The role of dialectology in L2 vowel acquisition; Evidence from Mandarin Chinese

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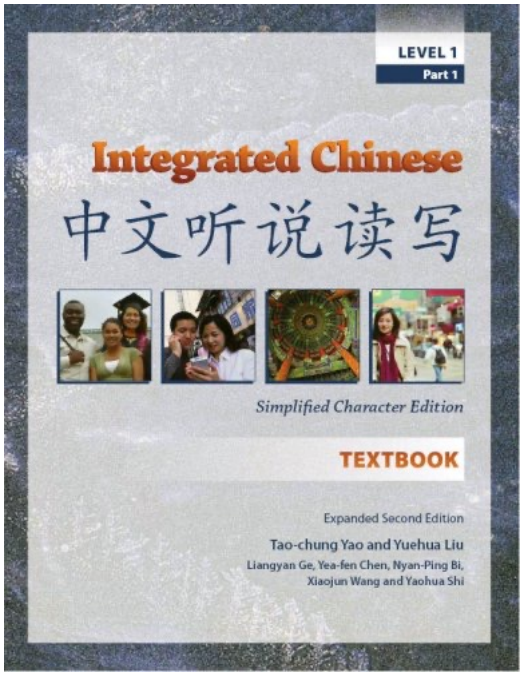
Phonemic approach to pronunciation teaching

Teaching Mandarin Chinese Vowels to L1 US English Speakers

- English: /i ɪ e ɛ æ ɑ ɔ o ʊ u ʌ ɝ/ (Hillenbrand et al 1995)
- Mandarin: /i y u ə ɤ a/ (Lee and Zee 2003)
- Common sounds: /i u/

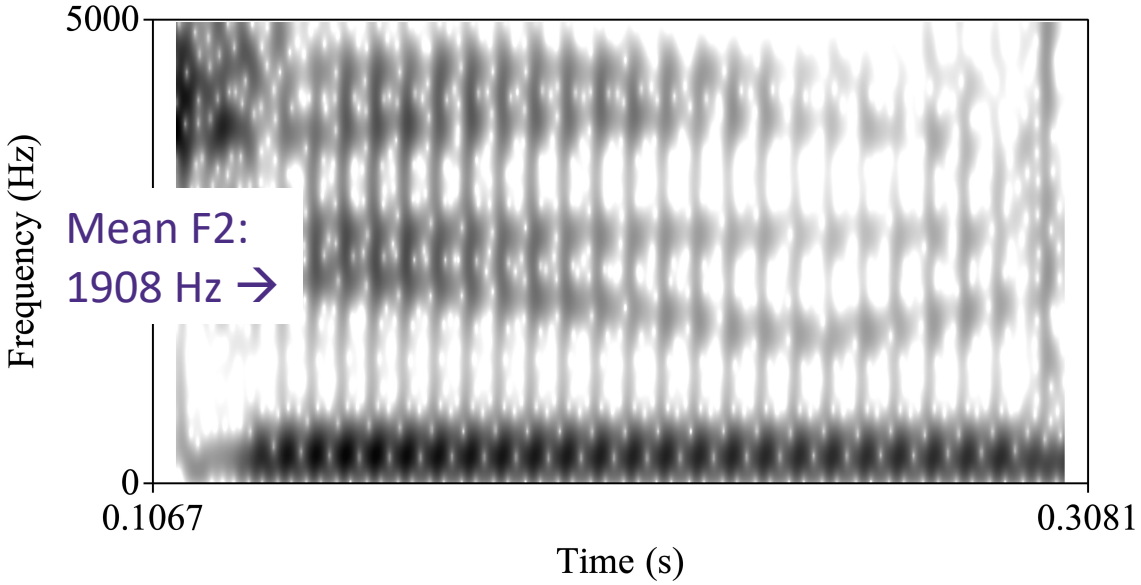


Sub-phonemic differences

Regional & social variants

> In most L1 US English varieties, /u/ as [ʉ], not [u] (Labov, Ash & Boberg 2006)

‘do’



