

Yiya Chen

Leiden University Centre for Linguistics (LUCL) & Leiden Institute for Language and Cognition (LIBC)

yiya.chen@hum.leidenuniv.nl

Carlos Gussenhoven

Centre for Language Studies, Radboud University Nijmegen

c.gussenhoven@let.ru.nl

Shanghai Chinese (Shanghainese; 上海话) is a Wu dialect (ISO 639-3; code: wuu) spoken in the city of Shanghai (CN-31), one of the four municipalities in the People's Republic of China. Over the last century, the dialect has been heavily influenced by neighbouring dialects spoken in the provinces of Jiangsu and Zhejiang, such as Jianghuai Mandarin (江淮官话), the Suzhou Wu dialect (吴语苏州话), and the Ningbo Wu dialect (吴语宁波话), in addition to two other, more distant dialects, Cantonese (广东话) and Northern Mandarin (北方官话). Most native speakers of Shanghai Chinese are in fact descendants of immigrants from Jiangsu and Zhejiang provinces who moved to Shanghai in the late nineteenth and early twentieth century. More recently, the position of Shanghai Chinese has been eroded with the influx of immigrants from other parts of the country and the widespread adoption of Standard Chinese. Today, virtually all speakers also speak (Shanghainese-accented) Standard Chinese. There has been considerable research on the synchronic and diachronic changes of the dialect. Representative works include Xu & Tang (1962) on socially stratified variation in Shanghainese; Qian (2003) and Hu (2003), which provide detailed accounts of the evolution of Shanghainese over the last century; Liu (2004), which focuses on the sound structure of Shanghainese and attempts to trace its historical development; Shi & Jiang (1987), which reports significant individual variation among speakers of broadly similar age (born between 1928 and 1948); Xu, Tang & Tang (1982) on synchronic variation in Shanghai Chinese; and Xu, Tang & Tang (1988), which investigates variation among three generations of ten families (grandparents: born between 1807 and 1915; parents: 1930–1948; and children: 1967–1968).

Shanghai Chinese is generally understood to be the modern dialect spoken in the urban districts that were recognized as the city centre of Shanghai before the incorporation of various surrounding suburbs and towns into the municipality since the 1980s. The dialect is therefore also known as 上海闲话, the 'Shanghai urban variety', as opposed to 本地闲话, the 'Shanghai suburban variety' (see Xu & Tao 1997 for further details and You 2010 for a detailed survey of the sound system changes in suburban varieties). The commonly recognized first attempt at a systematic description of Shanghai Chinese is Edkins (1853). Since the beginning of the 20th century, various aspects of the sound structure of Shanghai Chinese have been investigated,

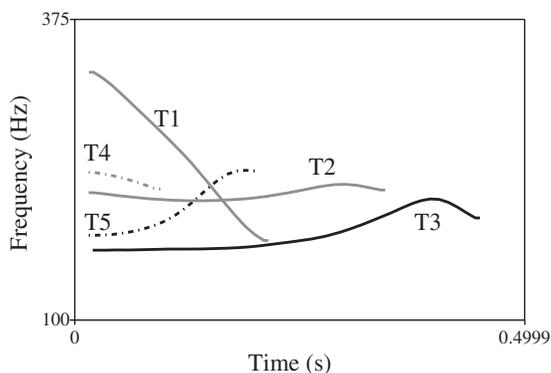


Figure 1 f0 tracks of the morphemes /tɔ¹/ 'knife', /tɔ²/ 'island', /dɔ³/ 'peach', /tu⁴/ 'to supervise', and /du⁵/ 'to read' exemplifying the five lexical tones.

with some providing an overview (e.g. Chao 1928, Sherard 1972, Xu & Tang 1988, Xu & Tao 1997), some addressing segmental properties (e.g. Ren 1992, Shen, Wooters & Wang 1987, Ping 2005, and Z. Chen 2010 on consonant production; Svantesson 1989 and Chen 2008a on vowels), and most focusing upon lexical tone and tone sandhi (e.g. Zee & Maddieson 1980; Shen 1981a, b, 1982, 1985; Xu, Tang & Qian 1981, 1982, 1983; Jin 1986; Rose 1993; Zhu 1999; Z. Chen 2007; Chen 2008b). Shanghai Chinese has also been taken as an important case language in the development of phonetic and phonological theories of tone realization (e.g. Selkirk & Shen 1990; Duanmu 1995, 1997, 1999; M. Chen 2000; Yip 2002; Chen 2011) and syllable structure (e.g. Duanmu 1994, 2008).

The present description is accompanied by recordings of a female native speaker who was born in the 1950s and grew up in the Huangpu District. According to Xu & Tao (1997), she belongs to the Middle Generation Shanghainese group of speakers (市区中派方言), those born roughly around 1940–1965.¹ She has lived mostly in the Netherlands since 1989, but visits Shanghai regularly. She speaks mainly Shanghai Chinese at home. Our motivation for the present account is not only to bring together existing descriptions of Shanghainese in an accessible form, but also to propose a number of analytical innovations relative to traditional treatments of the Shanghainese data. These are: (i) the analysis of prevocalic glottal stop [ʔ] and voiced [ɦ] as allophonic features of onsetless syllables conditioned by tone; (ii) the rejection of [i] or [j] in diphthongs/triphthongs following the alveolo-palatal obstruents; (iii) the rejection of a fricative vowel symbol in favour of a syllabic fricative; (iv) the absence of a contrastive palatal nasal; and (v) the interpretation of the front rounded glide as allophonic.

Lexical tone

Shanghai Chinese has evolved from the eight-tone system recorded in Edkins (1853) to the current five-tone system (Qian 2003). Figure 1 illustrates the f0 contours of the five tones (T1–T5) uttered in isolation (i.e. /tɔ¹/ 'knife', /tɔ²/ 'island', /dɔ³/ 'peach', /tu⁴/ 'to supervise/check', and /du⁵/ 'to read') by our female speaker.²

¹ Speakers born around the 1920s are classified as speakers of Old Generation Shanghainese, while speakers born after 1965 are taken to speak New Generation Shanghainese. This classification is mainly based upon the investigation reported in Xu, Tang & Tang (1988) on Shanghainese spoken by 30 speakers from ten families of three generations. More recently, Gu (2004) has investigated speakers born after 1969, and found further changes among the younger generation, mainly due to the influence of Standard Chinese.

² In contrast to Zee (1999) and Lee & Zee (2003, 2009), we do not use the Chao tone letters, one of the notations recommended by the IPA, mainly because their iconic character becomes largely meaningless

Researchers vary greatly in the conventions of numerical values used to describe the pitch contours of the five tones. For example, Xu & Tang (1988), a classic description of Shanghai Chinese, adopts the five-scale pitch system developed by Chao (1930), which divides a speaker's pitch range into five levels with 5 indicating the highest end and 1 the lowest. T1–T5 are transcribed as 53, 34, 23, 55, and 12, respectively.³ Strictly speaking, this system does not accurately reflect the f₀ contours plotted in Figure 1 (even with non-linear transformation of the f₀ values). This discrepancy is an indication of the considerable variation in pronunciation that exists both within the same generation of Shanghainese speakers as well as across generations, as is also evident in the various transcriptions offered by other researchers (e.g. Zee & Maddieson 1980 [T1: 51, T2: 34, T3: 14, T4: 5, T5: 14];⁴ Shen 1981b, 1985 [T1: 52, T2: 334/34, T3: 113/13, T4: 4/5, T5: 23]; Zhu 1999 [T1: 41ⁱ, T2: 23ⁱ, T3: 14^a, T4: 33ⁱ, T5: 24^a] with ⁱ indicating high pitch register and ^a indicating low pitch register).⁵

At a more abstract level, these transcriptions converge on the basic f₀ patterns of the lexical tones. T1 is a Falling tone, while T2 starts at a high register with a rise towards the end and can be termed high Rising. T4 shows a high and slightly falling f₀. It has a short duration and sounds like a high-level pitch. Hereafter, we will refer to it as a short High tone. These three tones all start within the relatively higher f₀ range, traditionally known as the *Yin* (阴) register tones. T3 is a low Rising tone and T5 is a low Rising tone with the same relatively short duration as T4. T3 and T5 start within a low f₀ range, traditionally known as the *Yang* (阳) register tones. Note that both tones end with a quite high pitch level. In other words, tonal register in Shanghainese is evident in the beginning part of the tonal contours, indicating that it is in part governed by the laryngeal specification of the onset consonant. T4 and T5 only occur in syllables closed by a glottal stop and are known as *Rusheng* (入声), as opposed to the other three tones, which are known as *Shusheng* (舒声). Because of this set of complex tone–segment/rime co-occurrence patterns, tonal contrasts in Shanghai Chinese have been argued to be syllable-level contrasts (e.g. Zee & Maddieson 1980, Zhu 1999). In multisyllabic constituents, lexical tones contrast only in the initial syllable of a tone unit and thus neutralize in non-initial positions. (See the sections on syllable structure and tone contrasts below for more details.)

