Abstract*

The present study investigates four kinds of pitch variations in the running speech of Standard Chinese: (1) the down-step effect on the second H tone in a HLH tonal sequence motivated by the L tone; (2) the up-step effect on the focal H tone and the drop-step effect on the following H tone in the same sentence; (3) the lift-step effect on the H tone when it follows a focal L tone in the same sentence. Findings suggest that the pitch values of the running speech in Standard Chinese are determined by two types of factors: the pitch features of syllabic tones and some kinds of modification effects which play the role of raising or lowering the pitch register of the syllabic tone. Although these two kinds of factors work simultaneously on parallel on different tiers, the pitch features (e.g. H or L) of syllabic tones determine the manner of association between these two kinds of factors.

1. Introduction

Standard Chinese is a tone language with four syllabic tones: level tone, rising tone, fall-rise tone and falling tone. In citation forms, the pitch values of a syllable are manipulated largely by its syllabic tone. For example, the pitch value of a level tone is 555, while the pitch value of a falling tone is 51. Xiong (2004) found that 81.7% of the pitch variations in mono-syllabic words are determined by their syllabic tones; 69.1% in disyllabic words are determined by the syllabic tones of each syllable, 33.2% in sentence, 27.7% in passage, and 13.3% in spontaneous speech. This results show that the control power of the syllabic tone over the pitch values in running speech is greatly restricted. That means, besides syllabic tones, there must be some modification effects which play the role of raising or lowering the pitch values of syllabic tones, and therefore form the complicated sentential pitch contour. So it is very important to know the details of each modification effect. Xiong’s (2005) corpus-based research identified the modification effect of the down-step, which can be applied to explain four kinds ‘abnormal’ phenomena existing in the HLH tonal sequences of disyllabic words. These studies suggest that the pitch values in continuous speech are not only influenced by the syllabic tone, but by the modification effects to some extent as well.

In running speech, especially in spontaneous speech, various modification factors may take effect simultaneously on the same position, and sometimes the interwoven situation may dilute the individual effect of each factor, which makes it difficult to identify each kind of modification effect by analyzing the sentential pitch contour. Since Chao’s proposal of the Chinese intonation is actually the sum of the syllabic tone and the intonation’, some scholars (Shen, 1995; Wu, 1990; Cao, 2002) have tried to differentiate syllabic tones from intonation. Shen (1995) brought forward a concept of ‘tonal pitch range’. He measured thetonal pitch range of four-syllabic tones for each syllabic position in a sentence and then described and analyzed the overall pitch contour by using ‘the high pitch line’ and ‘the low pitch line’. Shen also pointed out that ‘intonation may modify the pitch value of tones directly by acting on the upper and lower limits of the tonal pitch range’. Wu (1990) advanced a new concept of ‘basic intonation unit’, which is an intermediate unit between ‘intonation’ and ‘syllabic tone’. He maintained that, ‘with the influence of intonation, the pitch values of tone groups in a sentence may move upward or downward as a whole’. In other words, intonation controls the pitch range of ‘a basic intonation unit’, rather than the pitch range of each syllabic tone. Based on prosodic structures, Cao (2002) proposed that ‘a mid pitch line’ should be used to describe and analyze the overall pitch contour of prosodic words, prosodic phrases and intonational phrases. These studies all come down to how to realize the intonation and the syllabic tones simultaneously in Chinese, i.e. how pitch features mark the differences among tones as well as the different intonation types at the same time. In spite of various research methods, previous studies seem to support the same view that intonation may modify the pitch values of syllabic tones by controlling their pitch range (such as raising or lowering, extending or contracting). However, an agreement on how intonation controls the pitch range of syllabic tones does not seem to have been reached.

2. Down-step effect in Standard Chinese

Xiong recently found in his study that there are four kinds ‘abnormal’ phenomena in the tonal sequences of disyllabic words: 1) When after a falling tone, the pitch values of level tone is observably lower than that after any of the other three syllabic tones. 2) When a falling tone comes after another falling tone, the pitch values of onset of the second falling tone is a bit lower; contrastively, when the falling tone comes after any of the other three syllabic tones, the onset is a bit higher. 3) When the rising tone comes after a fall-rise syllabic tone, the pitch values of the tail for the rising tone is a bit higher; contrastively, when the rising tone comes after any of the other three syllabic tones, the pitch values of the tail for the rising tone is a bit lower. 4) The pitch range of the four-syllabic tones is significantly narrowed down if it comes after a falling syllabic tone, but the pitch ranges of the four-syllabic tones remains relatively broad when it comes after any of the other three syllabic tones.

