

# Register and Representation of Shanghai Chinese

Shanghainese (Shanghai Chinese) is a variety of Wu Chinese spoken in Shanghai. It has long served as an important case for illustrating the interaction between tone and segmental features. Despite being relatively well studied, Shanghainese still presents a number of long-standing, unresolved debates concerning the behavior and representation of its tones. One of the central debates concerns the representation of register. Yip (1980). Murmur is a phonetic manifestation of register: in addition to the usual pitch lowering, it is accompanied by breathy voice. Previous research differs on where register should be located within tonal geometry. Two competing views exist: one treats register as a feature that dominates at the word level, while the other treats it as a feature associated with the voicing node of a segment.

This paper is motivated by that question and has two goals. First, we provide a more rigorous mathematical framework to model these two approaches, allowing for a precise comparison of their predictive power and expressiveness. Second, we employ computational methods to learn the tonotactics of Shanghainese under both representational assumptions, comparing the learning results to evaluate their relative outcomes.

## 1 Shanghai Tonology

Shanghai Chinese has five tones (T1–T5). Previous research has shown a variety of transcription systems for these tones, whether using the five-point scale notation (Chao, 1930) or more phonologically oriented representations indicating tonal height (Yip, 1980). These systems largely converge on the overall contour shapes but differ in the precise pitch value of tonal onsets and offsets.

Tone	CUHK (2018)	Xu and Tang (1988)	Duanmu (1999)	?	Zee and Maddieson (1979)
T1	53	53	/HL/	/H/	HL
T2	34	24	/LH/	/L/	/MM/
T3	23	13	/LH/	/L/	/ML/
T4	5	<u>55</u>	/LH/	/L/	/H/
T5	12	<u>13</u>	/LH/	/L/	/LM/

Table 1: Transcriptions of Shanghai tones across sources

The Shanghai tonal system is regarded as a *complex* system. Unlike Mandarin, in which tonal contrasts are primarily distinguished by pitch, tonal recognition in Shanghai Chinese also relies on *register* and vowel *length* (Zhu and Wang, 2015). As shown in Figure 2, there are two registers [UPPER] (discussed in detail in the next section), and two major syllable types: slack syllables and checked syllables (those closed by a glottal stop). The following section will focus on previous studies of register and length contrasts in Shanghai tonology.

Register	Tone	Slack syllable			Checked syllable		
		TV(ŋ)	DV(ŋ)	SV(ŋ)	TV?	DV?	SV?
+upper	T1	pa “father”	×	ma “mother”	×	×	×
	T2	pa “dam”	×	me “pretty”	×	×	×
	T4	×	×	×	pa? “eight”	×	a? “duck”
-upper	T3	×	ba “climb”	ma “horse”	×	×	×
	T5	×	×	×	×	ba? “white”	ma? “pulse”

Table 2: Co-occurrence restrictions on tones with consonants (Chen and Gussenhoven, 2015).

## 1.1 Register

Register is the primary distinction in Shanghai tones. Although it is often associated with overall pitch shift cross-linguistically, in Shanghaiese, a lower register is also accompanied by breathy phonation. Yip (1980) classifies Shanghai syllables into murmured and clear (or plain) types, with murmured syllables corresponding to those that co-occur with the [–upper] register. Murmur can thus be understood as the phonetic realization of Shanghai register (Zhu, 1999). The terminology for this feature varies across researchers, including [slack] (Duanmu, 1999), [+voice] (Ren, ???), and [spread glottis] (Keating, as cited in Yip 1993). For consistency, this paper will use the term register, with the understanding that it refers not only to pitch lowering but also to breathy phonation.

Figure 2 shows that all syllables with voiced obstruents onsets fall neatly under the [–upper] register. This is why register is often regarded as a feature of voicing. For syllables beginning with sonorants, however, both registers are possible and contrast with each other. Two points should be noted in the phonetic realization of register. First, in monosyllabic words, the [–upper] register, even when restricted to voiced obstruents, causes devoicing of these segments (e.g., [d] → [d̥]), nearly neutralizing the VOT distinction between voiced and voiceless unaspirated stops. This distinction is retained when the syllable occurs in a non-initial position. Second, in polysyllabic words, only the register of the initial syllable is realized on the surface, and will also dominate the whole phrase and change the voicing of the following consonants.

give some examples

## 1.2 Representation of Shanghai Tones

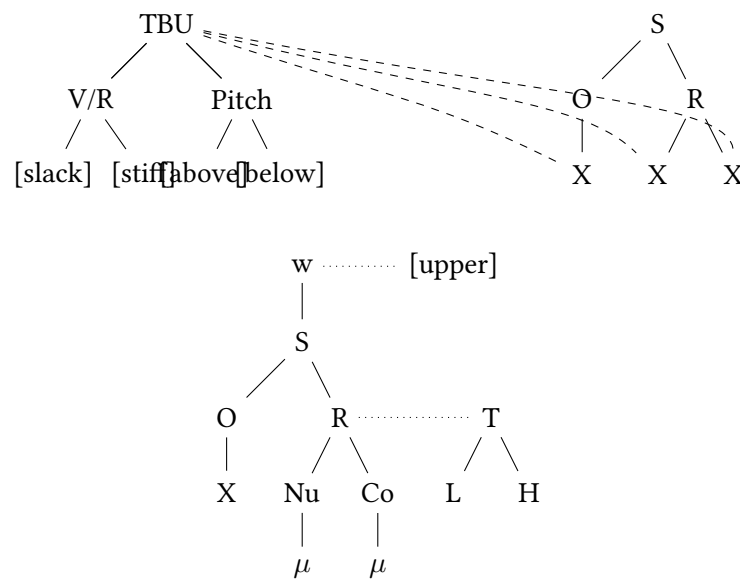
Since the register is a major distinction in shanghai tonology, many models of shanghai tones have been proposed based on feature geometry (Sagey, 1986), where the most detbaitng come from where the resgiter should locate.

Yip (1993) propose three possible candidates for the representation of register: (i) a laryngeal feature [VOICE, +SPREAD GLOTTIS], (ii) a tonal feature [–UPPER], or (iii) a feature that has affinities with both tonal and laryngeal nodes. Each option has consequences. (i) directly predicts that murmur correlates with onset voicing, but fails to explain the deletion of murmur in non-initial syllables. This gap is addressed by (ii), which can capture murmur deletion, but does not explain why [+upper] should condition onset voicing.

In light of this, Yip proposes that murmur should be analyzed as a hybrid feature, sharing properties of both laryngeal and tonal domains. This view, however, is challenged by Zhu (1999), who observes that syllable-initial voiced obstruents are sometimes realized as voiceless (see also Chen and Gussenhoven (2015)).

Building on Bao's model, Duanmu proposes that register is consistently reflected in voice quality but not always in pitch. His model treats pitch and register as two planes: one plane encodes the stiff/slack distinction in voice quality, while the other contains tonal features. Similarly, Ren (1992) treats murmur as a feature associated with the initial consonant.

Another issue in the feature geometry of Shanghaiese concerns the representation of medial and coda positions. Beyond the placement of register, scholars also debate how the syllable should be internally structured. Duanmu proposes that all Chinese dialects share the same underlying syllable structure. Rather than mora theory, he employs X-slots, positing three slots under the syllable node: one for the onset and two for the rime. Zhu, however, diverges from this proposal, offering a different analysis of syllable structure in Shanghaiese.



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