Consonants

	Bilabial	Labio-dental	Alveolar	Alveolo-palatal	Palatal	Velar	Glottal
Plosive	p ^h p b		t ^h t d			k ^h k g	ʔ
Affricate			ts ^h ts	tɕ ^h tɕ dz			
Nasal	m		n			ŋ	
Fricative		f v	s z	ɕ ʑ			h
Approximant	w				j		
Lateral approximant			l				

when words are combined into phrases, as in the transcription of the recorded passage. For isolated citation pronunciations of monosyllables, three tone letters would be usable (1↓ for Tone1, 1 for Tone4, 4↓ for Tone3 and Tone5, and 4↓ for Tone2, to be placed after the syllable), although the iconicity is compromised by variations in pitch levels and additional and more realistic symbols could be devised (see also Maddieson 1999).

³ Xu & Tang (1988: 8) notated the actual realization of the five lexical tones as follows: T1[53/52], T2[334/434], T3[113/223], T4[55/54], and T5[12/23].

⁴ Zee & Maddieson (1980) adopted letters to indicate pitch range as follows: [T1: HL, T2: MM↑, T3: ↑ML, T4: H, T5: LM↑]. In this illustration, we converted the letters to numbers for ease of comparison.

⁵ Zhu (1999) argued that four pitch levels, instead of five as proposed in Chao (1930), are necessary and sufficient to transcribe the Shanghai tones, if pitch register is adopted into the transcription system.

p ^h	p ^h ɔ ¹	‘to throw’	t ^h	t ^h ɔ ¹	‘wave’			k ^h	k ^h ɔ ¹	‘to knock’	
p	pɔ ¹	‘bag’	t	tɔ ¹	‘knife’			k	kɔ ¹	‘tall’	
b	bɔ ³	‘to hold’	d	dɔ ³	‘rice’			g	gɔ ³	‘to cause’	
			ts ^h	ts ^h ɔ ¹	‘to copy’	tɕ ^h	tɕ ^h ɔ ¹	‘spade’			
			ts	tsɔ ¹	‘terrible’	tɕ	tɕɔ ¹	‘tender’			
						dʒ	dʒɔ ³	‘bridge’			
m	mɔ ³	‘fur’	n	nɔ ³	‘boisterous’	ɕ	ɕɔ ¹	‘to vanish’	ŋ	ŋɔ ³	‘proud’
f	fu ¹	‘man’	s	sɔ ¹	‘to cook’	ʒ	ʒa ³	‘thanks’	h	hɔ ¹	‘a plant’
v	vu ³	‘father’	z	zɔ ³	‘to build’	j	jɔ ³	‘to shake’	ʔ	kuʔ ⁴	‘country’
w	wa ³	‘bad’	l	lɔ ³	‘sturdy’						

We have identified 28 consonants. Corresponding key words/bound morphemes are provided below the consonant chart. A prominent feature of Shanghai Chinese is the three-way laryngeal contrast in obstruents, known as *quanqing* 全清 ‘all clear’, *ciqing* 次清 ‘secondary clear’, and *quanzhuo* 全浊 ‘all muddy’. In modern phonetic terms, they are often labeled as voiceless unaspirated, voiceless aspirated, and voiced, respectively (Chao 1967), and we adopt these labels in this description. These labels should not mask the important observation that these obstruents vary in their phonatory state from modal or stiff for the ‘clear’ types to slack for the ‘muddy’ types (see Ladefoged & Maddieson 1996: 63) and may also be classified as tense, aspirated, and lax, respectively.

In the initial position of a prosodic tone unit, there is little VOT difference between the voiceless unaspirated and voiced categories, both of which differ in VOT from voiceless aspirated obstruents. In the non-initial position of a tone unit, voiced obstruents are fully voiced, giving rise to a three-way laryngeal distinction in VOT. While VOT thus serves as a cue in these positions, there are other acoustic and articulatory correlates for the three-way contrast in both tone unit initial and medial positions (e.g. Shen et al. 1987 on closure duration; Ren 1992 on transillumination/photoglottography data in the stops’ laryngeal adjustments; Cao & Maddieson 1992 on phonation cues such as H1–H2 around the onset of the following vowel).

Among the alveolar consonants of Shanghai Chinese, /t^h t d/ tend to be denti-alveolar and /s z ts^h ts/ apical alveolar, with /s z/ having a contact area slightly further front than /ts^h ts/ (there is no */dz/). /n l/ are typically laminal alveolar but their place of articulation varies due to coarticulation. Consonants are palatalized before high front segments (i.e. /i y j/), which is particularly noticeable in alveolars, as in /ti¹/ [tʰi¹] ‘low’, /ŋjɔ³/ [ŋ¹jɔ] ‘to circle’. It is important to note that there is no contrast between alveolar /t^h t d n l/ and their palatalized versions, and we therefore do not posit any palatal or palatalized nasal in the system, despite its inclusion in other descriptions of the language (e.g. Xu & Tang 1988). The contact areas for the alveolo-palatals (/tɕ^h tɕ dʒ ɕ ʒ/) include the alveolar ridge and the forward part of the palatal region, again with the contact being laminal. These consonants generally show a raised tip/blade and front of the tongue and are thus laminal palatalized alveolo-palatal (Ladefoged & Maddieson 1996: 180). Further, /ɕ ʒ/ have a slightly more front contact area than /tɕ^h tɕ dʒ/, an observation that is supported by electropalatographic data in Ping (2005). Phonotactically, alveolo-palatal sounds share the distribution of palatal /j/. However, following widely observed practice in Illustrations of the IPA, we have placed the alveolo-palatals and /j/ in different columns in the above chart.

Syllables with an alveolo-palatal fricative or affricate onset evolved from alveolar or velar consonants due to the palatalization triggered, historically, by the following high front vowel or glide /j/ (see Liu 2004 for further discussion and references). The convention among Sinologists has been to transcribe syllables with an alveolo-palatal onset with a high vowel /i/ after the consonants (e.g. Xu & Tang 1988), as in /tɕiɔ¹/ ‘tender’ and /ɕiɔ¹/ ‘vanish’.⁶ The

⁶ Such a treatment sometimes allows more transparent descriptions of cross-dialect comparisons or within-dialect language changes. For example, /tɕiɔ¹/ ‘tender’ in the neighbouring dialect Suzhou has the alveolar

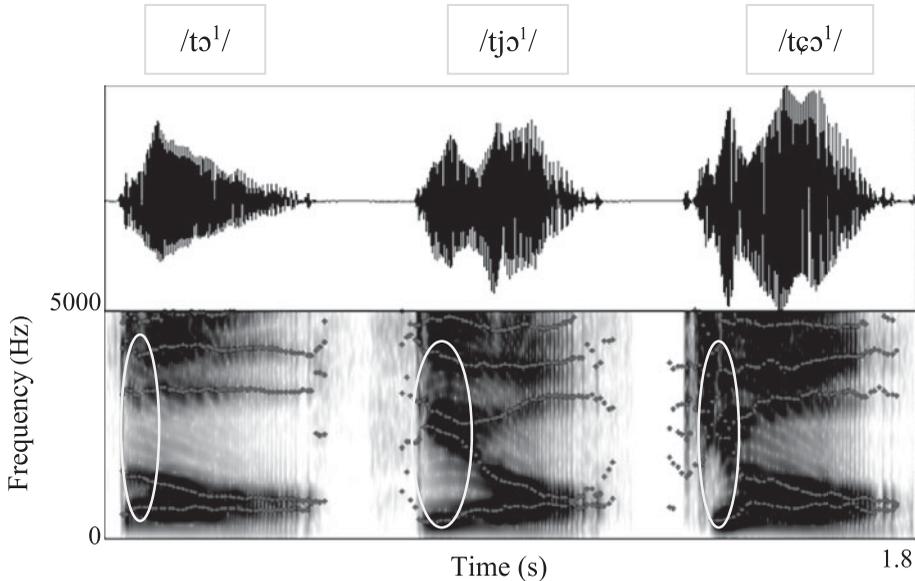


Figure 2 Waveforms and spectrograms of /tɕ¹/ 'knife' (left), /tjɔ¹/ 'marten' (middle) and /tɕɔ¹/ 'tender' (right), respectively. The white circles highlight the transitions from the onset obstruent to the vocalic nuclei.

spectrograms in Figure 2, however, do not support this practice. They show a considerable period of time over which the second formant converges toward the value of the back rounded vowel in the case of /tjɔ¹/, while the transition after /tɕ/ is more rapid, temporally comparable to the transition in /tɕ¹/. Moreover, the inclusion of /j/ after alveolo-palatals would amount to the presence of a phoneme which is fully predictable from the context. We therefore treat any transitional effects after an alveolo-palatal onset as phonetic, without the need to posit an underlying phoneme /i/ or /j/.

