The Mental Representation of L2 Phonological Lexicons: Implications from the Recognition and Production of Mandarin Words by Cantonese and Mandarin speakers

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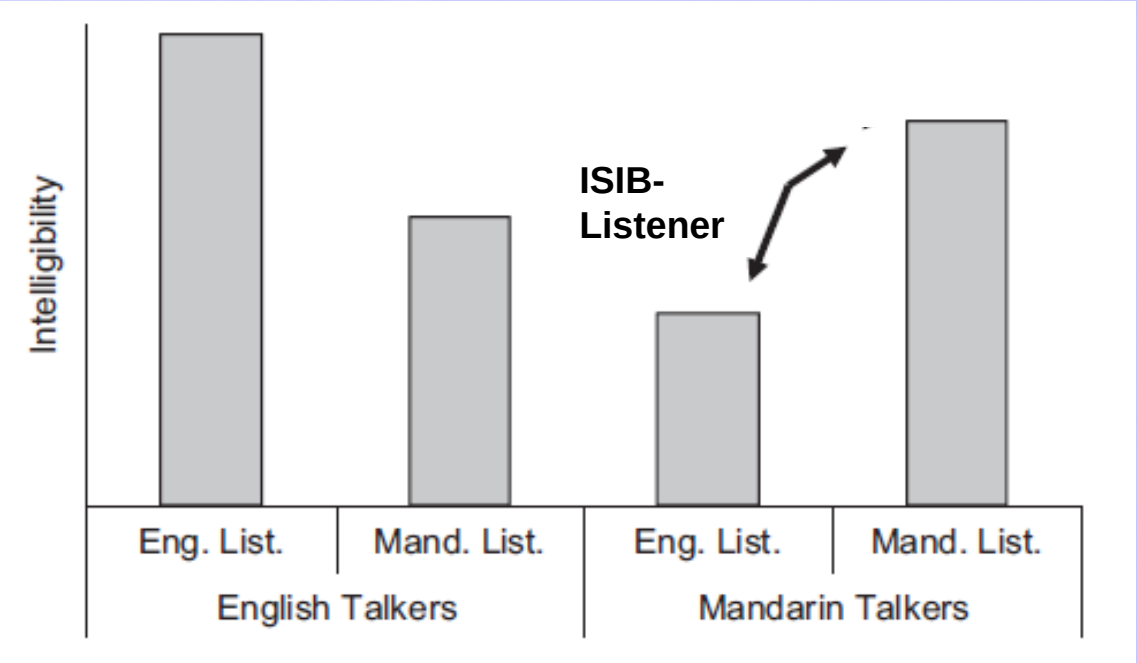
Interlanguage speech intelligibility benefit (ISIB)



(Hayes-Harb et al., 2008:666)

ISIB-Listener - Non-native listeners are better than native listeners in understanding accented speech produced by speakers from the same language background.

Interlanguage speech intelligibility benefit (ISIB)

Studies	Native language of the listeners	Task	Variables	ISIB – Listner
Bent & Bradlow (2003)	Mandarin & Korean	Sentence transcription	N/A	✖
Stibbard & Lee (2006)	Korean & Arabic	Sentence transcription	N/A	✖
Imai et al. (2004)	Spanish	Word transcription	Word frequency, neighborhood density	✓ (dense neighbourhood)
Munro, Derwing & Morton (2006)	Japanese & Cantonese	Sentence transcription	N/A	✓ (Japanese)
Bent et al. (2008)	Mandarin	Forced choice identification	Vowel length before voiced and voiceless obstruent	✓ (LP talker)
Hayes-Harb et al. (2008)	Mandarin	Forced choice identification	Word final voicing	✓ (LP talker and listener)
Chu & Taft (2010)	Cantonese	Word transcription	Relative word frequency	✓ (minimal pairs where L2 speakers can't tell the difference)

Relationships between Cantonese and Mandarin pronunciations

- There exist many homophones in Cantonese and Mandarin
- Words that are homophones in Cantonese may not be homophones in Mandarin

Word	Meaning	Cantonese pronunciation	Mandarin pronunciation
星	‘star’	*/sing1/*	*/xing1/*
聲	‘sound’	*/sing1/*	*/sheng1/*
升	‘rise’	*/sing1/*	*/sheng1/*
昇	‘ascend’	*/sing1/*	*/sheng1/*
興	‘cheerful’	*/hing3/*	*/xing1/*

Relationships between Cantonese and Mandarin pronunciations

- Cantonese-accented Mandarin due to transfer from L1 at the **lexical** level
  - If two words are homophones in Cantonese (e.g., 聲 and 星), Cantonese speakers may treat them as homophones in Mandarin also.

