Signalling affect in Mandarin Chinese - the role of non-lexical utterance-final edge tones

Patricia Mueller-Liu

Institute of Phonetics, Saarland University, Germany
pmueller-liu@vistanet.de

Abstract

Of the 5 pitch-phenomena contained in Y. R. Chao's framework of Mandarin Chinese intonation ([1], [2]), the phenomenon termed 'successive tonal addition' has proved highly elusive. Using communicatively-based spontaneous speech samples, the first instrumental evidence of successive tonal addition is presented here, found to consist of non-lexical pitch-movements added to the lexical tones of utterance-final syllables. Investigation into the functions of these phenomena, referred to as 'edge tones', showed these to be affective in nature, signalling emotio-attitudinal messages.

1. Introduction

1.1 The beginnings with Y.R. Chao

The foundations of research on intonation and affect in Mandarin Chinese (MC) were laid by the Chinese linguist Y. R. Chao, in whose opinion 'a great deal of pitch-movement in Chinese speech [is used to express] the moods and attitudes of the speaker' ([1]), despite the phonological use of pitch for the signalling of the four lexical tones ([8], [12]). Chao's position, at odds with the prevailing view of researchers at the time, grew out of his research on MC intonation, which yielded 5 phenomena based on pitch, signalling linguistic, i.e. information-oriented, as well as paralinguistic - i.e. affective, or emotio-attitudinal meaning ([2], [4], [11], [16]). Chao's investigations into the phonetic form of these phenomena showed them to consist of global and local variations of pitch and pitch-range, with global variations extending over whole utterances, local variations limited to shorter sequences of syllables. While global and local variations in pitch-range are achieved by global and momentary enlargements and compressions of this feature, global variations in pitch are obtained by raising and lowering the overall pitch (register) of MC utterances. Finally, his local pitch-variations, whose phonetic form proved very difficult to determine without the sophisticated technical means at out disposal today, are described as the results of utterance-final 'tonal additions', in which the pitch-movements of intonation melody are 'added to' the pitch-movements of clause- and sentence-final lexical tones ([1], [2]). Two types of tonal additions are distinguished: (1) 'successive tonal additions', in which rising/falling pitch-movements are 'added onto the pitch-movements of the tones after their completion', and (2) simultaneous tonal additions, which take on one of the following two forms: When tonal - i.e. lexical - and intonational pitch-movements run in the same direction, tonal pitch-movements are 'stretched', i.e. amplified, rising tones made to rise higher, falling tones to fall deeper. When tone and intonation run in the opposite direction, tonal pitch-movements are 'neutralized', i.e. attenuated, rising tones now reaching less high, falling tones less low than otherwise the case ([2]).

Coming to the functions of these intonational phenomena, on the linguistic, information-oriented, dimension Chao finds local pitch-range variation to be linked to stress and prominence, while local pitch-variation of the simultaneous type is associated with what is referred to today as the 'information status' of corresponding utterances, involving the distinction between 'finality' and 'non-finality', corresponding to Chao's terms of 'suspense' and 'conclusion' ([4], [11], [17]). In this function, local pitch-variation receives support from global pitch-variation, also linked to 'suspense' and 'conclusion' [2]. On the paralinguistic dimension, global variation in pitch-range is described as signalling different degrees of intensity and emotional states, e.g. 'anger', 'impatience' and 'disapproval', while local pitch-variation of the successive type receives a large variety of emotional and attitudinal meanings. Rising successive tonal additions are associated with 'incredulity', 'strong, peremptory' commands' and 'impatience', falling tonal additions with 'lively, impressive enumeration', 'remonstrance', 'hearty agreement', 'reassurance' and 'pretended emotion' [2]. Chao's detailed discussion of these phenomena shows his profound interest in the affective functions of MC intonation. His graphic representation of falling/rising successive tonal additions is shown in Figs. 1-3.

Fig. 1: *Falling successive tonal additions (Tones 1 - 4)*

Fig. 2: *Rising successive tonal additions (Tones 1 - 4)*

Fig. 3: *Falling successive tonal additions (atonal syllables)*

1.2 Follow-up research in MC intonation

In contrast to Chao's deep interest in the paralinguistic functions of MC intonation, follow-up research in this field has seen a shift away from the paralinguistic and a strong focus on the linguistic dimension, bringing a decline in interest in global pitch-range variation and 'successive' local pitch-variation. As a result, particularly during the last 25 years, research activity has largely focussed on the role of global and simultaneous local pitch-variation in the signalling of sentence modality and syntactic type ([5], [6], [7], [16]) and the contribution of local pitch-range variation in the signalling of stress and prominence ([3], [10], [18], [19]). A third research area associated with MC intonation is

