A Phonological and Morphosyntactic Analysis of Mandarin T0 Within Disyllabic Sequences

by

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ABSTRACT

This thesis gives a phonological representation of the Mandarin Chinese Neutral tone (T0) within disyllabic sequences using Optimality Theory, morphology, and semantic structure. This thesis states that T0 in Mandarin is caused by a phenomenon called Loss of Coda Licensing, which states that codas of non-head syllables that have a low semantic influence on the disyllabic sequence lose their ability to associate with a tone, causing the syllable to become a T0 syllable. To experience Loss of Coda Licensing, non-head syllables are evaluated for their semantic influence and subsequently placed into two categories: high influence and low influence. Low-influence syllables are then placed into one of five categories, with each category containing a phonological constraint that affects the syllable's coda to license a tone. This thesis utilizes Optimality Theory to posit a phonological representation that shows, like Mandarin's four lexical tones, that T0 is also a tone, even if it is shorter in length than the lexical tones. This thesis's phonological representation shows that a T0's Tone differs from that of a lexical tone because T0's Tone depends on the preceding lexical syllable's coda tone. The implications of this thesis are that tonal realization within disyllabic sequences depends on semantic contributions, that T0 syllables contain a coda that cannot license a tone, and that non-head syllables can be categorized within Chinese.

DEDICATION

I'd like to dedicate this thesis to my parents, for offering their undying love and support throughout the years, as well my older sister Relle, for always being my biggest supporter in the world. I'd also despise myself if I didn't dedicate this thesis to my older brother Brando, who is the coolest person I'll ever know and the person I look up to the most. In addition, I'd like to also dedicate this thesis to whoever takes the time to read it. Thanks for taking the time to read through my ramblings on a subject I find interesting!

I'd also like to dedicate this thesis to my middle and high school Mandarin Chinese teacher Mr.Lin! He's the one who kickstarted my passion for studying Chinese, and without his guidance and influence early on in my life, I wouldn't have gotten to the point where I want to do linguistic research.

Finally, a special dedication goes out to… future me! If future me is reading this, I just want to let you know that you're successful and that if you ever feel like a fraud, you aren't! After six years, I can finally tell say that you and I are pretty smart!

"I am thou… thou art I…

The bond thy hast nurtured has finally matured

The innermost power of the fool arcana hast been set free

We now bestow upon thee…

The ultimate form of the fool within thyself"

- Persona 3 Reload

ACKNOWLEDGMENTS

Major thanks go to my committee chair Dr. Oh for guiding me throughout the research process! Without his input and our discussions, this paper would have truly been a messy pile of loosely connected ideas. I'd also like to give a major thanks to my committee member Dr. Pruitt, for helping me become familiar with the linguistic theories utilized in my research. Of course, I must give a major thanks to my other committee member Dr. Ling! Without her CHI501 class, I don't think I would be able to handle abstract ideas and organize theoretical models the way I can now.

I'd also like to acknowledge the songs that were constantly playing in the background during the creation of this thesis! Without them the task of researching, writing, and revising would have been impossible.

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INTRODUCTION

1.1 Background Information on Mandarin Tones

Mandarin is a tonal language that consists of four contrastive lexical Tones labeled first tone (T1), second tone (T2), third tone (T3), and fourth tone (T4). In addition to the four lexical tones, there is a unique Tone called Neutral Tone (T0). An example of a T0 syllable would be *piaoliang*, 'pretty.' In that example, the first syllable contains a T3 and thus has a tonal value of '214'. Usually, *liang* would be pronounced with T4 and have a tonal value of '52'; however, that is not the case. In the example, *liang* is

pronounced with a low (L) tonal value and is shorter in length than the syllable with a lexical tone.

T0 is found in Mandarin polysyllabic phrases and words. Shen (2022) gives four general morphological environments where T0 shows up:

1. Within verb phrases that have a duplicated syllable such as *tīng tīng* '*to listen briefly',* in this example the second ting carries T0 while the first carries its underlying tone of T1.

2. locative expressions such as '*na li*', where *li* carries T0.

3. Kinship terms such as *māma* 'mother' where the second ma carries T0 and the first carries T1.

4. Noun phrases such as *xuésheng* '*student'*. In that example *xue* carries T2 while sheng carries T0.

Previous studies on T0 in Mandarin have focused on the phonetic realization, classification of T0, and phonological constraints governing T0. Phonetic studies of T0 have found that it differs from the four contrastive lexical tones primarily in length. In addition, phonetic studies generally have concluded that T0's phonetic information is unstable and varies on its tonal environment. However, studies differ regarding whether T0 is simply one tone or if it resembles lexical tones in terms of creating a Tone, something all lexical tones do.

Studies on T0's phonological representation have focused on the constraints that govern T0 and how it is expressed in terms of metrical structure. Previous phonological studies have posited that T0 is a 'weak syllable' that carries only one tone-bearing unit

and, therefore, only one mora. That differs from 'full syllables' because 'full syllables' have two tone-bearing units and thus two moras, which explains the phonetic differences in length between T0 syllables and syllables with lexical tones. Finally, phonological studies have posited a series of constraints that explain T0's occurrence within phonological phrases and disyllabic compounds.

Finally, previous studies have also focused on how to classify T0 in Mandarin and if there are multiple types of T0. Studies have posited that T0 is atonic and, therefore, does not carry a tone at all, while others have stated that it is a light syllable with only one tone licensed.

In this thesis, I examine T0 within disyllabic sequences within Mandarin Chinese. More specifically, I will give a phonological representation of the phonetic properties of T0 by utilizing Optimality Theory in addition to Autosegmental Licensing theory to help further build off previous research findings regarding T0 and prosodic structure. To accomplish that, I will create a phonological representation that reflects T0's nature within disyllabic sequences. Next, it proposes that T0's realization in Mandarin is due to morphological and semantic influence. It also builds a model to demonstrate how semantic contribution and morphology influence what syllables can be T0 syllables.

With these goals in mind, chapter two will introduce T0's phonetic data and certain phenomena that arise due to T0. Chapter three will summarize previous phonological representations of T0 in Mandarin and introduce the persisting problems that previous phonological representations have yet to address. Chapter four will introduce the new phonological representation of T0 and propose new constraints associated with T0. Chapter five will then introduce the semantic evaluation model that

dictates what syllables can be realized at T0 syllables and introduce more phonological constraints directly associated with the semantic evaluation. Chapter six will then combine the new phonological representation of T0 and the semantic evaluation model to give a complete example of a T0 phonological representation that accounts for the role of semantics and phonology. Finally, chapter seven will introduce further issues regarding the nature of T0.

1.2 Theoretical Approaches

Optimality Theory

Optimality Theory (Prince & Smolensky, 1993) is a constraint-based generative grammar that seeks to take underlying representations of phonemes and derive surface representations based on constraints applied to the underlying representation. There are four main parts of optimality theory: The underlying representation, the constraint set (CON), the generator (GEN), and the evaluator (EVAL).

The constraint set (CON) consists of two types of constraints: markedness and faithfulness, and all constraints must be based on articulation, acoustics, or processing (Zsiga, 2013). Markedness constraints govern the surface representations to ensure that they abide by well-formedness. Meanwhile, faithfulness constraints ensure that the surface representation matches the underlying representation in specific places (Zsiga, 2013). These constraints are then ranked based on a constraint's tolerability to be violated. Finally, constraints can be violated to abide by a higher-ranked constraint.

The next aspect of optimality theory is the generator (GEN). GEN creates the candidate surface representations that align with a given underlying representation. GEN

creates an infinite number of possible surface representations; at least one GEN surface representation will match the UR, and the rest will make one or more changes to the underlying representation.

Finally, the Evaluator (EVAL) takes the surface representation generated by GEN and chooses the optimal UR-SR pairing. Even optimal UR-SR pair violate at least one constraint in Optimality Theory (Zsiga, 2013). EVAL will pick between the pairings that obey the higher-ranked constraints even if they violate the lower-ranked constraints.

Autosegmental Phonology

Autosegmental phonology (AP) is a theory that was created to describe tonal languages such as Mandarin Chinese (Zsiga, 2013). AP states that the tonal features of a syllable act independently of the segments to which they are connected, i.e., they are autonomous. Essentially, AP states that tones and Tones are features linked to different parts of the syllable but not a part of it. Instead, different parts of the syllable will license a tone; the parts that license or link to a tone are called licensers and reside in different licensing domains. In Mandarin, there are two: the nucleus and the coda. In AP, licensers are linked to their tone via association lines, a solid line from the licenser to the autosegment (Zsiga, 2013). There are also dashed lines which indicate reassociation. A syllable that can license two tones will create a ‘Tone,’ either T1, T2, T3, or T4.

