Phonotactic and prosodic adaptation ofnon-native consonant sequences by Mandarin native speakers

Qianwen Guan, Harim Kwon

Phonotactic and prosodic adaptation of non-native consonant sequences by Mandarin native speakers

Qianwen Guan*, Harim Kwon CLILLAC-ARP, Université Paris Diderot, *qianwen.guan@linguist.univ-paris-diderot.fr

2016 ASA @ Honolulu

Background

Perception of non-native consonant sequences is influenced by:

- **Phonological knowledge**
  - Language-specific phonological knowledge [1]
  - Universal sonority restrictions [2]
- **Phonetic factors**
  - Acoustic-phonetic properties of the stimuli [3]
  - Language-specific phonetic sensitivity [4]

Adaptation of non-native consonant sequences

- **Phonotactic adaptation** (e.g., [1], [2], [3], [4])
  - Vowel epenthesis/prosthesis
  - Consonant deletion/change/metathesis
- **Prosodic adaptation** (e.g., [5])
  - Stress-to-tone : processing input pitch

Research questions

1. How do speakers with simple **phonotactics** adapt non-native consonant sequences (CC)?
2. How do speakers with native tonal system **prosodically** adapt non-native prosodic structure?

	Phonotactics	Prosody
Participants' native language: Mandarin	• No onset clusters • Sequence allowed: C(G), N.C	Lexical tones
Stimulus language: Russian	• Various clusters allowed in onset	Dynamic stress

Hypotheses

- Phonotactic knowledge repairs illicit CC sequences by inserting a vowel or deleting one of the consonants.
- Specific repair strategies are determined based on detailed phonetic properties of the stimuli and the listeners' sensitivity to those properties.
- Prosodic adaptation: Listeners will adapt the input *f0* into tones.

References: [1] Dupoux, E., Kakehi, K., Hirose, Y., Pallier, C., & Mehler, J. 1999. Epenthetic vowels in Japanese: A perceptual illusion? *Journal of Experimental Psychology* 25, 1568-1578. [2] Berent, I., Steriade, D., Lennertz, T., & Vaknin, V. 2007. What we know about what we have never heard: Evidence from perceptual illusions. *Cognition* 104, 591–630. [3] Wilson, C., Davidson, L., & Martin, S. 2014. Effects of acoustic–phonetic detail on cross-language speech production. *Journal of Memory and Language* 77, 1-24. [4] Davidson, L., & Shaw, J. A. 2012. Sources of illusion in consonant cluster perception. *Journal of Phonetics* 40, 234–248. [5] Silverman, D. 1992. Multiple scansions in loanword phonology: evidence from Cantonese. *Phonology,* 9. 289 – 328.

Acknowledgements: We would like to thank Ioana Chitoran for her valuable guidance and advice, Hu Fang and Liang Hongli for help with data recording. This research was supported by China Scholarship Council and Université Paris Diderot.

Transcription experiment

Task

"Listen to the stimuli and transcribe them in Pinyin with tones."

Participants: monolingual Mandarin listeners (N=24)

- 14 females and 10 males, mean age = 38.0
- No knowledge of a foreign language (e.g., English, Russian)

Stimuli

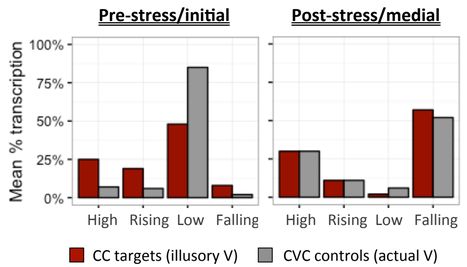
Russian pseudo-words produced by a female Russian native speaker

- Targets (with CC sequences) vs. controls (with CVC sequences)
- Position: word-initial (pre-stress) vs. word-medial (post-stress)
- Consonant makeup: SS vs. SN vs. SL (S /k, t, p/; N /n/; L /l/)
- 2 different tokens per word
- /á/ denotes a stressed vowel.

	consonant makeup	initial, pre-stress	medial, post-stress
Targets with CC (n=16)	SS	**kt**ápa **tk**ápa **pt**áka	ák**t**a át**k**a íp**t**a át**p**a
	SN/NS	**kn**ápa	ák**n**u ún**k**a
	SL/LS	**pl**áka **kl**ápa	ák**l**u íp**l**a ál**k**a ál**p**a
Controls with CVC (n=16)	SS	**kat**ápa **tak**ápa **pat**áka	ák**at**a át**ak**a íp**at**a át**ap**a
	SN/NS	**kan**ápa	ák**an**u ún**ak**a
	SL/LS	**pal**áka **kal**ápa	ák**al**u íp**al**a ál**ak**a ál**ap**a

Which tones are transcribed on the illusory vowels?

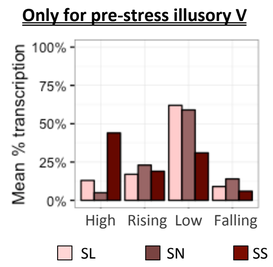
Effects of position: Pre-stress vs. Post-stress



Mixed effects logistic regression on tone on the illusory V:

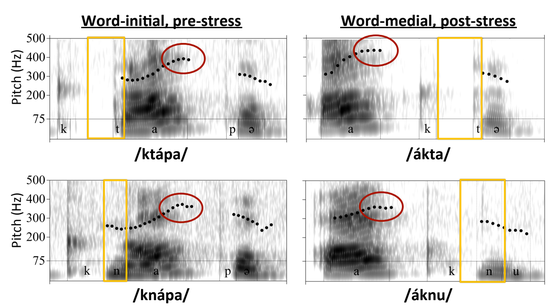
- Low: pre-stress > post-stress [$\beta = 2.52$, $p = 0.001$]
- Falling: pre-stress < post-stress [$\beta = 2.85$, $p < 0.0001$]
- High/Rising tones do not show significant effects of position.