the investigation of the prosodic units contained in MC utterances, involving the segmentation of MC intonation-units into their smaller, hierarchically-structured constituents, which are paired with their syntactic correlates ([14], [20]). On the other hand, while global variation in pitch-range has recently resurfaced as a feature of MC intonation linked to emotional involvement and intensity ([11], [21]), research on successive tonal addition has been scarce: Only one study, ([15]), has reported evidence of a phenomenon in reminiscent of Chao's successive tonal additions. Unfortunately, due to the limited circulation of this work and the lack of precision in the author's discussions, the nature and phonetic form of his 'supplementary post-tonal stretches of phonation' remain unclear and no new insights on successive tonal additions have been gained from this work. However, some instrumental evidence has recently been found by the present author.

2. Successive tonal additions in MC

2.1 First evidence

The study presented here grew out of an earlier research project investigating suprasegmental attitude-signalling in German and Chinese, based on a speech corpus of spontaneous utterances selected from 12 dialogues involving native speakers of the two languages ([11], [12]). During the course of analysis, pitch-phenomena highly reminiscent of Chao's falling successive tonal additions were found in two of the MC utterances under examination. These consisted of falling non-lexical pitch-movements located on the latter half of utterance-final syllables, added onto the lexical tone in a manner which immediately called to mind Chao's description of falling successive tonal additions. An example is given in Fig. 4.
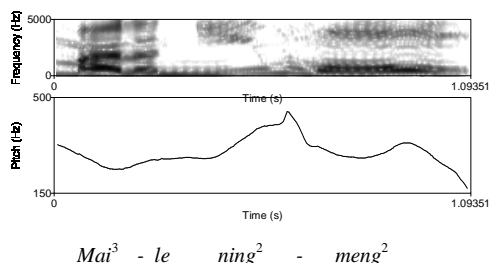

Fig. 4 : *A falling edge tone with a 2nd tone*

Here, the additional fall can be clearly seen on the second half of the utterance-final syllable *meng*, which bears the mid-rising 2nd Tone. In order to distinguish this pitch-phenomenon from the pitch-patterns of utterance-final lexical tones, it was termed "caudal pitch-pattern". In keeping with autosegmental terminology, the term "non-lexical edge tone" would be appropriate ([12]).

Investigations into the communicative functions of the phenomena revealed that the utterances in question had been produced during passages of intensive, at times highly emotional speech. Also, in judgement tests, both utterances had been analysed in terms of a strong, rather aggressive speech behaviour/attitude, some judges of the utterance shown in Fig 4 evoking the communicative strategy of *sajiao* - a wailing, complaining, exaggerated manner of speaking adopted by speakers wishing to get their way with their interaction partner. Upon comparison with Chao's discussion of falling successive tonal additions, these judgements were found to be compatible with his labels of

'remonstrance', 'peremptoriness' and 'pretended emotion'. The apparent formal and functional similarity between these tonal movements and Chao's falling successive tonal additions called for further investigation to seek additional evidence.

2.2 Experiment

2.2.1 Procedure

The procedure followed here consisted of three steps: 1. Focussed re-examination of the MC speech material recorded for the earlier project to find more examples of falling edge tones; 2. Acoustic and auditory analysis of all edge tones found to determine their phonetic form in as many contexts as possible; 3. Judgement tests to ascertain the communicative functions of edge tones and the discoursal circumstances likely to lead to their production.

2.2.2 Data and speech analyses

The re-examination of the 12 dialogues (mean duration 9 mins.) yielded 16 additional falling edge-tones produced by 6 different speakers and occurring with 1st tones (3), 3rd tones (11) and atonal syllables (2). In addition to these, 3 pitch-phenomena highly reminiscent of Chao's rising successive tonal additions were found, with 2nd (1) and 3rd (2) tones. The remainder of this paper is devoted to the falling edge tones, as a greater number of them was detected.

