A Phonetic Analysis of Mandarin Chinese

Description

For this project, I will be studying the Mandarin language by eliciting data from a native speaker of Mandarin. She was born in Hong Kong and grew up bilingual with her mother's side speaking Mandarin; she moved to Los Angeles, CA at the age of twelve where she has been living ever since. She is 21 years of age and speaks Cantonese, Mandarin, and English fluently as well as conversation-level Korean and intermediate-level Japanese. Due to her fluency in both Mandarin and Cantonese, I will be focusing on how her knowledge of Cantonese affects her Mandarin. I am especially interested in what vowels, consonants, and/or tones she has that are different from my source, as she told me that she sometimes mixes vowels and tones in Cantonese and Mandarin, especially in uncommon words.

I will be specifically focusing on the different vowels, consonants, and/or tones she uses that are not found in the inventories I will be referencing. I will be comparing the consonants and vowels from my transcription with the Consonant and Vowel Pages of Modern Standard Mandarin from the University of Washington, which was created for a Chinese linguistics course for the reference use of the students as well as the general public. I will also be referencing transcriptions from the UCLA Phonetics Lab Archive, which is a collection of recordings, transcriptions, and source materials for phonetic and phonological research; its intended audience includes scholars, researchers, students, and anybody interested in linguistics. Most of the challenges I anticipate facing are in transcription, especially regarding tones and identifying the correct vowels because the same vowel sounds different when it has a different tone. Additionally, I expect to struggle with identifying other sounds in Mandarin that are not found in English as well as spectrogram reading because (aside from this class) I have no prior experience or knowledge of how to read or use them.

The IPA Model

I found a lot of different Mandarin phonetic inventories online and decided to go with the U of Washington's course page instead of others' dissertations. Attempts to find whether the "extra" sounds were phonemic were inconclusive.

I found an aspiration distinction in the stops [p^h, t^h, k^h] and affricates [$\widehat{ts}^h$, $\widehat{tʂ}^h$, $\widehat{tɕ}^h$]. A lot of vowels that preceded a nasal consonant were at least partially nasalized but I did not encounter any perfect minimal pairs illustrating phonemic differences. I did not find any vowel length contrasts in my sample.

The consonants I encountered were similar to those from my source, but I found both [ɻ and ɽ] instead of [ɹ], which the U of W had on their pages. I noticed that [my speaker] tends to curl her tongue back a lot so that could be a personal or dialectal preference/difference. Additionally, her mother said that people from Northern China (she's from Beijing) curl their tongues back more

than the ‘standard’ pronunciation. Both retroflex sounds were found in the UCLA archive as well but not in the same words (they didn’t have the same words). I also found the consonants [j, w, h] that were not in the U of W’s inventory. However, these sounds are used in the UCLA archive.

I had trouble telling the aspirated and unaspirated consonants apart. It seemed possible that [b] in ‘father’ could have just been an unaspirated [p] with voicing spreading from the following vowel. I opened it on Praat and it was voiced, possibly because of the vowel it was followed by and the UCLA archive, had it down as [ˈb̥ɑ̀bə]. Similar cases with [d, g] and voiceless [g] vs unaspirated [k] sound. I found a lot of the voiceless consonants to be affected and at least partially voiced from the following vowel. Additionally, the different tones made it sound like the same vowels were different vowels; assimilation and speaker preference interfered with the inventories as well.

I was also surprised at how many retroflex sounds were in the inventory, and I had trouble identifying them. They were unfamiliar to me, and I had trouble telling [t͡ʂ, [t͡s, t͡ɕ] apart. It got easier when I tried to pronounce the words myself; I would try all the probable places of articulation and ask which one was correct.

