Taiwan Mandarin Tone Sandhi
Variation of the Intonational Phrasing in Fast Speech

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This paper discusses the domain of Taiwan Mandarin tone sandhi under the framework of Nespor & Vogel's (1986) Prosodic Hierarchy based on a Taiwan Mandarin spoken corpus of 324 sentence tokens consisting of 6-24 third tone syllables. The analysis first shows that under fast speech (i.e. above 200 beats per minute) both cyclical and simultaneous tone sandhi may apply within a long utterance. Second, the phonological and the intonational phrasing as defined by Nespor & Vogel needs a revision to account for the various surface tone patterns of the sentence tokens. Third, the revised prosodic hierarchy incorporates explanation of the classifier cliticization without making stipulations.

0. Introduction

Mandarin Chinese is a tone language consisting of four lexical tones and a neutral tone, and Taiwan Mandarin (TM) is one of the Mandarin dialects spoken in Taiwan. In terms of its lexical tones, the first tone (marked as 1 in the following derivations) is a high level tone; the second (2) a mid-rising tone; the third (3) a low tone; and the fourth (4) a high-falling tone. When a sequence of third tones occurs in an utterance, the non-final third tones may undergo a phonological rule and surface as second tones. This rule is referred to as third tone sandhi (3TS). The domain within which 3TS applies influences the number of derived second tones and is argued to be the prosodic domains such as the foot, the phonological phrase or the intonational phrase by previous studies (Shih 1986; Hung 1987; Cheng 1987; Hsiao 1991; Lin 2002). In other words, when the prosodic domains of a single sentence vary, different tone patterns can be observed, which is reflected in the Taiwan Mandarin corpus. Therefore, to describe and predict the various surface tone patterns, it is necessary to define the prosodic domain within which 3TS applies.

However, different studies assume different prosodic domains. Shih (1986), Hung (1987) and Hsiao (1991) assume that 3TS applies cyclically from the foot to the intonational phrase, while Cheng (1987) adopts the prosodic hierarchy comprising the word, clitic group, phonological phrase and the intonational phrase level and argues that 3TS applies cyclically from the word to the intonational phrase. Despite that the 3TS domains they propose differ from each other, these proposals are unanimous in assuming that the highest domain within which 3TS applies is the intonational phrase. When the
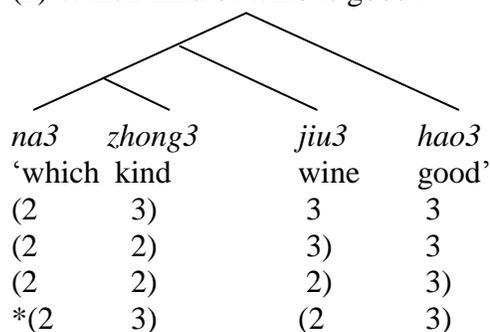
speech rate is fast, simultaneous 3TS optionally applies to the whole intonational phrase. In these approaches, the domain formations under the intonational phrase (e.g. foot/phonological phrase formation etc.) are clearly defined and their variations restricted. Yet, the construction and reconstruction of the intonational phrase are not as clearly defined.

Accordingly, based on a Taiwan Mandarin corpus of 324 sentence tokens containing 6-24 third tone syllables, the following sections of the paper first discuss the observation of the surface tone patterns, then review the problems incurred by the above-mentioned approaches to 3TS in sentences and suggest a revision of the prosodic hierarchy approach to account for intonational phrase variations. The cliticization of classifiers is also explained.
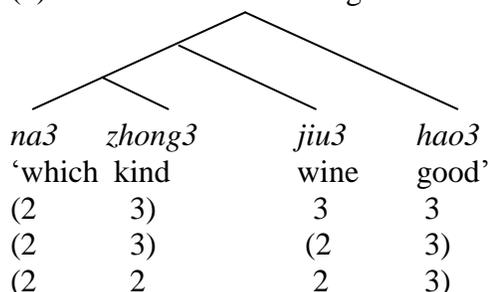
1. Literature review

Previous studies have shown that 3TS domain is not determined by the syntactic structure, but derived from it. For instance, in (1), if 3TS applies within syntactic constituents, the natural tone pattern 2323, cannot surface.

