On the Distribution of Neutral Tone in Southern Min: LCC and Beyond

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1   Introduction

The aim of this paper is to address an often-overlooked topic in Southern Min (SM) tonology: neutral tone. Tone sandhi domain in SM has been a textbook example for the right alignment of phonological phrases (φ) with syntactic XPs since M. Chen's (1987) seminal work.[1] In SM, the base tone (a.k.a. juncture tone, citation tone) appears in XP-final positions, while the other syllables undergo a chain-shift tone sandhi and consequently bear a sandhi tone (a.k.a. context tone). Cheng (1968) and M. Chen (1987, 2000) proposed that the tone sandhi domain may be defined by means of the so-called tonal/tone groups (TGs), roughly equivalent to p(honological)-phrases (Truckenbrodt 1999, 2007). In a TG-based analysis, almost every syntactic XP is aligned at the right edge with a TG, and the general shape of a TG can be schematized as $(S_0^n \textbf{B})_{TG}$: only the rightmost syllable of a TG bears the base tone (**B**), and all the other syllables (if any) bear the sandhi tone (**S**). The right edge of a syntactic XP is aligned with a TG at the right edge, and vice versa (1).

(1) $Bi\eta^5.hua^5$ kio^3 $Si\partial k^4.hui^7$ $k\mathfrak{z}^3$ $Ka^1.i\eta^5.$
         [[PN]NP   [ask   [[PN]NP   [watch   [PN   ]NP]VP]CP]VP]S
         (S **B**)TG   (S   S **B**)TG   (S   S **B**)TG
         'Bîng-huâ asked Siok-huī to look after Ka-îng.'

There are, however, exceptions to this generalization (see also M. Chen 2000). Here we focus on the role of the so-called contentive–functional divide in the formation of the tone sandhi domain.[2] Given the same syntactic structure in (1), there are no TG boundaries demarcating the right edge of determiner phrases (DPs) which are "unfocused" (or, in Soh's (2001) terms, a p(rosodically)-weak determiner). Consider (2). Given the identical syntactic structure to that of (1), TG parsing does not, metaphorically speaking, "stop" on the right edge of the sentence-medial pronouns. As a result, the whole utterance is parsed into one large TG as in (2), rather than three TGs as in (1).

(2) Gua^2 kio^3 li^2 $k\mathfrak{z}^3$ $Ka^1.i\eta^5.$
         [<1SG >DP   [ask   [<2SG>DP   [watch   [PN   ]NP]VP]CP]VP]S
         (S   S   S   S   S **B**)TG
         'I asked you to look after Ka-îng.'

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[1] In this paper, Southern Min (proper) is a cover term for Xiamen Chinese, Taiwanese, Quanzhou Chinese, Zhangzhou Chinese, and the varieties of Hokkien spoken in Southeast Asia; these are all closely related languages or dialects. Broad transcriptions of SM expressions are given using the IPA equivalents of Taiwanese Romanization (Ministry of Education 2008). Tonal categories (if not underlyingly toneless) are labeled syllable-finally with a superscript numeral, instead of the use of diacritics. Different from the usage of Taiwanese Romanization, hyphens are only used to mark significant morpheme boundaries. Pronunciations, examples, and judgements are mainly based on Taiwanese Southern Min, the native variety of the first and the second authors. Abbreviations: 1/2/3 = 1st/2nd/3rd person; CL = classifier; EXP = experiential; PN = proper name; SG = singular.

[2] In terms of the "lexical–functional" opposition mentioned in the literature, we use *contentive* in place of *lexical*, which is reserved for the meaning "to do with the dictionary or lexicon" (Bauer 2007:112), for clarity.

In other words, a pronominal DP does not count as "visible" in TG formation; such an invisibility has been attributed to the Lexical Category Condition (LCC) by Truckenbrodt (1999: 226): "Constraints relating syntactic and prosodic categories apply to lexical [contentive] syntactic elements and their projections, but not to functional elements and their projections, or to empty syntactic elements and their projections." A pronominal DP is only headed by a functional element and does not contain any contentive head, the right edge of such a DP is thus not applicable to TG formation.

Although there is merit in the TG-based analysis, we believe this is not the whole story for SM tone sandhi. For a more complete picture, an overlooked factor, *neutral tone* (schematized as *N*), must be taken into consideration. Precisely, when a functional morpheme occurs at the XP-final position, that morpheme will be rendered as the neutral tone. The XP-final position is also TG-final in the previous analyses. In such a situation, the base tone of the TG will "retreat" to a preceding syllable which is not a functional morpheme; that is, the base tone appears non-XP-finally when there is a neutral-tone syllable in the TG. An example is illustrated in (3). If we adopt the conventional TG analysis, the whole sentence is parsed into one large TG, because the pronominal DPs are all invisible to TG formation. Yet the TG's right edge can still be aligned with that of the VP, in either the matrix or the embedded clause.

(3) Gua^2 kio^3 li^2 $kɔ^3$ i^1.
    [<1SG >$_{DP}$ [ask   [<2SG>$_{DP}$ [watch <3SG>$_{DP}$]$_{VP}$]$_{CP}$]$_{VP}$]$_S$
    (S   S   S   **B**   *N*   )$_{TG}$
    'I asked you to look after him/her.'

