Some challenges for the IPA from languages of China

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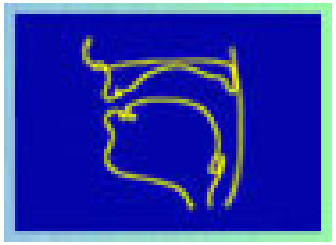


13th Phonetic Conference of China (PCC2018)

Jinan University, Guangzhou Nov. 2018

Overview of the talk

- The International Phonetic Association, and its Alphabet, have already benefited from the work of Chinese phoneticians, and from taking into account the sounds of Chinese languages
- But recent “Illustrations of the IPA” for languages of China (and other work) have shown gaps in the IPA’s ability to represent contrasts

How the IPA has previously benefited from Chinese languages and phonetics

Some history from the IPA's original journal, *Maître Phonétique* (1886-1970), in which all content was printed in IPA; and more recently from the *Journal of the International Phonetic Association*

(1) Tone: first hundred years

- 1888: first International Phonetic Alphabet (no tones)
- 1908: IPA publishes a way to transcribe Cantonese tones, using an accent mark before each syllable:

(b). ðə fɑlouiŋ ekspləneiʃn əv ðə tounz iz səfiʃənt fə ðis sʌbdʒikt:

1. ˉsɔ: ˉ dinouts ə hai mɑnətoun.
2. ˍsɔ: ˍ „ „ lou mɑnətoun.
3. ˊsɔ: ˊ „ „ hai raiziŋ.
4. ˌsɔ: ˌ „ „ lou raiziŋ.
5. ˋsɔ: ˋ „ „ hai fɔ:liŋ.
6. ˏsɔ: ˏ „ „ lou fɔ:liŋ.

High monotone
Low monotone
High rising
Low rising
High falling
Low falling

Seers 1908, “Tʃainiːz Foˈnetiks”, *Maître Phonétique 23:* 30-34

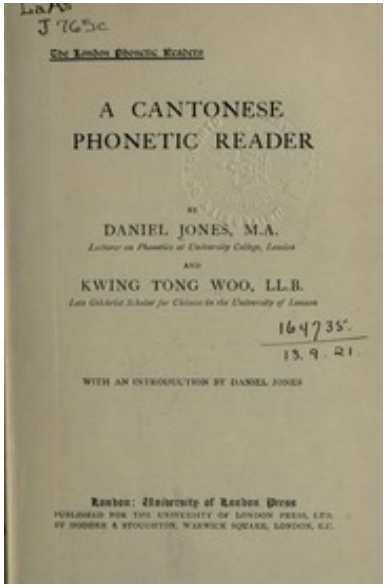
1911-12: Cantonese tone transcription by Daniel Jones

The *Cantonese Phonetic Reader* was important for bringing the Chinese treatment of tones to the attention of European phoneticians:

CANTONESE NAMES OF THE TONES

Number of tone according to scientific classification.	Scientific description (based on musical value, see Section IV.).	Cantonese Name.	Literal meaning of Cantonese name.
1st Tone	Upper falling (*with variant* uppermost level)	when syllable does not end in p, t or k: -sœŋ˩p'iŋ˥	upper level.
		when syllable ends in p, t or k: -sœŋ-jap	upper entering.
2nd Tone	Upper rising	when syllable does not end in p, t or k: -sœŋ˧sœŋ˥	upper rising.
		when syllable ends in p, t or k: *wanting*	———
3rd Tone	Upper level	when syllable does not end in p, t or k: -sœŋ-hœy	upper departing.
		when syllable ends in p, t or k: *wanting*	———
4th Tone	Lower falling	-ha˨p'iŋ˥ [1]	lower level.
5th Tone	Lower rising	-ha˨sœŋ˥ [1]	lower rising.
6th Tone	Lower level	when syllable does not end in p, t or k: -ha-hœy	lower departing.
		when syllable ends in p, t or k: -ha-jap	lower entering.

[1] The 4th and 5th tones do not occur in words ending in p, t or k.



Jones 1911, "tʃainiːz: stændəd kæntoniːz daiəlekt", *Maître Phonétique 26:* 80-84
Jones & Woo 1912, *A Cantonese Phonetic Reader*, University of London Press

1912: Mandarin tone transcription

These Cantonese tone marks were extended to Mandarin, but now placed directly above the vowel symbols:

Tone	example
1	ō
2	ṓ
3	ǒ
4	ò

¯ + ´

Guernier 1912, Notes sur la pronunciation de la langue mandarine de Pékin, Supplément du *Maître Phonétique 27*

1926: IPA chart shows 8 tone marks

- first IPA chart providing diacritics of any kind
- including for tone: 2 levels, 2 rises, 2 falls, + 2 complex (new)
- low tones go *under* the vowel symbol, high tones *above*

used (... etc.), or the marks ... or ͜ (... or ..., etc.).