(1) Which kind of wine is good?

na3	zhong3	jiu3	hao3
'which	kind	wine	good'
(2	3)	3	3
(2	2)	3)	3
(2	2)	2)	3)
*(2	3)	(2	3)

To solve this problem, previous studies have regarded the domain of 3TS as determined by the prosodic categories (i.e. the foot, PhP and IP), and the boundaries of the prosodic categories are derived from syntax. One example of the prosodic approach is Shih's (1986) *Foot Formation Rules* (FFR), who states that immediate constituents (*na3 zhong3* 'which kind') form into disyllabic feet first, and then the unpaired syllables (*jiu3 hao3* 'wine', 'good') form into binary feet if they branch to the same direction. It derives the tone pattern 2323. Also, under a fast speech rate, 3TS optionally applies to the whole sentence, which is the IP domain (*na3 zhong3 jiu3 hao3* 'which kind of wine is good?'), producing a 2223 tone pattern. The derivations are shown in (2).

(2) Which kind of wine is good?

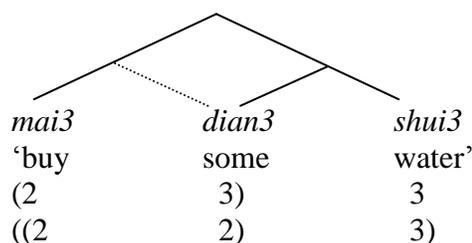| na3	zhong3	jiu3	hao3
'which	kind	wine	good'
(2	3)	3	3
(2	3)	(2	3)
(2	2	2	3)

The prosodic approaches have succeeded in proving and explicating the mismatches between 3TS domain and the syntactic boundaries, though they disagree in the formation of the prosodic boundaries or the prosodic categories 3TS applies to. Shih (1986) and Hsiao (1991) both see the foot as the domain of 3TS, but their theories differ to some extent. Hsiao (1991) proposes a set of *Beat Assignment Rules* and *Foot Formation Rules*. Unlike Shih (1986), in his theory foot formation forms beats, rather than syllables into feet, and that every syllable has to be assigned a beat before foot formation operates. In addition, the beat assignment of function words only takes place after the beat assignment and foot formation of lexical words. He also separates the foot from the PhP and the IP into different hierarchies. The foot belongs to the metrical hierarchy. The PhP and the IP belong to the prosodic hierarchy. These two hierarchies operate simultaneously and interact with each other in the grammar, and the domain of foot formation is restricted by the domain of the PhP and by the IP. In other words, foot formation operates cyclically on the PhP and the IP level.
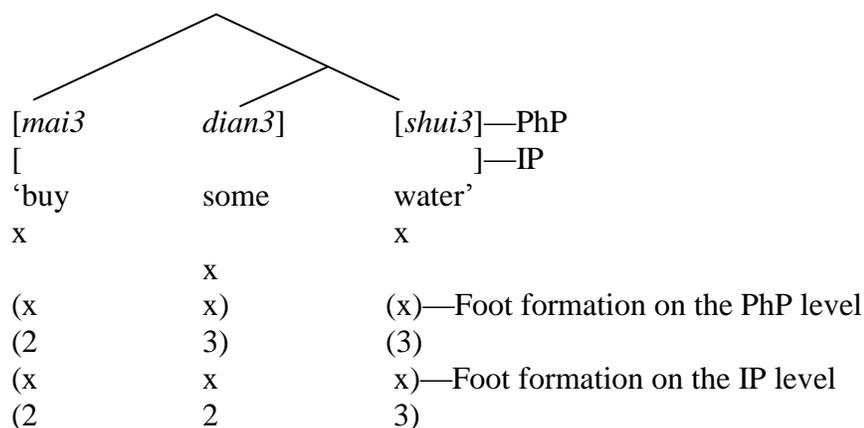
However, both Shih (1986) and Hsiao (1991) need to stipulate the cliticization of classifiers to derive correct surface tone patterns for phrases with classifiers. The classifier *dian3* 'some' in (3a) is within an immediate constituent with *shui3* 'water', so Shih (1986)'s FFR require that *dian3* and *shui3* form a foot first. If this were the case, a wrong surface tone pattern 323 would surface. To repair this problem, she stipulates that the classifier cliticizes to the verb on its left to form a word regardless of the syntactic structure, in order to form *mai3* and *dian3* into a foot and derive a 223 pattern, this stipulation weakens the FFR. The cliticization is shown by the dotted line in (3a). Hsiao (1991) also draws on cliticization, which is of the phonological phrase. The boundaries of the PhP and the IP are indicated by the square brackets in (3b). The classifier *dian3* cliticizes to *mai3* to form a PhP, and foot formation can only operate within the PhP on the PhP level. Hence, *mai3* undergoes 3TS on the PhP level, and *dian3* undergoes 3TS on the IP level. The correct tone pattern 223 is thus derived.