Stops: [p, t, k]
Aspirated Stops: [pʰ, tʰ, kʰ]
Nasals: [m, n, ŋ]
Tap: [ɾ]
Fricatives: [f, s, ʃ, ʂ, ɕ, x, (h)]
Affricates: [t͡s, t͡ʂ, t͡ɕ]
Aspirated Affricates: [t͡sʰ, t͡ʂʰ, t͡ɕʰ]
Approximants: [ɹ] (j, w)
Lateral Approximants: [l]

1. ‘father’ [pà pa]
2. ‘breast’ [ɕío̯ŋ]
3. ‘day’ [ɻɨ]
4. ‘hit’ [tă]
5. ‘big’ [tâ]
6. ‘play’ [wa̰ɻ]
7. ‘bone’ [kŭ tʰo̯ʊ̯]
8. ‘five’ [wŭ]
9. ‘fog’ [wù]
10. ‘belly’ [tû tsɨ]

(1) There was some confusion regarding [b̥], as it was not in the U of Washington’s Mandarin IPA inventory but rather an unaspirated [p] (e.g. ‘father’). I opened it on Praat (more in the acoustic analysis section) and the VOT confirmed was an unaspirated voiceless stop.

(2) The sound [ɕ] was confusable with the [ʂ] sound as well (e.g. ‘breast’). I tried to reproduce this word with other retroflex sounds and this seemed to be the closest match.

(3) The [ɽ] and [ɻ] sounds both seemed possible in this word’s transcription because [my speaker] tends to curl her tongue back more than average, so [ɻ] sounded backer than alveolar at times. I thought it seemed more like an approximant than a tap.

(4) and (5) are minimal pairs with contrasts in tone; note the unaspirated stop that made it sound like its voiced counterpart

(6) The UCLA archive and [my speaker] had both [wăɻ] and [wãn] for this word; she told me the latter was the standard way but she used [wăɻ] more often. I noticed that the [ɻ] sound brought the [a] back a little so I added the diacritic for retracted tongue root

(7) I wasn’t sure if it was the voiceless [g̊] or an unaspirated [k]; this was the same problem as discussed in (1) and I did a similar analysis on Praat to resolve this

(8) and (9) are minimal pairs with tone contrast

(10) The [ɨ] sound was not found in the U of W’s inventory but I thought the [i] was too front for this case.

Note: Sound Files in appendix

Vowels:

It was difficult telling vowels apart as well, mostly because of the different tones imposed upon them. I resolved this by trying to say the vowels with each possible tone to figure out which sounded the most similar to [my speaker's] recording. I encountered a lot of diphthongs in my transcription as well.

[i, y, (ɨ), u, ɤ, o, ə, ɛ, a, ɔ]

Diphthongs: [e͡ɪ, a͡ɪ, ə͡ʊ, a͡ʊ, o͡ʊ, o͡u, u͡o, i͡o, i͡ɛ]

The vowels I identified matched up with the U of Washington's inventory for the most part, which had the additional vowel [e]. This sound did not surface alone in my data except for in the diphthong [e͡ɪ], and when I asked [my speaker] if there were any sounds she pronounced with [e], she couldn't think of any. For my previous attempt for Part III, I read a few articles on the underlying representations of Cantonese vowels, one of which mentioned that [e, o] are only found in diphthongs. This matched my data set for the instance of [e] but not for [o], so I looked on the UCLA database for instances of [e] I could compare with my transcriptions (more in Part III).

I did not expect to find the [ɨ] sound because this was not in the U of W's inventory. However, [i] was too front so this seemed more accurate. I thought that it could be caused by articulation i.e. tongue pulled back from the near-retroflex [ɹ] in [ɹɨ] (more in my second acoustic analysis). This sound was found in other words in the UCLA Archive as well (although I couldn't find the transcription for this exact word).

Tones:

Because Mandarin is a tonal language, most of the words I transcribed had tones. The five tones I have identified are as follows: High, low, rising, falling, and toneless. In the Swaedish list, I was unable to find very many minimal pairs, but there was a distinction with 'big' and 'hit', 'five' and 'fog', and 'splash' and 'grandma' involving low, high, rising, and falling tones. It was difficult for me to identify the exact tone (I could hear a difference but I didn't know which it was), but I found that trying to reproduce the sounds with different tone options made it easier, as did tracing the pitch on Praat.

