSC), Leids Universiteits Fonds (LUF), and Leiden University Centre for Linguistics (LUCL). Without them, I would not have been able to come to Leiden and complete this dissertation.

On 5<sup>th</sup> September 2015, when I set foot on Leiden's soil, I had taken this journey into the ocean of my PhD life. I must admit without my supervisors – Yiya Chen and Maarten Mous, I would have drowned already and have become bubbles in the sea. Yiya, you accompanied me to grow up. There are currently 368 conversations containing more than 1,500 emails between us in my mailbox. Maarten, you are the beacon of hope – a place that keeps orienting my sailing direction. I am looking forward to our next encounter in the market on Saturdays.

I owe a debt of gratitude to all the participants and native speakers of my experiments, too numerous to list, who ended up teaching me the most about the languages I worked on. Particularly, I would like to thank my two principal consultants – Mr. Liangquan Cheng and Mrs. Suxin Xu for making Chapter 2 and Chapter 4 possible. I am also grateful to Mr. Haimin Li and Mr. Shijia Zhou for your coordination and arrangement for the fieldwork sessions conducted in Lili and Shuangfeng, respectively.

There are also a lot of senior scholars whom I owe a deep gratitude to: Prof. Huan Tao, for enlightening the entrance of linguistics for me; Prof. Zhongmin Chen, for bringing me the first breeze of international studies of linguistics; Prof. Rujie You, for introducing Leiden University to me; Prof. Zhongwei Shen, for inspiring me to take Lili Wu Chinese as a case language in my dissertation; Academician Dah-an Ho and Prof. Hsiu-Fang Yang, for encouraging me to go along my own path. Besides, I really appreciate those who agreed to evaluate my dissertation, including Prof. Laura Downing, Dr. Silke Hamann, Dr. James Kirby, and Prof. Claartje Levelt. Thank you all for spending time reading this work and providing excellent comments and suggestions.

This paragraph is for my paranympths – Hang Cheng and Cesko Voeten. Even if it is time for us to grow apart, it doesn't change the fact that for these years we grew side by side.

This PhD project received great help from many other people. In particular, I am very grateful to Qian Li, for introducing growth curve analysis to me; to Min Liu, for instructing me model settings; to Yifei Bi, Ruiqing Shen, and Dan Yuan, for your comments on some chapters of this dissertation; to Feng Ling and Minghui Zhang, for your help on Praat scripts from time to time; to Jiayin Gao, Yan Gu, Mengru Han, Han Hu, Yaohua Jin, Xinyi Wen, Jiang Wu, Shengyi Wu, Qing Yang, Yang Yang, Tingting Zheng, and Jinlei Zhou, for your insightful discussion with me; to Jianjing Kuang, Jia Tian, and Yingyi Zhou, for your valuable remarks on the issue of phonation; to Feifan Wang, for helping me collect pilot recordings; to Qi Zhao, for helping me contact consultants; to Prof. Fang Hu, Prof. Yun Mai, Prof. Rujie Shi, Prof. Hongjun Wang, Prof. Ping Wang, Prof. Wei Zheng, Prof. Xiaonong Zhu, Ruoxi Cheng, Jian Ding, Chengyu Guo, He Huang, Yiming Sheng, Huaqiang Song, Lei Wang, Jingting Ye, Jingwei Zhang, Menghan Zhang, and Yifei Zheng, for sharing various literature and materials with me. The proofreading assistance from Kate Bellamy, Seamus Leith, Seumas Macdonald, Daan van de Velde, and Andrew Wigman are gratefully appreciated. I would also thank André Radtke for your audio editing guidance.

Further thanks go to my teachers in the Netherlands. You share your interesting thoughts with me on various aspects. They are: Aojun Chen, Lisa Cheng, Janet Grijzenhout, Carlos Gussenhoven, Willemijn Heeren, Maarten Kossmann, Constance Kutsch Lojenga, Jos Pacilly, Leticia Pablos Robles, Gijsbert Rutten, Niels Schiller, Rint Sybesma, and Jeroen Wiedenhof.

All colleagues at LUCL and friends in the Netherlands are a source of my strength during these years. Ami, Astrid, Gulnaz, Hanna, Lis, Renzi, Sarah, Xander, and Zhen, I will cherish the time I spent with you in our PhD Council. Ailin, Brother Sao, Chunhai, Feng, Hongling, Jing, Kejia, Libo, Meiyu, Shaoyu, Sister Xin, Wei, Weiqing, Xinxin, Yuan, Zexu, and Zhaole, I shall never forget those indelible moments with you. Others like Aliza, Adrian, Chams, Chen, David, Federico, George, Hana, Hongmei, Jie, Junru, Laura, Meike, Rasmus, Shuangshuang, Ting, Xiaowen, Xin, Yao, and Zhuoyi, each of you lent me continued encouragement and support.

At last, I own my thanks to Vijf Meibad and De Zijl – the two swimming pools in Leiden, which accompanied me through hundreds of evenings.

Leiden

February 2020