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Diagnosing dominance: Problematic sandhi types in the Chinese Wu dialect of Jinshan

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Abstract. The concept of phonological dominance plays an important role in typologizing tone sandhi behavior in Sinitic languages. We confront the diagnostic criteria for dominance with data from Jinshan, a northern Wu dialect with complex disyllabic lexical tone sandhi. Auditory and acoustic data for the seven Jinshan tones in monosyllabic words are presented and compared with their realization in several different types of disyllabic word tone. It is argued that the current criteria for deciding the dominance of tone sandhi require refinement, which, when applied, reveal examples of both left and right dominance within the same lexical tone sandhi system.

Keywords. tone sandhi; Chinese dialects; Jinshan dialect; metrical strength; tone preservation; tone neutralisation; tonal acoustics.

1. Introduction. Language likes to exploit the polarity of metrical strength, one striking example being the typological difference found in the highly complex morphotonemics of China's eastern coastal provinces (Ballard 1984, Zhang 2007). In the northern Wu dialects, in the north of what Norman (1988: 202) called the *sandhi zone*, the sandhi shape of words is said to be determined by tones on the morphemes on syllables at the beginning of a word. The word-initial morphotoneme often spreads onto following syllables, thus obliterating any non-initial tonal contrast. The tone spreading was first documented in the northern Wu dialect of Tangxi (Kennedy 1953), long before autosegmental phonology. Shanghai is a canonical example (e.g. Zee & Maddieson 1979). This type of tone sandhi is often called *left-dominant.* In the southern Wu and northern Min dialects in the middle of the sandhi zone, lexical sandhi behavior is said to be almost exactly the opposite (Pan 1991: 287): it is the morphotonemes on the word-final syllables which determine the word's tonal shape. The tone on the word-final syllable is said to be 'preserved', 'unchanged' or 'in agreement with' the citation tone, and tonal contrasts on the preceding syllables tend to be neutralised, although the neutralisation groupings are often bewilderingly complicated. This type is often called *right-dominant*.

Although Northern Wu varieties are described as typically left-dominant, and southern Wu as right-dominant, both types of sandhi can in fact be found in a single variety, where the difference is usually associated with different morpho-syntactic structures like words and phrases. One of the things we show in this paper is differences in dominance within a single system of lexical tone sandhi. But our paper's main aim is to assay the diagnostic criteria for dominance in greater depth using citation tone and sandhi data from the Chinese northern Wu dialect of Jinshan (Rose & Yang 2022), and focus on some of the problems in applying the concept to Jinshan tone sandhi. Jinshan is a good choice: its tone sandhi is much more complex than its immediate neighbor Shanghai, which is often cited as an archetypical left-dominant variety. Jinshan thus provides much better data for testing the notion of dominance. As will be seen from our multispeaker tone acoustics, we also take seriously Zhang's (2014: 457) comment on the need for "careful phonetic

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descriptions of the acoustic correlates for stress and tone" to reduce the uncertainty inherent in the typically impressionistic descriptions upon which much of modern tonology is still based.

2. Previous work. The typological dominance distinction in Sinitic varieties was, to the best of our knowledge, first proposed in Ballard (1984), who used the term *focus* for the feature. Ballard's focus feature is binary, with two values relevant to the beginning and ending of words: *left* and *right*. Ballard mentions several diagnostic features for focus, including segmental contrasts in Onset and Coda position, phonetic features of stress and spreading, and preservation of tone. However, from the number of times it is mentioned, *preservation of tonal contrasts* (p.5 *et pass*.) is for him the most important. Left focus is associated with preservation in the first position in lexical tone sandhi groups; right focus with preservation in the last position. Ballard does not specify what he means by tone, although it is likely from his use of *tonal contrast* that he has toneme in mind.

Later, Yue-Hashimoto (1987) used the notion of dominance in her typology of tone sandhi patterns in Chinese dialects. She recognises four types of sandhi, which she calls (pp.451, 452) *first-syllable dominant*, *last-syllable dominant*, *merging* and *local modification*. Dominance is involved in the first three types. Her single criterion for dominance (p.451) is the relationship between sandhi tones and citation tones (i.e. the tone used when reading a Chinese character out). Dominance can be identified by identity or similarity between citation tone and sandhi tone on the first or last syllable of the sandhi domain (p.451). The merging type is the absence of similarity or identity between sandhi form and citation form.

In describing the Wu tone sandhi types he surveyed, Qian (1997: 613) classifies the most common types under two headings: 前主后附 (lit. *front dominant - rear appended*) and 后主前附 (lit. *rear dominant - front appended*). In the first type, it is the initial tone which determines the sandhi and the final tone which is appended. The second type he is unable to fully characterise due to relative scarcity of data. Although he conceives the sandhi involving a relationship between a monosyllabic tone 单音调 and a sandhi tone 连读调 Qian makes an important observation (p.612) as to the typical 'imbalance' 不平衡 between them in Wu. Because of this 'imbalance', he prefers to represent the monosyllabic tone with its Middle Chinese tonal category.

In the major work on Chinese tone sandhi (Chen 2002), dominance is not actually explicitly mentioned. However, the main tonal properties Chen associates with metrical strength – tonal stability, tone modification, tonal neutralisation, tonal loss – are very similar to those associated in previous studies with dominance, and thus it appears that dominance may be taken as synonymous with metrical prominence, an interpretation reinforced by Chen's treatment of tone sandhi in several Wu dialects including Shanghai. The arguments in Chen (2002) are couched in a GP/OT framework, from which one can assume that for him the comparison is also between a sandhi tone and a unique underlying morphotoneme.

Note that Chen emphasises (p. 294) that one can infer the metrical structure from the tonal behaviour:

> "The fundamental insight implicit in virtually all studies on tones in context is that tonal behaviour is diagnostic of metrical prominence in that *tonal stability is a characteristic of accentual prominence*, while *tonal modification, neutralisation, or complete loss typically affect syllables in metrically recessive position*."

Furthermore, he argues for a metrical solution to the tone sandhi. In other words the he says the sandhi makes more phonological and phonetic sense if it is considered part of the realisation of

metrical structure, rather than just an isolated system of tone rules.