Therefore, neutral tone in Southern Min poses several puzzles in the current accounts for its domain of tone sandhi. For example, the Allomorph Selection Hypothesis (Tsay & Myers 1996) dictates that whether a juncture tone (base tone) or a context tone (sandhi tone) allomorph is selected is totally based on a syntactically defined criterion, i.e., XP-final versus elsewhere. The occurrence of a non-XP-final base tone and the neutral tone are not predicted; such instances were, in fact, treated by Tsay and Myers (1996) as lexical exceptions. In an indirect reference account such as the TG analysis (M. Chen 1987, 2000, among others), the non-final base tone and the neutral tone miss the generalization that the final syllable bears the base tone, i.e., $(S_0^n \mathbf{B})_{TG}$.

In this paper, we set out to elaborate on the nature of the so-called "tone group" in Southern Min. First, we describe the distribution of neutral tone in SM with existing examples and novel data found in Taiwanese. Second, we propose a level between p-word and p-phrase, dubbed the *Tone Sandhi Domain* (TSD); which is somewhat akin to the status of a minor phrase (McCawley 1968) or an accentual phrase (Pierrehumbert & Beckman 1988) in Japanese. Third, we argue that the p-word also plays an important role in the formation of TSDs as evidenced in the so-called (eu)rhythmic effect, some of which have been reported in M. Chen (2000). In sum, we will show that TSDs may be defined via an appropriate ranking of alignment constraints, making reference to the established prosodic constituents.

2   Neutral tone in Southern Min: background and distribution

The neutral tone in Southern Min has been documented since the nineteenth century (Douglas 1873). It can be found in a number of SM varieties, including Xiamen (Chiu 1931; Li 1962; Lo 1930; Zhou & Ouyang 1998), Taiwanese (Ang 1985, 1998; Cheng 1997; Cheng & Cheng 1978; Ogawa 1993[1931]), Zhangzhou (Yang 2008), Quanzhou (Wang 1996), and Hui'an (W. Chen & Wu 2015). A neutral tone syllable in SM is usually realized with a low-ish pitch (usually mid-low or low) and a reduced duration; however, cases of tone extension are also attested in Taiwanese (Ang 1998; Liu, Hsieh, & Chang 2021) and Zhangzhou (Yang 2008), but they are limited to a certain set of morphemes.

The neutral tone syllables, or *enclitics* (after Douglas 1873), in SM generally belong to the functional categories or have been grammaticalized from contentive categories (albeit with lexical idiosyncrasies). Previous studies have established several inventories of the function morphemes under different morphosyntactic assumptions (Ang 1998; Cheng 1997; Du 1988; Li 1962). We follow Liu (2021) and Liu, Hsieh, and Chang (2021), classifying these function morphemes into three major types by syntactic properties: particle, suffix, and phrase. We will focus only on the suffixal and phrasal function morphemes (including their non-neutral-tone and neutral-tone variants) in this paper.

A functional morpheme does not always bear a neutral tone. In fact, a functional morpheme is rendered as the neutral tone only at the end of a syntactic phrase. In other words, a non-XP-final functional element still undergoes the chain-shift tone sandhi. For example, the experiential marker *kue³* (literally 'to pass') is rendered as the neutral tone when it is XP-final, and not followed by an object NP (4). But when the marker occurs XP-medially (i.e., non-final), it still participates in the regular tone sandhi (5).[3]

(4)　　*Tai⁵.pak⁴ᵢ,*　　*gua²*　　*bat⁴*　　*kʰi³-kue³*　　　eᵢ.
　　　　[[Taipei]NP　　[<1SG>DP　[ever　[go.toV-EXPAsp　< >NP]VP]AspP]TP]CP
　　　　(S　**B**)TG　　　(S　　S　　**B**　*N*　　　　　)TG
　　　　'Taipei, I have been there.'

(5)　　*Gua²*　　*bat⁴*　　*kʰi³-kue³*　　*Tai⁵.pak⁴.*
　　　　[<1SG>DP　[ever　[go.toV-EXPAsp　[Taipei]NP]VP]AspP]S
　　　　(S　　　S　　S　S　　　　S　**B**)TG
　　　　'I have been to Taipei.'

In addition, a "focused" DP (such as a quantity numeral denoting a specific number or a definite referent, or an emphatic form of personal pronoun) is phonologically "strong" and behaves in the same way as a regular NP in terms of tone sandhi. For example, (6) poses the contrastive focus on each of the pronouns, and once these pronouns are focused, a TG boundary is required to be aligned with them.

(6)　　*Gua²*　　*kio³*　*li²*　　*kɔ³*　　*i¹.*
　　　　[[1SG]DP　[ask　[[2SG]DP　[watch　[3SG]DP]VP]CP]VP]S
　　　　(**B**)TG　(S　**B**)TG　(S　　　**B**)TG
　　　　'*I*Foc asked *you*Foc to look after *him/her*Foc.'

In sum, the neutral tone can only appear in final position, whereas the base tone can appear non-finally. It is important to reiterate that this empirical fact is left unanswered in previous studies.

