Mandarin Neutral Tone as a Phonologically Low Tone

普通话轻声音系特征为低调

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文章内容简介

本文的基本理论于１９９８年在第四届全国语音学学术会议上宣读，随后发表在吕士楠等编辑并出版的１９９９《现代语音学论文集》中（林华，《普通话轻声调值的综合分析》。《现代语音学论文集》，吕士楠等编，金城出版社，1999。北京。175-183页）。

文中和1999年文的主要思想是：从音系学角度来讲

- 轻声有本调，其调值为低调；
- 轻声的低调用林华”调素论”理论来表示则为（L）；（用传统的赵元任五度标调法为（１））
- 轻声直接出现在三声后面产生低调序列，由于“低调制约规则”则会出现异化变调，调值升高；
- “低调制约规则”亦是引起上声变调的诱因，上上相连出现一系列的低调，必异化；前调调值升高；
- 注：林 华，1998，“调素”论及普通话连读变调。《中国语文》，1998，第1 期，31-39 页 一文中提出“调素论”，“边缘调素脱落”，“低调制约规则”等一套完整的普通话连读变调音系理论；

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Mandarin Neutral Tone as a Phonologically Low Tone[1]

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Abstract:

This paper has examined the Mandarin neutral tone values in phonological terms. Essentially, it has developed a unified analysis accounting for the surface values of Tone 0. In doing so, the analysis accounts for why Tone 0 behaves differently after Tone 3. Or, why does it rise after Tone 3 but falls after the other three tones? It is argued that Tone 0 is phonologically a low tone with a low pitch target. When preceded by another low tone--Tone 3, Tone 0 is raised by a Neutral Tone Sandhi Rule (0TS) triggered by an Obligatory Contour Principle that disallows identical L tones across a syllable boundary. Finally, this paper reveals the connection between 0TS and the well-known Third Tone Sandhi process of Mandarin.

Keywords:

The neutral tone, tone, tone sandhi, Mandarin Chinese

0. Introduction

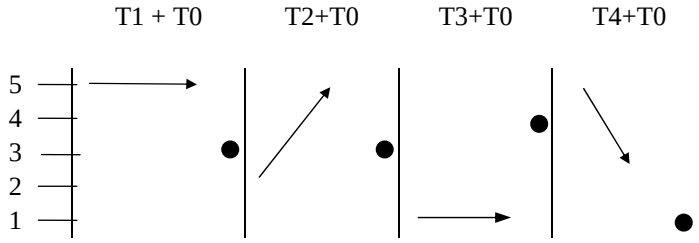
The multiple values of the Mandarin neutral tone (Tone 0 or T0[2]) have been well documented (e.g., Qi 1956, Lin 1962, Chao 1968, and Wu 1985). These values are shown below on a scale of five pitch levels developed by Chao. The arrows represent the four basic Mandarin tones valued at (55), (35), (113) and (51)[3], respectively, and the black dots represent the neutral tone.

[1] An earlier version of this paper was presented at the Fourth National Conference on Modern Phonetics, Beijing, 1998. The feedback from the audience at the conference as well as that from the anonymous reviewers of this journal have greatly helped the revision of this paper. The author wishes to thank Miss Carolyn Pytlyk for her comments, feedback and proofreading. Needless to say, all mistakes are mine.

[2] In this paper, the expressions Tones 1, 2, 3, 4 and 0 (or T1, T2, T3, T4 and T0) are used interchangeably with the First, Second, Third, Fourth and the Neutral Tones, respectively.

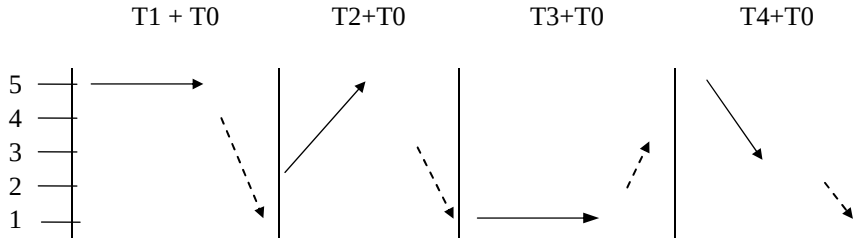
[3] Tone 3 is always a 'half-third' (Chao 1968) in non-final position, and according to the acoustic study by Shen (1992), Tone 4 does not reach its low target before another tone.