(3) Comparison of Shih's (1986) and Hsiao's (1991) models
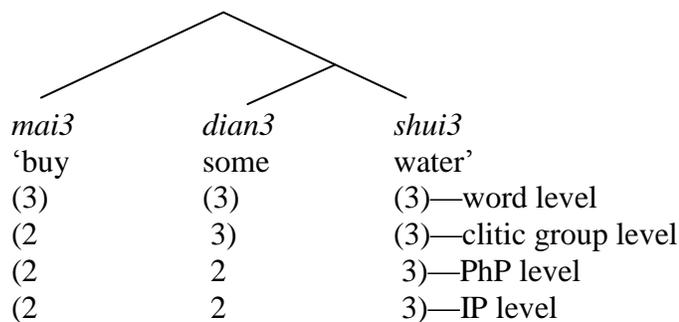a. Cliticization in Shih (1986)

```
        mai3          dian3          shui3
        'buy          some           water'
        (2            3)             3
        ((2           2)             3)
```

b. Cliticization in Hsiao (1991)

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        [mai3         dian3]         [shui3]—PhP
        [                            ]—IP
        'buy          some           water'
        x                            x
                      x
        (x            x)             (x)—Foot formation on the PhP level
        (2            3)             (3)
        (x            x              x)—Foot formation on the IP level
        (2            2              3)
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Cheng (1987) follows Hayes's (1986) *Prosodic Hierarchy* and maintains that 3TS operates cyclically within the word, the clitic group, the PhP and the IP level, rather than within the foot. Yet, her model still warrants a stipulation that, unlike other function words, classifiers always cliticize to their left. A demonstration of her model is shown in (4).
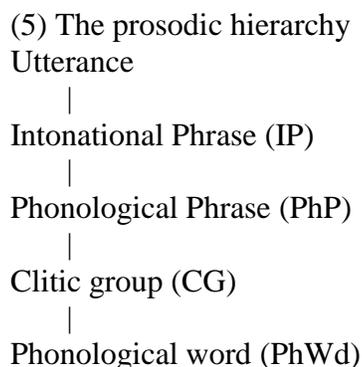
(4) Cliticization in Cheng (1987)

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        mai3          dian3          shui3
        'buy          some           water'
        (3)           (3)            (3)—word level
        (2            3)             (3)—clitic group level
        (2            2              3)—PhP level
        (2            2              3)—IP level
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Another problem in Cheng's (1987) model is the construction rule of the phonological phrase, which is formed by obligatorily adjoining all the materials on the non-recursive side to their head. The PhP domain varies only in whether the complement on the recursive side is also adjoined. This definition may make the PhP too wide if the non-recursive side of the head contains many clitic groups. Hsiao (1991) also gave a definition of the PhP boundaries, which is marked on the left edge of every branching maximal projection, but this definition deprives the PhP domain of its variability, because this means the head obligatorily adjoins the complement on the recursive side as well. Therefore, the following analysis adopts Nespor & Vogel's (1986) definition that a PhP obligatorily contains all the clitic groups on the nonrecursive side of a head X within its maximal projection XP and optionally contains the first complement on the recursive side. In this way, the length of the PhP domain is restricted while retaining its flexibility to adjoin the complement.

Although previous theories are consistent in the assumption that 3TS does not apply across IP boundaries, their definition of the IP domain remains vague. Since in Cheng (1987) and Hsiao (1991) the IP belongs to the prosodic hierarchy, an IP must be composed of one or more PhPs according to the Selkirk's (1984) *Strict Layer Hypothesis* that requires a prosodic constituent on one level (e.g. an IP) to immediately dominate only constituents of the next lower level (e.g. a PhP). Hsiao (1991) further adds that the IP should also conform to the Selkirk's (1984) *Sense Unit Condition*, which commands that the constituents within an IP must bear either a head-modifier or a head-argument relation. Nevertheless, to provide an explicit definition of the IP, the definitions of the lower prosodic categories (i.e. the word, the clitic group, the PhP) must also be given.

