

Looking for Ong's Grammatical Units that Correspond to Tone Groups*

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ABSTRACT

This paper investigates the correlation between tone groups and syntactic units in Taiwanese sentences. Previous research has identified tone groups but failed to establish a systematic relationship with grammatical structures. By examining existing studies and the phenomena based on Phase Theory, this paper demonstrates that tone groups in Taiwanese closely align with syntactic phases, specifically DP, vP, CP, and PP. While phonological and pragmatic factors influence tone sandhi, the core mechanism appears to be syntactic. This finding offers a novel perspective on tone sandhi in Taiwanese and contributes to a deeper understanding of the interface between syntax and phonology.

The paper begins by reviewing previous studies on tone groups and their relationship to syntactic structures. It then introduces Phase Theory and its core concepts. Subsequently, the paper analyzes Taiwanese tone sandhi patterns in light of Phase Theory, demonstrating the alignment between tone groups and syntactic phases. Additionally, the study discusses potential exceptions and limitations, emphasizing the need for further research into the complex interplay of syntax, phonology, and pragmatics in shaping tone sandhi patterns.

Keywords: tone sandhi, syntax-phonology interface, Phase Theory, Taiwanese

1. Tone Sandhi in Taiwanese Sentences

The rules of tone sandhi in Taiwanese have long been organized and discussed by many. However, based on the author's personal experience of teaching Taiwanese to foreigners, learners familiar with the rules of tone sandhi and who can correctly pronounce non-monosyllabic words immediately face a second challenge: sentence-level tones—that is, when learners want to speak or read a complete sentence, they cannot grasp if the final syllable of each word in the sentence should undergo tone sandhi. After all, a sentence is different from a word. In a word, except for a few exceptions (such as some subject-predicate compounds), most follow the principle of maintaining the original tone of the final syllable and changing the tone of the non-final syllables. However, once words are combined into sentences, the final syllables of each word are either those that maintain their original tones or those that undergo tone sandhi. If learners are not provided with clear instructions, they may find it difficult to speak or read complete sentences with the appropriate tones.

When discussing where tone sandhi occurs in a sentence, researchers usually employ the term 'tone group'. The term 'tone group' refers to a range between two syllables without tone sandhi in a sentence, where all the syllables flanked between them undergo tone changes. A tone group can be as small as a single monosyllabic word or can span multiple words or even an entire sentence. It is also referred to as a 'continuous tone-changing domain' (e.g., Luo 2008). Earlier than the frequently cited studies, Iok-tek Ong has already pointed out in the 1960s that tone groups are not only words, but also phrases and clauses. Additionally, Ong identified the following rules of tone groups: (reprinted 2000:55-56)

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The following abbreviations are used in the glosses of the example sentences.

ASP: grammatical aspect; COMP: complementizer; CL: classifier; IRR: irrealis; LK: linker; LOC: localizer; NEG: negation; NLR: nominalizer; PREP: preposition; PROG: progressive; PRT: particle; YNQ: yes-no question particle

- (1) a. The constituent before the linker particle ‘ê’ is a tone group.
- b. Pronouns are not tone groups.
- c. The subject and the predicate belong to different tone groups. Subject pronouns are exceptional.
- d. The verb and the complement form a tone group.
- e. The demarcation of tone groups depends on semantics and phenomena where tones are neutralized.
- f. Tone groups are neither breath-group nor a way to strengthen the last nuclear syllable musically.

Interestingly, Ong suggested that tone groups are grammatical units that serve as a stepping stone for linguists to access the comprehensive grammatical system. (reprinted in Ong 2000:57)

The link between tone groups and syntax (grammatical units) has been investigated by many studies (Chen 1987; Lin 1994; Ang 2002; Luo 2008, 2018 etc.). However, no existing study offers an exhaustive list of tone groups. Moreover, while some early studies hinted at the nature of tone groups (e.g. Chen 1987; Lin 1994), none recognized the general concept of grammatical units proposed by Ong.

This study aims to demonstrate the value of Ong’s idea. In fact, there is a remarkable correspondence between tone groups in Taiwanese and syntactic computation phases. In other words, tone groups in Taiwanese remarkably align with the boundaries of syntactic computation units, the phase DP (determiner phrase), vP (light verb phrase), PP (prepositional phrase), and CP (complementizer phrase), proposed in Phase Theory (Chomsky 1995, 2001, 2008; Svenonius 2004; Hiraiwa 2005).

In the next section, we will review the studies which concern with the relationship between grammatical units and tone sandhi. From the review, we will see the research on the syntactic underpinnings of tone sandhi. After that, we will introduce the Phase Theory, in which the abstract concept of syntactic computation units embodies Ong’s speculation in the 1960s. We then elaborate Ong’s idea, tone groups in Taiwanese, and their relevance to human language. This paper is concluded with a caveat in section 5.

2. Previous studies on Tone Sandhi in Sentences

In this section, we will revisit studies that attempted to uncover the interaction between syntax and tone sandhi in Taiwanese sentences.

2.1 Chen (1987)

Although the title and content of Chen’s study focus on Amoy (Xiamen vernacular), the discussion actually includes Taiwanese (1987:110). Additionally, the research by Cheng (1968, 1973), cited by Chen, is based on Taiwanese. Given the mutual intelligibility between Amoy and Taiwanese within the Southern Min language family, Chen’s research is relevant to this study.¹

Chen (1987) observes that tone groups vary in length within sentences and cannot be predicted based on syllable count or stress patterns. Furthermore, Chen argues against defining tone groups solely based on syntax, as their boundaries do not align perfectly with syntactic constituents or immediate constituent (IC) hierarchy (1987:114-115). Nevertheless, Chen considers Cheng’s (1968, 1973) proposal – that tone group boundaries correspond to the right edge of noun phrases (NP), verb phrases (VP), sentences (S), subordinate clauses (S’), and adverbial phrases (sentence AvP) – as the most

¹ Zhou (1991) and Lin (1994) are included in the review in section 2 for the same reason.

promising approach in previous research. However, Chen rejects this proposal primarily due to theoretical concerns about phonological rules applying differently to various parts of speech. Additionally, Chen argues that the syntactic constituents listed by Cheng do not constitute a natural class and provides counterexamples of tone sandhi in the final syllables of noun phrases to support this claim (1987:115-117).

