Temporal articulatory stability, phonological variation, and lexical contrast preservation in diaspora Tibetan
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It takes a village to write a dissertation

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• Teachers, mentors, collaborators, colleagues, students, conference buddies, co-work partners…

We’ll get through this
Introduction

• Framework ← Articulatory Phonology: represents temporal coordination
  \[\text{(Browman & Goldstein 1988; Nam & Saltzman 2003)}\]

• Methods ← audio recordings, articulatory imaging

• Perspectives:
  • Cognitive/Theoretical ← representations and processes
  • Social ← variation between speakers
  • Historical ← change over generations
Coordinating gestures in time
Articulatory Phonology in one slide

• *Gesture*: dynamic movements in the vocal tract that unfold over time.

• Gestural coupling modes:
  - *In-phase coupling*: (synchronous) and *Anti-phase coupling* (sequential) are most stable
  - *Competitive coupling*: combination of in-phase and anti-phase coupling relations
  - *Eccentric coupling*: one coupling relation, just not intrinsically stable

(Nam & Saltzman 2003, Nam et al. 2009, Goldstein 2011)
Coordinating tone gestures
Articulatory Phonology in one slide

• **Tone gesture**: treat F0 targets similar to articulatory targets

• For lexical tone languages, C-V timing has a lag suggesting competitive coupling

• difference between lexical tone and intonational tone...

(Gao 2008, Niemann et al. 2011, Karlin 2014)
A “Natural Laboratory”

• A language with variation across dialects & speakers:
  • lexical tone
  • onset consonant clusters
  • laryngeal phonology

• Tone gestures predicts that tone affects relative C-V timing. Observed in:
  • lexical tone languages (Mandarin, Thai, Lhasa Tibetan) (Gao 2008, Karlin 2014, Hu 2016)
  • contextually-toneless syllables (Mandarin) (Zhang et al. 2019)
  • across speakers of the same language…
Tibetan

- “archaic”/“cluster”
- “innovative”/“non-cluster”
- dialect continuum
- post-1959 diaspora

Approx. extent of tone

Xinjiang Uyghur Autonomous Region

- “Western”
  - Balti
  - Purik
  - Ladakhi

“Central”

Tibet Autonomous Region

- Ü-Tsang
  - “Central”
- Kham
  - “Eastern”

Amdo
- “Northeastern”

Dzongkha

Sherpa

Drenjongke

Gansu

Qinghai

Sichuan

Yunnan
Dialects: Natural laboratory

- tonogenesis
- laryngeal variation
- cluster simplification
- vowel shifts, spirantization, retroflexion, palatalization
- evidential, honorifics, modality, etc.

<table>
<thead>
<tr>
<th>Written (Classical)</th>
<th>Balti (Western)</th>
<th>Rebkong (Northeastern)</th>
<th>Tokpe Gola (Central)</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>khrag</td>
<td>[kʂʌk]</td>
<td>[tɕɤɣ]</td>
<td>[tʰák] ([tʰák])</td>
<td>‘blood’</td>
</tr>
<tr>
<td>rtswa</td>
<td>[xstsoa]</td>
<td>[xtsa]</td>
<td>[tsá]</td>
<td>‘grass’</td>
</tr>
<tr>
<td>spyang ki</td>
<td>[spjaŋ.'ku]</td>
<td>[xtcaŋ.'kʰɤ]</td>
<td>[tʃaŋ.gú]</td>
<td>‘wolf’</td>
</tr>
<tr>
<td>bcu bdun</td>
<td>[tɕub.'don]</td>
<td>[tɕxb.'dɤn]</td>
<td>[tʃúp.tô] ([tʃúp.tô])</td>
<td>‘seventeen’</td>
</tr>
</tbody>
</table>

(Adapted from Caplow 2013)
Tonogenesis  
(tonal dialects only)

