

Tone and Prominence in Standard Chinese

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Abstract

This paper studies the relationship between tone and prominence in Standard Chinese (SC). Unlike in English and some other intonation languages where intonational prominence is phonologically free to be associated with L tones as well as H tones, we have found that the four SC lexical tones behave quite regularly yet distinctively under prominence. Specifically, as emphasis on the tones escalates from none to strong, Tone 1 constantly raises its pitch level; Tone 2 constantly raises its H target, with its L target moderately raised only under strong prominence. Besides, as prominence increases, Tone 2 shows an increasingly upstepping effect on the following tone; Tone 3 generally keeps its L target unchanged, with its prominence level more clearly indicated by the pitch level (i.e., degree of upstepping) of the following tone; Tone 4 constantly raises its H target, with its L target moderately lowered only under strong prominence. On the whole, the realization of prominence in SC intonation is more dependent on the raising either of the H target of the lexical tones themselves or of the following (or maybe also the preceding) tone if they do not have one. The L targets do have an effect in Tones 2 and 4 as prominence becomes very strong, but still this effect is only auxiliary. As for the L target of Tone 3, its realization of prominence has a heavy reliance on the H target of the following (or preceding) tone.

1. Introduction

Standard Chinese (i.e. Mandarin Chinese, SC hereinafter) distinguishes four lexical tones, namely, high level, rising, low rising, and falling, which are traditionally referred to as Tone 1, Tone 2, Tone 3 and Tone 4 respectively. In Chao's fivepoint scale tonal marking system, the citation forms of these four are generally scaled as [55], [35], [214] and [51], where [5] represents the top level of the scale and [1] the bottom. While tone sandhi has long been a central topic of the Chinese phonological study, more and more attention has now been paid to the dynamic properties of the lexical tones under the macro-background of sentence or even utterance level prosody and intonation. This paper studies the relationship between prominence, an essential prosodic element, and the SC lexical tones. Our emphasis is on the question: How is prominence realized on the SC tones? Besides, we shall also take a look at what happens to the post-prominence tones. Previous researches have drawn important yet divergent conclusions on the first problem. Among them, Shen (1985) holds that the Chinese tonal ranges can be expanded both upward and downward, but only the expansion of the top-line is relevant to the expression of sentential prominence while the expansion of the bottom-line serves as a major indicator of normal stress on the lexical level. Shih (1988) proposes that prominence causes pitch expansion, rather than just pitch raising. Lin&Wang (1992) identifies three main features of a stressed syllable in SC, among which, besides a relatively longer duration, are a relatively wider pitch range and a relatively complete tone shape. Based on her model of the underlying features of the four SC lexical tones proposed in Yip (1980) as follows:

- (1) Tone 1: [+upper], H
Tone 2: [+upper], LH
Tone 3: [-upper], L
Tone 4: [+upper], HL

where $[\pm \text{upper}]$ represents the register features of the tones, and H, L represents their contour features, Yip (1993) proposes that theoretically there are three possible predictions for the effects prominence may have upon the four SC lexical tones. First, prominence affects the register feature only and leaves the contour feature intact (the so-called "register scaling"). In such a case, the register is moved but the tonal pitch range is roughly maintained. Specifically, Tones 1, 2, 4, which are [+upper], should be raised throughout, including both the L and H targets of Tones 2 and 4. Tone 3, which is [upper], should be lowered throughout. Second, prominence affects the contour features only (the so-called "tone scaling"). In such a case, the H target of Tones 1, 2, 4 should raise, but the L of Tones 2, 3, 4 should lower. The result would be an expansion of the pitch range of the contour tones. Third, prominence affects both register and contour in an eclectic way (the so-called "complex scaling"), still raising the [+upper] H and lowering the [-upper] L, but leaving the conflicting [+upper] L intact. The above three possibilities are summarized as follows (Yip 1993:264):

- (2) a. *Register scaling*
Tones 1, 2, 4: Raise throughout; shapes unchanged
Tone 3: Lower throughout; shape unchanged
- b. *Tone scaling*
Tone 1: Raise throughout
Tones 2, 4: Ends stretched apart; greater rise, fall
Tone 3: Lower throughout
- c. *Complex scaling*
Tone 1: Raise throughout
Tones 2, 4: H targets raised; L targets unchanged
Tone 3: Lower throughout

Among the above three possibilities, Yip (1993) rejects the first one, prefers the third one but leave the second one open.

2. Data

To facilitate comparison, we use the same test sentences as in Shih (1988) with minor modifications (the numbers following each syllable indicates its lexical tone):

- (3)
 - a. Wang2-xian1-sheng1 *jin1-tian1* yao4 mai3 yu2. (Mr. Wang wants to buy fish *today*.)
 - b. Wang2-xian1-sheng1 *ming2-tian1* yao4 mai3 yu2. (Mr. Wang wants to buy fish *tomorrow*.)
 - c. Wang2-xian1-sheng1 *mei3-tian1* yao4 mai3 yu2. (Mr. Wang wants to buy fish *everyday*.)
 - d. Wang2-xian1-sheng1 *hou4-tian1* yao4 mai3 yu2. (Mr. Wang wants to buy fish *the day after tomorrow*.)