LENGTH, STRESS, PITCH.— : (full length). · (half length). ˈ (stress, placed at beginning of the stressed syllable). ¯ (high level pitch); ˍ (low level); ˊ (high rising); ˏ (low rising); ˋ (high falling); ˎ (low falling); ^ (rise-fall); ˇ (fall-rise). See *Ecriture Phonétique Internationale*, p. 9.

MODIFIERS.— ˜ nasality. ̥ breath (l̥ = breathed l). ̬ voice (s̬ = z). ʻ slight aspiration following p, t, etc.

- IPA charts ***through 1979*** provided these same tone marks
- Clearly inadequate for many languages!

Maître Phonétique 41, July-Sept, inside cover

1930: Y. R. Chao's (趙元任, *Zhào Yuánrèn)* tone letters

streit tounz. toun-letə.	neim.	səːkəmfleks tounz. toun-letə.	neim.	ʃoːt tounz. toun-letə.	neim.
˩	11:	˧˩	131:	˩	1:
˨˩	13:	˧˥	153:	˨˩	2:
˨˦	15:	˥˩	242:	˧	3:
˩˩	22:	˦˧	313:	˦	4.
˨˦	24:	˦˥	315:	˥	5:
˧˩	31:	˥˩	351:		
˧	33:	˥˦	353:		
˦	35:	˦˥	424:		
˥˩	42:	˦˧	513:		
˧	44:	˦˥	535:		
˧˩	51:	wið ə vjuː tə kəmbain ækjursi, eligəns, ənd kənviːnjəns fə			
˥˦	53:	printiŋ, ai əv divaizd ðə fəlouiŋ sistim əv "toun-letəz" fə ðə			
˦	55:	kənsidəreiʃn̩ əv felou founitiʃn̩z.			

"With a view to combine accuracy, elegance, and convenience for printing, I have devised the following system of 'tone-letters' for the consideration of fellow phoneticians."

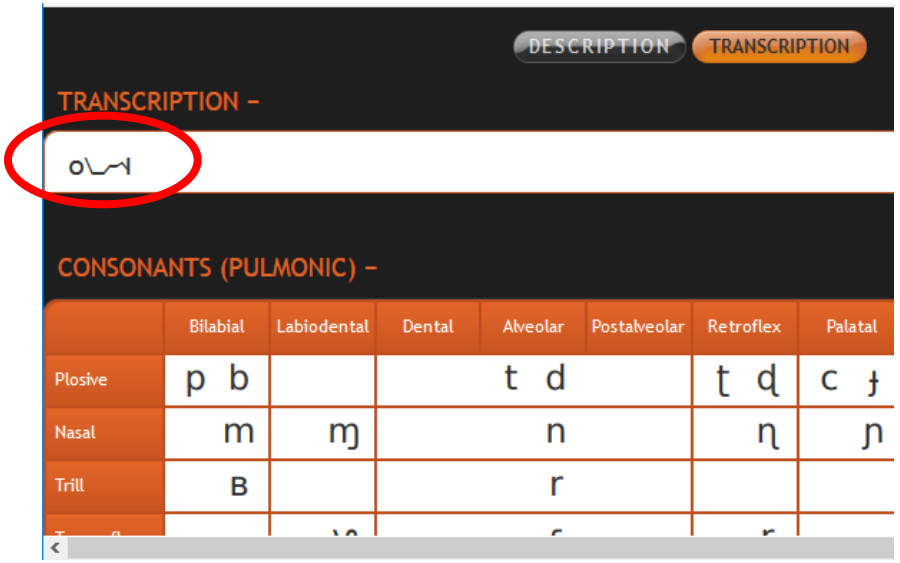
"ə sistim əv 'toun-letəz'", *Maître Phonétique 45,* 24-27

1989 - now: Chao tone letters in the IPA

TONES AND WORD ACCENTS

LEVEL			CONTOUR		
˝	or ˥	Extra high	ˇ	or ˩˥	Rising
ˊ	˥	High	ˆ	˥˩	Falling
ˉ	˧	Mid	ˇ	˧˥	High rising
ˋ	˩	Low	ˇ	˩˧	Low rising
ˏ	˩˩	Extra low	ˆ	˥˩˥	Rising-falling
↓	Downstep		↗	Global rise	
↑	Upstep		↘	Global fall	

IPA fonts and symbol "pickers" can combine any number of tones into complex tone letters – here is a crazy example I made on the IPA's picker:



https://linguistics.ucla.edu/people/keating/IPA/IPA_charts_2018.html,
https://linguistics.ucla.edu/people/keating/IPA/inter_chart_2018/IPA_2018.html

