Zooming-in on Oujiang Wu: tonal homogeneity and acoustic reconstruction in a small sub-group of Chinese dialects

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Abstract

Acoustic descriptions of citation tones are presented for speakers from seven sites in the Oujiang sub-group of the Wu dialects of east central China. The homogeneity of two tones within the Oujiang sub-group is demonstrated by quantified comparison with Shanghai tones, and it is pointed out that the normalised tonal acoustics can be interpreted historically as reconstructions of proto-Oujiang tones.

1. Introduction

We do not expect tones, as phonological phenomena, to vary without limit, but to show similarities, or so-called tonological universals, across varieties. Nevertheless, when one samples tones from different tone languages, or even different dialects, they often show a great variety of pitch shapes. Zhu and Rose (1998) for example demonstrated no less than 25 different tones in four varieties from different sub-groups within the Wu dialects of east central China (*tone* is used here in a sense analogous to *phone*, i.e. a constellation of pitch, length and phonation characteristics that constitutes observation data for tonemic analysis). In exploring the nature of phonological variation in Language, we normally concentrate on differences. This paper focuses rather on the flip-side and explores how similar tones can be. It looks at variation in tones at seven localities distributed over a fairly small geographical area where the varieties are assumed to be homogeneous because they belong to the same dialectal sub-group. It asks: how do tones within a dialectal sub-group vary from one locality to the next?

Although this study reveals some interesting synchronic variation, the main reason for undertaking it is not typological, but historical. As mentioned, the Wu dialects of Chinese are well-known for their tonal complexity. Not only do they exhibit probably the most complex tone sandhi in the world (Rose 1990), but they also show a bewildering variety in their citation tones. Most Wu varieties have eight citation tones, but these can differ considerably in their shape. It is a major challenge to find out how it got that way. In reconstructing previous stages of a language, historical linguists use the comparative method to work backwards from the present-day distribution of features. In order to apply the comparative method, it is normal to start from the smallest well-defined groupings. That is what this paper starts to do for a sub-group of Wu called Oujiang 甌江. It brings together the acoustic descriptions of tones of speakers from seven different Oujiang sites, to gain a better understanding of the historical relations of the dialects within this sub-group.

2. Wu and Oujiang

The Wu dialects are a sub-group of Sinitic, along with the other six major dialect groups of Chinese (Mandarin, Min, Hakka, Yue, Xiang & Gan). They are spoken in the two eastern coastal provinces of Zhejiang and (southern) Jiangsu. Oujiang is one of the sub-groups currently recognised for Wu (Zhengzhang 1987). The Oujiang sub-group, eponymous with the river bisecting it in a N.W. to S.E. direction (jiāng = *river*), is located in the S.E. corner of Zhejiang province. About five million people speak Oujiang varieties, of which Wenzhou is probably the best known.

In historical linguistics, sub-groups can only be established on the basis of shared, unusual innovations. Oujiang can be considered a *bona-fide* sub-group because of its unusual development of two proto-Wu tones. Proto-Wu is reconstructed with eight tones, two of which - tones *IVa and *IVb - occurred on short syllables with final stops. Elsewhere in the Wu area, reflexes of these tones are usually short, with a word-final glottal-stop, e.g. Zhenhai [pǎʔ 5] (< proto-Wu *pak 45) 百 *hundred*; & [bǎʔ 24] (< proto-Wu *bak 23) 白 *white* (Ballard 1969: 90, 92). Oujiang dialects, however, show an unusual compensatory lengthening, whereby the proto-Wu final stop in *tones IVa & b has been lost, and the original short tone has developed a complex pitch. The cognates of the Zhenhai IVa & b tone morphemes *hundred* & *white* in the Oujiang dialect of Wenzhou, for example, are [paːː 312] & [baːː 212].

