Drivers of tonal assignment for English loans into Mandarin: An experimental approach

Zhuting Chang & Dianne Bradley
CUNY Graduate Center

CUNY Phonology Forum: Conference on the Segment
January 11–13, 2012 ZChang@gc.cuny.edu

English loanwords: Five strategies

- Adaptation, purely
  jítā *guitar*: Syllables [jí], [tā] mimic source pronunciation
  - Translation of meaning
    mìyuè *honeymoon*, cf. mì *honey*, yuè *moon*
  - Adaptation plus meaning support
    àizībìng *AIDS*
    cf. àizī *AIDS* (adapted)+ bìng *disease* (supporting)
  - Mixed: partly adapted, partly translated
    yīntèwǎng *internet*
    cf. yīntè *inter-* (adapted)+ wǎng *net*
  - Adaptation/translation convergence
    bèngjí *bungee*, cf. bèng *bounce*+ jí *extreme*

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Illustrative instances of adaptation

- Personal and place names

bù.lā.dé pí.tè	*Brad Pitt*
ān.jí.lì.nà zhū.lì	*Angelina Jolie*
niǔ.yuē	*New York*
huá.shèng.dùn	*Washington*
jiā.lì.fú.ní.yà	*California*

- Other

kù	*cool*
jí.tā	*guitar*
qiǎo.kè.lì	*chocolate*

Each adapted syllable takes an assigned tone, e.g., jí.tā *guitar* takes Tone 2 on σ_1 and Tone 1 on σ_2

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Mandarin Tone Inventory

Tone	Pitch Contour	Chao Digits	Pinyin, Character, Gloss
T1	High-level	55	mā 妈 *mother*
T2	Mid-rising	35	má 麻 *hemp*
T3	Low-dipping	214	mǎ 马 *horse*
T4	High-falling	51	mà 骂 *to curse*
Neutral			ma 吗 *question marker*

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Previous studies: Corpus research

Partial systematicity in tonal assignments in loan corpora suggests that perceptual similarity counts:

- Wu (2006): T1 (55) is assigned to initially stressed syllable of disyllabic words. *Stress-to-Tone?*
  ... but T1 (55) is less likely for sonorant syllable onsets. *F0 lowered by onset voicing?*
- Xu & Xu (2003): T2 (35), rather than T1 (55), is assigned to syllables with aspirated onsets.
  F0 lowered by aspiration, also?

But there are grounds for caution: "Spotty data" can be problematic in corpus studies (Duanmu, 2008).

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Experimentally induced adaptation

What tones do native speakers typically assign to phonotactically legal English nonsense words that they hear, under instructions to find "the most natural way" to render these in Mandarin?

Nonsense disyllables, satisfying a minimal-word constraint (Duanmu 2007), can be constructed to differ in:

- Stress position, ˈσσ versus σˈσ
- Onset consonant properties, e.g., sonority, aspiration
- Vowel features, e.g., height, backness

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Materials & Design, I

110 disyllabic English nonsense word stimuli were constructed as 55 pairs differing in stress position, ˈσσ ~ σˈσ. Only the σˈσ stress pattern induces a syllable-internal H*L–L% pitch contour.

- 31 of 55 pairs used CV.kə ~ kə.CV templates, e.g., [ˈbu.kə], [kə.ˈbu]
- The remaining 24 pairs used CVN.Cə ~ Cə.CVN e.g., [ˈbæn.tə], [tə.ˈbæn]; [ˈbɑŋ.kə], [kə.ˈbɑŋ]
- The critical syllable drew its nucleus from the set of American English 'corner' vowels {i, æ, ɑ, u}
- Stimuli sampled a range of consonantal contrasts

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Materials & Design, II

CV syllables			CVN syllables		Notes
bi	bu	bɑ	bæn	bɑŋ	{fi, si, ʃi, ...} excluded because corresponding syllables are absent in Mandarin lexicon
pʰi	pʰu	pʰɑ	pʰæn	pʰɑŋ	
di	du	dɑ	dæn	dɑŋ	
tʰi	tʰu	tʰɑ	tʰæn	tʰɑŋ	
	fu	fɑ	fæn	fɑŋ	Coda [n, ŋ] induces allophones [a, ɑ] for Mandarin's central /a$_c$/ (Lin, 2008)
	su	sɑ	sæn	sɑŋ	
	ʃu	ʃɑ	ʃæn	ʃɑŋ	
	ʤu	ʤɑ	ʤæn	ʤɑŋ	
	ʧu	ʧɑ	ʧæn	ʧɑŋ	Voicing contrast within English non-continuants corresponds to voiceless unaspirated-aspirated in Mandarin
mi	mu	mɑ	mæn	mɑŋ	
ni	nu	nɑ	næn	nɑŋ	
li	lu	lɑ	læn	lɑŋ	

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Other protocol details

- Participants were 8 Mandarin speakers from Mainland China (4 males, 4 females), who had lived in the United States for 1–4 years.
- A male native speaker of American English uttered each stimulus "as if the word by itself were a declarative statement". Two tokens, separated by a short pause, were recorded.
- Participants moved (self-paced) through a pseudo-randomized stimulus list arranged in two blocks, and clicked on screen icons to hear successive stimuli.

  e.g., Participants responded by writing (N=4) or saying (N=4) the "most natural way" to render each form in Mandarin.

