A phase-based account of Mandarin third tone sandhi domains

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Abstract

The present paper argues for an account of Mandarin Third Tone Sandhi (T3S) domains in terms of phase-based syntax-phonology mapping. Given the phase-based architecture of the grammar, a T3S domain is assumed to include everything inside a phase (XP), excluding material at the phase edge (the head X and Specifier). Unlike previous prosody based accounts of T3S domains, the phase based account does not require domain formation to satisfy two conditions, the immediate constituency and the syllable count, because they are automatically satisfied as each phase is built up and spelt out before T3S can apply. In order for the phase based analysis of T3S domains to work, however, the minimalist understanding of Mandarin syntactic structures is required. In other words, direct syntax-phonology mapping in T3S domain formation is possible only within the minimalist framework.

Index Terms: syntax-phonology mapping, phase, minimalist, tone sandhi, Mandarin.

1. Introduction

This study seeks to understand how syntax and tone interact to form various T3S domains in Mandarin. The T3S process can be represented by '3 3 → 2 3', meaning that a T3 (third tone) syllable becomes a T2 (second tone) one when followed by another T3 syllable. For example, the word *ma3 yi3* ('ant') includes two T3 syllables. Because T3S turns the first T3 into T2, the word is actually read as *ma2 yi3*. Although the T3S process is simple by itself, it has an otherwise complex application in words, phrases, and clauses, and can be further complicated by prosodic factors such as stress and intonation. The example below shows different T3S domains in two expressions with the same branching structure [1].

(1) Asymmetry in the same branching structure:

a. 3 3 3-1 → 3 2 3-1	b. 3 3 3 1 → 2 2 3 1
[xiao [zhi [lao-ying]]]	[xiang [mai [hao shu]]]
small paper old-eagle	want buy good book
'small paper eagle'	'want to buy good books'

Example (1a) and (1b) have the same right branching structure but different output tones. This is because the T3S domain is made up of the middle two T3s in the former but the first three T3s in the latter. The asymmetry between (1a) and (1b) indicates that T3S domains cannot be derived through direct syntactic mapping.

2. Prosody based accounts

To avoid direct syntax-phonology mapping, previous studies have relied on prosodic factors to account for the T3S asymmetry in (1). Among such prosody based accounts are the syllabic foot [2], the Minimal Rhythmic Unit (MRU) [3], and the stress foot [1].

2.1. Syllabic foot

In the syllabic foot based account, a minimal T3S domain is a disyllabic foot and foot formation depends on syntactic as well as prosodic structures. Specifically, T3S domain formation is subject to two conditions below [1, 2, 3, 4]:

1) IC (unseverable Immediate Constituency)
   The minimal T3S domain is a foot.
   Immediate constituents belong to the same foot.
2) SC (left-to-right Syllable Count)
   Remaining syllables form a foot from left to right.

IC usually applies at the lexical level and SC at the phrasal level. The example below illustrates how they are used to derive T3S domains in (1):

(2) IC and SC apply at different levels:

a. Compound	b. Phrase
'small paper eagle'	"want to buy good books'
[xiao [zhi [lao-ying]]]	[xiang [mai [hao shu]]]

	a.		b.
	3 3 3-1		3 3 3 1
IC:	3 3 (3-1)*	IC:	(3 1)*
	→ 3 (2 3-1)	SC:	(3 3) 3 1
	→ (3 2 3-1)*		→ (2 3) 3 1
SC:	*T3S not applicable		→ 2 (2 3) 1

In Example (2a), *xiao zhi lao-ying* ('small paper eagle') is treated as a compound noun. Since SC does not apply at the lexical level, the T3S domain formation is based solely on IC. First, the innermost compound noun *lao-ying* ('old-eagle') forms a foot first. Then, the noun *zhi* ('paper') is added to this foot to form a so-called super foot *zhi (lao-ying)* ('paper eagle') [2]. Last, the adjective *xiao* ('small') is added to this super foot to form yet another super foot *xiao (zhi lao-ying)* ('small paper eagle'). Since T3S applies only to the middle super foot *zhi (lao-ying)* ('paper eagle'), the final tone sequence is '3 2 3-1.'