CHAPTER 2

PHONETIC INFORMATION OF T0

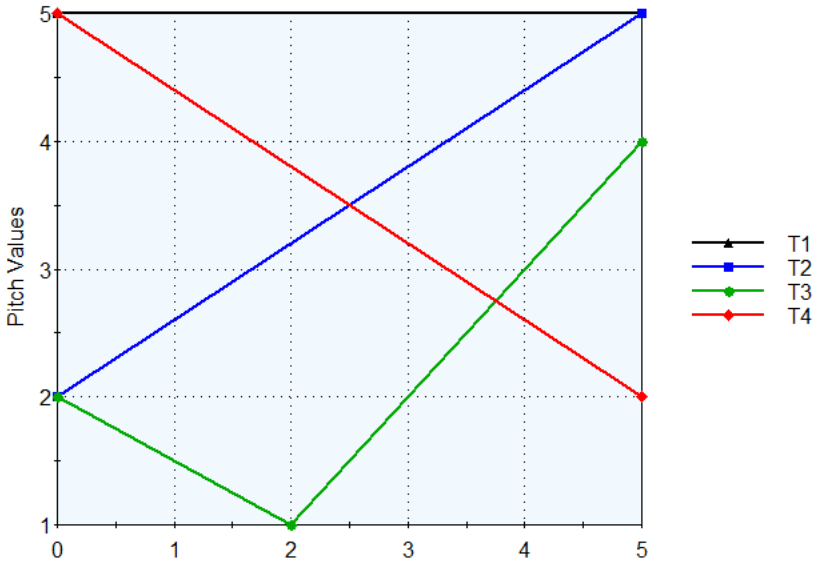
Mandarin T0 differs from full tones in duration and is a dependent toneme that gathers tonal information from the preceding syllables. The reason for being shorter than the full lexical tones is that Mandarin T0 underlyingly is not a Tone but a tone. However, phonetic studies in the past have suggested that there is a sense that T0 within a disyllabic sequence can be considered a Tone.

Before continuing, it is important to state that this thesis will adopt a distinction between 'Tones' (T) and 'tones' (t) as proposed in Wang (1997). For this study, 'tones will refer to the specific tone of either H, M, or L, while 'Tones' will refer to a combination of two or three of these 'tones' to create one of the four lexical Tones.

Mandarin's four contrastive lexical tones each share the property of having at least two F0 points or tones and creating a slope along which the pitch of the speaker's voice travels from the beginning tone to the ending tone (Tupper et al., 2020) The range of tones is between 1 and 5, 1 being the lowest tone and five being the highest (Cheng, 1973). The current thesis organizes tones 1-5 into three categories: Low (L), Medium (M), and High (H). tones 1 and 2 are L, values 3 and 4 are M, and value 5 is H. T1 is a high-level tone represented as HH, meaning the tone does not rise or fall while moving from each tone. T2 is a rising tone represented as LH; the tone starts low and ends high, creating an upward slope. T3 is different from the others in that it is longer than the other Tones and is classified as a complex Tone. That means it has three tone points and creates two Tones. T3 is a low falling-rising tone in that it is always low and rises to the final tone, which is either low or medium. Research gives different results (See Wang

2000; Tupper et al. and Duanmu (2002). The current study will represent T3 as LLM. Finally, T4 is a high-falling tone, represented as HL. The graph below shows the different slopes created by the lexical Tones.

Figure 1 – Tone shapes of Mandarin's Four Lexical Tones



Mandarin's T0 differs from these lexical Tones in that it has a shorter duration, and its tonal information is unstable in that it depends on the preceding syllable's lexical Tone (Shen (1992) as cited in Lin (2006); Chao 1968 as cited in Duanmu (2000); Wang (1997), Zadoenko (1958) as cited in Cheng (1973); Dreher et Lee (1966) as cited in Cheng (1973)). One typical pattern among T0's different tones is that it almost always has an L tone, except for following a T3 syllable. After a T3 syllable, T0 carries an M tone (Wang (2000); Li et Li (2021)).

While most previous studies analyze T0's phonetic realization in the pre-pausal position, Wang (1997) recorded their phonetic findings on T0 in non-pre-pausal position and the pre-pausal position, as seen below in Table 1. Wang (1997) showed that there is a difference in T0's value depending on if it is in a non-prepausal position. He found that T0's tone in a non-prepausal position was M when occurring between two syllables with the same lexical tone (T1, T2, and T4). He also found that T0 had an M tone when between two T3 syllables. In addition to analyzing T0s in non-pre-pausal positions, Wang also created a phonetic mapping of a sequence of T0s next to each other. His tone mapping showed that when T0s are preceded by other T0s, their tone is L. Again, however, he found that if the final T0 in a sequence of T0s is in a non-prepausal position, the values of T0s increase to M.

Table 1– Wang's Findings on T0 in Prepausal and Non-Prepausal Positions

	Non-Prepausal Position	Prepausal Position
After T1	M	L
After T2	M	L
After T3	M	M
After T4	M	L

Previous phonetic studies on T0 have also found that like the lexical tones, it too creates a Tone. Zadoenko (1958, as cited in Cheng 1973), Wang and Li (1967, as cited in Cheng 1973) and Dreher and Lee (1966, as cited in Cheng 1973) all found that T0 creates a Tone. Dreher and Lee (1966, as cited in Cheng 1973) show that T0 creates a Tone

whose first tone is determined by the preceding syllable and falls lower, except for when the preceding lexical tone is T3. A table of the T0 Tone values is given below based on Dreher and Lee (1966, as cited in Cheng 1973).

Table 2 – Tone of T0 based on Dreher and Lee (1966, as cited in Cheng 1973).

After T1	41
After T2	31
After T3	23
After T4	21

Considering the previous findings on T0's phonetic realization, a few patterns become clear that the phonological representation of T0 needs to account for. The first and most important is that T0 syllable can never have an H tone. As shown by Wang (1997), no tone in T0 can reach H. Next, it seems that T0 has an L tone target. That is supported by findings in Wang (1997) that showed T0's tone in prepausal positions, as well as in a sequence of T0s. It is also supported by other phonetic studies' finding that T0 does tend to have a falling attribute to it (Li & Li, (2021); Zadoenko, (1958) as cited in Cheng, (1973). Next, the phonological representations need to account for the findings that T0 can be considered as a Tone, and its starting tone depends on the preceding lexical tone. The phonological representation also needs to account for the difference in length between T0s and lexical tones. Finally, it must explain why a T0's Tone rises after T3.

CHAPTER 3

PREVIOUS PHONOLOGICAL REPRESENTATIONS OF T0

This chapter will introduce and detail the previous phonological representations of T0 in Mandarin and offer new perspectives and ideas to be adopted from them, in addition to complications found within the previous analyses to help ground the current approach. The chapter will start with an account of the syllable structure that Duanmu (1999) posited concerning tone-bearing unit (TBU), stress, tones, and prosodic structure. Then two OT analyses of T0 from Wang (1997) and Li (2004) will be given. Finally, an autosegmental analysis of T0 from Dai (1991) will also be described.

3.1 Duanmu's Analysis on Syllable Structure

Duanmu (1993, as cited in Duanmu (1999)) posits that Mandarin consists of full and light syllables. According to Duanmu (1993) full syllables are classified as heavy, meaning they contain two moras (bimoraic). Meanwhile, light syllables are monomoraic. In the article, five constraints that govern Mandarin syllable structure are given (Duanmu, 1999):

1. The basic metrical unit is a moraic trochee (i.e. a bimoraic foot, see Figure 2 below)
2. The TBU is the moraic segment.
3. A tonal domain is also a stress domain.
4. Only a stressed syllable can retain its underlying tone.
5. A minimum word must be bimoraic.

Below is an example of phonological representation of a heavy syllable and a light syllable according to Duanmu (1999), μ represents mora, ( ) represent metrical foot boundaries and x represents stress and is at the head of a foot. The symbol "." represents no stress.

Figure 2 - Difference between Heavy syllable and light syllable based on Duanmu (1992 as cited in Duanmu 1999).

Heavy Syllable	Light Syllable
L H	L
p a n	d e
(μ μ)	(μ)
x	.

Duanmu (1993) states that each bimoraic foot creates its own separate tonal domain and, in turn, its own stress domain because his study states that a tonal domain is a stress domain. Because light syllables have one mora, they are not able to form a tonal domain and thus lose their underlying Tone. Duanmu also cites the weight-to-stress principle (Prince 1990) as cited in Duanmu (1999)) to show that heavy, bimoraic syllables attract stress.

