

# VOWEL TYPOLOGY IN CHINESE

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## ABSTRACT

This paper presents the typological facts about the vowels, vowel systems, and nasal vowels in the Chinese dialects. Nine vowel systems are identified. The size of the vowel systems of the 86 sample dialects ranges from three to eleven. The 7-vowel system is most frequent. The next most frequent systems are the 6-, 8-, 9-, and 5-vowel systems. 3-, 4-, 10-, and 11-vowel systems are uncommon. The most frequent vowel phonemes are /i u a y/, to be followed by /o e ɔ ε ɿ ɤ ɶ œ ə ʊ ɒ ɥ ɸ ð ɪ ʏ/ in descending order of frequency. The findings are discussed in terms of the principle of maximal vowel dispersion and defective vowel system. As for the nasal vowels, /ã/ is most frequent, to be followed by /ɔ̃ ẽ ã æ õ ẽ̃ ĩ ù ẽ̃ ẽ̃ ỹ ɸ̃ ɸ̃/ in descending order of frequency. The vowel systems of the Chinese dialects are basically consistent with the principle of vowel dispersion. The high frequency of /y/, the low frequencies of /ĩ ù/, and the common appearance of /ɿ/ are characteristic of the vowel inventories in Chinese.

**Keywords:** Vowel typology; typology of vowel system; nasal vowels; Chinese dialects

## 1. INTRODUCTION

[1] and [6] are two well-known publications of typology and universals of vowel systems of the languages of the world. [1] is based on a representative sample of 209 languages developed by the Stanford Phonology Archiving Project, and [6] on the UCLA Phonological Segment Inventory Database (UPSID) including the inventories of the sound systems of 317 languages. Both report that a contrast between five basic vowels is the norm for the sound systems of languages and the smallest number of vowel phonemes of any languages is three. They differ in the largest number of vowel phonemes. In [1] it is 12, but 24 in [6].

The present study is a typological investigation of the vowels, vowel systems, and nasal vowels in the Chinese dialects. The phonological systems of the Chinese dialects are certainly not as diverse as those of the languages of the world. However, the differences in the sound systems among the Chinese dialects are very considerable ([7]), due to prolonged separation and isolation as a result of geographical

barriers. In fact, the Chinese spoken by over a billion Chinese has been regarded as an abstraction that covers a number of mutually unintelligible forms of speech ([2]), for instance, a native of Shanghai and a native of Xiamen (Amoy) cannot understand what the other says in his own forms of speech.

## 2. PROCEDURE

In this study, an areally and genetically balanced representative sample of 86 Chinese dialects was constructed. Ten geographically distant dialects were selected from each one of the seven major Chinese dialect families, *Mandarin Chinese* (or *Northern Chinese*) (*MC*), *Min* (*M*), *Wu* (*W*), *Kejia* (or *Hakka*) (*K*), *Yue* (*Y*), *Gan* (*G*), and *Xiang* (*X*), and five or three were selected from the minority dialect families, *Jin* (*J*), *Hui* (*H*), *Ping* (*P*), and *Tu* (*T*). The selection was based on the information about distribution and classification of the Chinese dialects spoken in China which is detailed in the *Language Atlas of China* ([9]). The breakdown of the 86 dialects by dialect family is shown in Table 1.

**Table 1:** The breakdown of the 86 Chinese dialects by dialect family.

<i>MC</i>	<i>M</i>	<i>W</i>	<i>K</i>	<i>Y</i>	<i>X</i>	<i>G</i>	<i>J</i>	<i>H</i>	<i>P</i>	<i>T</i>
10	10	10	10	10	10	10	5	5	3	3

The ten *Mandarin Chinese* dialects were selected from 7 regional sub-groups, with one dialect from each of the following four sub-groups, City of *Beijing*, Northwestern, Central Eastern Coastal (or *Jiang-Huai*), and Northeastern Coastal (or *Jiao-Liao*), and two from each of the following three sub-groups, Northeastern, Southwestern, and Central.