A detailed study of dominance is found in Zhang (2007), who is concerned with accounting for the asymmetry between left- and right-dominant systems in the tonological processes involved. Zhang also mentions dominance in his (2014) chapter on the typology of Chinese tone and tone sandhi patterns and their contribution to tonology, although he characterizes the distinction as *crude*. Zhang makes use of a GP/OT framework in his arguments, so for him the comparison is probably between a sandhi tone and a unique underlying morphotoneme.

All the researchers above observe that both left and right dominance can be found in the same dialect; however, the difference usually correlates with different morpho-syntactic behavior. For example in Shanghai dialect, verb + object phrases are right-dominant, whereas most of the lexical sandhi is left-dominant (Zhang 2007: 267; Ling & Liang 2019).

Common to this research on dominance are two ideas. The first is that dominance involves the relationship between some kind of basic tone (tone, toneme, citation tone, monosyllabic tone, unique underlying morphotoneme) and its realisation in sandhi. The second is that dominance is shown by the extent to which this basic tone is preserved. Lack of dominance, on the other hand, is shown in the extent to which the reference tone is modified, neutralised, or in some other way lost. As mentioned, different researchers have different ideas on the phonological status of their basic tone. For several reasons, we think it best for this investigation to initially define our basic tone as the tone observed on monosyllabic words, i.e. free morphemes. This avoids several thorny epistemological issues (Burton-Roberts et al. 2000: 1-18), including Kennedy's (1953) nightmare scenario: when a bound constituent morpheme occurs in a position which is always affected by tone sandhi, thus making it impossible to know the morpheme's underlying tone.

Our approach can be illustrated with the Jinshan word *pig liver*: [tsɿ kʉ 34.51] 猪肝. This is a compound word built from two free morphemes {tsɿ 猪 PIG} and {kʉ 肝 LIVER}, both of which have /51/ tones when they occur as monosyllabic words[1]. One can reasonably argue from this that the native speaker knows that, in the word *pig liver*, the word pitch of [34.51] corresponds to a combination of /51/ and /51/ monosyllabic tones. We can then reasonably point to preservation of /51/ on the word-final syllable, and modification on the word-initial syllable, inferring therefrom an instance of right dominance.

3. Procedure. Because of recent documented changes in the speech of younger Shanghai speakers (Gao & Hallé 2013), it was considered advisable to collect data from older Jinshan speakers, and so nine locals over 60 years old were selected and recorded by the second author, who is a native Jinshan speaker (albeit a youngish one). All participants self-reported to be native speakers of Jinshan who speak dialect in their daily life.

Informants were given a list of basic words for exemplifying Chinese dialect lexicon (HYFYCH 1964: 18-26) and asked to read out the equivalent Jinshan word. Recordings were made at 48 kHz, 24-bit on a computer in an acoustically absorbent recording studio using Adobe Audition 2021. Each speaker produced some 270 monosyllabic words comprising mostly nouns, stative verbs (adjectives), and functive verbs, and some 500 disyllabic lexical items. Together they provide a good idea of the nature of the monosyllabic and sandhi tones involved. Consent from all participants was acquired before the experiment.

[1] The free vs. bound status of a Jinshan morpheme can often be determined from the corpus we used. Since it is a list of Jinshan words, if the informant provides a monosyllabic form it must be free. In other cases we resorted to a very useful dictionary of Mandarin, which marks morphemes as free or bound (Chao & Yang 1970). We are aware that Chinese dialects can differ in the bound/free status of morphemes, so this is suboptimal.

The recordings were phonetically transcribed and manually labelled in *Praat*. Transcription is an essential part of the process: it enables one to become familiar with a voice and note features of possible phonetic and/or phonological importance (to take an actual example from the recordings, between-speaker variation in the use of labio-dental vs. labial-velar approximants ([ʋ], [w]). Tone acoustics (F0[2] and duration) were quantified with the same method used in previous studies of Wu varieties, e.g. Rose (2016a).

4. Jinshan monosyllabic word tones. Jinshan has seven tones on monosyllabic words (Rose & Yang 2022). They can be named after their pitch features, and represented using Chao tone letters, as follows: *high fall* 51, *mid rise-fall* 341, *high level* 44, *delayed mid rise* 224, *delayed low rise* 112, *short high* 4 and *short mid rise* 34 (underscoring indicates a short pitch when the Chao tone letter is greater than one). Figure 1 shows normalised acoustics from five speakers. F0 was z-score normalised, as this has been shown to be the best method for reducing between-speaker variation (Rose 2016b). Duration was normalised as percent of mean tonal duration. The arrangement of the panels in figure 1 shows how the seven tones are cross-classified in the typical Northern Wu manner by dimensions of *truncation* and *register*. The third important feature is *pitch target*. These three dimensions are now briefly discussed.

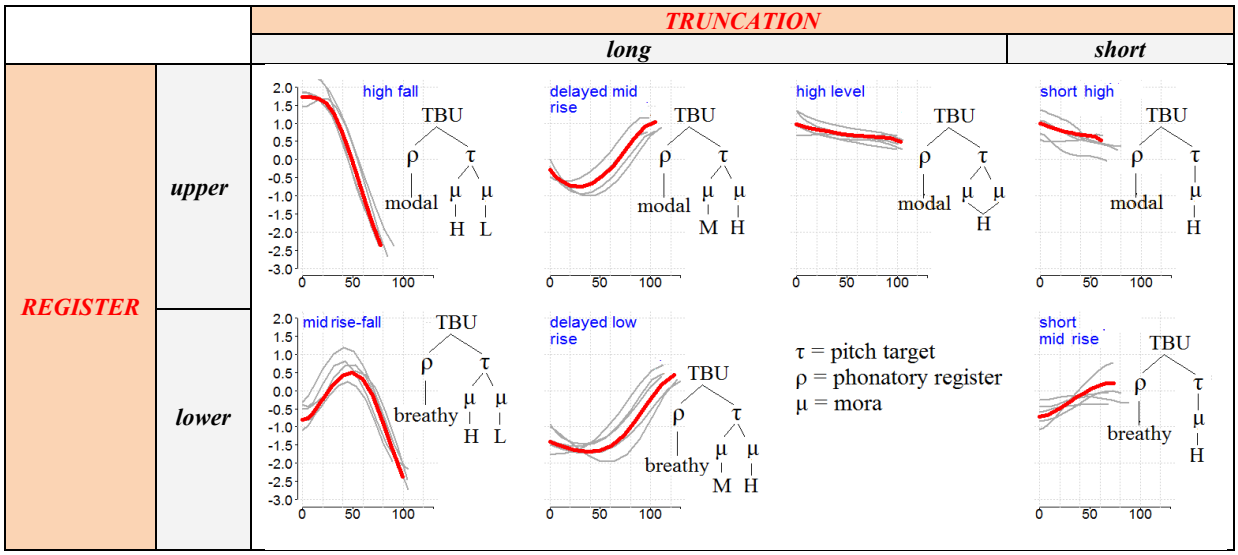


Figure 1. Normalized acoustics and tonological representation of the seven Jinshan tones on monosyllabic words. Thick red lines = mean normalized values. Thin lines = normalized values of five individuals. X-axis = normalised duration (%). Y-axis = z-score normalised F0 (sds around mean).