Synchronically, Fu et al. (1985: 20) mention the tonal homogeneity of Oujiang as one of its characteristics. The homogeneity lies in the very similar pitch shapes Oujiang dialects have for reflexes of some Middle Chinese (and by extension proto-Wu) tones. Oujiang reflexes of Middle Chinese tone *Ia are said to have a high level pitch contour; *Ib reflexes are mid-falling, *IIa and *IIb reflexes have rising contours, with *a* being higher than *b*; *IIIa reflexes are high falling; *IIIb are low level. This realization of the proto-tones results in a neat pattern with three contours: level, rising and falling, each with a relatively higher and lower pitch. The level tones come from *Ia & *IIIb; the rising tones from *IIa & *IIb; and the falling tones are from *IIIa & *Ib. In each case, the *a* reflex is higher than the *b*. The two remaining tones – the elongated reflexes of *IVa & *b – also typically form a

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Table 1: Pitch of the eight Wenzhou citation tones (after Cao 2005).

	level	rising	falling	complex
higher	44 (Ia)	45 (IIa)	42 (IIIa)	323 (IVa)
lower	22 (IIIb)	34 (IIb)	31 (Ib)	212 (IVb)

higher and lower pair, but their contour varies. Typically, however, it is complex. Table 1 shows a pitch transcription of the tones of the Oujiang dialect of Wenzhou, from Cao (2005). It shows the three higher and lower contours and also a pair of complex dipping tones for *IVa & *b. Although this paper will uncover some variation in this pattern, it helps to keep it in mind, when the individual speakers' tones are discussed, as a typical template for Oujiang tones.

3. Data and sources

The seven Oujiang sites described are: Wēnzhōu 溫州, in the centre of the Oujiang area; and two sites fairly close to it: Yǒngjiā 永嘉, ca. 16 km. to the north, and Xiàngyáng 象陽 ca. 15 km. to its east. Yuèqīng 樂清, ca. 30 km. N.E. of Wenzhou, lies further away. Qīngjiāng 清江 lies even further away, near to the northern border of the Oujiang area, where it abuts the Taizhou sub-group of Wu. Píngyáng 平陽 lies ca. 40 km. to the south of Wenzhou and near the southern border of the Oujiang area. Wénchéng 文城 lies ca. 60 km. W.S.W. of Wenzhou and near the south-west border of Oujiang. The selection of sites gives a fairly evenly distributed sampling of all the Oujiang area except for the N.W., where the Oujiang dialects border on the Chuqu sub-group of Wu.

The acoustic descriptions of the speakers from the seven Oujiang sites are mostly from my measurements and analysis of some very nice recordings made by W.L. Ballard in the 1980's and by Zhu Xiaonong in the 1990's. Ballard (1994) published descriptions of F0 and duration from his recordings, but sampled F0 only at inflection points. This is inadequate for the kind of descriptive and analytical work necessary in this paper, since it does not give a sufficiently detailed picture of the tonal F0 time course. I have completely remeasured Ballard's data for this paper. I am, needless to say, extremely grateful to these two scholars of Wu for their generosity. The procedure used to extract the acoustic tonal features can be found in Rose (1990, 2002).

Auditory descriptions of the tones of all but one of the sites in the paper (Xiangyang) can be found in Fu et al. (1985: 109, 110) and Cao (2005: chart 4-1). They are in Chao's 'tone letters' five-point scale, with 5 = highest pitch and 1 = lowest pitch, and underlining to indicate short duration. Although it is adequate for representing categorical tonal differences *within* a variety, it is far from clear whether this kind of five-point representation is adequate for potentially continuous differences *between* varieties. The tones of two sites, Wenzhou and Yongjia, are also found transcribed in quasi-musical notation.

Figure 1 shows the mean citation tonal acoustics for the seven Oujiang sites. Each panel has the tones of a single speaker (means of between 5 and 10 tokens). F0 is plotted as a function of absolute duration: this is because there are some characteristically big differences in the duration of different tones in Oujiang. The top three rows show Wenzhou, Xiangyang and Yongjia, each row with two speakers shown side by side. The remaining four sites are represented by one speaker each, and are shown in the bottom two rows. Yueqing and Qingjiang – the northernmost two sites – are placed above the southernmost sites Wencheng and Pingyang. The tones are identified and colour-coded by their Middle Chinese tonal categories: Ia & b are shown in red; IIa & b are in black; IIIa & b in blue; and IVa & b in green. This makes it easier to see which tones are cognates, an important consideration because there are some potentially confusing differences between speakers and varieties. The tones are also labeled with simple pitch descriptors, like 'mid level'. +D indicates depression: a phonological effect associated with word-initial position in many Wu dialects, whereby the F0/pitch onset of a tone is lowered, so for example a depressed mid *falling* tone will have a *convex* pitch/F0 shape (Rose 2002).