    Example: *sheng1yin1* (聲音 'sound') → *xing1yin1* (i.e. 星音)

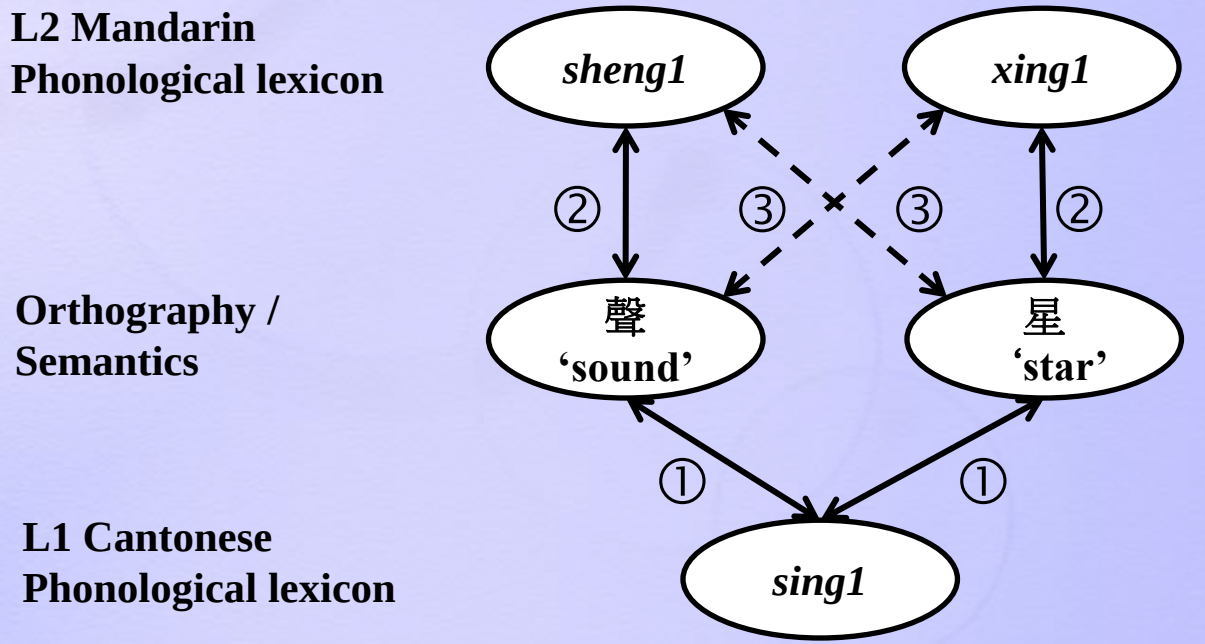


Figure 1. Cantonese-Mandarin pronunciation association

Relationships between Cantonese and Mandarin pronunciations

- These kinds of lexical transfer errors may not be completely due to negative phonological transfer from L1 (lack of a particular L2 phoneme in L1)
  - /*wei3ba1*/ (尾巴 'tail') → /*mei3ba1*/ (i.e., 美巴)
  - Both /w/ and /m/ are existing phonemes in Cantonese

Experiment 1

- Examine whether Cantonese listeners are better than Mandarin listeners in understanding Mandarin mispronounced (MP) words that show characteristics of Cantonese-accent at the lexical level