Chen's proposed tone group formation is as follows:

- (2) Tone group formation (Chen 1987:131 (47))
Mark the right edge of every XP with #, except where XP is an adjunct c-commanding its head.

The term 'adjunct' in (2) indicates circumstantials and modifiers, in contrast to arguments including the subject and phrases strictly subcategorized by the head X (1987:117; 123). Chen provides the definition of 'adjunct' as follows:

- (3) XP is an adjunct of Y, if XP (Chen 1987:123 (28))
 - (a) appears in [. . . XP . . .]_{YP} and
 - (b) is not a strictly subcategorized argument of Y

In addition to proposing general principles, Chen also presents some exceptions, such as pronouns, conjunctions, and sentence particles. Unless they are emphasized or used for contrast, these constituents are not considered XP in this case (1987:120-121). Overall, although Chen has identified a general rule, in addition to exceptions (see Lin, 1994:262-263), Chen's proposal was criticized by Lin (1994) for the following reasons. First, the distinction between adjuncts and arguments is an additional component. Second, the relationship between this distinction and the output of phonetic form (PF) is unclear and puzzling.

2.2 Zhou (1991) and Hsiao (1991)

Zhou (1991) proposes the following four major principles for within-sentence tone sandhi:

- (4) a. A tone group boundary exists between the subject and the predicate, and the final syllables of both the subject and the predicate do not undergo tone sandhi.
 - b. In verb-object structures, the final syllable of the object does not undergo tone sandhi.
 - c. In modifier-modified structures, the final syllable of the modifier before the particle 'ê' does not undergo tone sandhi.
 - d. The syllable immediately preceding a word pronounced with a neutral tone does not undergo tone sandhi.

While Zhou's generalizations are largely accurate, they do not encompass more detailed aspects such as adverbials and pronouns.

Hsiao (1991) refers to the tonal groups within a sentence as phonological phrases. Similar to Chen (1987), he argues that their division must occur at the right boundary of the maximal phrase projection (XP), excluding adjuncts and clitics. Since pronouns are considered clitics, their final syllables undergo tone sandhi. Hsiao's analysis closely aligns with Chen's (1987) perspective.

Overall, Zhou's research is primarily observational and, as Chen points out, lacks identification of underlying general rules (not belonging to a natural class). Hsiao's study shares similar limitations with Chen's work.

2.3 Lin (1994)

In contrast to Chen (1987), Lin (1994) argues that instead of relying on the adjunct-argument distinction, it's preferable to return to the syntactic government relationship to provide a consistent explanation for tone group formation across languages.

Similar to Cheng (1968, 1973), Lin observes that sentence adverbs, unlike elements acting as adverbials, form their own tonal group (1994: 242-243; 248). Lin uses this phenomenon as his primary argument.

Lin's proposal is as follows:

- (5)] X^{\max} , if X^{\max} is not lexically governed, X^{\max} is a tone group. (refer to Lin 1994:248 (25))

Lin specifically proposes that all noun phrases in Taiwanese fall under a determiner phrase (DP) (1994:250; 254). Since determiners are function words, noun phrases are not governed by lexical items. Lin uses this to explain why the final syllable at the right edge of noun phrases does not undergo tone sandhi, thus forming a tone group.

Lin acknowledges that his analysis does not significantly outperform Chen's (1987) in terms of explaining the data. However, Lin believes that his proposition is conceptually simpler and more universal, with the potential for cross-linguistic explanatory power without requiring additional assumptions (1994:261).

2.4 Ang (2002), Dong (2002), Lu (2002)

Ang (2002), building on Chen (1987), introduces modifications. Ang argues that XP should be defined by lexical category at the syntactic level, namely 'noun phrases', 'verb phrases', 'adjective phrases', or 'prepositional phrases', excluding functional categories like inflectional phrases (IP) and complementizer phrases (CP). This, according to Ang, explains why sentence-final particles and function words do not retain their original tones. Ang also contends that Chen's restriction on 'modifiers' (a term Ang uses, equivalent to 'adjuncts') is unnecessary as temporal and locative words, while considered adjuncts, preserve the original tones on their final syllable. Ang's paper offers detailed discussions on various phrases, including proverbs and words not yet nativized. Areas for future research include achieving greater theoretical simplicity and clarity, along with a more principled analysis.

Dong (2002) summarizes positions where tone sandhi does not occur: the final syllable of nouns, the syllable preceding words with neutral tone, the syllable preceding conjunctions and prepositions, the final syllable of temporal and locative phrases, and the final syllable of topics and comments. However, conjunctions, prepositions, and pronouns do undergo tone sandhi. Dong's approach, grounded in parts of speech and function, provides a clearer description than Zhou (1991) and Cheng (1968, 1973).