(1)



Tone 0 has the value of (3) after Tones 1 and 2, the value of (4) after Tone 3 and the value of (1) after Tone 4. In instrumental studies such as Dreher and Lee (1966), Cao, 1992, and Cao et al. (1995), Tone 0 not only has varied but also contoured values. Specifically, after Tones 1, 2 and 4, Tone 0 falls with values at (41) and (31) and (21), respectively, while after Tone 3 it rises at (23), as shown below. The dotted lines represent the contoured neutral tone.

(2)



How Tone 0 acquires these surface values has been an issue of debate. The most widely-held position is that Tone 0 does not have its own value, but derives values from the immediately preceding full tone (Chao 1930, 1968, Cheng 1973, Lin 1962, Qi 1956, Shen 1992, among many others). However, this position suffers from an outstanding problem: there is no reason for Tone 0 to derive a higher tone from a preceding Tone 3. In addition to this major problem, there are several other questions that remain unanswered. How precisely does Tone 0 derive its value from the tone before it? Through what mechanism? If Tone 0 assumes these values on the surface, what is Tone 0 like before it derives these values? that is, when synchronically or diachronically, stress assignment leaves the concerned syllable morphologically or syntactically unstressed and 'de-toned' [4] ? Furthermore, why does Tone 0 exhibit a rising contour after Tones 1, 2 and 4 but a falling one after Tone 3? These are among the questions one has to answer in order to achieve an adequate analysis for the Tone 0 data. This paper will try to answer these above-mentioned questions. It will attempt to probe into the fundamental nature of Tone 0, and propose a unified analysis to account for all its surface values. It will demonstrate (a) that the underlying representation of Tone 0 is a low tone; (b) that the surface forms of Tone 0 are not all derived at the same time, but there is a process which raises Tone 0 after Tone 3 followed by feature spreading due to carry-over tone co-articulation.

1. Previous studies

[4] While most morphologically induced neutral tones can still be traced back to their full tones synchronically, many syntactically reduced ones, such as the perfective verb suffix le and the possessive marker zhe, can only be traced back to their full tones diachronically.

Although there is no lack of studies aiming at Tone 0's phonetic gestures such as duration, intensity and fundamental frequency, or its functional aspects (e.g. Ba 1987, Cao 1986, 1992, 1995, Cao et al. 1995, Dreher and Lee 1966, Hockett 1966, Jiang 1956, Lin and Yan 1980, 1990, Martin 1957, Shen 1990, Shih 1987, Xu 1983, Yin 1982, Zadoenko 1958, and Zhang 1958), few studies have attempted a phonological analysis for Tone 0. Two notable exceptions are Yip (1980) and Shen (1992).

Yip's tonal framework of analysis consists of two features: [upper] and [raised].[5] The two features combine to define four tonal levels:

(3)

Register Feature	Tone Feature	4 Tonal Levels
[+upper]	[+raised]	[+upper, H]
	[-raised]	[+upper, L]
[-upper]	[+raised]	[-upper, H]
	[-raised]	[-upper, L]

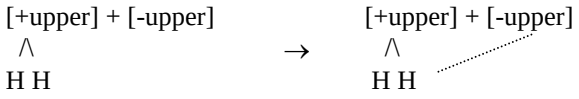
Occupying a separate autosegmental tier, the feature [upper] partitions the range of the voice pitch into two equal portions, a [+upper] and a [-upper] portion. On Chao's (1968) scale, [+upper] covers a pitch range from 5 to 3, and [-upper] from 3 to 1. Each of the two portions, in turn, is divided into two sub-portions by the tonal feature [raised]. Thus, in terms of coverage of the pitch range, these two features overlap each other. Yip argues that Mandarin Tone 0 is pre-specified for its register feature [+/-upper], but not for its tonal feature [raised], and therefore, Tone 0 consists of the following underlying representation[6]:

(4) [-upper]