The labial, alveolar, and alveolo-palatal fricatives⁷ have a two-way laryngeal contrast, commonly labeled as voiceless vs. voiced. Similar to the stops, their phonatory states vary from stiff in the voiceless ones to more slack in the voiced ones. In the initial position of a tone unit, the voiced fricatives are fully devoiced, paralleling the lack of VOT cues for initial voiced obstruents. Other cues are nevertheless present; voiceless fricatives show greater amplitude of the noise component and are often longer than their voiced counterparts. Their difference is also evident in their different spectral centres of gravity (7140 Hz in /z/ of /zzɿ³/ 'tree' vs. 7638 Hz in /s/ of /sz²/ 'try'; 1834 Hz in /v/ of /vu³/ 'father' vs. 5143 Hz in /f/ of /fu¹/ 'husband'). Non-initially in the tone unit, the voiceless fricatives remain voiceless, but their voiced counterparts are fully voiced and are produced with glottal pulse turbulence. This contrast is illustrated in Figure 3 (/fu¹/ 'man/husband' vs. /zɛŋ³ + fu¹/ 'husband') and Figure 4 (/vu³/ 'father' vs. /jɛŋ³ + vu³/ 'adopted father'). Lastly, /h/ is pronounced [x] before /w/ and non-low back vowels, as in /hwɛ¹/ [xwei¹] 'dust' and [h] before other vowels.

Syllabic /z/ occurs in syllables with an alveolar sibilant onset and no coda, e.g. /sz²/ 'try' and /zzɿ³/ 'tree'. The later portion of syllabic /z/ tends to lose its friction, in which case it ends with the spectral quality of a central close-mid vowel, commonly transcribed as /ɿ/ (e.g. Xu & Tang 1988 after Karlgren 1940, but see Ladefoged & Maddieson (1996: 314) on fricative

onset /ts/, requiring the presence of /i/ in the rhyme. The onset /tɕ/ in Shanghai Chinese has also been noted to evolve from /ts/ when preceding the vowel /i/ (Xu & Tao 1997).

⁷ Some speakers of Shanghai Chinese, especially the old-generation speakers, have the bilabial fricatives /ɸ/ and /β/ instead of the labial-dental fricatives /f/ and /v/.

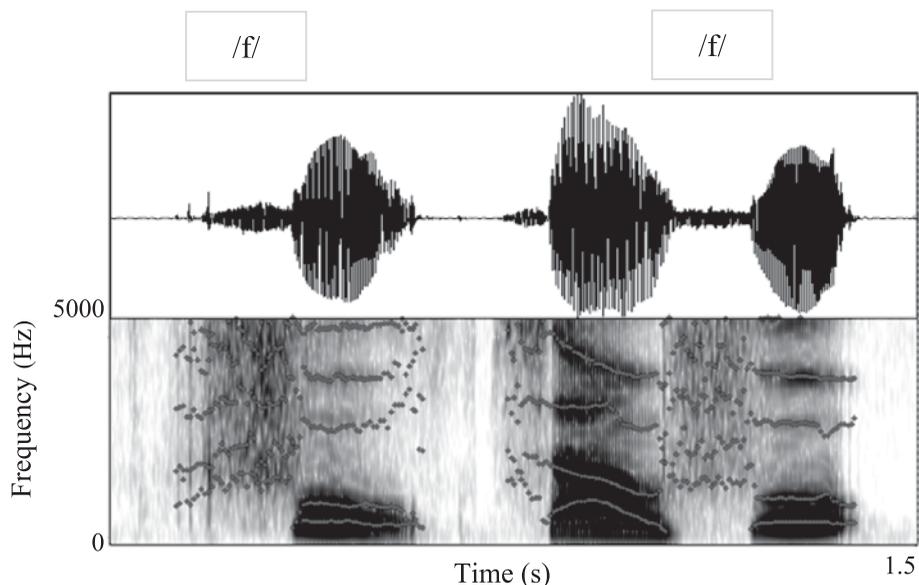


Figure 3 Waveforms and spectrograms of initial /f/ in /fu¹/ 'man/husband' (left) vs. medial /f/ in /zɛŋ³ + fu¹/ 'husband' (right).

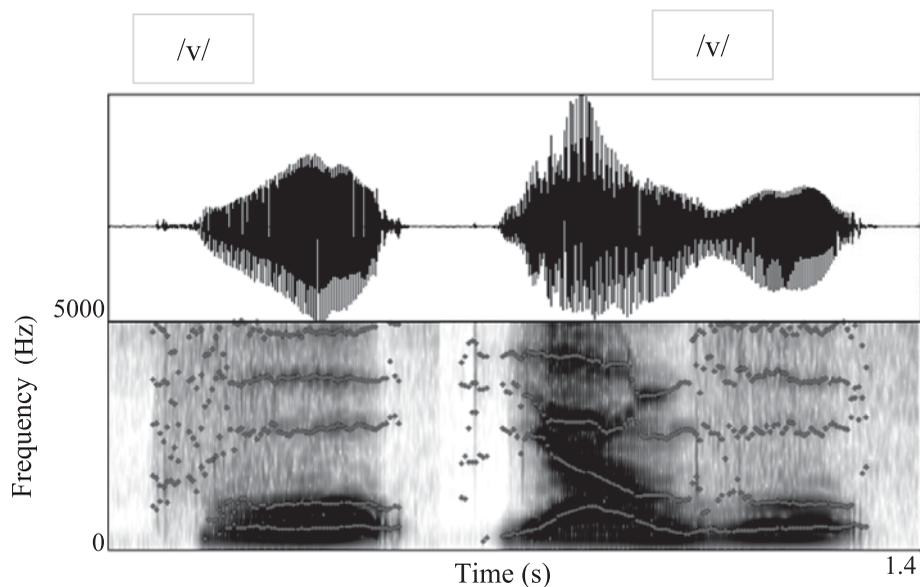


Figure 4 Waveforms and spectrograms of initial /v/ in /vu³/ 'father' (left) vs. medial /v/ in /jɛŋ³ + vu³/ 'adopted father' (right).

vowels). The suspension of friction is visible in Figure 5 for the larger part of /z/ in /sz²/ and for the final part in /zz³/.⁸

⁸ Across Chinese dialects, what have been evolved into a syllabic fricative in Shanghai Chinese take on different vowel spectral qualities and are realized with varying degrees of friction, and therefore cannot be simply treated uniformly as syllabic fricatives.

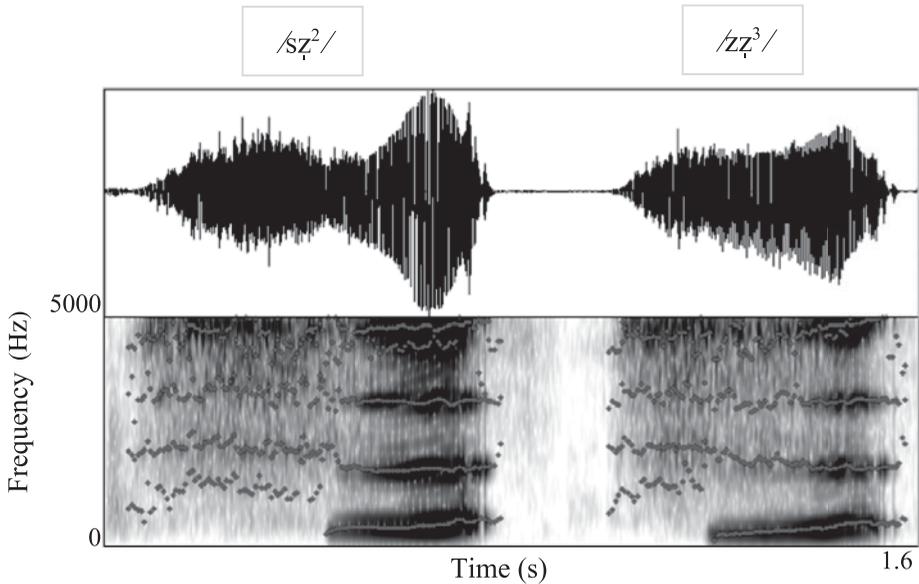


Figure 5 Waveforms and spectrograms of /sz̩³/ 'try' (left) and /zz̩³/ 'tree' (right).