(2) 2007: IPA chart with Chinese metatext produced by the Phonetic Association of China

published by the IPA in 2011

国际音标（修订至 2005 年）

辅音（肺部气流）

中文版© 2007 中国语言学会语音学分会

	双唇	唇齿	齿	龈	龈后	卷舌	硬腭	软腭	小舌	咽	喉
爆发音	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
鼻音	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
颤音	ʙ			r					ʀ		
拍音或闪音		ⱱ		ɾ		ɽ					
擦音	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
边擦音				ɬ ɮ							
近音		ʋ		ɹ		ɻ	j	ɰ			
边近音				l		ɭ	ʎ	ʟ			

成对出现的音标，右边的为浊辅音。阴影区域表示不可能产生的音。

辅音（非肺部气流）

喷音	浊内爆音	喷音
ʘ 双唇音	ɓ 双唇音	’ 例如：
ǀ 齿音	ɗ 齿音/龈音	p’ 双唇音
ǃ 龈（后）音	ʄ 硬腭音	t’ 齿音/龈音
ǂ 腭龈音	ɠ 软腭音	k’ 软腭音
ǁ 龈边音	ʛ 小舌音	s’ 龈擦音

元音

成对出现的音标，右边的为圆唇元音。

其他符号

ʍ 唇-软腭清擦音
w 唇-软腭浊近音
ɥ 唇-硬腭浊近音
ʜ 会厌清擦音
ʢ 会厌浊擦音
ʡ 会厌爆发音
ɕ ʑ 龈-腭擦音
ɺ 龈边浊闪音
ʩ 同时发 ʃ 和 x

若有必要，塞擦音及双重调音可以用连音符连接两个符号，如：k͡p t͡s

超音段

ˈ 主重音
ˌ 次重音 ˌfoʊnəˈtɪʃən
ː 长 eː
ˑ 半长 eˑ
˘ 超短 ĕ
| 小（音步）组块
‖ 大（语调）组块
. 音节间隔 ɹi.ækt
‿ 连接（间隔不出现）

附加符号 如果是下伸符号，附加符号可以加在上方，例如：ŋ̊

◌̥ 清化	n̥ d̥	◌̤ 气声性	b̤ a̤	◌̪ 齿化	t̪ d̪
◌̬ 浊化	s̬ t̬	◌̰ 嘎裂声性	b̰ a̰	◌̺ 舌尖性	t̺ d̺
◌ʰ 送气	tʰ dʰ	◌̼ 舌唇	t̼ d̼	◌̻ 舌叶性	t̻ d̻
◌̹ 更圆	ɔ̹	◌ʷ 唇化	tʷ dʷ	◌̃ 鼻化	ẽ
◌̜ 略展	ɔ̜	◌ʲ 腭化	tʲ dʲ	◌ⁿ 鼻除阻	dⁿ
◌̟ 偏前	u̟	◌ˠ 软腭化	tˠ dˠ	◌ˡ 边除阻	dˡ
◌̠ 偏后	e̠	◌ˤ 咽化	tˤ dˤ	◌ˀ 无闻除阻	dˀ
◌̈ 央化	ë	◌~ 软腭化或咽化	ɫ		
◌̽ 中-央化	e̽	◌̝ 偏高	e̝	（ɻ̝ =龈浊擦音）	
◌̩ 成音节	n̩	◌̞ 偏低	e̞	（β̞ =双唇浊近音）	
◌̍ 不成音节	e̍	◌̘ 舌根偏前	e̘		
◌˞ r音色	ɚ a˞	◌̙ 舌根偏后	e̙		

声调与词重调

平调		非平调	
e̋或˥	超高	ě或˧˥	升
é	˦ 高	ê	˥˩ 降
ē	˧ 中	ě	˨˩˦ 高升
è	˨ 低	ě	˧˩˨ 低升
ȅ	˩ 超低	ê	˥˩˥ 升降
↓	降阶	↗	整体上升
↑	升阶	↘	整体下降

Journal of the IPA 41.2: 245

10

2018: New IPA project in progress, to do the same for as many languages as possible, using social media to solicit volunteers, and posting draft charts for comments:

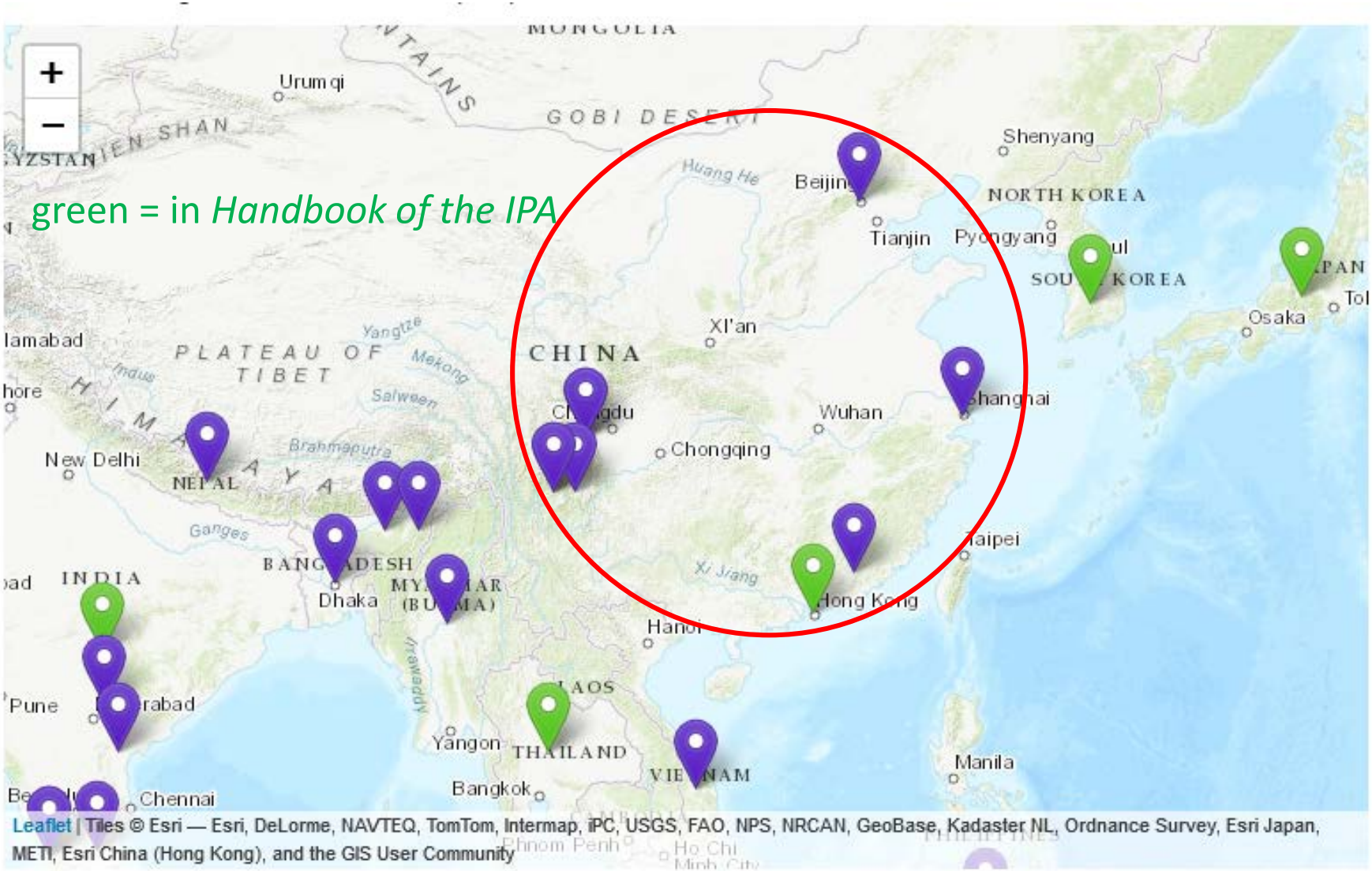
LANGUAGE CODE:	LANGUAGE:	TRANSLATED BY:	LANGUAGE CODE:	LANGUAGE:	TRANSLATED BY:
[CAT]	Catalan / Català	*Daniel Recasens*	[POL]	Polish / j. polski	*Małgorzata Deroń*
[DAN]	Danish / Dansk	*Dr Anna Jespersen*	[POR = PT-BR]	Brazilian Portuguese / Português brasileiro	
[DEU]	German / Deutsch	*Prof. Adrian Simpson*	[POR = PT-PT]	European Portuguese / Português europeu	*Pedro Oliveira*
[EST]	Estonian / eesti	*Dr Pärtel Lippus*	[SPA]	Spanish / Español	*José Alejandro Correa Duarte*
[FRA]	French / français	*Jean-Michel Builles*	[SWE]	Swedish / Svenska	*David Avellan-Hultman*
[HEB]	Hebrew / עברית	*Prof. Asher Laufer*	[THA]	Thai / ภาษาไทย	*Pongprapunt Rattanaporn*
[JPN]	Japanese / 日本語	*Prof. Masaki Taniguchi*	[TUR]	Turkish / Türkçe	*Ahmet Bilal Özdemir*
[KOR]	Korean / 한국어	*Prof. Jiyoung Shin*	[VIE]	Vietnamese / tiếng Việt	*Nguyễn Thị Minh Châu and Phạm Thị Thu Hà*
[NLD]	Dutch / Nederlands	*Dr Matthias Franken*			

https://linguistics.ucla.edu/people/keating/IPA/IPA_charts_2018_trans.html

JIPA "Illustrations of the IPA" for Chinese languages

Illustrations not only make available phonetic descriptions of individual languages (using the IPA), but also serve to highlight shortcomings or gaps in the current set of IPA symbols

Not many Illustrations of languages of China!



https://richardbeare.github.io/marijatabain/ipa_illustrations_all.html

List of these Illustrations:

- 1991/1999 *Handbook*: Hong Kong Cantonese (Zee)
- 2003: Standard (Beijing) Chinese (Lee & Zee)
- 2009: Hakka Chinese (Lee & Zee)
- 2013: Upper and Lower Xumi (Chirkova et al.)
- 2013: Lizu (Chirkova & Chen)
- 2015: Shanghai Chinese (Chen & Gussenhoven)
- 2015: Ersu (Chirkova, Wang, Chen, Amelot & Antolik)
- 2017: Nuosu Yi (Edmondson, Esling & Lama (拉玛兹偓))

Some issues for the IPA in these (and related) languages

(1) Tone transcription

Several of these Illustrations use non-IPA transcriptions of tones:

- numbers as tone *names* (e.g. T1)
- letters indicating pitch shape (e.g. R for rising)

Issue:

How can IPA tone transcription work for Chinese languages?

Chao's tone letters were adopted for the IPA, but not his numerical equivalents (e.g. 55, 51), which are often preferred to the tone *letters* –

This would be a simple addition to the IPA, though they might be hard to fit onto the 1-page IPA chart

(2) Falsetto voice on extra-high tone

2. Falsetto – Tai-Kadai.

Three T5 [^{4}66] words with falsetto in Gaoba Dong 高坝侗语, a variety of the Tai-Kadai family (a male speaker). Falsetto is marked with an accent acute (same below).

ʔú^{66} ‘祖父 grandfather’ ɕóŋ^{66} ‘枪 gun’ t^{w}éi^{66} ‘娃娃鱼 baby fish’

3. Falsetto – Xiang.

Three *yinqu* 阴去 [56] and three *yinru* 阴入 [66] words with falsetto in Yueyang Xiang, Hunan 湘语湖南岳阳城区方言 (a male speaker). The last word pǽ^{66} ‘八’ is produced with an incredibly high pitch.

fən^{56} ‘粪 excrement’ tsə́ŋ^{56} ‘正 upright’ tɕí^{56} ‘醉 drunk’

tɕió^{66} ‘脚 foot’ hú^{66} ‘福 fortune’ pǽ^{66} ‘八 eight’

4. Falsetto – Gan.

Two *yinru*阴入 [66] words with falsetto in Wucheng Gan of Yongxiu County, Jiangxi 赣语江西永修县吴城镇方言 (a male speaker).

tsúʔ^{66} ‘竹 bamboo’ píʔ^{66} ‘笔 pen’

Examples from Xiaonong ZHU (2012) Supplementary materials
http://www.cuhk.edu.hk/journal/jcl/jcl/chin_lin/40/40_1_1_audio.html

Issues

- Do we need a 6th pitch level, or is “5”, “extra-high”, already high enough?
- IPA has diacritics for breathy voice and creaky voice, separate from pitch marking, but not for falsetto*

The best case to be made for the IPA would involve showing that some phonemic contrast (not just a phonetic variant) cannot be represented without some additional notation.

*the separate, clinical “Voice Quality Symbols” system by Ball et al. uses the letter “F” to mark falsetto on a stretch of speech

(3) Tense/lax register contrasts on vowels

Example: Mpi (plays by rows)

TONE (PITCH)	REGULAR VOICE	ENGLISH	TENSE VOICE	ENGLISH
Low rising	**si**	'to be putrid'	**si**	'to be dried up'
Low level	**si**	'blood'	**si**	'seven'
Mid rising	**si**	'to roll rope'	**si**	'to smoke'
Mid level	**si**	(a color)	**si**	(classifier)
High falling	**si**	'to die'	**si**	(name)
High level	**si**	'four'	**si**	(name)

James Harris & Peter Ladefoged: http://www.phonetics.ucla.edu/vowels/chapter12/mpi.html

Audio examples from Nuosu Yi

o	po^{33}	$p\underline{u}:^{33}$	to rummage
ɔ (o)	$pɔ^{33}$	$p\underline{ɔ}^{ə33}$	to split
z	pz^{33}	$pz:^{33}$	eagle call
ẓ	$pẕ^{33}$	$p\underline{z}^{ə33}$	to poop
u	pu^{33}	$pv\widetilde{u}:^{33}$	river deer
u̱	$pu̱^{33}$	$p\underline{u}:^{33}$	to go back