Via observing the tone patterns in the corpus, the following analysis examines whether Nespor & Vogel's (1986) prosodic hierarchy, as in (5), is able to account for the variability of Taiwan Mandarin 3TS domain formation. In their model, the foot and the syllable are below the phonological word; however, this study assumes that the metrical categories like the foot and the syllable should belong to a different hierarchy (see Hsiao 1991). Thus, the prosodic hierarchy in (5) does not include these two metrical categories.

(5) The prosodic hierarchy
Utterance
    |
Intonational Phrase (IP)
    |
Phonological Phrase (PhP)
    |
Clitic group (CG)
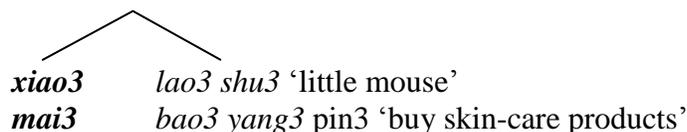 |
Phonological word (PhWd)

2. Data collection and corpus organization

As pointed out by Shih (1986), Cheng (1987) and Hsiao (1991) among others, 3TS applies either cyclically or simultaneously to the IP level under a fast speech rate, so the corpus data were recorded under the speech rate of 200 beats/word per minute with an attempt to see how 3TS applies to the IP and where the IP boundaries sit in the utterances of 6 to 24 syllables. The informants are two female and two male Taiwan Mandarin native speakers aging from 25 to 27. Each of them was asked to read 81 sentences naturally with at least the speed of 200 beats per minute, while a metronome was present for their reference. All in all, the corpus contains 324 sentence tokens of 49 types of syntactic structures.

In Nespor & Vogel (1986), the PhWd is defined as coextensive with the terminal node of the syntactic tree. The following analysis incorporates Cheng's (1987) definition of the word and treats any lexical item or "anything that is derived through a morphological process" as a PhWd (p.40), so compounds are also seen as individual PhWds. To investigate whether 3TS applies on the PhWd level or skips applying on this level, 624 binary branching XPs were examined. Each of the XPs either contains a head and its modifier (*xiao3 lao3 shu3* 'little mouse') or a verb head and its object (*mai3 bao3 yang3 pin3* 'buy skin-care products') as shown in (6). If the final syllable of the modifier (*xiao3* 'little') or the final syllable of the verb head (*mai3* 'buy') undergoes 3TS, it can be assumed that 3TS operates on the PhWd level. If they do not undergo 3TS, 3TS skips this level.

(6) Binary branching XPs

xiao3   *lao3 shu3* 'little mouse'
mai3   *bao3 yang3* pin3 'buy skin-care products'

The next higher prosodic category is the CG, which includes one non-clitic (lexical) word plus, if there are any, one or more clitic (function) words. It should be noted that the present analysis assumes Hung's (1987) and Lin's (2006) hypothesis that prepositions are lexical, not functional, in Mandarin because they are developed from the grammaticalization of verbs, so they still preserve some verbal characteristics such as taking aspectual markers and functioning as the main predicate of a sentence. This study supports their hypothesis in arguing that the phonological phrasing of prepositions also behaves like verbs, so prepositions are not considered as clitic words (see Section 4).

The total number of clitic tokens is 20 (12 pronouns and 8 classifiers). If the clitic word (*dian3*) cliticizes to the left, its preceding non-clitic word undergoes 3TS, as in (7). If the clitic word (*wo3*) cliticizes to the right, the clitic word itself undergoes 3TS, as in (8).

(7) Left cliticization

gei3   dian3   shui3
'give   some   water'
(3)   (3)   (3)—PhWd
(2   3)   (3)—CG

(8) Right cliticization

wo3   xiang3   xi3   leng3   shui3   zao3
'I   want   take   cold   water   shower'
(3)   (3)   (3)   (2   2   3)—PhWd
(2   3)   (3)   (2   2   3)—CG

On the PhP level, a CG which is a head X in the syntactic structure obligatorily adjoins all the CG(s) on its nonrecursive side within XP and optionally includes the first complement on its non-branching recursive side. Here, the recursive side refers to the complement side, and the non-recursive side refers to the opposite side (Giorgi and Longobardi, 1991). If the recursive side branches, optional inclusion of the complement is not permitted. Optional phonological phrasing is the most seen in that of the verb heads because they occur with modifiers and complements much more frequently than the noun heads. Therefore, the analysis focuses on 584 verb head tokens and classifies them into 5 types, as in (9). The first type denotes the verb heads containing only the recursive sides. The second type of verb heads has only the nonrecursive sides. The third type of verb heads has both the recursive and the nonrecursive sides. To examine whether Nespor & Vogel's (1986) definition of PhP construction and reconstruction is capable of describing the phonological phrasing of the verb heads, three targets of observation are made, as shown in (10).