Sonorants

Labial and velar nasals can form syllable nuclei, e.g. /ŋ³/ 'fish', /m³ məʔ/ 'not in possession', and /m¹ ma/ 'mother'. /ŋ/ is the only nasal that may occur in all three positions in the syllable – onset, nucleus, and coda. However, the specific place of articulation for the nasal coda varies, partly due to the articulatory latitude that the nasal coda enjoys, given that the language neutralizes place contrasts in coda position. For example, following /ə/ and /ɿ/, the nasal coda is closer to an alveolar [n] or alveolo-palatal [ɲ¹] (as in /kəŋ³/ [kəŋ³] 'to follow' and /tɕɿŋ¹/ [tɕɿŋ¹] 'army'). An open vowel before coda /ŋ/ is strongly nasalized (as in /zəŋ³/ [zəŋ³] 'bed'). Very often, the vocal tract configuration for the low vowel is maintained till the end of the syllable and there is no complete velic closure (as in /kəŋ¹/ [kə¹] 'hard (rice)'). (See the section on vowels below for more discussion on nasalized vowels.) When a sonorant serves as the onset of a syllable, its phonatory state varies from stiff with a high-register tone to more slack with a low-register tone. It is common to annotate this allophonic change of phonatory state with [ʔ] and [ɦ], respectively, as in [ʔm] and [mɦ] (Xu & Tang 1988: 7).

Vowels

There are 15 vowels in the basic inventory.⁹ Nine monophthongs occur in open syllables, as plotted in Figure 6. Vowels in closed syllables are plotted in Figure 7, where six occur in syllables closed by a nasal coda (left diagram) and five in syllables closed by a glottal coda (right diagram). We adopted the same set of symbols for vowels followed by a glottal stop and those followed by nasal coda, although their articulations often differ. However, the symbols for the vowels in Figure 6 are all different from those in Figure 7, so as to emphasize the fact

⁹ For different proposals on the vowel system of Shanghaiese, see Xu & Tang 1988, Svantesson 1989, Xu & Tao 1997 and Zhu 1999, among others.

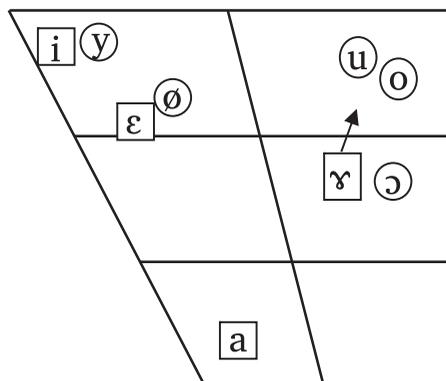


Figure 6 Auditory plots of monophthongs in open syllables, based on the accompanying sound files.

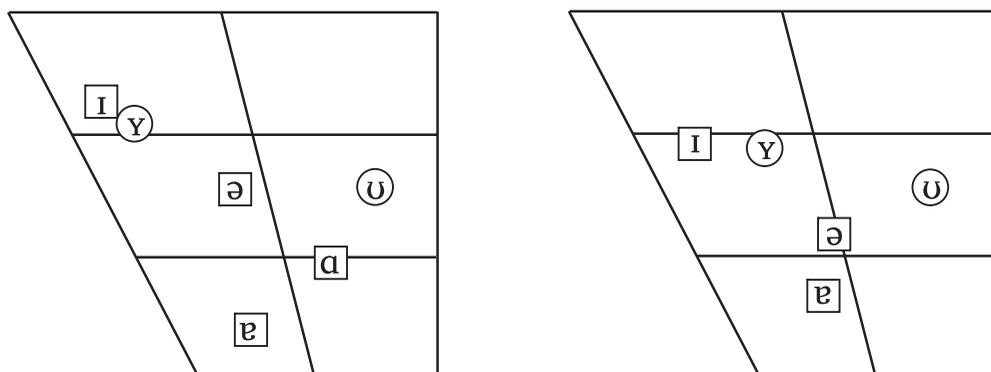


Figure 7 Auditory plots of monophthongs in closed syllables (left panel: for vowels in syllables closed by a nasal; right panel: for vowels in syllables closed by a glottal stop), based on the accompanying sound files.

that for no pair of open-syllable vowel and closed-syllable vowel do we assume phonological equivalence. In general, vowels in closed syllables are more central and lower than vowels in open syllables. The auditory plots here are based on accompanying sound files produced by our informant. For acoustic analyses of vowels produced by several speakers, readers are referred to Chen (2008a).

Monophthongs in open syllables

i	ti ¹	'low'	u	tu ¹	'capital'
y	ly ³	'donkey'	o	ko ¹	'melon'
ɛ	kɛ ¹	'should'	ɤ	kɤ ¹	'ditch'
ø	kø ¹	'liver'	ɔ	kɔ ¹	'tall'
			a	ka ¹	'street'

Monophthongs in closed syllables

ɪ	tɪŋ ¹	‘nail’	ɔ	kuŋ ¹	‘public’
	tɪŋ ⁴	‘drop’		kuŋ ⁴	‘country’
ɤ	tɕɤŋ ¹	‘army’	ə	kəŋ ¹	‘to follow’
	tɕɤŋ ⁴	‘bound morpheme for resolution’		kəŋ ⁴	‘to reform’
ɐ	kəŋ ¹	‘hard (rice)’	ɑ	kaŋ ¹	‘jar’
	kəŋ ⁴	‘to cut’			

The back unrounded vowel /ɤ/ is more diphthongal (i.e. [ɤu]) in our sound files than in the speech of the older speakers in Chen (2008a), whose monophthongal pronunciation is illustrated in /dɤ³/ ‘head’ by one of them. No durational difference was found between the diphthongized and non-diphthongized realizations. The back rounded /u/ and /o/ are both close to close-mid back monophthongs with compressed lip rounding. The lips for /o/ are more protruding, while in the case of /u/, the lips are less rounded but more compressed. The lips typically converge towards the end of the vowel, sometimes making a light contact. The difference in lip position enhances the difference between the two vowels /u/ and /o/ (see Ladefoged & Maddieson 1996: 295). The lip convergence is particularly clear when /u/ occurs in combination with an onset /t k/ (e.g. /tu¹/ ‘capital city’ and /ku¹/ ‘song’, compared to /vu³/ ‘father’).

Typologically, the vowel system in open syllables is remarkable for the clustering in the close-mid to close area. The mid front unrounded vowel resulted from a merger of /e/ and /ɛ/ by the late 1980s (Xu & Tang 1988).¹⁰ Given the height of the vowel produced by our informant, we may symbolize it as /e/, but we have chosen /ɛ/ because native speakers appear to enjoy considerable latitude in the tongue height of this vowel, and some may have an opener realization, as illustrated in /fiɛ³/ ‘salty’ by an older speaker reported in Chen (2008a). Our informant also produces the vowel as [ei] in some lexical items which contain /ei/ in Standard Chinese. This is evidently due to the influence of Standard Chinese, and /ei/ thus has the status of a ‘marginal’ vowel of our informant’s language. A contrastive pair is /tei¹/ ‘to accumulate’ vs. /te¹/ ‘dumbfounded’. /a/ is often transcribed as /A/ in the Sinological literature, a non-IPA symbol for a central, open unrounded vowel (e.g. Xu & Tang 1988).

For some older speakers and our informant, there is a contrast between /t^hjɛ¹/ [t^hi] ‘sky’ vs. /t^hi¹/ ‘ladder’, and /pje²/ [pi] ‘to change’ vs. /pi²/ ‘arm’, and /zɛ³/ [zi] ‘front’ vs. /zi³/ ‘surname Xu’). While we assume that the underlying forms are /je/ or /ɛ/ and /i/, respectively, this difference has been documented in different ways (Qian 2003). The two forms are known to have merged in the younger generation by the 1980s (Xu & Tang 1988). In terms of articulation, the tongue body for /ɛ/ after a palatal is raised, which results in a more peripheral (i.e. mainly higher F2) realization, as shown in the contrast between /çɛ¹/ [çi] ‘fresh’ (left) vs. /çi¹/ ‘west’ (right) in Figure 8.

As for vowels in closed syllables, the contrast between /ɐ/ and /a/ only exists before /ŋ/ (i.e. not before /ŋ/). /ɐ/ is more centralized, while /a/ is further back. These two vowels are often described as fully nasalized (e.g. as [ã] and [ã] in Xu & Tang 1988). However, spectrogram inspection of the rhyme realizations by our informant shows that the vowels are indeed consistently nasalized, but often followed by a brief velar closure at the end. A case in point here is /zaŋ³/ [zãŋ³] ‘bed’ in Figure 9. This observation is supported by Ping (2005: 24).

Vowels preceding a glottal stop in the coda show a general displacement towards an open back position, possibly due to a retracted tongue root for the glottal constriction. Lip

¹⁰Among the younger generation, there is a merger reversal and /e/-/ɛ/ words have been reported to become distinct again and some produce the /ɛ/ words with /ei/, presumably due to Mandarin influence (Gu 2004).

