RESUME

L'auteur donne une description perceptuelle, acoustique et physiologique des modes phonatoires - chuchottement, voix chuchottée, et "grondement", qui caractérisent les syllabes aux tons yang du dialecte Wu de Zhenhai. Il en discute également les implications phonologiques.

(*) This is a revised version of a paper read at the 1st International Conference on Wu Dialects, Hong Kong 1988. I should like to thank Francis Nolan for kindly providing his auditory impressions of some Zhenhai data in an extensive commentary which, among other things, brought to my attention the whiskery (as opposed to breathy) nature of some of the syllables.

1.0. INTRODUCTION

Descriptions or characterisations of Wu dialect phonology (e.g. Ramsey 1987:91; Norman 1988:199) often mention the correlation between Tone and/or Initial and phonation type. For example, two of the tones of Shanghai are said to co-occur with breathy voice or murmur (Sherard 1972:48, 49, et pass.). The relationship between Tone and phonation type is particularly salient in the Wu varieties spoken in the N.E. Zhejiang county of Zhenhai, where several auditorily different phonation types or inferred glottal states can be distinguished: modal voice, tense voice, whisper, whispery voice, harsh voice and growl (1). It is likely that harsh voice and growl contribute to the well-known Wu stereotype of the dialects of the Ningpo region (of which Zhenhai is one) as being "very hard" and it being "better to argue with a person from Suchow than converse with someone from Ningpo". This paper is an attempt to describe and account for three of the phonation types that occur in Zhenhai: whisper, whispery voice and growl. These three phonation types are only found in the Zhenhai Yang tones, (i.e. the tones which occur on reflexes of Middle Chinese syllables with the so-called Zhuo, or "muddy" Initials). Because of the extensive tone sandhi in Zhenhai (Rose, forthcoming), the actual pitch shape of the Yang tones varies considerably, although they do all have a low pitch onset. Figure 1 shows the mean fundamental frequency (F0) characteristics of the Zhenhai isolation tones of two speakers. Tones 3, 4 and 6 are the Yang tones. In the rest of the paper I shall exemplify the acoustic characteristics of the phonation types using data from several speakers; make some inferences about their physiological characteristics; and describe their linguistic conditioning factors. I shall then examine how they relate physiologically, and comment on how they might be analysed phonologically.

2.0. WHISPER

Of all the phonation types discussed here, whisper is perhaps the least problematic: it is easy to recognize on vowels, and its physiological correlates are well known. Whispered vowels appear to be conditioned by the presence of a syllable-initial obstructant. They are most noticeable on tones from the historical Yang Ru category which would otherwise have a short, low

(1) With the exception of growl, which is an auditory term proposed in Rose (1982b), these terms are defined in Laver (1980) and exemplified on the tape which accompanies the book.
FIGURE 1. Raw mean fundamental frequency shapes for 2 Zhenhai male speakers' isolation tones (after Rose 1987). 1 2 5 = Yin tones; 3 4 6 = Yang tones; .... = Yang Ru; 5 = Yin Ru.
FIGURE 2. Wide-band spectrograms of utterances containing whispered vowels.
PHONETICS AND PHONOLOGY OF YANG TONE
PHONATION TYPES IN ZHENHAI

level pitch, e.g. [p A ɔ ɔ] "sugar" ² ² (2). Whisper also characterises
the syllable-initial obstruents on all Yang tones in non-close juncture (e.g. in
isolation or citation form). In these cases it can often be heard in the first few
centiseconds after obstruent release before whispery voice or growl onsets
e.g. [p A a ɔ ɔ] "stupid" ² ². In other words, the obstruent initials on
Yang tones in non-close juncture in Zhenhai are not simply voiceless, but
voiceless whispered.

According to Laver (1980:120ff.) the productional correlates of
whisper are not controversial. Local turbulence is caused by air flowing
through the cartilaginous glottis (i.e. between the arytenoids), with the
ligamental glottis closed and not vibrating. This setting is achieved by low
adductive tension (to allow the arytenoids to keep apart posteriorly), and
moderate to high medial compression (to "toe-in" the vocal processes of
the arytenoids and help to keep the ligamental glottis tightly closed and therefore
prevent vibration). We might infer from this description that the whispered
onset to Zhenhai Yang syllables occurs because the medial compression at the
time of supraglottal release is so strong that it requires time for it to relax
enough to allow periodic activity at the ligamental glottis to begin. The total
devoicing of some Ru tones to whisper occurs because the time required for
relaxation of medial compression to allow phonation to begin exceeds the
extrinsically very short duration of the syllable. (The extrinsically short
duration of the Ru tones can be appreciated from the F0 data in Figure 1.)