- Task: Disyllabic word transcription task

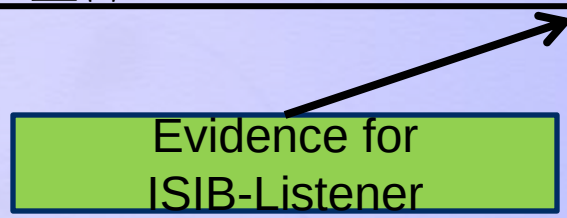
- Participants:
  - 20 Mandarin listeners (mean age: 22.9)
  - 28 Cantonese listeners (mean age: 21.9) who have learnt Mandarin for at least 3 years

Experiment 1 - Design

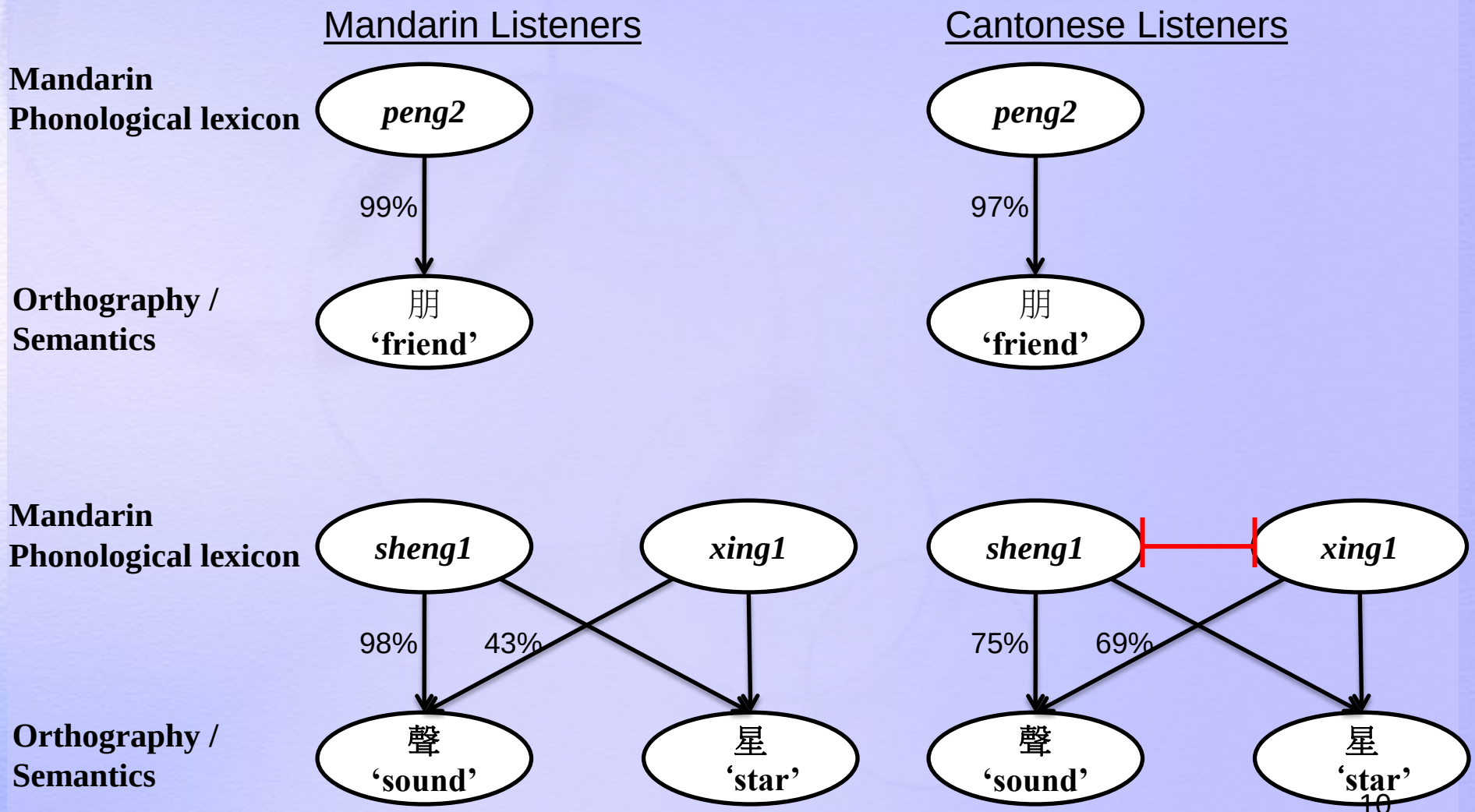
- Type of words
  - Target words with mispronunciations (MP)
    - nonwords (e.g., *xing1yin1* 星音)
  - Target words without mispronunciations (MP)
    - (e.g., *sheng1yin1* 聲音 ‘sound’)
  - Control words (e.g., *peng2you3* 朋友 ‘friend’)