Sub-phonemic differences

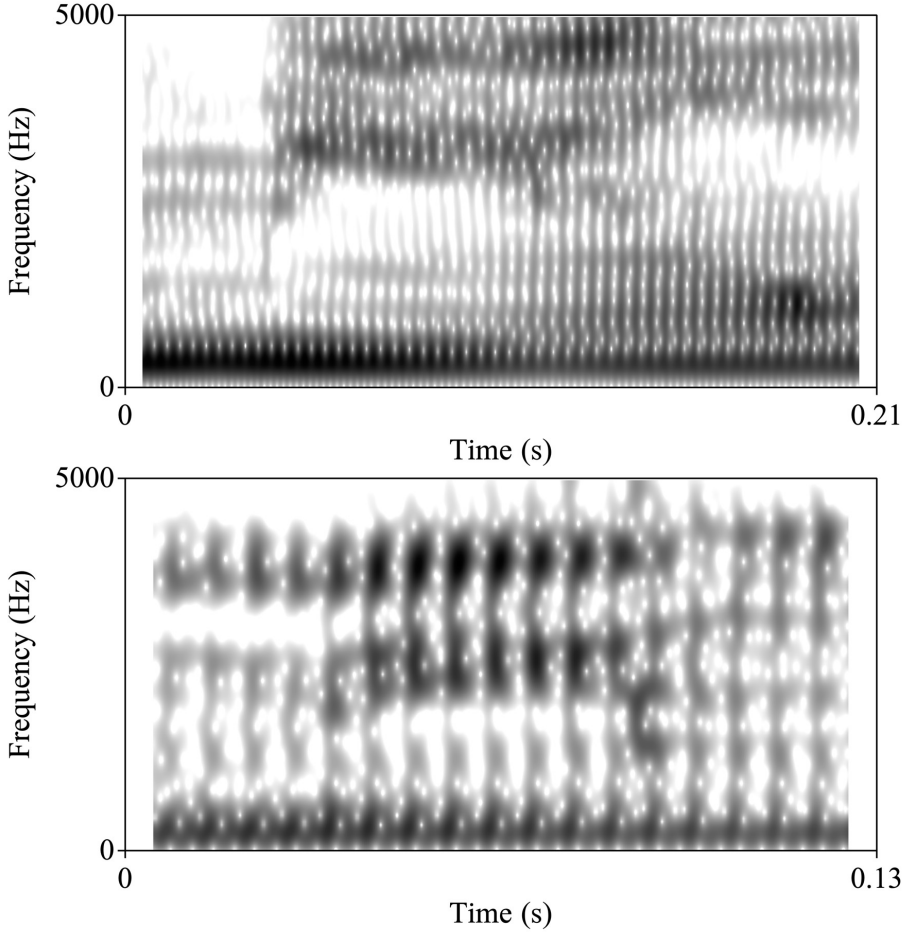
[miᵊŋ˥]

Regional and social variants

> For some L1 Mandarin speakers, /i/ before /ŋ/ as [iᵊŋ] (Li 2004)

> 明 /miŋ˥/ ‘bright’

[miŋ˥]



So what?

Learners' perception of speech

- Fronted American English /u/ could be perceptually similar to Mandarin /y/
- Schwa in[iᵊŋ] as a perceptual cue to place of articulation
  - /n ŋ/ are regularly deleted when in coda position (J. Li & Cheng 2014)
  - Deletion is considered standard and occurs even in the speech of news and radio broadcasters (C. W.-C. Li 2004)
  - Place of articulation is preserved based on the quality of the previous vowel, as all vowels have separate allophones when preceding [n] vs. [ŋ], with the exception of speakers who produce [iŋ] instead of [iᵊŋ].

So what?

Perception of learners' speech

- Sub-phonemic differences shown to be relevant for intelligibility and comprehensibility of L2 speakers
  - Vowel duration (Poretta & Tucker 2015)
  - Utterance-level prosody (Yang 2016)