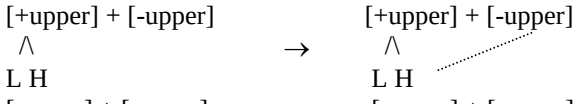
According to Yip, the surface values are achieved through derivations done in the following manner:

(5)

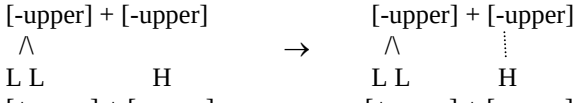
a. T1+ T0:



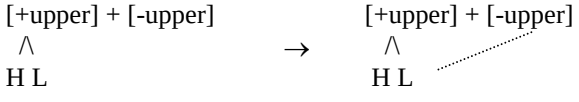
b. T2+T0:



c. T3+T0:



d. T4+T0:



[5] Yip used the name [high] for this feature in this 1980 work, but changed it to [raised] later (e.g. Yip 1989) following Pulleyblank (1986).

[6] Yip's analysis is meant only for those "permanent" T0s on such grammatical particles as zhe and le, while making no claim that the same also holds true for the T0s on other morphemes.

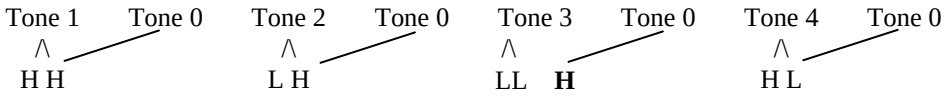
First, in each case, the neutral-toned syllable appears with its prespecified feature [-upper]. Then, the feature [raised] (represented as H or L) spreads from the full tone to its following Tone 0, and gives the latter its final form. Like the traditional position, this analysis has a problem with Tone 0 after Tone 3. To solve this problem, Yip posits 'a special rule that inserts an H tone after the third tone when no other tone follows (p.162).' By 'no other tone follows', Yip explains that she means 'pre-pausally or before a neutral tone.' Her rule can be roughly captured in the following manner:

(6) LL → LLH / ___ pause or a neutral tone

The problem with this theory is that, while it seems natural to consider a pause as a case of 'no other tone follows', it is not clear how, theoretically or empirically, the neutral tone can function likewise. Another problem with Yip'theory is that it cannot explain the instrumental data produced in Dreher and Lee (1966), Cao (1992) and Cao et al. (1995) mentioned earlier; namely, that Tone 0 falls after Tones 1, 2 and 4 but rises after Tone 3.

Shen (1992) is another study that gives a phonological account for Tone 0. In this analysis, Shen applies a simple binary tonal feature which gives the two register values of H and L for the description of Mandarin tones. For Tone 0, she argues for the following derivations:

(7)



This analysis is similar to Yip in that Tone 0 after Tones 1, 2, and 4 derives its values by left-to-right feature-spreading, and acquires a H tone after Tone 3. It differs from Yip by positing that the H tone, rather than being inserted from some external source, is part of the underlying representation of Tone 3. This H tone somehow 'floats' there, and gets linked to the toneless syllable when the opportunity presents itself.

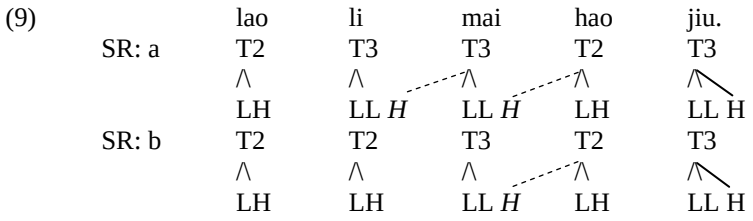
A problem with this analysis is that it is not clear how Tone 3 should have an underlying representation that has one of its three tone not associated with it. This causes a problem when a domain-final Tone 3 is considered. Take the following famous case from Cheng (1973) as an example:

(8)

	[[Lao	li]	[mai	[hao	jiu.]]]
	old	li	buy	good	wine
	'Old Li buys good wine.'				
UR:	3	3	3	3	3
SR: a.	(2	3)	3	(2	3)
SR: b.	(2	2	3)	(2	3)