Experiment 1: Result

Word types	Examples	Mandarin listeners		Cantonese listeners
Control	*peng2you3* 朋友 'friend'	99%	=	97%
Target (without MP)	*sheng1yin1* 聲音 'sound'	98%	>	75%
Target (with MP)	*xing1yin1* 星音	43%	<	69%



The mental representation of the phonological lexicon



Experiment 2

- If two words are homophones in Cantonese (e.g., 聲 and 星), Cantonese speakers may treat them as homophones in Mandarin also.
  - 聲 *sheng1* → 星 *xing1*
    聲音 'sound' *sheng1yin1* → *xing1yin1* (i.e. 星音)
  - 星 *xing1* → 聲 *sheng1*
    星球 'planet' *xing1qiu2* → *sheng1qiu1* (i.e. 聲球)

- This experiment investigates whether non-native listeners still have an advantage over native listeners in understanding Mandarin MP words if the lexical transfer occurs in the other direction

Experiment 2 - Design

- Type of words
  - 20 Target words without MP (e.g., *xing1qiu2* 星球 'planet')
  - 20 Target words with MP (e.g., *sheng1qiu2* 聲球)
  - 20 Control words (e.g., *peng2you3* 朋友 'friend')

- Participants:
  - 20 Mandarin listeners (mean age: 24.2)
  - 30 Cantonese listeners (mean age: 22.1) who have learnt Mandarin for at least 3 years

Comparison of results: Experiments 1 and 2

Word types	Experiment 1			Experiment 2		
	Mandarin listeners		Cantonese listeners	Mandarin listeners		Cantonese listeners
Control	99%	=	97%	99%	=	97%
Target (without MP)	98%	>	75%	97%	>	76%
Target (with MP)	43%	<	69%	31%	<	49%

Evidence for ISIB-Listener

Reanalysis of Experiments 1 and 2 based on the phonological proficiency of Cantonese listeners

- Examine whether there are differences in the mental representation of Mandarin speech sounds among Cantonese speakers with high and low phonological proficiency

- Task:
  - The 28 Cantonese listeners in experiment 1 pronounced the 60 words in Mandarin after the word transcription task.
  - A native Mandarin speaker with phonetic training transcribed those words using Mandarin pinyin.

- Results:
  - High proficiency (HF) group:12 Cantonese listeners with the highest phonological proficiency score
    (Expt 1 mean: 85%; Expt 2 mean: 90%)
  - Low proficiency (LF) group: 12 Cantonese listeners with the lowest phonological proficiency score
    (Expt 1 mean: 58%; Expt 2 mean: 77%)

Comparison of results: Experiments 1 and 2

Word Type	Experiment 1					Experiment 2				
	Cantonese LP listeners		Cantonese HP listeners		Mandarin listeners	Cantonese LP listeners		Cantonese HP listeners		Mandarin listeners
Control	93%	<	99%	=	99%	93%	<	99%	=	99%
Target (without MP)	66%	<	85%	<	98%	68%	<	85%	<	97%
Target (with MP)	66%	<	73%	>	43%	45%	<	53%	>	31%

- When Cantonese listeners' Mandarin proficiency increases, there is a stronger association strength between correct pronunciation and the lexicon.
- The association strength between the incorrect pronunciation and the lexicon does not get weaker.

