

# THE BLOCKING OF TONE SANDHI IN MANDARIN CHINESE

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Tone sandhi has been a core issue in Mandarin phonology and it has received a lot of attention in previous discussions. However, in the literature of Mandarin phonology, people usually deal with the application of tone sandhi and the blocking phenomenon has received very little attention. This paper addresses blocking phenomena of both tone 3 sandhi and tone 4 sandhi within the Optimality Theory (OT) framework (Prince & Smolensky, 1993; McCarthy & Prince, 1993). A basic set of constraints are proposed to apply to both application and blocking of tone 3 sandhi and tone 4 sandhi to give them a unified account, which has never been done before in Mandarin phonology. The present paper shows that tone sandhi blocking is the result of conflicts between markedness and faithfulness. It will be demonstrated in the paper that the blocking phenomenon is due to such factors as pragmatics, information structure and relative importance of morphemes.

In order to understand the blocking phenomenon of tone sandhi some ideas of Mandarin tonal system are helpful. There are four basic tone categories in Mandarin Chinese. Every stressed syllable belongs to one of the four, although actual realizations may vary according to context (Ch'en et al., 1994). When the four tones are applied to the same syllable, four different lexical items may result (Wang & Norval, 1997). In analyses of the Mandarin tonal system, the voice range is divided into five levels: upper, upper middle, middle, lower middle and lower. The numbers from 1 to 5 is used to designate these levels, where 1 represents the lowest comfortable pitch of the vocal range and 5 represents the highest. The first tone (tone 1) (**55**) is high and level. It is pitched near the top of the comfortable voice range. The second tone (tone 2) (**35**) starts around the middle of the voice range 3 and rises straight towards the level of the first tone 5. The third tone (tone 3) (**214**) begins near the bottom of the comfortable voice 2, proceeds to the bottom 1, and then upward to end above the middle 4. The fourth tone (tone 4) (**51**) begins at the top of the comfortable range 5 and falls quickly to the bottom 1 (Ch'en et al., 1994).

## 1. Tone Three Sandhi and Tone Four Sandhi

A well-known phenomenon in Mandarin phonology is tonal variations according to different phrasal contexts, among which tone 3 sandhi is the most noticeable and most complicated. Furthermore, tone 3 sandhi contains much more surface (output) variations than any other Mandarin tone sandhi. Before any other tone except another tone 3, a tone 3 loses its terminal rising part and becomes a low falling tone. According to traditional analyses, when it precedes another tone 3, however, the first tone 3 changes to a tone 2. When people speak of tone 3 sandhi they usually refer to the latter situation. Traditional analyses about tone 3 sandhi fail to account for differences between sandhi tone 3 and lexical tone 2. Yin (2002) claims that Mandarin tone 3 sandhi is a kind of tonal reduction phenomenon rather

than being fully neutralized to lexical tone 2. In Mandarin, there is other sandhi rule which has not received as much attention as tone 3 sandhi. This rule is very similar to that of tone 3 sandhi: when a tone 4 follows another tone 4, it retains its first half (53) but loses its second half (31). Thus, in the present OT analysis, both tone 3 sandhi and tone 4 sandhi are regarded as tonal reduction phenomena.

### 1.1. Tone Three Sandhi

Phonetic studies have demonstrated that the changed tone 3 in a two tone 3 sequence does not become a tone 2 but rather it becomes a new tone. In some previous discussions, it has been incorrectly observed that a tone 3 which undergoes this kind of sandhi is phonetically indistinguishable from a lexical tone 2. Hockett (1950) on the other hand, points out that, phonetically, the first tone 3 in a 33 sequence has a terminal rise in pitch characteristic of tone 3. Martin (1963) and Xu (1997) also insist that there are differences between the changed tone 3 and the lexical tone 2. A number of linguists (e. g. Zee, 1980; Shen, 1990; Xu, 1993) have data that indicate that tone 3 sandhi results in a changed tone lower than a lexical tone 2. In fact, the sandhi tone 3 does not really neutralize to tone 2 but instead keeps its rising portion (the second half). Thus, this phenomenon could be viewed as a kind of tonal reduction.