Phonemic transcriptions using underscore for tense

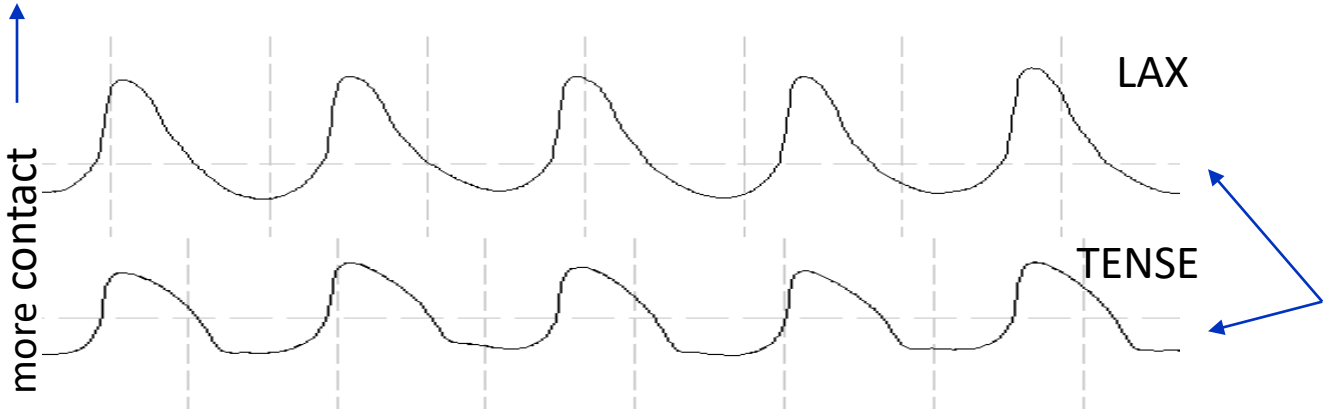
Phonetic transcriptions showing differences in tongue position

Edmondson et al. *JIPA 47*

Southern Yi

Jianjing Kuang 邝剑菁 (now at U. Penn.)

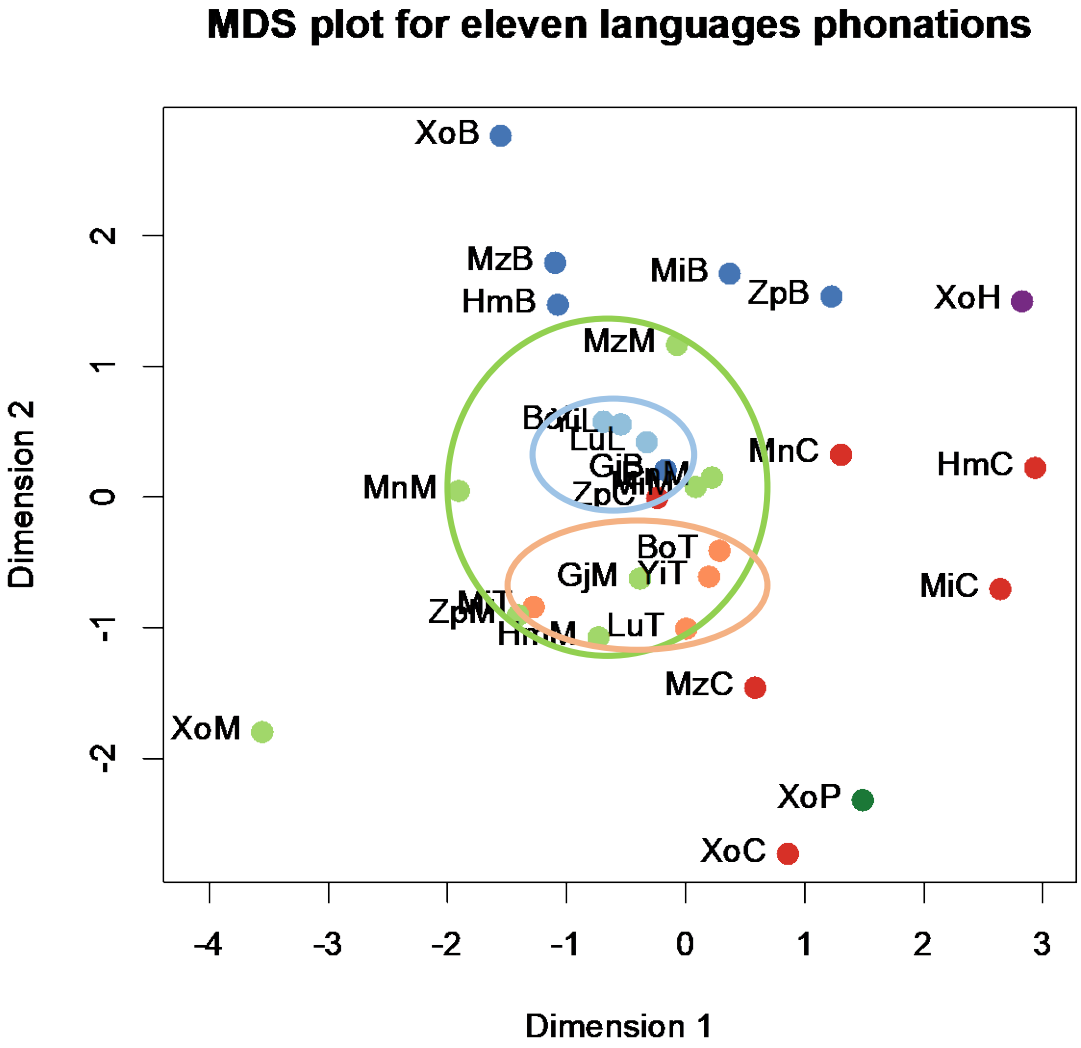
	Low tone	Mid tone
Lax phonation	be ^{21} (mountain)	be ^{33} (fight)
Tense phonation	be̲ ^{21} (foot)	be̲ ^{33} (shoot)