After exclusion of overlapping speech, 10 of the utterances containing the newly-found falling edge tones were digitised and their F0 analysed. Figs. 5-10, show the frequency-contours of 5 of these utterances.
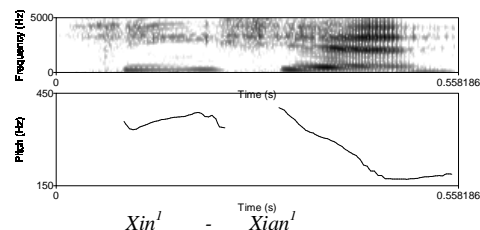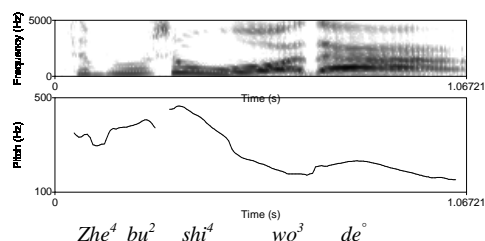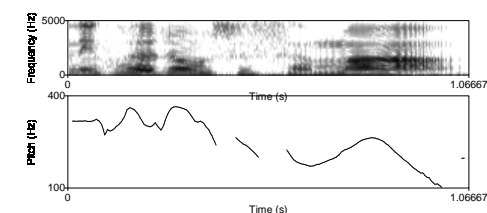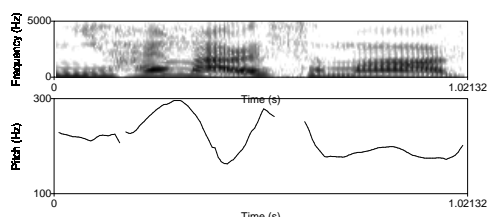

Fig. 5: *Falling edge tone with a 1st tone*

Fig. 6: *Falling edge tone on an atonal syllable*

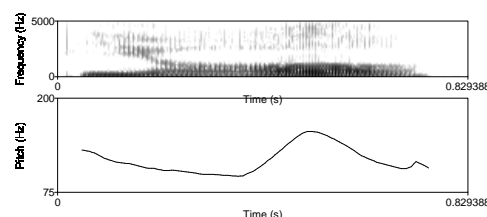The analyses showed that the new edge tones also consist of falling pitch-movements added to the pitch-movements of utterance-final tones. A comparison with Chao's representation of falling successive tonal additions occurring with 1st and 3rd Tones and atonal syllables (see Figs. 1 and 3) revealed a strong similarity between the two phenomena. These falls indeed appear to be more examples of Chao's successive tonal additions.
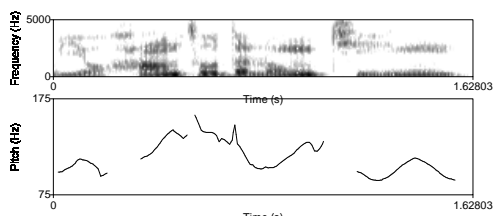
Nei⁴ kuai⁴ rou⁴ shi⁴ shen²-ma°

Fig. 7: *Falling edge tone on an atonal syllable*

Ni³ hai² mai³-le° shen² - ma°

Fig.8: *Falling edge tones on an atonal syllable*

You³

Fig.9: *Falling edge-tone with a 3rd tone*

You³ Hang²-Zhou¹ de° long³ᐟ² - jing³

Fig.10: *Falling edge-tone with a 3rd tone*

2.2.3 Judgement tests

To determine the functions of the 10 edge tones, judgement tests were held with 7 native speakers of MC, the majority (5) unacquainted with the speakers of the utterances under examination. In these tests, which took place in the form of discussion rounds, the judges were presented with the edge tones embedded in their carrier-sentences and asked to describe the message conveyed by the speaker in each case, concentrating on the utterance-final pitch-phenomena. In difficult cases, particularly at the beginning of tests, discourse contexts were included, consisting of one or two exchanges immediately preceding the sentence containing the edge tone to be judged.

2.2.4 Results and discussion

A first evaluation of the judges' responses revealed the common message of the phenomena under discussion to be the speakers' strong, emphatic, at times aggressive manner of speaking, translating into a strong, assertive, rather dominant and superior interpersonal attitude. Apart from these basic attitudinal messages, the emotionally-laden messages of 'insistence', 'protest', 'criticism' and 'reproach' were also named. Further enquiry revealed pitch-phenomena of this kind to be most typical of communicative situations in which the speaker is either expecting criticism, doubt, or contradiction from the listener, or wishes to express these messages himself. It was also noted that a number of judges - especially those unacquainted with the speakers - often had difficulty deciding whether the emotions they had detected were meant seriously or non-seriously, the latter case involving the humour strategies of joking and teasing. Comparisons showed these judgements to be very similar to those given for the edge tone discovered in the earlier project (see above), as well as compatible with the labels found in Chao's discussion of falling successive tonal additions. In particular, the judgements 'strength', 'dominance', 'insistence' and 'contradiction' not only point in the same direction as the 'superior, condescending attitude' which is evoked by Chao, but are also highly compatible with the labels 'reassurance', 'remonstrance' and 'correcting errors' which he also gives. Finally, the judges' difficulty in distinguishing between seriously- and non-seriously-meant emotions fits very well with Chao's label of 'pretended, insincere emotion'. Given these striking formal and functional similarities between Chao's falling successive tonal additions and the pitch-phenomena under examination here, it was thus concluded that these utterance-final edge tones must represent the first acoustic evidence of falling successive tonal addition.

