TONAL COMPLEXITY AS CONDITIONING FACTOR: MORE DEPRESSING WENZHOU DIALECT DISYLLABIC LEXICAL TONE SANDHI

Phil Rose
Phonetics Laboratory, Linguistics (Arts), Australian National University

ABSTRACT: An acoustic description and tonological analysis are presented for the lexical tone sandhi in a subset of tonal combinations in the Southern Wu dialect of Wenzhou. Realisation of first syllable tones is shown to involve a change to a high rising tone, with and without a depressor, conditioned by the tonological complexity of the tone on the second syllable. Changes to both first and second syllable tones are shown to be part of a wider set of changes governing tonal realisation in Wenzhou sandhi.

INTRODUCTION

This paper is another in a series describing aspects of lexical tone sandhi in the Southern Wu Oujiang dialect of Wenzhou (Wz). The Wu dialects of China are well known for their complex tone sandhi, and Wz is no exception. One of the many sources of the complexity is the often opaque morphotonemic relationship between a dialect's isolation tones, and the tones when they occur on morphemes within a word. It is a goal to try to make tonological sense of these relationships. Wenzhou dialect contrasts eight tones on monosyllabic words or citation forms, but as a result of neutralisation commonly found in Wu there are much less than (8^2 =) 64 combinations to be explained. An account of the morphotonemics in about a third of the Wz tone sandhi can be found in Rose (2001). A further 16 combinations were analysed in Rose (2000). This paper focuses on one of the remaining two subsets of sandhi combinations involving 12 more tonal combinations.

CITATION TONES

Phonetic description and names of the eight Wz citation tones are given in table 1. Figure 1, from Rose (2001: 45), shows the F0 values of the eight Wz citation tones of a male native speaker plotted as a function of absolute duration. Each curve is a mean of ca. 10 tokens. From table 1, and figure 1, it can be seen that the eight Wz tones comprise upper ("a", [+ upper register]) and lower ("b", [-upper register]) values of the same four pitch shapes: *level* (tones Ia and IIIb); *rising* (tones IIa and IIb); *falling* (tones IIIa and Ib); and *dipping* (tones IVa and IVb). Length also appears to be an important auditory dimension for some tones. Thus the high-rising tone IIa is notable for its shortness, and the low-level tone IIIb and especially the dipping tones IVa and IVb sound long.

A	B	C
Ia	mid-level	[33]
IIa	short high-rising	[34]
IIIa	high-falling	[52]
Ib	mid-falling	[331]
IIb	low-rising	[114]
IIIb	long low-level	[222]
IVa	long mid-dipping	[3312]
IVb	long low-dipping	[2212]

Table 1. Wenzhou citation tones. A = tone name, B = simple auditory descriptor, C = Chao integer pitch transcription.

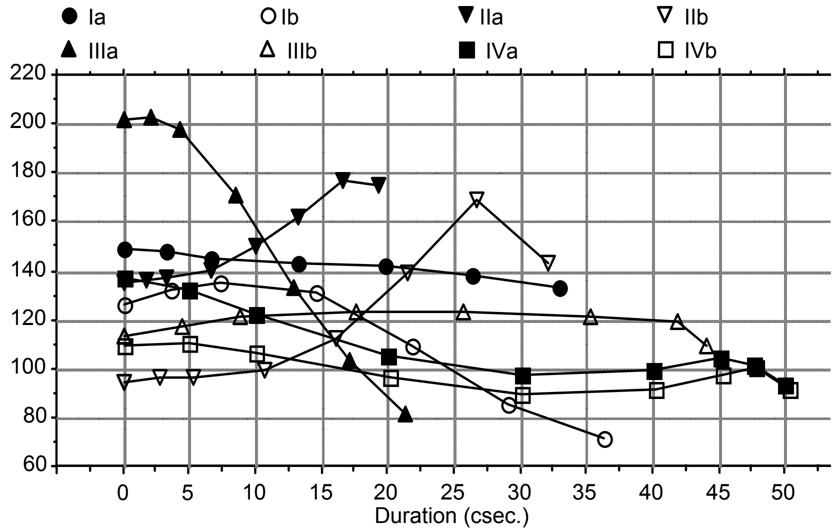


Figure 1. Mean F0 shapes of the eight Wenzhou citation tones.