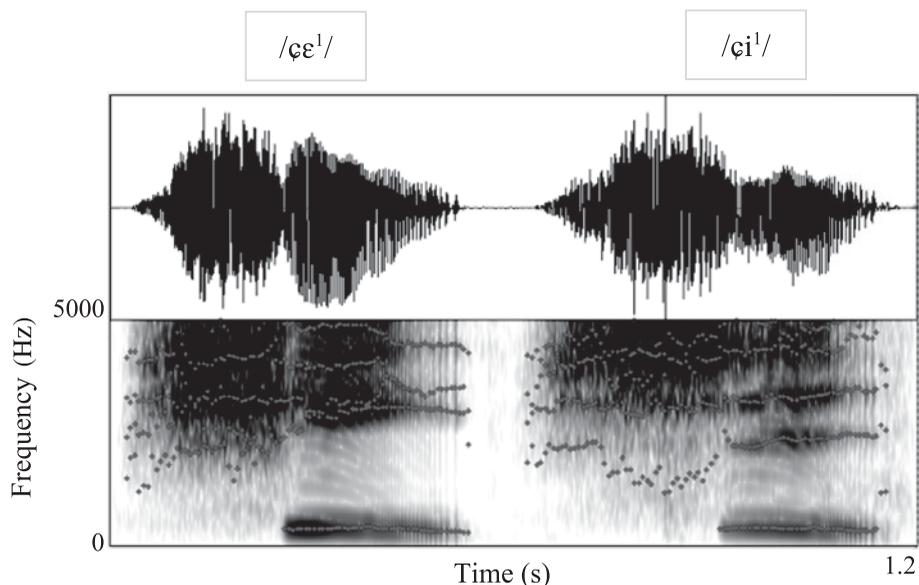


Figure 8 Waveforms and spectrograms of /çɛ¹/ [çi¹] 'fresh' (left) vs. /çi¹/ 'west' (right).

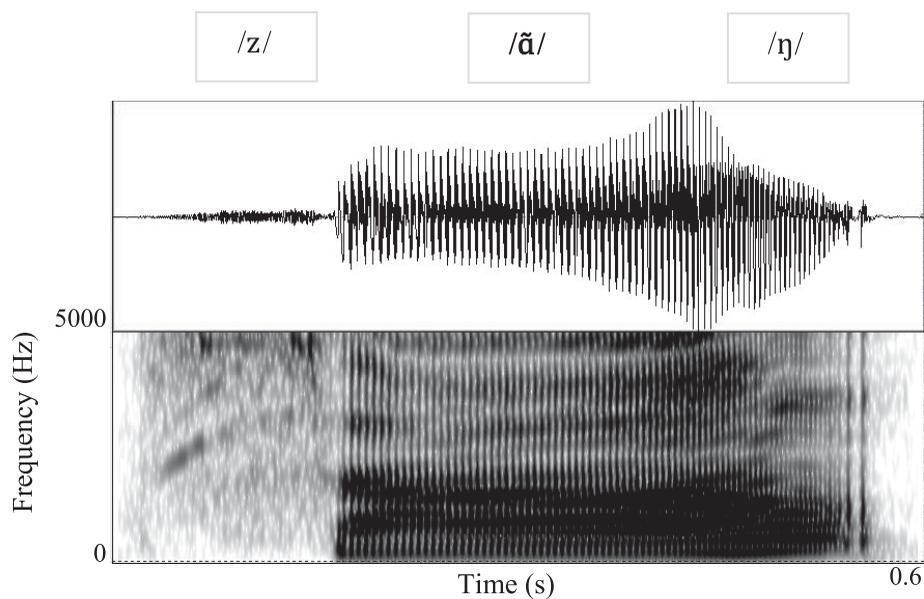


Figure 9 Waveforms and spectrograms of /zãŋ³/ [zãŋ³] 'bed'.

unrounding occurs just before the glottal closure and the velar nasal, such that /tçɣʔ⁴/ 'bound morpheme for resolution' is realized as [tçɣ¹ʔ⁴], and /kuʔ⁴/ 'country' as [ku³ʔ] where the [ɪ/ə] element is very brief. Finally, /əʔ/ and /ɐʔ/ are interchangeable for some speakers, particularly after /w/.

Table 1 Co-occurrence restrictions on consonants with the high vowels /i u/ and glides /j w/.

Vowel/Glide	Labial/Labio-dental	Alveolar	Alveolo-palatal	Velar	h
i	p ^h i, pi, bi, mi, fi, vi	t ^h i, ti, di, li, ni	Yes	No	No
u	Yes	Yes	No	Yes	Yes
j	p ^h j, pj, bj, mj	t ^h j, tj, dj, lj, lj	No	No	No
w	No	No	No	Yes	Yes

Syllable structure

Shanghainese syllable structure is (C)(G)V(C), where G is either /j/, as in /tja¹/ ‘daddy’, or /w/, as in /kwa¹/ ‘well-behaved’. As noted in the section on vowels, the coda C is either /ŋ/ or /ʔ/, as in /kuŋ¹/ ‘public’ and /kuʔ⁴/ ‘country’. The glides /j w/ may occur syllable-initially, as in /jɔ³/ ‘to shake’ and /wa³/ ‘rotten’, or following C, but /j w/ do not appear in combination (*wɨj/ *jwɨ/). Within an open syllable, j before /i y o u/ is banned, while /w/ is only found before /a ε ø/. Within a closed syllable, /j/ is absent before /i ɣ ə/ and /w/ before /i ɣ u/.

Before a rounded vowel, /j/ is rounded to [ɥ], as in /juʔ⁵/ [ɥuʔ] ‘bath’, /p^hjɔ¹/ [p^hɥɔ] ‘to float’, and /jɔ³/ [ɥɔ] ‘round’ (compare /ø³/ [fɕ] ‘cold’ and /y³/ [j^wy] ‘rain’). While a rounded glide /ɥ/ is commonly posited as a separate phoneme, we treat it here as an allophone of /j/, since it never occurs before a non-round vowel.

In the literature, /j w/ have been analyzed as initial elements in the syllable nucleus, i.e. the ‘medial’ in traditional Chinese phonology, and as onset consonants. In combination with a preceding C, they have additionally been analysed as secondary articulations (see Yip 2003, Duanmu, forthcoming, for further details). Regardless of the analysis of prevocalic glides as either onset or nucleus, there are a number of complementary distributions between (non-glide) onset consonants and glides. Before /j/, either a labial or alveolar consonant can appear (e.g. /p^hjɔ¹/ ‘to float’, /pjɔ¹/ ‘to mark’, /bjɔ³/ ‘prostitute’, /mjɔ¹/ ‘to peek’ and /t^hjɔ¹/ ‘to shoulder’, /tjɔ¹/ ‘marten’, /djɔ³/ ‘stripe’, /njɔ³/ ‘to circle’, /ljɔ¹/ ‘to uncover’). In addition to the alveolo-palatal and velar obstruents rejecting a following /j/, the sequences */fj vj wj hj¹¹/ are excluded. Before /w/, only velar plosives can appear (e.g. /k^hwɛ¹/ [k^hwei¹] ‘debit’, /kwɛ¹/ ‘to close’ and /gwɛ³/ ‘to circle (N.)’) or /h/ (e.g. /hwɛ¹/ [xwei¹] ‘dust’).

Further phonotactic restrictions can be observed in CV sequences. First, while the alveolar sibilants /s z ts ts^h/ do not appear before /i y i ɣ j/, syllabic /z/ occurs precisely after this group of consonants. Examples include /tsz²/ ‘paper’, /ts^hz²/ ‘here’, /sz²/ ‘try’, and /zz³/ ‘tree’. Secondly, /i y i ɣ j/ do not appear after velars (e.g. */ki/, */ŋy/, */gji/, etc.). Thirdly, the high front rounded /y ɣ/ only occurs after /l n/ and /tɕ^h tɕ dʒ ɕ z/. Table 1 summarizes the distribution of post-C /j i w u/.

Onsetless syllables

Onsetless syllables at the start of a tone unit begin with a glottal stop if they have T1, T2 or T4. That is, initial [ʔ] is a predictable beginning of vowel-initial syllables with (non-low) *Yin* register tones. Generally, syllables with these non-low tones have stiff voice. By contrast, slack voice is a predictable beginning of vowel-initial syllables with low tone, T3 or T5, the *Yang* register tones in traditional Chinese. While it is common to assume phonemic glottal stops and voiced glottal fricatives as syllable onsets, we propose that these syllables should be analyzed as onsetless. Initial slack voice is an enhancement of the realization of T3 and T5, just as initial stiffness can be seen as an enhancement of T1, T2 and T4.