2.2.4. Further analyses: results and discussion

As a final step, in order to gain a better understanding of the communicative message of each individual edge-tones, a more detailed evaluation of the judges' responses was made in terms of strength, valence - i.e. the positive/negative undertone of speech ([11]) - and the presence of humour detected by the judges in each case. The results of this evaluation, which was also applied to the judgements originally made for the first discovered edge tone (see above) are given in Table 1. They show clearly that, apart from the attitudinal messages which they had in common, the 11 utterances under examination were not judged alike, and often differed markedly with respect to strength and valence.

Edge tone no.	Fig. no	Strength			Valence		Humour	
		str.	mid	wk.	pos.	neg.	yes	no
1	4	6	1			7		7
2	7	6	1		1	6		7
3	8	5	2		1	6		7
4	6	5	2		1	6		7
5	5	3	4		5	2	3	4
6	-	2	4	1	4	3	1	6
7	9	3	3	1	4	3	4	3
8	-	1	3	3	6	1	2	5
9	-	4	2	1	5	2	3	4
10	-	1	3	3	6	1	2	5
11	10	1	3	3	6	1		7

Table 1: *Results of judgements*

To investigate the origins of these differences, the 11 utterances were analysed - instrumentally - with respect to overall (mean) intensity and tempo, the pitch-range of the edge tones and - auditorily - for voice quality. These features are known to be linked to the strength, emotional intensity and valence of speech ([11],[21]). A comparison of the results of these analyses, listed in Table 2, with those in Table 1 yields a number of interesting patterns. While the role of each individual feature is difficult to pinpoint, the obtained results evidence a number of links between the analysed suprasegmental features and the strength, intensity and undertone communicated by the utterances.

Edge tone no.	Intensity (dB)	Tempo (ms./syll.)	Range (Hz.)	V.Q.
1	67-72	268	54/148	very tense
2	67-70	167	91/70	very tense
3	60-66	163	20/74	tense
4	65-70	197	55/74	very tense
5	61-67	270	220	modal/tense
6	56-61	220	129	modal
7	55-64	(700)	29/42	modal
8	49-59	(701)	21/9	modal/lax
9	54-59	(748)	39/70	modal
10	51-62	302	6/6	breathy/lax
11	55-64	309	19/25	modal/lax

Table 2: *Suprasegmental features of utterances*

Thus, with respect to strength, the 6 utterances judged to signal a rather strong, at times aggressive message (nos. 1 - 6) are all marked by a relatively high intensity and tempo and/or wide pitch-range, while the 3 utterances with the highest number of 'weak' judgements (nos. 8, 10, 11) share the lowest values for intensity, tempo and pitch-range. With respect to valence, these 3 weakest utterances, sharing a gentle (lax) to soft (breathy) voice quality are also those with the highest number of 'positive undertone 'judgements, while the 4 utterances judged to signal a negative undertone (nos. 1 - 4) are marked by a tense to very tense voice quality not found in other utterances. Finally, with respect to humour, the utterances judged most often to contain joking/teasing (nos. 5, 7, 9) were found to be marked by a relatively wide pitch-range coupled with steep, very abrupt pitch-movements on their edge tones (see Figs. 5, 9). This effect is similar to that of stylised intonation in western non-tonal languages ([9], [11]). Taken together, these findings, in agreement with previous research on the signalling of strength, valence and humour ([11]), suggest that the attitudinal messages of strength and insistence, found in all 11 utterances, are signalled by the edge-tones themselves, while the degree of strength signalled, ranging from mere emphasis to strong aggressiveness, is dependent on the features intensity, tempo and pitch-range. The positive/negative undertone of utterances is dependent on voice quality, while the presence of humour is linked to the contour characteristics of the edge-tones: Edge tones marked by sudden, abrupt pitch-movements were frequently associated with joking and/or teasing.

3. Conclusion

In contrast to previous studies on MC intonation, the data presented here provide the first instrumental evidence for non-lexical, intonationally-motivated pitch-movements following utterance-final tones - phenomena previously described by Y.R. Chao as 'successive tonal additions'. Examinations of the communicative functions of these phenomena showed them to be affective, and complex, in that the attitudinal component is signalled by the pitch-movement itself, while the emotional component is the product of accompanying non-tonal features, such as (overall) amplitude, pitch-range and voice quality.

4. References

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