

# Prosodic Prominence and Phrasing in Spoken Mandarin: The Case in the 3<sup>rd</sup> tone

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## Abstract

Prosodic prominence and phrasing has some general principle commonly existed in the world languages, but their execution is language-specific, especially in tone languages like Chinese. The kernel of the issue is that how the pitch manifestation of individual tones accommodate to achieve prominence and phrasing within certain prosodic domain. This paper tries to explore the peculiarity on pitch alignment of the 3<sup>rd</sup> tone in Mandarin Chinese by examining its F0 movements in different accent status. The primary result leads to a consideration that, the pattern of pitch manifestation for prominence and phrasing may greatly depend on the register distinction among the tones, even without regard to other context environments.

**Index Terms:** prominence, phrasing, pitch manifestation, 3<sup>rd</sup> tone, Mandarin Chinese

## 1. Introduction

Prosodic prominence has attracted more and more attention both in speech science and technology. Certain patterns of pitch manifestation were used as one of the main parameters for both of prominence and phrasing. For example, focus expression in previous studies have always been regarded as a pitch lifting of certain tones, it is commonly existed in many tone languages. Nevertheless, some doubts in this aspect were raised and discussed recently. For example, does the pitch behavior for prosodic prominence follow the same way in all tone languages, or all tones in the same language will follow the same manner [1, 2]?

Referring to spoken Mandarin, the main disputation is about the pitch behavior of 3<sup>rd</sup> tone. As what exhibited in other languages, tones in accent condition are generally manifested by driving up of pitch level and expansion of pitch range in Mandarin, and it is mainly satisfied by raising the high point of F0 [3, 4]; however, the 3<sup>rd</sup> tone is in exception, it exhibits a quite different manner from other tones.

Many studies have reported the peculiarity on 3<sup>rd</sup> tone's pitch movement, but the conclusions are inconsistent up to date. The main argument is that whether its pitch level is lifted or lowered in accented condition, and how does it execute in real speech? Specifically, there are at least two types of viewpoints. One of them suggested that pitch level of 3<sup>rd</sup> tone is driven down in reverse to the case of other tones, and it is mainly manifested by lowering the L-point of F0, in stead of rising the H-point of F0 [4, 5, 6, 7], because 3<sup>rd</sup> tone with a distinctive feature of low pitch register [8], which is remarkably distinguished from other tones in Mandarin.

. Another type of opinion claimed that focus information in the 3<sup>rd</sup> tone case does not implement in itself, but by adjusting the pitch level of neighboring tones, so that to foil the focal information of the 3<sup>rd</sup> tone [9, 10, 11]. For example, Chen [11] found that pitch prominence of the 3<sup>rd</sup> tone can not be executed through pitch regulation of itself, though there is

some case does show a depressing L-point of the F0, but mostly manifested through raising the F0 H-point of its neighboring tones', especially through the afterward one's.

However, the major attention of above studies have often concerned the prominence on the focal effect in general, but regardless the effect from register distinction among the tones. Thus, the exact behaviors of pitch prominence, especially in the 3<sup>rd</sup> tone case, remain not as clear in Mandarin.

This study tries to further examine whether the pitch behavior for prosodic prominence to be affected by the register distinction of the tones. Aim at this purpose, the 3<sup>rd</sup> tone both in accented and unaccented cases were inspected to see if its prominence pattern is identified or not with other tones, since unaccented tokens are generally not expected to trigger a pitch prominence, so it may be of benefit to pry into the pure situation about focal effects in 3<sup>rd</sup> tone case.

## 2. Test materials and methods

Heretofore, the speech materials used for studies on prosodic prominence of Mandarin were mostly designed for the comparing between typically focused vs. non-focused instance. However, in real speech, the influences come from multi-factors are unavoidable, any results obtained from designed materials must be proofed by natural speech.

Therefore, test materials and methods employed in this study will try to adapt the prominence situation occurred naturally in discourse, in stead of some paired tokens designed deliberately. Therefore, the examining will be made through the comparison between different degrees of prominences, in stead of that between typically focal and non-focal cases.

In addition, research into the relationship between prominence and phrasing is also considered.