Note: The numbers 2 and 3 stand for Tones 2 and 3 respectively

All the syllables in this sentence are underlyingly Tone 3. Some of them, depending on their syntactic and/or prosodic positions, undergo the Third Tone Sandhi[7] (3TS) and turns into Tone 2. Depending on the speech tempo, the surface outcome can be (a) in slow speech or (b) in faster speech. Problem arises with Shen's analysis as to how the stipulated floating H tone should be dealt with. It is not clear how the floating H tone (italicized here) gets associated to the preceding Tone 3 it belongs to, and there is no mechanism to stop it from being wrongly associated with the following tone, as shown by the dotted lines:



As well, Shen also cannot account for the fact that Tone 0 falls after Tones 1, 2 and 4 but rises after Tone 3 (Dreher and Lee, 1966; Cao 1992, and Cao et al. 1995). Finally, the most serious problem with Shen's analysis is an empirical one. It does not yield grammatical results. As shown in (7), it produces a Tone 0 with a value of H (i.e., a high tone) after Tones 1, 2, and 3. Empirically, this is hardly the case, and is very counterintuitive. Although Tone 0 may derive a high-pitch value from the offset of its preceding tone, it is not at all identical to that offset in pitch. In any event, it is NOT a high tone, derived or otherwise.

2. An Alternative Analysis

So far no phonological analysis has been found that provides a principled account for the Mandarin Tone 0 data. The fundamental problem with the previous analyses lies in their assumption that all the surface values occur at the same level. By doing so, they have to treat Tone 0 after Tone 3 a case of an idiosyncratic exception, necessitating certain patch-up mechanism. By doing so, they lose sight of an important distributional characteristic of Tone 0, as demonstrated below.

2.1 The Underlying Form of Tone 0

This section follows Chan (1991) and Lin (1996 and 1999) by adopting a simple tone feature system that contain the two features [high] and [low].[8] These two features interact to yield three tonal levels, H, M, and L.

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[7] The Third Tone Sandhi Rule is traditionally formulated as Tone 3→Tone2/ ___ Tone 3. Please see Section 2.5 for more information.

[8] More features may be needed to differentiate tones of a language or dialect of Chinese with more complex tonal categories or structures.

(10)

	[+high]	[-high]
[+low]	---	**L**
[-low]	**H**	**M**

A closer look at how Tone 0 behaves after the full tones is now necessary. According to Chao (1968), Dow (1972), Qi (1956) and many others, Tone 0 is always *higher* than the offset of a preceding Tone 3, but *lower* than those of the rest of the full tones. Furthermore, in phonetic/instrumental studies by Dreher and Lee (1966), Cao (1986, 1992) and Cao et al. (1995), Tone 0 *rises* after Tone 3, but *falls* after other tones. Cao (1992) observed, 'there exist two different types of pitch contours among the Neutral Tone syllables, namely, ... a mid-level or slightly rising contour after a third tone syllable, and a mid-falling after all of the other tones' syllables (p.49).' Although previous observations vary as to whether Tone 0 is level or contoured, researchers all agree that *Tone 0 behaves one way after Tone 3, but another after the other tones.*

This is perhaps the most important *phonological* characteristic of Tone 0. In all likelihood, it points to a classic case of complementary distribution. Perhaps due to Tone 0's varied surface values, this characteristic has somehow been overlooked in phonological studies, in spite the fact that, in the literature on Mandarin tone, there is no lack of intuitive descriptions that recognise this distributional fact. Cheng (1973), for instance, remarks:

> "the refined acoustic details [about the neutral tone] perhaps do not necessarily represent the native speaker's knowledge. *The speaker's aim perhaps is to produce the neutral tone low after first, second, and fourth tones and higher after third tone*." (p. 56)

A similar remark is seen in Chao (1968) who gives the pedagogical advice that 'for practical purposes, it is sufficient to remember the neutral tone as being high after a half third tone and (relatively) low after the other tones (p. 36).' Dow (1972) does not even bother with Tone 0's varied values after Tones 1, 2 and 4, but describes them as having a uniform low pitch in those positions:

(11)