Most important to the analysis of T0 within disyllabic sequences is Duanmu's idea of a Syllabic foot (S-foot). Duanmu (1999) states an S-foot consists of two syllables, either in a heavy-heavy or heavy-light orientation. A tonal domain encompasses both syllables, and stress is placed on the first syllable in the S-foot. A diagram of Duanmu's s-foot structure is given below.

Figure 3 – Mandarin S-foot structure of heavy-heavy foot based on Duanmu (1999)

X

(x x) – The tonal domain

(mm mm) – The bimoraic foot

Finally, Duanmu (1999) gives metrical constraints for Mandarin:

1. S-FOOT – Heavy-Heavy or Heavy-Ligh
2. KEEP WEIGHT – Syllables must preserve their underlying weight.

In my thesis, I propose the following changes to Duanmu's representation of Chinese metrical structure. The first change I make is to delete the m-foot and s-foot levels and replace them with just a foot level. The foot level can contain up to two syllables but must have a minimum of one. I propose that the only acceptable combination of syllables that can make up a metrical foot are: 1. Heavy, 2. Heavy-Heavy, and 3. Heavy-Light. I still adopt Duanmu's proposal that a foot creates its own tonal and stress domain. I provide my new representations of Duanmu's modified foot structure below:

Figure 4 – The Modified Mandarin Foot Structure of a Heavy-Heavy Foot

X

(x x) – The tonal domain

(Heavy Heavy) – The Foot

Figure 5 – The Modified Mandarin Foot Structure of a Heavy Foot

X

(x) – The tonal domain

(Heavy)– The Foot

Figure 6 – The Modified Mandarin Foot Structure of a Heavy-Light Foot

X

(x .) – The tonal domain

(Heavy Light) – The Foot

3.2 Wang's analysis

In Wang's (1997) account of T0, he first uses the phonological mora as the tone-bearing unit and a timing unit. His model for the difference between a T0 syllable and a full lexical tone syllable closely matches the previous models proposed by Duanmu. Wang's model also shows that a full syllable has two mora, and those two moras each license a tone. Wang's representation of a T0 syllable is a syllable that has one mora, and that mora licenses a tone. Therefore, a T0 syllable equals a light syllable in Mandarin phonology.

In their analysis, Wang (1997) assumes that each mora can only be linked to one tone at a time. In addition, Wang believes that the syllable itself is directly associated with mora and not tone.

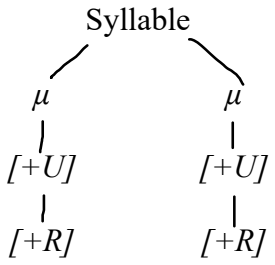
Wang uses a coplanar autosegmental approach to describe how syllables license tones. The approach involves two tiers that are connected to the mora: the register tier, which associates with the mora and includes (+upper) and (-upper), and the sub-register tier that associates with the register tier and includes (+raised) and (-raised). A tone is realized based on the combination of the register tier and sub-register tier, as seen below:

Table 3 – Wang's tier combinations and equivalent tone (H, H', M, L)

Register Tier	Sub Register Tier	tone
+Upper	+ Raised	H
	- Raised	H'
-Upper	+ Raised	M
	- Raised	L

Next, an example of Wang's model for representing tones and a Tone is given below, the example will give the representation for T1:

Figure 7 – Wang's representation for T1.



Wang's representation also states that register features not linked to a mora and moras not linked to a register feature associate with each other. The association of free register features and moras is left-to-right, and they each associate one by one.

During a discussion on T3 sandhi, one of Mandarin Chinese's major phonological rules, Wang (1997) makes an important observation: "Third tone sandhi shows that while the mora is the TBU, the syllable plays a crucial role in the tone sandhi process" (p.166).

That entails that the syllable does matter in terms of phonological processes, something I seek to represent in my new model.

Before Wang (1997) gives their model for T0, he takes the time to define two default rules and a language specific rule that is important to tones. The two default rules he cites are based on Pulleyblank (1986 as cited in Wang (1997)):

Figure 8 – Default rules based on Pulleyblank (1986, as cited in Wang (1997))

1. [U] default rule – [ ] -> [-U]
2. [R] default rule – [ ] -> [+R]

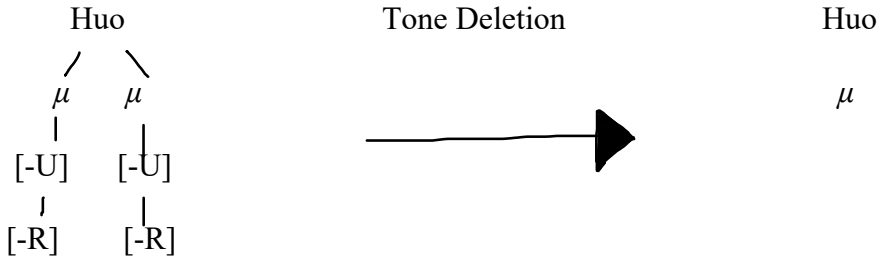
Essentially, these two rules state that if there is nothing in the register tier or sub-register tier, a [-upper] register and [+raised] sub-register are inserted. The language-specific rule is the [+Upper] insertion rule, which states that after T3 in the non-prepausal position, a floating [+Upper] feature is inserted and connects to the [-R] sub-register value that was connected to the previous [-Upper] register feature.

Wang utilizes those three rules to create a constraint that indicates T3 syllables have three mora, but only in the prepausal position. I will not adopt this constraint, as I assume that all Mandarin syllables have only two mora and that a difference in length between T3 and other lexical tones is due to vowel lengthening in the nucleus vowel node.

The next language-specific phonetic rule Wang gives is the [+raised] spreading rule, which entails that in full syllables where one mora licenses [+upper] and the other licenses [-upper], the [+raised] feature associated with the [+upper] feature will spread to the [-upper] feature, causing them to share the same sub-register feature.

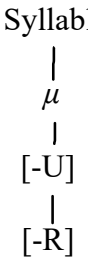
Wang's representation of T0 starts with him stating that he believes stress is in a separate tier above the syllable. He uses this to indicate that T0 is a product of the tone-deletion rule, which states that a full syllable becomes a T0 syllable when stress is not associated with the syllable. Wang's representation deletes one of the moras in addition to all the features associated with both moras. as seen below:

Figure 9 – Wang's representation of tone deletion rule to derive T0



In terms of phonological rules that accurately represent T0's phonetic realization, Wang (1997) creates the [-R] insertion rule and combines it with the [-U] default rule. The [-R] insertion rule occurs before the [-U] default rule and entails that for monomoraic syllables, a [-R] sub-register feature is licensed. The [-R] insertion rule and [-U] default rule are applied after the tone deletion process. An example from Wang is given below:

Figure 10 – Representation of T0 using Wang's Representation



Like Duanmu, Wang also believes that a full-tone syllable combined with a T0 syllable constitutes one metrical foot. In addition, Wang states that without the default rules given earlier [+U], features associated with moras would be able to spread

throughout the metrical foot. Wang states that because of the default rules [-U], features do not spread, which allows T0 to be realized. Wang's study shows that Mandarin T0 is closely related to the preceding syllable in the case of following a T3. However, he does not make any claims to show that T0 is a Tone like the lexical tones. In addition, outside of T3, Wang's analysis supports the idea that T0 is simply one tone and not a Tone unlike the previous studies discussed in Chapter 2 that show T0 can be considered a Tone.

3.3 Li's analysis

Li (2004) builds on Wang (1997) and other previous analysis. Li (2004) firstly agrees with previous accounts by stating T0 is an unstressed syllable, monomoraic, and most importantly, the mora has no tone underlyingly, instead getting its tonal information from the preceding syllable. I disagree with Li's statement that it has no underlying tone. The current study believes that all morae have an underlying tone and that T0 forbids any tone but L, a position with which Li's analysis seems to agree with.

Li (2004) also states that an unstressed syllable has something called a weak mora. According to Li (2004), a weak mora is any mora that is associated with a non-head syllable. Li uses the idea of a weak mora to create three T0 markedness constraints that the current study will adopt with modifications. They are defined by Li below:

1. NON-HEADSYLLABLE/MONO-MORA (*σw/μμ) - Non-head syllable (σw) in a syllabic foot bans two morae.
2. NON-HEADSYLLABLE/NON-HEADMORA (*σw/μs) - Non-head syllable bans head mora.
3. NONHEADMORA-NONHIGH (*μw/[H]) - Non-head mora bans tonal feature H.

