Tone Realization in Sung Mandarin

Murray Schellenberg
Department of Linguistics, University of British Columbia

TAL 2012
Possible Manifestations of Tone (in singing)

• Structural – tone in composition

• Phonetic – tone in production
  – Compensatory: “deliberate enhancement of alternative phonetic cues”
  – Residual: “preservation of redundant features”

Ladd & Remijsen, (in progress), Singing in a tone language: Evidence from Dinka
Singing in Mandarin
Singing in Mandarin

• Tone system – ask your neighbour!
Singing in Mandarin

• Composition (structure)
  – Chan (1987): Match only ~35% of the time
  – Wee (2007): Matches in places of metrical prominence
Phonetic realization?

• 10 subjects sang specially written song
• Looked at
  – Slope
  – Contour
  – Duration
Stimuli

<table>
<thead>
<tr>
<th>tone</th>
<th>char</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>wúshī</td>
<td>1 high level</td>
<td>吾師 ‘teacher’</td>
</tr>
<tr>
<td>xíshí</td>
<td>2 rising</td>
<td>昔時 ‘time’</td>
</tr>
<tr>
<td>qíngshǐ</td>
<td>3 fall-rise</td>
<td>情史 ‘love history’</td>
</tr>
<tr>
<td>chéngshì</td>
<td>4 falling</td>
<td>城市 ‘city’</td>
</tr>
</tbody>
</table>

• Inserted in song
• Linguistic/poetic constraints
  – Bi-syllabic words
  – First syllable tone 2
As I was walking down the road
I couldn’t see what was around me
I was so tired
I opened my eyes and saw the city

As I was walking through the city
I couldn’t see what was around me
I was so alone
I opened my eyes and saw the teacher

As I was walking with him
I couldn’t see what was around me
I miss her so much
I opened my eyes and saw my love history

As I was walking through the past
I started to see what was around me
I am so afraid
I closed my eyes but saw only my time
The Song

當我沿著路走我看不見四周疲憊極致我張眼卻看到城市

當我沿著街走我看不見四周孤單極致我張眼只看到吾師

當我陪伴他走我看不見四周想念極致我張眼即看到情史

當我往過往走我看見了四周恐懼極致我閉眼卻揮不去昔時
Subjects

• 10 native Mandarin speakers
  – Taiwanese (4) & Mainland (6) speakers

• Had choice of:
  – Traditional or simplified characters
  – 3 musical keys (most comfortable range)
Procedure

• Presented as karaoke
  – On computer screen
  – Head mounted mic
  – Musical accompaniment
    • speakers behind directional mic
    • little to no pick up
  – Learned song by following karaoke track
  – Sang song 6 times

• Recorded on separate computer
  – Audacity (44 000 Hz)
Analysis

- Segmented in PRAAT
- Analysed in R

- Normalized duration
  - Slope
  - Contour (Smooth spline ANOVA)

- Raw duration values
Slope

- Early and mid slopes
- Mixed-effects model
  - subject as random-effect factor
  - tone as fixed-effect factor
  - intercept was set variously as tone 1, 2 and 4.
- No significant interactions were found.
Spoken Duration

- Tone 3 – longest
- Tones 1 and 2 – middle
- Tone 4 – shortest

Sung Duration

- Tone 1 – longest
- Tone 4
- Tone 3
- (Tone 2)

- repeated measures ANOVA
  - significant effect
  - \((F(3,28) = 4.7861, p = 0.00815)\).

- post hoc Tukey’s HSD test
  - tones 1 and 2 \((p = 0.0142)\)
  - tones 2 and 4 \((p = 0.0162)\)
  - 2 and 3 was approaching significance \((p = 0.062)\)
  - BUT: tone two set to shorter note

- all other pairings were not significant.

<table>
<thead>
<tr>
<th>tone</th>
<th>mean (msec)</th>
<th>sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1418.474</td>
<td>263.8451</td>
</tr>
<tr>
<td>2</td>
<td>1080.955</td>
<td>202.5875</td>
</tr>
<tr>
<td>3</td>
<td>1349.826</td>
<td>218.0666</td>
</tr>
<tr>
<td>4</td>
<td>1400.964</td>
<td>262.5157</td>
</tr>
<tr>
<td>all</td>
<td>1313.485</td>
<td>272.961</td>
</tr>
</tbody>
</table>
Conclusions

• Mandarin tones get very little attention in vocal music
  – Limited structural manifestation
  – No phonetic manifestation
    • Slope
    • Contour
    • Duration
  – Singers can “turn it off”
Comments

• Comprehension
  – By context

• Further work
  – Perception
Thank you!

References


Chen, Szu-Wei (2007), ‘The music industry and popular song in 1930s and 1940s Shanghai, a historical and stylistic analysis’, PhD thesis, University of Stirling, UK.


Cross Linguistic Comparison

Correspondence (%)

Language

- Xhosa
- Ewe1
- Ewe2
- Shona
- Hausa
- Zulu
- Cantonese
- Thai
- Tai
- Kalami

Regions:
- Africa
- Eastern Asia
- Pakistan
Non-opposing