### 2.1. Test materials

The 3<sup>rd</sup> tones examined here are occurred in two sets of clauses extracted from the ASCCD discourse corpus, where they were read aloud by two male and two female speakers.

Set1:..... 可以用极简单的事例加以说明  
(.....it can be illuminated by using quite simple instance)

Set2: 现代经济学是这样表述的: 制度至关重要, 制度是人选择的, 是交易的结果

(It is described in such a way in modern economics: institution is most crucial, institution is chosen by people, is the result of bargaining)

The material in set1 is a clause within the sentence of 世间的的问题, 原来极复杂的, 可以用极简单的事例加以说明. There are total four 3<sup>rd</sup> tone syllables in the clause, namely, 可/ke/, 以/yi/ (hereafter yi-a), 简/jian/ and another 以/yi/ (hereafter yi-b), but the 可/ke/ has become a 2<sup>nd</sup> tone in terms of tone sandhi

rule, thus, only three 3<sup>rd</sup> tones (as marked with italics) to be examined here. Perceptually, /jian/ is accented, /yi-a/ and /yi-b/ is unaccented in this clause.

The material in set2 is a composed sentence that consists of 4 clauses, where includes total four 3<sup>rd</sup> tones, i.e., 表/biao/, 紧/jin/, 选/xuan/ and 果/guo/. They all locate at a broad focal area in each clause respectively. Relative speaking, their accent degree should be in following order: /xuan/ > /jin/ > /biao/ > /guo/ according to their grammatical position in the clause. In the fact, this grade has been proofed by perceived impression.

## 2.2. Exam methods

Prosodic prominence is relatively compared to those of non-prominent parts within certain domain on one hand, but must be influenced by other prosodic factors on the other hand. In order to examine the pitch manifestation at any position in phrasal level, we have to set some scale, so that to normalizing the measured F0 as the equivalent of perceived pitch measurements, including the high point (hereafter H-point), low point (hereafter L-point) and pitch level in each domain (here within a clause). The following equation defines a reference scale, which is set to eliminate the influence from pitch declination due to physiological mechanism:

$$FO_r = f0h.b - (f0h.b - f0h.e) / (\text{syll}.n - 1) * (ta.n - 1)$$

Where  $FO_r$  represents the pitch value (Hz) of reference scale corresponding to certain position of the tone in test,  $f0h.b$  is the pitch height of beginning syllable and  $f0h.e$  is that of ending syllable in that clause,  $\text{syll}.n$  is the number of total syllables in the clause and  $ta.n$  is the order number of the tone in test. Then, both the direction and magnitude of pitch deviation for each test tone can be obtained by calculating the difference between measured value and reference value. If calculated deviation is a minus value, it means the pitch of test tone is lower than reference scale; contrary, if result in a positive value, then means the pitch of test tone is higher than reference scale.

## 3. Results and Discussion

### 3.1. Result from test 1

The data obtained from test 1 is summarized in Fig.1 and Table 1. First, from Fig.1 we can see that the deviation on H-point (shown as the red column) of accented /jian/ is not much higher than that of unaccented /yi-a/, and even lower than that of unaccented /yi-b/. On the other hand, however, its L-point (shown as the blue column) is significantly lower than /yi-a/ and /yi-b/. And such a regular phenomenon presents identically in all of the 4 speakers' utterance.

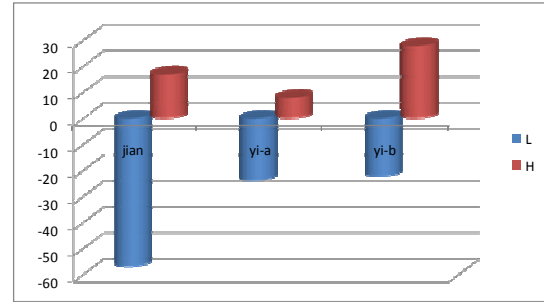


Figure 1: Illustration on the H- and L-point (Hz) deviated from the reference scale in accented and unaccented 3<sup>rd</sup> tones

Secondly, according to the data listed in Table1, pitch level of the 3<sup>rd</sup> tones in the clause are driven down generally, and there exists obvious difference between accented /jian/ and unaccented /yi-a/ and /yi-b/, though the magnitude of deviation in male speakers case is smaller than that of female ones', and the data of male speakers even higher than the reference scale in unaccented /yi-a/ case. All these differences indicate that a sharply pitch lowering is the key point for the prominence of 3<sup>rd</sup> tone in utterance.