An explanation of these ‘abnormal’ phenomena lies in the allophone, i.e. the same phoneme has different allophones in different phonetic contexts. Experts holding this point of view may give such an explanation: when after a falling syllabic tone,
the pitch value of a level tone is realized as 33; when after any of the other three syllabic tones, the pitch value of a level tone is realized as 44. Obviously, this analysis is only a description rather than a reasonable explanation. Besides, this kind of analysis will lead to excessive allophones for a phoneme, and varieties of phonetic contexts for each allophone, which makes the description of the phonetic system more complicated. This analysis, therefore, is not economical.

Then how to give a brief and effective explanation of these ‘abnormal’ phenomena? Are there any consistent explanations? It is found in Xiong’s study that these ‘abnormal’ phenomena of pitch values have something to do with the tonal sequence of the disyllabic words. Standard Chinese is a tone language and it has four contrastive tones: level, rising, fall-rise and falling tone, these four tones can be coded as H-, LH, L-, and HL respectively. Besides the tonal sandhi of “fall-rise + fall-rise”, the disyllabic words have 15 different types of tonal sequences (shown in Table 1).

### Table 1: 15 types of tonal sequences of disyllabic words

<table>
<thead>
<tr>
<th>Tone Combination</th>
<th>Tone Types</th>
<th>Tone Combination</th>
<th>Tone Types</th>
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<tbody>
<tr>
<td>1 + 1</td>
<td>H-</td>
<td>2 + 1</td>
<td>LH</td>
</tr>
<tr>
<td>3 + 1</td>
<td>L- H-</td>
<td>4 + 1</td>
<td>HL H-</td>
</tr>
<tr>
<td>1 + 2</td>
<td>[H- LH]</td>
<td>2 + 2</td>
<td>[HL LH]</td>
</tr>
<tr>
<td>3 + 2</td>
<td>L- H-</td>
<td>4 + 2</td>
<td>[HL LH]</td>
</tr>
<tr>
<td>1 + 3</td>
<td>H- L-</td>
<td>2 + 3</td>
<td>LH L-</td>
</tr>
<tr>
<td>3 + 3</td>
<td>LH L-</td>
<td>4 + 3</td>
<td>HL --</td>
</tr>
<tr>
<td>1 + 4</td>
<td>H- L-</td>
<td>2 + 4</td>
<td>LH -L</td>
</tr>
<tr>
<td>3 + 4</td>
<td>L- HL</td>
<td>4 + 4</td>
<td>HL HL</td>
</tr>
</tbody>
</table>

As shown in Table 1, five out of the fifteen tone types contain the ‘.H.L.H.’ tonal sequence (framed). When the four kinds ‘abnormal’ phenomena discussed above are studied in association with these five tonal sequences, a concise phonological rule can be applied to explain the ‘abnormal’ phenomena: the register of the second H Tone in an ‘.H.L.H.’ tonal sequence is significantly lowered. This phenomenon was found long ago in African tone languages and later in non-tone languages like Japanese and English. This phenomenon thus got its name ‘down-step’.

It is believed that the pitch values of running speech are not only determined by the syllabic tone, but also by some modification effects at the same time. The down-step effect and the pitch feature of syllabic tone work together on parallel at different tiers (see Figure 1 below).

**Figure 1: Down-step effect in ‘4+4’ disyllabic word**

![Figure 1](image)

3 Pitch features of focal accents

Xu’s (1999) study analyzed the effect of the focal accent on the sentential pitch contour in Standard Chinese. He found the pitch range relating to the focal accent can be realized in three ways: (1) When the word bearing the focal accent locates on the pre-final position of the sentence, the pitch range of this focused word is extended significantly; (2) When the focused word is not on the final position of the sentence, the pitch range of post-focus word is restrained obviously (lowered or reduced); (3) The pitch range of words at other positions remain unaffected.

It has been reported by some studies that the pitch values of H Tones are raised and the pitch values of L Tone are lowered when accented. Therefore, it is necessary to make a difference between the H Tone and the L Tone in discussing the pitch representations of accentuation. The present study, hence, designs to investigate the focal accents in Standard Chinese on the basis of the pitch feature of syllabic tones. Further, based on Xu’s view, the modification effects of the focal accent on the pitch feature of the syllabic tones at the focus position and the post-focus position will be investigated respectively.