3　A new analysis of the "Tone Group"

In this paper, we propose a new analysis of the "Tone Group." This analysis refers to three different levels of prosodic constituents. The p-phrase (φ) remains the fundamental ingredient in our analysis, while we will also elaborate on the word level, where there are dual routes through which a syntactic X° can be mapped to a p-word (ω): contentive-ness and focus. In addition, we propose an "intermediate" level called the *Tone Sandhi Domain* (TSD, τ). We will show that a TSD must be right-aligned with a p-word, which is probably motivated by the final prominence and/or stressability inherent to the prosodic word-hood.

3.1　*P-word*　Regarding the word level, we follow the general assumption that only a contentive X° is mapped to a p-word (ω). In addition, a focused determiner, such as a pronoun in emphatic/contrastive use and a quantity numeral denoting a definite entity or a specific number, will also be mapped to a p-word. This mapping may be achieved directly by mapping Focus to a p-word, or indirectly by stating that a focused element must be prominent in terms of stress or accent, which can only be realized on a p-word.

The correspondence at the word level can be achieved through the interaction of MAX and DEP constraints which are sensitive to the contentive–functional distinction, adapted from Ito and Mester (2019):

(7)　　Let *S* be an input syntactic representation and *P* its corresponding output phonological representation.
　　　a.　SP:MAX-*cnt*: MAX(*cnt*, ω)
　　　　　A constituent of type *cnt* (content word) with phonological content in *S* corresponds to some constituent of type ω (prosodic word) in *P*.

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[3] The syntactic structures in (4) and (5) are simplified for ease of discussion. The "VP" is actually the phrase headed by the experiential aspect marker *kue³*. We assume the surface word order of V-Asp is due to a head adjunction operation that raises the contentive verb to the Asp head.

b. PS:DEP-ω: DEP(ω, *cnt*)
    A constituent of type ω (prosodic word) in *P* corresponds to some constituent of type *cnt* (content word) in *S*.

The two constraints are top-ranked, ensuring that in every optimal candidate the p-words are in strict correspondence with the contentive heads in the input. The two constraints are sensitive to the contentive–function divide and outranks a general MAX constraint, as shown in (8):

(8) INPUT: 'I have been to [Taipei].'
         Gua²   *bat⁴*   *kʰi²-kue³*   ___.
         1SG   ever   go.to-EXP
         [< D >DP   [Asp*cnt*   [V*cnt*-Asp   < >DP] VP]AspP]TP
     CAND 1: ( )ω   ( )ω   ( )ω( )ω
     CAND 2:   ( )ω   ( )ω
     CAND 3:   ( )ω

/INPUT/	DEP(ω, *cnt*)	MAX(*cnt*, ω)	MAX(X°, ω)
CAND 1	*!*		
☞ CAND 2			**
CAND 3		*!	***

When the pronoun *gua²* is focused, another constraint that requires a focused X° to be mapped to a ω is ranked higher than the PS-DEP constraint. Despite the exact motivation (focus or stress), let us use MAX(Foc, ω) as a shorthand for the current purpose. In this treatment, a function word must correspond to a ω in the output when it is focused, and outputs with a non-focused function word (such as the experiential aspect marker *kue³*) corresponding to a ω is penalized. (9–10) illustrates the effect brought by focus.

(9) SP:MAX-FOC: MAX(Foc, ω)
     A focused constituent with phonological content in *S* corresponds to some constituent of type ω (prosodic word) in *P*.

(10) INPUT: '*I* have been to [Taipei].'
         Gua²   *bat⁴*   *kʰi²-kue³*   ___.
         1SG   ever   go.to-EXP
         [[D_Foc]DP   [Asp*cnt*   [V*cnt*-Asp   < >DP] VP]AspP]TP
     CAND 1: ( )ω   ( )ω   ( )ω( )ω
     CAND 2: ( )ω   ( )ω   ( )ω
     CAND 3:   ( )ω   ( )ω

/INPUT/	MAX(Foc, ω)	DEP(ω, *cnt*)	MAX(*cnt*, ω)	MAX(X°, ω)
CAND 1		**! (D, Asp)		
☞ CAND 2		*(D)		*
CAND 3	*!			**

3.2 *P-phrase* Regarding the phrase level, we follow the line of the previous TG-based analyses, which is a non-recursive and exhaustive parsing of an utterance into one or more p-phrases (φ). The p-phrase parsing is sensitive to the contentive–functional divide and focus, but the crucial difference lies only in the DPs: when a DP contains only a non-focused D° (e.g., a personal pronoun, or a bare quantity numeral without an NP), this DP is invisible in the parsing at the p-phrase level. Therefore, we may revise the LCC such that when a maximal projection dominates no focus (or [+definite], cf. Soh 2001) nor any non-empty contentive category, such a maximal projection is invisible in the Syntax-to-Phonology mapping. A TG-like p-phrase parsing can be predicted using the constraints listed in (11), and TGs can be predicted in tableaux (12–14). We shall return to the neutral tone in section 3.3.

(11)   Alignment constraints (adapted from Truckenbrodt 2007: 436–439)
      a.   ALIGN-XP,R: ALIGN(XP, R, φ, R)
          The right edge of each syntactic XP is aligned with the right edge of a p-phrase.
      b.   ALIGN-φ,R: ALIGN(φ, R, XP, R)
          The right edge of each p-phrase is aligned with the right edge of an XP.
      c.   WRAP-XP
          For each XP there must be a p-phrase that contains the XP.
      d.   NONREC(URSIVITY)-φ
          No φ is contained in another φ.

