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  
   [xiao [zhi [lao-ying]]]  
   small paper eagle  
   ‘small paper eagle’

b. 3 3 3 1 → 2 2 3 1  
   [xiang [mai [hao shu]]]  
   want buy good book  
   ‘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  
   ‘small paper eagle’  
   [xiao [zhi [lao-ying]]]  
   small paper eagle  
   ‘small paper eagle’

b. Phrase  
   ‘want to buy good books’  
   [xiang [mai [hao shu]]]  
   want buy good book  
   ‘want to buy good books’

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

<table>
<thead>
<tr>
<th>a. Compound</th>
<th>`small paper eagle'</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 3 3-1</td>
<td>Base tones</td>
</tr>
<tr>
<td>(3-1)*</td>
<td>Lexical MRU</td>
</tr>
<tr>
<td>3 (2 3-1)</td>
<td>Lexical MRU, T3S</td>
</tr>
<tr>
<td>(3 2 3-1)*</td>
<td>Lexical MRU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b. Phrase</th>
<th>`want to buy good books'</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 3 3 1</td>
<td>Base tones</td>
</tr>
<tr>
<td>(3 1)*</td>
<td>Lexical MRU</td>
</tr>
<tr>
<td>(2 3) 3 1</td>
<td>Phrasal MRU, T3S</td>
</tr>
<tr>
<td>(2 2) (3 1)</td>
<td>Cross-MRU, T3S optional</td>
</tr>
</tbody>
</table>

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):

<table>
<thead>
<tr>
<th>a. Compound</th>
<th>b. Phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>x x x</td>
<td>x</td>
</tr>
<tr>
<td>[xiao [zhi [lao-ying]]]</td>
<td>[xiang [mai [hao shu]]]</td>
</tr>
</tbody>
</table>

\[
3 3 3 1 \rightarrow 3 3 (3-1)^* \rightarrow 3 (2 3-1)^* \rightarrow (3 2 3-1)^* \rightarrow (3 2 3-1)^* (optional) \rightarrow 2 (2 3 1)
\]

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

\[
\begin{align*}
\text{wo} & \text{ hao} \rightarrow \text{ wo} \text{ (hen hao)} \text{ or } (\text{wo} \text{ Ø}) \text{ (hen hao)} \\
\text{I} & \text{ very good} \\
\text{I am fine.}
\end{align*}
\]

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

<table>
<thead>
<tr>
<th>a. NP</th>
<th>lao-ying</th>
<th>‘small paper eagle’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input tones</td>
<td>3 3 3 1</td>
<td></td>
</tr>
<tr>
<td>T3S Domain</td>
<td>Output tones</td>
<td>3 2 3 1</td>
</tr>
</tbody>
</table>

Phase 1: [ɔpØ [NP lao-ying]]
(3-1)* 3-1
End of derivation: [ɔpØ [NP xiang]]
(2 3 1) 2 3-1
[ɔpØ [NP xiang]]
(2 3 1)* 3 2 3-1

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

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

Phase 1: [ɔpØ [NP shu]]
(3-1) 3-1
End of derivation: [VP xiang [VP mai] [ɔpØ hao shu]]
(2 3 1) 2 3 1
Optional: 2 (3 1) 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 adjoin 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 (‘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, and VP2 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’

Old-Li buy good wine

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

Phase 1: [ɔpØ [NP hao jiu]]
(3 3) 2 3

Phase 2: [ɔpØ [NP lao-lii]]
(3 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-lii (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-lii 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-lii (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

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

Phase 1: [ɔpØ [NP ma xiao]]
(3 3) 3 2 3

Phase 2: [ɔpØ [NP ma xiao]]
(3 3) 2 3 2 3

b. Preposition
3 3 3 3 | base tones |
(2 3) | IC, T3S |
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, vP, or CP. Without resorting to prosodic factors, the phase based account provides a simpler solution to T3S domain formation than previous accounts.

5. Acknowledgements

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6. References