The important distinction for this paper is between the natural class of *complex* (also termed *extra complex*) tones, i.e. the dipping tones IVa and IVb, and the other six *non-complex* tones. Complex tones have a tritonal HLH melodic component in their tonological representation (Yip 1989: 155). The combinations to be examined in this paper can now be nominated as those with the complex upper and lower tones IVa and IVb on the second syllable, and all six non-complex tones on the first.

Ia + IVa					
tseɪ 33	+	ɕy 3312	⇒	tseɪ ɕy	*pig's blood*
pig		*blood*		45 311	豬血
Ia + IVb					
ta 33	+	dəʊ 2212	⇒	ta dəʊ	*alone*
single		*alone*		45 311	單獨
Ib + IVa	+				
daʊ 331		hu 3312	⇒	daʊ hu	*hair*
head		*hair*		35 311	頭髮
Ib + IVb	+				
maŋ 331		ba 2212	⇒	maŋ ba	*understand*
clear		*white*		35 311	明白
IIa + IVa					
pə 34	+	tʰa 3312	⇒	pə tʰa	*pagoda*
precious		*pagoda*		45 311	寶塔
IIa + IVb					
pʰu 34	+	dʑaɪ 2212	⇒	pʰu dʑaɪ	*popular*
universal		*reach*		45 311	普及
IIb + IVa					
də 114	+	te 3312	⇒	də te	*moral*
way		*virtue*		35 311	道德
IIb + IVb					
zaŋ 114	+	ma 2212	⇒	zaŋ ma	*vein*
quiet		*pulse*		35 311	靜脈
IIIa + IVa					
kʰa 52	+	səʊ 3312	⇒	kʰa səʊ	*speed*
quick		*speed*		45 311	快速
IIIa + IVb					
pʰəʊ 52	+	li 2212	⇒	pʰəʊ li	*to burst*
to break		*to split*		45 311	破例
IIIb + IVa					
ba 222	+	hu 3312	⇒	ba hu	*method*
arrange		*way*		35 311	辦法
IIIb + IVb					
dəʊ 222	+	ma 2212	⇒	dəʊ ma	*maize*
big		*maize*		35 311	大麥