The OT device of constraint conflict permits an analysis of tone 3 sandhi as a resolution of conflict between markedness and tonal faithfulness (Yin, 2002). This could largely explain the loss of the falling portion of tone 3 in a 33 sequence and the loss of its rising portion in other contexts. As mentioned previously, the full tone 3 contour is 214. Thus, I will use the notations of [214] for a full tone 3, [14] for tone 3 with loss of the falling portion and [21] for tone 3 with loss of the rising portion in the OT analysis in this paper.

In tone 3 sandhi in Mandarin, one of the important markedness constraints is final lengthening/non-final shortening in a phonological phrase.

(1) Final-L/Non-Final-S

In a phonological phrase, the final syllable is lengthened and the non-final syllable(s) is shortened.

This markedness constraint is well motivated cross-linguistically (e.g., Nootboom, 1997, Duanmu, 2000). In the case of Mandarin Chinese the final syllable in a phonological phrase usually indicates a major boundary.

Another markedness constraint in tone 3 sandhi is the following constraint:

(2) \* tone 3/ShortSyl Tone 3 should be prohibited in shortened syllables.

The tone 3 sandhi process can be characterized as a tonal reduction (loss of the first part –the falling portion of tone 3 in a 33 sequence) in contexts where the syllable has a shortened or non-lengthened duration. Duanmu (1999) claims that

the duration of tone 3 is longer than other tones. If enough duration cannot be maintained, the full tone 3 will not be realized. This is a consequence of the effort minimization principle – the shortened duration increases the effort cost of achieving all 3 tonal targets.

Faithfulness constraints require that “outputs preserve the properties of their basic (lexical) forms, requiring some kind of similarity between the output and the input” (Kager, 1999). The relevant faithfulness constraint in tone 3 sandhi is one of the correspondence constraints.

(3)  $M_{Ax}(\text{contour})$

Correspondent segments in input and output have identical values for tone contours. In the case of tone 3, the contour refers to both the falling part (I use contour numbers 21 to represent it) and the rising part (I use contour numbers 14 for this part). Thus we can derive two sub-constraints of correspondence regarding tone 3:

- (a)  $M_{Ax}(21)$  Input segments must have output correspondents in terms of the falling part of tone 3.
- (b)  $M_{Ax}(14)$  Input segments must have output correspondents in terms of the rising part of tone 3.



In Mandarin, when Final-L/Non-Final-S and \*tone3/ShortSyl rank higher than  $M_{Ax}(\text{contour})$ , tone 3 sandhi rule will apply as the following example *hao3 jiu3* ‘good wine’ illustrates. (In the input, I will specify which tone it is and in the output I will use contour numbers to represent it, e.g. [214] for a full tone). Following conventions of OT, relevant constraints are listed on the top row horizontally in a descending ranking from left to right. However, the dashed line shows that there is no crucial ranking between the constraint on the right and the one on the left. The input is shown in the top left cell. The output candidates are indicated in the first column. An asterisk mark ‘\*’ indicates a violation of a constraint heading the column and an exclamation mark ‘!’ indicates a violation that rules out a candidate. The optimal candidate is marked by the index ‘

Tableau 1

Input /hao3 jiu3/	Final-L/ Non-Final-S	*tone3/ ShortSyl	$M_{Ax}(21)$	$M_{Ax}(14)$
 a. (hao[14] <b>jiu</b> [214])			*	
b. (hao[14] jiu[14])	*!		**	
c.(hao[214] <b>jiu</b> [214])		*!		
d.( <b>hao</b> [214] <b>jiu</b> [214])	*!			

In tableaux in this paper, a parenthesis represents a phonological phrase boundary and bold letters represent the lengthening. From Tableau 1, we can see that the optimal candidate is (a): *hao*[14] *jiu*[214] which violates the lower ranked *Max(contour)* but satisfies *Final-L/Non-Final-S* and *\*tone3/ShortSyl*. Here we can discern one of the essential assumptions made by OT: constraints are violable when higher constraints need to be satisfied.