(12)   INPUT: 'Bîng-huâ asked Siok-huī to look after Ka-îng.' [= (1)]
                $Bi\eta^5.hua^5$ kio^3 $Si\jmath k^4.hui^7$ $k\jmath^3$ $Ka^1.i\eta^5$.
                PN   ask   PN   look.after   PN
                [[N$_{cnt}$]$_{NP}$ [V$_{cnt}$ [[N$_{cnt}$]$_{NP}$ [V$_{cnt}$ [N$_{cnt}$]$_{NP}$]$_{VP}$]$_{CP}$]$_{VP}$]$_{S}$
      CAND 1:   { }$_φ$ {   }$_φ$ {   }$_φ$
      CAND 2:   {   }$_φ$
      CAND 3:   {{ }$_φ$ { {{ }$_φ$ { { }$_φ$ }$_φ$ }$_φ$ }$_φ$ }$_φ$

/INPUT/	ALIGN-φ,R	ALIGN-XP,R	NONREC	WRAP-XP
☞ CAND 1				***
CAND 2		*!*		
CAND 3			*!	

(13)   INPUT: 'I asked you to look after him/her.' [= (3)]
                Gua^2 kio^3 li^2 $k\jmath^3$ i^1.
                1SG   ask   2SG   look.after   3SG
                [< D >$_{DP}$ [V$_{cnt}$ [< D >$_{DP}$ [V$_{cnt}$ < D >$_{DP}$]$_{VP}$]$_{CP}$]$_{VP}$]$_{S}$
      CAND 1:   { }$_φ$ {   }$_φ$ {   }$_φ$
      CAND 2:   {   }$_φ$
      CAND 3:   {   {   {   {   }$_φ$ }$_φ$ }$_φ$ }$_φ$

/INPUT/	ALIGN-φ,R	ALIGN-XP,R	NONREC	WRAP-XP
CAND 1	*!*			***
☞ CAND 2				
CAND 3			*!	

(14)   INPUT: 'I have been to [Taipei].' [= (8)]
                Gua^2 bat^4 $k^hi^2\text{-}kue^3$ ___.
                1SG   ever   go.to-EXP
                [< D >$_{DP}$ [Asp$_{cnt}$ [V$_{cnt}$-Asp < >$_{DP}$] $_{VP}$]$_{AspP}$]$_{TP}$
      CAND 1:   { }$_φ$ {   }$_φ$
      CAND 2:   {   }$_φ$
      CAND 3:   {   }$_φ$
      CAND 4:   {   {   {   }$_φ$ }$_φ$ }$_φ$

/INPUT/	ALIGN-φ,R	ALIGN-XP,R	NONREC	WRAP-XP
CAND 1	*!			*
☞ CAND 2				
CAND 3		*!		*
CAND 4			*!	

This analysis is not unproblematic, however. For example, the contentive–functional divide is duplicated at both phrase and word levels (see section 3.1). More discussion is postponed to section 5, along with a comparison with alternative approaches.

3.3   *A level in-between*   We propose the tone sandhi domain in SM cannot be equivalent to a p-phrase. Instead, the *Tone Sandhi Domain* (TSD, τ) is an intermediate level between p-word (ω) and p-phrase (φ). Being dominated by a p-phrase, the largest TSD is isomorphic with the p-phrase. We believe this is the origin for the illusion of the right-alignment in the literature. Yet in other cases, as in (16) below, we see that a TSD is not isomorphic with a p-phrase at the right edge.

The prosodic requirement for a well-formed TSD is that any TSD should be aligned with that of a prosodic word at the right edge. With the constraints listed in (15), it means that ALIGN-τ-ω,R should outrank ALIGN-τ-φ,R. The theoretical status of the TSD is akin to that of a minor phrase (McCawley 1968) or an accentual phrase (Pierrehumbert & Beckman 1988) in Japanese. The τ-final base tone may be interpreted as a rightmost accent assigned at this level. The right edge alignment could thus be rooted from the demand that an accented syllable should be hosted or "protected" by a prosodic word.

(15)   Alignment constraints for TSD (τ)
   a.   ALIGN-τ-ω,R: ALIGN(τ, R, ω, R) The right edge of each τ is aligned with the right edge of a ω.
   b.   ALIGN-τ-φ,R: ALIGN(τ, R, φ, R) The right edge of each τ is aligned with the right edge of a φ.
   c.   ALIGN-τ-φ,L: ALIGN(τ, L, φ, L) The left edge of each τ is aligned with the left edge of a φ.

Given that only a contentive head or a focused D may be mapped to a p-word, it follows that phrase-final non-focused functional elements are neutral-toned. For example, the non-focused pronouns in (16) and the aspect suffix *-kue³* in (17) do not form a p-word. The final pronoun in (16) bears the neutral tone because it cannot be contained within a TSD; otherwise, the prosodic constraint regarding a well-formed τ would be fatally violated. As for the functional elements in non-final positions, they are not reduced to the neutral tone, because TSD only needs to end with a p-word. Consequently, the other two pronouns in (16) and the sentence-medial suffix *-kue³* in (18) can be included in a TSD and undergo the regular tone sandhi.

(16)   INPUT: 'I asked you to look after him/her.'