The phonation difference between stiffness vs. slackness of the vowel in these syllables is shown in Figure 10, which plots the Fast Fourier transform (FFT) spectrum of the vowel

¹¹We also note one lexical exception for the cluster /vj/, /vjɔ³/ ‘don’t want’, which we believe is due to the coalescence of two syllables /vəʔ/ ‘not’ and /jɔ²/ ‘want’.

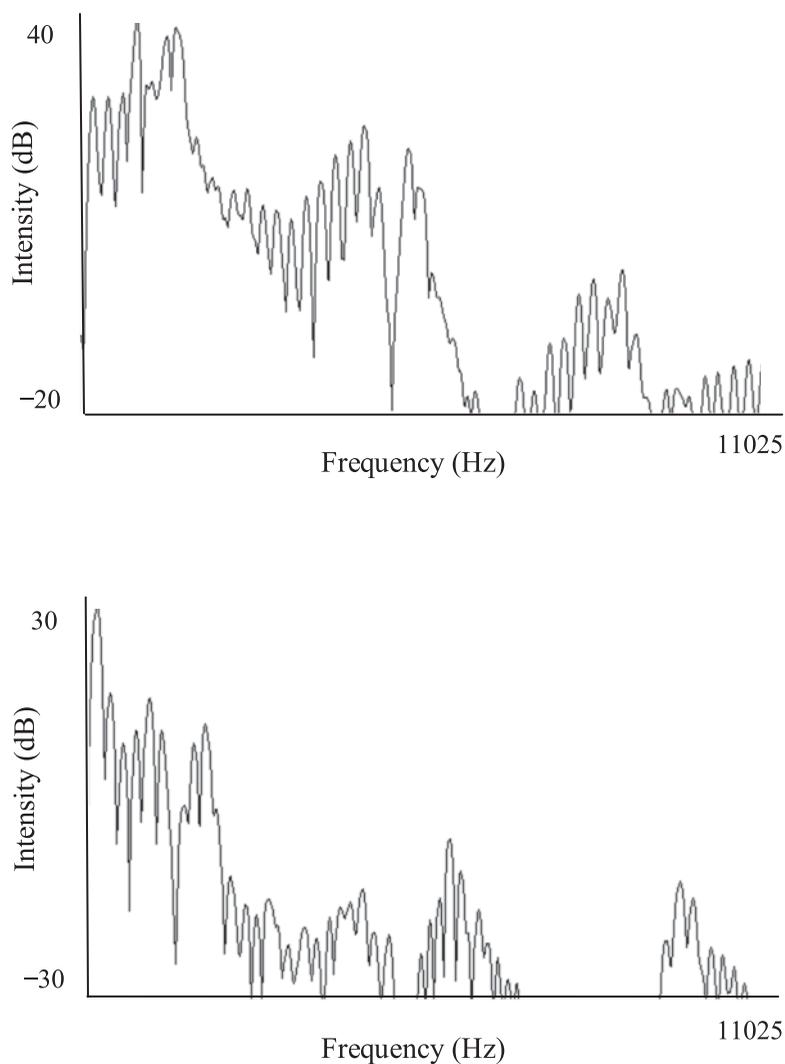


Figure 10 FFT spectrum of the vowel /a/ in /a¹/ [ʔa¹] ‘bound morpheme a’ (top panel) and /a³/ [ʔa³] ‘short’ (bottom panel), taken over an interval of approximately 30 ms from the first regular vocal pulse of the vowel.

/a/ in /a¹/ [ʔa¹] ‘bound morpheme a’ (top panel) vs. /a³/ [ʔa³] ‘shoe’ (bottom panel), taken over an interval of approximately 30 ms from the beginning of the vowel. It is clear from the measurements on both H1–H2 (i.e. amplitude difference between the first and second harmonics) and H1–A1 (i.e. amplitude difference between the first harmonic and first formant) that there is a phonation difference between the two vowels with /a³/ [ʔa³] showing more breathiness (i.e. slack voice) than /a¹/ [ʔa¹]. (See Blankenship 2002 for more details on the acoustic correlates of phonation types.)

The tone-dependent slack voice is heard as the phonetic segment [ɦ] only with mid and open vowels, as in /ø³/ [ɦø] ‘cold’, /ɛ³/ [ɦɛ] ‘to harm’, /ɔ³/ [ɦɔ] ‘unrestrained’, /a³/ [ɦa] ‘shoe’. Before less open vowels, the glottal friction is absent, causing /lʔ⁵/ ‘leaf’, /ʏʔ⁵/ ‘moon’ and /uʔ⁵/ ‘to live’ to sound like [jʔ], [ʏʔ] and [wʔ], respectively. In the case of the high vowels /i y u/, there tends to be weakly voiced cavity friction produced along the place of articulation

Table 2 Realization of the onsetless vowels /i u/ and the glides /j w/ in tone-unit initial vs. medial position.

Vowel/Glide	Initial	Medial
/i ³ /	[j ³ fu] 'uncle'	[ɕɔ ² ifu] 'younger uncle'
/i ¹ /	[ʔi ¹ sɛŋ] 'doctor'	[ɕɔ ² isɛŋ] 'young doctor'
/u ³ /	[βu ³] 'pot'	[ɕɔ ² u] 'small pot'
/u ¹ /	[ʔu ¹] 'surname'	[ɕɔ ² u] 'nickname for youngster with the surname'
/jɛŋ ³ /	[jɛŋ ³ çi sɛŋ] 'Mr. Yang'	[ɕɔ ² jɛŋ] 'nickname for youngster with the surname'
/wɑŋ ¹ /	[wɑŋ ¹ çi sɛŋ] 'Mr. Wang'	[ɕɔ ² wɑŋ] 'nickname for youngster with the surname'

Table 3 Realization of the predictable segments [ʔ h] and the phonemic onset /h/ in isolation vs. tone unit medial position

Morpheme	In isolation	Preceded by /tɕ ^h ɪŋ ¹ / within the same tone unit
/o ¹ /	[ʔo ¹] 'frog (bound morpheme)'	[tɕ ^h ɪŋ ¹ o] 'frog'
/o ³ /	[hɔ ³] 'splendid (bound morpheme)'	[tɕ ^h ɪŋ ¹ o] 'the name of a university'
/ho ¹ /	[ho ¹] 'flower'	[tɕ ^h ɪŋ ¹ ho] 'blue flower in porcelain glazing'

of the vowel. Thus, /i³/ 'aunt' is [ji], /y³/ 'rain' is [j^wy] and /u³/ 'fox' is [βu]. As explained in the section on tone contrasts below, the tone of non-initial syllables in the tone unit is deleted, with the tone of the first syllable determining the f₀ contour for the tone unit. The relevance of this fact for the segmental analysis is that tone-dependent segmental features in non-initial syllables of the tone unit disappear. Thus, the homorganic glides/fricatives disappear in medial position in the tone unit, while underlying /j w/ remain, as shown in Table 2. Likewise, the tone-dependent status of the phonetic segments [ʔ] and, for non-high vowels, [h] is shown by their disappearance in non-initial position in the tone unit. This can be seen in Table 3, where [ʔ] and [h] disappear after a domain-initial morpheme /tɕ^hɪŋ¹/. By contrast, the phoneme /h/ is retained in non-initial position.

Tone contrasts

Tone contrasts in Shanghai Chinese are signalled by a complex set of features. In addition to the f₀ differences, there is a constellation of phonetic and phonological features of the tone-bearing syllable, which include voice quality (slack voice for T3/T5 and stiff voice for T1/T2/T4), pre-vocalic state of the glottis (a glottal closure before onsetless syllables with T1/T2/T4 and slack vocal fold vibration/weak voiced friction for those with T3/T5), as well as the post-vocalic state of the glottis and the duration of the vowel (short vowel and presence of a glottal closure after T4/T5 vs. long vowel and absence of a glottal closure for T1/T2/T4). A similar point was made in Sherard (1972).

Table 4 summarizes the distributional restrictions. In an open syllable or a syllable with nasal rhyme, aspirated and unaspirated obstruent onsets allow for a two-way contrast between T1 and T2 (column 2). When the onset is a voiced obstruent, only T3 is possible (column 3). As for nasal and approximant onsets (column 4), T1 and T3 occur frequently on syllables with nasal onsets, while T2 is rare. In the speech of our informant, a sub-minimal triplet is: /mɛ¹/ 'very', /mɛi²/ 'beautiful', /mɛ³/ 'slow'. The pitch for T3 after nasal onsets seems to be not quite as low as that after voiced obstruents, perhaps reflecting the absence of the f₀ perturbation effect that occurs after voiced obstruents on the one hand and the low functional load of the contrast with T2 on the other. In checked syllables, voiceless obstruents condition T4 (column 5), leaving voiced obstruents to co-occur with T5 (column 6). After nasal and approximant onsets (column 7), T5 abounds and T4 is rare.

Table 4 Co-occurrence restrictions on tonal categories with consonants and syllable structure.