Production data analysis on target words

Examples:

- Experiment 1: Target word 尾 'tail'
  - Non-MP version: *wei* (64%)
  - MP version: *mei* (25%)
  - Others: *mi* (4%), *yi* (7%)
- Experiment 2: Target word 美 'beauty'
  - Non-MP version: *mei* (97%)
  - MP version: *wei* (0%)
  - Others: *mi* (3%)

Percentage of responses produced by Cantonese speakers across all target words

Conditions	Experiment 1	Experiment 2
Non-MP version	56%	72%
MP version	24%	13%
Others	20%	15%

- Evidence for the production of the MP versions
- Some MPs cannot be accounted for by the MP version (e.g., *mi* for 尾 'tail' and 美 'beauty')

A possible confounding factor: Sound similarity between Cantonese and Mandarin MP

- Cantonese listeners understood the mispronounced words (e.g., ***mei3ba1***) correctly (e.g., as 尾巴) more often than Mandarin listeners because of the sound similarity between Mandarin MP (e.g., ***mei3***) and the Cantonese pronunciation (e.g., ***mei5***).

- Sound similarity judgment task
  - divide the target items with MP into Cantonese-, Mandarin- or neutral-sounding items
  - examine whether Cantonese listeners are better than Mandarin listeners in understanding mispronounced words in Mandarin- and neutral-sounding items.

Sound similarity judgment task

- Task:
  - 18 Native English listeners decide whether the Cantonese sound is more similar to the Mandarin non-MP or MP version
    - 1st sound: Cantonese ***mei5*** (i.e., 尾, 美)
    - 2nd and 3rd sound: Mandarin ***wei3*** / ***mei3***
  - Examples of stimulus items

Cantonese syllable	**Mandarin syllables**
bei6	Cantonese-sounding: ***bei4*** (92%) > Mandarin-sounding: ***bi4*** (8%)
zou2	*Neutral-sounding:* ***zu3*** *(47%)* = Neutral-sounding: ***zao3*** (53%)

Results: Accuracy rates

Mandarin-sounding items

Word type	Experiment 1 (18 items) Mandarin listeners		Experiment 1 (18 items) Cantonese listeners	Experiment 2 (6 items) Mandarin listeners		Experiment 2 (6 items) Cantonese listeners
Target (without MP)	98%	>	71%	98%	>	79%
Target (with MP)	60%	=	61%	27%	<	42%

Cantonese-sounding items

Word type	Experiment 1 (18 items) Mandarin listeners		Experiment 1 (18 items) Cantonese listeners	Experiment 2 (6 items) Mandarin listeners		Experiment 2 (6 items) Cantonese listeners
Target (without MP)	98%	>	75%	96%	>	87%
Target (with MP)	37%	<	68%	52%	<	87%

Neutral-sounding items

Word type	Experiment 1 (18 items) Mandarin listeners		Experiment 1 (18 items) Cantonese listeners	Experiment 2 (6 items) Mandarin listeners		Experiment 2 (6 items) Cantonese listeners
Target (without MP)	99%	>	75%	97%	>	75%
Target (with MP)	47%	<	74%	25%	<	48%

Summary of results

- Cantonese listeners understood Mandarin mispronounced words (with Cantonese characteristics) better than Mandarin listeners and this is not simply due to the sound similarity between the Cantonese pronunciation and the Mandarin mispronounced versions

  → Evidence for ISIB-Listener with Mandarin as the target language

- When Cantonese listeners become more proficient in their Mandarin pronunciation, their recognition ability of target items without MP improves while that of target items with MP does not deteriorate.