The main source material consulted was *Fangyan*, a journal of the Chinese dialects, published by the Institute of Linguistics at the Chinese Academy of Social Sciences (*Beijing*). The other sources include dialect survey reports and monographs. As the descriptions of the sounds in all the publications are phonetic rather than phonemic, standardized phonemic analyses were carried out for all the 86 selected dialects. As the vowels and nasal vowels concerned occur in the CV and C $\tilde{V}$  monosyllables, the phonemic analyses were uncomplicated. In Chinese, there are the so-called ‘apical vowels’. These vowels are syllabic approximants produced

with the tip of the tongue positioned under the alveolar ridge or post alveolar region. Phonologically they function as vowel nuclei in the CV syllables. The four types of the apical vowels (represented here with the non-IPA symbols [ɿ ʮ ʮʮ] ([8])) found in the Chinese dialects are [ɿ] (plain apical vowel), [ʮ] (retroflex apical vowel), [ʮʮ] (rounded plain apical vowel), and [ʮʮ] (rounded retroflex apical vowel). An apical vowel can be a phoneme or an allophone, for instance, in *Meixian (Kejia)*, /i/ and the apical vowel /ɿ/ are phonemes, as both of them occur after /s ts tsʰ/ in the CV syllables. In *Beijing Mandarin*, the apical vowels [ɿ ʮ] are analyzed as the allophones of /i/, as /i/ occurs after all the initial consonants except /s ts tsʰ sʃ tsʃʰ/, whereas [ɿ] occurs only after /s ts tsʰ/ and [ʮ] only after /sʃ tsʃʰ/.

3. RESULTS AND DISCUSSION

As shown in Table 2, of the 86 sample dialects, 9 phonemic vowel systems are identified in terms of number of vowels. The smallest size of the vowel system is 3 and the largest is 11. The 7-vowel system is most frequent. The number of the dialects with 7 vowels is 22, which accounts for 25.6% of the sample dialects. The next most common systems are 6-, 8-, 9-, and 5-vowel systems and the numbers of the dialects with these systems are 17, 16, 12, and 9, respectively, which account for 62.8% of the sample dialects. The least common systems are the 3-, 4-, 10- and 11-vowel systems, which account for 11.6% of the sample dialects. The 3-vowel system is rare as only a single dialect has it as the vowel system. Thus, the systems with less than five vowels or more than nine vowels are uncommon in Chinese.

Table 2: Nine phonemic vowel systems and the number of the dialects with given number of vowels.

Vowel Systems	3	4	5	6	7	8	9	10	11
No. of Dialects	1	2	9	17	22	16	12	3	4
%	1.2	2.3	10.5	19.8	25.6	18.6	14.0	3.5	4.7

As shown in Table 3, a total of 75 different types of the 9 vowel systems are found in the 86 sample dialects, with the vowel phonemes in the systems numbering from 3 to 11. A single type of 3-vowel system /i a i/ is found in a single dialect, *Yongding (Kejia)*. Such a vowel system is considered defective, as one of the point vowels, /u/, is lacking, thus violating the principle of maximal vowel dispersion for not exploiting the vowel space to the maximum ([3]). Apart from being rare in Chinese, the system /i a i/ is not found in the languages of the world referred to in [1], nor predicted by [4] and [5]. Historically, /i/ in *Yongding* has evolved from /u/. The change from a perfectly balanced system of /i a u/ to a defective one /i a i/ involves a reduction of the

number of the primary peripheral vowels from three to two, contradicting the principle of maximal vowel dispersion ([3]), though the vowel system /i a i/ supports the observations that in the defective vowel systems the missing vowel is “generally /e/, /o/, or /u/, never /i/” ([1]: 108) and “... the vowel /u/ is more often absent than /i/ or /a/” ([6]: 134).

Table 3: Types of the vowel systems of the 86 sample dialects; number of dialects and dialect family in parentheses.