Those three constraints are constantly applied to all Mandarin T0 syllables and are ranked the highest in all constraint sets they are involved in. However, throughout the paper, Li (2004) proposes other constraints that are also useful for predicting the surface representation of T0 in disyllabic sequences. Those constraints will be listed below:

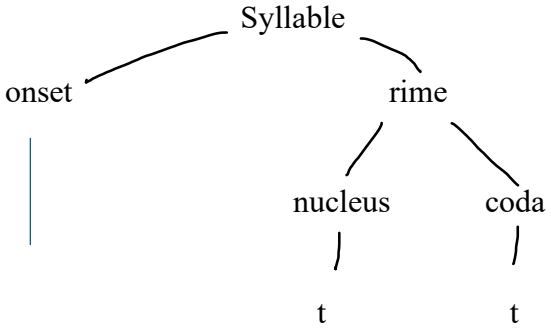
1. MORA-TONE – Each mora can only be connected to one tone.
2. ANCHOR-IO-L – Tonal feature on the left edge of the output should correspond with the tonal feature on the left edge of the input.
3. HEAD-SYLL-MAX-T – Head syllables must have complete tone.
4. HEAD-SYLL-IDENT-T – Head syllables must maintain same tone in input and output.
5. LL. L – Three L tones cannot be in a sequence with each other.

In Chapter Five of their thesis, Li (2004) describes a tonal spreading phenomenon in the Nantong Chinese dialect. The spreading phenomenon occurs when a weak mora has the same tone value as the preceding full syllable's final non-head mora. This shows that tones can be shared among T0 and full syllables in Chinese. However, Li states that Mandarin does not have this phenomenon, and instead, Mandarin's T0 is classified under the 'default value with dissimilation' category. Li states that Mandarin's T0 does not match the previous Tone's final tone. However, it will change its value to dissimilate after a T3 syllable and become an M tone.

3.4 Dai's Representation of T0

The final article discussed in this section is by Dai (1991), who gives an autosegmental representation of T0 and Mandarin full tones. Dai states that Mandarin has the obligatory syllable licensing node, which licenses a segment and a tone, and a coda licensing, which licenses a tone when it contains a sonorant segment. Mandarin coda endings are all sonorants. Therefore, Mandarin coda nodes always license a tone. An example of this licensing is given below.

Figure 11 – An example of autosegmental licensing in Mandarin according to Dai (1991).



Importantly, Dai (1991) states that for a syllable to have a Tone associated with it, that the nucleus vowel and coda each need to have one tone associated with them. Interestingly, Dai (1991) also states that when there is only one vowel in the nucleus and no coda ending, the nucleus vowel spreads to the coda spot, allowing a lexical tone to be realized.

Later, during their discussion about rime types, Dai stated that a T0 syllable with a dropped sonorant coda is one of the four main rime types. Dai cites Woo (1969 as cited in Dai (1991)) in that T0 syllables drop their sonorant coda because of being unstressed. However, examples of T0 syllables that have a sonorant coda ending exist in Mandarin.

Dai also states that T0 syllables have a coda node that licenses a tone before the syllable is reduced in stress. Dai claims that the coda node needs to be deleted because if it is not, then the nucleus vowel can fill in the coda spot by process of vowel spreading.

3.5 Summary of Current Trends in T0 Phonological Representation

Based on the studies discussed in this chapter, there is a common opinion on what T0 is phonologically. The first significant finding is that T0 phonologically is a light syllable with only one mora, causing it to be half the length of a full, heavy syllable. In addition, T0 syllables, according to Duanmu's constraints on syllable structure, cannot be standalone phonemes due to an inability to create its own foot.

Next, it is clear a light syllable cannot carry an H tone. That is because they cannot create a foot by itself, and therefore cannot attract stress which leads to T0 syllables being unable to have an H tone.

Equally important is Dai's autosegmental model, which proposes that when a syllable lacks stress, its coda licensing node is deleted. Once the coda licensing node is deleted, the nucleus vowel can only license one tone. However, when combining Wang and Li's models, the tone associated with the nucleus vowel immediately becomes L. That phenomenon is essential as it shows that all syllables license at least one tone, and the minimum syllable requirement in Mandarin is a nucleus vowel that is associated with a tone.

In general, T0 syllables can be phonologically defined as monomoraic syllables that lack a coda licensing node and a tonal domain with a nucleus vowel associated with an L tone.

3.6 Persisting Problems

Three significant problems persist regarding the nature of T0: T0's phonetic data showing that it is a Tone, T0 syllables still being expressed with coda endings, and what dictates a loss of stress in a syllable. Recall that Li & Li (2021) and Zadoenko (1957, as cited in Cheng (1973)), as well as Dreher & Le (1966, as cited in Cheng (1973)), all found that T0, like the T1, T2, T3 and T4, is a Tone. The previous representations show the ending tone of those Tones incredibly well; however, they do not account for the first tone that previous phonetic studies found. Wang's representation comes the closest with their +Upper and -Raised default rules, as well as their model that shows that sub-register features not linked to register features can connect to a register feature. However, Wang's model states that this happens on a left-to-right basis. Even Nantong's tone spreading happens on a left-to-right basis. Therefore, the light syllable nucleus should link to a register feature on the right and not simply want to be a tone. Recall Wang's constraint KEEPWEIGHT that states syllables must maintain their original weight. Wang's constraint of KEEPWEIGHT can help explain the phonetic findings of T0 syllables having a Tone. In addition, the starting tone is determined by the preceding full lexical Tone because T0 syllables cannot be the head syllable of a foot, which shows why they cannot get their first tone from any syllable to the right of them.

The next problem is that T0 syllables with coda endings. Based on this chapter's phonological representations and autosegmental models, a light syllable should not have a coda ending. However, that is not true; there are many examples of light syllables having a coda ending in Mandarin. For example, *xuésheng 'student*'. *Xue* carries T2,

while *sheng* is read with T0, yet still has a coda ending. One possible explanation is that in Wang and Li's representation, the nucleus vowel and coda both occupy the one mora in a light syllable. However, I propose an alternative model.

3.7 An Introduction to the New Representation and Model

I use previous concepts introduced by Duanmu (1999), Dai (1991), Li (2004) and Wang (1997) to create a new representation of Mandarin syllable structure and Mandarin T0 in order to explain the following questions regarding T0:

1. When does a non-head syllable lose stress?
2. Why is T0 considered to be a Tone phonetically but a tone phonologically?
3. Why do T0 syllables maintain a coda ending even though it should be deleted?

I propose that T0 in Mandarin is created through a loss of coda licensing phenomenon, which causes the syllable to lose stress. The loss of coda licensing is determined by a morphosyntactic and semantic process that evaluates non-head syllables' influence within a foot. It proposes that all Mandarin syllables start with a lexical tone licensed and that after going through the semantic and morphosyntactic evaluation process, they are eligible to go through a process called Coda Licensing Loss, given that they meet specific requirements. In addition, it proposes that phonologically, head syllables within a disyllabic foot inherit the tone of a light syllable to fulfill a constraint that entails all tones within a foot must be linked to a tone.

Finally, I propose a new version of the phonological representation of Mandarin syllables that still agrees with the previous model's belief that the tone-bearing unit is a mora but modifies the role of the nucleus vowel and coda of a syllable. I will first explain

the new phonological representation of Mandarin syllables and the representation of light syllables becoming a part of a tone. I adopt previous constraints from Duanmu (1999), Li (2004), and Wang (1997) and make necessary modifications, and add new constraints. After the phonological model is described, I will describe the morphosyntactic and semantic processes that affect T0's realization.

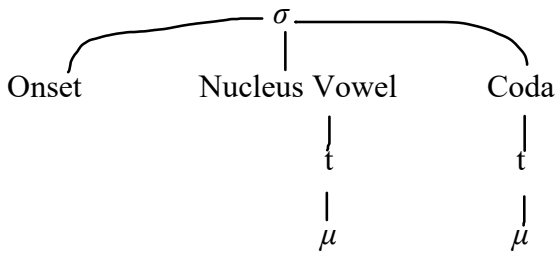
CHAPTER 4

THE NEW REPRESENTATION OF T0 (PART 1)

4.1 The New Representation of T0

First, I will reimagine mora's relationship with syllables and tone in the new representation. I believe that the vowel and coda nodes directly license tones. Then, if a node licenses a tone, that node gains one mora. In that regard, it takes heavy inspiration from Wang's representation that included register level and sub-register levels that are above the mora. An example of the new model is given below:

Figure 12 – The New Representation of Mandarin Syllables. t stands for tone.



While my representation differs from previous representations it still agrees with previous phonological representations of Mandarin syllables in some aspects. My representation adopts the idea that mora are timing units and must be directly linked to tones that are associated with nucleus vowel or the coda licensing node. However, I propose that what carries the tone are the syllable nodes themselves and that each tone comes with a mora inherently. One benefit my representation has is that the mora and syllable nodes are not directly linked; therefore, if a tone were to be lost, the node would lose its weight unit and not the entire node, unlike Dai's representation. I propose that

nodes that license a tone carry a timing value of one, while nodes that do not carry a tone have a timing value of zero. In addition, my representation abides by Duanmu's heavy syllable and light syllable definitions, as a heavy syllable is still bimoraic, while a light syllable is still monomoraic.