4. Descriptions of individual sites

4.1. Wenzhou tones

Acoustic information is available for two Wenzhou speakers: a middle-aged male recorded by Ballard, and a young female recorded by me in 2006. The corpus and elicitation is described in Rose (2002), and was exactly the same for both speakers. The two Wenzhou speakers' tones are shown in the first row of Figure 1. They both show the three level, rising and falling F0 contours, which can be picked out reasonably easily. Tones Ia (red) & IIIb (blue) are level; tones IIa & IIb (black) are rising; and tones IIIa (blue) & Ib (red) are falling.

Although both speakers are fairly typical, they differ from the conventional descriptions, and each other, in several ways. The most important of these are: (1) The female does not distinguish an upper and lower rising tone: both her IIa and IIb tones are realised with the same low rising pitch/F0. Compare this with the male's separate reflexes of IIa and IIb, which present a typical Oujiang configuration. Thus the female can be said to only have seven citation tones. Interestingly, a low rising [13] pitch for Wenzhou tone IIa is also transcribed in another source, so this citation tone merger is not a new phenomenon. (2) Whereas the male has typical long complex falling-rising realizations for his IVa and IVb tones (the falling part being the more salient), the female lacks the rising component for both these tones. They are consequently higher and lower mid falling. (3) The female's mid falling tonal F0 (Ib), seems to fall from a relatively higher value than the male's, and this is presumably related to the fact that she already has a mid falling tone: IVb. It can be seen that the F0 of her IVb tone has a very similar level-falling shape to that of the male's mid falling Ib tone.

4.2. Xiangyang tones

Material from two youngish Xiangyang speakers, a brother and a sister, is available. They were recorded by Ballard, with the same corpus and elicitation as the Wenzhou speakers above. Both speakers have eight tones, arranged in the conventional way. Their acoustic citation tone profiles are shown in row two of Figure 1. Their tones are similar to the male Wenzhou speaker in having three pairs of level (or quasi level), falling, and rising contours; and a pair of complex

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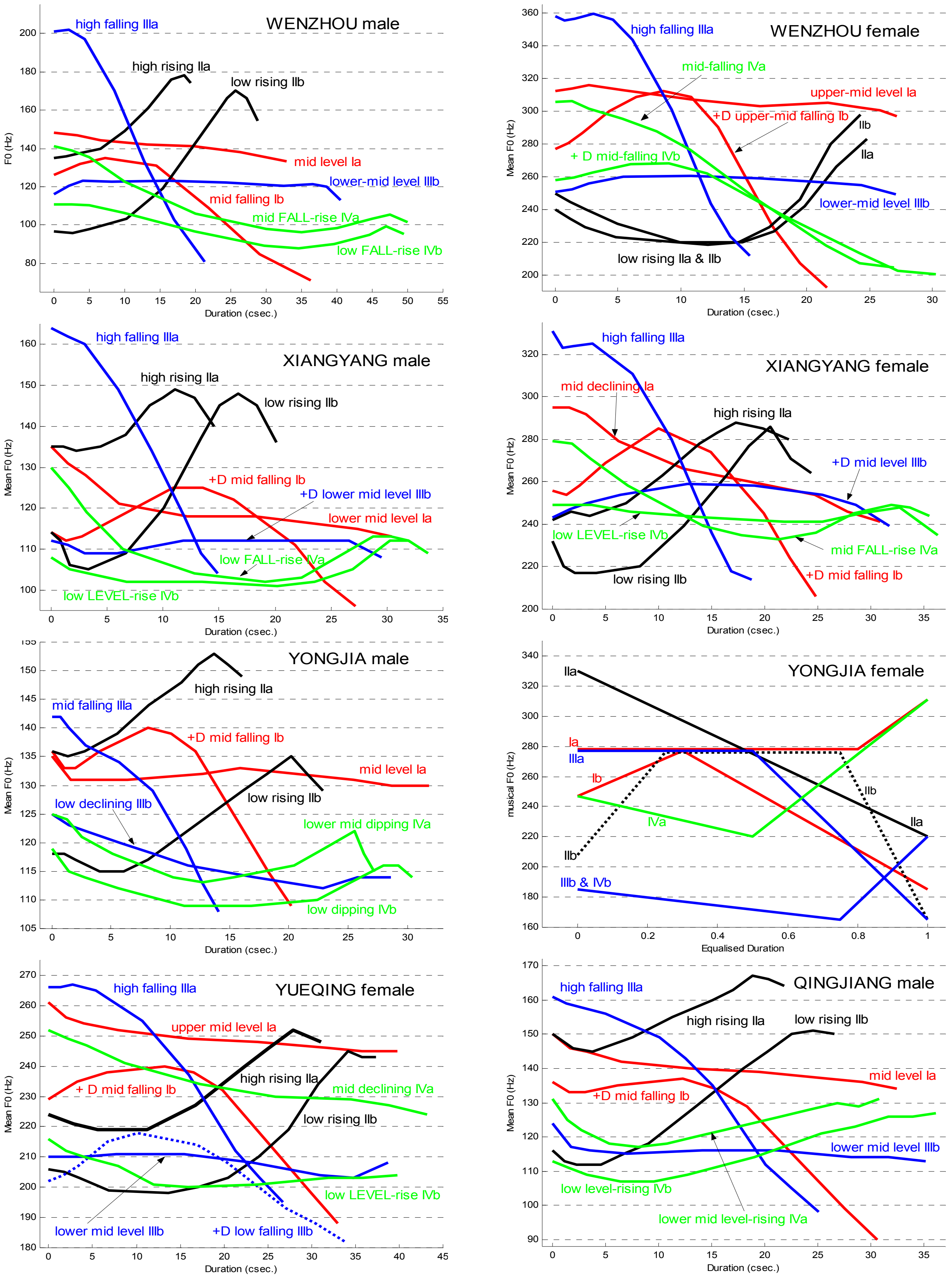