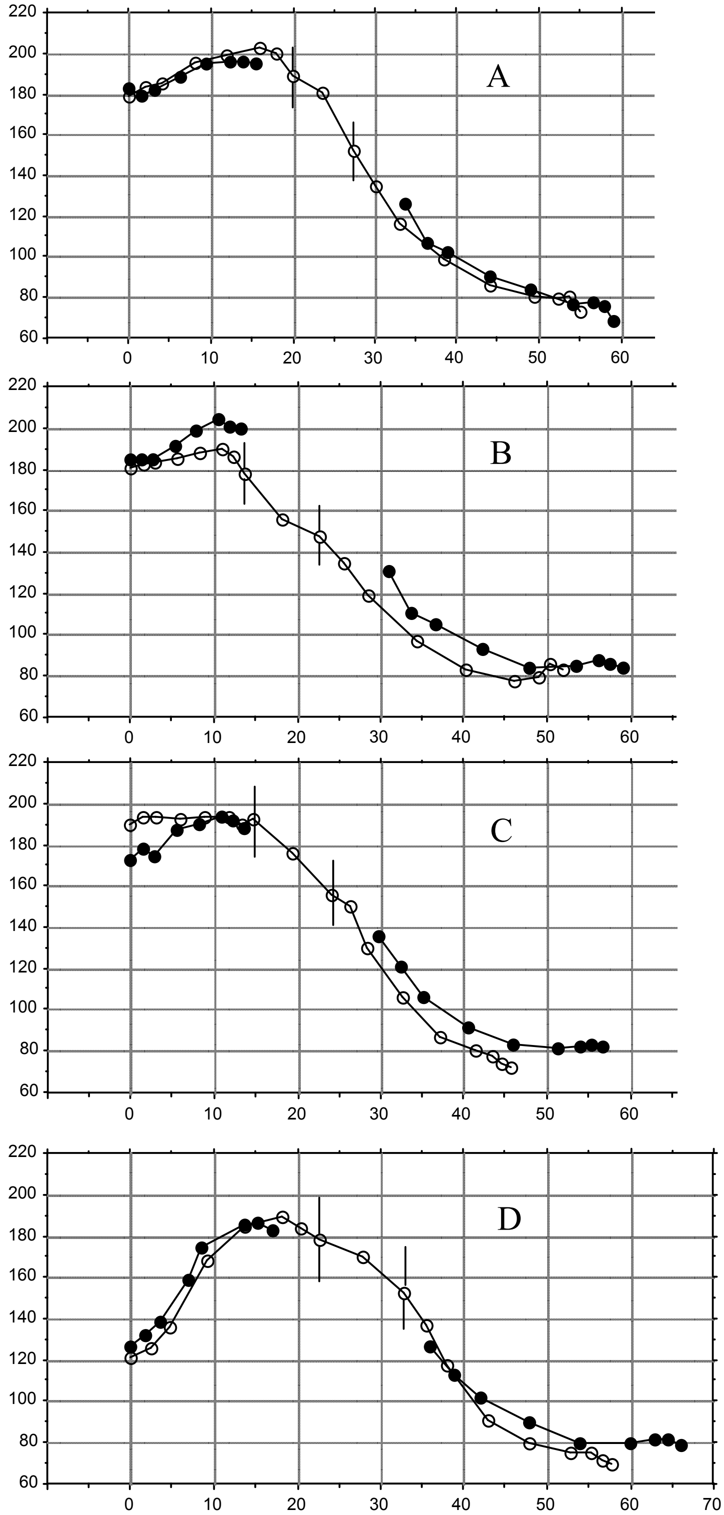
Table 2. Examples of Wenzhou tone sandhi in disyllabic words with input non-complex tones on the first syllable and complex tones IVa and IVb and the second syllable

The upper ("a") and lower ("b") Wz citation tones are distributed in typical Wu fashion with respect to several segmental and suprasegmental features of the syllable, in particular the manner of articulation of syllable-initial obstruents. Like other Wu dialects, Wz has three morphophonemically separate sets of syllable-initial stops (voiceless aspirated; voiceless unaspirated; and voiced), and two sets of syllable-initial fricatives (voiceless and voiced). The first two sets of stops occur on syllables with the upper ("a") tones and are realised by voiceless aspirated and voiceless unaspirated allophones. The third set of stops, which co-occurs with the lower ("b") tones, has different realisation depending on position in the word. Word-internally the realisation is modally voiced. Word-initially, the third series of stops is realised in this corpus predominantly by voiceless, coincident VOT articulations, but there is a small amount of free variation with modal, VOT lead tokens. The same applies *mutatis mutandis* to the two sets of fricatives: voiceless in upper, "a" tones; voiced word-internally, and voiceless in free variation with voiced word-initially in lower, "b" tones. In this paper, the morphophonemically voiced series are transcribed with voiced symbols.