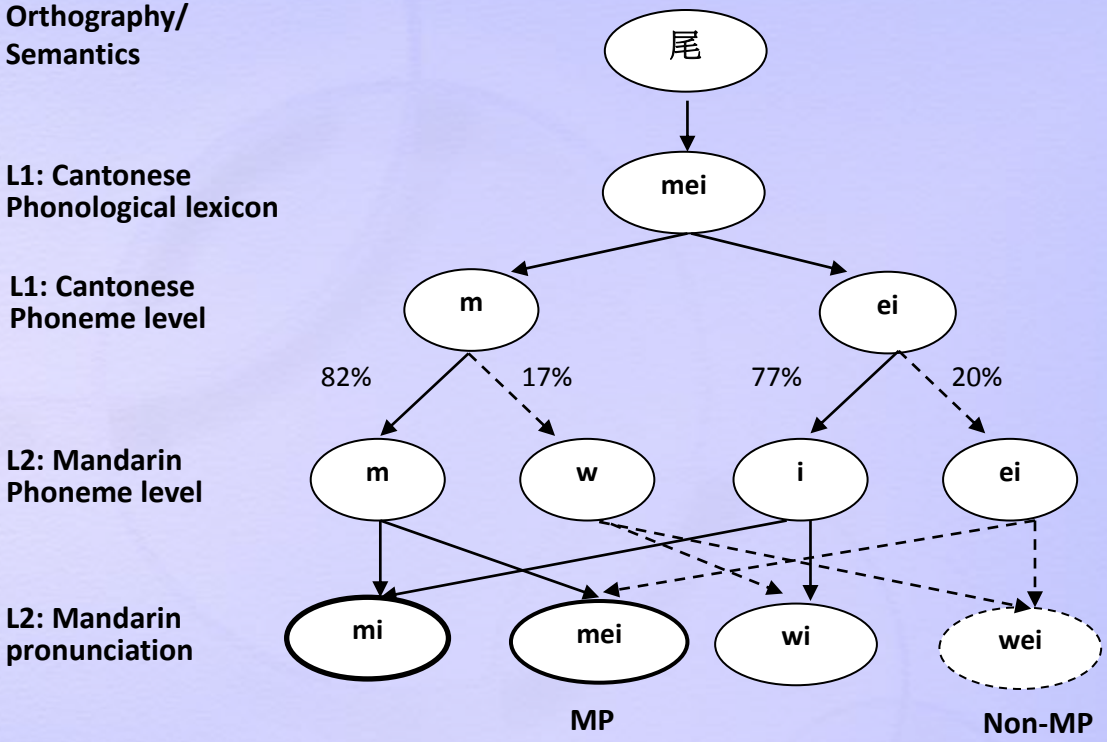
- Production data from Cantonese speakers show that there are other kinds of pronunciation errors (e.g. *mi3* for the 尾) that are not due to accent at the lexical level.

Cantonese-Mandarin pronunciation corresponding relationships (Zhang & Gao, 2000)

Cantonese onset	Mandarin onset	Number of words	Percentage	Example	Cantonese / Mandarin pronunciation
m	m	160	82%	媽 'mother'	*maa1 / ma1*
	w	33	17%	萬 'ten thousand'	*maan6 / wan4*
	b	2	1%	剝 'to shell'	*mok1 / bo1, bao1*

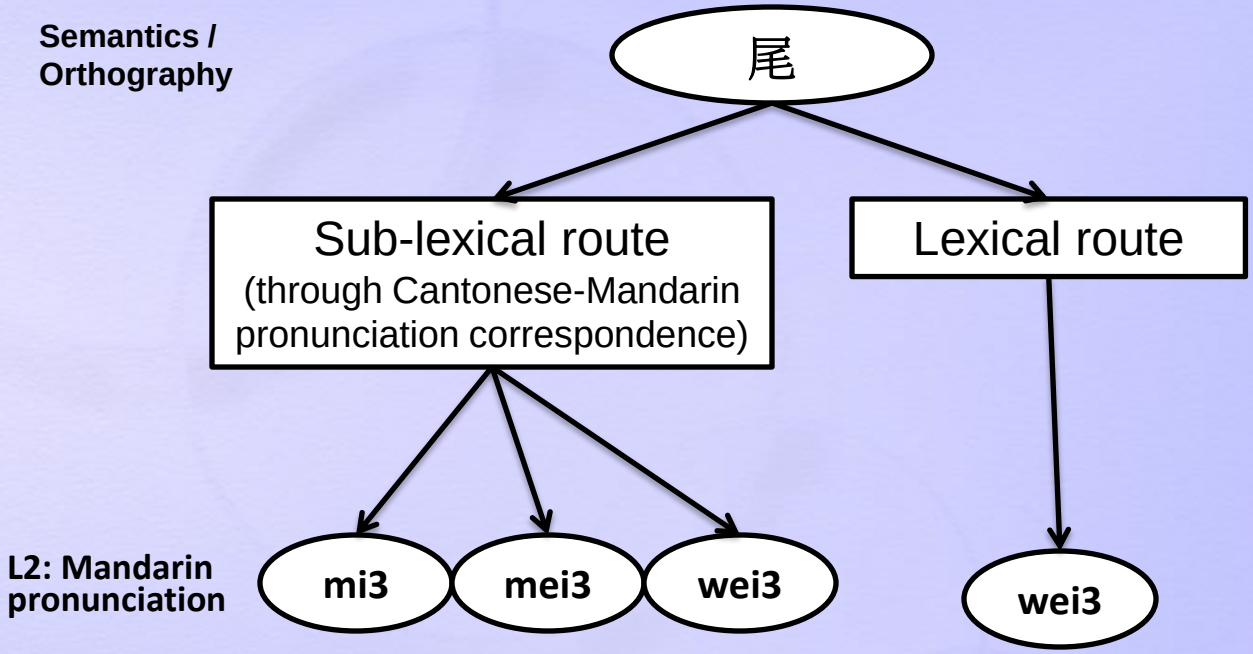
Cantonese rhyme	Mandarin rhyme	Number of words	Percentage	Example	Cantonese / Mandarin pronunciation
ei	i	99	77%	皮 'skin'	*pei4 / pi2*
	ei	26	20%	悲 'sad'	*bei1 / bei1*
	in	1	1%	您 'you'	*nei5 / nin2*
	ü	1	1%	履 'shoes'	*lei5 / lü3*
	er	1	1%	餌 'bait'	*lei6 / er3*