Vowel Systems	Vowel Phonemes of the (C)V Syllables	
3-vowel (1 type; 1 dialect)	/i a i/ (1; K)	
4-vowel (1 type; 2 dialects)	/i a ɔ u/ (2; Y, K)	
5-vowel (6 types; 9 dialects)	/i e a o u/ (4; K, M, M, MC)	/i e a ɔ u/ (1; Y)
	/i e a ɔ u/ (1; Y)	/i a u y ɿ/ (1; K)
	/i e a o u/ (1; Y)	/i a u y ə/ (1; J)
6-vowel (12 types; 17 dialects)	/i e a o u y/ (3; Y, X, G)	/i e a ɔ u y/ (1; K)
	/i e a o u ɿ/ (1; K)	/i a ɔ u y ə/ (1; G)
	/i e a o u ɔ/ (1; M)	/i a o u y ə/ (1; G)
	/i e a o u e/ (1; M)	/i a ɔ u y ɿ/ (2; T, K)
	/i e a o u ʮ/ (1; G)	/i a ɔ u y ə/ (1; K)
	/i e a o u ɿ/ (2; G, K)	/i a u y ɿ ə/ (2; MC, J)
7-vowel (20 types; 22 dialects)	/i e a o u y ə/ (1; X)	/i e a o u y ə/ (1; G)
	/i e a o u y ə/ (1; X)	/i e a o u y ə/ (1; W)
	/i e a o u y ɔ/ (2; W, M)	/i e a o u y ə/ (1; X)
	/i e a o u y ɿ/ (1; X)	/i e a o u y ə/ (1; W)
	/i e a o u y ə/ (1; X)	/i e a o u y ɔ/ (1; MC)
	/i e a o u y ə/ (1; G)	/i e a o u ʮ ə/ (1; MC)
	/i e a o u ə ə/ (1; P)	/i e a ɔ u y ə/ (2; Y, Y)
	/i e a ɔ u y e/ (1; J)	/i e a ɔ u y u/ (1; MC)
	/i e a ɔ u y ə/ (1; P)	/i a o u y ə ɿ/ (1; G)
	/i e a ɔ u e ɿ/ (1; M)	/i a o u y ɿ ə/ (1; MC)
8-vowel (16 types; 16 dialects)	/i e a o u y ə ɔ/ (1; M)	/i e a o u y ə ɿ/ (1; T)
	/i e a o u y u ə/ (1; M)	/i e a ɔ u y ə ɿ/ (1; Y)
	/i e a o u y u ə/ (1; X)	/i e a ɔ u ʮ ə ɿ/ (1; G)
	/i e a o u y e ə/ (1; X)	/i e a ɔ u y ɿ u/ (1; MC)
	/i e a o u y ɿ ə/ (1; X)	/i e a o u y ɿ ə/ (1; W)
	/i e a o u y ɔ ə/ (1; Y)	/i e a o u y ɿ u ɿ/ (1; K)
	/i e a ɔ u y ə ɿ/ (1; T)	/i a o u y ɿ ɿ ə/ (1; MC)
	/i e a o u y ə ɔ/ (1; Y)	/i a ɔ u y ə ə ə/ (1; J)
9-vowel (12 types; 12 dialects)	/i e a o u y ɔ e ə/ (1; M)	/i e a o u y u ɿ ɿ/ (1; W)
	/i e a o u y e ə ə/ (1; W)	/i e a o u y ə ɔ ɿ/ (1; G)
	/i e a o u y ɔ e ɿ/ (1; H)	/i a o u y ə ɔ ɿ ə/ (1; J)
	/i e a o u y ɔ ə ə/ (1; P)	/i a o u y ɿ ɔ ə ɿ/ (1; H)
	/i e a ɔ u y ə ə ɿ/ (1; H)	/i a o u y ɿ ɔ ə ɿ/ (1; X)
	/i e a ɔ u y ə ə ɿ/ (1; MC)	/i a ɔ u y ə u ə ɿ/ (1; MC)
10-vowel (3 types; 3 dialects)	/i e a o u y ə e ɔ ɿ/ (1; W)	
	/i e a o u y ə e ɔ ə/ (1; M)	
	/i e a o u y ə e ɔ ɿ/ (1; W)	
11-vowel (4 types; 4 dialects)	/i e a o u y u ə e ɿ ɿ/ (1; W)	
	/i e a o u y e ɿ ɿ ə ɿ/ (1; H)	
	/i e ɔ u y u ə e ə/ (1; W)	
	/i e a o u y ə ɿ ɿ ɿ/ (1; H)	

All the 86 sample dialects, except one, have /i a u/, /i a u/, or /i ɔ u/. This is consistent with the claims made in the past studies of the universals of vowel systems that “All languages have /i a u/” ([1]: 115) and “/i a u/ are the most widespread” ([6]: 125).