Figure 1 (above & next page): Citation tone acoustics of speakers from seven Oujiang varieties.

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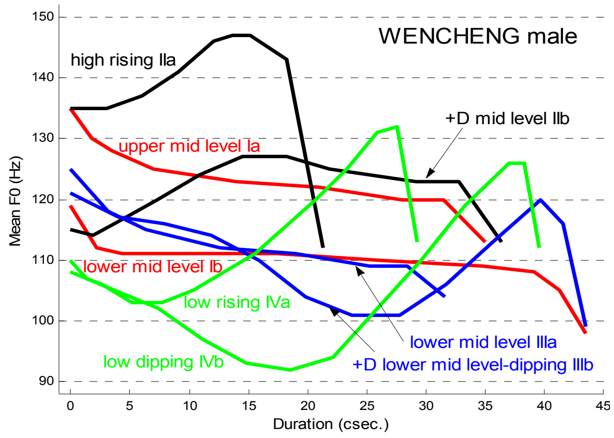

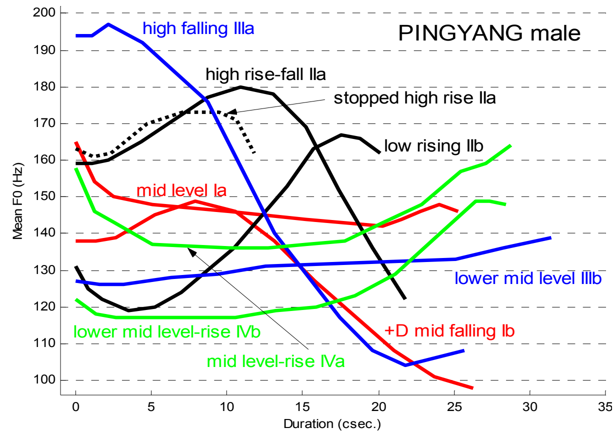

contours. They differ from his tones mostly in the contour of the complex IVb tone, which has a level, not falling component before its rise. The two Xiangyang speakers differ in the location of their (green) complex IVa & IVb tones: they lie lower in the male. The female also shows a higher position for her (red) Ia and Ib tones.

4.3. Qingjiang tones

The Qingjiang speaker's citation tone acoustics are on the right of the fourth row in Figure 1. They are from recordings made by Zhu in 1997 of a young male speaker. These tones are very similar to those already presented for the Wenzhou male and the Xiangyang speakers. They differ in the contour for the fourth pair of tones – IVa & IVb – which is delayed low rising, as opposed to falling-rising or falling.