Example (2b) includes a verb-object (VO) phrase. The object *hao shu* ('good book') is treated as a compound noun, so it forms a foot first based on IC. At the phrasal level, only SC is at work, so *xiang mai* ('want buy') and *mai hao* ('buy good') form two syllabic feet iteratively from left to right regardless of their internal structures. Since T3S applies only to the latter two feet, the final tone sequence is '2 2 3 1.'

Although the above syllabic foot based analysis is able to account for the asymmetry in (1), it requires the differentiation of words from phrases in order for IC and SC to apply at different levels.

2.2. MRU

The MRU is a special prosodic unit within which T3S applies obligatorily. The MRU based account uses lexical and phrasal MRUs instead of syllabic feet formed by level ordered IC and SC. The example below illustrates how T3S domains in (1) are formed based on MRUs.

(3) Lexical and Phrasal MRUs

a. Compound
[xiao [zhi [lao-ying]]]   'small paper eagle'

3	3	3-1	Base tones
		(3-1)*	Lexical MRU
3	(2	3-1)	Lexical MRU, T3S
(3	2	3-1)*	Lexical MRU

b. Phrase
[xiang [mai [hao shu]]] 'want to buy good books'

3	3	3 1	Base tones
		(3 1)*	Lexical MRU
(2	3)	3 1	Phrasal MRU, T3S
(2	2)	(3 1)	Cross-MRU, T3S optional

Similar to (2a), *lao-ying* ('old-eagle'), *zhi (lao-ying)* ('paper eagle'), and *xiao (zhi lao-ying)* ('small paper eagle') in (3a) form three lexical MRUs cyclically. Since T3S applies only to the middle MRU *zhi (lao-ying)*, the final tone sequence is '3 2 3-1.'

In (3b), *hao shu* ('good book') forms a lexical MRU and *xiang mai* ('want buy') forms a phrasal MRU. Since T3S applies only to the phrasal MRU, the resulting tonal sequence is '2 3 3-1.' Now there are two adjacent T3s across the phrasal and lexical MRUs on *mai hao* ('buy good'), so T3S applies optionally across the two MRUs, turning '2 3 3-1' into '2 2 3-1.'

Example (3) shows that the MRU based account faces the same issue that the syllabic foot based account does: the need to differentiate words from phrases. If *xiao zhi lao-ying* ('small paper eagle') is treated as a noun phrase (NP), then *xiao zhi* ('small paper') and *zhi lao-* ('paper old-') will form two phrasal MRUs iteratively from left to right. After T3S applies to the two MRUs, the final tone sequence will become '2 2 3-1' instead of '3 2 3-1.' The tonal reading '2 2 3-1' is usually acceptable when the adjective *xiao* ('small') is stressed. For the MRU based account, the lexical status of an expression has a bearing on its T3S outcome.

2.3. Stress foot

Unlike the above two accounts, the stress foot based account defines a T3S domain by stress assignment, specifically, the assignment of Non-Head Stress (NHS). According to [1], NHS is a type of information stress to be differentiated from the prosody-based stress. Therefore, the NHS assignment is based on the syntactic structure of an expression rather than its foot structure: In the syntactic structure such as [X YP], where X is the syntactic head, the NHS goes to YP. NHS is assigned to YP because the complement YP carries more information load than the head X. The example below illustrates how T3S domains in (1) are formed based on the NHS assignment.

(4) Non-Head Stress (x):

a. Compound   b. Phrase

'small paper eagle'   'want to buy good books'

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                                             x
 x    x    x
[xiao [zhi [lao-ying]]]      [xiang [mai [hao shu]]]
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3 3 3 1 → 3 3 (3-1)*   3 3 3 1 → 3 3 (3 1)*
  → 3 (2 3-1)   → (2 3) 3 1
  → (3 2 3-1)*   (optional) → 2 (2 3) 1

In (4a), *lao-* ('old-'), *zhi* ('paper'), and *xiao* ('small') receive NHS cyclically because they are respectively the syntactic non-heads of the compounds *lao-ying* ('old-eagle'), *zhi (lao-ying)* ('paper eagle'), and *xiao (zhi lao-ying)* ('small paper eagle'). These compounds each form a left-headed stress foot or super stress foot. Since T3S applies only to the middle super foot *zhi (lao-ying)*, the final tone sequence is '3 2 3-1.'