Lu (2002) expands on Dong's (2002) approach with more detailed investigations. Lu addresses areas not covered by Dong, such as the final syllable of attributives or adverbials undergoing tone sandhi, while the final syllable of non-pronominal attributives with 'ê' does not, despite 'ê' itself undergoing tone sandhi. Lu also discusses serial verb constructions and co-verbal structures. Notably, Lu observes that in coordinative and appositive constructions, the final syllable of each part does not undergo tone sandhi, and whether localizers are monosyllabic or disyllabic influences the tone sandhi of preceding

modifying elements. This observation, absent in previous studies, is particularly significant for teaching purposes.

2.5 Luo (2008; 2018)

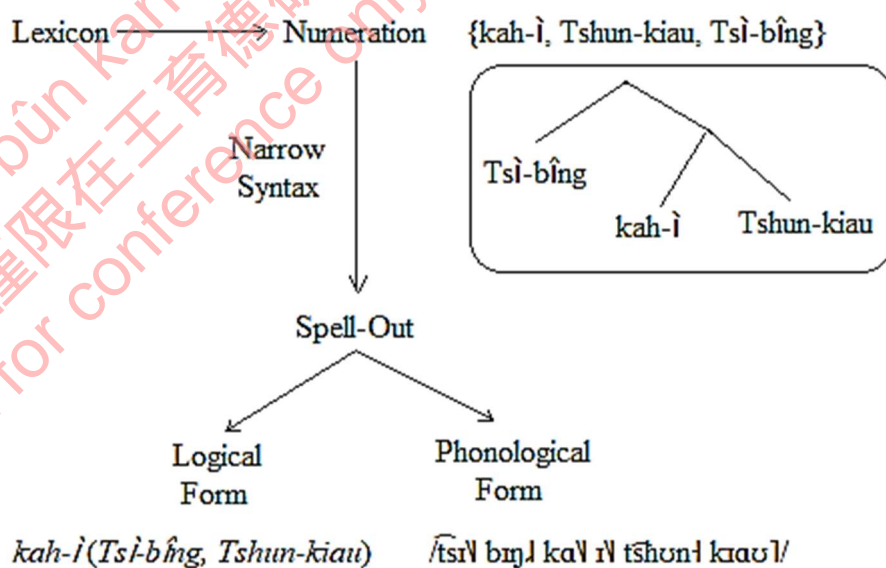
Luo (2008) proposes several abstract principles for tone sandhi, including: ‘light before heavy’, ‘focus enhancement’, ‘tightly structured elements form a tone sandhi unit’, ‘content words do not undergo tone sandhi, function words do’, and the prominent ‘metrical foot principle’. Luo suggests that the variation in tone sandhi for modifying elements of locative and temporal words, as observed by Lu, is due to metrical foot structure. Disyllabic words form a normal metrical foot, trisyllabic words a super-foot, and longer words multiple feet. Final syllables of normal and super-feet retain their original tones. Luo’s analysis highlights phonology’s significant role in tone group formation within syntactic structures.

In contrast to the abstract approach of his 2008 paper, Luo (2018) shifts towards a part-of-speech and syntax-centered perspective similar to Cheng (1968, 1973), Dong (2002), and Lu (2002). Luo argues that part of speech is fundamental: noun final syllables do not undergo tone sandhi, sentence-final particles are tone neutralized, and other parts of speech typically undergo tone sandhi unless preceding a neutral-tone element. Luo discusses various word classes, incorporating previous findings and new observations. The paper also explores ‘linguistic rhythm’, examining tone sandhi’s potential for ambiguity and pragmatic effects. Luo’s research underscores the influence of phonological and pragmatic factors on within-sentence tone sandhi. However, a general principle linking tone sandhi and part of speech remains elusive.

3. Introducing Phase Theory

Phase Theory is a hypothesis regarding the syntax-phonology interface within Generative Grammar. The conventional Y-Model posits that sentences are formed by merging lexical items from the Lexicon and subsequently spelled out in both Logical Form (LF; semantic representation) and Phonetic Form (PF; phonological representation) following syntactic operations (Narrow Syntax), as illustrated below (Chomsky 1995).

(6) Y-Model of Grammar



A crucial question arises regarding the timing of Spell-Out. One possibility is to construct the entire syntactic structure before sending it to the interfaces, while another involves building and sending parts of the structure incrementally. The latter, known as the Multiple Spell-Out model (Uriagereka 1999, among others), reduces computational load by limiting accessible information. Phases represent these units spelled out during sentence construction. In other words, phases are convergent objects marking Spell-Out points (Murphy 2018:3).

To identify these phases, Chomsky (2000:106) suggests that they should constitute ‘natural syntactic objects’ with relative independence in terms of interface properties.

Chomsky proposes light verb *v* and complementizer *C* as phase heads due to their θ -completeness and ‘isolability’ at interfaces. While phonetic independence is evident for complementizer phrases (CPs) as propositional units, evidence for light verb phrases (*v*Ps) as phases comes from pseudo-clefting (7), fronting (8), and response fragments (9) (from Chomsky 2000:16).²

(7) what John did was [_{vP} insult the dean]

(8) John said he would insult the dean and [_{vP} insult the dean] he did.

(9) [_{vP} me insult the dean]?!

On the LF-side, CP determines sentence Tense and Force, while *v*P assigns θ -roles. Passive and unaccusative *v*Ps, lacking external θ -roles, are not strictly phases. However, their phonetic independence (Legate 2002) suggests maintaining them as phases of interpretation as well.

DPs, similar to CPs (Szabolsci 1989, et al.), are also considered phases (Chomsky 2005:9), though this remains debated. Svenonius (2004), Legate (2002), and Hiraiwa (2005) provide supporting evidence. Conversely, Matushansky (2005) argues that while Legate’s diagnostics support DP as PF phases, they fail on the semantic side.