4.2 The Constraints Included in the New Representation

Next, the phonological constraints included within the model will be discussed and given. I adopt Li's NONHEADNODE constraint, however I make modifications to it. The first modification is that instead of opting for head mora and non-head mora, I utilize the distinction between heavy syllables and light syllables as well as their associated licensing nodes. For example, instead of stating that a non-head mora bans H, I propose that a light syllable's licensing node bans tone H:

LIGHTSYLL-H – light syllable licensing node ban tone H

It should be stated that Li's constraint that posits non-head syllables ban two nodes will be decomposed in the next chapter, as I propose that morphosyntactic evaluation determines what types of non-head syllables ban coda node licensing.

The next set of constraints are adopted from Li (2004) as well as Duanmu (1999) and slightly modified. I consolidate Li's ANCHOR-IO-L, HEAD-SYLL-MAX-P and HEAD-SYLL-IDENT-P constraints into one HEADMAXFAITH constraint.

HEADMAXFAITH – Surface Representations of head syllables must be maximally faithful to the Underlying Representation

LL. L – Three L tones cannot be in a sequence.

NODE-TONE – Each node can only associate with one tone.

KEEPWEIGHT – All syllables must keep their underlying weight

While these constraints dictate the phonological representation of T0 by itself, it still does not show how T0 could be a part of a tone. Therefore, the current model proposes the following constraint titled TONECONNECT:

TONECONNECT – all tones within a foot must be a part of a Tone.

Another constraint must be added to limit TONECONNECT's range of connecting tones. I believe that the coda of the head syllable associates with its own tone in addition to the tone of the light syllable to abide by TONECONNECT. I propose that the coda associates with the tone of the proceeding light syllable due to Wang (1997) stating any feature linking happens on a left-to-right basis. To limit TONECONNECT's range, I propose the following constraint:

INHERIT-FOOT – tones associated with a light syllable can only be inherited by head syllable licensing nodes within the same foot.

4.3 Ranking of Constraints

I propose that in terms of constraint ranking, that faithfulness constraints such as HEADSYLLMAXFAITH and KEEPWEIGHT are ranked lower than the

markedness constraints. That is because for T0 to be realized it must violate a faithfulness constraint to fulfill a markedness constraint. In my ranking, I propose that HEADSYLLMAXFAITH is an inviolable constraint, however, Duanmu's KEEPWEIGHT constraint is violable.

Next is the ranking of the markedness constraints, I propose that the lowest ranked markedness constraint is NODETONE as NODETONE must be violated in order to abide by TONECONNECT. However, the other markedness constraints all carry an equal rank.

While all markedness constraints besides NODETONE have an equal rank, the order that the constraint are applied in is important. The first constraint to be applied after NODETONE is TONECONNECT, which is followed by INHERIT-FOOT. TONECONNECT is ordered before the other two constraints because a violation of TONECONNECT would be fatal, and a syllable must abide by TONECONNECT before the other two constraints can be accounted for.

Finally, the LL.L and LIGHTSYLL-H constraints are applied last. I propose that the order of these constraints does not matter. Finally, the LL.L and LIGHTSYLL-H constraints are applied last. I propose that the order of these constraints does not matter. A sample tableau of the constraints discussed in this chapter are given below:

Table 4 – Tableau Showcasing Rankings of Constraints Included in New T0 Representation.

HEAD-SYLL-MAX-FAITH << NODE-TONE << TONECONNECT << INHERIT-FOOT << LL.L << LIGHT-SYLL-H

HEAD-SYLL-MAX-FAITH	NODE-TONE	TONECONNECT	INHERIT-FOOT	LL.L	LIGHT-SYLL-H

I will return to the constraints presented in this chapter after going over the second part of the proposed model, as the morphosyntactic and semantic analysis of non-head syllables creates new constraints that must be added. I believe that phonological constraints are accounted for after the semantic analysis of non-head syllables, which will be discussed in the next chapter.

4.4 Important Implications Gained from the Model

The previously mentioned constraint set implicates that tonal inheritance does not happen between heavy-heavy syllables and that Mandarin left-headedness primarily works at the word level between heavy-light syllables, while right-headedness works at both the word and phrasal level between heavy-heavy syllables. A study by Lee (1997) that focused on the prosodic domains of T3 sandhi demonstrated that T3 sandhi can occur across syntactic boundaries. Lee (1997) proposed that five alignment constraints dictate how T3 sandhi is realized phonologically.

It appears that T3 sandhi demonstrates right-headedness because it primarily functions within heavy syllables that can create their tonal domain and thus already meet Duanmu's minimum syllable and word requirements, as well as the TONECONNECT

requirements. Therefore, if a sequence of syllables meets those requirements, Mandarin's headedness becomes right headed in nature. However, T0 is left-headed because the light syllable does not meet the minimum word and TONECONNECT requirements. The light syllable is a dependent phoneme that needs to be with a heavy syllable and, therefore, holds no influence regarding tonal change.

4.5 Summary

This chapter has reviewed the previous phonological representations of Mandarin T0, while also introducing a new model that accounts for phonetic data that previous representations did not. The current model proposes that nucleus vowels and syllable codas directly license a tone which comes with a mora. It also proposes that all tones in a disyllabic sequence must be attached to a Tone.

CHAPTER 5

SEMANTIC AND MORPHOSYNTACTIC INFLUENCE ON T0 REALIZATION

In this chapter, I will discuss the next part of the model that helps describe the realization of T0. This part of the new representation is labeled as the Non-Head Contribution Evaluation (NHCE). NHCE determines if a non-head syllable within a disyllabic word causes lexical overload. Lexical overload occurs when the non-head syllable's semantic contribution highly influences a disyllabic word's semantic sense. The current thesis argues that the head syllable within a disyllabic word is the left-most syllable and that the head syllable's underlying tonal information is always realized. Non-head syllables attempt to maintain their underlying tonal information to keep their syllabic weight. However, to do so, they must ensure that their semantic contribution to the disyllabic word is enough so that the underlying tonal information that matches its sense is realized in the surface representation.

5.1 Categorization of Non-Head Syllables

The first thing that must be considered is when a disyllabic word can experience coda licensing loss. I propose that Coda Licensing Loss is the process by which the coda node of a non-head syllable loses its ability to license a tone. First, the NHCE model decides what category of disyllabic compound a disyllabic word is. Duanmu (1999, b) states there are two types:

1. Disyllabic words whose meanings are compositional.
2. Disyllabic words whose meaning are not fully compositional.

The previous categories can be broken down even further using Gu, Kasua et al.'s (2002) categories as well. Those categories are:

1. First syllable's semantic contribution to word is more important to the 2nd's.
2. 2nd syllables semantic contribution to word is more important to the 1st's.
3. Both contributions from the syllables are equal.
4. Words in which relative semantic weight is subject to context.

Putting the four previous categories proposed by Gu, Kasua et al. (2002) into two main categories posited by Duanmu (1999), the current model proposes the following categorization of Mandarin disyllabic words:

1. Disyllabic words whose meanings are compositional. These include:
    a. 2nd syllables semantic contribution is more important to the 1sts.
    b. Both contributions from the syllables are equal.
2. Disyllabic words whose meanings are not fully compositional. These include:
    1st syllables semantic contribution to word is more important than the 2nds.
3. Disyllabic words whose meaning can be both fully compositional or not fully compositional depending on sense and syntactic placement.

Disyllabic words that fall within the first category have a much higher chance of experiencing lexical overload. Meanwhile, disyllabic words in the second category are susceptible to coda licensing loss. Lexical overload is when a non-head syllable's

semantic contribution to a disyllabic word is equal to or stronger than the head syllable's contribution. These syllables must have their tone fully realized in the surface representation because their contribution to the semantic sense is important. When the semantic contribution of a non-head syllable is less than the head syllable's contribution, then T0 becomes an acceptable phonological realization. However, specific non-head syllables are required to go through a loss of coda licensing.

Finally, disyllabic words that fall into the third category are considered fluid. They can exist in both the first category and the second category. What dictates what category they fall into is sense and syntactic placement. In addition, the current model believes that disyllabic words that fall into this category use T0 in addition to change in the syntactic category to indicate contrast between the two surface representations and senses.

The NHCE system determines the ability of non-head syllables to experience coda licensing loss. The system primarily does three things: First, it matches sense with a disyllabic word. Second, all non-head syllables are marked and labeled as high-influence or low-influence. High-influence syllables belong to the first category of disyllabic words. One constraint that the current model proposes is that high-influence non-head syllables must maintain their underlying tonal information:
KEEPWEIGHT-HI – High influence non-head syllables must maintain original tones.