4.1. REGISTER. The dimension of *Register* partitions the seven tones into two sets. High fall, high level, delayed mid rise and short high level belong to the upper register, and mid rise-fall, delayed low rise and short mid rise are lower register. Register governs many phonetic and phonological features, both segmental and supra-segmental. For example, voiced obstruent phoneme Onsets are only found in the low register tones. One important realization of register is depression: lower register tones have depressed pitch onsets. Figure 1 has been arranged to demonstrate this, with the vertical pairs of tones differing in depression: the mid rise-fall tone is the depressed version of the high fall; the delayed low rise the depressed version of the delayed

[2] Please note we distinguish between *pitch* (perceptual) and *F0* (acoustic) attributes.

mid rise; and the short mid rise the depressed version of the short high tone. The upper register high level tone has no lower register counterpart.

Another important realization of register is in phonation type. For several speakers – although not all – lower register is extrinsically non-modal. The female speaker described in Rose & Yang (2022), for example, had very clear whispery voice for her lower register tones; another, male, had both growl (aryeppiglottic trill) and whispery voice. The non-modal phonation types occur with all types of syllable Onsets – obstruent, sonorant and zero – and are thus clearly not a function of syllable-initial obstruents.

Register also correlates to a certain extent with overall pitch height – upper register tones have pitch contours mostly in the upper half of the pitch range and lower register tones have pitch contours mostly in the lower half of the pitch range. But figure 1 clearly shows that there is considerable overlap between the high and low register tones' normalised F0 values, whichever value one choses to demarcate upper from lower (the mid z-score normalised F0 range lies of course at 0). This means it is not possible to define Jinshan register in terms of location of pitch/F0 in the upper or lower half of the pitch/F0 range, as is commonly assumed for Asian and African tone languages (Yip 2002; Hyman 1993: 77).

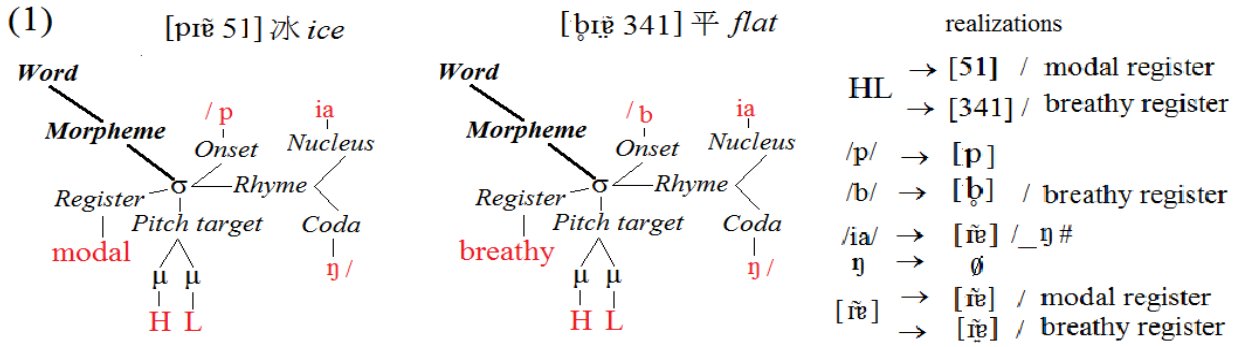
Since register is realized in many different ways, and therefore represents a higher level of abstraction, there is a problem with specifying it in terms of a single feature (unless of course the different realisations can all be related intrinsic-phonetically to the putative feature). In the tonological representations of figure 1, we have used phonation type (*modal* vs *breathy*) as the implementation of the upper vs lower register features. A possible articulatory characterization, following Moisik & Esling (2011), would be [+/- CET] (*constricted epilaryngeal tube*). For those speakers whose low register tones lack non-modal phonation, we would implement low register with a L tone, thus making it a kind of depressor. Below we have, for convenience, stuck to the relatively anodyne terms *upper* and *lower* register tones, and a phonatory register implementation. It is not crucial to the central argument of the paper.

4.2. PITCH TARGET. Factoring out register leaves us with just three tonal pitch targets: HL, MH and H. This insight is incorporated formally in the tonological representations in figure 1. It is important to note the vertical depressed and non-depressed tonal pairs do not only minimally differ in register; as will be seen later in the paper, they also behave as natural classes in the tone sandhi. Thus for example the high fall and the mid rise-fall undergo and condition the same tone sandhi processes. Representing them with the same tonal pitch target gives formal recognition to their natural class relationship as well as, of course, formalizing the effect of depression.

4.3. TRUNCATION. The dimension of *Truncation* also partitions the tones into two sets: long and short. Truncation is realized in duration, phonation offset and vowel inventory and quality. Short tones (short high, short mid-rise) have shorter Rhymes which are often terminated in a glottal stop word-finally. The relative difference in duration can be seen in figure 1 to be about 2 : 1 between the high level and short high tones, which have comparable F0. Truncation is also realized segmentally in a reduced number of Rhyme contrasts, with slightly different vocalic quality to those in long tones. As shown in figure 1, truncation can be represented straightforwardly in moraic structure: short tones have a single mora, long tones are bimoraic.