4.4. Yongjia tones

The Yongjia tonal acoustics in the third row of Figure 1 are from two sources: a male speaker recorded by Ballard, and the female speaker described by Chao in 1928. In his pioneering description of Wu dialect phonetics, Chao transcribed tonal pitch musically, using a sliding pitch pipe. The musical basis of Chao's notation permits easy transformation into fundamental frequency (F0) values on the simplifying assumption that tonal pitch is a primary function of F0 (see Rose (1993: 215, 216) for similarly reconstructed Shanghai tonal F0). Unfortunately, the duration of the tones cannot be reconstructed, and so the tonal F0 is plotted as a function of equalized duration. The Yongjia speakers' tones show several interesting things: (1) Both appear to have a mid falling reflex for IIIa, as opposed to the high falling tones of the previous speakers. A lower onset for IIIa might well be a Yongjia characteristic, therefore. (2) Chao's speaker has a high *falling* reflex for IIa, and a depressed mid fall for IIb, whereas Ballard's speaker has the same high and low *rising* contours seen in the previous speakers. An extrinsic falling pitch/F0 for these two tones would of course present a problem for reconstruction, given that the other speakers have rising pitches for IIa and IIb. According to Zhengzhang (1995: 359), who is a native Wenzhou speaker, a falling pitch for these tones occurs if the speaker tries to prolong their intrinsically short duration, as is the case when Wenzhou scholars declaim citation tones. Thus, he says, Chao's 1928 transcription was in error. There are arguments both for and against this hypothesis, but it is worth noting that the Pingyang speaker below shows free variation of a very similar kind, at least for IIa, between a stopped high rising pitch and an unstopped rise-fall pitch. (3) Chao's speaker is described as having merged tones IVb and IIIb, whereas Ballard's speaker keeps them separate. (4) A new, dipping, contour for both IVa & IVb tones can be heard from Ballard's speaker.

4.5. Yueqing tones

The female Yueqing speaker's tones in the fourth row of Figure 1 are from a recording made by Zhu. Her tones differ in two main ways from the previous speakers: (1) She has two allotones for the reflex of IIIb. One is the low level version common to most other speakers; the other, plotted with dots in the figure, is a depressed low falling tone. There is no obvious segmental conditioning to the split which would predict which morphemes are said with level pitch and which with falling, and it may be that her depressed low falling IIIb morphemes represent a merger in progress with Ib which also has a depressed falling pitch/F0. Against this hypothesis is the fact that the falling IIIb morphemes have much lower F0, and sound much lower in pitch than the Ib morphemes. (2) Zhu's speaker has yet another shape for IVa: a slightly falling pitch in her mid pitch range.

4.6. Pingyang tones

The female Pingyang speaker's tones in the last row of Figure 1 are from a recording made by Zhu. The speaker shows the same basic configuration as the others, but has two interesting features. (1) Her IIa morphemes showed free variation between a short stopped high rising pitch, i.e. [34ʔ], and an unstopped high rise-fall pitch, i.e. [342]. The F0 corresponding to these two variants can be easily seen in Figure 1, where the Pingyang stopped tone F0 is plotted with dots.

4.7. Wencheng tones

Wencheng is very different. The data on the last row of Figure 1, from a recording of a male speaker by Ballard, show far more differences from the other dialects than similarities. There are, to be sure, paired higher and lower level tones, and higher and lower rising tones, but they are not the same reflexes as for the other Oujiang varieties. The lower rising tone, for example, is a reflex of IVa, not IIb, and the lower level tone is a reflex of Ib, not IIIb. There are not even any falling tones. The only thing that Wencheng clearly shares with the other varieties is a mid level tone for Ia, and a high

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rising tone for IIa (its final falling F0 is from a [ʔ]). The other tones do not appear elsewhere in the Oujiang group examined. For example, there is no depressed upper-mid level tone (IIb), neither is there the marvelous super-complex reflex for IIIb, which seems to consist of a lower-mid *level* target followed by a *dipping* contour. Even the low dipping contour for IVb rises much higher than in the other varieties, and the apparent merger of Ib and IIIa is a very rare phenomenon in Chinese. Despite these differences, Wencheng still shows elongated reflexes of proto-Wu *IVa & b tones, and thus must count as a synchronic Oujiang variety. However, whether it is diachronically an Oujiang variety that has undergone considerable subsequent changes independently of the other Oujiang dialects; or whether it is originally not Oujiang but has changed under the latter varieties' influence, remains to be determined.