## 1.2. Tone Four Sandhi

Tone 4 sandhi looks very similar to tone 3 sandhi rule. In a sequence of two fourth tones the first fourth tone begins where the full fourth tone begins and falls only about half as far as the full fourth tone (Ch'en et al., 1994). Like tone 3 sandhi, tone 4 sandhi can be viewed as a tonal reduction process since the sandhi tone retains its first half (53) but loses its second half (31) as in (4):

- (4) kan(51) bao(51) ----> kan(53) bao(51)  
 'read newspapers'

There are two basic constraints: the *Final-L/Non-Final-S* constraint and the *MAX(contour)* constraint working in both tone 3 sandhi and tone 4 sandhi. In the case of tone 4, the contour can be analyzed to consist of two parts and as such it can refer to both the first half (I use contour numbers 53 to represent it) and the second half (I use contour numbers 31 for this part). Thus we can derive two sub-constraints of correspondence regarding tone 4:

- (5) a. *MAX(53)* Input segments must have output correspondents in terms of the first part of tone 4.  
 b. *MAX(31)* Input segments must have output correspondents in terms of the second part of tone 4.

In addition to the *Final-L/Non-Final-S* constraint and the *MAX(contour)* constraint, there are two constraints which play a role in tone 4 sandhi. One is a faithfulness constraint and the other is a markedness constraint. The markedness constraint is the following:

- (6) \*44 The sequence of two full fourth tones in a phonological phrase is prohibited.

Actually this markedness constraint is phonetically motivated. Among all the four tones, tone 4 has the highest pitch at its initial portion. Xu (1997) has demonstrated that when tones are produced in isolation, tone 4 has the highest  $f_0$  value (140 Hz)

of the four tones at the start point and tone one is the second highest (a little below 130 Hz) at its initial portion. Therefore, if tone 1 is viewed as a high tone the initial portion of tone 4 could be regarded as the super high. As a result, if we use the number 6 to indicate the super high pitch, it could be justified in using 61 instead of 51 to describe tone 4.

In a two tone 4 sequence, the distance of pitch between the end of first tone 4 and the beginning of the second tone 4 is the greatest. In order to reach the super high pitch of the second tone 4, the first tone 4 doesn't fall all the way to the bottom (1) instead it falls half way to (3). In order to ease articulation as in the case of Canadian raising (Myers, 1997), the half tone 4 comes into being in this way.

Then why is it that the first tone 4 should be changed to the half tone instead of changes in the second tone 4? This is because there is still another relevant faithfulness constraint which is at work in tone 4 sandhi.

(7) Kp-FullT/L-Syl: A lengthened syllable keeps its lexical full tone.

In a two tone 4 sequence, the final syllable gets lengthened and the lengthened syllable should keep its lexical full tone. That is why in this case the first tone 4 rather than the second tone 4 should be changed to a half tone as the following tableau illustrates (in input I will specify which tone it is and in the output I will use the numbers [51] for a full tone 4 and [53] for a half tone 4 in the tableaux in this paper):

Tableau 2

Input / kan4bao4/	Final-L/ Non-Final-S	Kp-FullT/ L-Syl	*44	MA <sub>x</sub> (53)	MA <sub>x</sub> (31)
a. (kan[53]bao[51])					*
b. (kan[51]bao[51])			*!		
c. (kan[51]bao[53])		*!			*

Tableau 2 shows that candidate (b) violates the markedness constraint \*44 which is ranked higher than the faithfulness constraint MA<sub>x</sub>(31) while candidate (c) does not keep the lexical full tone in a lengthened syllable so that it does not satisfy the faithfulness constraint Kp-FullT/L-Syl. As a result, both candidates are worse than candidate (a) since this candidate only violates the lower ranked MA<sub>x</sub>(31) constraint and it survives to be the ideal candidate.

## 2. The Blocking of Tone Sandhi in Mandarin Chinese

Although the application of Mandarin tone sandhi has received much attention in the literature of Chinese phonology, very little has been done about the blocking of

tone sandhi in Mandarin Chinese (Zhang, 1997). This blocking phenomenon can also be accommodated within the OT framework. There are several tone sandhi blocking cases which will be discussed in this paper and these cases involve pragmatic constraints, reduplication and topicalization.

## 2.1. Pragmatic Constraints

Besides syntax, pragmatic factors also play a role in Mandarin tone sandhi. If a speaker wants to focus on or stress a particular element, he/she can lengthen the focused element and block the tonal change, thus overriding other constraints. First, we will deal with the blocking case of tone 3 sandhi due to pragmatic factors.

