

# Contents

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>Introduction</b>   | <b>1</b>  |
| 1.1      | Mandarin Tone Categories  | 1         |
| 1.1.1    | Mandarin Syllable Structure   | 3         |
| 1.1.2    | Tone Categories in Mandarin Chinese                                       | 4         |
| 1.2      | Features of Tones   | 6         |
| 1.2.1    | Some Terms  | 6         |
| 1.2.2    | Physiological Features of Tones   | 7         |
| 1.2.3    | Acoustic Features of Tones  | 8         |
| 1.2.4    | Psychological Features of Tones   | 8         |
| 1.3      | Tone Sandhi and Tone Variations   | 9         |
| 1.3.1    | What is Tone Sandhi   | 9         |
| 1.3.2    | Tone Sandhi in Mandarin   | 10        |
| 1.3.3    | Variations of Tones in Mandarin   | 15        |
| 1.3.4    | Coarticulation: Tone Sandhi Versus Variations                             | 17        |
| 1.4      | Tone Models   | 18        |
| 1.4.1    | Articulation Models   | 19        |
| 1.4.2    | Phonological Models   | 20        |
| 1.4.3    | Evaluation  | 21        |
| 1.5      | Transcription of Tones  | 22        |
| 1.6      | Conclusion  | 25        |
|          | References  | 26        |
| <b>2</b> | <b>Literature Review</b>  | <b>29</b> |
| 2.1      | Why is it Difficult for Non-native Speakers to Learn<br>Mandarin Tones?   | 30        |
| 2.2      | Survey of Research on Tone Perception and Production<br>of Mandarin as L2 | 32        |
| 2.2.1    | Introduction  | 32        |
| 2.2.2    | Order of Acquisition of Tones   | 32        |
| 2.2.3    | The Relationship Between Perception and Production                        | 33        |

|          |   |           |
|----------|---|-----------|
| 2.2.4    | Categorical Perception of Tones . . . . .                   | 35        |
| 2.2.5    | Speaker and Rate Normalization . . . . .                    | 39        |
| 2.3      | The Largest Difficulties in NNS Tone Acquisition . . . . .  | 39        |
| 2.4      | Problems with NNS Tone Acquisition Research . . . . .       | 40        |
| 2.4.1    | Lack of Context . . . . .                                   | 40        |
| 2.4.2    | Method of Acquisition Research . . . . .                    | 41        |
| 2.4.3    | Tones as a System of Contrasts . . . . .                    | 42        |
| 2.4.4    | Empirical Measurements . . . . .                            | 42        |
| 2.4.5    | Differentiating Between Tonal L1 and Non-tonal L1 NNS . . . | 43        |
| 2.5      | Conclusions and Research Questions . . . . .                | 43        |
|          | References . . . . .  | 44        |
| <b>3</b> | <b>Variables and Pitch Normalization . . . . .</b>          | <b>49</b> |
| 3.1      | Acoustic Variables . . . . .                                | 49        |
| 3.1.1    | Acoustic Cues . . . . .                                     | 49        |
| 3.1.2    | Variables . . . . .   | 50        |
| 3.2      | Another Factor . . . . .                                    | 53        |
| 3.2.1    | Sample Corpus . . . . .                                     | 53        |
| 3.2.2    | Procedure and Analysis . . . . .                            | 53        |
| 3.2.3    | Results . . . . .   | 55        |
| 3.3      | Pitch Normalization . . . . .                               | 55        |
| 3.3.1    | Intraspeaker Normalization . . . . .                        | 56        |
| 3.3.2    | Interspeaker Normalization . . . . .                        | 62        |
| 3.4      | Summary . . . . .   | 66        |
|          | References . . . . .  | 67        |
| <b>4</b> | <b>Native Speakers' Production . . . . .</b>                | <b>69</b> |
| 4.1      | Methodology . . . . .                                       | 69        |
| 4.1.1    | Instrument . . . . .  | 69        |
| 4.1.2    | Participants and Procedure . . . . .                        | 71        |
| 4.1.3    | Pitch Normalization . . . . .                               | 71        |
| 4.2      | Results and Discussion . . . . .                            | 72        |
| 4.2.1    | Common Features . . . . .                                   | 72        |
| 4.2.2    | Boundary Areas in the Four Contexts . . . . .               | 74        |
| 4.2.3    | Movement of the Boundary Areas . . . . .                    | 77        |
| 4.3      | Summary . . . . .   | 78        |
|          | References . . . . .  | 78        |
| <b>5</b> | <b>Native Speakers' Perception . . . . .</b>                | <b>79</b> |
| 5.1      | Purpose of the Experiment . . . . .                         | 79        |
| 5.2      | Methodology . . . . .                                       | 79        |
| 5.2.1    | Calculation of the $F_0$ Value for Synthesis . . . . .      | 80        |
| 5.2.2    | Carrier Sentences . . . . .                                 | 82        |
| 5.2.3    | Synthesizing Tones . . . . .                                | 85        |
| 5.2.4    | Perception Experiments . . . . .                            | 89        |