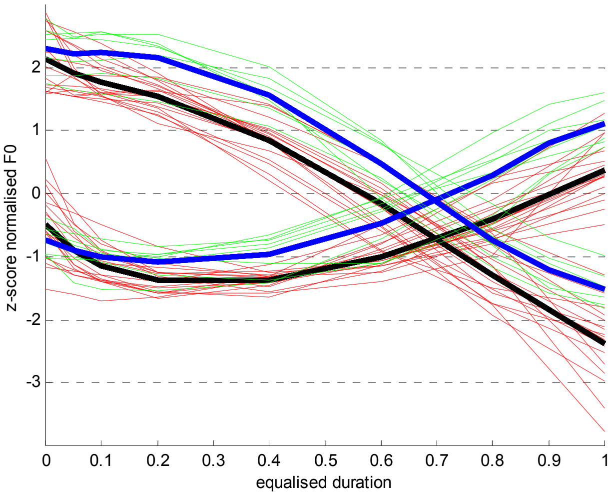

Figure 2: Comparison by z-score normalisation of Shanghai and Oujiang high falling and low rising tones.

Table 2: Comparison between Shanghai and Oujiang of standard deviations around mean normalised F0 for high falling (SH Tone 1 / OJ IIIa) and low rising (SH Tone 3 / OJ IIb) tones.

	0%	5%	10%	20%	40%	60%	80%	100%
SH T1	0.49	0.32	0.28	0.23	0.33	0.43	0.40	0.61
OJ IIIa	0.39	0.36	0.38	0.38	0.31	0.36	0.33	0.29
Δ	*0.10*	-0.03	-0.10	-0.14	*0.01*	*0.08*	*0.07*	*0.33*
SH T3	0.55	0.39	0.30	0.22	0.13	0.22	0.36	0.44
OJ IIb	0.23	0.27	0.23	0.22	0.30	0.44	0.49	0.31
Δ	*0.32*	*0.12*	*0.07*	*0.00*	-0.17	-0.22	-0.14	*0.14*

5. Quantifying tonal homogeneity in Oujiang

The sections above have described the tones of speakers from seven different sites in the Oujiang sub-group. It is clear that some tones show very little variation from site to site. The reflex of Ia is mid or upper mid level in most sites, for example. How can one quantify the degree of this variation, however? One possibility is to measure the degree of homogeneity of the different speakers' tones by how well they cluster after normalisation. If it can be shown that the amount of variance around the mean normalised F0 shape for a given tone across the Oujiang varieties is the same as that found for a comparable tone *in a single dialect*, it can be claimed that the tones from the different sites are as homogenous as a single dialect. This idea was trialed using comparison with two tones from the Wu dialect of Shanghai, a dialect for which there is data on 18 speakers' citation tones (Rose 1993, Zhu 1999), and for which there is consequently a reasonable estimate of the within-dialect between-speaker variance in normalised tonal F0. Shanghai (SH) has a high falling tone (Tone 1) and a low rising tone (Tone 3) which sound very similar to the high falling IIIa and low rising IIb tones of Oujiang (OJ), and it was these two tones that were compared.

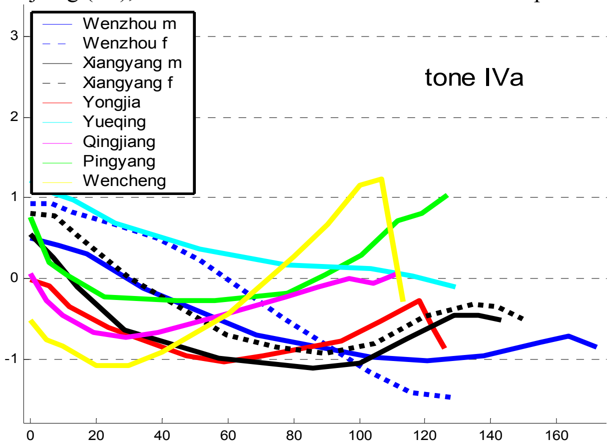

Figure 3: Normalised acoustics (F0, duration) of reflexes of proto-Wu *IVa in Oujiang dialects.

The tones of both sets of data (SH and OJ) were z-score normalised (Rose 1987). SH and OJ have different numbers of tones, most of which do not correspond. Therefore the normalisation parameters of mean and standard deviation would not be expected to be comparable, and consequently the variance around the mean normalised F0 would also not be expected to be comparable. Thus it was expected that a further calibration would be necessary before the tones could be legitimately compared. As can be seen in Figure 2, this turned out not to be the case. Figure 2 shows the z-score normalised values for the four tones plotted against equalized duration. The thin red lines represent the normalised Shanghai tones and the thick black line their mean normalised value. The thin green lines represent the normalised Oujiang tones and the thick blue line their mean normalised value. It can be seen that the OJ falling and rising tones lie less than a standard deviation above the corresponding SH tones, but that otherwise the two varieties' normalised contours are remarkably similar. Because of this, the variances around the mean normalised F0 are comparable. Their standard deviations at each of the sampling points, and the difference between them, are given in table 2. In table 2 it can be seen for example that at onset (0%), the sd for the mean normalised F0 of Shanghai high falling tone SHT1 was 0.49, and the corresponding value for the Oujiang high falling tone IIIa was slightly less: 0.39. This means that at the onset of the high falling tone there was actually less variation *between* the Oujiang varieties than *within* the single dialect of Shanghai. Table 2 shows that generally there is very little difference between Oujiang and Shanghai in these tones. The differences are of the order of one tenth of a standard deviation, which is