Table 1: Pitch register (Hz) deviated from reference scale in accented and unaccented 3<sup>rd</sup> tones

	f	m
jian	-30.55	-14.065
yi-a	-15.95	10.34
yi-b	-1.525	-0.65

### 3.2. Result from test 2

Figure 2 gives an additional comparison on the deviation of H-point and L-point among the 3<sup>rd</sup> tones, which with different accent degree in the sentence. From this picture we can see that, L-point of the 3<sup>rd</sup> tones is all deviated downward from reference scale regardless of their accent degree, but the magnitude is regularly depending on their accent degree. On the other hand, however, the H-point exhibits a rather irregular situation and seems have no clear relation to their accent degree. It may be why some people consider 3<sup>rd</sup> tone in Mandarin have no clear contribution to prosodic prominence [11, 12], because the attention of majority studies were concentrated on the behavior of H-point, but ignore that of L-point.

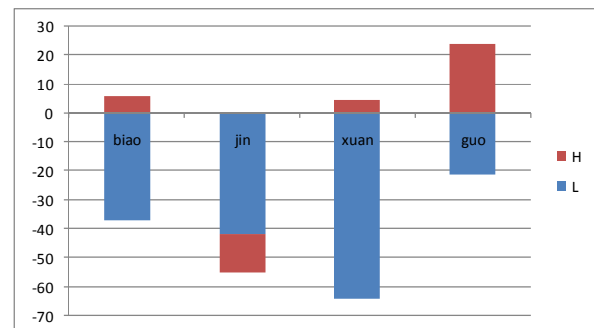


Figure2: Illustration on H- and L-point deviated from reference scale in the 3<sup>rd</sup> tones with different degree of accentuation

### 3.3. Discussion

As the picture shown in Fig.1, the H-point of the 3<sup>rd</sup> tone seems have no regular correlation with its accent status; while its L-point is systematically deviated downward from reference scale, and the magnitude of deviation is significantly greater in accentuated case (in /jian/). It tells us that prosodic prominence in the 3<sup>rd</sup> tone case does implemented through pitch adjustment in itself, but not leaning from the H-point raising of neighboring tones.

The data obtained here have also confirmed previous finding on pitch range expansion in focal condition. Besides, a much greater onset f0 of the 3<sup>rd</sup> tone is found in accented cases, it might be the main source that causing the pitch range expansion. However, another question might be raised at the same time, that is, how to view the onset f0 raising in accent case? Obviously, it is not an intrinsic feature of 3<sup>rd</sup> tone itself, because the phonological target of 3<sup>rd</sup> tone is originally lowest among the four tones in Mandarin.

This phenomenon may be explained by consulting Xu Yi's PA model [13].

At first, according to the model, underlying target for certain tone can be considered as remaining constant, and it is always implemented near the end of a syllable that the tone attached to. Secondly, pitch movement toward a tonal target starts at the syllable onset, ends at the syllable offset, it must take time to change pitch in order to approximation the target. And the third, in seriate speech, the onset f0 of a tone is determined by the offset f0 of preceded tone due to co-articulation. For example, when a 1<sup>st</sup> tone followed by a 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> tone (represents as High, Rising, Low and Falling) respectively, as what shown in the upper part of Fig. 3, the f0 at the start point of the following tones are all very high and close to one another, then apart from each other and going their own targets gradually. Whereas, when a 3<sup>rd</sup> tone preceded by the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> tone respectively, its onset f0 will be quite discrete as shown in the lower part of Fig.3. Obviously, the onset f0 of the 3<sup>rd</sup> tone is raised in all the case, and specific height is depending on the underlying target of the preceding tones. Thus, a transition course between neighboring tones will be resulted inevitably in this case.