	Gua²	*kio³*	*li²*	*kɔ³*	*i¹*.
	1SG	ask	2SG	look.after	3SG
	[< D >DP	[V*cnt*	[< D >DP	[V*cnt*	< D >DP]VP]CP]VP]S
CAND 1:	{(S	**B**ω)τ	(S	**B**ω)τ	N }φ
CAND 2:	{ N	(Sω	S	**B**ω)τ	N }φ
CAND 3:	{(S	Sω	S	Sω	**B**) τ }φ
CAND 4:	{(S	Sω	S	**B**ω)τ	N }φ

/INPUT/	ALIGN-τ-φ,L	ALIGN-τ-ω,R	ALIGN-τ-φ,R
CAND 1	*!		**
CAND 2	*!		*
CAND 3		*!	
☞ CAND 4			*

(17)   INPUT: 'I have been to [Taipei].'

	Gua²	*bat⁴*	*kʰi²-kue³*	___.
	1SG	ever	go.to-EXP	
	[< D >DP	[Asp*cnt*	[V*cnt*-Asp	< >NP] VP]AspP]TP
CAND 1:	{(S	**B**ω) τ	(**B**ω)τ N	}φ
CAND 2:	{(S	Sω	Sω **B**)τ	}φ
CAND 3:	{(S	Sω	**B**ω)τ N	}φ

/INPUT/	ALIGN-τ-φ,L	ALIGN-τ-ω,R	ALIGN-τ-φ,R
CAND 1	*!		**
CAND 2		*!	
☞ CAND 3			*

(18)   INPUT: 'I have been to Taipei.'
         Gua²   *bat⁴*   *kʰi²-kue³*   *Tai⁵.pak⁴.*
         1SG   ever   go.to-EXP   Taipei
         [< D >$_{DP}$ [Asp$_{cnt}$ [V$_{cnt}$-Asp   [N$_{cnt}$]$_{NP}$]$_{VP}$]$_{AspP}$]$_{TP}$
CAND 1:   {(S   S$_\omega$ **B**$_\omega$)$_\tau$ N   (**S B**$_\omega$)$_\tau$ }$_\varphi$
CAND 2:   {(S   S$_\omega$ S$_\omega$ S   **S B**$_\omega$)$_\tau$ }$_\varphi$

/INPUT/	ALIGN-τ-φ,L	ALIGN-τ-ω,R	ALIGN-τ-φ,R
CAND 1	*!		*
☞ CAND 2			

To sum up, the contentive–functional distinction in Southern Min has two prosodic consequences. On the one hand, non-focused functional heads are not p-words, hence excluded at right edges (i.e., "extra-prosodic") by the prosodic requirement of the TSD (τ); on the other hand, XPs which contain only non-focused functional heads are not visible phrase boundaries according to the LCC.

4   Neutral tone syllables in sentence-medial position

So far, we have only examined the neutral tone found on a functional element in sentence-final position. In fact, neutral tone syllables can also appear in sentence-medial position. Here we explore the utterance-medial neutral tones by revisiting the quantity numerals (cf. M. Chen 2000, Soh 2001, among others).

The DP boundary of a quantity numeral is visible when it refers to a definite entity or a specific number. The behavior of such a DP is not different from a normal contentive NP. In (19), the phrase-final 'two/this cup(s)' receives the base tone in the latter syllable, showing that the DP is mapped to a p-word so that TSD can be right-aligned with it. When a purposive clause is added in (20), the right edge of the same DP is still aligned with a p-phrase boundary and the last syllable of the DP also receives the base tone.[4]

(19)   *be²*   *nŋ⁷/tsit⁴-pue¹*   ___
         [buy   [two/this-cup.CL   ___   ]$_{DP}$]$_{VP}$
         {[(S)$_\omega$ (S   **B**)$_\omega$]$_\tau$ }$_\varphi$
         'buy two cups [of tea]' / 'buy this cup [of tea]'

(20)   *be²*   *nŋ⁷/tsit⁴-pue¹*   ___   *lai⁵*   *lim¹*
         [buy   [two/this-cup.CL   ___   ]$_{DP}$ [to   [drink   ]$_{VP}$]$_{CP}$]$_{VP}$
         {[(S)$_\omega$ (S   **B**)$_\omega$]$_\tau$ }$_\varphi$ {[S   (**B**)$_\omega$]$_\tau$ }$_\omega$
         'buy two cups [of tea] to drink' / 'buy this cup [of tea] to drink'

In contrast, the phrase boundary of an indefinite quantity numeral denoting a non-specific number is invisible in p-phrase parsing, as in the case of non-emphatic pronouns. Therefore, the end of the DP 'two cups' in (21) must not be aligned with a p-phrase boundary. The contrast between (20) and (21) was distinguished with # versus = in M. Chen (2000:437) and Soh (2001:43–44), and we interpret their notations as 'two separate TGs' versus 'one run-on TG' in the two conditions.

(21)   *be²*   *nŋ⁷-pue¹*   ___   *lai⁵*   *lim¹*
         [buy   <two-cup.CL   ___   >$_{DP}$ [to   [drink   ]$_{VP}$]$_{CP}$]$_{VP}$
         {[(S)$_\omega$ S   S   S   (**B**)$_\omega$]$_\tau$ }$_\omega$
         'buy *some* cups [of tea] to drink' (where *some* = '$^{\%}$1, 2, 3, …')

Plus, a non-specific quantity numeral carries neutral tone phrase-finally (22), like a phrase-final pronoun.