The phase nature of propositions (CP), events (*v*P), and entities (DP) aligns with fundamental elements of human communication. While theoretical, this suggests sentence computation proceeds in these basic chunks. Interestingly, Taiwanese tone sandhi indirectly supports this hypothesis (see section 4).

Beyond CP, *v*P, and DP, researchers explore phasehood for other projections, such as PPs. PPs exhibit cross-linguistic variation in island effects and quantifier raising (Citko 2014), complicating phase status determination. Some argue for PP phasehood in certain languages or under certain circumstances. For example, Lee-Schoenfeld (2008) proposes theta-independent PPs as phases.

Before illustrating Phase Theory, we introduce the Phase Impenetrability Condition (PIC):

(10) Phase Impenetrability Condition (Chomsky 2001:14)

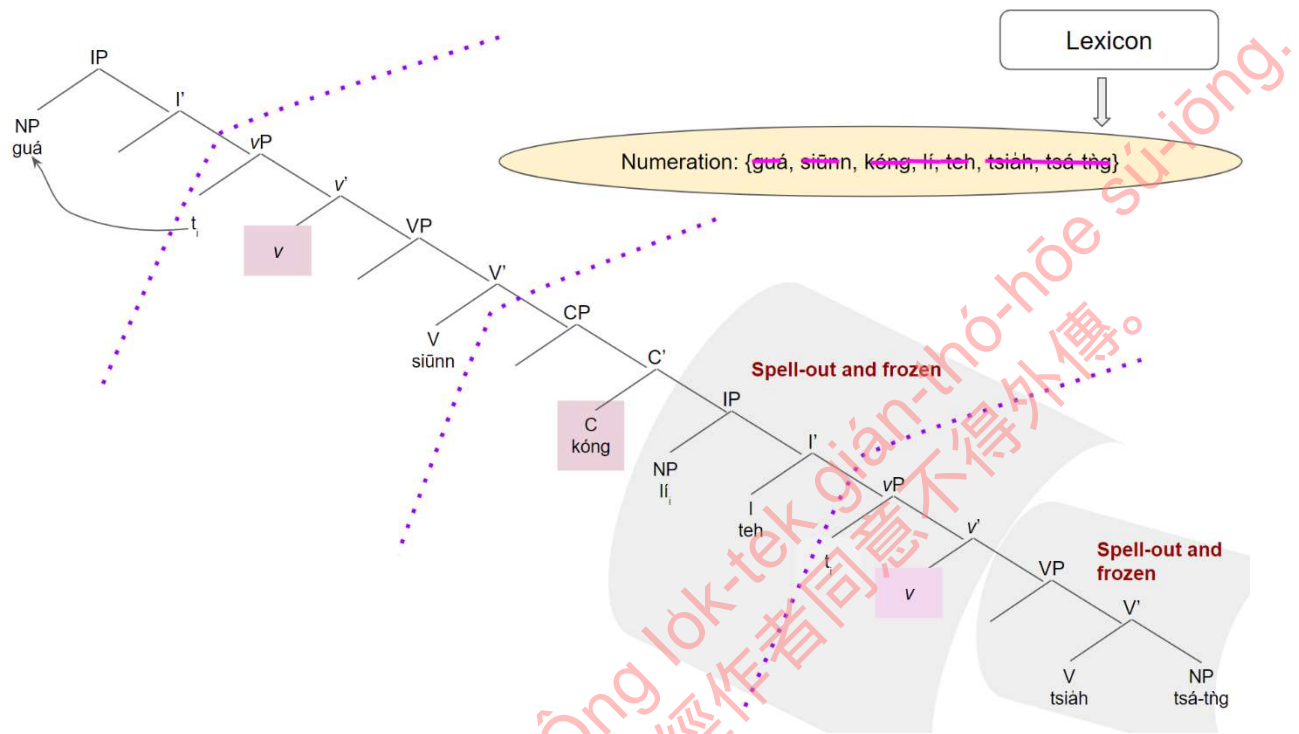
Given the structure [_{ZP} Z ... [_{HP} α [_{H'} H YP]]], where H and Z are phase heads, the domain of H is not accessible to operations at ZP; only H and its edge are accessible to such operations.

In (10), heads refer to phase heads, the domain of H is H’s complement, and the edge of H includes H and its specifiers. This later version of PIC freezes a phase after the next phase head merges. PIC specifies post-Spell-Out phase behavior.

The Multiple Spell-Out model with phases can be illustrated as follows:

² Due to the absence of verb inflection and the obscured distinction between *v*P and CP in Taiwanese, concrete examples cannot be provided in our target language.

- (11) Guá siūnn kóng lí teh tsiáh tsá-tng.
 I think COMP you ASP eat breakfast
 ‘I thought that you were eating breakfast.’



In addition to the Phase Theory evidence found in other languages (e.g., Keine 2017, Rouveret 2012, Butler 2004), the next section explores the potential alignment of Taiwanese tone sandhi with these theoretical computational units, phases.

4. The Grammatical Units that Demarcate Tone Groups

While previous researchers have tried to exhaustively catalog positions where sentence-final syllables resist tone change, the constituent elements within these tone groups appear varied and disorganized. This echoes Chen's (1987) critique of Cheng's (1968, 1973) list, suggesting these positions lack a natural class. Consequently, past studies on Taiwanese sentence tone group composition either fail to comprehensively account for empirical observations or achieve at most descriptive adequacy, lacking explanatory power for the underlying linguistic mechanisms governing sentence acceptability. Identifying these mechanisms will also reveal the grammatical units corresponding to Lok-tek Ong's tone groups.

Despite apparent surface variation, scholars since Cheng (1968) consistently identify 'noun phrases' and 'clauses' (including subordinate and embedded clauses) as inherent tone groups. Specifically, the final syllable of maximal "noun phrase" and "clause" projections typically resists tone change within sentences.