A single type of the 4-vowel system /i a u ɔ/ is found in only two dialects, *Taishan (Yue)* and *Lian-*

*Jiang-Shi-Jiao (Kejia)*. The vowel system is regarded as defective ([3]), as a major region of periphery of the vowel space, mid-front, is left empty. The system is not predicted by [4] and [5], but it resembles the observed systems /i u a o/ in [5] and /i a u o/ in [1]. A 4-vowel system with a missing mid-front vowel is also reported in [3], i.e., a 4-vowel system of Bardi in which the single mid vowel is /o/.

There are 15 dialects with a system of 4 or more vowels that consists of /i a u ə/, /i a u o/, /i a u ə/, or /i a u o/, but not /e/ or /ɛ/, and there is a single dialect with a vowel system that consists of /i a u ɛ/, but not /o/ or /ɔ/. Thus in the Chinese dialects if a primary peripheral mid vowel is lacking in a vowel system, it is usually an unrounded mid front vowel /e/ or /ɛ/, rather than a rounded mid back vowel /o/ or /ɔ/.

Six types of the 5-vowel systems are found in nine dialects. Four of the six types, i.e., /i e a o u/, /i e a ə u/, /i e a o u/, and /i e a ə u/ consist of the primary peripheral triangular vowels. The triangular pattern is explained by the theory of maximal vowel dispersion, in that all the five major regions along the periphery of the vowel space are filled with a vowel ([3]). The other two types of the 5-vowel system /i a u y ɿ/ and /i a u y ə/ are not considered as defective despite the lack of primary peripheral mid vowels, as “a high or mid region may be left empty without being considered as a gap so long as no other peripheral vowel in the system has a similar value on the height scale” ([3]: 142).

An examination of the vowel systems with 5 or more vowels in Table 3 shows that 64 (74.4%) of the 86 sample dialects consist of one of the four patterns of the five maximally dispersed peripheral vowels, /i e a o u/, /i e a ə u/, /i e a o u/, and /i e a ə u/. These vowels may be regarded as the foundation vowels of the vowel systems with 5 or more vowels. Systems larger than 5 vowels may be constructed by adding to the foundation vowels one or more primary peripheral mid vowels /e ɛ o ə/ and the vowel systems may further expand by adding an apical vowel /ɿ/ or /ʮ/, one or more the secondary peripheral vowels /y ø œ u ɤ/ and interior vowels /ə ə ɐ ɨ ʏ/.

The high front rounded /y/ though not a primary peripheral vowel is frequent. As shown in Table 3, 66 (76.7%) of the 86 sample dialects with a vowel system larger than four vowels have /y/. The distribution of /y/ among the vowel systems of different sizes is as follows: 2 (22.2%) of the 9 dialects with the 5-vowel system, 11 (64.7%) of the 17 dialects with the 6-vowel system, 19 (86.4%) of the 22 dialects with the 7-vowel system, and 34 (97.1%) of 35 dialects with the 8-, 9-, 10-, and 11-vowel systems have /y/. The frequency of /y/

increases with an increase in the size of the vowel system.

Table 4 shows the distribution of the vowel systems of different sizes by dialect family. The vowel systems of the *Kejia* dialects on average have a smaller number of vowels (5.5) than the vowel systems of the other dialects. Those of the *Hui* dialects have the largest number of vowels (9.8). Those in between are *Yue* (6.3), *Gan* (6.8), *Jin* (7.0), *Min* (7.1), *Tu* (7.3), *MC (Mandarin Chinese)* (7.3), *Xiang* (7.4), *Ping* (7.7), and *Wu* (8.9) in ascending order of the average size of the vowel systems. Comparatively the vowel systems of the *Yue* dialects are considered small, and those of the *Wu* dialects are considered large.