Tone	TV(ŋ)	DV(ŋ)	SV(ŋ)	TV?	DV?	SV?
T1	Yes	No	Yes	No	No	No
T2	Yes	No	Yes	No	No	No
T3	No	Yes	Yes	No	No	No
T4	No	No	No	Yes	No	Yes
T5	No	No	No	No	Yes	Yes

T = voiceless obstruent, S = sonorant consonant, D = voiced obstruent, V = vowel

Table 5 Realizations of onsetless syllables in five tone contexts, illustrated with the nuclei /i/ or /ɪ/? and /a/ or /ɛ?/. The vowels in open syllables have been provided with a length mark to indicate the short nature of the vowels in checked rhymes.

Tone	i/ɪ?	a/ɛ?
T1	/i/ [ʔi:] 'doctor'	/a/ [ʔa:] 'prefix for aunt'
T2	/i/ [ʔi:] 'chair'	/a/ [ʔa:] 'short'
T3	/i/ [ʔi:] 'to move'	/a/ [ʔa:] 'shoe'
T4	/ɪ/? [ʔɪ?] 'one'	/ɛ?/? [ʔɛ?] 'pressure'
T5	/ɪ/? [ʔɪ?] 'leaf'	/ɛ?/? [ʔɛ?] 'narrow'

Onsetless syllables and syllables beginning with /j w/ allow the full set of tonal contrasts: T1 vs. T2 (or T4) vs. T3 (or T5). Table 5 summarizes the phonetic effects of the tone for syllables beginning with a high vowel and a low vowel. All of these examples in fact occur as morphemes, as indicated by the glosses.

Understandably, given these distributional restrictions, there have been conflicting summary statements of the number of tones in Shanghaiese. For example, Jin (1986) and Selkirk & Shen (1990) assume a three-way contrast, Duanmu (1993, 1999) a two-way contrast, and Zee & Maddieson (1980) work with five phonetic contours of the lexical tones.

Within a tone unit, the tonal contours of non-initial syllables never surface, and the tone of the first syllable determines the f0 contour for the whole domain. After the second syllable, f0 falls gradually, and converges to low pitch as the number of non-initial syllables increases. (Readers are referred to Chen 2008b for further details.) This pattern is known as *guangyong shi* 广用式 'commonly applied pattern', as opposed to *zhaiyong shi* 窄用式 'less commonly applied pattern' (Xu & Tang 1988), with the latter referring to tonal reduction processes due to the lack of phrasal-level prominence – a topic for future research.

Many factors can affect f0 contour realization, including prosodic grouping and the information status of the constituents (see e.g. Chen 2012 for review on tonal variation). There is a large literature on tonal variation over the non-initial syllables of tone units as well as on how tone units, together with larger prosodic domains, are realized (see Zee & Maddieson 1980, Selkirk & Shen 1990, Duanmu 1999, Chen 2008b). It is beyond the scope of this paper to evaluate these proposals or to provide a new analysis.

Transcription of recorded passage

This passage is transcribed phonemically, using the symbols presented in the vowel and consonant charts. Tones are marked for each tone unit on the basis of the tone of the initial syllable. The boundaries between syllables are indicated by spaces, the boundaries of tone units are marked by parentheses, while | marks the end of major phrases and || that of utterances.

(jɣ³ t^hɑŋ tsz) | (puɣ⁴ fuŋ) | (təɣ⁴) (t^ha² jɛŋ) | (tsɛŋ² hɔ) | (ləɣ⁵ ləʔ) (tsɛŋ¹) | (sa² nɪŋ) | (pəŋ² zz) (du³) || (tsɛŋ¹ lɛ) | (tsɛŋ¹ tɕ^hi) | (tsɛŋ¹ vəʔ tɕ^hɪŋ¹ sɑŋ) | (gəʔ zəŋ³ kwɑŋ) || (lu³ lɑŋ) | (tsɣ² ku lɛ) | (iɣ⁴ gə) (nɪŋ³) || (səŋ¹ lɑŋ) | (tsɛɣ⁴ lə) (iɣ⁴ dzɛ) | (ɣ³ da i) || (i³ la) (ljɛŋ³ ka dɣ) | (dzɣ³) (kɑŋ² hɔ) || (tɕa² sz) (sa² nɪŋ) | (nəŋ³ kɣ) (tɕɔ²) | (gəʔ⁵ gəʔ) (nɪŋ³) | (ɕɛ¹) (t^hɐ^ʔ t^həʔ) (da³ i) || (dzɣ³) (s²ə) | (sa² nɪŋ) | (pəŋ² zz) (du³) || (puɣ⁴ fuŋ) (dzɣ³) | (jɔŋ³ tsuʔ) (liɣ⁵ tɕ^hi) | (dzɔŋ³ ts^hz) | (pɛɣ⁴ ts^hz) || (pəɣ⁴ ku) || (i³) | (ɣ⁵) (ts^hz¹ təʔ) (tɕiɣ⁴ kwəŋ) || (gəʔ⁵ gəʔ) (tsɣ² lu gəʔ) (nɪŋ³) | (nɛ¹) | (da³ i) | (ku² təʔ) | (ɣ⁵) (tɕɪŋ²) || (ɣ³ lɛ) | (puɣ⁴ fuŋ) | (m³ məʔ) (tɕɪŋ² ləʔ) || (tsəɣ⁴ hɔ) | (vəʔ⁵) (ts^hz¹ ləʔ) || (kəɣ⁴ məʔ) | (t^ha² jɛŋ) (ts^həɣ⁴ lɛ ləʔ) || (i³) (gəʔ⁵ nəŋ ka) | (iɣ⁴) (so²) || (gəʔ⁵ gəʔ) | (tsɣ² lu gəʔ) (nɪŋ³) | (mo³ zɛŋ) | (tɕɣ²) (nɛ¹) (i³ dzɛ) (da⁵ i) | (t^hɐ^ʔ t^həʔ ləʔ) || (kəɣ⁴ məʔ) (puɣ⁴ fuŋ) | (tsəɣ⁴ hɔ) (zəŋ³ nɪŋ) || (ljɛŋ³ ka dɣ) | (təŋ¹ tsuŋ) || (ɛ³ zz) (t^ha² jɛŋ) | (tswɛ²) (jɣ³) | (pəŋ² zz) ||

Orthographic version

有趟子, 北风搭太阳正好勒勒争啥人本事大。争来争去争勿清爽格辰光, 路浪走过来一个人, 身浪着勒一件厚大衣。伊拉两家头就讲好, 假使啥人能够叫格个人先脱恁大衣, 就算啥人本事大。北风就用足力气穷吹八吹。不过伊越吹得结棍, 格个走路格人拿大衣裹得越紧。后来北风勿没劲勒, 只好勿吹勒。格么太阳出来勒。伊格能嘎一晒, 格个走路格人马上就拿伊件大衣脱恁勒。格么北风只好承认, 两家头当中, 还是太阳最有本事。

Acknowledgements

We would like to thank first and foremost our informant Zhiqi Deng for making this study possible. In addition, we are grateful to Yueling Ping, Huan Tao, Rujie You, and Dunming You for sharing their thoughts with us on various linguistic aspects of the language, and to Zhongmin Chen and Menghui Shi for sharing references. We are also greatly indebted to the anonymous reviewers, whose comments have led to a large number of improvements in the exposition as well as to various additions to the text. The editorial assistance from Ewa Jaworska, Roger Lo, and Myrthe Wildeboer at various stages of the writeup is gratefully appreciated. The work was in part supported by a VENI grant and a VIDI grant awarded to the first author, and the Network grant ‘Forms and Functions of Prosody’, awarded to both authors, all by the Netherlands Organisation for Scientific Research (NWO). YC was also supported by the European Research Council (ERC-Starting Grant 206198).

References

- Blankenship, Barbara. 2002. The timing of nonmodal phonation in vowels. *Journal of Phonetics* 30, 163–191.
- Cao, Jianfen & Ian Maddieson. 1992. An exploration of phonation types in Wu dialects of Chinese. *Journal of Phonetics* 20, 77–92.
- Chao, Yuen Ren. 1928. *现代吴语的研究 [Studies of the modern Wu dialects]*. Beijing: Tsing Hua College Research Institute.
- Chao, Yuen Ren. 1930. A system of tone-letters. *Le Maître Phonétique* 45, 24–27.
- Chao, Yuen Ren. 1967. Contrastive aspects of the Wu dialects. *Language* 43, 92–101.
- Chen, Matthew. 2000. *Tone sandhi*. Cambridge: Cambridge University Press.
- Chen, Yiya. 2008a. The acoustic realization of Shanghai vowels. *Journal of Phonetics* 36, 629–748.
- Chen, Yiya. 2008b. Revisiting the phonetics and phonology of tone sandhi in Shanghai Chinese. *Speech Prosody 2008*, Campinas, Brazil, 253–256.
- Chen, Yiya. 2011. How does phonology guide phonetics in segment–f0 interaction? *Journal of Phonetics* 39, 612–625.
- Chen, Yiya. 2012. Tonal variation. In Abigail Cohn, Cecile Fougeron & Marie Huffman (eds.), *Oxford handbook of Laboratory Phonology*, 103–114. Oxford: Oxford University Press.