Examples of a conventional autosegmental derivation are given at (1) for the two monosyllabic words: [pɪ̃ 51] 冰 *ice*, with a high fall tone; and [b̥ɪ̤̃ 341] 平 *flat* with a mid rise-fall tone. Their tonal-geometric underlying forms are given to the left and centre, with the realization rules to the right. As can be seen, both words have the same HL tonal pitch target, but differ in register. The register then conditions the realization of the HL as [51] in modal register and [341] in

breathy. The realization of the phonation type is also, of course, conditioned by register. It is shown for the nonce as part of the realization of the nucleus /ia/: one typically hears a breathy vowel rather than a breathy pitch. The phonotactics of the Onset are an additional segmental effect conditioned by register, as /b/, along with other voiced obstruent phonemes, can only occur in low register morphemes, while /p/ and its ilk are restricted to upper register morphemes (the separate phonemic status of /p/ and /b/ can be demonstrated elsewhere in the phonology). The voiceless lenis realization of the /b/ as [b̥] is a word-initial allophone, but may also be explicable in terms of phonatory register aerodynamics. The derivation of the nasalized vowel is one often found in northern Wu, where an independently motivated nasal coda nasalizes a preceding vowel before dropping off.



We are now in a position to examine the tone sandhi in disyllabic words for several combinations of monosyllabic tone, and see how well they can be assigned a dominance value according to the customary criteria of preservation vs. modification / neutralisation / loss.

S1		S2		Word Pitch		Example
4	+	51	>	[2.51]	ă ku	*elder brother* 阿哥
		341		[2.ʱ341]	tsă dɐɯ	*bamboo* 竹头
		44		[4.44]	pĭ fu	*house lizard* 壁虎
		224		[2.34]	kə̆ tɑ	*here* □□
		114		[2.ʱ24]	ĭ dɪ̤ɛ̃	*certainly* 一定
		4		[4. 21̃]	pă pă	*father's elder brother* 伯伯
		34			ĭ zə̆	*continuously* 一直
34	+	51	>	[ʱ1.51]	lɛ̤̆ tɕɔ	*pepper* 辣椒
		341		[ʱ1.ʱ341]	mɔ̤̆ zą	*firewood* 木柴
		44		[ʱ23.33]	z̤ă tsɿ	*brother's son* 侄子
		224		[ʱ1.34]	z̤ɛ̤̆ sɿ	*fourteen* 十四
		114		[ʱ1.ʱ24]	z̤ɛ̤̆ na	*you (pl.)* "拾哪"
		4		[ʱ34.21̃]	z̤ə̤̆ tă	*worth* 值得
		34			z̤ə̤̆ lŏ	*sixteen* 十六

Table 1. Disyllabic lexical sandhi in Jinshan words with short morphotonemes on the word-initial syllable. S1, S2 = word-initial, word-final morphotoneme.

5. Disyllabic words with short morphotonemes on the word-initial syllable. The first pattern we present is in disyllabic words where the initial syllable has one of the two short morphoto-

nemes /4/ and /34/. Table 1 gives examples of these morphotonemic combinations and their corresponding word pitches in words said by one of our female subjects. Non-modal phonation type is shown with a superscript $^{\text{ɦ}}$. Underscoring indicates monomoraicity in tones with two Chao letters. Thus, for example, a disyllabic word with a short high /4/ morphotoneme on the word-initial syllable and a high fall /51/ morphotoneme on the word-final syllable has a [2.51] word

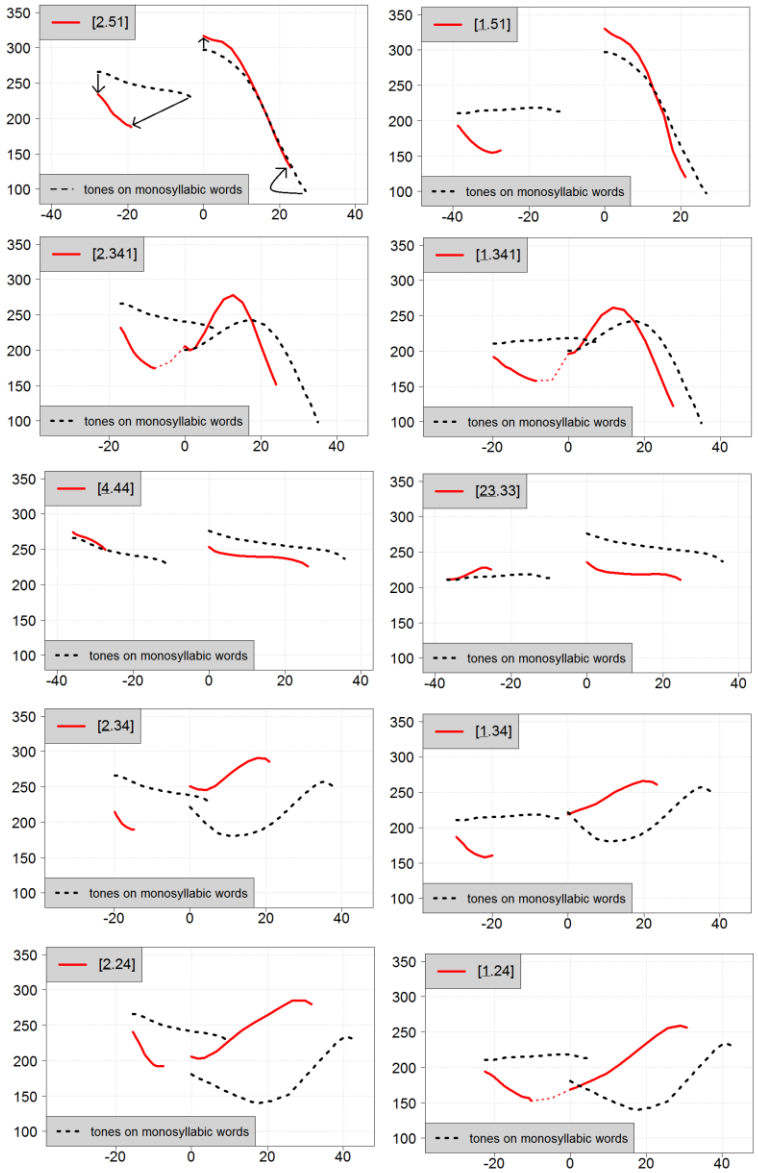


Figure 2. Mean F0 and duration for female speaker's disyllabic words with short tones on the word-initial syllable and long tones on word-final syllable. X-axis = duration (csec.), y-axis = F0 (Hz).

pitch: short lower-mid pitch on the first syllable and high falling pitch on the second. A disyllabic word with a short mid-rise /34/ morphotoneme on the word-initial syllable and a mid rise-fall /341/ morphotoneme on the word-final syllable has a [$^{\text{ɦ}}$1.$^{\text{ɦ}}$341] word pitch: short low pitch with breathy voice on the word-initial syllable and mid rise-fall pitch with breathy voice on the

word-final. Table 1 shows two different behaviors depending on whether the word-final tone is long or short. These will be treated separately, as they differ in dominance.