**Table 4:** The distribution of the vowel systems of different sizes by dialect family; average size in parentheses.

Dialect Family	Size and Frequency of Vowel System
<i>Kejia</i>	3, 4, 5, 5, 6, 6, 6, 6, 8 (5.5)
<i>Yue</i>	4, 5, 5, 5, 6, 7, 7, 8, 8, 8 (6.3)
<i>Gan</i>	6, 6, 6, 6, 6, 7, 7, 7, 8, 9 (6.8)
<i>Jin</i>	5, 6, 7, 8, 9 (7.0)
<i>Min</i>	5, 5, 6, 6, 7, 7, 8, 8, 9, 10 (7.1)
<i>Tu</i>	6, 8, 8 (7.3)
<i>MC</i>	5, 6, 7, 7, 7, 7, 8, 8, 9, 9 (7.3)
<i>Xiang</i>	6, 7, 7, 7, 7, 7, 8, 8, 8, 9 (7.4)
<i>Ping</i>	7, 7, 9 (7.7)
<i>Wu</i>	7, 7, 7, 8, 9, 9, 10, 10, 11, 11 (8.9)
<i>Hui</i>	9, 9, 9, 11, 11 (9.8)

**Table 5:** Frequencies of the 22 vowel phonemes of the vowel systems of the 86 sample dialects.

Vowel	/i/	/u/	/a/	/y/	/o/	/e/	/ɔ/
Frequency	86	85	76	66	57	41	41
%	100	98.8	88.4	76.7	66.3	47.7	47.7

  

Vowel	/ɛ/	/ɿ/	/ʮ/	/ə/	/æ/	/ɑ/	/ɔ/
Frequency	38	23	18	15	13	11	11
%	44.2	26.7	20.9	17.4	15.1	12.8	12.8

  

Vowel	/æ/	/ə/	/u/	/ɒ/	/ʮ/	/ə/	/i/	/y/
Frequency	10	10	9	4	3	3	1	1
%	11.6	11.6	10.5	4.7	3.5	3.5	1.2	1.2

Table 5 shows the frequency of the 22 vowel phonemes of the vowel systems of the 86 sample dialects. The most frequent vowel phonemes are the point vowels, /i/ (100%), /u/ (98.8%), and /a/ (88.4%) as well as /y/ (76.7%), to be followed by /o/ (66.3%), /e/ (47.7%), /ɔ/ (47.7%), /ɛ/ (44.2%), /ɿ/ (26.7%), /ʮ/ (20.9%), /ə/ (17.4 %), /æ/ (15.1%), /ɑ/ (12.8%), /æ/ (11.6%), /ə/ (11.6%), /u/ (10.5%), /ɒ/ (4.7%), /ʮ/ (3.5%), /ə/ (3.5%), /i/ (1.2%), and /y/ (1.2%) in descending order of frequency. Thus, the more common vowels include /i a u y/ and those in the mid range /o e ə ɛ/. The other vowels are either

less common (/ɿ ʏ ə œ ø æ ʊ/) or rare (/ɔ ʧ θ ð ɪ ʏ/). The vowel data presented here are similar to what has been reported in [6] which is based on the UPSID sample of 317 languages of the world, for instance, /i/ (91.5%), /a/ (88.3%), /u/ (83.9%), /"o"/ (43.8%), /"e"/ (37.3%), /ɛ/ (37.2%), /o/ (34.4%), /e/ (31.5%), /ɔ/ (31.2%), with /"o"/ and /"e"/ representing the mid vowels and /o/ and /e/ the higher mid vowels.