As has been addressed, the duration of tone 3 is longer than other 3 tones in Mandarin. If substantial duration cannot be maintained, it will be difficult for the full tone 3 to be realized. That is why at faster speech rates, more third tones will be changed since this rule is sensitive to speech rates. Speech rates determine the duration of syllables. In slow speech, phonological phrase structures largely rely on immediate syntactic constituents. In that case, there are more phonological phrases and less tonal reductions than in faster speech. However, in fast speech rates or out of other pragmatic considerations, the number of phonological boundaries will be reduced and thus the domain of phonological phrases could be expanded. When the phonological phrases are reduced the number of final syllables is also reduced. Accordingly, in fast speech, the domain of the rule application will also increase because the tonal reduction constraint is sensitive to phonetic duration. Once the originally final syllables in slow speech are changed to non-final syllables in faster speech they are not licensed to get lengthened and thus, they do not have enough duration to realize its underlying target tone. Therefore, speech rates are correlated to tonal reductions: the faster one speaks, the more third tones get reduced.

Conversely, if the speaker maintains enough duration of a syllable anywhere in an utterance for the seek of emphases or focuses, it is more likely that its underlying tone will not be changed. I term this faithfulness constraint as the following:

- (8) FocusEle/End      A focused element constitutes the end of a phonological phrase.

Even in faster speech, we can focus on MAI (capital letters indicate focus or emphasis) in (9) and retain its lexical tone 3 in its output with all other non-sentence final third tones changed. Thus, the tone sandhi is blocked in (9) for the syllable MAI out of pragmatic considerations.

- (9) Input            Lao [214]    Li [214]    MAI [214]    hao[214]    jiu[214].  
                          Old            Li            buy            good            wine  
                          ‘Old Li bought good wine.’  
       Output        Lao[14]    Li[14]      MAI [214]    hao[14]    jiu[214].

The following ranking enables us to obtain the output for (9):

- (10) FocusEle/End >> Final-L/Non-Final-S, \*tone3/ShortSyl >>  
 M<sub>AX</sub>(21), M<sub>AX</sub>(14)

Tableau 3

input /Lao3-li3 mai3 hao3 jiu3/	Focus Ele/End	Final-L/ Non-Final-S	*tone3/ ShortSyl	M <sub>AX</sub> (21)	M <sub>AX</sub> (14)
☛ a. (Lao[14]-Li[14] <b>MAI</b> [214])(hao[14] <b>jiu</b> [214])				***	
b. (Lao[14]- <b>Li</b> [214]) (MAI[14] hao[14] <b>jiu</b> [214])	*!			***	
c. (Lao[14]-Li[14] MAI[14]) (hao[14] <b>jiu</b> [214])		*!		****	
d. (Lao[14]-Li[14] <b>MAI</b> [214]) (hao[214] <b>jiu</b> [214])			*!	**	

Candidate (b) violates the higher ranked FocusEle/End constraint, so it should be ruled out. Candidates (c) and (d) violate either the constraint Final-L/Non-Final-S or the constraint \*tone3/ShortSyl, however, (a) only violates the lower ranked constraint M<sub>AX</sub>(21) and satisfies all the higher ranked constraints. As a result, the winning candidate is (a).

In the case of tone 4, if the speaker intends to focus on or stress a particular syllable, he can lengthen the focused element which constitutes the end of a phonological phrase. Since the focused element gets lengthened it will keep its lexical tone 4, abiding by the constraint of Kp-FullT/L-Syl as the following pair of question-answer illustrates (bold indicates emphasized elements):

- (11) Ni zai **gan** shenme?  
 You PROGRESSIVE **do** what  
 ‘what are you **doing**?’

- (12) Wo zai **kan4** bao4.  
 I PROGRESSIVE **read** newspaper.  
 ‘I am **reading** newspapers.’