In these Yi dialects (unlike e.g. Nuosu), for most speakers the tense-lax contrast is made primarily by phonation -- electroglottography shows different vibration patterns

Kuang 2011, UCLA MA thesis

Voice quality acoustic space for 7 phonation categories in 11 languages shows that Tense and Lax categories both overlap with Modal



Lax: Bo, Luchun Hani, S.Yi

Modal: English, Gujarati, White Hmong, Mandarin, Mazatec, Black Miao, Zapotec

Tense: Bo, Luchun Hani, S.Yi, Black Miao

Keating et al., in preparation

Issue

- New diacritics, for both Lax and Tense?
  - Underscore is already used in IPA for Retracted articulation
  - But any new diacritic should go under the vowel base symbols, since tone/ nasalization diacritics are likely to appear above or after the vowel
  - Will have to be made clear that this kind of Tense/Lax is different from (a) Germanic vowels or (b) Germanic, Korean, and other consonants, and even (c) lower register in Wu Chinese (which is about noise, not spectrum)

(4) Apical and Fricative vowels

Several of these Illustrations treat

- apical vowels (舌尖元音) – common across Chinese languages (Zee & Lee 2007)
- fricative vowels (摩擦化元音) – less common in Chinese languages, but more common worldwide

Transcription of apical vowels is varied, depending in part on whether they are viewed as primarily

- vowels, e.g. ɿ ʅ
- syllabic fricative consonants, e.g. z̩ ʐ̩
- syllabic approximants, e.g. ɹ̩ ɻ̩

But within each approach, symbols are generally agreed on, even if not IPA

Zee & Lee 2007, *ICPhS 16*

Example: Apical vowels in Standard Mandarin

[ɹ̩] occurs only in isolation or after [s, ts, tsʰ, ʃ, tʃ, tʃʰ]. [ɹ̩] in isolation or when following [ʃ, tʃ, tʃʰ] is a syllabic apical post-alveolar approximant; when following [s, ts, tsʰ] it is a syllabic apico-laminal or laminal denti-alveolar approximant. Syllabic apico-laminal or laminal denti-alveolar and syllabic apical post-alveolar approximants, often called apical vowels, occur only in open syllables.

Syllabic consonants

ɹ̩	sɹ̩˥	'to think'
	ʃɹ̩˥	'poem'

Lee & Zee 2003 *JIPA 31;* see also Lee-Kim 2014 *JIPA 44*

Fricative vowels

- Example seen above in Nuosu

z	pz^{33}	pz:^{33}	eagle call

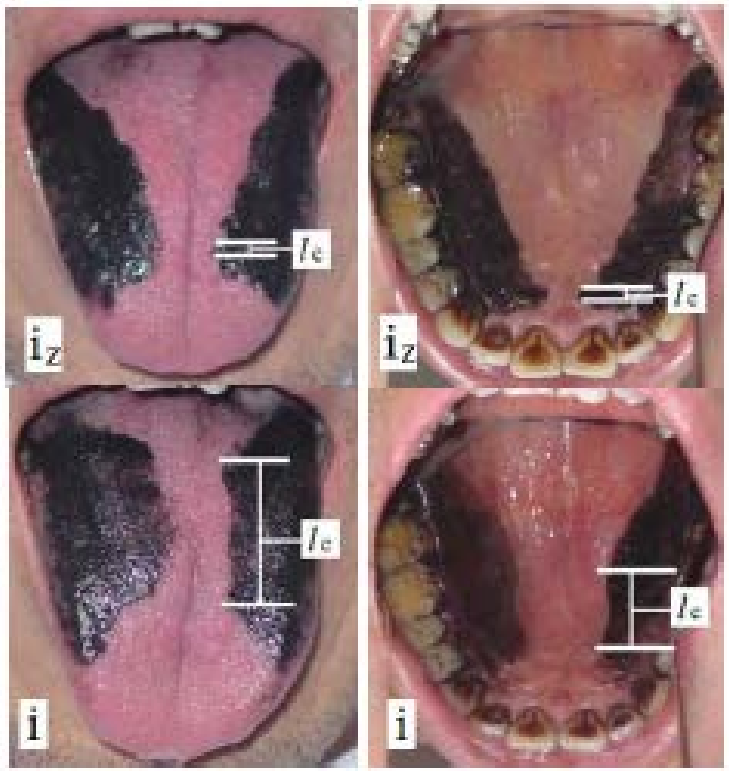
- Suzhou 苏州 Chinese: has both fricative and apical vowels
  - both postalveolar and labial fricative vowels
  - transcription is even more varied than for apical vowels, but basically as vowels or as fricatives