**Table 6:** Nasal vowel phonemes and the (oral) vowel systems; dialect family in parentheses.

(Oral) Vowel Systems (Size: 5-11)	Nasal Vowel Phonemes
5   <i>ī e a o u</i> / (M)	/i ē ā ō ū/
6   <i>ī e a o u</i> ɔ / (M) <i>ī e ɔ u y</i> æ / (K) <i>ī a u y ɿ ə</i> / (J) <i>ī e a ɔ u y</i> / (X)	/i ē ā ɔ /
	/ē ā ɔ /
	/æ ɔ /
	/ā /
7   <i>ī e a o u</i> æ ə / (P) <i>ī e a o u y</i> ɔ / (W) <i>ī e a o u y ɿ</i> / (X) <i>ī e a o u</i> ε ɿ / (M) <i>ī e a o u y</i> ʉ / (MC) <i>ī e a o u y</i> a / (W) <i>ī e a o u y</i> ε / (J) <i>ī e a o u y</i> ə / (X) <i>ī e a ɔ u y</i> ø / (W) <i>ī e a o u y</i> ɔ / (MC)	/ē ā ō ū æ /
	/ē ā æ ə /
	/ē ā ɔ /
	/ā ɔ ə /
	/ā ɔ /
	/ū ɿ /
	/ē /
	/ɔ /
	/æ /
	8   <i>ī e a o u y</i> œ ɿ / (T) <i>ī e a ɔ u</i> ʧ œ ɿ / (G) <i>ī e a o u y ɿ</i> ʉ / (MC) <i>ī e a o u y ɿ ə</i> / (X) <i>ī e a u y ɿ ʉ</i> / (K)
/ē ā ɔ /	
/ē ā ɔ /	
/ā /	
9   <i>ī e a o u y</i> ɔ æ ø / (P) <i>ī a o u y ɿ</i> ɔ ø ɿ / (H) <i>ī e a ɔ u y</i> a ɿ / (H) <i>ī e a ɔ u y</i> ə ɿ ɿ / (MC) <i>ī a o u y ɿ</i> ɔ æ ɿ / (X) <i>ī e a o u y</i> æ ɔ ɿ / (G) <i>ī e a o u y</i> ʉ ɿ ɿ / (W) <i>ī e a o u y</i> ɔ ε ɿ / (H)	/i ē ā ō ū ø æ /
	/ē ā ɔ /
	/ā ɔ ā /
	/ē ā /
	/ā ā /
	/œ æ /
	/ā /
	/ɔ /
10   <i>ī e a o u y</i> ø ε ɔ ɿ / (W) <i>ī e a o u y</i> ø ε ɔ ɿ / (W)	/ā ū ɔ /
	/ā ā /
11   <i>ī e a o u y</i> ø ɿ ɔ ɿ / (H) <i>ī e ɔ u y</i> ʉ ø ε æ ə / (W) <i>ī e a o u y</i> ʉ ø ε ɿ ɔ / (W)	/i ā ɔ ɿ ɿ /
	/ā ɔ œ æ /
	/ā ɔ /

Table 6 shows the nasal vowel phonemes of any (oral) vowel systems with given number of (oral) vowels. A number of observations can be made: (i) 33 (38.4%) of the 86 sample dialects have a contrast of oral and nasal vowels; (ii) the number of the nasal vowel phonemes in the dialects ranges from 1 to 7; (iii) no nasal vowels are found in vowel systems with three or four vowels; (iv) in any of the vowel systems the number of nasal vowels is smaller than the number of oral vowels; (v) the frequency of the nasal vowels is lower than that of the equivalent oral vowels; (vi) all the nasal vowels are peripheral vowels with the exception of /ɔ̃/, and there are no nasal apical vowels; and (vii) unlike the oral vowel

phonemes, there is no patterning of the nasal vowels, which may indicate that the nasal vowel inventories are either not structured or structured according to the principles that are different from those which apply to oral vowel systems.

Table 7 shows the frequency of the 15 nasal vowel phonemes found in 33 (38.4%) of the 86 sample dialects. The most frequent nasal vowel is /ā/, to be followed by /ɔ̃ ē ā æ ō ẽ ı ū ɔ̃ / in descending order of frequency. The frequencies of /œ ɿ ɿ ø ɔ̃ / are low and all under four. Thus the most common nasal vowels are non-high vowels. A comparison of Table 5 and Table 7 shows that the nasal vowel frequency is not correlated with the frequency of the equivalent oral vowels.

**Table 7:** Frequencies of the 15 nasal vowel phonemes in 33 of the 86 sample dialects.

Nasal Vowel	/ā/	/ɔ̃/	/ē/	/ā/	/æ/	/ō/	/ẽ/	/ı/
Frequency	22	11	8	8	7	7	6	5
%	66.7	33.3	24.2	24.2	21.2	21.2	18.2	15.2

Nasal Vowel	/ū/	/ɔ̃/	/œ/	/ɿ/	/ɿ/	/ø/	/ɔ̃/
Frequency	4	4	2	2	1	1	1
%	12.1	12.1	6.1	6.1	3.0	3.0	3.0

#### 4. CONCLUSION

The typological data in this study show that the vowel systems of the Chinese dialects are basically consistent with the principle of vowel dispersion. The higher frequency of /y/ than those of /e ε o ɔ/, the lower frequencies of /ı ū / than those of /ē ẽ ō ɔ̃/, and the fairly common appearance of /ɿ/ are characteristic of the vowel inventories in Chinese.

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