Vowel F1 and F2 Table

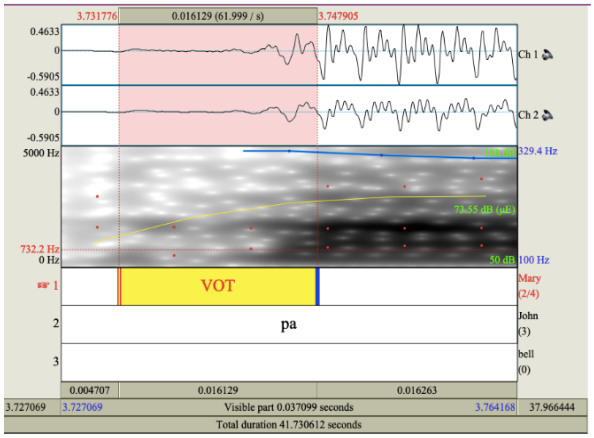
Vowel	F1	F2
[i]	299.11	2037.65

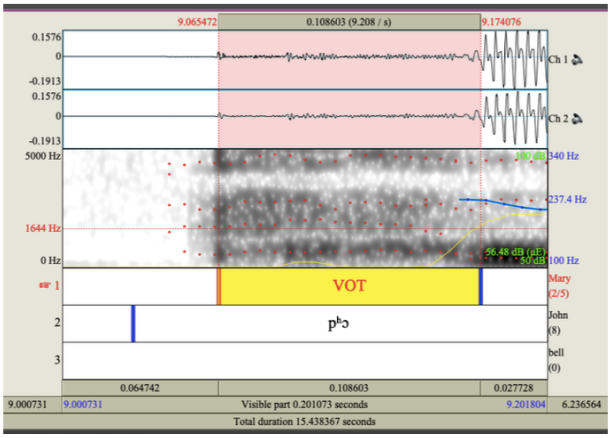
[y]	382.22	2235.54
[ɨ]	398.16	1938.03
[u]	351.87	925.88
[ɤ]	628.15	970.20
[o]	649.58	1090.22
[ə]	578.41	1317.40
[ɛ]	445.95	2080.32
[ɔ]	535.16	818.32
[a]	630.00	1567.18

The examples that I ran on Praat were all high tones.