In (4b), the adjective *hao* ('good') receives NHS twice, first as the syntactic non-head of the NP *hao shu* ('good book') and then as part of the object, that is, the syntactic non-head of the VO phrase. Then, *hao shu* ('good book') forms a left-headed stress foot. Next, *xiang mai* ('want buy'), not receiving any NHS stress, forms a syllabic foot from left to right by default. Since T3S applies only to the syllabic foot, the final tone sequence is '2 3 3 1.' Last, T3S applies optionally across the syllabic foot *xiang mai* ('want buy') and the stress foot *hao shu* ('good book'), turning '2 3 3 1' into '2 2 3 1.'

Although the stress foot based account does not care about the lexical status of an expression, it has to face the issue of stress clash. The example below illustrates such an issue:

(5) Subject-Predicate clause

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 x   x          x         x      x
wo hen hao → wo (hen hao) or (wo Ø) (hen hao)
 I  very good
'I am fine.'
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In (5), *hao* ('good') is a predictive adjective. The subject *wo* ('I') and the adverb *hen* ('very') both receive NHS, because they are respectively the syntactic non-heads of the entire clause and the predicate. To resolve the stress clash on *wo hen* (' I very'), either *wo* ('I') loses its NHS so that *hen hao* ('very good') forms a left-headed stress foot, or *wo* ('I') forms a stress foot with an empty beat or a pause (Ø) and then *hen hao* ('very good') forms another stress foot. If the first solution is adopted, the final tone sequence is '0 2 3' ('0' means toneless or unstressed). If the second solution is adopted, the final tone sequence is '3 Ø 2 3', with a pause after the first T3. Both tonal readings are acceptable depending on the context: the first emphasizes the adverb *hen* ('very') and the second the subject *wo* ('I'). Neither solution, however, is a principled way to handle stress clash.

3. The phase based account

3.1. Proposal

The phase based account assumes that once a phase is built from a lexical item, its content is spelt out immediately and subject to T3S at the syntax-phonology interface. The detailed proposal is as follows:

(6) Phase based T3S domain formation

a. Build an XP at each phase.
b. Spell out its content at each XP. Phase edge (Spec, XP) and Phase head (X°) are spelt out in

the next phase if such a phase exists or at the end of derivation. X is C, υ, and D [5].

   c. Form T3S domains from left to right at the output of each phase or at the end of derivation.

The example below illustrates how to derive the final tone sequences in (1) based on (6).

(7) Illustration of phase based T3S domains

  a. NP
xiao zhi lao-ying 'small paper eagle'

Input tones	T3S Domain	Output tones
3 3 3-1		3 2 3-1

Phase 1: [$_{DP}$Ø [$_{NP}$ lao-ying]]
                (3-1)*   3-1
End of derivation: [$_{DP}$Ø[$_{NP}$[$_{N}$zhi][$_{NP}$ lao-ying]]]
              (2 3-1)   2 3-1
         [$_{DP}$Ø[$_{NP}$[$_{A}$xiao][$_{NP}$ zhi lao-ying]]]
         (3 2 3-1)*   3 2 3-1

  b. VP
xiang mai hao shu 'want to buy good books'

Input tones	T3S Domain	Output tones
3 3 3 1		2 3 3 1

Phase1: [$_{DP}$Ø [$_{NP}$ shu]]
               1   1
End of derivation: [$_{VP1}$xiang [$_{VP2}$mai [$_{DP}$ hao shu]
           (3 3) 3 1   2 (3 3) 1
     Optional: 2 (3 3) 1   2 2 3 1