This is evident in a general sentence:

- (12) Gîn-khuân# bîn-á-tsài# beh tī tshù# hó-hó-á tsún-pī#.³
 Ginkhuan tomorrow will at house well prepare
 ‘Ginkhuan will stay home to well prepare for it tomorrow.’

In (12), the first three words whose last syllable maintains their original tone, regardless of their function as subject, time adverbial, or place adverbial, are all nouns in terms of their word class. As for the fourth word whose last syllable maintains its original tone, it is located at the end of the sentence, which also aligns with the aforementioned general principle.

This general principle is unlikely to cause much controversy. However, there are apparent exceptions. These exceptions include those that scholars have already noted in the previous section. We can summarize the phenomena of tone change in Taiwanese sentences as follows:

- (13) a. The final syllable of a noun phrase does not undergo tone change, but pronouns, except when emphasized, are pronounced with a tone change or in a neutral tone within a sentence.
 b. The final syllable of the component before ‘ê’ does not undergo tone change.
 c. The final syllable of adverbs located at the left periphery of the sentence (CP) can optionally undergo tone change.
 d. The final syllable of components before conjunctions or transition words does not undergo tone change. Even without conjunctions or transition words, as long as the structure presents coordination or apposition, the final syllable does not undergo tone change.
 e. The final syllable of the topic and preposed components does not undergo tone change.
 f. The final syllable of classifiers (unit words or measure words) sometimes undergoes tone change even when not followed by a noun.
 g. Some components are pronounced in a neutral tone within a phrase.
 h. Some special sentence patterns, such as the evaluative verb reduplicative construction (Lau 2021), do not undergo tone change on the final syllable of the verbal component. Some post-verbal particles maintain their original tone, such as ‘tiòh’ (著) and ‘liáu’ (了) when followed by a complement.

Here, we briefly discuss how to integrate the phenomena above into the framework explaining sentence tone sandhi within a syntactic phase model.

When connecting tone sandhi with syntactic computation, we don’t exclude non-syntactic factors like pragmatics. For example, pragmatics can cause tone neutralization and affect tone change based on information structure (Ang 1987:68-80). Phonology also plays a role, as evidenced by the distinction between mono- and multi-syllabic words noted by Luo (2008). This explains why pronouns, being monosyllabic and conveying old information pragmatically, may not follow the typical nominal phrase tone sandhi rule (example (13a)).⁴

Let’s now turn to example (13b). Li (2012) offers generalizations about the use of the particle ‘ê’ (Li 2012:28 (25)):⁵

- (14) a. The sequence e_0 - e_5 can occur in place of a single \hat{e} in the form $[DP/NP \text{ XP } \hat{e} \text{ YP}]$ when XP is adjectival or clausal, but not when it is nominal:
 $[DP/NP \text{ DP } \hat{e} \text{ YP}]$ vs. $[DP/NP \text{ Adj/Clause } e_0$ - $e_5 \text{ YP}]$.

³ Syllables followed by # maintain original tone.

⁴ Alternatively, we could follow Hsiao (1991) in claiming that pronouns are clitics

⁵ In (14-15), e_0 indicates a tone-neutralized \hat{e} ; e_5 represents an \hat{e} on citation tone, and e_7 represents an \hat{e} on sandhi tone.

- b. When only one \hat{e} is used, the form is e_5 (and undergoes tone change) when an overt YP follows. When YP is null, a nominal XP is followed by e_5 and an adjectival or clausal XP is followed by e_0 : [DP/NP DP e_5 \emptyset] vs. [DP/NP Adj/Clause e_0 \emptyset].

Based on the observation that ‘ e_0 - e_5 ’ can often replace ‘ \hat{e} ’, Li analyzes the relevant structures, resulting in the generalizations above. From example (14), Li further argues for the following analysis (2012:29 (26)):

- (15) a. adjectival and clausal XP
 [DP/NP XP e YP] is phonologically simplified from [DP/NP [XP e_0] [e_5 YP]]
 i. When YP is overt, the constituent [e_5 YP] is intact and the neutral-tone e_0 attached to the preceding XP is not pronounced, deriving [DP/NP XP e_5 YP], where e_5 undergoes tone change to become e_7 .
 ii. When YP does not appear overtly, [e_5 YP] is not spelled out. The form that surfaces is [DP/NP XP e_0 \emptyset].
 b. nominal XP [DP/NP XP e YP] has only one possible form: [DP/NP XP e_5 YP]
 i. When YP is overt, e_5 undergoes tone change to become e_7 .
 ii. When YP does not appear overtly, YP is not spelled out. The form that surfaces is [DP/NP XP e_5 \emptyset], and e_5 retains its citation tone.

The explanation for example (13b) revolves around the functions of ‘ e_0 ’ and ‘ e_5 ’. According to Li (2012:30-31), the phrase [XP e_0] before ‘ \hat{e} ’ (‘ e_5 ’) is syntactically nominal and semantically a type e expression. Remember that a DP, a nominal phrase, is a phase in syntactic computation. When XP is nominal (see example (15b)), it forms a phase and is spelled out even before the entire sentence is fully computed. Consequently, XP forms a tone group as part of the multiple spell-out in syntax. For clausal XP (example (15a)), being a CP phase, it also constitutes a tone group. By interpreting ‘ e_0 ’ as a nominalizer, ‘XP e_0 ’ would also be nominal when XP is adjectival. In either case, the final syllable of XP undergoes no tone change because the presence of ‘ e_0 ’, a tone-neutralized syllable, indicates the preceding syllable retains its citation tone.⁶

Regarding example (13c), Chen (1987) offers observations on adverbials (1987:124-125 (30-31)):

- (16) a. I luān-tsú = kóng.⁷
 he mindlessly talk
 ‘He is talking mindlessly.’
 b. Tsinn # tióh khiām-khiām-á = ñng.
 money must sparingly use
 ‘One must use money wisely.’
 c. Tsit ê gín-á kut-lát = thák-tsheh.
 this CL boy diligent study
 ‘This boy studies hard.’
 d. Tsá = khí--lái.
 early rise-up
 ‘Get up early.’
 (17) a. Guá ka-tsài # tsē tsit pang hui-líng-ki.
 I fortunately take this CL flight
 ‘Fortunately, I am taking this flight.’