Low-influence non-head syllables belong to the second category of disyllabic words and have a group of constraints that come with them. Once all low-influence non-head

syllables are marked, they are placed into different categories. A list with the order of operations is given below:

1. Sense and phoneme matching.
2. Low influence non-head syllable evaluation
3. Loss of Coda Licensing

5.2 The Operations of NHCE

Next, the non-head syllables are evaluated and categorized as low-influence or high-influence. That evaluation, of course, depends on the sense that the speaker is attributing to the disyllabic compound. Using the example of *dōngxī*, the contribution of the non-head syllable *xī* is analyzed. It would be given a low-influence label because it does not carry any original semantic meaning and does not overload *Dōng's* semantic information. If *dōngxī* were attributed the sense of 'east and west,' then it would be given a high-influence label since *xī's* semantic contribution does equal the head syllable's contribution.

The next step includes an analysis of the low-influence non-head syllable, with each low-influence non-head syllable getting one of five labels. Notably, a low-influence non-head syllable can only have one label at a time. The analysis involves understanding the non-head syllable's contribution to the foot. I find that there are five general categories of low-influence non-head syllables:

1. Replica
2. Convertor
3. Semantic Assist

4. Grammatical
5. Suffixation

These labels are important because certain non-head syllables that fit within specific categories will automatically experience loss of coda licensing without fail. Meanwhile, other non-head syllables within specific categories are more likely to experience coda licensing loss than others. It should be noted that non-head syllables are checked for all categories at once and can only be in one category. Before the categories are defined and discussed in greater detail, I provide a table below consisting of examples of disyllabic words whose non-head syllables fit within one of the five categories.

Table 5 – Low-Influence Non-Head Syllable Categories with Examples

Disyllabic Words that contain Replica Non-head Syllables	*mā**ma*** 'Mother' *bà**ba*** 'Father' *tīng**ting*** 'to listen' *yé**ye*** 'Paternal Grandfather'
Disyllabic Words that contain Convertor Non-head Syllables	*yào**shi*** 'if' *shāng**liang*** **'**to consult; to discuss' *xiān**sheng*** 'Mister' *bēi**zi*** *'*Cup; Glass'
Disyllabic Words that contain Semantic Assist Non-head Syllables	*péng**you*** 'friend' *yī**fu*** 'clothing' *guān**xi*** 'relation' *chuāng**hu*** 'window'
Disyllabic Words that contain Grammatical Non-head Syllables	*tā**de*** 'Their' *kàn**le*** 'to have watched' *zuò**zhe*** 'to be sitting'
Disyllabic Words that contain Suffixation Non-head Syllables	*pián**yi*** 'cheap; inexpensive' *mào**zi*** 'Hat' *zǎo**shang*** 'Morning'

5.3 Replica Non-Head Syllables

Replica non-head syllables contain the same underlying phonological representation and semantic information as the head syllable. For example, phonological disyllabic words like *māma* '*mother'* and reduplicated verbs such as *kànkan* '*to look'* contain non-head syllables with the same underlying form and sense as the head syllable. Because these non-head syllables are exact replicas, they automatically experience a loss of coda licensing. To place a non-head syllable in the replica category, two criteria must be met:

1. The non-head syllable must have the same underlying representation as the head syllable.
2. The non-head syllable must have the exact same semantic information as the head syllable.

Once a non-head syllable is labelled as a replica. Its coda node is not allowed to license a tone, creating the following constraint based on Li's MONOMORA constraint:

MONONODE-R – Coda node of a replica non-head syllable cannot license tone.

Finally, violating MONONODE-R would constitute a fatal violation. Exact ranking of MONONODE-R and the other constraints that will be introduced in this chapter will be given in Chapter Six.

5.4 Convertor Non-Head Syllables

Convertor non-head syllables convert the part of speech that the head syllable underlying would be a part of. For example, the syllable *xué 'to study'* as the head syllable of a bimoraic foot is a transitive verb. However, when *shēng* is added to *xué*, the head syllable's semantic sense remains, but has become nominalized. This phenomenon works with measure words such as *bēizi 'glass; cup*' and the non-head syllable *zi.* Convertor non-head syllables do not always go through the loss of coda licensing like replica non-head syllables. Instead, they have the option to, with the T0 version being acceptable and the non-T0 version. One explanation could lie in well-formedness regarding Mandarin disyllabic compounds, historical linguistics, and semantics. However, those are outside the scope of this thesis. For a non-head syllable to be placed under the converter category, it must meet the following criteria:

1. The non-head syllable must indicate a change in part of speech between the head syllable's underlying part of speech and the disyllabic word's part of speech.

I propose the following constraint for convertor syllables. Unlike the constraint for replica non-head syllables, a violation of the convertor constraint would not be a fatal violation.

MONONODE-C – Coda node of convertor non-head syllable cannot license tone.

5.5 Grammatical Non-Head Syllables

The third category for low-influence non-head syllables to be placed in is the grammatical category. Non-head syllables in this category contribute zero lexical information to the disyllabic word. Take, for example, the disyllabic sequence of *kànle*

‘*watched’*. In that example, *le* contributes no lexical information of its own and instead indicates the aspect of the verb *kàn*. Like non-head syllables in the replica category, syllables placed in this category are always T0 in their surface representation. To be placed in the grammatical category, a non-head syllable must:

Contribute and/or contain no lexical information within the foot.

I propose the following constraint for grammatical non-head syllables, which shares the same qualities that the replica constraint had in that violating it would be fatal. MONONODE-G – Coda node of grammatical non-head syllable cannot license a tone.

5.6 Semantic Assist Non-Head Syllables

The fourth category of low-influence non-head syllables is the Semantic Assist category. Syllables in this category function to broaden, narrow, or reinforce the head syllable’s semantic information. These syllables often have similar semantic information as the head syllable, but the phonetic information differs. For example, the disyllabic word for clothing *yīfu* (underlyingly *yīfú*) contains the head syllable, which means ‘clothing; garment’ and the non-head syllable’s semantic contribution is clothing; garment. Due to the non-head syllable supporting the head syllable’s semantic meaning and not being a replica of the head syllable, it can experience a loss of coda licensing. Syllables placed in the fourth category must fulfill the following conditions:

1. The semantic contribution of the syllable must be similar or the same as the head syllable’s.
2. The phonetic information of the syllable must be different from the head syllable.

Non-head syllables in the Semantic Assist category have a similar constraint to those in the convertor category in that violating the constraint does not necessitate a fatal violation.

MONONODE-A – Coda node of a semantic assist non-head syllable cannot license a tone.

5.7 Suffixation Non-Head Syllables

The fifth and final category of low-influence non-head syllables is the suffixation category. Syllables within the suffixation category are believed not to be a part of the other four categories. Therefore, for a syllable to be placed in the suffixation category, it must fulfill the following condition:

> The non-head syllable does not fit within the replica, convertor, grammatical or assist category.

Syllables within the suffixation category can have their tone fully realized. Non-head syllables in the suffixation category have a similar constraint to those in the convertor and semantic assist categories, in that violating the constraint does not necessitate a fatal violation.

MONONODE-S – Coda node of a suffixation non-head syllable cannot license a tone.

5.8 Summary

This chapter introduced the Non-Head Contribution Evaluation (NHCE) process. The NHCE process aims to determine which syllables cause the lexical overload and which non-head syllables can experience loss of coda licensing. The lexical overload

phenomenon occurs when the semantic contribution of a non-head syllable is equal to or stronger than the head syllable in a disyllabic word. Loss of coda licensing occurs only in non-head syllables and is the process in which the coda node loses its ability to license a tone, causing the syllable to become light. NHCE first marks non-head syllables as high-influence or low-influence. High-influence non-heads must fully realize their underlying Tone, while low-influence syllables undergo further evaluation. Low-influence syllables are placed into one of five categories based on what criteria the syllable meets. Each category has a constraint that limits the coda node's ability to license a tone. However, some of these constraints can be violated, while violating others would constitute a fatal violation.

CHAPTER 6

THE NEW REPRESENTATION OF T0 (PART 2)

This chapter will bring together the phonological constraints proposed in Chapters three, four and five to create a ranking tableau for the constraints. First, a ranking of all proposed constraints is needed.

6.1 Applying Chapter Five Constraints to the Ranking Tableau

Referring back to Chapter Four, I proposed the following constraints are applied to disyllabic words and sequences to derive T0. Here I refer to Table 3 and the definitions of the constraints that were discussed in Chapter Four.