The first aspect of acoustic analysis

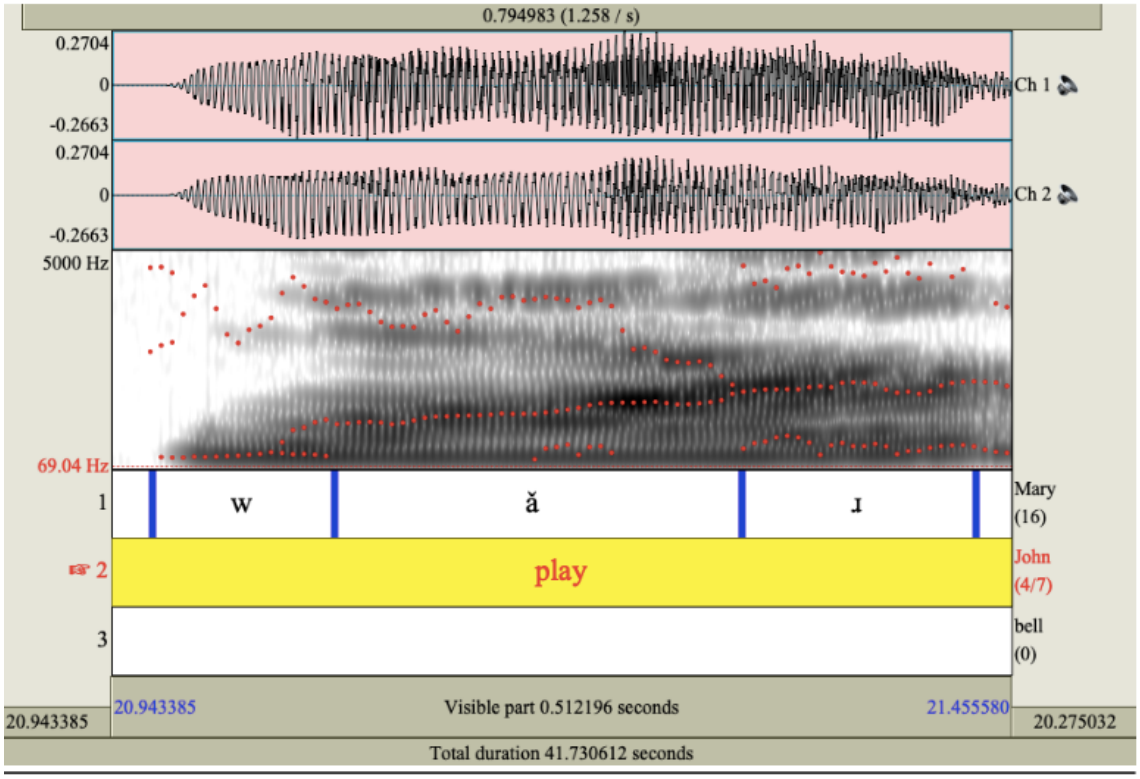
I will be measuring VOTs for the word ‘father’ and ‘grandma’. Initially I thought there was a [p] and [b] contrast, but after learning that [b] is not in the Mandarin consonant inventory, I was unsure whether it should have been [b̥] (which was in the UCLA archive) or an unaspirated [p]. To resolve this, I opened the word for ‘father’ on Praat and measured the VOT (first spectrogram), which was 16.1ms and confirmed that it was an unaspirated [p]. To put this into perspective, I also measured the VOT of ‘grandma’ which clearly sounded like an aspirated p (or just a regular p to me), and it was around 108.6ms. This is illustrated in the second spectrogram. I encountered similar problems with [t, k], and I opened them on Praat and found it was the same aspirated/unaspirated voiceless stop distinction.





The second aspect of acoustic analysis

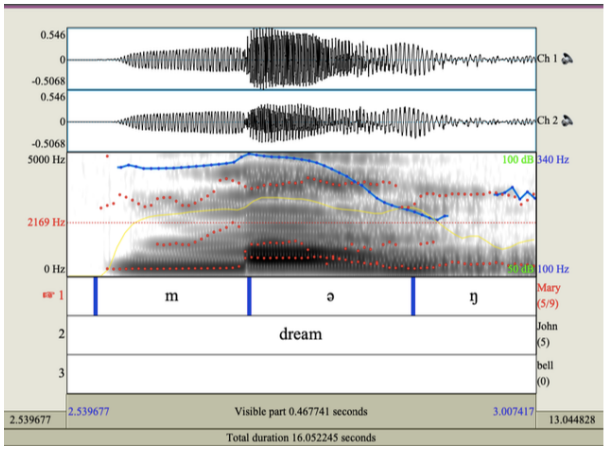
The second acoustic analysis I will be doing is on the effects of the [ɹ] sound. Because [my speaker] tends to curl her tongue back more than average, this causes the POA for [ɹ] to be backer than alveolar and closer to retroflex. I decided to see whether any retroflex place qualities show up on adjacent vowels, and I found an example in the word ‘play’. Her retroflex-like realization of the alveolar approximant is illustrated in the spectrogram below that shows a falling F3 and rising F2 in the vowel [a] before [ɹ]. This also shows that her [ɹ] has some retroflex qualities to it.