The present study

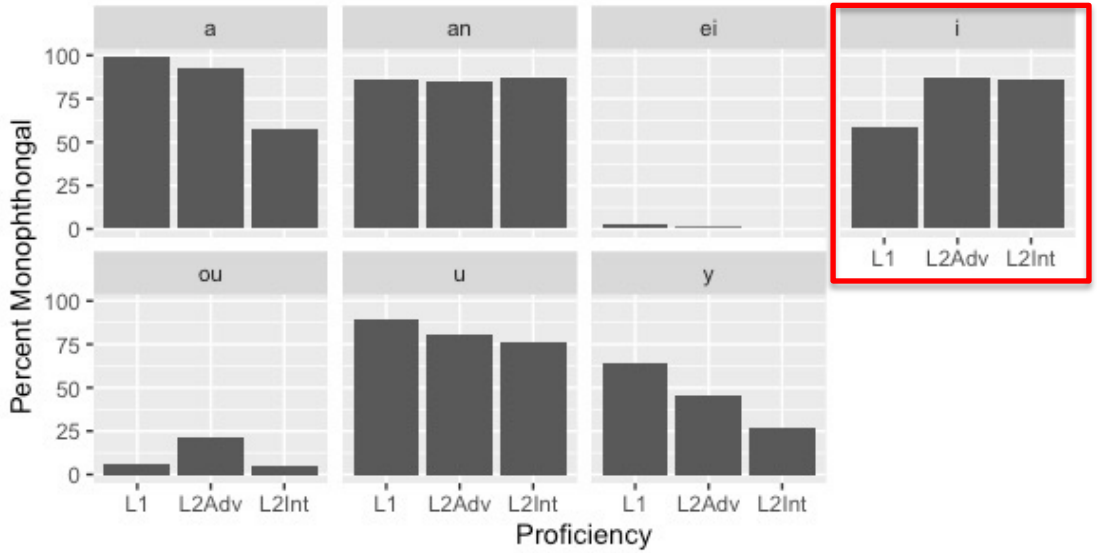
- Investigates transfer effects from L1 North American English into L2 Chinese, with attention to interspeaker phonetic variation
- Aims to provide an accurate description of L2 Mandarin vowels to provide a foundation for teaching and learning

Research Question 1: Do L1 regional pronunciations carry over into the L2?

- L1 English speakers had lower mean F2 of /u/ relative to L1 Mandarin speakers when speaking Mandarin (Shi & Wen 2009; Xie 2013)
- Both studies suffered from methodological shortcomings
  - Unnormalized formant data
  - Small number of speakers (Shi & Wen 2009)
  - No effect sizes given (Xie 2013)

Research Question 2: Are L2 Mandarin speakers acquiring [iᵊŋ] ?

> Preliminary auditory analysis (Squizzero 2022) showed differences between L1 and L2 Mandarin speakers



Materials (Yang 2011)

- 44.1 kHz, 24-bit recordings made in sound-attenuated studio
- 16 target sentences embedded in conversational scenarios
  - [iᵊŋ]: yīng [jiᵊŋ˥] qīng [tɕʰiᵊŋ˥] míng [miᵊŋ˧˥]
  - [u]: dú [tu˧˥] lù [lu˥˩] wū [u˥]
  - 3 repetitions per sentence per speaker
- 31 speakers total

Speakers

- 10 L1 Mandarin speakers (4 men, 6 women), born and raised in Beijing
- 21 American L1 English, L2 Mandarin speakers (15 men, 6 women) of intermediate and advanced Mandarin proficiency
- Age range: 19 to 35 years (mean: 25.64).

Measurement

- **Forced-Alignment:** Montreal Forced Aligner (McAuliffe et al 2017)
- **Formant Extraction:** Fast Track (Barreda 2021) for Praat
  - 20 measurement points per vowel, grouped into 5 bins
- **1382 tokens of /u/ and /iŋ/ analyzed**

Analysis

Data Cleaning: Mahalanobis distance (Mahalanobis 1936; Squizzero & Wassink in prep), corrections done by hand in Praat (Boersma & Weenink 2021)

Normalization: Nearey 2 (speaker-extrinsic) (Nearey 1978) using phonR (McCloy 2016)

Statistical Modeling: Generalized additive mixed models (GAMMs) (Wood 2017, Sóskuthy 2017)

Software: mgcv, itsadug packages in R (R Core Team 2021), tidyverse (Wickham 2018), ggplot2 (Wickham 2015)

Results

L1/L2 status	Vowel	F1 Mean (logHz)	F1 SD	F2 Mean (logHz)	F2 SD
L1	i	0.320	0.076	1.850	0.309
L2	i	0.338	0.073	1.880	0.324
L1	u	0.303	0.048	0.688	0.152
L2	u	0.296	0.042	0.818	0.220