Zhu 2015, *Encyclopedia of Chinese Language and Linguistics*

Example: Suzhou Chinese

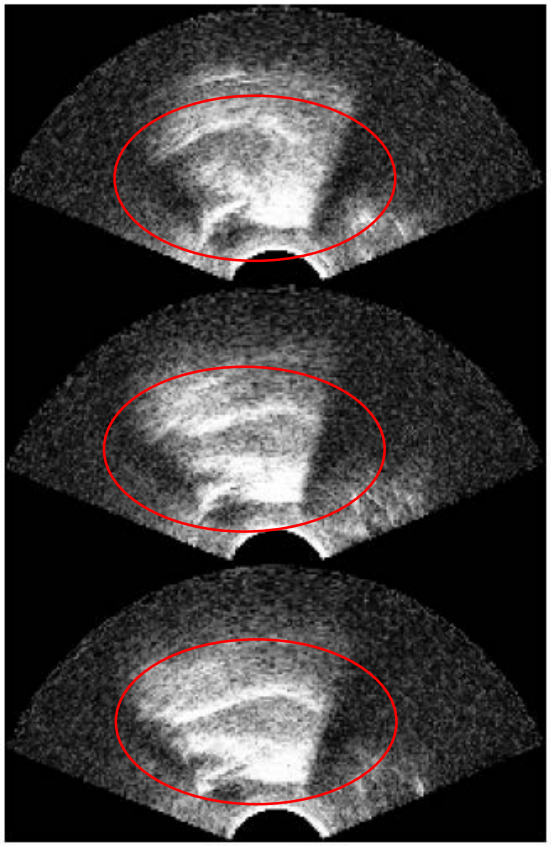
Ling (2007) shows narrower and fronter constriction for fricative vowel [i_z] compared to [i]:

Figure 2: Palatograms and linguagrams of [i_z] and [i] of a male speaker.



Ling 2007 *ICPhS XVI*; see also Ling 2009, *A phonetic study of the vowel system in Suzhou Chinese*, CUHK dissertation

Suzhou ultrasound study
Matt Faytak (now at UCLA)



- Gusu district in urban core of Suzhou city (Gūsū qū 姑苏区)

- Suzhou triplet:
  - 鲜 si^{44} ‘fresh’
  - 西 s̻ɨ̻z̻^{44} ‘west’
  - 丝 sɿ^{44} ‘thread’

Figure 4.8: Ultrasound images of the tongue for Speaker 3 at the acoustic midpoint of the vowels in the minimal triplet (from top to bottom) 鲜 [si^{44}] ‘fresh’, 西 [sɨ̻z̻^{44}] ‘west’, and 丝 [sɿ^{44}] ‘thread’. Left is anterior. Note different tongue blade positions for [ɨ̻z̻] and [ɿ].

Faytak 2018, *Articulatory uniformity through articulatory reuse*, UCBerkeley dissertation

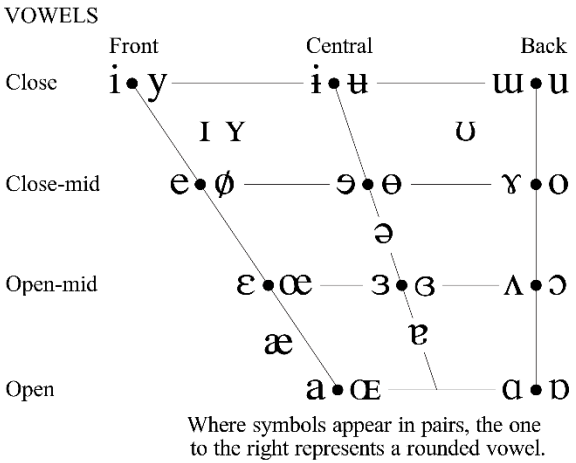
Example: Kom, a language of Cameroon
(from Matt Faytak)

- [iɬbiˀl] ‘kola nut’ 
- [əɬb͡ɬʒl] ‘goat’  

Faytak 2014, *ACAL 46*

Issues

- Does the IPA need new symbols for the apical vowels, or do the fricative or approximant treatments suffice?
- Does the IPA need a diacritic for blade raising, distinct from “Rhoticity” or full retroflexion?
- How are tongue-blade vowels to be understood relative to the dorsal vowels on the IPA’s traditional vowel chart?



Conclusions

- The IPA has gratefully adopted tone letter notation, but could also adopt its numerical equivalent
- The IPA has gratefully adopted the project of providing IPA charts with metatext in languages other than English
- The IPA will be grateful if Chinese phoneticians will contribute Illustrations of the IPA that reveal shortcomings of our Alphabet
- The International Phonetic Alphabet should grow to meet the needs of languages of China, some cases of which have been reviewed here

Thank you!