Table 3 – Tableau Showcasing Rankings of Constraints Included in New T0 Representation.

HEAD-SYLL-MAX-FAITH << NODE-TONE << TONECONNECT << INHERIT-FOOT << LL.L << LIGHT-SYLL-H

HEAD-SYLL-MAX-FAITH	NODE-TONE	TONECONNECT	INHERIT-FOOT	LL.L	LIGHT-SYLL-H

HEADMAXFAITH – Surface Representations of head syllables must be maximally faithful to the Underlying Representation

NODE-TONE – Each node can only associate with one tone.

TONECONNECT – All tones within a foot must be a part of a Tone.

INHERIT-FOOT – The tone associated with a light syllable can only be inherited by a head syllable's licensing nodes within the same foot.

LL. L – Three L tones cannot be in a sequence.

LIGHT-SYLL-H – light syllable licensing node ban tone H

The following constraints are applied based on the status of the non-head syllable, and I propose that they are placed between NODETONE and TONECONNECT. Besides KEEPWEIGHT-HI, I propose that the other constraints are ranked higher than NODETONE as a violation of NODETONE is needed to abide by the following MONONODE constraints.

KEEPWEIGHT-HI – High influence non-head syllables must maintain original tones.

MONONODE-R – Coda node of a replica non-head syllable cannot license tone.

MONONODE-C – Coda node of convertor non-head syllable cannot license tone.

MONONODE-G – Coda node of grammatical non-head syllable cannot license a tone.

MONONODE-A – Coda node of an assist non-head syllable cannot license a tone.

MONONODE-S – Coda node of a suffixation non-head syllable cannot license a tone.

I must also clarify that because I am only analyzing T0 within a foot that only contains two syllables, and I am not including another foot in my analysis, that the constraint table in this chapter will not include INHERIT-FOOT as all potential surface representations that abide by TONECONNECT also abide by INHERIT-FOOT. Next, LL.L will only be applied for the combination of a T3 syllable and a T0 syllable as the constraint is not applicable to the other syllable combinations.

First, however, the current representation for Mandarin T0 must account for non-head syllable type. The current representation states that a label is given to all non-head syllables to satisfy that requirement. The labels are High influence (HI), Replica (R),

Convertor (C), Grammatical (G), Assist (A), and Suffixation (S) to abide by the difference between high-influence non-head syllables and low influence non-head syllables as well as to classify what kind of low-influence syllable is being represented clearly. These labels exist along a semantic tier that covers the entirety of the non-head syllable, as is seen later in section 6.2.

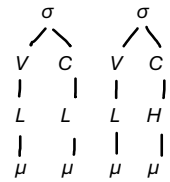
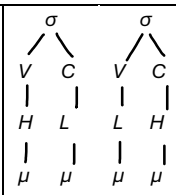
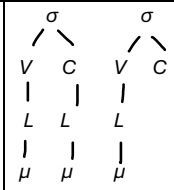
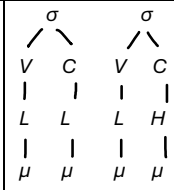
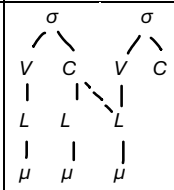
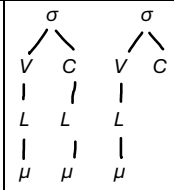
Once the non-head syllables are given the appropriate label, the underlying phonological form of the disyllabic word is put through a constraint set catered to that type of syllable. Please recall that this representation believes a disyllabic word consists of two syllables that both license a Tone in the underlying representation. Two examples of the EVAL process are given in section 6.2.

6.2 Example EVAL Processes for T0 Realization

The first example shows the EVAL process for foot containing a T3 head syllable and a grammatical T2 non-head syllable. Remember that MONONODE-G and MONONODE-R are both inviolable so the first example below would be applicable to situations where the non-head syllable is a part of either the replica category or the grammatical category.

The second example shows the EVAL process for a foot containing a T4 head syllable and a convertor T4 non-head syllable. I must note that like the first example, this example is applicable to other situations where the non-head syllable falls within the suffixation or the semantic assist category as MONONODE-C, MONONODE-S and MONONODE-A, all share the same trait of being constraints where a violation would not constitute a fatal violation.

Table 6 – EVAL process for T3+T0 foot with a Grammatical Non-Head Syllable

UR 	*HEAD SYLL MAX FAITH*	*KEEP WEIGHT*	*NODE TONE*	*MONO NODE G*	*TONE CONNECT*	*LL.L*	*LIGHT SYLL H*
Candidate A 	*!			*!			
Candidate B 		*			*!	*	
Candidate C 				*!			
Candidate D 		*	*			*	
Candidate E 		*			*!	*	

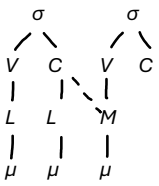
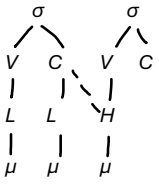
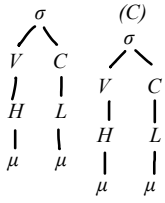
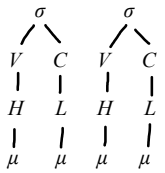
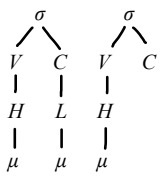
Candidate F			*	*				
Candidate G			*	*				*!

Table 6 shows that Candidate F is the optimal surface representation for the underlying form. That is because Candidate F only violates KEEPWEIGHT and NODETONE, two constraints that must be violated for T0 to be realized. Candidate A is suboptimal because it violates HEAD-SYLLMAX-FAITH and MONONODE-G, causing Candidate A to have two fatal violations. Candidate B is sub-optimal because it violates TONECONNECT which constitutes a fatal violation. Candidate C is also sub-optimal because it violates MONONODE-G and Candidate E is sub-optimal because it violates TONECONNECT. Candidate G is sub-optimal because it violates the LIGHT-SYLL-H constraint, which is a fatal violation because T0 can never be associated with an H tone. While Candidate D is not sub-optimal since it does not have any fatal violations, it is not the most optimal surface representation to pair with the underlying representation because it violates three constraints: KEEPWEIGHT, NODETONE and LL.L. However, Candidate F is more optimal than Candidate D because it only violates two: KEEPWEIGHT and NODETONE.

Candidate F accounts for all T0 phonetic information recorded so far while still resembling previous phonological representations of T0. First, it accounts for T0's shorter duration and monomoraic status by only having one mora associated with it. Secondly, it shows that T0 has Tone qualities by showing that it gets a starting tone from the coda node of the preceding full syllable, and its ending tone is M, which coincides with previous findings that T0 is an M tone when combined with a T3 syllable. It also coincides with Dai's previous statement that all nucleus vowel nodes must license a tone.

Table 7 – EVAL Process for T4+T0 foot with a Convertor Non-Head Syllable

UR		*HEADSYLL MAXFAITH*	*KEEP WEIGHT*	*MONONODE C*	*NODE TONE*	*TONE CONNECT*	*LIGHT SYLL-H*
Candidate A		*!		*			
Candidate B				*			
Candidate C			*			*!	*!

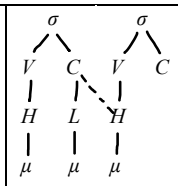
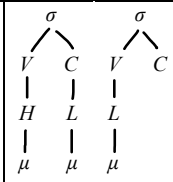
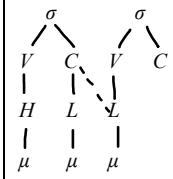
Candidate D			*		*		*!
Candidate E			*			*!	
Candidate F			*		*		

Table 7 shows Candidate B is the optimal surface representation to pair with the underlying representation. Besides Candidates B and F, all other surface representations contain a fatal violation. Table 7 suggests that non-head syllables that fall within semantic assist, suffixation, and convertor categories prefer to have a Tone within their surface representation. However, based on examples in Mandarin, there are instances where non-head syllables within these categories are realized with T0. Take, for example, the two words *xuésheng* 'Student' and *yīshēng* 'Doctor*'; in* both words, the non-head syllable *shēng* falls within the converter category as both head syllables are verbs. However, the *shēng* in *yīshēng* carries a Tone in the surface representation, while the same *sheng* in *xuésheng* is reduced to T0 in its surface representation. That implies that for non-head syllables within the convertor, semantic assist, and suffixation categories, another factor influences whether the surface representation is a lexical tone or T0.

Table 7 also shows that the optimal T0 surface representation for a non-head syllable within the category of semantic assist, convertor or suffixation is Candidate F as all other candidates that represent T0 either contain a fatal violation or have more violations than Candidate F.

CHAPTER 7

FURTHER ISSUES

This chapter seeks to address some further issues regarding the nature of T0 in Mandarin.