The acoustic spectrum of whisper is similar to breath, but with greater
concentration of the aperiodic energy into formant-like bands (Laver
1980:132). There is of course no harmonic structure because there is no periodicity in the time domain from vocal cord vibration. These characteristics
are fairly well exemplified in the two wide-band spectrograms of whispered
Yang Ru syllables in Fig. 2. Fig. 2b is an utterance of a young male (JMF)
[ŋ noo kœ ɾoŋ ʰi"i" A pʃ ho mah] "你這個 神奇特別"

"that thing of yours is really good".
The whispered syllable [t A ʃə] carries emphatic stress. A clearer noise-
excited formant pattern is shown in Fig. 2a, which is an utterance of a

(2) Whispered obstruents are transcribed with voiceless symbols plus the diacritic [ ]
(the use of voiced symbols would incorrectly imply auditory similarity with, e.g.
Hindi voiced aspirates). Whispered vowels are transcribed in upper case ([V]) to
avoid confusion with whispery voiced vowels ([v]). Growl is transcribed with
[ɾ].
young female native speaker (SYZ) saying [tʃŋ tɔŋ hɛ ɛwɔ tʃhɔ lɛlə ]

"read [them] out in Zhenhai dialect"
The whispered morpheme [tʃŋ] /ʃŋ/ carries stress; the following Yin Ru morpheme [tʃhɔ] /ʃhɔ/ is also devoiced, but as a normal result of destressing.

3.0. WHISPERY VOICE

Whispery voice can occur on all the Yang tones, but is clearly commonest on those with relatively close oral Finals, e.g. [tʃŋ ə] "ground", ə. It also occurs on syllable-initial sonorants in the Yang tones, e.g. [m tʃ ə] "secret" ə. Whispery voice is a compound phonation type, where local turbulence is generated from a direct current of air (flowing through the posterior shunt between the arytenoids (as in whisper), while the cords at the ligamental glottis vibrate, contributing a periodic energy component. The necessary tension vectors are high medial compression and minimal adductiv e tension (to allow airflow through the cartilagenous glottis), and low longitudinal tension (to allow simultaneous vibration at the ligamental glottis) (Laver 1980:136).

Because most of the descriptions of Wu phonation types refer to "breathy voice" or "murmur", it is important to note here that Laver's framework distinguishes between breathy voice and whispery voice, and that the Zhenhai examples are definitely identifiable as whispery voice, not breathy. The main productional difference between the two lies in the absence, in breathy voice, of the strong medial compression component. In breathy voice the glottis is kept open along most of its length, and the folds never meet in the mid line (Laver 1980:133). The significance of the difference between breathy voice and whispery voice lies in the fact that if one assumed - from the use of the term breathy voice for other Wu varieties - that the Zhenhai examples were indeed breathy voiced, then their relationship to the whispered vowels and whispered syllable-initial obstruents would be more difficult to explain. It would imply, for example, an improbable change in glottal configuration from strong to negative medial compression in the transition from initial consonant to vowel.

There do not appear to be any descriptions of the acoustics of specifically whispered voice, although Laver (1980:114, 115) includes illustrative wide-band spectrograms and laryngograms of breathy and whispery voice. Fig 3b shows the power spectrum and LPC envelope for four roughly equal periods of whispery voice, taken from the word [feŋ ə] "rice" /ʃŋ/ spoken by a young female (SYZ). Fig. 3a shows corresponding acoustic data from the same morpheme spoken with modal voice in the word [ja væ ə] "evening meal" /ʃə/ /ʃə/. (The change in phonation type and syllable-initial consonant is conditioned by the tone sandhi rules - see Rose
PHONETICS AND PHONOLOGY OF YANG TONE
PHONATION TYPES IN ZHENHAI

(forthcoming)). Fig. 3 also shows the corresponding wide-band spectrograms of these utterances.

A Comparison of Figs. 3a and 3b shows that, relative to her modal voice, SYZ's whispery voice has a less steep spectral slope and a higher level of interharmonic noise above 2.5 KHz (3). There are also differences in the damping of the upper formants, and the slope of the region immediately above F1.