⁶ A tone-neutralized syllable typically follows a syllable with citation tone in Taiwanese. See Ang 1987:68.

⁷ ‘=’ indicates a syllable with sandhi tone preceding it, and ‘#’ a syllable with citation tone. The Romanization of these example sentences has been revised according to the orthography promulgated by the Ministry of Education, Taiwan. Minor typographical errors have also been corrected.

- b. I tong-jiân # thiann in bóo ê uē.
 he of.course listen.to his wife LK talk
 ‘Of course, he listens to his wife.’
- c. Lí tē-it-tsió # mā tiòh puê-siông.
 you at.least also must pay.for.damage
 ‘At least you must pay for the damage.’
- d. Lí láu-sit-kóng # iá bô tsuè tsú-jīm ê king-giām.
 you frankly.speaking yet NEG-have be director LK experience
 ‘Frankly, you still don’t have the experience to be the director.’

Chen proposes a bipartite classification of adverbs into predicate and sentence modifiers based on the contrast between examples (16) and (17). Unlike predicate modifiers in (16), sentence modifiers in (17) form independent tone groups, according to Chen. However, Ang (2002) disagrees, suggesting that both predicate and sentence modifiers can optionally undergo tone change on their final syllables. Ang posits that when the final syllable retains the citation tone, the adverb is focused (2022:13). While Ang’s claim regarding optional tone change for sentence modifiers is accurate, it’s unnatural for predicate modifiers in (16) to maintain citation tone on their final syllables. Thus, Chen’s bipartite classification remains tenable. Predicate modifiers, part of the νP , are not phases. Conversely, sentence modifiers, structurally positioned under CP-spec or C^0 , can belong to different CPs (following Rizzi’s 1997 split CP), which are phases. Consequently, their final syllables may retain citation tones unless influenced by pragmatic factors like speed or information structure.⁸

Turning to example (13d), where constituents connected by conjunctions or transition words maintain citation tone on their final syllables. Since transition words intermediate between an adverbial and a matrix clause, what conjoined by the transition word are clauses, which are of CP phases. Therefore, here we focus only on conjuncts. In the literature, there’s a proposal strongly espouses analyzing a conjunct as a syntactic phase. Gleitman’s (1965) and Tai’s (1969) Clausal Conjunct Hypothesis (CCH) posits that all conjuncts are clausal, with apparent non-clausal conjuncts resulting from reduction. If CCH holds, the tone preservation of conjunct final syllables is explained by their CP phase status. However, CCH has faced criticism (Zhang 2010:65-69). To understand why conjuncts form tone groups, we must examine various coordination structures in Taiwanese. Our discussion will be based on (18) and (19) from Zhang (2010:45 (3.1-3.2)), which illustrate English coordination types:

- (18) Phrases:
- | | |
|-------------------------------|--|
| a. NP (noun phrase) | We still need the [bat and ball]. |
| b. NP (noun phrase) | my [friend and colleague] |
| c. DP (determiner phrase) | [John and Mary] are coming. |
| d. ϕP (pronoun) | [your and her] letters; [yours and hers] |
| e. PP (preposition phrase) | [In London and in Berlin], it is still cold. |
| f. AP (adjective phrase) | the [red and blue] flag |
| g. VP (verb phrase) | Mary has [[left] and [gone to England]] |
| h. IP (inflectional phase) | I don’t know if [[Mary left] and [Peter returned]] |
| i. CP (complementizer phrase) | [[What do you gain] and [what do you lose]]? |
- (19) Words:
- | | |
|--------------------|--|
| a. N (noun) | He is both the [father and employer] of my friend. |
| b. Num (numeral) | [[Two] and [three]] is five. |
| c. P (preposition) | The events took place [in and around] Toronto. |
| d. A (adjective) | . . . both [[glad] and [sad]] about this . . . |
| e. V (verb) | Judith [[washed] and [dried]] the towels. |

⁸ Additionally, refer to Hsieh and Sybesma 2011 for their observations of multiple CPs in Taiwanese and Mandarin.

- f. I (inflectional head) We both [[can] and [will]] visit her.
 g. I (inflectional head) Bill [[was] and [is]] the best tennis player in the club.
 h. C (complementizer) [[Can] and [will]] you do this?
 i. C (complementizer) [[If] and [when]] she arrives, the party will begin.

Except for DPs (determiner phrases; in (18c)), CPs (in (18i)), and vPs (in (18g)), which are phases, we follow Lin (1994) in assuming, with Fukui (1986), Speas (1986), Abney (1987), T.-C. Tang (1989), and C.-C. Tang (1990, 1991), that NPs ((18a-b, 19a)) are also DPs. Pronouns in (18d) have been discussed previously, and IPs (inflectional phrases) in (18h) contain a vP (a phase) and overlap with the embedded vP at their right edge. Consequently, the final syllable of an IP clause retains its citation tone. This leaves PPs and APs in (18e) and (18f), and (19b-i) for consideration.