5.1. WORDS WITH FINAL LONG TONES. In words with long tones on the word-final syllable, the word-final syllable tone shows a clear resemblance to its monosyllabic tone. Thus the high fall /51/ and mid rise-fall /341/ tones do not change; the high level /44/ is a slightly lower [33] after a preceding [23]; and the delayed rising tones have a slightly higher onset. The phonation type is also preserved on the word-final syllable. The truncation and phonation type of the word-initial tones is preserved, but their pitch changes. The short high /4/ assumes a lower-mid [2] pitch before all tones except the high level /44/, when it has the same pitch as in monosyllabic words. The short mid-rise /34/ is realized as short low [1] before all tones except the high level /44/, when it has a slightly lower pitch than in monosyllabic words.

The speaker's mean F0 and duration acoustics corresponding to this pattern are shown in Figure 2. The left column shows acoustics for words with a word-initial short high /4/ morphotoneme, the right column shows words with a word-initial mid rise /34/ morphotoneme. Each row corresponds to a different word-final long morphotoneme. When the word-final morphotoneme is low register (in the even rows), its Onset is voiced, and the F0 corresponding to the voicing is then shown with a thin dotted line. In order to show how the disyllabic word tones relate to their monosyllabic tone, the mean F0 and duration of the latter are plotted with thicker dotted lines, with the monosyllabic and disyllabic F0 trajectories aligned at corresponding Rhyme onset. In the top left panel, the relationship between the monosyllabic tones and their disyllabic shapes is further suggested by arrows pointing from the monosyllabic tones to their disyllabic counterparts. Although the similarity between the F0 shapes on monosyllabic words and the word-final syllable is clear, they are of course not the same, and it remains a matter of faith to claim *preservation of tone* on the basis of eyeballing the acoustics. In order to properly assess the extent to which the tone is *preserved* one needs the arithmetical functions relating the monosyllabic to the disyllabic forms which make clear the factors conditioning the realization of the F0. This is, unfortunately, beyond the scope of this paper.

5.2. WORDS WITH FINAL SHORT TONES. Table 1 shows that the word-initial short tones in these combinations have pitches similar to their corresponding tones in monosyllabic words, with phonation type and short duration also preserved. When the word-final syllable has a short morphotoneme, however, its pitch is uniformly low falling and unlike its corresponding tone in monosyllabic words. Its phonation type is also often creaky and thus also unlike either the modal or breathy phonation types of the corresponding monosyllabic tone. Short duration is the only monosyllabic tonal property preserved.

Figure 3 shows the acoustics of this pattern. Unlike figure 2, each panel shows F0 traces for words with both short high and short mid rise morphotonemes on the word-final syllable. The trajectories in red are for words with the high morphotoneme; blue shows the mid rise morphotoneme. F0 for the voiced Onset that occurs with the mid morphotoneme is shown with a thin dotted line. The high morphotoneme has voiceless Onsets, so there is no F0. It can be seen that the F0 of the word-initial tones is similar to their monosyllabic form, although considerably shorter, being in a disyllabic word. All four word-final shapes, however, are very similar, with any F0/duration differences being conditioned by the voicing of the Onset. Note that the F0 on the word-final syllable falls well below the speaker's F0 floor, which figure 2 shown is a little below 150 Hz. This is a realization of the word-final creak.

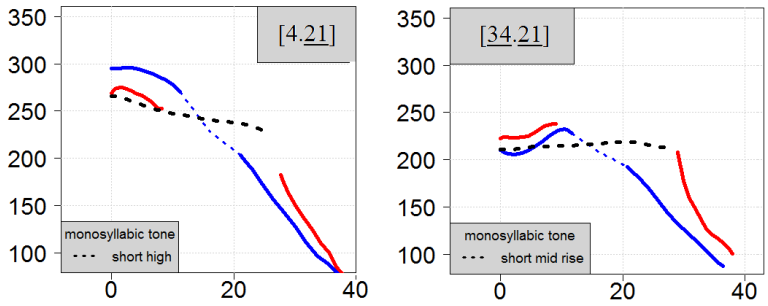


Figure 3. Mean F0 and duration for female speaker's disyllabic words with truncated tones on both syllables. Left panel = words with short high morphotoneme on word-initial syllable. Right panel = words with short mid rise morphotoneme on word-initial syllable. X-axis = duration (csec.), y-axis = F0 (Hz).

It is clear from the impressionistic and acoustic descriptions above that we are looking at the preservation of long word-final tones, and the preservation of short word-initial tones before short word-final tones. No change is thus required in the tonal phonology of these forms; only in their tonetics.

On the other hand it is also clear that we *are* looking at tonological changes in the case of short word-initial tones before long tones. The lowering observed in both word-initial short high and short mid rise tones (which both have a H pitch target – see figure 1) can be represented as a change from H to L. Since phonation type is preserved, the resulting difference in pitch between [2] and [$^{\eta}$1] is easily accounted for by the difference in phonatory register: [2] is the realization of L in modal register, [$^{\eta}$1] is the realization of L in breathy register. The lowering change of H to L is blocked when short tones occur before the high level tone: a plausible inhibitory phonetic conditioning.

Changes also occur to word-final short tones after short tones. There is no register difference in these word-final forms, and any residual difference in pitch is easily related to the effect of voicing on the syllable Onset. Thus the contrast between the short /4/ and /34/ tones is neutralised. The result of the neutralisation is a pitch at the bottom of the speakers' range which often becomes creaky, and is unlike the corresponding monosyllabic word tones. This marks this neutralisation typologically as one where "… NEITHER member of the opposition appears, … but some third … segment sharing properties of the others, but with some of its own" (Lass 1984 : 50).

It is clear that these tonal combinations with short word-initial tones, with their tonological changes and neutralisation on the one hand, and tonal preservation on the other, instantiate a canonical example of dominance. Words with long word-final tones are examples of right dominance, or a weak-strong metrical structure; words with short word-final tones are examples of left dominance, or a weak-strong metrical structure. Moreover, it looks as if we can go a step further and link the metrical structure to moraic structure. As far as these combinations are concerned, bimoraic tones are strong. This leaves words where both tones are monomoraic, in which case the word-initial tone is strong.