It is interesting to note that an acoustic metric used successfully to distinguish breathly from modal voice does not work for these examples. In breathy voice, the amplitude of the fundamental is relatively strong compared to that of the strongest harmonic under the F1 transfer function peak. This is also clear in the time domain, where the motion of the cords results in a quasi sinusoidal pressure function with consequently less energy in the upper frequencies, and a steeper spectral slope (Ladefoged 1983:345, 356). In modal voice, with its more discontinuous glottal volume velocity flow, there is greater energy in the upper frequencies, and a relatively less steep spectral slope, and the amplitude of the fundamental is relatively slower than that of the F1 harmonic. It is clear from the examples in Fig. 3 however, that there is no appreciable difference between the F0 - F1 harmonic measure for the two phonation types. For whispery voice, the F0 is 19 dB down on the F1 harmonic (H4); in modal voice the F0 is 17 dB down on the F1 harmonic (H3). This, of course, makes sense in terms of the inferred glottal configuration for whispery voice. The relatively strong fundamental associated with breathy voice is absent from the whispery voice, because the A.C. component of the whispery voice glottal flow is not sinusoidal, produced as it is by normal phonation at the ligamental glottis.

4.0. GROWL

This remarkable phonation type occurs on Finals with relatively open oral vowels, and nasalised vowels. It seems to occur with equal frequency on all Yang tones, and shows no obvious conditioning by the syllable-initial consonant. It gives the auditory impression of a series of strong pulses

(3) For SYZ's modal voice sample, the mean amplitude of noise above 2.5 KHz is 8.2 dB less than the mean amplitude of the harmonic energy, but in her whispery voice it is 2.6 dB greater than the harmonic energy. The less steep spectral slope is reflected in the fact that, if the two spectra are aligned with reference to the LPC first formant peak, the energy above 2.5 KHz is lower in modal than in whisper.
FIGURE 3. Spectra and wide-band spectrograms showing whispey (B) and modal (A) voice.
FIGURE 4. Audio wave forms and corresponding wide band spectrograms of 3 speakers' growled syllables.
accompanied to a greater or lesser extent by harsh voice. The pulse train is also sometimes perceivable as a second pitch, much lower than the pitch of corresponding Yang tones with whispery voice, and so growl can also be described as diplophonic.

Fig. 4 shows the audio wave forms and corresponding wide band spectrograms of 3 speakers' growled syllables, each said with a substantial portion of low level pitch. Fig. 4a, spoken by a young male (JMF) shows most of the word \( [\text{p} \text{a} \text{j}] \) "to spread out". Fig. 4b, spoken by an elderly female (ZSC), is the first syllable of the word \( [\text{t} \text{ei} \text{f} \text{a} \text{r}] \) "hair"; Fig. 4c, spoken by an elderly male (LBX), is the first syllable of the word \( [\text{t} \text{a} \text{r}] \) "overcoat".

The most obvious shared feature in the wave forms is their dichroic nature, with alternating pulses of high and low peak-to-peak amplitude: presumably it is the sequence of pulses with high peak-to-peak amplitude which contributes to the auditory impression of a pulse train mentioned above. For each of the tokens in Fig. 4 the mean frequency of the weaker pulses is almost the same as that of the strong pulses. For JMF, weak = 81 Hz, strong = 91 Hz; for ZSC weak = 89 Hz, strong = 88 Hz, for LBX, where there is a pattern of one strong pulse alternating with two weak, strong = 43 Hz, 1st weak = 42 Hz, 2nd weak = 41 Hz. This indicates that the sources of the strong and weak pulses are not independent (like for example the vocal cords and tongue tip in a voiced alveolar trill), but are coupled. Moreover, the F0 of non-growled (i.e. whispery voiced) Yang tone syllables corresponds very closely to the frequency calculated from growled syllables if the differences between strong and weak pulses are ignored. For this reason I shall call this the fundamental frequency rather than the frequency of the strong or weak pulses which, since it is the rate of repetition of the complex wave, should by definition be the fundamental frequency. All speakers have fundamental frequencies in their growled syllables which are nearly whole number multiples of their strong amplitude pulses: JMFs's and ZSC's strong amplitude pulses are half the value of their F0; LBX's is a third. The frequency relationships described above indicate a low frequency amplitude modulation of a higher frequency source - presumably the vocal cords - by some as yet unidentified structure coupled to the cords.