TONE SANDHI

Table 2 shows the auditory characteristics of tones in disyllabic words with input complex tones IVa and IVb on the second syllable, and all non-complex tones on the first. The particular input tonal combination, e.g. "Ia + IVa", is given at the left, and under it an actual example. Thus it can be seen that a word like tse□□y *pig's blood*, with an input non-complex mid level [33] Ia tone on the first syllable and an input complex mid dipping [3312] IVa tone on the second, has a short high rising pitch on the first syllable and a mid falling then low level pitch on the second: [45 311]. Table 2 shows that these combinations all share the following pitch characteristics. The pitch on the first syllable is short and rises to high in the speaker's pitch range. Lower register input tones (i.e. tones Ib, IIb, IIIb) have a pitch onset about in the middle of the speaker's pitch range, and upper register input tones (i.e. Ia, IIa IIIa), have a higher onset. The pitch of the second syllable tone resembles that of the input citation tone IVa or IVb without its final rise: the pitch falls from the speaker's mid pitch range, and then has a prolonged low level component.

Figure 2. Mean F0 shapes for disyllabic words with complex input tones IVa and IVb on the second syllable, and non-complex tones Ia (A), IIa (B), IIIa (C), Ib (D), IIb (E), and IIIb (F) on the first. Axes = F0 (Hz) and duration (csec.)



The acoustics corresponding to the combinations in table 2 are shown in figure 2. This figure shows F0 on the first and second syllable rhymes, and on their intervocalic consonant if voiced, in Wz disyllabic words. The same speaker is used as in figure 1. Each curve is the mean of at least three different words. In each of the panels, two F0 curves are shown corresponding to each second syllable tone: one (solid circles) for the mean value with tone IVa on the second syllable, and one (empty circles) for the mean value with tone IVb. Thus the F0 shape with solid circles in panel 2A shows mean values for input tone Ia before input IVa, and the F0 shape with empty circles shows mean values for input Ia before IVb. This graphing permits examination for possible progressive assimilatory effects. The F0 curves are aligned at the onset of the first syllable rhyme, in order to best show the degree of similarity between them. Vertical lines indicate adjudged onset and offset of the voiced intervocalic consonant.

Panels A through C in figure 2 show that the F0 on the first syllable high register input tones Ia, IIa and IIIa rises about 20 Hz, from an onset of ca. 180 Hz, in about 10 to 15 csec. (The level F0 shape in panel C correlates with aspirated syllable-initial consonants). Panels D through F show the F0 on the low register input tones Ib, IIb and IIIb rising from ca. 120 Hz to between 160 and 180 Hz in about 15 to 20 csec.

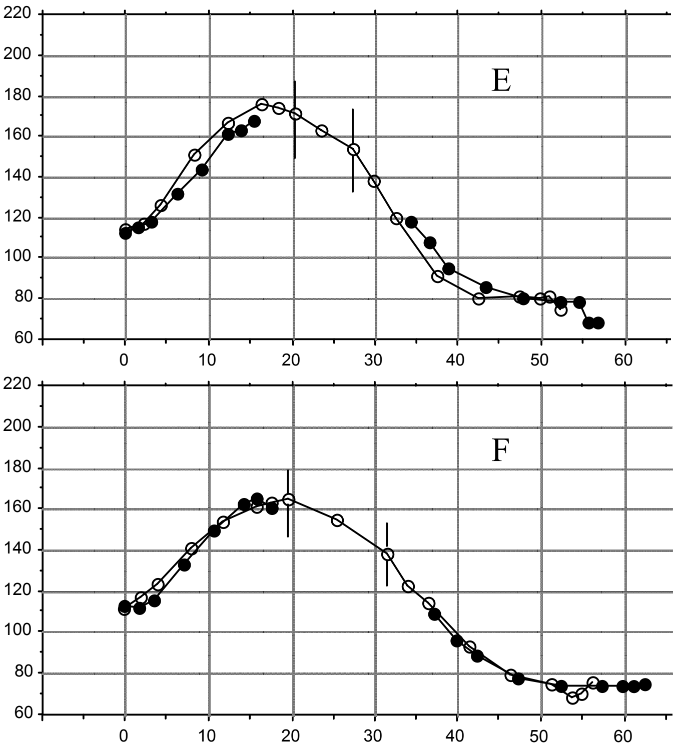
The F0 on the second syllable tones falls from about mid F0 range (150 Hz - 160 Hz), with the F0 onset of IVa lying lower than that of IVb. The F0 derivative then slows down and F0 usually flattens out at about 80 Hz. Both IVa and IVb F0 shapes occur on Rhymes of very similar (ca. 25 csec.) duration. The expected intrinsic differences in the first syllable F0 shapes associated with the intervocalic consonant are present. Thus F0 shapes before IVb tones, with the latters' preceding voiced consonant, are slightly longer; and F0 shapes before IVa tones, with a voiceless consonant, show a sharper negative offset perturbation.