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very small. Thus, in spite of the fact that the Oujiang descriptions span some twenty years, it is possible to claim considerable homogeneity for these two tones in the Oujiang dialects examined. The same could probably be demonstrated for all the other OJ tones except reflexes of IVa & b, which, as this paper has shown, do vary over the Oujiang area.

The nature of this variation is shown in Figure 3, which plots the F0- and duration-normalised acoustics of the Oujiang reflexes of *IVa. They present a coherent Wittgenstinian set, ranging from low rising (WC, QJ [yellow, purple]) through dipping (YJ PY [red, green]) and falling-rising (XY WZ ♂ [black, blue]) to falling (WZ ♀ [blue dots]) and declining (YQ [cyan]). Deriving from proto-Wu 45ʔ, their development is probably best reconstructed as a change from mildly falling through low rising, the initial fall in pitch /F0 being triggered by an intrinsic drop in F0 from the *[ʔ]. However, the development can also be seen in the reverse order, as a rightwards shift in the location of the L tone, culminating in its disappearance (<u>L</u>H > H<u>L</u>H > H<u>L</u>h > H<u>L</u> > H).

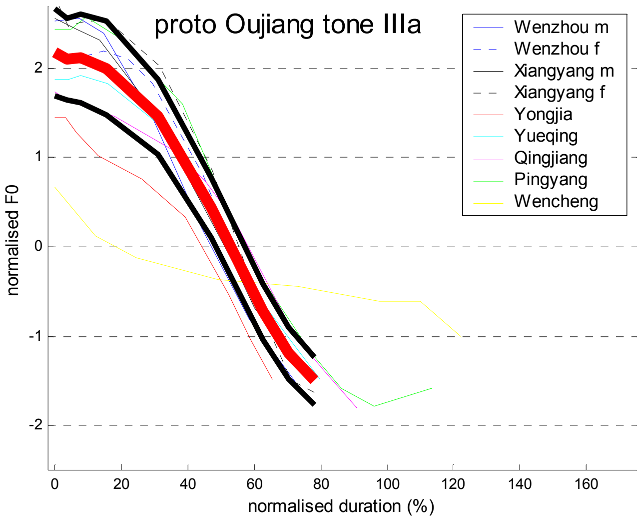

Figure 4: Reconstruction of proto-Oujiang tone IIIa from acoustics of modern varieties.

6. Acoustic reconstruction of proto-Oujiang tones

A final point, and one that does not seem to have been realised before, emerges from the demonstrated homogeneity of the normalised tonal acoustics in the Oujiang area. This is that they can be interpreted in a completely new light, namely as *historical* constructs. The normalised tonal F0 contours in Figure 2, together with a quantification of their variation, constitute the best estimate yet of the proto-Oujiang tones from which the modern forms derive. As an example, Figure 4 shows the acoustic reconstruction of high falling proto-Oujiang tone IIIa, based on F0- and duration-normalised values from all varieties except Yongjia (which has a mid falling IIIb) and Wencheng (which has a mid level IIIb). The thick red line shows the z-score normalised mean F0. This is the best estimate of the F0 of proto-Oujiang IIIa. The thinner black lines are one standard deviation corridors above and below the reconstructed mean, and give a crude idea of the variation around it. A more sophisticated model of the variation must take into account the fact that values at the different sampling points are not independent, and give the probability of a particular set of values conditional upon a starting value for the tone, and the mean contour.

This proto-Oujiang tone is now ready for quantified comparison with similarly reconstructed IIIa cognates from other first-order Wu dialect subgroups for which there are modern acoustic data. The result will be an estimate of the proto-Wu IIIa shape. It can be appreciated that this opens up the possibility of a whole new level of accuracy in historical tonological reconstruction and comparison, one that also might be extended to vowel acoustics.

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