Phonotactic Constraints in Four Southern Min Dialects

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Abstract

This thesis seeks to discover the phonotactic constraints in four closely related Chinese Dialects, namely Xiamen, Quanzhou, Zhangping and Shantou Dialects, all of which belongs to the Southern Min family. The main focus of this thesis will be on the labial co-occurrences and nasalization.

Data from the four dialects demonstrate that the four dialects in fact have very similar phonotactic constraints. All four dialects display co-occurrence restrictions in labial codas with other [+labial] segments, with a slight difference in the co-occurrence of rounded vowels within a syllable. Also, occurrences and interaction of [+nasal] segments within a syllable are to a large extent very systematic, with a slight variation in Shantou nasalization.

Studies on these two issues are not uncommon, especially within the autosegmental framework, but a more in-depth review of these analyses have shown that they have been inadequate in their respective ways, and especially challenges the supposed universality of OCP as a formal rule in UG. Therefore in this thesis, the Optimality Theory framework is chosen in favor of its universal constraints but language-specific rankings.

In this thesis, I claim that:

a. labial co-occurrence restrictions in the four dialects can be explained with the following constraints: OCP[LAB] & NO-CODA, MAX-IO,UNIFORMITY [lab], $\text{IDENT}_{\text{Onset}}$, IDENT-IO[F] and OCP[LAB];

b. nasalization in the four dialects can be explained with the following constraints:

NASVOI, RHYMEHARMONY, ALIGN-R, MAXNASAL, *NASALVOWELS and ALIGN-L.

With minor adjustments in the rankings, the different restrictions in the four dialects can be accounted for. By comparing different rankings of the same set of constraints among the four dialects, I shall try to develop a Southern Min typology. This typology will be useful in future cross-linguistic studies on other Chinese languages.

摘要

本論文以優選理論(Optimality Theory)作框架，探討及比較四個關係密切的閩南方言（夏門方言、泉州方言、漳平方言和汕頭方言）之間的語音限制的異同。

這四個方言顯示他們有著非常相似的語音限制，尤以唇音特徵共現限制和鼻音化現象特別明顯。雖然四個方言各有少許分別，但整體來說，它們在唇音特徵和鼻音化上的語音限制是非常有系統的。關於以上兩種現象的研究及分析其實並不罕見，但大部份文章都以自主音段音系學作框架，亦似乎未有任何十分完善的分析。本文將揭示這些研究的部份不足之處，尤其是這些分析引申出來對普遍語法觀念的挑戰，從而闡明本文採取優選理論之優勝之處。

本文將逐步證明：

一、四個方言的唇音特徵共現限制現象可以下列制約條件(constraints)來解釋：OCP[LAB] & NO-CODA、MAX-IO、UNIFORMITY [lab] 、$\text{IDENT}_{\text{Onset}}$、IDENT-IO[F]及OCP[LAB]；

二、四個方言的鼻音化現象可以下列制約條件來解釋：NASVOI、RHYMEHARMONY、ALIGN-R、MAXNASAL、*NASALVOWELS及ALIGN-L.

這四個方言之間的不同之處可以簡單以制約條件的排序變更來捕捉，而不需爲每個方言特地設計專有的制約條件，爲閩南方言的語音限制提供了一個統一的分析機制。透過比較不同排序，本文最後將嘗試爲四個方言建立一個方言類型，而這個方言類型對於未來其他中國語言的跨語言研究將帶來新觀點及突破。