TONOLOGICAL ANALYSIS

The changes involving the complex tones on the second syllable are more simple and will be described first.

Second syllable tones The auditory impression in table 2 indicated that second syllables have a mid falling then low level [311] pitch. Figure 3 shows the corresponding mean F0 shapes for second syllable tones IVa and IVb after the short high rising [45] and mid rising [35] pitch on the first syllable. The F0 shapes have been aligned and plotted with respect to their end-points, and the F0 on the second half of the voiced intervocalic onset consonant on syllables with input tone IVb has been retained (the onset of the IVb Rhyme is shown by a vertical line). It can be seen that all four shapes have a falling F0 which then levels out. It can also be seen that the four shapes constitute two groups according to input tone. The two F0 shapes associated with input tone IVb group together, and have a 30 Hz to 40 Hz higher onset that the two F0 shapes associated with input tone IVa.

Figure 2 (con't).



F0 values at second syllable Rhyme onset and mid consonantal duration appear to be slightly higher after [45] pitched tones, with their higher F0 peak, than after [35] pitched tones. The significance of this effect was tested with a two way ANOVA with second syllable tone (IVa, IVb) and first syllable pitch/F0 ([35], [45]) as independent variables. No significant effect was demonstrated for first syllable F0 on second syllable F0 values, either at Rhyme onset in the four shapes (p = 0.08), or at Rhyme onset in IVa input tones and mid-consonantal duration in IVb tones (p = 0.06). These p-values are still not far off 0.05, however, so it seems sensible to interpret this as indicative of an expected, i.e. perseverative, but minimal, conditioning of cord vibration rates in the second syllable by vibration rates in the first.

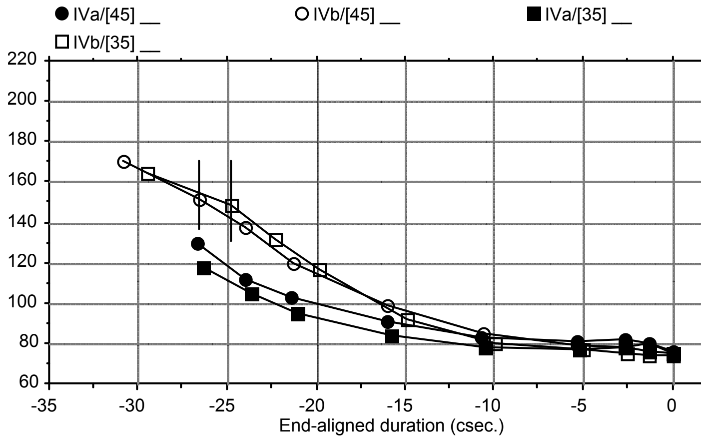


Figure 3. Mean F0 shapes for second syllable input tones IVa and IVb after [45] and [35] pitch on the first syllable.