In the question, the verb *gan* ‘do’ is stressed and thus the verb *kan* ‘read’ in the answer is also emphasized. In that case, *kan* forms the end of a phonological phrase and even though it is followed immediately by another tone 4 it does not

undergo tone sandhi as the following tableau display (capital letters indicate the focused or stressed element):

Tableau 4

Input: /KAN4 bao4/	Focus Ele/End	Final-L/ Non-Final-S	Kp-FullT/ L-Syl	*44
☛ a. (KAN[51]) (bao[51])				*
b. (KAN[53] <b>bao</b> [51])	*!			
c. (KAN [53]) ( <b>bao</b> [51])		*!		

As indicated in Tableau 4, candidate (b) violates the high ranked FocusEle/End constraint and candidate (c) does not satisfy Final-L/Non-Final-S constraint while candidate (a) only violates the low ranked \*44 constraint. Therefore, candidate (a) survives as the best candidate.

## 2.2. Reduplication Case

In Mandarin Chinese, total reduplications of a bi-syllabic word are common, especially for kinship terms. In the case of total reduplications, the sandhi rule could also be blocked from applying. As in *jie3 jie3* ---> *jie3 jie* ‘elder sister’ and in *tai4 tai4* ---> *tai4 tai* ‘wife’, the first syllable has not undergone the sandhi. In total reduplications, the second syllable (the reduplicated one) is usually a weak syllable (even weaker than non-reduplicated weak syllables so I will not use any lexical tone to specify it in its output) and thus, it does not get lengthened due to the \*WeakSyl-L constraint. Actually, the second syllable acts like clitics and its duration is also shorter than other kinds of weak syllable according to my and my consultants’ intuitions as native speakers. In total reduplications, the first syllable carries new information and the second syllable is the mere repetition of the first one and it is usually phonetically reduced in terms of duration because of its being non-salient. Maybe for the sake of compensation for shorter duration of reduplicated syllables (the second one), the first syllable in reduplication cases always gets lengthened. This kind of lengthening can be formulated as the following markedness constraint:

- (13) FirstSyl/Redup In a bi-syllabic word of a total reduplication case the first syllable is lengthened.

In the case of tone 3, this lengthened syllable has enough duration to realize both its falling portion and its rising portion of a tone 3. With the FirstSyl/Redup constraint being at work, the first tone 3 in a reduplication case should keep its



lexical full tone because of its lengthening and the sandhi rule is thus blocked as Tableau 5 shows (the capital letter ‘W’ following the tone indicates a weak syllable):

Tableau 5

Input /jie3 jie3W/	FirstSyL/ Redup	*WeakSyl-L	Final-L/ Non-Final-S	*tone3/ ShortSyl
☛ a. ( <b>jie</b> [214] jie)			*	
b. (jie [14] jie)	*!		*	
c. ( <b>jie</b> [214] <b>jie</b> [214])		*!	*	

In Tableau 5, candidate (b) does not lengthen its first syllable in the case of reduplications and thus it loses in the first round of the competition since it violates the undominated constraint FirstSyL/Redup. Candidate (c) lengthens the weak (reduplicated) syllable so that it does not satisfy the constraint \*WeakSyl-L. Candidate (a) lengthens its first syllable so that the full tone 3 can be realized and the sandhi rule is blocked. This candidate finally survives because it incurs the least serious violations of the relevant constraints.

In the case of a two tone 4 sequence of total reduplications, since the first syllable gets lengthened this lengthened syllable should keep its underlying lexical tone and thus tone 4 sandhi turns out to be blocked as in *tai4 tai4W* ---> *tai4 tai* ‘wife’ (again the capital letter ‘W’ following the tone indicates a weak syllable).

Tableau 6

Input /tai4 tai4W/	FirstSyL/ Redup	*WeakSyl -L	Final-L/ Non-Final-S	Kp-FullT/ L-Syl	*44
☛ a. ( <b>tai</b> [51] tai)			*		
b. ( <b>tai</b> [51] <b>tai</b> [51])		*!			*
c. (tai[35] tai)	*!		*		

As illustrated in Tableau 6, candidate (a) lengthens its first syllable which is then able to keep its full tone. Though this candidate violates the Final-L/Non-Final-S constraint its violations are the least serious and this candidate is better than candidates (b) and (c) since candidate (b) lengthens its second syllable (weak syllable) which violates the \*WeakSyl-L constraint while candidate (c) fails to lengthen the first syllable which does not conform to the FirstSyL/Redup constraint. Both \*WeakSyl-L and FirstSyL/Redup are ranked higher than Final-L/Non-Final-S.