For PPs in (18e), adjunct PPs are phases under Lee-Schoenfeld's (2008) proposal. Regarding APs in (18f), Taiwanese disallows the identical construction as (18f), as shown below:

- (20) hit bīn [âng kah tshenn] *(ê) kî-á
 that CL red and blue LK flag
 'that red and blue flag'

The sentence becomes ungrammatical without an additional linker 'ê' between the conjoined adjectives and the noun. Recall that the 'e₀-e₅' sequence can replace a single 'ê' in this context (examples (14-15)). Example (20) can be pronounced as follows:

- (21) hit bīn [âng --ê kah tshenn --ê] ê kî-á
 that CL red NLR and blue NLR LK flag
 'that red and blue flag'

The sequence and the example in (21) indicate these adjectives are nominalized with a tone neutralized 'ê' and, consequently, they preserve their citation tone.

Numerals in (19b) function as nouns in conjoined subjects, similar to (18a-b) and (19a). Taiwanese uses post-nominal localizers instead of prepositions to express relative positions (cf. (19c)):

- (22) Tsia-ê tāi-tsi huat-sing tī Toronto [lāi-bīn kah sî-tsiu-uī].
 these event occur PREP Toronto LOC and LOC
 'The events took place in and around Toronto.'

The localizers 'lāi-bīn' and 'sî-tsiu-uī' literally mean 'inside' and 'surroundings' respectively and belong to the DP phase. Unlike the disyllabic localizers in (22), monosyllabic localizers cannot form conjuncts:

- (23) a. Mih-kiānn lak tī toh-á-tíng kah toh-á-kha.
 thing fall PREP table-LOC and table-LOC
 'The things fell on and under the table.'
 b.*Mih-kiānn lak tī toh-á tíng kah kha.
 thing fall PREP table LOC and LOC
 (Intended) 'The things fell on and under the table.'

The contrast between (22) and (23) highlights the difference between multi-syllabic and monosyllabic localizers. (Lu 2002; Luo 2018) Only multi-syllabic localizers can function as conjuncts, behaving like nouns.

Regarding verbs in (19e), recall that verbs are the core of vPs, which are phrases. When transitive, as in (19e), the first bare-verb conjunct is essentially a reduced verbal phrase.

(24) Judith washed ~~the towels~~ and dried the towels.

Apparent verb conjunction is actually vP conjunction. The ellipsis of the object in the first conjunct leaves the verb at the vP's end. Consequently, the verb's final syllable retains its citation tone.

Lastly, regarding (19d) and (19f-i), unlike English, Taiwanese conjunction 'kah' (and) has limited applicability:

- (25) a. Tshun-kiau suí *kah / koh khiáu.⁹
 Tshunkiau pretty and also smart
 'Tshunkiau is pretty and smart.'
- b. Guán ē-tàng *kah / jî-tshiánn ē khi.
 we can and and will go
 'We can and will go.'
- c. A: Tsì-bîng kám sī lí ê hák-sing?
 Tsibing YNQ is you LK student
 'Is Tsibing your student?'
- B: I sī *kah / jî-tshiánn sī tsiok hó ê hák-sing.
 he is and and is very good LK student
 'He is. And he is a very good student.'
- d. *Nā kah tng i lâi, pá-thih tō ē khái-sí.
 if and when she come party then will begin
 (Intended) 'If and when she arrives, the party will begin.'

These examples demonstrate that 'kah' cannot conjoin adjectives, co-verbs, copulas, or complementizers in Taiwanese, unlike 'koh' (also) and 'jî-tshiánn' (and) which conjoin clauses:

- (26) a. Tshun-kiau suí koh Tsì-bîng khiáu.
 Tshunkiau pretty also Tsibing smart
 'Tshunkiau is pretty and Tsibing is smart.'
- b. Guán ē-tàng khi jî-tshiánn (guán) ē khi.
 we can go and we will go
 'We can and we will go.'
- c. Tsì-bîng sī guá ê hák-sing jî-tshiánn (i) sī tsiok hó
 Tsibing is I LK student and he is very good
 ê hák-sing.
 LK student
 'Tsibing is my student and he is a very good student.'

⁹ Compare the following example in (i), which appears to have adjective conjuncts. In fact, they are reduced conjoined NPs, as shown in (ii).

(i) Pē-bú lóng khah thiánn suí kah khiáu ê gín-á.
 parents all more love pretty and smart LK child
 'Parents cherish pretty and smart kids.'

(ii) Pē-bú lóng khah thiánn suí ê gín-á kah khiáu ê gín-á.
 parents all more love pretty LK child and smart LK child
 'Parents cherish pretty kids and smart kids.'

Adjectives, co-verbs, copulas, and complementizers cannot undergo bare conjunction in Taiwanese but appear within clausal conjuncts, which are CP phases.

Returning to example (13e) on topics, Taiwanese allows nominal appositives for any part of speech serving as a topic:¹⁰

- (27) a. Sì (tsit-ê sò-jī), tsin tsē lāng bō kah-ì. (Numeral)
 four this number very many people not like
 ‘As for four, many people don’t like this number.’
- b. Tī Tâi-pak (tsit khuán sóo-tsāi), lāng beh bé tshù khah
 PREP Taipei this CL place people want buy house more
 oh. (PP)
 difficult
 ‘In Taipei, it’s difficult for one to buy a house.’
- c. Tsáu (tsit hāng ūn-tōng), Tsì-bīng sī siōng gâu --ê. (V)
 run this CL exercise Tsibing is most capable PRT
 ‘As for running, Tsibing is best at it.’

These appositives indicate the nominal nature of topics, aligning them with (18a-b) and (19a).