- Chen, Zhongmin. 2007. 上海市区话舒声阳调类合并的原因 [On the merging of the *Yang*-register tones in Shanghainese open syllables]. *方言* [Dialects] 29(4), 305–310.
- Chen, Zhongmin. 2010. 吴语清音浊流的声学特征及鉴定标志—以上海话为例 [The acoustic and perceptual cues for the voiced stops in Wu dialects: Evidence from Shanghainese]. *语言研究* [Linguistic Studies] 30(3), 20–34.
- Duanmu, San. 1993. Rime length, stress, and association domains. *Journal of East Asian Linguistics* 2, 1–44.
- Duanmu, San. 1994. Syllabic weight and syllabic duration: A correlation between phonology and phonetics. *Phonology* 11, 1–24.
- Duanmu, San. 1995. Metrical and tonal phonology of compounds in two Chinese dialects. *Language* 71, 225–259.
- Duanmu, San. 1997. Recursive constraint evaluation in Optimality Theory: Evidence from cyclic compounds in Shanghai. *Natural Language & Linguistic Theory* 15, 465–507.
- Duanmu, San. 1999. Metrical structure and tone: Evidence from Mandarin and Shanghai. *Journal of East Asian Linguistics* 8, 1–38.
- Duanmu, San. 2008. *Syllable structure: The limits of variation*. Oxford: Oxford University Press.
- Duanmu, San. Forthcoming. Syllable and syllable structure in Chinese. In Rint Sybesma, Wolfgang Behr, Yueguo Gu, Zev Handel & C. T. James Huang (eds.), *Encyclopedia of Chinese language and linguistics*. Leiden: Brill.
- Edkins, Joseph. 1853. *A grammar of colloquial Chinese as exhibited in the Shanghai dialect*. Shanghai: Presbyterian Mission Press.
- Gu, Qin. 2004. 最新派上海市区方言语音的调查分析 [New investigation of the sounds of Shanghainese city variety]. MA thesis, Shanghai Normal University.
- Hu, Mingyang. 2003. 上海话一百年来的若干变化 [Several changes in Shanghainese over the last century]. In Mingyang Hu (ed.), *胡明扬语言学论文集* [Collection of linguistic essays by Mingyang Hu], 59–72. Beijing: Commercial Publishing House.
- Jin, Shunde. 1986. Shanghai morphotonemics. MA thesis, The Ohio State University. [Distributed by Indiana University Linguistics Club, Bloomington, IN]
- Karlgren, Bernhard. 1940. *Grammata serica: Script and phonetics in Chinese and Sino-Japanese*. Stockholm: Museum of Far Eastern Antiquities.
- Ladefoged, Peter & Ian Maddieson. 1996. *The sounds of the world's languages*. Oxford: Blackwell.
- Lee, Wai-Sum & Eric Zee. 2003. Standard Chinese (Beijing). *Journal of the International Phonetic Association* 33, 109–112.
- Lee, Wai-Sum & Eric Zee. 2009. Hakka Chinese. *Journal of the International Phonetic Association* 39, 107–111.
- Liu, Mingang. 2004. *上海话语音简史* [A brief history of the sounds in Shanghainese]. Shanghai: Academia Press.
- Maddieson, Ian. 1999. The transcription of tone in the IPA. *Journal of the International Phonetic Association* 20, 28–32.
- Ping, Yueling. 2005. *上海方言语音动态腭位研究* [An electropalatographical investigation of Shanghai sounds]. Hong Kong: Hong Kong Wenhui Publishing House.
- Qian, Nairong. 2003. *上海语言发展史* [The history and development of the Shanghai Dialect]. Shanghai: Shanghai People's Publishing House.
- Ren, Nianqi. 1992. *Phonation types and stop consonant distinctions: Shanghai Chinese*. Ph.D. dissertation, University of Connecticut.
- Rose, Phil. 1993. A linguistic-phonetic acoustic analysis of Shanghai tones. *Australian Journal of Linguistics* 13, 185–222.
- Selkirk, Elisabeth & Tong Shen. 1990. Prosodic domains in Shanghai Chinese. In Sharon Inkelas & Draga Zec (eds.), *The phonology–syntax connection*, 313–339. Chicago, IL: The University of Chicago Press.
- Shen, Tong. 1981a. 老派上海方言的连读变调 [Tone sandhi in Old Shanghainese [part 1]]. *方言* [Dialects] 3(2), 131–144.
- Shen, Tong. 1981b. 上海话老派新派的差别 [Differences between Old and New Shanghainese]. *方言* [Dialects] 3(4), 275–283.

- Shen, Tong. 1982. 老派上海方言的连读变调(二) [Tone sandhi in Old Shanghainese, part 2]. *方言* [Dialects] 4(2), 100–114.
- Shen, Tong. 1985. 新派上海话声调的底层形式 [The underlying representation of the tones in New Shanghainese]. *语言研究* [Linguistic Studies] 2, 85–101.
- Shen, Zhongwei, Charles Wooters & William S.-Y. Wang. 1987. Closure duration in the classification of stops: A statistical analysis in a Festschrift for Ilse Lehiste. *Working Papers in Linguistics* 35, 197–209.
- Sherard, Michael. 1972. *Shanghai phonology*. Ph.D. dissertation, Cornell University.
- Shi, Rujie & Jianping Jiang. 1987. 上海市区中年人语音共时差异的五百人调查 [A synchronic study of the individual differences in the phonetics and phonology of Shanghai Chinese: Samples from 500 middle-aged speakers]. *中国语言集刊* [Chinese Languages and Linguistics] 1, 271–295. Shanghai: Fudan University Press.
- Svantesson, Jan-Olaf. 1989. Shanghai vowels. *Working Papers of Lund University* 35, 191–202.
- Xu, Baohua & Zhenzhu Tang. 1962. 上海方音的内部差异 [Within-dialect variation in Shanghainese]. *复旦大学学报* [Bulletin of Fudan University] 1, 87–104.
- Xu, Baohua & Zhenzhu Tang. 1988. *上海市区方言志* [A description of Shanghainese spoken in the urban districts of the Shanghai City]. Shanghai: Shanghai Education Press.
- Xu, Baohua, Zhenzhu Tang & Nairong Qian. 1981. 新派上海方言的连读变调 [Tone sandhi in New Shanghainese [part 1]]. *方言* [Dialects] 3(2), 145–155.
- Xu, Baohua, Zhenzhu Tang & Nairong Qian. 1982. 新派上海方言的连读变调(二) [Tone sandhi in New Shanghainese, part 2]. *方言* [Dialects] 4(2), 115–128.
- Xu, Baohua, Zhenzhu Tang & Nairong Qian. 1983. 新派上海方言的连读变调(三) [Tone sandhi in New Shanghainese, part 3]. *方言* [Dialects] 5(3), 197–201.
- Xu, Baohua, Zhenzhu Tang & Zhixiang Tang. 1982. 上海方音的共时差异 [Synchronic variations in the sounds of the Shanghai dialect]. *中国语文* [Chinese Linguistics] 169, 265–271.
- Xu, Baohua, Zhenzhu Tang & Zhixiang Tang. 1988. 上海人祖孙三代语音情况的抽样调查 [Survey of linguistic variations in three-generation Shanghainese families]. *吴语论丛* [Essays on Wu dialects], 120–131. Shanghai: Shanghai Education Press.
- Xu, Baohua & Huan Tao. 1997. *上海方言词典* [Dictionary of Shanghainese]. Jiangsu: Jiangsu Education Press.
- Yip, Moira. 2002. *Tone*. Cambridge: Cambridge University Press.
- Yip, Moira. 2003. Casting doubt on the onset/rime distinction. *Lingua* 113, 779–816.
- You, Rujie. 2010. 上海郊区语音近30年来的变化 [Development of the sound systems of Suburban Shanghainese dialects]. *方言* [Dialects] 32(3), 194–200.
- Zee, Eric. 1999. Chinese (Hong Kong Chinese). *Journal of the International Phonetic Association* 21, 46–48.
- Zee, Eric & Ian Maddieson. 1980. Tones and tone sandhi in Shanghai: Phonetic evidence and phonological analysis. *Glossa* 14, 45–88.
- Zhu, Xiaonong. 1999. *Shanghai tonetics* (LINCOM Studies in Asian Linguistics 32). Munich: LINCOM Europa.