L2 Mandarin production model (sublexical route)



Evidence:
Existence of the Mandarin production of /mi3/ for the word 尾 although none of the Cantonese homophones /mei5/ has this Mandarin pronunciation.

L2 Mandarin production model (dual route model)



When the Mandarin phonological proficiency of the Cantonese speakers improves, they will shift from the sub-lexical to the lexical route in pronouncing Mandarin words.

Mandarin-Cantonese pronunciation corresponding relationships (Zhang & Gao, 2000)

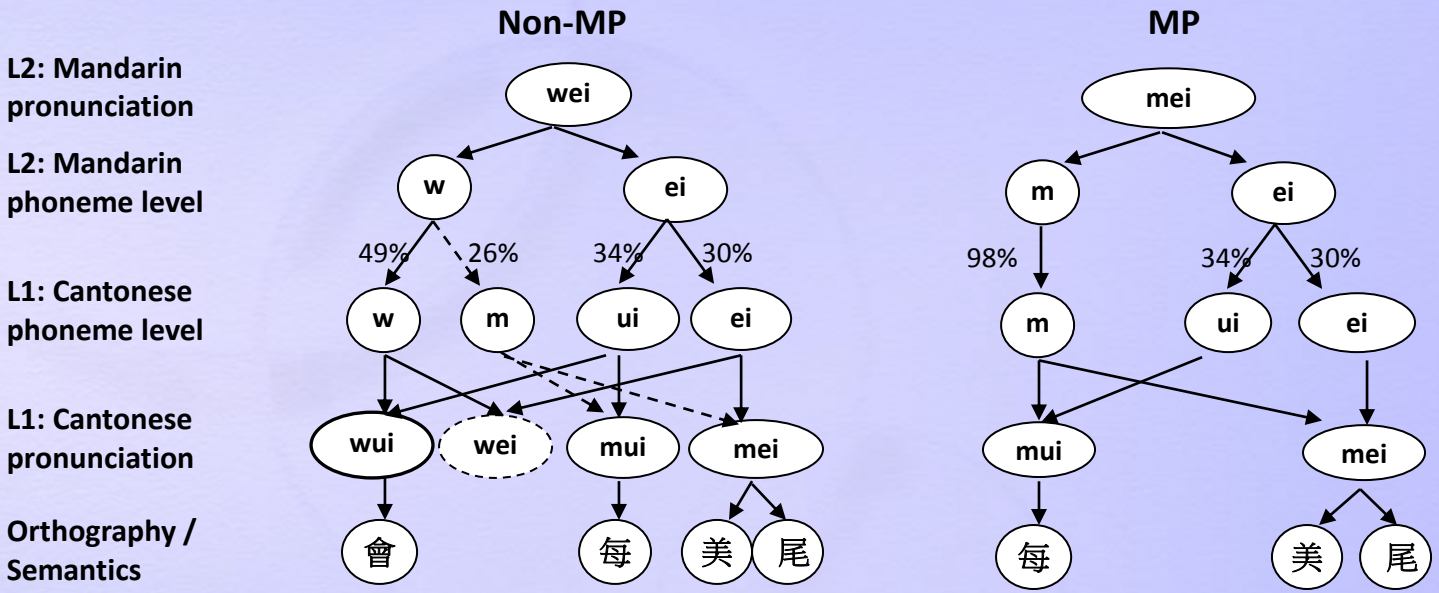
Mandarin onset	Cantonese onset	Number of words	Percentage	Example	Mandarin / Cantonese pronunciation
m	m	160	98%	媽 'mother'	*ma1 / ma1*
	b	2	1%	秘 'secret'	*mi4 / bei3*
	n	1	1%	彌 'fill'	*mi2 / nei4*