Interestingly, the Taiwanese reason-why interrogative word ‘sī-án-tsuánn’ exhibits dialectal variation in final syllable tone. Some speakers apply sandhi tone, while others maintain the citation tone. This aligns with Tsai’s (2008:107-108) proposal of two syntactic positions for reason-why phrases. Either as an IP adjunct or as the head of IntP, the former not constituting a phase and undergoing sandhi tone, the latter potentially a CP-level phase (under split CP) with citation tone preservation for the final syllable.

We have yet to discuss (13f-h). Example (28) demonstrates (13f) and (13g) simultaneously.

- (28) Tshèh thèh sann pún hōo --guá.
 book take three CL give me
 ‘Take three books to me.’

The classifier ‘pún’ can exhibit either sandhi or citation tone, influenced by factors like speed and pragmatics. Additionally, the sentence-final first-person pronoun can be neutral or retain citation tone for emphasis.

Previous research, including Cheng (1968, 1973), Chen (1987), and Lin (1994), largely overlooks neutral tones. This is understandable, as neutral tones can arise from lexical semantics, syntax, or pragmatics, with complex underlying causes. We suggest treating neutral tones separately in future research.

¹⁰ We exclude NPs (DPs), VPs (vPs), PPs, and clauses (CPs) as topics since they are inherently phases. Adjective topics are also excluded as adjectives cannot undergo extraction and topicalization:

- (i) a.* [Tsin súi]_i, lín tsa-bóo-kiánn sit-tsāi t_i.
 really pretty your daughter truly
 (Intended) ‘Really beautiful, your daughter is such a female.’
- b.* [Khah kui]_i, in ū teh bē t_i ê tshia.
 more expensive they IRR PROG sell LK car
 (Intended) ‘More expensive ones. They do sell cars of this kind.’

Apart from neutral tones, pragmatic factors can also influence tone sandhi occurrence. Since this paper focuses on the basic relationship between grammatical units and tone groups, the pragmatic flexibility in tone sandhi application is beyond its scope.

Some exceptional cases remain due to incomplete understanding of certain syntactic structures. For example, the evaluative verb reduplicative construction defies typical verb-object tone sandhi patterns, preserving the reduplicated verb's final syllable citation tone.¹¹

- (29) a. Gín-á-lâng thák-thák # he ìng-á-tsheh.
children read-read that leisure.reading.book
'The children read those leisure reading books that I disapprove.'
b. Tsì-bîng tsiànn-tng̃ m̃-tsiáh, tsiáh-tsiáh # he.
Tsibing main.meal NEG-eat eat-eat that
'Tsibing skipped main meals and eat the things that are not nutritious.'

This construction, limited to monosyllabic verbs, differs from standard verb-object tone sandhi, where the verb's final syllable undergoes tone change. Additionally, this construction inherently conveys the speaker's negative evaluation of the following object. This pattern, along with the 'V-liáu', 'V-tiòh' constructions mentioned in (13h) and other special sentence types, requires further investigation into their internal structures before definitive conclusions can be drawn.¹²

Our review of Taiwanese sentence tone sandhi reveals a strong correlation between tone group positions and Phase Theory phases: DPs, vPs, CPs, and PPs. This potential solution addresses the lack of commonality in tone groups identified by previous researchers like Chen (1987). Phase Theory, as a framework for syntactic computation, offers a promising explanation for tone changes at constituent final syllables in Taiwanese sentences. Furthermore, it enables speculation on phase boundaries that were previously difficult to determine, contributing to Phase Theory itself.

5. Concluding Remarks and a Caveat

Ong Iok-tek posed a critical question about Taiwanese language in the early 1960s: What constitutes a tone group? He speculated that tone groups were grammatical units essential for understanding the broader grammatical system (translated and reprinted in Ong 2000:57). Subsequent researchers observe and categorize Taiwanese sentence tone sandhi phenomena but fail to recognize the connection between tone groups and grammatical/syntactic units. Chen (1987) even claims that tone groups lack a natural class and cannot be defined solely by syntax. This raises a paradox: if tone groups were readily identifiable by native speakers, how could underlying general rules be absent?

This study validates Ong's insight. A remarkable correspondence exists between Taiwanese tone groups and syntactic computation phases. Tone groups align with the boundaries of syntactic computational units: DP, vP, PP, and CP, as proposed in Phase Theory (Chomsky 1995, 2001, 2008; Svenonius 2004; Hiraiwa 2005). Furthermore, the seemingly inconsistent behavior of different adverbials aligns with the CP-split hypothesis (Rizzi 1997, *inter alia*). As Ong suggested, Taiwanese adverbial tone sandhi can inform investigations into sentence left periphery structure and other understudied constructions.

Aligning tone groups with fundamental syntactic computational units resolves the mystery of seemingly scattered tone sandhi positions in Taiwanese sentences. We propose that Taiwanese

¹¹ Refer to Lau (2021) for a possible analysis of this construction.

¹² Readers interested in 'V-liáu' and 'V-tiòh' constructions can refer to Lau (2024) for preliminary generalizations from a survey.

sentence tone sandhi reflects syntactic operations, specifically those related to computationally efficient units. These units correspond to basic human communication concepts: entities, events, and propositions. Thus, Taiwanese tone groups constitute a natural class.

While this study emphasizes the syntactic basis of sentence tone groups, phonological and pragmatic factors also play a role. For example, Lu (2002) and Luo (2018) note that tone sandhi for nouns preceding monosyllabic and disyllabic localizers differs. Additionally, tone neutralization and reversal often serve lexical or pragmatic purposes. These phenomena likely occur in post-syntactic phonology.

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