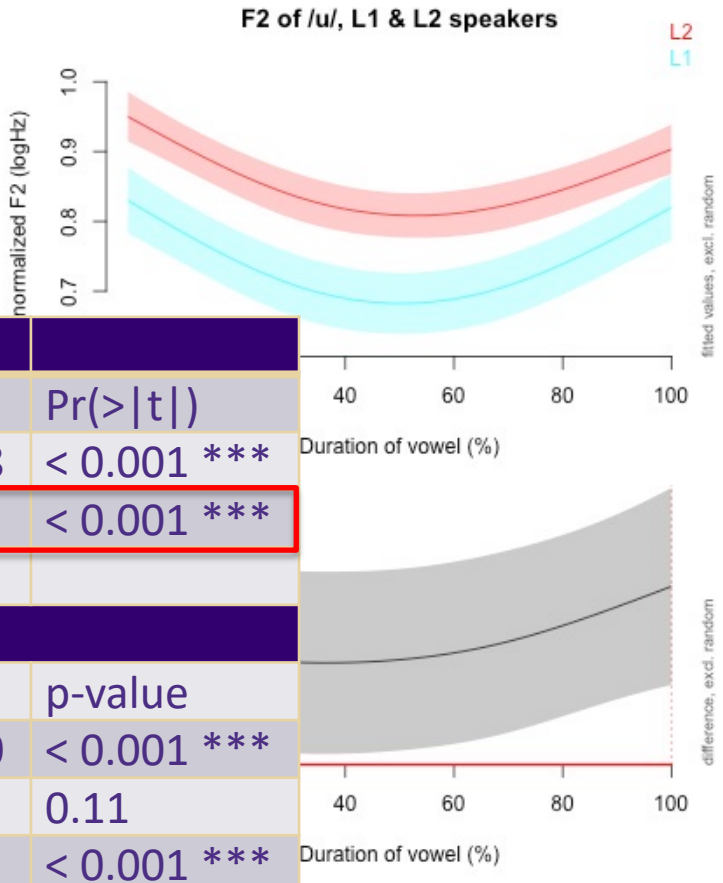
Means and standard deviations for F1 and F2 at midpoint, by vowel and L2 status

Model specification

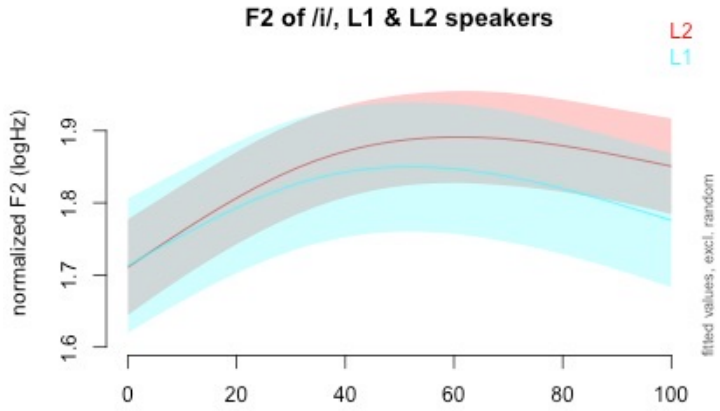
```
> normF2 ~ L1Status
    + s(Interval, bs="cr", k=4)
    + s(Interval, by = L1status bs="cr", k=4)
    + s(Interval, speaker, bs = "fs", m=1, k=4)
```

Results: /u/

Parametric coefficients:				
	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.75590	0.02117	35.698	< 0.001 ***
L1statusL2	0.11361	0.02594	4.379	< 0.001 ***
Approximate significance of smooth terms:				
	edf	Ref.df	F	p-value
s(Interval)	2.891	2.976	37.690	< 0.001 ***
s(Interval):L1statusL2	1.822	2.184	2.074	0.11
s(Interval,speaker)	25.562	120.000	1.819	< 0.001 ***



Results: /iŋ/



Parametric coefficients:				
	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	1.79532	0.04528	39.653	<2e-16 ***
L1statusL2	0.03647	0.05518	0.661	0.509
Approximate significance of smooth terms:				
	edf	Ref.df	F	p-value
s(Interval)	2.795	2.96	25.814	<2e-16 ***
s(Interval):L1statusL2	1.000	1.00	5.484	0.0192 *
s(Interval,speaker)	36.005	120.00	5.858	<2e-16 ***