In (7a), *lao-ying* ('paper eagle') forms the content of an empty headed DP. Next, the monosyllabic noun *zhi* ('paper') and the adjective *xiao* ('small') as the adjuncts of NP are successively inserted into the existing DP and spelt out at the end of derivation. Note that the idea of late adjunction is based on [6]. When *zhi* ('paper') is spelt out and combined with *lao-ying* ('old-eagle') to form a T3S domain, the tonal sequence becomes '2 3-1.' When *xiao* ('small') is spelt out and combined with *zhi lao-ying* ('paper eagle'), there are no longer adjacent T3s. Hence, the final tone sequence of the phrase is '3 2 3-1.'

The late insertion of *zhi* ('paper') and *xiao* ('small') into the already formed DP is crucial here: If they adjoins *lao-ying* ('old-eagle') before DP is formed, then the spellout is the whole DP. Next, when the first T3s in the DP form two T3S domains iteratively from left to right, the final tone sequence will become '2 2 3-1' rather than '3 2 3-1.'

In (7b), the noun *shu* ('good book') as the content of an empty-headed DP is spelt out first at the end of Phase 1. Next, the adjective *hao* ('good') is inserted into the existing DP. Then *xiang mai* ('want buy') forms a so-called serial verb construction (SVC) and it is commonly assumed to have a VP-sell structure, with the V1 *xiang* ('want') heading VP2 *mai hao shu* ('buy good book'). At the end of derivation, *xiang* ('want') and *mai* ('buy') as the heads of VP$_1$ and VP$_2$ are spelt out together with *hao* ('good') and form two T3S domains iteratively from left to right. When T3S applies to these two domains, the final tone sequence is '2 2 3 1.' Note that the tonal change from '2 3 3 1' into '2 2 3 1' can be optional, because T3S is more of a phonetic than phonological nature at this stage of derivation.

The example below illustrates how the phase based analysis derives the normal tone sequence for a classical T3S clause.

(8) CP:
'Mr. Li buys good wine'
lao-li mai hao jiu
Old-Li buy good wine

Input tones	T3S Domain	Output tones
3 3 3 3 3		2 2 3 2 3

Phase 1: [$_{DP}$Ø [$_{NP}$hao jiu]]   (3 3)   2 3

      [$_{DP}$Ø [$_{NP}$lao-li]]   (3 3)   2 3

Phase 2: [$_{CP}$Ø [$_{VP}$[$_{DP}$lao-li][$_{V}$mai [$_{DP}$hao jiu]
           (2 3 3) 2 3   2 2 3 2 3

The clause in Example (8) occurs almost in all of the previous T3S studies. Here the object *hao jiu* ('good wine') and the subject *lao-li* (a proper name) each form a DP and get spelt out at the end of Phase 1. When T3S applies, their tonal sequence both becomes '2 3.' In Phase 2 and also the end of derivation, when the subject *lao-li* and the verb *mai* ('buy') as the content of CP are spelt out, they can form a T3S domain. After T3S applies to this domain, the final sequence becomes '2 2 3 2 3.' This reading is the most natural one among all the acceptable readings of this clause. According to [7], for instance, '2 3 2 2 3' is usually uttered when the verb *mai* ('buy') (corresponding to T2 in the middle of the sequence) is in focus, and '2 2 2 2 3' is usually uttered when the subject *lao-li* (corresponding to the first two T2s in the sequence) is in focus.

The above phased based analysis of T3S domains takes the morpho-syntactic structure rather than the lexical status of an expression into account, hence eliminating the need to stipulate that IC and SC operate at different levels.

3.2. Further support

Further support of the phase based account involves the so-called coverb construction. A typical coverb expression is the phrase *na dao qie rou* ('cut meat with a knife'; literally 'take knife cut meat'). Here *na* ('take') is a coverb but has a preposition-like meaning equivalent to English *with*. Whether to treat a coverb as a preposition or as a verb has a bearing on T3S domain formation. The example below illustrates the phase based analysis of a coverb clause and compares it with previous analyses.