7.1 Are T0 Syllables Truly Contrastive?

One phenomenon noted in the current study is that speakers use Mandarin T0 to convert the meaning of underlying disyllabic sequences. In addition, previous studies have stated that T0 syllables are lexicalized as such, and thus, they are always T0. However, the current model and previous research (Dai 1991) argue that all syllables in the underlying form have a full lexical tone. Therefore, it is worth exploring if T0 itself is contrastive like the lexical Tones or if it is an allotone of a Tone.

I hypothesize that T0 is a non-contrastive allotone of an underlying Tone. The reason behind this hypothesis is that in the examples seen, the contrast in meaning arising from T0 is solely contained within disyllabic words, not monosyllabic words. Due to T0 syllables not being able to be a head syllable, and therefore a word, prevents T0 syllables themselves from containing any unique lexical information that can differ from the four lexical tones. Instead, T0 can be seen as a wild card: It can contain all lexical information that the four lexical tones can carry, but it cannot have any unique lexical information exclusive to the T0 Tone itself. Therefore, while T0 can lead to contrastive meanings within words, T0 itself is not contrastive with the four lexical tones, as T0 cannot be used to create a lexical word in Mandarin.

7.2 What is the underlying form of a T0 syllable?

The next question that remains is underlying form of a T0 syllable within a disyllabic sequence. Based on the previous hypothesis, from a purely phonological standpoint, a T0 syllable would have four underlying representations to pick from within a disyllabic sequence, one for each lexical tone. Then, the problem arises of which underlying form to pick from. One method this thesis proposes is to test how the influence level of the non-head syllables or their semantic contribution would change based on the multiple different underlying representations and the senses packaged with them.

Another method would be to utilize Chinese characters and the written form of the phrase to determine the underlying form of the T0 non-head syllable. Knowledge of the written form of the disyllabic word or sequence would give users a clear understanding of the T0 syllable's underlying form. For example, a speaker with knowledge of written Chinese would be able to add the written characters to the underlying representation of a disyllabic word in order to find the non-head syllable's correct underlying representation.

7.3 Does T0 Have Advantages Over Lexical Tones?

I hypothesize that T0 is a tool used to avoid ambiguity within an utterance better than the lexical tones due to homophony and parts of speech boundaries. As mentioned in chapter three, Mandarin T0 only occurs at the end of a phonological word (Duanmu, 1999), meaning that what follows it should be the head syllable of another syntactic

category. An example utterance of multiple heavy syllables together can help show T0's usefulness in parsing phonological phrases:

Sample Phonological Phrase: *Wǒ jiějiě shì*

The previous utterance with no T0 has two accepted readings: "My sister explains" and "My older sister is." Essentially, the ambiguity lies in whether the second jieT3 is a non-head syllable in the noun phrase or the head syllable of the verb phrase. Of course, context can help decipher this; however, without context, T0 itself is incredibly efficient at eliminating this ambiguity.

Even in non-homophonous examples like the one above, T0 is incredibly efficient at helping listeners distinguish syntactic boundaries and can help speed up the processing rate of a sentence. Again, light-heavy syllable combination is not acceptable in Chinese (Duanmu, 2000); therefore, upon hearing a T0 syllable, speakers know the following phoneme is part of another category. Applying this knowledge to the example above, if T0 is placed on the second *jie*, there can only be one accepted reading: "My older sister is."

The sample phonological phrase shows that applying T0 in a phonological phrase can help Mandarin listeners parse the phonological word boundaries. Building off the previous example, if a phonological phrase has a sequence of four heavy syllables, there are a total of four phonological word combinations:

1. Four monosyllabic words.
2. One monosyllabic and one trisyllabic word.
3. Two disyllabic words

4. One disyllabic word and two monosyllabic words.

Therefore, the word boundaries are muddled for the listener, which can cause confusion as to which syllables belong to which word boundaries and which syntactic domains.

However, as soon as T0 is inserted into any of the final three spots (the first spot is invalid since there are no light-heavy feet), word boundaries and foot boundaries become more transparent, and there are fewer options for interpretation. The possible phonological word combinations go from four to two:

1. two monosyllabic words, one disyllabic heavy-light word,
2. one disyllabic heavy-heavy word, and one disyllabic heavy-light word.

While this example shows that T0 does help resolve word combination ambiguity within phonological phrases, further research must be done to examine the extent to which Mandarin speakers utilize phonetic cues such as T0 to parse phonological phrases compared to context, non-verbal cues, and stress.

7.4 How Can T0 be classified?

Based on previous phonological accounts and the current representation, I propose that T0 can be classified as a Dependent Tone. A Dependent Tone relies on previous Tones to gain its status as a Tone and is non-contrastive. A Dependent Tone is a Tone that is created from two tones that are associated with two different syllables. Using T0 as an example, the first tone in a T0 syllable is associated with only the preceding syllable's coda node, and the second tone is associated with the light syllable's licensed

tone as well as the head syllable's coda node. In addition, a Dependent Tone contains all lexical information associated with lexical tones but, at the same time, does not have any lexical information exclusive to itself.

CHAPTER 8

CONCLUDING REMARKS

In this thesis, I have shown that Mandarin T0 is determined by phonological and phonetic constraints and primarily by semantic and morphosyntactic constraints. Chapter Two examined previous phonetic data of T0 and found that it is an underlyingly L tone that is phonetically realized as a shorter tone, with it getting its starting tone from the preceding syllable's coda. Chapter Three summarized the previous phonological representations of Mandarin T0 and found that it can only appear in phonological word final positions, and that the reason for it being shorter than full syllables is because it only has one mora associated with the syllable. To be more specific, the tone and mora associated with the coda are lost.

Chapters four, five and six introduced a new representation of Mandarin T0, as well as non-head syllables. The new representation proposes that the coda licenses a tone, and that all tones come with a mora and proposed the new TONECONNECT constraint. Chapter five delved into the Non-Head Contribution Evaluation model which states that non-head syllables are given a label, and that non-head syllable's ability to be realized with T0 depends on their category. Chapter six then combined the phonological constraints from previous representations in addition to the ones proposed in chapters four and five to show the optimal surface representation of an underlyingly heavy-heavy syllable and how the non-head syllable's label affects the EVAL process. Finally, chapter seven introduced lingering questions about Mandarin T0.

REFERENCES

Cheng, C.-C. (1973) A *Synchronic Phonology of Mandarin Chinese*. Mouton & Co., The Hague.

Dai, Y. (1991). The Phonological Domain of Tone in Chinese: Historical Perspectives. Simon Fraser University

Duanmu, S. (1999). Metrical Structure and Tone: Evidence from Mandarin and Shanghai. Journal of East Asian Linguistics, 8(1), 1-38.

Duanmu, S. (1999b) *Stress and the Development of Disyllabic Words in Chinese. Diachronica 16(1), 1-35.*

Gu, Z., Mori, H., & Kasuya, H. (2003). Prosodic variations in disyllabic meaningful words focused with different stress patterns in Mandarin Chinese. *Acoustical Science and Technology*, *24*(3), 111–119. https://doi.org/10.1250/ast.24.111

Lee, K. (1997). Chinese Tone Sandhi and Prosody. University of Illinois at Urbana-Champaign

Li, A., & Li, Z. (2022). Prosodic realization of tonal target and F0 peak alignment in Mandarin T0. *Language and Linguistics (Taipei)*, *23*(1), 47–81. https://doi.org/10.1075/lali.00099.li

Li, M. (2004). T0s in Disyllabic Sequences Across Chinese Dialects: An OT Account. Tianjin Normal University.

Lin, H. (2006) Mandarin T0 as a Phonologically Low Tone.
Journal of Chinese Language and Computing, 16 (2): 121-134.

Prince, A., & Smolensky, P. (2002). *Optimality Theory: constraint interaction in generative grammar.* Rutgers University & University of Colorado at Boulder.

Shen, J.H. (2022) A Study of the Neutral Tone in Standard Mandarin. *Open Access Library Journal*, **9**, 1-7. doi: 10.4236/oalib.1109104.

Tupper, P., Leung, K., Wang, Y., Jongman, A., & Sereno, J. A. (2020). Characterizing the distinctive acoustic cues of Mandarin tones. The Journal of the Acoustical Society of America, 147(4), 2570–2580. https://doi.org/10.1121/10.0001024

Wang, J. (1997). The representation of T0 in Chinese Putonghua. In *Studies in Chinese Phonology* (Originally published 1997, Vol. 20, pp. 157–184). De Gruyter, Inc. https://doi.org/10.1515/9783110822014.157

Zsiga C. E. (2013). The Sounds of Language: An Introduction to Phonetics and Phonology. Wiley-Blackwell.