Discussion

- Significant sub-phonemic differences exist in production of [iᵊŋ] and [u] between L1 and L2 Mandarin speakers
- These differences occur despite the ostensible similarity of the vowels between Mandarin and American English
- Differences between vowels are sometimes only observable by examining their dynamics
  - Formant trajectories are important for perception (Hillenbrand 2013)

Pedagogical implications

- L2 pronunciation teachers should consider the shortcomings of a phonemic approach
- L2 Mandarin teachers of L1 US English students might consider teaching pronunciation /u/ and of /iᵊŋ/, though perceptual research is needed
- Language learners and teachers would benefit from taking a critical view of the sounds that differ between the learners' L1s and L2s, a view that goes beyond simple comparison of phonemic inventories

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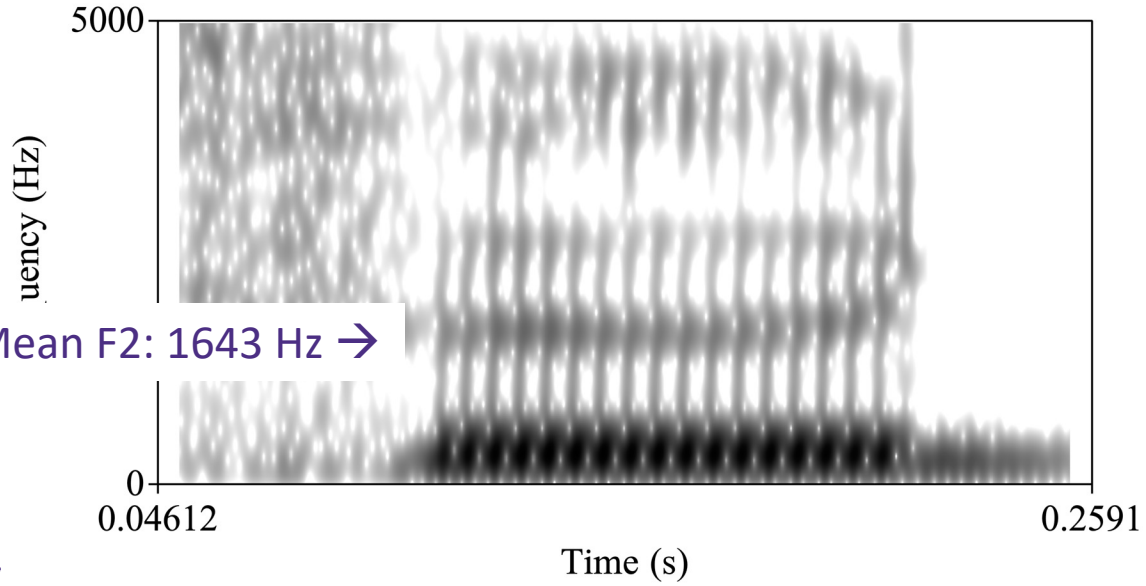
Extras

‘Food’



Mean F2: 1643 Hz →

Perceptual study (Squizzero 2022)

- Greater distance between /y/ and /u/ is positively correlated with comprehensibility and negatively correlated with accentedness.
- Distance between /y/ and /u/ *per se* was not correlated with intelligibility, but there was a significant interaction between distance and perceived ethnicity
  - Supports *reverse linguistic stereotyping* (Kang & Rubin 2009)

Model specification

Vowel	Overall Height	Overall Backness	Vowel-inherent spectral change
a#	L2 lower	L2 backer	Difference in height & backness
an	N.S.	N.S.	N.S.
ei	N.S.	L2 fronter	N.S.
i/ŋ	N.S.	N.S.	Difference in backness
u	N.S.	L2 fronter	N.S.
y	N.S.	N.S.	Difference in backness

Summary of acoustic results for vowels by L1 status

Differences between L1 & L2 speakers

- **Prosody** (Yang 2011)
  - Lexical tone accuracy
  - Tone target undershoot
- **Segmental differences - relative to L1 Mandarin speakers, L1 English speakers tend to have:** (Squizzero 2022)
  - Either advanced or retracted /ɐ/
  - Fronter /u/ and /ei/
  - Backer and lower /a/ in open syllables
  - Less movement in the vowel dynamics of /i/ before /ŋ/
  - More movement in the vowel dynamics of /y/