(9) 'Dogs are smaller than horses.'
    gou bi   ma   xiao
    dog compare horse small

  a. Coverb

Input tones	T3S Domain	Output tones
3 3 3 3		2 3 2 3

Phase 1: [$_{υP}$gou [$_{υ}$bi [$_{VP}$ma xiao]]]
           3 3 (3 3)   3 3 2 3
Phase 2: [$_{CP}$Ø [$_{υP}$gou bi ma xiao]]
           (3 3) 2 3   2 3 2 3

  b. Preposition

3	3	3	3	base tones
	(2	3)		IC, T3S

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--------------------------------------------------------------
3    2    (2   3)        SC, T3S
3    2    2    3         output tones

c. Clitic
3    3    3    3         base tones
(2   3)                  lexical MRU, T3S
--------------------------------------------------------------
2    3    (2   3)        phrasal MRU, T3S
2    3    2    3         output tones
```

In (9), *bi* ('compare') is a coverb but has a preposition-like meaning equivalent to English *than*. In (9a), it is treated as a verb syntactically, and following [8], a coverb clause has a υP structure with the coverb as the head of υP. Then, *ma xiao* ('horse small') as the content of υP gets spelt out first and forms a T3S domain in Phase 1. Next in Phase 2 and also the end of derivation, *gou bi* ('dog compare') respectively as the Spec and head of υP is spelt out together and forms another T3S domain. After T3S respectively applies to the two T3S domains, the final tone sequence is '2 3 2 3', which is the normal tone reading of this clause.

In (9b), *bi* is treated as a preposition, so *bi ma* ('than horse') forms a T3S domain first according to IC. Next, *ma xiao* ('horse small') forms another T3S domain based on SC. After T3S successively applies to *bi ma* ('than horse') and *ma xiao* ('horse small'), the final tone sequence is '3 2 2 3.' This tonal reading is acceptable only when the subject *gou* ('dog') is the focus of the clause.

Example (9c) is the approach adopted by [3]. Here *bi* is treated as a clitic. Lacking of an independent phonological status, *bi* has to attach to its preceding host *gou* ('dog') to form a phonological word. Then, the phonological word *gou bi* ('dog than') forms a lexical MRU. Next, *ma xiao* ('horse small') forms a phrasal MRU based on SC. After T3S applies to the two MRUs, the final tone sequence is '2 3 2 3', the normal tone reading.

Treating *bi* as a clitic, however, is not well justified. Commonly known Mandarin clitics such as *de*, the possessive marker equivalent to English *-'s*, are usually toneless or unstressed (T0). If *bi* is a clitic, it should become toneless and the resulting tonal sequence of the clause should be '3 0 2 3' rather than '2 3 2 3.'

Example (9) shows that treating coverbs as verbs structurally not only captures coverbs' grammatical function but also allows the phase based analysis to yield normal tonal outcomes for coverb expressions. In fact, even treating *bi* as a preposition should yield the same tonal outcome, because a prepositional phrase (PP) in Mandarin, unlike an English PP, also has a υP structure [9]. Similarly, the VP-shell structure of the SVC *xiang mai hao shu* ('want to buy good books') mentioned in (7b) can be replaced by υP without changing the tonal outcome. The υP structure unifies the traditional SVC, coverb construction, and PP in Mandarin, thus able to simplify syntactically based T3S domain formation.

So far, this paper has shown that the phase based account can derive T3S domains directly from the associated syntactic structures. In other words, T3S domain formation reflects a straightforward mapping between syntax and phonology, given the phase based grammar and current minimalist understanding of Mandarin phrasal structures.

4. Conclusion

By examining different Mandarin T3S domains, this study provides evidence for the important role of syntax in the phonological patterning of T3S. The crucial constraint in the phonology-syntax interaction proposed here is that a T3S domain must belong to a phase, a DP, υP, or CP. Without resorting to prosodic factors, the phase based account provides a simpler solution to T3S domain formation than previous accounts.

6. References

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