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[4] The pitch values of the DP 'buy two cups' are [be^H nŋ^L pue^H] in (19–20), [be^H nŋ^L pue^M] in (21), and [be$^{\overline{HL}}$ nŋ^L pue^L] in (22) (superscript capital letters refer to the pitch levels), according to the first and the second authors' intuitions. The three pronunciations correspond to the prosodic structures {[SS**B**]$_\tau$ }$_\varphi$, {[SSS …]$_\tau$ }$_\varphi$, and {[**B**]$_\tau$ NN}$_\varphi$ respectively.

(22)   *be²*   *nŋ⁷-pue¹*   __
         [buy   <two-cup.CL   __   >DP]VP
         {[(**B**)ω]τ   *N   N*   }φ
         'buy *some* cups [of tea]' (where *some* = '%1, 2, 3, …')

The run-on p-phrase in (21) can be predicted if we treat the purposive clause as an argument (precisely, a complement) of a covert verb, following the analysis proposed in Liao and Lin (2019) for *lái*-purposives in Mandarin, partially reproduced in (23). Under such an analysis, there is no other visible XP boundary between the DP and the purposive clause, so it is predicted that the utterance is parsed into a large run-on p-phrase, as shown in (24).

(23)   [vP [DP Zhangsan*i*] [v' buyV-v [VP [DP that book*j*] [v' tv [CP Op*j* [C' toC [IP PRO*i* read tOp*j*]]]]]]]

(24)   *be²*   *nŋ⁷-pue¹*   ___   *lai⁵*   *lim¹*
=(21)   [buy   [<two-cup.CL   ___   >DP   [to   [drink]VP]CP]VP]vP

φ:	{						}
τ:	[						]
ω:	(σ)	σ	σ			σ	(σ)
SR:	S	S	S			S	**B**

Furthermore, another possible tone sandhi pattern of (21) is attested, at least in Taiwanese. As shown in (25), the V-DP sequence is parsed separately from the purposive clause, so that the non-specific DP carries the neutral tone, and the base tone of the former p-phrase falls on the contentive verb. Our analysis can predict such a pronunciation if we treat the purposive clause as a VP-level adjunct. The former p-phrase can thus be aligned with the VP formed first by the V-DP sequence. Given the non-p-word status of the quantity numeral, it cannot be included in the TSD at the right edge, so the resulting TSD excludes the last two syllables and can only be aligned with the verb.

(25)   *be²*   *nŋ⁷-pue¹*   ___   *lai⁵*   *lim¹*
               [[buy   <two-CL   ___   >DP]VP   [to   [drink]VP]CP]VP

φ:	{			}	{		}
τ:	[ ]				[		]
ω:	(σ)	σ	σ		σ	(σ)	
SR:	**B**	*N*	*N*		S	**B**	

The run-on p-phrase in (21) somewhat parallels control and ditransitive constructions in (26) and (27) respectively. In these two constructions, the sentence-medial pronouns must not be aligned with a p-phrase boundary. However, the constituents after the DP cannot serve as adjuncts, but only as arguments; hence the V-DP sequence cannot form a syntactic constituent, so that (26b) and (27b) are impossible.

(26)   *Biŋ⁵.hua⁵*   *kio³*   *li²*   *kɔ³*   *Siɔk⁴.hui⁷*.
               PN   ask   2SG   look.after   PN
               [[N*cnt*]NP   [V*cnt*   [< D >DP   [V*cnt*   [N*cnt*   ]NP]VP]CP]VP]S
       a.   {(<u>S **B**</u>ω)τ }φ   {(S ω   S   S ω   <u>S **B**</u>ω)τ }φ
       b.   * {(<u>S **B**</u>ω)τ }φ   {(**B**ω)τ   *N* }φ   {(S ω   <u>S **B**</u>ω)τ }φ
               'Bîng-huâ asked you to look after Siok-huī.'

(27)   *Biŋ⁵.hua⁵*   *hɔ⁷*   *gua²*   *tsit⁸-tĩũ¹*   *pʰue¹*.
               PN   give   1SG   one-CL   mail
               [[N*cnt*]NP   [V*cnt*-v   [< D >DP   eV   [Num-Cl   [N*cnt*]NP]DP]VP]vP]S
       a.   {(<u>S **B**</u>ω)τ }φ   {(S ω   S   S   S   **B**ω)τ }φ
       b.   * {(<u>S **B**</u>ω)τ }φ   {(**B**ω)τ   *N* }φ   {(S   S   **B**ω)τ }φ
               'Bîng-huâ gave me a mail.'

5   Discussion

So far, we have introduced the Tone Sandhi Domain (τ), a level between the word and phrase levels, to account for the "exceptional" tonal alternations in SM due to the phrase-final function morphemes. First, we have shown that functional morphemes are not prosodically invisible across the board—it participates in the tone sandhi in non-phrase-final positions. Second, previous accounts including Tone Group, the LCC, and the Allomorph Selection Hypothesis, all fail to account for the phrase-final neutral tone and non-phrase-final base tone. The use of the TSD/τ solves these problems; ALIGN-R(τ, ω) captures the nature of the TSD and may be motivated by the final prominence of Southern Min tone sandhi, if only a p-word/ω can host prominence such as stress and accent, which is realized in the form of a base tone. We compare some alternative approaches with our analysis in the following sections.