(9) Classification of verb heads

	[±branching] Complement	Number of tokens
With a recursive side	-	252
	+	140
With a nonrecursive side		76
With both sides	-	92
	+	24
Number of V heads		584

(10) Targets of observation

a. Whether the head obligatorily includes all the CG(s) on its nonrecursive side within the maximal projection

b. Whether the head obligatorily includes, optionally includes, or obligatorily not includes the CG(s) on the recursive side

c. Whether the recursive side of the adjoined CG(s) branches or not

A verb head X is regarded as obligatorily includes all the CG(s) on its nonrecursive side within XP when the final syllable (*jin3*) on the nonrecursive side undergoes 3TS as in (11). If it undergoes 3TS the verb head forms a PhP with the CG(s) on its nonrecursive side and vice versa.

(11) Verb head forming a PhP with the CG on its nonrecursive side
gan3 jin3   zhao3
'quickly   find'
(2   3)   (3)—PhWd
(2   3)   (3)—CG
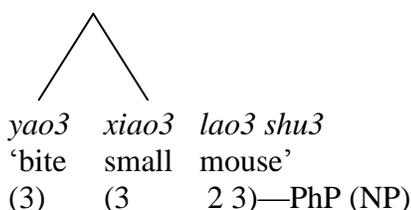(2   2   3)—PhP

If the verb head forms a PhP with the CG(s) on the recursive side, the final syllable (*yao3*) of the verb head undergoes 3TS, as in (12). Note that the phonological phrasing of the NP also operates on this level, so the derivation in (12) shows the phonological phrasing of the NP before the verb head forms a PhP with the NP. As for (10c), the branchingness of the recursive side will also be observed when the inclusion occurs.

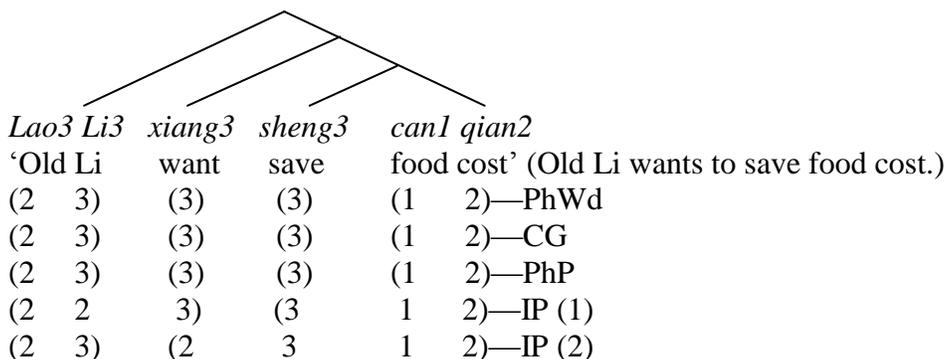(12) Verb head forming a PhP with the CG on its recursive side
yao3   xiao3   lao3 shu3
'bite   small   mouse'
(3)   (3)   (2 3)—PhWd
(3)   (3)   (2 3)—CG
(3)   (3   2 3)—PhP (NP)
(2   3   2 3)—PhP (VP)

Here the branchingness refers to that of the prosodic structure, not of the syntactic structure, as in (13) and (14). If the prosodic structure of the complement (*xiao3 lao3 shu3*) does not branch, the recursive side is considered non-branching. If the prosodic structure of the complement (*xiang3 sheng3 can1 qian2*) branches, the recursive side is considered branching. As will be shown in the following analysis, the variation of the IP domain and the surface tone pattern is strongly related with the flexibility of phonological phrasing.