Although figure 3 shows the IVa and IVb F0 shapes on the second syllable to be separate over the first 3/5ths of the rhyme duration, it is clear that their relationship is reversed from that in citation form, where IVa has a higher onset than IVb (figure 1). The IVa second syllable shapes also appear to have similar onsets, at ca. 120Hz, to the IVb citation shape (figure 1). A possible tonological interpretation for this is that the second syllable complex tones IVa and IVb are neutralised in sandhi in favour of the low-dipping IVb tone. Phonetically, a low falling-level F0 target is involved, but it is being intrinsically perturbed by the effect of F0 trajectory of the first syllable tone and +/-voice on the intervocalic consonant. This interpretation is strongly supported by the comparable behaviour of the non-complex Wz tones on the second syllable, which have also been shown to neutralise in phonetically similar pairs in favour of a low register tone. Thus the level pitched tones Ia and IIIb are neutralised to [22], the rising pitched tones IIa and IIb are neutralised to [23] and the falling pitched tones are neutralised to [21] (Rose 2001: 60-65). This appears, then, to be a nice example of a citation target realisation. ('Citation target' is one of the categories of relationship between citation tones and tones in sandhi, and refers to cases where tones in sandhi 'can be identified as one of the citation tones, once allowance is made for intrinsic influence of various conditioning factors...' (Rose and Toda 1994: 271)).

First syllable tones It is clear from table 2 that there is neutralisation of tonal contrast on the first syllable too, but here it is massive. The three-way tonal contrast between upper register first syllable tones (Ia, IIa, IIIa) is neutralised in favour of a short high rising [45] tone; and the three-way contrast between the lower register first syllable tones (Ib, IIb, IIIb) is neutralised in favour of a short mid rising [35] tone. Figure 4 shows the mean F0 values corresponding to these neutralised pitch shapes. Two curves are plotted for each pitch shape showing the acoustic allotone before voiced and voiceless intervocalic consonants. Figure 4 shows F0 shapes that correspond fairly well to the transcribed [45] and [35] pitches. Assuming an F0 range for this speaker from about 70 Hz to 220 Hz, the F0 on the former can be described as rising from high in the speaker's F0 range to higher, and F0 on the latter as rising from mid range to a peak value about 20 Hz lower than the high rising F0 peak. As can be seen, the mean duration of the F0 shapes lies between ca. 15 and 20 csec., which is about half that of the second syllable rhymes and about the same as the short rising [34] citation IIa.

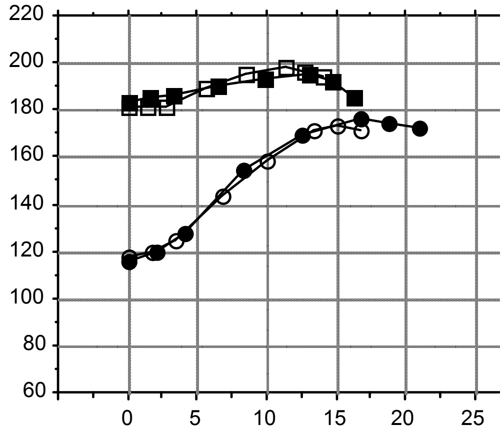


Figure 4. Mean F0 shapes for neutralised tones on first syllable. [45] & [35] pitches are shown by squares and circles respectively, solid and empty symbols indicate occurrence before voiced and voiceless C respectively.

The phonological interpretation of these first syllable shapes is complicated, and requires reference to phonological constructs of tonological *melody*, *register* and *depression*. The first two of these are often used in the tonological representation of Asian tone languages, and refer to the tonal pitch shape, and the division of a speaker's tonal pitch range into an upper and lower register [+/-U] (Yip 1980). Thus one possible representation of a tone with a high rising pitch, e.g. [35], is [LH, +U], i.e. consisting of a LH melody in the upper pitch register; and a tone with a low falling [31] pitch can be represented as [HL, -U]. Depression ([+/- D]) refers to the lowering of pitch at the onset of a tone. Thus one possible representation of a tone with a convex [341] pitch is as a depressed high fall [51], viz: [+U, HL, +D]. Depression is a well-known phenomenon in the tonology of African tone languages, e.g. Zulu, but has recently also been shown to play an important part in Wenzhou tone sandhi (Rose 2001). Within this conceptual framework, the first syllable pitch shapes [45] and [35] appear in fact to be depressed and non-depressed versions of an upper register rising tone, and as such represent a change of all non-complex tones to the high rising citation tone IIa before second syllable complex tones.