6. Word-final high falling pitch preceded by either mid rising or low rising pitch. The vast majority of words with a high fall /51/ morphotoneme on the word-initial syllable and either a high fall /51/, mid rise-fall /341/ or high level /44/ morphotoneme on the word-final syllable were said with a mid-rising pitch on the word-initial syllable followed by high falling pitch on the word-final syllable: [34.51]. Words with a mid rise-fall /341/ morphotoneme on the word-

initial syllable and either a high fall /51/, mid rise-fall /341/ or high level /44/ morphotoneme on the word-final syllable have a low rising pitch on the word-initial syllable followed by a high falling pitch on the word-final syllable: [23.51. Examples are in Table 2. Note that the word-initial [23] pitch preserves the breathy phonation of its morphotoneme, but that all word-final syllables are modally voiced, even if they are related to low register, i.e. breathy morphotonemes.

S1 Morphotoneme	S2 Morphotoneme			Word Pitch	Example	
51	+	51	>	[34.51]	tɕɐŋ tsɔ	*today* 今朝
	+	ʱ341			sɛ li	*pear*生梨
	+	44			tsʰɵu tɵu	*drawer* 抽斗
ʱ341	+	51	>	[ʱ23.51]	mi̤ɐŋ tsɔ	*tomorrow* 明朝
	+	ʱ341			lẹ̤ ŋi̤	*next year* 来年
	+	44			d̥ẹ̤ tsɿ	*peach* 桃子

Table 2. Disyllabic Jinshan words with mid rise + high fall and low rise + high fall word pitch.

Figure 4 shows the mean acoustics of these two word pitches for four speakers. [34.51] is shown on the left; [23.51] on the right. For each panel, two F0 trajectories are shown: one in red for words with voiceless intervocalic consonant and one in blue for voiced. The examples with voiced intervocalic consonant are those with a lower register mid rise-fall morphotoneme on the second syllable. The F0 is also shown of the speakers' monosyllabic tone on the corresponding word-initial morphotoneme: high fall on the left; mid rise-fall on the right.

It is clear from figure 4 that all word-final F0 shapes are the realization of the same high falling pitch target as in the high fall monosyllabic tone, with differences due to expected intrinsic effects from the voicing on the intervocalic consonant. The F0 corresponding to the higher and lower rising pitches on the initial syllable is also clear (the higher rise corresponds to the high fall morphotoneme, the lower rise to the mid rise-fall morphotoneme). The difference between the higher and lower rising F0 shapes diminishes throughout the Rhyme, so that the lower rise has only slightly lower F0 peak than the higher. Most examples show expected intrinsic effects on Rhyme duration from the intervocalic consonant.

This case appears *prima facie* to involve quite a lot of tone change and consequently very little preservation of tone involved on either syllable. The word-initial rising tones are clearly very dissimilar from their high fall and mid rise-fall morphotonemes. As for the word-final tone, its high falling pitch corresponds to three different monosyllabic morphotonemes: /high fall/, /mid rise-fall/ and /high level/, so the one case in which tone preservation appears clear is when the word-final morphotoneme is /high fall/. However, recall from figure 1 that both mid rise-fall and high fall morphotonemes share an underlying HL pitch target; and furthermore that the rise-fall pitch of the monosyllabic mid rise-fall tone results from word-initial depression, itself part of the word-initial realization of breathy register. It is therefore clear that, in the case of a word-final mid rise-fall morphotoneme, its high fall realization needs no explanation: there is no depression because the tone is not word-initial. This means that in two out of the three word-final cases, there is clear preservation of tone on the word-final syllable, but only in the sense of tonal *pitch target*, as there is no register contrast on the word-final syllable. In the remaining case, when the word-final morphotoneme is high level, there is clearly no preservation, either of tone or of tonal pitch target.

To what extent can dominance be diagnosed with these word tones? On the face of it, obviously in no absolute sense: there is modification, and thus lack of preservation of tone, on both

syllables, but less on the word-final syllable. This points weakly to a right-dominant pattern. However, the high fall word-final tone appears to involve a case of neutralisation with the high level tone, and neutralisation is supposedly diagnostic of lack of dominance! This indeterminacy