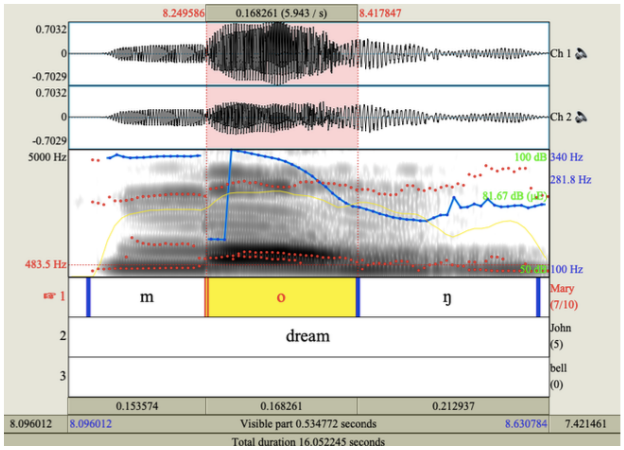


Creative Extension of Analysis:

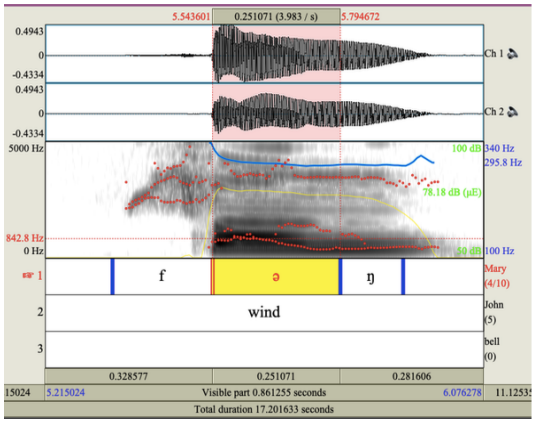
For this part of the paper, I decided to take a closer look at tone and vowel differences in Mandarin that might have been caused by [my speaker] Cantonese knowledge. When she gave me two options for pronunciation of the words ‘dream’, her way and the standard way, I noticed how similar her version sounded to the Cantonese word for ‘dream’. If I hadn’t known that, my methodology would have involved finding the Cantonese transcription of this word, because I am studying the effects of Cantonese on [my speaker’s] Mandarin in this paper. However, since I already know Cantonese (but not Mandarin), [my speaker[and I decided to work through this alternation together, as well as look for other similar alternations. We did this by rhyming the word and trying other tones to see if her alternation held. After that, we transcribed her pronunciation and compared it with the standard pronunciation (which she knew but did not do), as well as with the corresponding Cantonese word which we also transcribed. Lastly, we looked at the environments where these alternations happened as well as other possible causes.

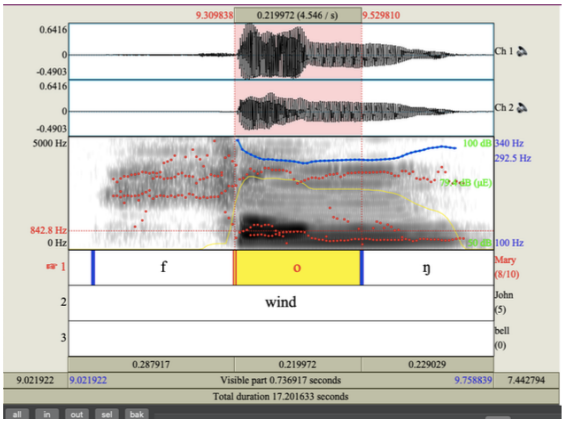
The first spectrogram is for the standard pronunciation, and the second is her pronunciation.





Here is another example ‘wind’. The left is the standard, the right is [my speaker’s] pronunciation. In both cases, the F2 is higher in schwa (standard).





There appears to be an alternation between schwa and [o] in Mandarin by Cantonese speakers in words that mean the same thing and are spelled the same way excluding the vowel (in IPA not Chinese). Wind in Cantonese is [fóŋ] which is the same as [my speaker’s] Mandarin pronunciation, and ‘dream’ in Cantonese is [moŋ]. We made a list other words (with the same IPA save the schwa/[o] alternation) in which [my speaker’s] pronunciation did not reflect the standard way.