• Voiceless onsets > high tone

• Voiced onsets > low tone

• Sonorants with pre-initial > high tone

• *pʰar ‘over there’ > H
  *sa ‘earth’ > H

• *bar ‘between’ > L
  *za ‘eat’ > L
  *mar ‘butter’ > L

• *sman ‘medicine’ > H
# Laryngeal differences

<table>
<thead>
<tr>
<th>Orthography</th>
<th>Etymological onsets</th>
<th>Innovative features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old Tibetan</td>
<td>$s^\text{a}p\text{a}$</td>
<td>$p^\text{ha}$ ba $s^\text{a}b\text{a}$</td>
</tr>
<tr>
<td>Northeastern and</td>
<td>spa</td>
<td>$p^\text{ha}$ ba $b\text{a}$</td>
</tr>
<tr>
<td>Western dialects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern dialects</td>
<td>$p\text{a}$</td>
<td>$p^\text{ha}$ $p\text{a}$ $b\text{a}$</td>
</tr>
<tr>
<td>Central dialects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Lhasa)</td>
<td>$p\text{a}$</td>
<td>$p^\text{ha}$ $p^\text{ha}$ $p\text{a}$</td>
</tr>
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<td></td>
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</tbody>
</table>
• Why do languages have the temporal coordination they do?
  • Cognitive ← representations and combinations
    • lexical tone—how does it affect timing of other gestures?
  • Social ← variation between speakers
    • variation in community around tone
  • Historical ← change over generations
    • documented history of tonogenesis and tone change
Corpus study
Goals

- Establish facts about consonantal and tonal contrasts
  - Interspeaker variation?
  - How to tone and laryngeal contrasts co-occur?
- Inform hypotheses for controlled articulatory study
Methods

- Word list presented in Tibetan orthography
  - 22 items * 2 repetitions (from 64-item wordlist)
- Data presented from 19 speakers raised in diaspora (30s or younger)
- Part of a larger study:
  - speakers from other dialects
  - sociolinguistic interviews with other tasks
**F0-tone**

F0 at onset of voicing

- H > L significant for 11/19 speakers
- no significant difference for 7/19 speakers
VOT and tone categories

- Unaspirated vs. aspirated

- Unaspirated vs. aspirated... plus tone
Summary of corpus study

- Confirmed:
  - no clusters in diaspora speakers
- Novel findings:
  - some speakers lack tone contrast (production)
  - effect of tone on aspiration duration
  - effect of tone on prevoicing
Articulatory study
Hypotheses

• H1: variation in timing conditioned by presence/absence of lexical tone
  • speakers with tone contrast will have competitive coupling (pos. C-V lag)
  • speakers without tone contrast will have in-phase C-V timing (no C-V lag)

• H2: timing convergence:
  • all speakers will have similar coordination patterns despite interspeaker variation in presence/absence of tone

• What kind of tone contrast is there?
  • If H-∅, then difference will be visible in high vs. low tone words
  • If H-L, then no difference in timing by tone.
Electromagnetic Articulography (EMA)

• A method to track movement with high spatial and temporal resolution

• Speakers read words in carrier phrase on a screen, in Tibetan orthography

• EMA sensors on each lip and three on tongue; head movement corrected w/r/t three sensors on rigid points of the head

• Gesture start labelled at 20% of peak velocity to target
EMA data
articulatory trajectories

- Tracks movement of sensors over time
- \([p \, p^h \, m]\): distance between lip sensors
- \([i] \rightarrow [u \, o \, a]\): tongue dorsum retraction

(Mview software: Tiede 2005)
Results: tone contrast

- 4 speakers produce a tone contrast, two do not (on /mV/)

![F0 trajectories, Speaker F01, CV](image1)

![F0 trajectories, Speaker F02, CV](image2)

![F0 trajectories, Speaker M01, CV](image3)

![F0 trajectories, Speaker M02, CV](image4)

![F0 trajectories, Speaker F03, CV](image5)

![F0 trajectories, Speaker F04, CV](image6)
Results: C-V lag

• There is a positive C-V lag… for speakers with and without the tone contrast
• No significant difference between the tones
Two systems of laryngeal contrasts

- Both conditioned by tone:
  - Left speaker:
    - no prevoicing
    - long VOT only with H tone
  - Right speaker:
    - prevoicing with L tone
    - long VOT with both tones
EMA Study conclusions

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Summary of Findings

• Tibetan speakers in diaspora..

• ... vary in their phonology
  • presence/absence of tone
  • two laryngeal contrast systems

• … preserve lexical contrasts

• tone-conditioned VOT categories persist even when speakers don’t have tone contrast

• ... maintain temporal stability in articulation
Implications

• Members of a speech community can have different phonologies
• Multi-lingual, multi-dialectal situations are helpful for linguistic research
• C-V lag related to tone, but not always through competitive coupling
  • at least not for non-tonal speakers
• Stable C-V timing amid variation
  • this is something we can learn
  • even the “mechanical” is social
Thank you!