### 3.1 Research design and data collection

In order to investigate the pitch features of the focal accents in Standard Chinese, nonsensical tone combinations comprising 6 numerical figures were employed. 7 different focus positions were devised, indicated by a1, a2, a3, p1, p2, p3 and T. In a1, a2, and a3, the focus is assigned to the first, the third and the fifth syllables respectively; in p1, p2 and p3, the focus is assigned to the second, the fourth and the sixth syllable respectively. T is a tone combination without any narrow focus on the sentence. Two male speakers of standard Chinese were asked to read the 7 randomly ordered numerical combinations in the sound treated booth. For every numerical combination, five different recordings were made for speech analysis.

### 3.2 Speech annotation and data extraction

Four skilled annotators were recruited to do segmental and accentual annotations. Both syllabic and prosodic information, along with the types and positions of the focal accents, were annotated for further analysis. After the annotation, speech analysis software was used to extract the pitch data of each recording, and necessary manual refinements were made to ensure the accuracy of the data. On the basis of the segmental and pitch data, pitch values of 10 evenly distributed points for each syllable were obtained. Finally, the recordings were categorized according to the types of tone combinations as well as the types of focal accents, so that the means of pitch values of each category of sentences were computed.

### 3.3 Data analysis

Xu’s (1999) research shows that in any sentence with a narrow focus, the pitch range of the pre-focus syllable tends to be unaffected. Therefore, this study attempts to analyze the pitch data of the focus itself and the post-focus syllable, so as to investigate the modification effect of the focal accent.

#### 3.3.1 Focal accent falling on H Tone

Below is the pitch contour of ‘387593’, where ‘111331-p1’ indicates that the focal accent falls on the second syllable (‘8’), and ‘111331-T’ indicates that there is no narrow focus.
As shown in the figure 2, when the focal accent falls on the second syllable ‘8’, the pitch of the H Tone is raised to some extent. In this study, such a rising tendency is called ‘lift-step’. However, the pitch of the H Tone in the third and the following syllables are dropped dramatically, such a phenomenon is called ‘drop-step’ in this paper. It is not difficult to see from the above figure that ‘lift-step’ only occurs on the H Tone in the focus position. In addition, ‘drop-step’ only occurs on the H Tone of the post-focus syllables, and the pitch values of the L Tone in the post-focus position will not be significantly affected. Besides, ‘drop-step’ can cross the boundary of the prosodic word and extend to the end of the sentence. Even if there is another L Tone, the ‘drop-step’ can go across the L Tone and exert its effect on the H Tone following the L Tone. On the basis of the pitch data viewed above, this study describes the pitch features of the focal accent falling on the H Tone as Figure 3.

Figure 3: Pitch Feature of the Focal Accent Falling on the H Tone

3.3.2 Focal accent falling on L Tone

Below is the pitch contour of ‘535353’, where ‘313131$ a_2’ indicates that the focal accent falls on the second syllable ‘5’, ‘313131$ p_2’ indicates that the focal accent falls on the fourth syllable ‘3’, and ‘313131$ T’ indicates that there is no narrow focus in the sentence.

As seen in figure 4, when the focal accent falls on the third syllable ‘5’, it does not have a significant modification effect on the pitch of the L Tone, but it does have an significant effect on the proclitic H Tone: it raises the H Tone to a certain extent. This phenomenon is therefore called ‘up-step’ in this study. However, as this effect of up-step is lesser when it is compared with the effect of the focus falling on the fourth syllable ‘3’, it becomes necessary to distinguish lift-step from up-step. Besides, it can also be seen from figure 4 that the focal accent falling on an L Tone has a dual effect: it not only puts the proclitic H Tone into an up-step process, but it also puts the following un-neighboring H Tone into a drop-step process. On the basis of what can be observed from the figure, this study describes the pitch feature of the focal accent falling on an L Tone as Figure 5.

Figure 5: Pitch Feature of the Focal Accent Falling on the L Tone

4. Summary

This study discusses four kinds of pitch variations in the running speech of Standard Chinese: (1) the down-step effect on the second H tone in a HLH tonal sequence motivated by the L tone; (2) the up-step effect on the focal H tone and the
drop-step effect on the following H tone in a same sentence; (3) the lift-step effect on the H tone when it follows a focal L tone in a same sentence. Findings suggest that the pitch values of the running speech in Standard Chinese are determined by two types of factors: the pitch features of syllabic tones and some kinds of modification effects which play the role of raising or lowering the pitch register of syllabic tone. These two kinds of factors work simultaneously on parallel on different tiers.

5. References