As we can see, the sentences in (3) repeat each other except the part of the time words (italicized) which share the same

internal structure, include the same second syllable but alternate the four SC tones on the first syllables. Each sentence in (3) is uttered by a male SC speaker in three ways: 1. plain statement assumedly corresponding to the question “What’s the matter?”; 2. statement with moderate nuclear emphasis on the time words; 3. statement with strong nuclear emphasis on the time words.

3. Results

The results of the F0 curves of the time words in each sentence under different prominence conditions are shown in Figures 1-4, where the thin solid line (further indicated by

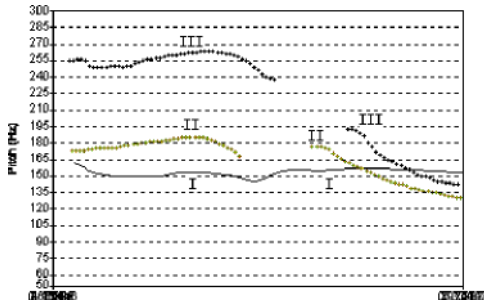


Figure 1: F0 curves of Jin1-tian1 with no emphasis, moderate emphasis, and strong emphasis

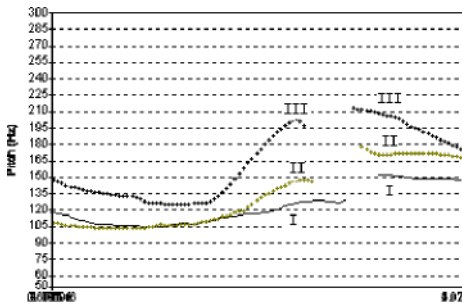


Figure 2: F0 curves of Ming2-tian1 with no emphasis, moderate emphasis, and strong emphasis

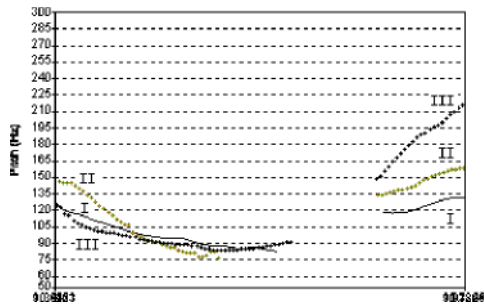


Figure 3: F0 curves of Mei3-tian1 with no emphasis, moderate emphasis, and strong emphasis

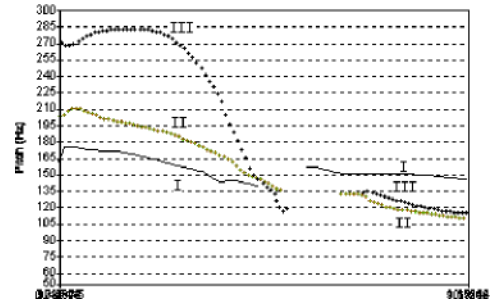


Figure 4: F0 curves of Hou4-tian1 with no emphasis, moderate emphasis, and strong emphasis

Table 1: The pitch levels (in Hz) of the tone on the first syllable of the time words

	No emphasis	Moderate emphasis	Strong emphasis
Jin1 (mean)	153.9 (145.1-162.7)	175.3 (165.7-184.9)	250.1 (237.5-262.6)
Ming2 (range)	104.6-128.5	102.5-146.5	124.6-201.3
Mei3 (F0min)	82.0	75.8	83.1
Hou4 (range)	175.7-140.2	210.5-132.5	282.6-116.7

number I), the grey dotted line (number II), and the black dotted line (number III) represent F0 curves with no emphasis, moderate emphasis, and strong emphasis respectively. The pitch levels (in Hz) of the tones on the first syllables of the time words in each sentence are given in Table 1. Each line or number is an average of six repetitions. The results in Figures 1-4 and Table 1 can be briefly summarized as follows:

As emphasis escalates from none to strong, Tone 1 constantly raises its pitch level; Tone 2 constantly raises its H target, with its L target moderately raised only under strong prominence. Besides, as prominence increases, Tone 2 shows an increasing upstepping effect on the following tone; Tone 3 generally keeps its L target unchanged, with its prominence level more clearly indicated by the pitch level (i.e., degree of upstepping) of the following tone; Tone 4 constantly raises its H target, with its L target moderately lowered only under strong prominence.