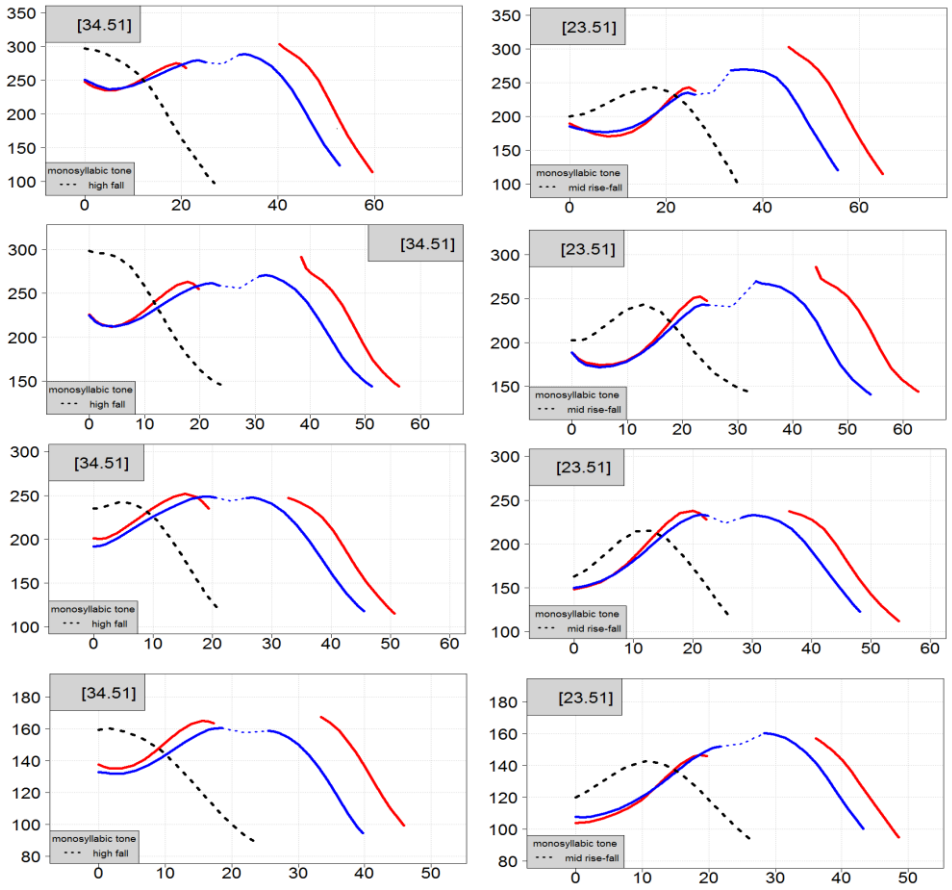


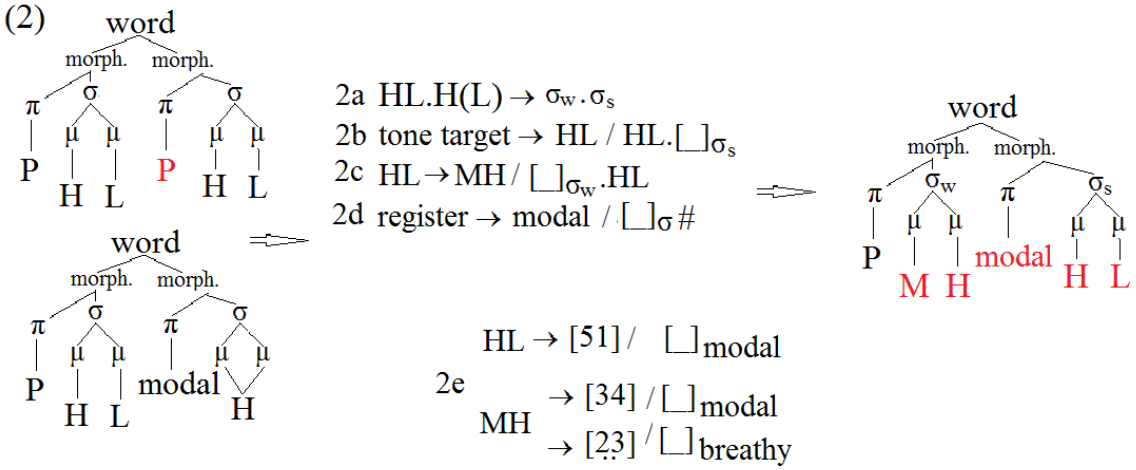
Figure 4. Mean tonal acoustics from four Jinshan speakers' disyllabic words with [34.51] (left) and [23.51] word pitch. Small dotted lines show F0 on voiced intervocalic consonants. Thicker dotted line shows F0 on monosyllabic high falling tone (left) and mid rise-fall tone (right). X-axis = duration (csec.), y-axis = F0 (Hz).

can again be resolved by recalling that there are different types of neutralisation (Lass 1984: 49ff.), depending on the realization involved. In the neutralisation of the word-final /4/ and /34/ short tones after short tones discussed in the previous section, the [21] realization resembled neither of the tones being neutralised, and could legitimately be considered therefore an example of a weak position. In the case in this section, however, one member of the neutralised opposition – high fall – appears to the complete exclusion of the other – high level. One might see in the persistence of the high fall an indication of the strength of the position, hanging on, so to speak, to at least one morphotoneme. There is, however, another way of interpreting the result of the neutralisation that is less metaphorical. It can, namely, be seen as an example of tone-to-stress attraction, a well-known indicator of metrical strength (Chen 2002: 69, 291 ff.). Suppose the word-initial HL tone target in these words is attracted to a metrically strong word-final position. This would account for the apparent neutralisation between the high and high fall tones. Interestingly, very similar tonal behavior has been demonstrated for the dialect of Zhenhai, across the bay from Jinshan (Rose 1990, Chen 2002: 69 ff.). Note, however, that this kind of argument goes

beyond simply eyeballing the criteria for dominance listed above. Rather, it involves an analytic choice which maximizes the phonetic naturalness of the derivation, i.e. we are asking "which kind of dominance will better motivate our derivation?" To make this kind of judgment one needs already to have derivations at hand.

In any case, we thus end up, after some refinement of the criteria for dominance, evaluating these [34.51] and [23.51] word pitches as instances of right dominance. Given this, it is then possible to include the metrical structure to write more plausible rules to derive the word pitch from underlying forms. An example is shown at (2): an autosegmental derivation of these [34.51] and [23.51] word pitches. In the left-hand column are shown the underlying representations for the relevant tonal combinations, which have either high fall or mid rise-fall morphotonemes on the word-initial syllable, followed by either high fall, mid rise-fall or high level on the word-final syllable (see table 2). P stands for either breathy or modal register, so [P, HL] represents both high-fall and mid rise-fall morphotonemes, and [modal, H] represents the high level morphotoneme. The tonological changes required to derive the surface forms are shown at top centre. (2a) formalizes an initial metrical strength assignment based on the tone target: any disyllabic sequence of HL and HL/H is deemed weak-strong. (2b) is a tone-to-stress association rule moving the word-initial HL to the metrically strong word-final position; (2c) is a natural tonal assimilation rule changing a weak fall (HL) to a rise (MH) before a strong fall (HL); and (2d) register on the word-final syllable is modal. Some of the changes will apply vacuously, of course. The output of these rules is shown on the left. (2e) are the realization rules for tonal pitch conditioned by register: MH is realized as [34] when register is modal and as [2̗3] when register is breathy. Modal HL is realized as [51].

(2)



7. Words with high level pitch on both syllables. Some Jinshan disyllabic words have high level pitch on both syllables. This happens mostly when the word-initial morphotoneme is either high level /44/ or delayed mid rising /224/, and the word-final morphotoneme is either delayed mid rise /224/ or delayed low rise /114/. Table 3 gives examples. Note that the word-final syllables in these combinations have modal phonation, irrespective of whether they come from upper or lower register morphotonemes, i.e. the low register morphemes on the word-final syllable do not retain the breathy voice of their monosyllabic tone.

S1 Morphotoneme		S2 Morphotoneme	Word Pitch		Example
44	+	224	> [44.44]	sɵʉ tʰɔ	*glove* 手套
	+	114		tsɔ ʊɛ	*breakfast* 早饭
224	+	224		ɕi pʰɪɔ	*movie ticket* 戏票
	+	114		pe lu	*in mid journey* 半路

Table 3. Disyllabic Jinshan words with high level word pitch.