It was mentioned above that, apart from the pulse train, growl gives the auditory impression of greater or lesser degrees of harshness. Among the acoustic manifestations of vocal harshness are the amount of local variance in a) the fundamental period ("pitch jitter") and b) the peak-to-peak amplitude ("amplitude shimmer") (Baken 1987:113ff., 166ff.). Measurements of LBX's \( [\text{t} \text{a} \text{r}] \) syllable showed it to have much greater overall jitter (Pitch Variation Index = 10.6) than normal, and an amount of shimmer (Amplitude Variation Index = 0.14) which is comparable with clinically hoarse voice. Calculating the jitter and shimmer separately for the strong and
weaker pulses resulted in a decrease of the PVI and AVI values, but not enough to bring them within normal range. Therefore, on the basis of these very limited measurements, growl can be characterised as acoustically harsh. Interestingly, LBX's modal voice (as measured from 2 tokens of [iɛ̃ — ]) showed much smaller values of jitter and shimmer than normal.

Fig.1 shows the location of growled portions in the raw mean F0 contours for two male speakers' isolation tones. It can be seen that both speakers have the same pattern, with tones 6 and 3 showing the same, much shorter durational extent and higher cut-off point for growl than tone 4. Apart from the obvious phonological restriction of growl to Yang tones, the extent of the growled portion in the speakers' frequency range and Final duration is conditioned by three factors: 1) the tonal F0 target contour - growl lasts longer in tone 4 because of the quasi level F0 over the first half of its duration; 2) the mode of F0 increase - growl cuts - out some 20 Hz higher in tones 3 and 6 (where the F0 rise is produced by a burst of pulmonically induced sub-glottal pressure) than in tone 4 (where the F0 rise is to a greater extent the result of an increase in vocal cord tension) (Rose 1984); 3) the direction of the F0 - growl does not occur on the falling F0 of tone 3, even though it enters the F0 range where growl occurs on the rising part.

Evidence for the physiological correlates of growl is at best indirect, since it bases on video recordings of fibre-optic investigations of my own imitations (4) and comparisons of these with data from a language with a phonation type which, at least as far as my auditory impressions of one speaker are concerned, sounds very similar to growl.

The most obvious gesture revealed by a fibre-optic investigation of my own imitations of Zhenhai growl was extreme epiglottalisation. The epiglottis was deliberately pulled backwards until it touched the arytenoids. The aryepiglottic area (bounded by the epiglottis anteriorly and the arytenoids posteriorly) was substantially reduced and the view of the vocal cords obscured. During growl, the whole visible laryngeal structure and the epiglottis were set into rather violent vibration. (This vibration was responsible for previously obtained fuzzy xeroradiographic images of the larynx during growl.) The apparent extrinsic nature of the epiglottalisation must be emphasised: the epiglottis was not being pushed back by a (low) back tongue position, since it also occurred when I growled a high front vowel.

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(4) I am grateful to Alison Bagnall and the staff of the South Australian Cranio-facial unit for use of the fibre-optic and video facilities.
I have only heard one other instance of non-pathological growl. This was in the word lao "base" as spoken by one of ten !Xoo informants. Trail (1985) provides some detailed instrumental data on the phonetics of this Bushman language, and it is instructive to compare his observations on the !Xoo 'strident' or 'ventricular' contrastive phonation type which is (at least for one speaker) auditorily very similar to Zhenhai growl: "The tip of the epiglottis articulates with the back wall of the pharynx ... The most important laryngeal adjustment involves an extreme constriction of the airway between the cushion of the epiglottis and the tips of the arytenoid cartilages ... During 'phonation', the arytenoid cartilages vibrate vigorously, and this vibration is imparted to the epiglottis" (p. 78).

Acoustically, the strident phonation type is associated with noise similar to that generated in breathy voice, and a low frequency pulse train. The latter, according to Trail, comes not from the true cords but from "... the vibration of the relatively gross structure of the two arytenoids against the cushion of the epiglottis and probably the vibration of the false vocal cords" (p. 80).

!Xoo strident phonation and my imitations of Zhenhai growl are productionally similar in involving extreme epiglottalisation (with consequent reduction in aryepiglottic area), and vigorous vibration of the arytenoids and epiglottis. To judge from a comparison between the spectrogram that Trail presents (p. 84) and the Zhenhai token in Fig. 4a, they also look acoustically similar. In view of this, I think it is justified to assume that real Zhenhai growl also involves epiglottalisation and epiglott-o-arytenoidal vibration. There still remain some important differences between the !Xoo and Zhenhai forms, however.