This tonological interpretation of the first syllable shapes is buttressed by reference to the tone-sandhi behaviour of non-complex first syllable tones in Wenzhou before non-complex tones. Rose (2001) showed that before a non-complex tone on the second syllable, the Wenzhou non-complex tones IIa and IIIa change to a tone with high falling pitch, and tones IIb and IIIb change to a tone with a mid convex pitch (the same change also happens to input tones Ia and Ib under slightly different conditions). For example the disyllabic compound word *common* consists of the tone IIa morpheme [p□u 45] *common*, followed by the tone Ia morpheme [t□□□ 33] *general*, and is said [p□ut□□□ 53 22], with a change from rising [45] to falling [53] on the first syllable; and the disyllabic compound word *dictionary* consists of the tone IIIb morpheme [zz□222] *character*, followed by the tone IIa morpheme [ti45] *scholarly book*, and is said [zz□ti343 23], with a change from low level [222] to convex [343] on the first syllable. These first syllable changes were interpreted tonologically as a global change to a high register falling tone (i.e. [+U, HL]) before a non-complex tone on the second syllable, with input tones Ib, IIb, and IIIb also showing a depressor effect, i.e. [+U, HL, +D]. An additional layer of interpretation sees these changes as so-called categorical shifts to the high falling citation tone IIIa, with and without a depressor.

The data presented in this paper indicate that a very similar thing is occurring with non-complex first syllable tones before complex tones. That is, all non-complex first syllable tones Ia, IIa, IIIa, Ib, IIb, IIIb change to a high register **rising** tone [+U, **LH**] before complex second syllable tones, with tones Ib, IIb and IIIb also showing a depressor effect, i.e. [+U, LH, +D]. This means that the first syllable F0 shapes in figure 4 represent a high rising [+U, LH] tone, with and without depression. Since citation tone IIa is a high rising tone, it is possible to interpret this change further and see in it, just as with the previously described changes to IIIa before non-complex tones, another categorical shift, this time to the high rising citation tone IIa, with and without a depressor. One apparent counter-indication to this putative categorical shift to IIa is the relationship between the citation F0 shape of IIa and the F0 shapes on the first syllable tones. It can be seen by comparing these shapes in figures 1 and 4 that, far from being the same as the putative [+U LH] sandhi tone, the IIa citation tone F0 shape, with a rise from ca 120 Hz to 170 Hz, is almost congruent with that of citation IIb, not IIa! However, it has been well established from Mandarin (Xu 1997), Standard Thai (Gandour et al. 1991) and Southern Thai (Thompson 1997: 172-182) that tonal co-articulation typically involves dissimilation in F0 height from a following syllable tone. Since the (neutralised IVa/IVb) tone on the following syllable is clearly low register, it is to be expected that a citation IIa will dissimilate in height from it and thus move upwards, thus making the observed F0 shapes a perfectly plausible candidate for a +/- depressed IIa target.

SUMMARY

This paper has solved a little more of the puzzle of Wenzhou tone sandhi. It has shown how the effect of complex tones on the realisation of preceding non-complex tones is to change the latter into high rising tones with and without depression. By comparison with changes before non-complex tones, the paper has also uncovered the principles governing the realisation of all first syllable non-complex tones in Wenzhou disyllabic lexical sandhi. These are (1) a change to high register, with all "b" tones showing a depressor effect; and (2) a change to a falling HL tone melody before non-complex second syllable tones, and to a rising LH melody before second syllable complex tones. How a difference in second syllable tonal complexity can apparently condition a falling versus rising difference in first syllable tonal melody is intriguing and remains to be investigated.

ACKNOWLEDGEMENTS

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