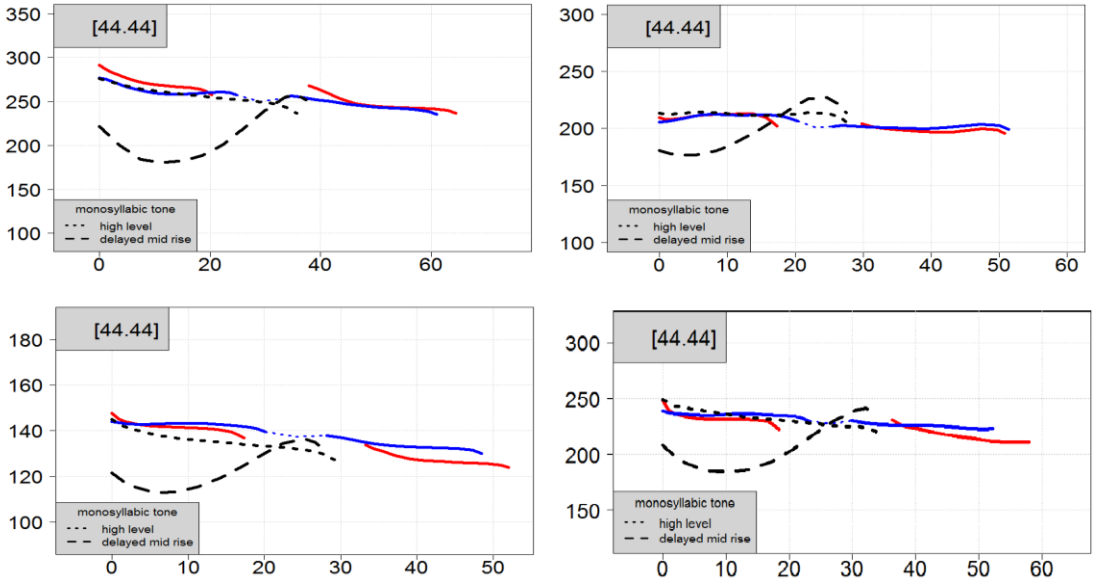


Figure 5. Mean tonal acoustics from four Jinshan speakers' disyllabic words with [44.44] word pitch. Small dotted lines show F0 on voiced intervocalic consonants. Thicker dashed lines show F0 on monosyllabic delayed mid rise tone; thicker dotted lines show F0 on monosyllabic high level tone. X-axis = duration (csec.), y-axis = F0 (Hz).

The acoustics of four speakers' disyllabic words with high level pitch are shown in figure 5. The F0 of their monosyllabic high level and delayed mid rise tones is also shown for reference. The four speakers' acoustics are all very similar and unremarkable for such a pitch, with F0 declining slowly over both syllables. Intrinsic duration and F0 perturbation effects due to the voicing on the second syllable Onset are also as expected, viz: longer rhymes before a voiced consonant and falling onset F0 perturbation after a voiceless consonant. It can be seen that the F0 on the word-initial syllable is very similar to that of the speaker's high level monosyllabic tone, but very different, of course, from their delayed mid rising monosyllabic tone.

For words like [sɵʉ tʰɔ 44.44] *glove* with high level /44/ morphotoneme on the first syllable, the high level word pitch looks very much like the result of a conventional spreading of a high level word-initial morphotoneme after the following morphotonemes have been deleted. This example would therefore seem unequivocally to qualify as left dominant by virtue of tone preservation, albeit in its spread realization. The problem of course is with those [44.44] words like [ɕi pʰɪɔ 44.44] *movie ticket* which have a word-initial mid-rise /224/ morphotoneme, since in this case there is no motivation for the origin of the high level word pitch. Once again, for words like [ɕi pʰɪɔ 44.44] *movie ticket*, one cannot invoke tonal preservation to diagnose dominance, since clearly no tone has been preserved. In the previous section, the type of neutralisation was invoked as a diagnostic aid, and this seems to help in this case also: neutralisation is in favour of one of the /44/ and /224/ pair being neutralised. Note also that the neutralisation on the word-

final syllable in favour of a high level pitch is of the type where the result is neither of the /224/ and /114/ pair being neutralised, and thus is indicative of lack of dominance.

8. Summary. This paper has described monosyllabic tones and several examples of disyllabic lexical tone sandhi from the Northern Wu dialect of Jinshan in order to illustrate, from the relationship between their sandhi form and the monosyllabic tone of their constituent morphemes, some of the complexities in diagnosing whether the lexical sandhi is left- or right-dominant. After suggesting that dominance is a manifestation of metrical strength, we have gone from cases where the dominance is clear from preservation of tone – in words with short morphotonemes on the initial syllable and long morphotonemes on the final – to cases where there is no preservation of tone – in cases where both constituent morphotonemes have a delayed mid rising tone.

We have shown that preservation of tone, at least in Wu, is not a straightforward notion, because it is sometimes the tonal pitch target that is preserved and not the whole tone, including phonation type. We have demonstrated that neutralisation is not automatically an indication of lack of dominance, as is generally assumed, but, depending on the type of neutralisation, can also be indicative of dominance. We have also suggested that dominance emerges from a deeper consideration of the implications of different derivational possibilities rather than just evaluating the customary criteria for dominance. It may also be the case that acoustic-phonetic experimentation with differential effects of speech rate and focus on F0, duration and intensity, as has been shown for Shanghai by Ling & Jiang (2019), can help in the diagnosis.

This paper demonstrates, adding to Rose & Shen (2016), that one can find both left and right dominance for non-truncated tones operating within the same lexical tone sandhi system, and we have hinted above that the metrical strength of a tonal combination within a word may be predicted – at least for Jinshan – from the tonal identity of the constituent morphemes. These two findings have implications for Chen's (2002) suggestion to have tone sandhi rules being conditioned by metrical strength. We certainly agree with the idea of stress phonetically conditioning tone, as shown for example in Kratochvil (1968: 35-47). However, first assigning metrical strength on the basis of tone, and then having the tone conditioned by metrical strength, looks circular. Perhaps it is the case that the different strong-weak and weak-strong metrical strengths we have seen in Jinshan have to be considered as underlying?

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