!Xoo strident phonation is also associated with depression and pharyngealisation of the tongue body (p. 78). It can only occur with phonologically [+back] vowels, which are then acoustically quite different (higher F1 and F2) from the non-pharyngealised vowels (p. 83). Hence it is possible that the !Xoo epiglottalisation results intrinsically from the pharyngealisation of the tongue body. Zhenhai growl, on the other hand, can occur with front vowels ([tʃeŋ] "straight" [ŋ], [keŋ] "to complain"), and auditory vowel quality does not appear to covary with the absence or presence of growl. Therefore the Zhenhai epiglottalisation must be extrinsic.

Whereas !Xoo strident phonation is sensitive to the vocalic feature [+back], Zhenhai growl is sensitive to the features [+high] and [-nasalised], since it does not occur on high oral vowels (it is not clear if this also applies to high vowels followed by the velar nasal). This suggests that epiglottalisation is basic to all Zhenhai Yang syllables. With relatively open oral vowels and nasalised vowels it results in growl; with relatively high oral vowels, the
aryepiglottic tension is intrinsically inhibited by some kind of vertical tension (perhaps via the palatoglossus).

Having inferred the articulatory basis of growl thus far, it must now be admitted that the link between the physiology and the acoustics (dichrotic wave with alternating strong and weak pulses) is still unclear.

Trail (1985:80) claims that the strong pulse train and periodicity from normal phonation which characterise !Xoo strident phonation do not occur simultaneously, and are from different sources. As pointed out above, comparative frequency measurements of the Zhenhai strong and weak pulse trains suggest a single vibrating source (the vocal cords) being periodically damped by a body coupled to the cords and vibrating at a lower frequency. Presumably this damping source has something to do with the vibrating mass of the arytenoids and epiglottis which, together with the false cords, periodically loads the true cords, thus producing the characteristic growl amplitude modulation. Why this mass should be vibrating is not clear, although I think it likely that it comes about as a forced vibration transmitted from the true cords, rather than the result of some Bernoulli effect at the aryepiglottic sphincter, as Trail implies.

5.0 DISCUSSION

In the sections above I have described how the three phonation types of whisper, whispery voice, and growl occur on Yang syllables in Zhenhai. (Initial observations suggest that the fourth - harsh voice - is a variant of growl with only one or two strong pulses at the onset of phonation). It remains to be discussed how they relate, how they should be analysed phonologically, and what other features condition them.

5.1. Relationship between the Phonation Types

It would be nice, of course, if all the phonation types could be shown to be intrinsically related, with differences between them plausibly conditioned by other segmental or suprasegmental factors.

The relationship between whisper (on vowels and syllable-initial obstruents) and whispery voice (on syllable-initial sonorants and relatively close vowels) is straightforward if one posits a syllable prosody associated with minimal adductive tension, and medial compression which is strong for obstruents and less strong for sonorants. As explained above, the different extent of devoicing of Finals to whisper will then reflect different degrees of medial compression strength associated with the obstruent. In the extreme case, as for example in some Yang Ru syllables with obstruent Initials, the medial compression is so strong that the whole vowel becomes whispered.
Although the presence of growl is plausibly conditioned by an intrinsic vowel height feature, there are problems associated with an intrinsic relationship between whispery voice and growl, even though their complementary distribution suggests one. This is because the gestures involved are, at least in principle, physiologically incompatible. Growl requires contraction of the aryepiglottic muscles to pull the epiglottis back. Whisper and whispery voice require minimal adductive tension to help keep the cartilaginous glottis open at the back. However, the aryepiglottic muscles are an extension of the transverse arytenoid muscles which actually implement adductive tension (5). Aryepiglottic contraction should therefore result in a closure of the cartilaginous glottis, which is exactly the opposite of the desired effect. However, I suspect that the combination of whispery voice and epiglottalisation can be achieved, because Trail demonstrates (1985:84, 85) that "!Xoo strident vowels have ... phonetic properties of both pharyngealised and breathy voiced vowels", and breathy voice also needs weak adductive tension. Therefore I hypothesise that Zhenhai Yang tones are produced with a complex phonatory gesture involving both epiglottalisation and whispery voice. The epiglottalisation is intrinsically suspended on relatively close vowels, which then are heard as whispery voiced. (One possible validation of this hypothesis would come from an examination of the ratio of harmonic and noise amplitude in growled vowels, to see if it is comparable with that between whispery and modal voice.)