5.1 *Match Theory, recursivity, and headedness*   The LCC as defined in our current analytic framework states that a syntactic phrase boundary is invisible when all pronounced heads that it dominates are functional and non-focused. The generalization seems to be equivalent to another prosodic well-formedness constraint, HEADEDNESS, given the analysis that only a contentive and/or a focused head in syntax is mapped to a p-word in phonology. Headedness of a p-phrase, for example, requires that it dominate at least one p-word. In SM, an XP is visible as a p-phrase right edge only when it dominates at least one contentive or focused head. Therefore, the question is whether this LCC-like effect could be explained away by HEADEDNESS. So far, we assume a non-recursive parsing at all three levels (ω, τ, and φ), and this assumption makes very different predictions from an analysis based on Match Theory (Selkirk 2011; Elfner 2012, 2015, 2018; Ito & Mester 2019). Some discussion is in order. First, following Ito and Mester (2019), we may alternatively assume that all phrase boundaries are equally "visible" in Syntax-to-Prosody mapping, since the contentive–functional distinction is dealt with only at the word level. One of such alternatives is to treat all TGs as p-phrases, under a recursive, non-exhaustive version of Match Theory. In this approach, a φ-final syllable protected by ω receives the base tone, while the phrase-final function morphemes are adjuncts to ι and are thus not dominated by φ, as demonstrated in (28). However, such an approach can hardly predict the sentence medial neutral tone syllables, as these syllables are always dominated by a larger p-phrase which corresponds to the maximal VP, as in (29).

(28)   *Gua²*   *bat⁴*   *kʰi³-kue³*   e$_i$.
          [[1SG]$_{DP}$ [ever   [go.to$_V$-EXP$_{Asp}$ < >$_{NP}$]$_{VP}$]$_{AspP}$]$_S$
          { S   { S   { **B**$_\omega$ }$_\varphi$ }$_\varphi$ }$_\varphi$ *N*
          'Taipei, I have been there.'

(29)   *be²*   *nŋ⁷-pue¹*   __   *lai⁵*   *lim¹*
          [[buy   [two-cup.CL   __   ]$_{DP}$]$_{VP}$ [to   [drink]$_{VP}$]$_{CP}$]$_{VP}$
          {{ **B** }$_\varphi$??S ??S   { S   { **B** }$_\varphi$ }$_\varphi$ }$_\varphi$
          'buy *some* cups [of tea] to drink' (where *some* = '%1, 2, 3, …')

Even with a non-recursive version of Match Theory, one can hardly predict a p-phrase containing a syntactic non-constituent. Take the control construction in (1) for example, repeated in (30). 'Ask Siok-huī' is not a constituent syntactically, but this chunk is still parsed into the same TG, excluding the other elements in the VP. The non-recursive Match Theory fails to predict such a prosodic constituent unless some prosodic structure requirements are placed with a higher priority.

(30)   *Biŋ⁵.hua⁵*   *kio³*   *Siɔk⁴.hui⁷*   *kɔ³*   *Ka¹.iŋ⁵.*
          [[PN]$_{NP}$ [ask   [[PN]$_{NP}$ [watch   [PN   ]$_{NP}$]$_{VP}$]$_{CP}$]$_{VP}$]$_S$
          (S **B**)$_{TG}$ (S   S **B**)$_{TG}$ (S   S **B**)$_{TG}$
          'Bîng-huâ asked Siok-huī to look after Ka-îng.'

Moreover, a sentence like (3) (repeated in (31)) should surface as the SR in (31a) rather than that in (31b). The Headedness approach may be used to predict the fact that an initial pronoun must belong to the same p-phrase as the following verb, but it wrongly predicts (31b), whereby the HEADEDNESS constraint is not

ostensibly violated, either. Such an approach misses the crucial generalization that unfocused DPs never mark a φ-boundary in all outputs.

(31)   *Gua²   kio³   li²   kɔ³   i¹.*
             [[1SG]$_{DP}$ [ask   [[2SG]$_{DP}$ [watch   [3SG]$_{DP}$]$_{VP}$]$_{CP}$]$_{VP}$]$_S$
     a.   {[S   S$_\omega$ S   **B**$_\omega$]$_\tau$ N   }$_\varphi$
     b.   *   {[S   **B**$_\omega$]$_\tau$ N   }$_\varphi$ {[**B**$_\omega$]$_\tau$ N   }$_\varphi$
             'I asked you to look after him/her.'

As for the choice between the ALIGN/WRAP and MATCH theories in dealing with tone sandhi domain in SM, Cao (2022) shows that MATCH constraints can derive the expected outputs without extra machinery, while the ALIGN/WRAP approach still relies on an additional prosodic structure constraint, BINMAX. Details aside, Cao posits that the absence of a p-phrase boundary after an adjunct may be explained away either by leaving MATCHNONMINSYNTAX(xp) undominated (à la MATCH approach), or by ranking WRAP-XP over ALIGNRIGHT-XP plus an undominated BINMAX (à la ALIGN/WRAP approach), assuming that NONREC and LAYERING are undominated. Some discussion is in order. Firstly, WRAP-XP ≫ ALIGN-XP,R runs into a ranking paradox: consider now Truckenbrodt's (2007) analysis, reproduced in (32).