(13) The prosodic structure of the non-branching complement on the PhP level

yao3   xiao3   lao3 shu3
'bite   small   mouse'
(3)   (3   2 3)—PhP (NP)

(14) The prosodic structure of the branching complement on the PhP level

Lao3 Li3   xiang3   sheng3   can1 qian2
'Old Li   want   save   food cost' (Old Li wants to save food cost.)
(2   3)   (3)   (3)   (1   2)—PhWd
(2   3)   (3)   (3)   (1   2)—CG
(2   3)   (3)   (3)   (1   2)—PhP
(2   2   3)   (3   1   2)—IP (1)
(2   3)   (2   3   1   2)—IP (2)

Although the IP domain in Nespor & Vogel's (1986) definition merely requires that it is formed by one or more PhPs, the present analysis adopts Selkirk's (1984) and Hsiao's (1991) view that the constituents within an IP should bear either a head-modifier or a head-argument relation. The argument here designates the subject or the object of the verb head. With a unified definition of the lower prosodic domains (i.e. PhWd, CG, PhP), when the derived surface tone pattern on the PhP level, like the one on the PhP level in (14), is not consistent with the collected surface tone pattern in the corpus, like the ones on the IP level in (14), it is assumed that the domain of the IP is at play. The construction and reconstruction rule of the IP can thus be inferred.

3. Cyclic and simultaneous TS within an utterance
Since previous studies only discuss the derivation of 3TS patterns in short sentences, the present study collected sentences of 6-24 syllables in order to see if the length of an utterance has any influence on the derivation. The observation of the collected data finds that both cyclic and simultaneous 3TS can apply to a single utterance as in (15). Statistics also suggests that sentence length does have influence on whether an utterance has both cyclic and simultaneous application in different IPs. This phenomenon is observed respectively in sentences of more than 7 syllables. The number of sentence tokens undergoing both cyclic and simultaneous application is shown in (16). There is a noticeable gap between 14- to 23-syllabled sentence tokens because the corpus lacks sentences of 14 to 17 syllables and of 19 syllables, but the influence of length is still obvious. Sentences that are shorter than 7 syllables do not show such a phenomenon. In

fact, this finding corresponds to Shih's (1986) assumption that while it sounds natural for a two-foot phrase to form an IP, it sounds relatively unnatural when an IP consists of more than three feet (i.e. more than 6 syllables). Therefore, sentences of more than 6 syllables should naturally be reconstructed into at least 2 IPs. Since 3TS does not apply across the IP boundaries, it is reasonable that cyclic 3TS applies to one IP and simultaneous 3TS applies to the other in long sentences.

 (15) Cyclic and simultaneous 3TS in an utterance
a. '…so Miss Jiang dares to buy skin-care products from Little Female Ghost'
suo3 yi3 jiang3 xiao3 jie3 gan3 zhao3 xiao3 nu3 gui3   mai3 bao3 yang3 pin3
'so   Jiang Miss   dare find Little Female Ghost buy skin-care products'
(2   3) (3) (2   3) (3)   (3)   (3) (2 3)   3   3 3 3 —PhWd
(2   3) (3) (2   3) (3)   (3)   (3) (2 3)   3   3 3 3 —CG
(2   3) (3   2   3) (2   3) (3   2 3)   3   3 3 3 —PhP
(2 2 3   2   3   2   2   3   2 3)   (2   2 2 3)—IP
b. '…apply to the face and to the toes'
wang3 lian3 mo3 ye3 wang3 jiao3 zhi3 mo3
'to   face apply and to   toes   apply'
(3)   (3)   (3) 3   3   3   3   3 —PhWd
(3)   (3)   (3) 3   3   3   3   3 —CG
(3)   (2   3) 3   3   3   3   3 —PhP
(3   2   3) (2   2   2   2   3)—IP

(16) Number of sentence tokens undergoing both cyclic and simultaneous 3TS

No. of syllables	7	8	9	10	11	12	13	23	22	23
No. of tokens	1	5	6	6	9	7	1	4	2	4

4. A revision of Nespor & Vogel's (1986) prosodic hierarchy

The following analysis examines whether Nespor & Vogel's (1986) prosodic hierarchy can account for the cliticization of function words as well as IP formation in the corpus. Due to limited space, the analysis focuses mainly on the definition of the PhP and the IP, because the definitions of the PhWd and the CG do not differ significantly from the original ones. First, a PhWd is defined as any lexical item or any morphologically derived word, and this does not contradict with the original definition that requires a PhWd to be coextensive with the terminal node of a syntactic tree. On the next higher level, a CG is formed by a non-clitic word (i.e. a lexical word) plus one or more clitic words if there are any function words. This definition also remains the same. However, it is important to note that this study claims prepositions to be lexical words in Mandarin because they are argued to retain some characteristics of verbs, which is the prosodic phrasing in the derivation of 3TS.