We have a table illustrating the differences

	Standard Mandarin	Standard Cantonese	Tiffany’s Mandarin
懵	/mén/	/moŋ5/	/móŋ/
猛	/meŋ3/	/moŋ2/	/moŋ3/
梦	/meŋ4/	/moŋ6/	/moŋ4/
风	/fén/	/foŋ1/	/foŋ1/
逢	/feŋ2/	/foŋ4/	/foŋ2/
缝	/feŋ4/	/foŋ4/	/foŋ4/

Note that we typed [e] instead of schwa in the first column. Also Mandarin and Cantonese tone numbers are different i.e. Cantonese tone 4 is extra low, not Mandarin’s low tone

Conclusion

This vowel alternation is important for getting a more complete look of the Mandarin language because it shows that meaning plays a part in the phonetic realization of words, both within and across languages. For Cantonese speakers that speak Mandarin, the striking phonetic similarities between these words coupled with a shared meaning likely caused this alternation. Because Mandarin and Cantonese are similar languages and even share the same writing system, most speakers have at least a little knowledge of the other language. Part III is a good addition to Parts I and II of this paper because it shows that there are phonetic alternations both between and within languages that might not surface in the language's writing system (Chinese characters in this case) but do so when transcribed in the IPA. It leads to the question of what other alternations there are to be found, because a lot of these cross-linguistic changes are not shown in in writing but in speech; as a result, the IPA is relevant because it makes identifying and illustrating alternations such as these much easier.

There is an audio file for 'dream' and 'wind' with Standard Mandarin, [my speaker's] pronunciation, and the Cantonese word in the appendix as well.

Works Cited

Barrie, M. “Contrast in Cantonese Vowels”. *Toronto Working Papers in Linguistics*, Vol. 20, Jan. 2003, https://twpl.library.utoronto.ca/index.php/twpl/article/view/6229.

Handel, Zev, et al. “Chinese 342- University of Washington.” *Chinese 342*, courses.washington.edu/chin342/ipa/about.html.

Yu, Dominic. *The Underlying Representation of Cantonese Vowels*. 2000. Stanford University, Undergraduate Honors Thesis. linguistics.berkeley.edu/~dom/underlying_representation_cantonese_vowels.pdf.

2007. The UCLA Phonetics Lab Archive. Los Angeles, CA: UCLA Department of Linguistics. http://archive.phonetics.ucla.edu/.

Appendix A: Swaedish List Transcription

Gloss		IPA	
All		sŭo̯ jə̀u	
And		hɤ̌	
Animal		tòŋ wù	
Ashes		xue̯ɪ	
At		ts͡aɪ	
Back		hə͡ʊ mi̯ɛn	
Bad		xa̯ɪ	
Bark		fe̯i̯	
Because		jín we̯ɪ	
Belly		tû ts͡ɨ	

Big		tâ:	
Bird		niaȍ	
Bite		jaȍ	
Black		heí	
Blood		ɕʷɛ̌	
Blow		tɕʰʷeí	
Bone		kǔ tʰoʊ	
Breast		ɕíoŋ	
Breathe		xú ɕí	
Brother		ɕíoŋ tî	
Burn		ʂaǿ	

Child		xa͡ɪ t͡sɨ	
Clothing		fû t͡ʂuáŋ	
Cloud		jy̌n	
Claw		t͡ʂuǎ	
Cold		lôŋ	
Come		la͡ǐ	
Cook		t͡ʂǔ	
Count		ʃŭ	
Cut		t͡ɕɛn	
Dance		tʰia͡ǒ wǔ	
Day		ɹɨ	
Die		sə̌	

Dig		wá	
Dirty		t͡saŋ́	
Dog		ko͡ŏ	
Drink		xə́	
Dream		mòŋ	
		məŋ	
Dry		kán	
Dull		àn	
Eight		pʰá	
Eye		jɛ̌n	
Fall (Autumn)		t͡sʰó͡ŏ tʰién	
Far		jyɛ̌n	
Fat/grease		jo͡ŏ nì	