Effects of consonant makeup



- High: SL/SN < SS [$\beta = 2.77$, $p = 0.015$]
- Consonant makeup does not significantly influence the occurrence of Rising/Low/Falling tones.

Perception of illusory tone influenced by *f0* of the stimuli



	Pre-stress		Post-stress
	SS	SL/SN	
f0 pattern in stimuli	low *f0*, rising toward the peak		falling *f0* contour
	no *f0* during C2 stop	*f0* contour starts during C2 liquid/nasal	
/CCá/ *f0* range	288~384 Hz (m=97)	259~420 Hz (m=161)	N/A
Illusory tones	High	Low	Falling

Only 8 participants (out of 24) were able to transcribe tones in Pinyin.

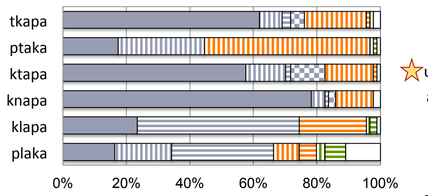
- Pinyin transcription rarely includes tones, although it is used frequently.

Examples of transcription (Pinyin with tones)

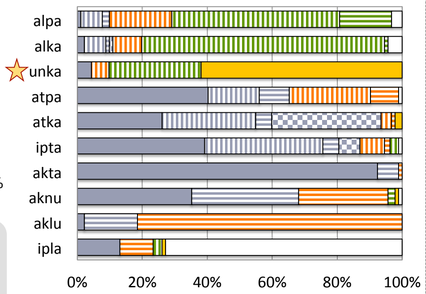
Stimuli		Pinyin	Tones
ktapa	→	<kědábù>	Low-Rising-Falling
katapa	→	<gădāpù>	Low-High-Falling

What types of strategies are used to modify non-native CC sequences?

Initial/pre -stress CC



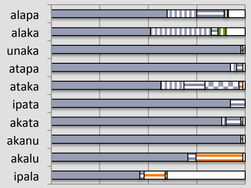
Medial/post-stress CC



Initial/ pre-stress CVC

CVC controls mostly transcribed with a vowel

Medial/ post-stress CVC



- **vowel perceived** /akta/ → <akete>
- with C1 change /plaka/ → <kelake>
- with C2 change /klapa/ → <kewapu>
- with metathesis /atka/ → <akete>
- **consonant deletion** /aklu/ → <aku>
- **consonant change** /alka/ → <aoke>
- **CC sequence correctly transcribed**
- others: multiple changes, pattern unrecognizable
- CC sequence licit in Mandarin

Vowel perceived in non-native CC

- Epenthetic vowels are frequently transcribed (62%).
- Medial /nk/ shows significantly less vowel epenthesis than other CCs [$F(1,1468) = 152.6$, $p < 0.001$], presumably because heterosyllabic /nk/ is licit in Mandarin phonotactics.

Stop C1 deletion

- C1 stop is deleted more often in initial positions than in medial positions [$F(1,1101) = 92.03$, $p < 0.001$].
- C2 stop is rarely deleted.

C1 place change

- C1 /p/ → <k> or <t>, with an epenthetic vowel both word-initially and word-medially: /**pt**aka/→<**ted**ake>
- C1 /n/ is often transcribed as <ng> /ŋ/: /u**nk**a/→<yi**ngk**e>

/l/: dark liquid [ɬ] in the stimuli

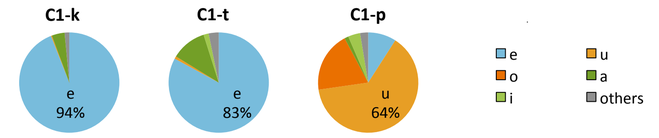
- C1 /l/ changes into <o, u>: /a**lp**a/→<a**op**u>
- C2 /l/ changes into <w> in initial /kl-, pl-/ with an epenthetic vowel: /**kl**apa/→<**kew**apu>
- But C2 /l/ deletes in medial /-kl-/: /a**kl**u/→ <a**ku**>
- Most of **"others"** in /i**pl**a/ are <i**po**>, <i**pu**>

Metathesis + epenthesis in SS sequences

- Most common in medial /tk/ sequence: /a**tk**a/→<a**ket**e>

Different V in different C1 contexts

Which vowels are used to transcribe the epenthetic vowel?



- A back mid unrounded vowel <e> [ɤ] is most frequent, but not when C1 is /p/.
- Significant effects of C1 identity on the epenthetic vowel [$\chi^2 = 672.54$, $p < 0.0001$]
- Co-occurrence restriction in Mandarin : [kɤ]/[tɤ]/[pu], but *[pɤ]

Conclusion

Phonotactic adaptation

Phonological knowledge

- Native-ness of CC sequences: word-medial /nk/
- Co-occurrence restriction *[pɤ] influences perception of the epenthetic vowel or C1 place

Phonetic properties

- Dark /l/ [ɬ] in Russian is transcribed as <o, u, w>.
- Word-initial C1 stop, lacking formant transitions, deletes.

+

Prosodic adaptation

- Perception of illusory tones accompanies perception of illusory vowels.
- Illusory tone perception is influenced by the input f0 patterns.
  - Pre-stress vs. Post-stress
  - SS vs. SL/SN