|          |  |            |
|----------|--|------------|
| 5.3      | Results and Discussion . . . . .   | 90         |
| 5.3.1    | Common Features . . . . .  | 90         |
| 5.3.2    | Perceptual Maps in Four Contexts . . . . .                                     | 94         |
| 5.3.3    | Movement of the Boundary Areas . . . . .                                       | 98         |
| 5.3.4    | Comparison with the D1 Map . . . . .   | 99         |
| 5.3.5    | Comparison with NS' Production. . . . .  | 100        |
| 5.4      | Summary . . . . .  | 101        |
|          | References . . . . .   | 102        |
| <b>6</b> | <b>Non-native Speakers' Perception . . . . .</b>                               | <b>103</b> |
| 6.1      | Purpose of the Experiment . . . . .  | 104        |
| 6.2      | Methodology . . . . .  | 104        |
| 6.2.1    | Stimuli . . . . .  | 104        |
| 6.2.2    | Participants . . . . .   | 106        |
| 6.2.3    | Procedure . . . . .  | 106        |
| 6.2.4    | Analysis . . . . .   | 106        |
| 6.3      | Results and Discussion. . . . .  | 106        |
| 6.3.1    | Features of TL' and HL' Perception Maps . . . . .                              | 107        |
| 6.3.2    | TL' and HL' Perception Maps in Four Contexts. . . . .                          | 112        |
| 6.3.3    | Starting and End Points of Tones . . . . .                                     | 114        |
| 6.4      | Summary . . . . .  | 121        |
|          | References . . . . .   | 122        |
| <b>7</b> | <b>Non-native Speakers' Production . . . . .</b>                               | <b>123</b> |
| 7.1      | Methodology . . . . .  | 123        |
| 7.1.1    | Instrument. . . . .  | 123        |
| 7.1.2    | Procedure and Target Tone Selection . . . . .                                  | 124        |
| 7.1.3    | Pitch Normalization . . . . .  | 124        |
| 7.2      | Results and Discussion. . . . .  | 125        |
| 7.2.1    | Features of TL' and HL' Production . . . . .                                   | 125        |
| 7.2.2    | Comparison of TL' and HL' Production . . . . .                                 | 132        |
| 7.3      | Comparison Between NNS' Perception and Production . . . . .                    | 132        |
|          | Reference. . . . .   | 133        |
| <b>8</b> | <b>Implications . . . . .</b>  | <b>135</b> |
| 8.1      | Summary of the Results . . . . .   | 135        |
| 8.1.1    | Answers to the Research Questions . . . . .                                    | 135        |
| 8.1.2    | The Three Cues that Influence NNS' Tone<br>Perception and Production . . . . . | 138        |
| 8.2      | NNS' Tone Generation . . . . .   | 139        |
| 8.2.1    | Register and Contour in Perception and Production . . . . .                    | 139        |
| 8.2.2    | NNS' Perception. . . . .   | 140        |
| 8.2.3    | NNS' Production . . . . .  | 144        |

|   |   |            |
|---|---|------------|
| 8.2.4   | Differences Between HL and TL . . . . .                                     | 146        |
| 8.2.5   | Procedures of Tone Generation . . . . .                                     | 147        |
| 8.2.6   | Can NNS Acquire Native-Like Tone Categories? . . . . .                      | 149        |
| 8.3   | Pedagogical Implications . . . . .  | 150        |
| 8.3.1   | Teaching Levels Based on the Three Levels<br>of Tonal Acquisition . . . . . | 150        |
| 8.3.2   | Assessment Based on the Instrument . . . . .                                | 152        |
|   | References . . . . .  | 152        |
| <b>Appendix A: Sampling Answer Sheet for Perception Experiments . . . . .</b>               |   | <b>155</b> |
| <b>Appendix B: Calculation of Cut-off Point in the Perception<br/>Experiments . . . . .</b> |   | <b>157</b> |
| <b>Index . . . . .</b>  |   | <b>159</b> |

Perception and Production of Mandarin Tones by Native  
Speakers and L2 Learners

Yang, B.

2015, X, 162 p. 39 illus., 25 illus. in color., Hardcover

ISBN: 978-3-662-44644-7