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Data Treatment I

- All participant responses were entered into a database in Pinyin transcription (with tone).
- Each response was evaluated for match with a "target" form, segmentally defined, predicted by prior work on *segmental adaptation* (Miao 2006; Lin 2008), e.g., [bi] → {pi}, [pʰi] → {pʰi}.
- Data exclusions: 12 stimulus pairs involving post-alveolar onsets proved notably subject to non-target realization → data for that series were removed wholesale. Experimenter error with one further pair → those data removed, also.

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"Trimmed" materials summary

CV syllables			CVN syllables		
bi	bu	bɑ	bæn	bɑŋ	Experimenter error → exclusion of responses to two stimuli using critical syllable [tʰɑŋ]
pʰi	pʰu	pʰɑ	pʰæn	pʰɑŋ	
di	du	dɑ	dæn	dɑŋ	
tʰi	tʰu	tʰɑ	tʰæn	~~tʰɑŋ~~	
	fu	fɑ	fæn	fɑŋ	Further exclusion, on grounds of non-target realizations: responses to all stimuli having post-alveolar onsets
	su	sɑ	sæn	sɑŋ	
	ʃu	ʃɑ	ʃæn	ʃɑŋ	
	ʤu	ʤɑ	ʤæn	ʤɑŋ	
	ʧu	ʧɑ	ʧæn	ʧɑŋ	
mi	mu	mɑ	mæn	mɑŋ	Tone analyses were thus run for responses to 84 stimuli (42x2)
ni	nu	nɑ	næn	nɑŋ	
li	lu	lɑ	læn	lɑŋ	

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Data Treatment, II

- The trimmed materials set afforded N=672 adaptations (8 participants, 42x2 stimuli).
- A proportion of those adaptations was set aside in our tonal analyses because:
  - realization of the critical syllable mismatched the pre-defined target (N=122 instances), or
  - assigned tone was ambiguous (N=6 instances) due to "third-tone sandhi", so-called (Chao, 1968; T3+T3 → T2+T3).
- For N=544 adaptations remaining (81%), the modality of response, written vs. spoken, was not considered further.

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Adjustment for tone “opportunity”

- Across the entire Mandarin lexicon, only 42% of syllables are compatible with all four tones (Chu & Jiang 2006). The remaining 58% exhibit tone “gaps”, e.g., *[lian] realized with Tone 1.
- In the current materials set, the situation is less dire. But all four tones were available for only 64% of N=42x2 target syllables; the remaining 36% each exhibited a single tone gap.
- Therefore, our tonal assignment data are adjusted for *tone opportunity*. Summary data are therefore expressed in terms of the percentage of responses for which an *available tone* was realized.

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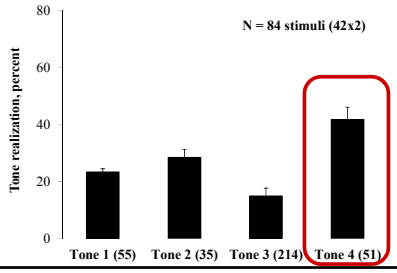
Results I: Tonal assignments, overall

- In “live” adaptation data, Tone 1 (55) does *not* predominate, cf. Wu (2006) for attested loans. Instead, Tone 4 (51) emerges as most likely.



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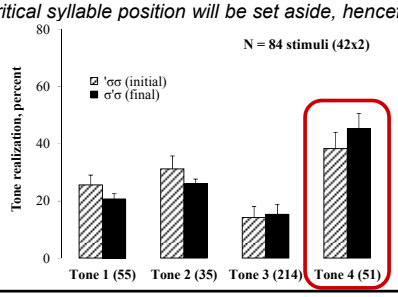
Results II: Syllable position, 'σσ~σ'σ

- Preference for Tone 4 (51) increases, though only modestly, in adaptations of σ'σ stimuli, cf. 'σσ.

Critical syllable position will be set aside, henceforth.



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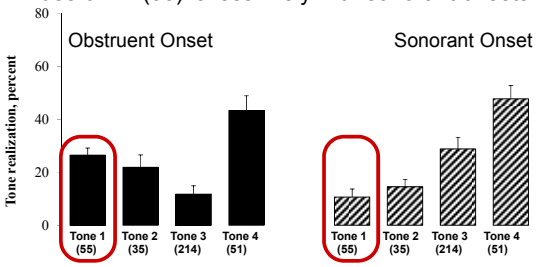
Results III: Sonority in CV syllables

- T4 (51) remains most likely regardless of onset type. But as in the corpus studies of Wu (2006), use of T1 (55) is less likely with sonorant onsets.