As for the post-prominence tones, their register is apparently determined by two factors: the type of their preceding tone and the degree of the prominence. On the whole, Tones 2 and 3 under prominence have an upstepping effect on the following tone while Tones 1 and 4 under prominence have a downstepping effect. Specifically, following Tones 2 and 3, the greater the prominence, the higher the H target of the postprominence tone is. Interestingly, the downstepping effect of prominent Tones 1 and 4 on the following tone functions in an apparently different way. As the degree of prominence increases, it is the range and speed of the downstep that increase constantly, but this does not follow that the absolute register of the pos-prominence tone necessarily falls to a lower level.

So far, a further question comes out. Since the upstepping effect of prominent Tones 2 and 3 is on the H target of the following tone, what happens if Tone 3 follows which assumedly features L target only? To answer this question, we

have our speaker utter the sentence in (4) just the same way as the sentences in (3), with changing emphasis degree on the adverbial “*Ming2xian3*”. Given that Tone 3 constantly changes into Tone 2 when preceding another Tone 3 in SC (the so-called “Tone 3 sandhi”), the sentence in (4) suffices for our purpose.

(4) Wang2-xian1-sheng1 *ming2-xian3* yao4 mai3 yu2. (Mr. Wang wants to buy fish *obviously*.)

Figure 5 shows the result of the F0 curves of the adverbial under the three prominence conditions. Table 2 gives target levels (in Hz) of the two tones respectively.

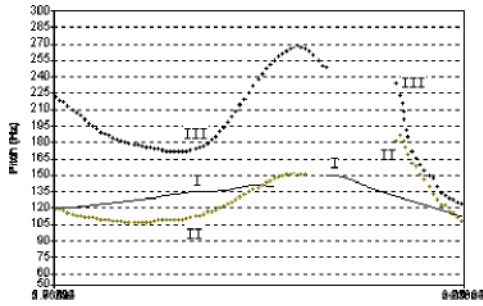


Figure 5: F0 curves of *Ming2-xian3* with no emphasis, moderate emphasis, and strong emphasis

Table 2: The target levels (in Hz) of the tones on *ming2* and *xian3*

	ming2	xian3
No emphasis	120.8-141.3	149.6-113.2
Moderate emphasis	105.7-150.9	186.2-107.3
Strong emphasis	171.3-267.2	233.1-123.5

From Figure 5 and Table 2, we see clearly that as emphasis on its preceding tone increases, the beginning of Tone 3 shows a strong tendency to assimilate to the previous H target, just as observed in Shih (1988). Meanwhile, however, the L target of Tone 3 remains roughly the same. Another interesting finding is that when followed by Tone 3 which has no intrinsic H target, the H target of strongly prominent Tone 2 climbs to a much higher pitch level (267.2Hz) than when followed by Htarget-including Tone 1 (201.3Hz). This result, together with the observation that in Table 1 Tones 1 and 4 under strong prominence climbs much higher than Tone 2, provides a good support for another tonal co-articulation rule drawn in Shih (1988): The final H of tone 2 is deleted if the following tone starts with H.

4. Discussion

In terms of the underlying features of SC tones in Yip (1980), our results about the relationship between tone and prominence in SC can be reinterpreted as follows: Among all the targets in SC tones,

[+upper] H is most easily affected by prominence; [-upper] L is the most stable; the conflicting [+upper] L is mainly affected by strong prominence, but the direction it goes depends on the direction of the movement of the tonal targets within the tone, moderately raising in Tone 2 but lowering in Tone 4. Thus, it seems that none of the three scaling approaches in Yip (1993) fully predicts the diversity of the performances of the SC tones under prominence, nor do they predict the variation with the degree of prominence. The downstepping effect of prominent Tones 1 and 4 and the upstepping effect of Tone 3 have sometimes been explained as the requirement of the so-called “pitch contrast” which is held to be necessary to make the emphasized tone stand out prominent. This account is generally feasible except that prominent Tone 2, which assumedly features an H target, should have upstepping rather than downstepping effect on the following H target. Nevertheless, the upstepping effect of Tone 2 seems to accord with the conclusion drawn by Xiao, Wang *et al.* (2003) that the essential pitch feature of Tone 2 is actually L while the essential feature of Tone 4 is H though their concrete observations about the performance of Tone 2 under prominence are rather distinct from our experimental result. We propose that the special properties of Tone 2 require further identification and interpretation.

5. Conclusions

On the whole, the realization of prominence in SC intonation is more dependent on the raising of the H target either of the lexical tones themselves or of the following (or maybe also the preceding) tone if they do not have one. The L targets do have an effect in Tones 2 and 4 as prominence becomes very strong, but still this effect is only auxiliary. As for the L target of Tone 3, its realization of prominence has a heavy reliance on the upstepping of the H target of its following (or preceding) tone. In this sense, it is not all accidental that Tone 3 sandhi should occur in SC. At least, it avoids the situation where a sequence of L targets come one after another and there is no one to help realize prominence.

6. References

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