As for the PhP formation, Nespor & Vogel (1986) contends that a head X obligatorily forms a PhP with all the CG(s) on the nonrecursive side within XP and

optionally includes the first complement on the nonbranching recursive side. The corpus data correspond to the reconstruction rule in that the head does optionally include the nonbranching complement, as in (17). The category "either" means that whether the head forms a PhP with the complement or not has no influence on the surface tone patterns. When the complement branches, the verb head does not form a PhP with the complement, as shown in (18). When the nonrecursive side branches, the verb heads obligatorily include all the CGs on the nonrecursive side, as shown in (19).

(17) Verb heads phrasing PhPs with nonbranching complements

Inclusion	Non-inclusion	Either	No. of verb heads
3.5% (12)	18% (62)	78.5% (270)	100% (344)

(18) Verb heads not phrasing PhPs with branching complements

Inclusion	Non-inclusion	Either	No. of verb heads
0	63% (103)	37% (61)	100% (164)

(19) Verb heads phrasing with the nonbranching nonrecursive side

Inclusion	Non-inclusion	Either	No. of verb heads
67% (35)	0	33% (17)	100% (52)

What Nespor & Vogel's (1986) definition fails to explain is how the verb heads form PhPs with the branching nonrecursive side. It is observed that even when the nonrecursive side branches, the verb head still forms a PhP with it, but the inclusion is restricted to only one CG on the nonrecursive side, as in (20). The domain formation of such verb heads is shown in (21).

(20) Verb heads phrasing with the branching nonrecursive side

Inclusion of 1CG	Non-inclusion	Either	No. of verb heads
39% (55)	30% (42)	31% (43)	% (140)

(21) Verb heads forming a PhP with one CG on the branching nonrecursive side
'Old Li asks my cousin to go north'
Lao3 Li3 qing3 biao3 jie3 wang3 bei3 zou3
'Old Li   ask   cousin   toward north go'
(2   3) (3)   (2   3)   (3)   (3)   (3)—PhWd
(2   3) (3)   (2   3)   (3)   (3)   (3)—CG
(2   3) (3)   (2   3)   (3)   (**2**   **3**)—PhP
(2   2   3   2   2   3   2   3)—IP

In (21) since prepositions are seen as lexical words, they form clitic groups by themselves on the CG level. On the PhP level, when the preposition head (*wang3*) does not form a PhP with the complement (*bei3*), the nonrecursive side of the verb (*zou3*)

branches. The verb head must include the CG *bei3* to derive the correct surface tone pattern. Accordingly, the branchingness of the nonrecursive side should be considered in Nespor & Vogel's (1986) definition of the construction rule of PhP. A revision is given in (22).

(22) Revision of the PhP construction rule

a. A head X obligatorily forms a PhP with the CG(s) on the nonrecursive side within its maximal projection (XP).

a-1. When the prosodic structure of the nonrecursive side branches, the head forms a PhP with only one CG on the nonrecursive side within XP.

a-2. When the prosodic structure of the nonrecursive side does not branch, the head forms a PhP with all the CGs on the nonrecursive side within XP.

b. A head X optionally forms a PhP with the first complement on the non-branching recursive side.

Having defined the formation of the PhP, we can now move on to the definition of the IP. The original construction rule for the IP only requires it to be composed of one or more PhPs. However, if this were the case, unnatural IPs would be produced, as in (23). As Nespor & Vogel (1986) observes, there is a tendency to avoid short IPs in natural speech. Therefore, the formation of IP should be revised as well.