	(T 1 T 0)	(T 2 T 0)	(T 3 T 0)	(T 4 T 0)
200Hz				
180Hz				
160Hz			*	
140Hz				
120Hz				
100Hz	*	*		*

All the intuitive remarks and treatment by these native Chinese-speaking linguists seem to zero in on the following: Tone 0 is underlyingly a L tone. The underlying representation of Tone 0 can be captured as follows:

(12)

T0
|
L

Immediately, this analysis begins to shed light on the Tone 0 data observed in instrumental studies mentioned earlier. Recall that in those studies, Tone 0 always falls after Tones 1, 2, and 4. Not only does Tone 0 fall but it also always ends with the low pitch value of (1).[9] This fact is readily explained as that the target of Tone 0 is the L tone[10], although to reach the L tone, Tone 0 must go through a transition from the offset of its preceding tone. Note that the T3-T0 context is not singled out as an exception to this analysis. Quite to the contrary, this theory proposes a unified analysis that applies to Tone 0 in all the four contexts (i.e., T1-T0, T2-T0, T3-T0 and T4-T0). We will return to this point later, but now let us continue our discussion of the transition between the preceding tone and Tone 0.

In the T3-T0 case, it seems that Tone 0's L target is somehow altered, or more specifically, *raised*, at the onset by the preceding tone. This 'raising' is readily explicable as being due to the carry-over tone co-articulation effect observed in studies such as Xu (1997). Xu analysed the tonal co-articulation between two adjacent tones. His subjects were instructed to utter the sequence of mama in all the 16 tonal combinations involving the four full Mandarin tones.[11] In addition, they were instructed to utter the syllable ma in isolation in all the four tones. The f_0 and duration of these utterances were calculated and compared. Among the discoveries of this study are (a) there are large carry-over effects whereby qualities of the preceding tone 'spilt over' the following tone. (b) Carry-over effects decrease only gradually—strongly present at the beginning consonant, 'still quite substantial at the onset of the vowel in the second syllable…and remaining quite sizeable at vowel mid-point (p.68).' And finally, (c) carry-over effects are not found beyond the immediate adjacent syllable.[12] Xu's findings suggest that Tone 0's onset values are due to carry-over tone co-articulation effects. Xu's findings also suggest that the fact that a surface tone carries a value derived from its preceding tone does not mean the tone is without its own phonological value. All the syllables in Xu's studies carry full tones which are somehow modified at the onset when following another tone.

One of the interesting findings in Xu has to do with the carry-over effects on a Tone 3. On all the Tone 3 syllables in T1-T3, T2-T3, and T4-T3 combinations (there is no real T3-T3 combination due to the Third Tone Sandhi), a visible sharp fall starts shortly before the initial consonant, passes the vowel and only then ends at the low target of the third tone (See Xu, Figure 3(c), p. 69). In fact Xu's figure is not unlike the one in Cao (1992, Figure 1(a) and 1(b), p.49) in which T1-T0, T2-T0, and T4-T0 strings have similar f_0 movements. Specifically, T1-T0, T2-T0, and T4-T0 strings have similar falling contours on T0 as T1-T3, T2-T3 and T4-T3 strings have on Tone 3. In other words, the Tone 0 target is the same as that in the Tone 3, a recognized low tone. Finally, if Tone 0 is a L tone in the underlying

[9] See (2) for the illustration.

[10] A recent study by Chen and Xu (2006) has a different view. Their phonetic study seems to suggest that the target is a mid tone. However, Chen and Xu is purely phonetic and makes no attempt at a phonological argument.

[11] Xu's subjects were instructed not to use the neutral tone in the Tone 1 + Tone 1 sequence, since this sequence means 'mother' which is normally uttered with a neutral tone on the second syllable.

[12] Cao (1996) has a similar conclusion working on the co-articulation of segmental phonetic gestures. She claims, "neither anticipatory nor carryover co-articulation effects for a syllable can go beyond the perception center of neighboring syllable (p.213)."

representation[13], we can give simple answers to the questions (a) why Tone 0's value after Tone 3 stands out, and (2) why Tone 0 exhibit rise and fall contours. The answers lie in that Tone 0 undergoes a sandhi process which I will demonstrate below.