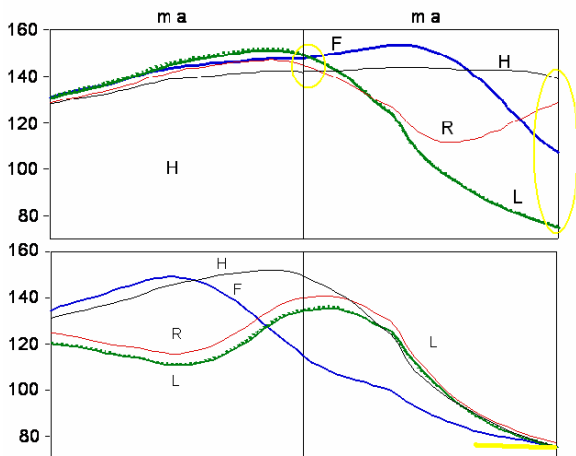


Figure3: Illustration on pitch alignment (quote from Xu, 1997)

Consequently, if take above viewpoint, the onset f0 raising of a 3<sup>rd</sup> tone should be regard as a transition state come from the preceding tones' naturally, no matter the 3<sup>rd</sup> tone is accented or not. In the fact, it is true in real speech, as the

example shown in Fig.4, the onset f0 is raised not only in accented 简/jian/, but also in unaccented 以/yi-a/ and 以/yi-b/ cases; the main difference between them is that, the f0 contour of 简/jian/ with a more cragged slope than that of 以/yi-a/ and 以/yi-b/. Apparently, such a difference is caused by following factors: On one hand, the onset f0 of 简/jian/ is much higher than that of 以/yi-a/ and 以/yi-b/, it is due to a much higher offset f0 of the preceding 极/ji/, which also locate in the focal area. On the other hand, the phonological target of 简/jian/ is manifested more typically than 以/yi-a/ and 以/yi-b/, its L-point is sharply driven down and has obviously broken through the declination trend for the whole utterance. Therefore, a longer distance must be taken for the approximation from the onset to the end of its target, thus, a much cragged f0 slope is reasonably resulted.



可以用极简单的事例加以说明

Fig. 4: The f0 movements in the clause of 可以用极简单的事例加以说明

In addition, the present study also presents some new data that related to the interaction between prosodic prominence and prosodic phrasing in either of focal and non-focal conditions. For example, the pitch behavior of 果/guo/ shown in Fig.2 may imply some important information that we may ignore before. At first, as mentioned in section 2.2, another purpose of this investigation is try to find the way of the integration between prosodic prominence and prosodic phrasing. To satisfy this purpose, the second set of material is selected to test how the two aspects is interacted and integrated each other. Now the 果/guo/s situation may imply some answer. Since the 果/guo/ is least accented and locates at the end of a clause, which is actually the last clause in this sentence, thus, both of its H- and L- points deviation are not only higher than its accented partners, but also deviated evenly from reference scale, so that to carrying phrase terminal information and accent information at the same time. In the fact, the exhibition of /yi-b/ in test 1 is also implying the same information.

## 4. Conclusions

According to the results obtained so far from both tests, it would be claimed again that, at first, the typical characteristics for prosodic prominence of the 3<sup>rd</sup> tone in Mandarin is the driven down of pitch level and manifested mainly by a sharp lowering in its L-point; it is obviously opposite to the case of other tones, where the prominence is executed as driving up of pitch level and manifested by further raising of H-point. And this fact has well revealed that, both direction of pitch standing out all have their own role in contributing to prosodic prominence. Consequently, we should pay more attention to the L-point of the 3<sup>rd</sup> tones, because there still some doubts without clear answer.

In addition, the present study has provided some new data on the interaction between prosodic prominence and

prosodic phrasing in both of accented and unaccented cases. This finding reminds us that the feature of the 3<sup>rd</sup> tone in Mandarin Chinese might be a bang-up window for the approach to the essence of the “neuter intonation”, it was found by Yuan-Ren Chao[14] and to be defined as the base of the intonation of a language, but is language-dependent, because the “neuter intonation” is “one model for one language or dialect”; now the special characteristics of 3<sup>rd</sup> tone is one of the souls of Mandarin intonation.

## 5. References

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