5.2 Phonological Integration

Although the precise physiological details of the Zhenhai Yang phonation types are still frustratingly unclear, I think enough has been demonstrated in this paper to indicate desirable approaches to their phonological integration. Firstly, it must be recalled that the Zhenhai phonation types whisper, whispery voice and growl constitute deliberate, extrinsic gestures involving the application of strong medial compression and aryepiglottic contraction. One reflection of the extrinsic nature of growl is its rarity - at present, it looks as if it is confined to the weird combination of the Zhenhai variety of Chinese and the Southern San (Bushman) languages. Apart from this, the usual reaction of speech therapists to Zhenhai growl leaves not doubt as to its pathological status - a good example of Ladefoged's bon mot 'one person's voice disorder is another person's phoneme' (1983:351.)

The obviously extrinsic nature of the phonation settings makes it counter-intuitive to analyse them as phonologically derived or conditioned in the same way as, for example, creak or whispery voice might be analysed on

(5) I thank Andy Butcher for pointing this out to me.
PHONETICS AND PHONOLOGY OF YANG TONE PHONATION TYPES IN ZHENHAI

the low dipping Standard Chinese tone 3. (Although I must acknowledge that this is not usually regarded as a constraint on phonological representations.) If they are to be analysed as derived, what could be conditioning the phonation types? Certainly not the syllable-Initial, since growl and whispery voice occur on Yang syllables without Initials e.g. [ j ʰ ʰ ʰ p t ᵃ ] "wall" \( \text{sv}^{\text{a}} \), [ \text{ŋ} ʰ r ] "rain" \( \text{sv}^{\text{a}} \) etc. In fact, the phonetic nature of syllable-Initial consonants on Yang syllables (whispery voiced sonorants, whispered obstruents) is best seen as determined by the phonation type, not vice versa. Another candidate for the conditioning factor would be the tone itself, that is, have six distinctive tones, with growl and whispery voice determined by the [Lo] feature on three of them. At least two considerations argue against this approach. Apart from the first half, the Yang tones show pretty much the same F0 contour (in the well-defined sense of Rose (1982a:11) as the corresponding Yin tones. This suggests an analysis which accounts for the F0 shapes in terms of the interaction between an extrinsic phonation setting ("Register") and a target F0 contour. The convex F0 contour of tone 3 for example can be seen as resulting from growl/whispery voice (the exponents of + Low Register) and a high falling F0 target contour. The second reason for eschewing analyses with conditioned phonation types is that the phonological rules for tone sandhi in Zhenhai are much simpler if formulated with Register as a phonological component (Rose, forthcoming). Once again, the Register seems to be determining other features, not the other way round. In summary, I think that the phonation types are best analysed as exponents of a phonological Register component - this also imparts phonetic substance to the otherwise ill-defined traditional phonological terms Yin and Yang, at least as far as Zhenhai is concerned. It is also difficult to avoid speculation on the possible historical implications of this analysis. It is certainly worth exploring whether reconstructing a difference in phonation type in addition to, or instead of, the difference in Initial consonants provides a better explanation for the Yin/Yang split of the Middle Chinese tones into an upper and lower series (c.f. Pulleyblank 1984; Maddieson & Hess 1987).

5.3. Conditioning

It is necessary to end this paper by emphasising that the overall conditioning of the different Yang phonetic types is still unclear. The phonetic factors mentioned above - especially vowel height (or [+/- palatoglossus] ?) - are necessary but not sufficient. For example, ZSC's growled token in Fig. 4b followed a few centiseconds after the same morpheme said with whispered voice. Clearly, most of the work still remains to be done to establish what the phonetic and phonological conditioning factors are and how they interact to produce a specific phonation type. In addition, I suspect that the question of sociolinguistic conditioning will need to be addressed: I only have data on 5 speakers, but it is of interest to note that of these 5 the males growl much
more than the females, and the young female growls less than the older. Finally, the geographical spread of the growl feature needs to be determined: I have not encountered it in the speech of the few informants I have transcribed from adjacent areas of Zhejiang (Ciqi; Xiangshan; Dinghai; Fenghua) who all have only whispery voice. There is, therefore, the possibility that it is being deliberately used by speakers to mark their Zhenhai origin or identity.

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REFERENCES


PHONETICS AND PHONOLOGY OF YANG TONE
PHONATION TYPES IN ZHENHAI