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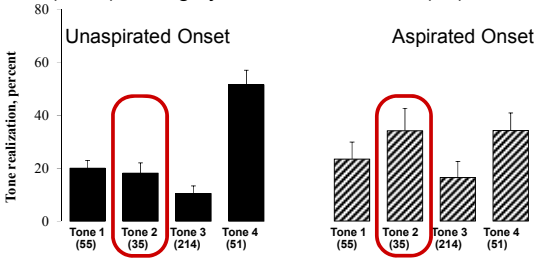
Results IV: Aspiration in CV syllables

- Aspiration in the onset of Stop-V stimuli raises the likelihood of T2 (35) usage — as per Xu & Xu (2003) — largely at a cost to Tone 4 (51).



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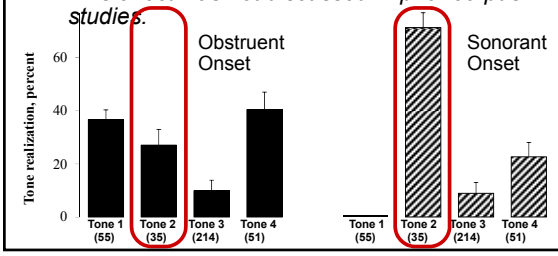
Results V: Sonority in CVN syllables

- CVN syllables with sonorant onsets pattern very differently: use of Tone 2 (35) shows a dramatic increase, at a cost to Tones 4 and 1 (51; 55). *This effect was not discussed in prior corpus studies.*



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Interpretations, I

- In live adaptation data, Tone 4 (51) was predominant rather than Tone 1 (55), cf. for attested loan corpora, and the preference for Tone 4 increased (albeit modestly) for final-stress as compared with initial-stress stimuli.

  Should we propose *Stress-to-Contour* mapping, in place of Wu's (2006) *Stress-to-Tone*?

- But in line with Wu's studies of attested loan corpora, elicited adaptations did show lower likelihood of Tone 1 (55) when onsets were sonorant rather than obstruent.

  This perhaps constitutes anther kind of evidence of the impact of *perceptual similarity* on tonal assignments, in a mapping of the F0 contour.

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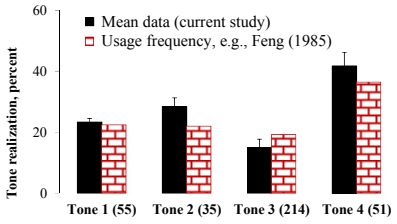
But ... native usage frequencies?

- Going forward, we must evaluate a very different hypothesis, namely that predominant Tone 4 (51) reflects a bias drawing on usage frequencies in the native system, cf. a *Stress-to-Contour* effect.



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Interpretations, II

- As in studies of attested loans, live adaptations show that the likelihood of T2 (35) was raised by aspiration in the onset of Stop-V stimuli.

  Given the F0 lowering effect of aspiration, this could be taken as further evidence favoring the idea that the F0 contour of a stimulus is mapped in the tone choice for an adaptation.

- Finally, an unexpected effect emerged in the elicited adaptations, taking the form of a *dramatically* increased use of Tone 2 (35) for sonorant-onset CVN syllables.

  Our suspicion that this too reflects F0 contour mapping awaits a detailed instrumental study.

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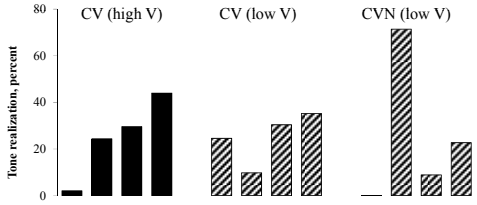
CVNs: Vowel height, or nasal coda?

- Comparison across the [mi,ni,li], [mɑ,nɑ,lɑ] and [mæn,næn,læn,mɑŋ,nɑŋ,lɑŋ] series strongly suggest that it was the nasal coda *per se* in the CVN stimuli that triggered Tone 2 (35).



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Future research directions

Our preliminary study was largely exploratory, and needed (not least) greater power. But we see the advantage of the elicited adaptation method lying in the wealth of targeted data it generates. Future directions of this line of research will include:

- In-depth studies of the impact on tone choice of sonority, aspiration, vowel height, and syllable type (CV, CVN), accompanied by instrumental studies of stimulus properties
- Explorations of the usefulness of F0 manipulation in the stimuli to be adapted

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Thank you!

For further information, send email to
Zhuting Chang, ZChang@gc.cuny.edu

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