Sentences in the corpus with [u]:

1. 邬安英修飞机。	Wū Ānyīng xiū fēijī.
“Wu Anying repairs planes.”	[u˥ an˥jiŋ˥ ɕjou˥ fei˥tɕi˥]
2. 邬安应修飞机。	Wū Ān yīng xiū fēijī.
“Wu An should repair planes.”	[u˥ an˥ jiŋ˥ ɕjou˥ fei˥tɕi˥]
13. 陆蔚用慢用药。	Lù Wèi yòng mànyòng yào.
“Lu Wei uses the slow medicine.”	[lu˥˩ wei˥˩ joŋ˥˩ man˥˩joŋ˥˩ jau˥˩]
14. 陆卫用卖孕药。	Lù Wèiyòng mài yùnyào.
“Lu Weiyong uses the contraceptive medicine.”	[lu˥˩ wei˥˩joŋ˥˩ mai˥˩ yn˥˩jau˥˩]
21. 陆岩练习育苗。	Lù Yán liànxí yùmiáo.
“Lu Yan practices growing seeds.”	[lu˥˩ jɛn˧˥ ljɛn˥˩ɕi˧˥ y˥˩mjau˧˥]
22. 陆言练学育苗。	Lù Yánliàn xué yùmiáo.
“Lu Yanlian practices growing seeds.”	[lu˥˩ jɛn˧˥ljɛn˥˩ ɕwɛ˧˥ y˥˩mjau˧˥]
23. 孟岩爱读外文。	Mèng Yán ài dú wàiwén.
“Meng Yan likes studying foreign languages.”	[məŋ˥˩ jɛn˧˥ ai˥˩ tu˧˥ wai˥˩wən˧˥]
24. 孟言艾读外文。	Mèng Yán’ài dú wàiwén
“Meng Yanai studies foreign languages.”	[məŋ˥˩ jɛn˧˥ ai˥˩ tu˧˥ wai˥˩wən˧˥]

Sentences in the corpus with [iᵊŋ]:

1. 邬安英修飞机。
“Wu Anying repairs planes.”
2. 邬安应修飞机。
“Wu An should repair planes.”
3. 殷安青摸猫咪。
“Yin Anqing pets a kitty.”
4. 殷安轻摸猫咪。
“Yin An gently pets a kitty.”
5. 王明来拿羊毛。
“Wang Ming comes to get wool.”
6. 王明涞拿羊毛。
“Wang Minglai gets wool.”

Wū Ānyīng xiū fēijī.
[u˥ an˥jiŋ˥ ɕjou˥ fei˥tɕi˥]
Wū Ān yīng xiū fēijī.
[u˥ an˥ jiŋ˥ ɕjou˥ fei˥tɕi˥]
Yīn Ānqīng mō māomī.
[jin˥ an˥tɕʰiŋ˥ mwo˥ mau˥mi˥]
Yīn Ān qīngmō māomī.
[jin˥ an˥ tɕʰiŋ˥ mwo˥ mau˥mi˥]
Wáng Míng lái ná yángmáo.
[waŋ˧ miŋ˧ lai˧ na˧ jaŋ˧mau˧]
Wáng Mínglái ná yángmáo.
[waŋ˧ miŋ˧lai˧ na˧ jaŋ˧mau˧]

Sentences in the corpus with [iᵊŋ]:

7. 刘明莱游云南。	Liú Mínglái yóu Yúnnán.
“Liu Minglai travels in Yunnan.”	[ljouˊ miŋˊlaiˊ jouˊ ynˊnanˊ]
8. 刘明来游云南。	Liú Míng lái yóu Yúnnán.
“Liu Ming comes to travel in Yunnan.”	[ljouˊ miŋˊ laiˊ jouˊ ynˊnanˊ]
19. 罗燕谈论名利。	Luó Yàn tánlùn mínglì.
“Luo Yan talks about fame and profit.”	[lwoˊ jɛnˋ tʰanˊlwənˋ miŋˊliˋ
20. 罗彦坛论名利。	Luó Yàntán lùn mínglì.
“Luo Yantan talks about fame and profit.”	[lwoˊ jɛnˋtʰanˊ lwənˋ miŋˊliˋ]