2.2 The Neutral Tone Sandhi Rule

Example (13) shows the four full tones of Mandarin where each is followed by a Tone 0. All tones are represented here using the framework given in (10), and employ [high] and [low] tonal features. Note that the full-tone values on the left represent the four tones in non-final position, since the point is to explore them in the context immediately preceding the neutral tone.[14]

(13)

T1	T0	T2	T0	**T3**	**T0**	T4	T0
/\	|	/\	|	/\	|	/\	|
HH	L	MH	L	***LL***	***L***	HM	L

The answer as to why Tone 0 behaves differently after Tone 3 is borne out from this analysis. When Tone 0 follows Tone 3, a sequence of L tones emerges *over a syllable boundary*. As a result, Tone 0 has to dissimilate. The L tone sequence violates the Obligatory Contour Principle[15], which disallows identical segments to be adjacent to each other. This dissimilation process can be captured by the following phonological rule:

(14) The Neutral-Tone Sandhi Rule (0TS)[16]

Thus, this sandhi rule solves the mystery of a higher Tone 0 after Tone 3 in contrast to the lower Tone 0 after Tones 1, 2 and 4.

2.3 Assimilation (Co-Articulation) after 0TS

The question, however, remains as to how Tone 0's surface values are acquired. First, in the underlying representation, Tone 0 uniformally targets a L tone in all the four

[13] That means at the level after the 0-stress assignment. The loss of stress on a syllable resulting in a neutral tone can be historical or synchronic. And, some losses are syntactic, others are morphological, and still others are due to personal or regional variation. This issue is large and complex, and thus will not be dealt with here. Interested readers may refer to Shen (1992).

[14] Refer to Lin (1992, 1996 and 1998) for further discussions of the representations of the non-final tones.

[15] First formulated by Goldsmith (1976) in his study of African tones.

[16] This process translates into Chao's notation as follows: (1) → (4) / (21) ___.

contexts. Then, 0TS as formulated in (15) is triggered resulting in the following output. Note that this output is identical to (14) except for the *H* tone after Tone 3.

(15)

T1	T0	T2	T0	T3	T0	T4	T0
/\	|	/\	|	/\	|	/\	|
HH	L	MH	L	LL	***H***	HM	L

Next, a simple feature-spreading mechanism applies consistently in all four cases, as schematically shown below:

(16)

a. Tone 1 Tone 0 b. Tone 2 Tone 0

H**H** **L** M**H** **L**

c. Tone 3 Tone 0 d. Tone 4 Tone 0

L**L** **H** H**M** **L**

thereby, resulting in the following neutral tone values:

(17)

T1	T0	T2	T0	T3	T0	T4	T0
/\	/\	/\	/\	/\	/\	/\	/\
HH	**HL**	MH	**HL**	LL	**LH**	HM	**ML**

The results given again in (18a) below are compared with the acoustic measurements of Cao (1992), Cao et al. (1995), and Dreher and Lee (1966) shown in (b):

(18)

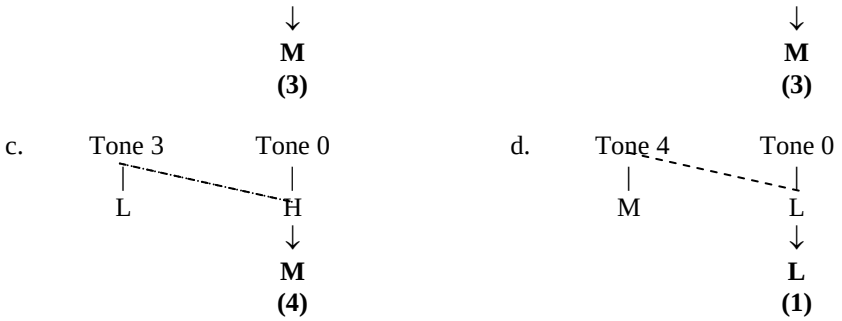
	T1	T0	T2	T0	T3	T0	T4	T0
	/\	/\	/\	/\	/\	/\	/\	/\
a.	HH	**HL**	MH	**HL**	LL	**LH**	HM	**ML**
b.		(41) fall		(31) fall		(23) rise		(21) fall