(32)   Xiamen Chinese: ALIGN-XP,R ≫ WRAP-XP (adapted from Truckenbrodt 2007: 440)

		[*hɔ⁷* [*in¹ sio².ti⁷*]$_{NP1}$ [*tsit⁸-pun² tsʰeʔ⁴*]$_{NP2}$]$_{VP}$	ALIGN-XP,R	WRAP-XP
		give his brother one-CL book		
	(a)	(give his brother one-CL book)$_\varphi$	*$_{NP1}$!	
☞	(b)	(give his brother)$_\varphi$ (one-CL book)$_\varphi$		*$_{VP}$

Secondly, Cao does not deal with the contentive–functional opposition and leaves it to the LCC. As we have shown throughout, the LCC is not unproblematic in several aspects in SM tonology. Finally, Strict Layering is incompatible with the empirical data: that certain (unfocused, functional) heads are not mapped to a p-word has a crucial bearing on the formation of the tone sandhi domain as well as the presence or absence of the neutral tone.

     In sum, given these potential problems, we believe that an ALIGN-based, non-recursive p-phrase parsing plus the active role of the prominence (e.g., the contentive-functional distinction, focus, etc.) still fares better than its competing analyses.

5.2   *Tone Sandhi Domain and p-phrase*   There is another piece of evidence supporting that "Tone Groups" (or, TSDs/τ's) are not p-phrases *per se*. Consider the rhythmic effect mentioned in M. Chen (2000: 471–474), the gist of which is that a long NP/DP can be parsed into more than one TG, such as the idiomatic compounds listed in (33) and the long place names in (34), in which long TSDs are not accepted. A syntax-based parsing can hardly predict the actual parsing. By contrast, a TSD, smaller than a p-phrase, has the potential to serve as the foot-like unit in SM tonology.

(33)   a.   *tiɔŋ¹.hua⁵-d͡zin⁵.bin⁵-kiɔŋ⁷.ho⁵.kɔk⁴*   'People's Republic of China'
            Chinese-people-republic   (M. Chen 2000: 473)
            [S   **B**]$_\tau$ [S   **B**]$_\tau$ [S   S   **B**]$_\tau$
    b.   *kue³.bin².siŋ³-pʰĩ⁷.giam⁷*   'allergic rhinitis'
            allergic-rhinitis   (M. Chen 2000: 473)
            [S   S   **B**]$_\tau$ [S   **B**]$_\tau$

(34)   a.   *ma².tatⁱ⁸.ka¹.su¹.ka¹*   'Madagascar'
              [S **B**]$_\tau$ [S   S   **B**]$_\tau$
        ??   [S   S   S   S   **B**]$_\tau$
    b.   *su¹.kan¹.te⁷.na².i⁵.a¹*   'Scandinavia'
              [S   S   **B**]$_\tau$[S S S **B**]$_\tau$
        *   [S   S   S   S   S   **B**]$_\tau$

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The parsings of the TSDs in (33) and (34) still obey the basic principle established earlier: a TSD is higher than a p-word but lower than a p-phrase, and the right edge of a TSD is always aligned with a p-word. As for the compounds in (33), the TSDs basically correspond to the major morpheme boundaries, so one may say that such a phrasing is due to the Base-to-Derivative correspondence. The place names in (34) are at first glance problematic, because they *are* monomorphemic words but parsed into more than one domain. A possibility is that since these place names are rendered via Character-based adaptation, it is likely that each Chinese character is treated as a p-word so that 'Madagascar', for example, may be regarded as a concatenation of five p-words, hence $\{[(S)_\omega\,(\mathbf{B})_\omega]_\tau\,[(S)_\omega\,(S)_\omega\,(\mathbf{B})_\omega]_\tau\}_\varphi$. By contrast, in Taiwanese Southern Min, phonological loanwords borrowed from Japanese show no apparent ω-boundaries. For example, the hexasyllabic loanwords $a^M.su^H.p^ha^H.la^H.ga^H.su\textipa{P}^M$ 'asparagus' and $san^{\widehat{MH}}.hu^H.la\eta^H.si^H.su^H.k^h\textturnc\textipa{P}^M$ 'San Francisco' (superscript capital letters refer to the pitch levels) are both produced in only one tonal template (Hsieh 2006). Since these Japanese loanwords are typically written in Katakana, we may entertain the possibility that the TSM speakers do not treat a kana as a p-word, hence the difference between the Character-based adaptation and the "kana-based" adaptation.

6　Conclusion

We have shown that the tone sandhi domain in Southern Min is not always isomorphic with an XP in syntax, as widely assumed. In fact, the tone sandhi domain may be smaller than a phrase, as evidenced in the phrase-final functional morphemes (e.g., unfocused pronouns, aspectual particles, etc.) as well as in the rhythmic effect. We proposed that the tone sandhi domain in SM is defined by the TSD/τ, a constituent between the p-phrase and the p-word. Finally, the TSD/τ corresponds to a prominence-bearing domain, while prominence here may refer to accent, stress, or focus. It follows that unfocused pronouns, grammatical particles, and the like cannot be licensed in a prominence-bearing domain, hence the superficial mismatches in the syntax–phonology interface.

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