Father		pà pa	
Formal Father		fù t͡ɕin	
Fear		kʰǒŋ t͡sỳ	
Feather		jǔ mā͡ʊ	
Few		ɕia͡ʊ ɕy̌	
Fight		tǎ t͡ɕia	
Fire		xu͡ʷǒ	
Fish		jy̌	
Five		wǔ	
		wǔ͡o	
Float		fũ	
Flow		liʷǔ	
Flower		xuʷá	

Fog		wù	
Foot		t͡ɕa͡ʊ	
Four		sɨ̀	
Freeze		tò^{w}ŋ	
Fruit		ʃue͡ɪ ku͡o	
Full		măn	
Give		ke͡ɪ	
Good		ha͡ʊ	
Grass		ts^{h}a͡ʊ	
Green		lỳ	
Guts		ne͡ɪ ts^{h}àŋ	

Hair		t͡oʊ fă	
Hand		ʃo͡ŏ	
He		tʰá	
Head		tʰŏ͡ʊ	
Hear		tʰíŋ	
Heart		ɕín	
Heavy		t͡sòŋ	
Here		t͡ʂə lĭ	
Hit		tă	
Hold/take		nă	
Horn		t͡ɕa͡ʊ	
How		ɽŭ hă	

If		ʈǔ kǔo	
In		tsaĭ	
Kill		ʂá	
Knee		ɕí kàɪ	
Know		tsɨ́ taʊ	
Lake		hǔ	
Laugh		ɕiaʊ	
Leaf		jè	
Left		tsuo	
Leg		tʰueɪ	
Lie		pʰìɛn	

Live		hu̍o	
Liver		kán	
Long		tɕʰăŋ	
Man		nă̍n ʈə̆n	
Male		nă̍n ɕìŋ	
Many		tu̍o	
Meat/flesh		ʈo͡ʊ	
Moon		y̍ɛ	
Mother		mŭ tɕʰíŋ	
		má ma	
Mountain		ʃán	
Mouth		kʰŏ͡u	
Name		mĭŋ tsɨ	

Narrow		t͡ʂa͡ɪ	
Near		t͡ɕìn	
Neck		pʰu͡o t͡sɨ	
New		ɕín	
Night		jè wǎn	
Nose		pǐ	
Not		pǔ	
Spit		tʰù kʰo͡u ʂʷe͡ɪ	
Old		la͡ʊ	
One		jí	
Other		t͡ɕʰǐ tʰá	

Person		ʈə̆n	R
Play		wă1, wãn	back a?
Pull		lá	
Right		jo͡u	
River		hə̆	
Road		ta͡o lù	
Root		kə́n	
Rope		ʂə̆ŋ	
Rotten		fŭ làn	
Splash		pʰʷɔ́	
Sister		ts͡iɛ ts͡iɛ	
Grandma		pʰʷɔ̆	

Sound Files:

First 10 words, 2x each word
https://drive.google.com/file/d/1Bz3bblEUloJrcxMA3eamVyjx5BTrsjSj/view?usp=sharing

1. 'father' [pà pa]
2. 'breast' [ɕi͡oŋ]
3. 'day' [ɻɨ]
4. 'hit' [tă]
5. 'big' [tà]
6. 'play' [wa̰ɻ]
7. 'bone' [kŭ tʰo͡ʊ] (voiceless diacritic won't show up with [g])
8. 'five' [wŭ]
9. 'fog' [wù]
10. 'belly' [tû ts͡ɨ]

'Dream' and 'wind' in Standard Mandarin, [my speaker's] version, and Cantonese (you have to open it on Praat)

https://drive.google.com/file/d/1qq_1_z62sM9r5Xhi94W7bJUV2IgazN2C/view?usp=sharing