(23) Unnatural IP formation
'Old Li asks my cousin to go north'

Lao3	*Li3*	*qing3*	*biao3*	*jie3*	*wang3*	*bei3*	*zou3*	
'Old	Li	ask	cousin		toward	north	go'	
(2	3)	(3)	(2	3)	(3)	(3)	(3)—PhWd	
(2	3)	(3)	(2	3)	(3)	(3)	(3)—CG	
(2	3)	(3)	(2	3)	(3)	(**2**	**3**)—PhP	
(2	3)	(3)	(2	3)	(3)	(**2**	**3**)—IP	

Selkirk (1984) and Hsiao (1991) suggest that IP formation should conform to the *Sense Unit Condition*, which demands either a head-modifier or a head-argument relation between the constituents in an IP. Despite that this condition does eliminate the possibility for an unnatural IP with the inner constituents bearing no semantic relations at all, the IPs in (23) do not violate the condition because individual words such as *qing3* and *wang3* can be sense units by themselves. This brings us to consider the length restrictions of IP formation. Shih (1986) and Hsiao (1991) both make sure that a 3TS domain is longer than at least two syllables by proposing foot formation rules. However, the foot formation approach is incompatible with the cliticization of classifiers without adding stipulations. Furthermore, Hsiao (1991) points out that the metrical and the prosodic hierarchy should be separated, which means that the foot and the syllable in Nespor & Vogel's (1986) prosodic hierarchy should belong to the metrical hierarchy.

This brings about the possibility that the length of an IP is restricted by the requirement of foot formation which avoids monosyllabic feet, and this is the work of the metrical hierarchy, not the prosodic hierarchy. Therefore, the construction rule of the IP does not need to include the length restriction of the metrical hierarchy. A revision of the original definition is given in (24).

(24) A revision of the IP construction rule
a. An IP constitutes one or more PhPs.
b. The constituents within an IP must satisfy the Sense Unit Condition

5. The cliticization of classifiers

The other issue this paper tackles is the cliticization of classifiers, that is, whether it can be accounted for by the prosodic hierarchy model without making further stipulations. The corpus contains two kinds of clitics: classifiers and pronouns. The cliticization of these two pronouns behave differently from each other in that classifiers cliticize only to the left, while pronouns cliticize to both directions, as seen in (25). Since one of the pronouns undergoes cyclic 3TS, it is considered to skip the phrasing on this level. The CG formations of classifiers and pronouns are shown in (26).

(25) Direction of cliticization

	Direction			Total
	Leftward	Rightward	Simultaneous TS	
Pronouns	1	10	1	12
Classifier	8	0	0	8
Total				20

(26) Cliticization of classifiers and pronouns
a. '…give **some** cold water'
gei3 dian3 leng3 shui3
'give some cold water'
(3) (3) (2 3)—PhWd
(2 **3**) (2 3)—CG
(2 3) (2 3)—PhP
(2 3 2 3)—IP

b. 'Miss Li says **you** only apply top skin-care products'
Li3 xiao3 jie3 jiang3 ni3 zhi3 mo3   ding3 ji2 bao3 yang3 pin3
'Li Miss   say   you only apply top   skin-care products'
(3)   (2 3) (3)   (3) (3) (3) (3 2) (2   2   3)—PhWd
(3)   (2 3) (3)   (**2** 3) (3) (3 2) (2   2   3)—CG
(3   2 3) (3)   (2   2   3) (3 2   2   2   3)—PhP
(3   2 2   3) (2   2   2   3   2   2   2   3)—IP

Like this study, Nespor & Vogel (1986) observes two kinds of clitics and proposes the directional and the non-directional ones. The directional clitics they found are in Greek possessives. They also state that the direction of cliticization must be seen as an inherent property of them, and such inherent property does not exist in non-directional clitics. In this model, the cliticization of Mandarin classifiers is explained because they always cliticize to the left. The cliticization of pronouns, on the other hand, is non-directional, so they can either cliticize to the left or the right clitic word. Without making stipulations in the model, the difference in the direction of cliticization is explicated.

6. Conclusion

This paper investigates how 3TS applies in sentences of different lengths, and finds that in utterances of more than 7 syllables both cyclic and simultaneous application of 3TS are observed. After the examination of Nespor & Vogel's (1986) prosodic hierarchy, revisions are made regarding the PhP and IP construction rule. It is assumed that the branchingness of the nonrecursive side also plays an important role in the formation of PhPs. For the IP construction, the requirement of the *Sense Unit Condition* is added, and the tendency to avoid monosyllabic IPs is believed to be constrained by factors outside the prosodic hierarchy (i.e. foot formation).

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