### 2.3. Topicalization Case

In Mandarin Chinese, a non-initial constituent can be preposed to the initial position of a sentence to serve as a topic. In Mandarin, as a general rule a sentence initial tone 3 or tone 4 followed by an identical tone often undergoes tone sandhi. However, even if the topicalized element is monosyllabic it usually does not undergo tonal changes. Tone sandhi blocking in topicalization cases may be due to information structure since the topicalized element serves as THEME which is relatively important in a sentence and it usually forms a phonological phrase by its own. Therefore, the following markedness constraint has an effect in tone sandhi blocking for the topicalized element:

- (14) PrepoEle/E: The preposed topicalized monosyllabic element constituents the end of a phonological phrase.

Since a topicalized monosyllable forms the end of a phonological phrase it should get lengthened and in that case its lexical tone can be fully targeted. In the case of tone 3, the lengthened topicalized monosyllable *jiu* ‘wine’ as in (34) has enough duration to realize its full tone (I will not specify the irrelevant syllables for their tones).

- (15) Jiu<sup>3</sup> gou<sup>3</sup> bu xihuan ---> Jiu[3] gou[3] bu xihuan  
 wine dog not like  
 ‘Wine the dog does like’

Tableau 7

Input / jiu <sup>3</sup> gou <sup>3</sup> bu xihuan /	PrepoEle/E	Final-L/ Non-Fin-S	*tone3/ ShortSyl
☛ a. ( <b>jiu</b> [214]) ( <b>gou</b> [214]) bu xihuan			
b. (jiu[214] <b>gou</b> [214]) bu xihuan	*!		
c. (jiu[214]) ( <b>gou</b> [214]) bu xihuan		*	*

From Tableau 7, it can be seen that candidate (b) violates the high ranked constraint PrepoEle/E since the preposed element does not form the end of a phonological phrase and while in candidate (c), though the preposed element do constitute the end of a phonological phrase it does not get lengthened and this non-lengthened syllable carries the full tone 3 and thus this candidate violates two constraints. On the other hand, candidate (a) does not violate any of the constraint in the tableau and it turns out to be the best candidate.

In the case of tone 4, since the preposed element gets lengthened and this lengthened syllable should keep its full tone. In this way tone 4 sandhi is blocked in topicalization as in example (16) (again the irrelevant syllables are not specified for their tones).

- (16) Shu4 tai4 tai4 bu xihuan ----> Shu4 tai4 tai4 bu xihaun  
 Tree wife not like  
 ‘Trees (my) wife doesn’t like.’

Tableau 8

Input /shu4 tai4 tai4 bu xihuan/	Prepo Ele/E	Final-L/ Non-Final-S	Kp-FullT/ L-Syl	*44
☛ a. (shu[51]) tai[51] ---				*
b. (shu[35] tai[51])---	*!			
c. (shu[35]) tai[51] ---		*!		

In Tableau 8, candidate (b) does not allow the preposed element to form the end of a phonological phrase and though candidate (c) does allow the preposed element to form the end of a phonological phrase the preposed element does not get lengthened. Both (b) and (c) become losing candidates since candidate (a) only violates the low ranked constraint \*44 in the tableau.

### 3. Conclusions

This paper investigated the most complicated tonal change in Mandarin: tone 3 sandhi, which is influenced by syntactic and metrical structures and other factors such as speech rates and pragmatic considerations. A constraints-based analysis within the OT framework is developed in this paper to look into tone 3 sandhi in Mandarin. This paper also addressed tone 4 sandhi as well, which has not received much attention. It has been shown in this paper that tone 4 sandhi can also be accounted for within the OT framework.

Tone sandhi application has become the main focus in Mandarin phonology, however, blocking of tone sandhi has received little attention in previous discussions. This study investigates the avoidance of tone sandhi in Mandarin from several respects. It has been demonstrated that such a phenomenon can be accommodated within the OT framework. A basic set of constraints are proposed to apply to both application and blocking of tone 3 sandhi and tone 4 sandhi to give them a unified account. The sandhi blocking phenomenon is mainly due to pragmatics, information structure and relative importance of morphemes.

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