Mandarin onset	Cantonese onset	Number of words	Percentage	Example	Mandarin / Cantonese pronunciation
w	w	63	49%	烏 'black'	*wu1 / wu1*
	m	33	26%	萬 'ten thousand'	*wan4 / maan6*
	Ø	13	10%	握 'shake'	*wo4 / aak1*
	j	10	8%	嗡 'buzz'	*weng1 / jung1*
	ng	8	6%	我 'I'	*wo3 / ngo5*
	gw	1	1%	撾 'beat'	*wo1 / gwo1*

Mandarin-Cantonese pronunciation corresponding relationships (Zhang & Gao, 2000)

Mandarin rhyme	Cantonese rhyme	Number of words	Percentage	Example	Mandarin / Cantonese pronunciation
ei	ui	25	34%	杯 'cup'	*bei1 / bui1*
	ei	22	30%	悲 'sad'	*bei1 / bei1*
	oey	13	18%	累 'tired'	*lei2, lei3, lei4 / loey6*
	ai	5	7%	肺 'lung'	*fei4 / fai3*
	ak	3	4%	北 'north'	*bei3 / bak1*
	oi	1	1%	內 'inside'	*nei4 / noi6*
	e	1	1%	啡 'brown'	*fei1 / fe1*
	aak	1	1%	賊 'thief'	*zei21 / caak3*
	ap	1	1%	給 'give'	*gei3 / kap1*
	ut	1	1%	沒 'no'	*mei2 / mut6*

L2 Mandarin recognition model (sublexical route)



When listening to Mandarin words, Cantonese listeners need to go through Cantonese phonological lexicons (through sublexical phonological correspondence between Mandarin and Cantonese) in generating the semantics of the word.

Conclusion

L2 Mandarin word production

- Both lexical and sublexical (through Cantonese-Mandarin pronunciation correspondence)
  - Beginning learners use the sublexical route more while advanced learners will shift to the lexical route

L2 Mandarin word recognition

- Always sublexical (through Mandarin-Cantonese pronunciation correspondence)
  - Advanced learners do not deteriorate in their ability to understand MP words
  - L2 spoken word recognition is always mediated through the L1 phonological lexicons

Implications for L2 word recognition model

- For speakers with spoken knowledge of 2 dialects (e.g., British and American English), are the pronunciations of the 2 variations stored separately or the speakers use a rule-based system in generating the pronunciation of the less proficient dialect?

- For L1-L2 pairs that both use the roman alphabets (e.g., English and Dutch) , the 2 languages employ different GPC rules. L2 speakers may use L1 GPC rules in producing L2 words and hence creating mispronunciations. Will non-native listeners understand these mispronounced words better than native listeners?

Word recovery mechanisms

- When Mandarin listeners hear MP nonwords, how do they recover the intended words? Do they tend to change the onsets, vowels, rhymes, or tones? Do they tend to change the first or the second syllables?

- MP: chou1tian1 → 抽天 / 抽添
- Possible word candidates
  - chou1_ian1
  - chou1t_1
  - chou1tian_
  - _ou1tian1
  - ch_1tian1
  - chou_tian1
  - chou1___
  - ___tian1
  - __1tian1
  - chou1__1

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