From (18), it is apparent that the processes argued for in this paper consistently represent the surface values found in previous instrumental studies. It seems that the carry-over tone-coarticulation effect observed in Xu (1997) has not only contributed to Tone 0's rise and fall, as detected in those above-mentioned instrumental studies, but it has also led to the perceptual (non-contoured) values of Tone 0 as described in (1). Specifically, when the offset of the preceding H tone of Tones 1 and 2 gets carried over to a following low tone, the mixing of H and L creates a M-tone impression. For the same reason, the mixing of the preceding offset L tone of Tone 3 with the Tone 0 sandhi tone H also yield an M-tone impression. As the offset of Tone 4 is going from M to L, the auditory impression picks up the mixed M (falling) and L signal as a L tone. The processes can be schematically represented as follows. The numbers below the derived tones are from (1).

(19)

a. Tone 1 Tone 0 b. Tone 2 Tone 0

H L H L



It should be pointed out again that phonetic experimental studies have always yielded contoured Tone 0s, while non-contoured ones are the results of linguists' auditory impression.

2.4 Towards An OCP for L Tones

To complete the phonological analysis for Tone 0, it is important to formalise the context in which Tone 0 is raised to become dissimilar to Tone 3. To that end, the following Well-Formed Condition (WFC) is proposed here for Mandarin:

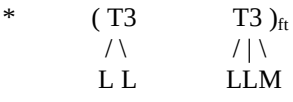
(20) *A sequence of three L tones is prohibited across one syllable boundary within the same metrical foot.*

Notice that this WFC does not rule out the actually occurring sequence of Tone 0s in the following fashion, since such a sequence has two syllable boundaries.

(21)


2.5 Connecting the Third Tone Sandhi and the Neutral Tone Sandhi

The WFC is also motivated elsewhere in Mandarin. As mentioned earlier, the language has a Third Tone Sandhi Rule (3TS) whereby the first Tone 3 in the T3-T3 sequence becomes Tone 2, a high-rising tone. Lin (1996, 1998) argues that the WFC as formulated in (21) is what causes the raising of the first Tone 3 in 3TS. Before the application of 3TS, a T3-T3 sequence would have the following representation:

(22)


However, with three L tones next to each other across the syllable boundary, the sequence violates the WFC the same way the context for the Neutral Tone Sandhi (0TS) does. As a result, a repair strategy in the fashion of 3TS is needed to fix the violation. One question arises here as to why in one case (i.e., T3-T0), the repair is on the right tone, whereas in the other (i.e., T3-T3), the repair is on the left tone. The difference may be simply explained in terms of the fact that in each case the changed tone (i.e., Tone 0 in 0TS and Tone 3 in 3TS)

is invariably the phonetically and prosodically shorter and weaker tone and thus is less stable and more easily undergoes change in face of a principle violation.

3. Conclusion

In sum, this paper has examined the Mandarin neutral tone values in phonological terms. Essentially, it developed a unified analysis accounting for the surface values of Tone 0. In doing so, the analysis accounts for why Tone 0 rises after Tone 3 but falls after the other three tones. It is argued that Tone 0 is underlyingly a low tone with a low pitch target, but when preceded by another low tone--Tone 3, it is raised by a tone sandhi process as outlined in the Neutral Tone Sandhi Rule (0TS) formulated in Section 2.2. The 0TS is, in turn, triggered by a Well-Formedness Condition that disallows identical L tones across a syllable boundary. Finally, it should be pointed out that the Condition that L tones are not allowed across syllable boundary need not be Mandarin specific.[17] At least some languages seem to show similar resistance to an L#L sequence. For instance, in the African languages such as Dagaare spoken in Ghana, disyllabic nominals systematically miss the tonal combination of L+L even though all the other possible combinations, H+H, H+L, and L+H, exist (Anttila and Bodomo 1996). More studies need to be carried out to see if the Well-Formedness Condition applies across-linguistically. Also needed are studies that explore the phonetic/articulatory reason behind the prohibition of cross-syllable L-L tonal sequence in language.

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[17] This topic will be explored further I a future paper focusing on the many Chinese dialects spoken in the northern province of Shandong.

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