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TABLE OF CONTENTS

ABSTRACT I

ACKNOWLEDGEMENTS IV

TABLE OF CONTENTS VI

CHAPTER 1 INTRODUCTION 1

1.1 Background of the Problem and Purpose of the Study 1

1.2 Research Questions and Significance of the Study 3

1.3 Scope of the Study 3

1.4 Thesis Organization 4

CHAPTER 2 DATA OF FOUR SOUTHERN MIN DIALECTS 1

2.1 Preamble 1

2.2 Basic Data of the four sub-dialects 2
2.2.1 Xiamen Dialect 2
2.2.1.1 Xiamen Onsets 3
2.2.1.2 Xiamen Rimes 4
2.2.1.3 Xiamen Tones 7
2.2.1.4 Xiamen Syllables 7
2.2.2 Quanzhou Dialect 8
2.2.2.1 Quanzhou Onsets 8
2.2.2.2 Quanzhou Rimes 9
2.2.2.3 Quanzhou Tones 11
2.2.2.4 Quanzhou Syllables 12
2.2.3 Zhangping Dialect 13
2.2.3.1 Zhangping Onsets 13
2.2.3.2 Zhangping Rimes 14
2.2.3.3 Zhangping Tones 16
2.2.3.4 Zhangping Syllables 16
2.2.4 Shantou Dialect 17
2.2.4.1 Shantou Onsets 17
2.2.4.2 Shantou Rimes 19
2.2.4.3 Shantou Tones 21
2.2.4.4 Shantou Syllables 21

2.3 Co-occurrence Patterns 22
2.3.1 On Labial Co-occurrence 22
2.3.1.1 Xiamen Labial Co-occurrence 23
2.3.1.2 Quanzhou Labial Co-occurrence 24
2.3.1.3 Zhangping Labial Co-occurrence 26
2.3.1.4 Shantou Labial Co-occurrence 27
2.3.1.5 Southern Min Labial Co-occurrence: A Summary 28
2.3.2 On nasalization 29
2.3.2.1 Xiamen Nasalization 30

2.3.2.2 Quanzhou Nasalization 32
2.3.2.3 Zhangping Nasalization 35
2.3.2.4 Shantou Nasalization 37
2.3.2.5 Southern Min Nasality: A Summary 40

2.4 Generalizing the Southern Min Phonotactic Observations 41

CHAPTER 3 PREVIOUS STUDIES ON CHINESE/MIN PHONOTACTICS 44

3.1 Autosegmental Phonology 44
3.1.1 Obligatory Contour Principle (OCP) 46
3.1.1.2 OCP and Labial Co-Occurrence in Chinese Syllables 49
3.1.1.3 Application of OCP in Southern Min Dialects 54
3.1.2 Syllable Theory in Chinese and Southern Min 58
3.1.3 Nasality in Southern Min 65
3.1.3.1 Nasal Consonants 65
3.1.3.2 Nasalized Vowels 67
3.1.3.3 Derivation of Nasality in Southern Min 68
3.1.4 Inadequacies of Autosegmental Framework 76

3.2 Optimality Theory (OT) 79
3.2.1 Revisiting OCP in OT 83
3.2.2 Nasalization in OT 89

CHAPTER 4 AN OPTIMALITY ANALYSIS OF THE SOUTHERN MIN PHONOTACTICS 93

4.1 On labial co-occurrence 93

4.2 On nasalization 103

4.3 Summary: a Southern Min 'Typology' 116

CHAPTER 5 CONCLUSION 118

5.1 Conclusion 118

5.2 Residual Issues and Future Research 119

APPENDICES 121

Appendix A – Xiamen Syllable Chart 122

Appendix B – Quanzhou Syllable Chart 128

Appendix C – Zhangping Syllable Chart 134

Appendix D – Shantou Syllable Chart 138

REFERENCES 144

CHAPTER 1 INTRODUCTION

1.1 Background of the Problem and Purpose of the Study

With more than 100 symbols and about 50 diacritics and suprasegmentals in the IPA system representing all the known sounds of spoken languages in the world, it would seem easy to create different languages, or sound systems, just by randomly selecting sounds and putting them in a basket. However, the fact remains that certain sounds occurs much more frequently in languages of the world than some others, and bearing this in mind, it is apparent that it takes more than randomly assembling different sounds into systems to have approximately 7000 known languages in the world. One of the criteria in making languages as distinct as it is is the difference in sound sequences, or otherwise known as phonotactics.

Phonotactics, which is derived from Greek morphemes *phono-* 'sound, voice' and *taktika* 'matters pertaining to arrangement')[1] is a branch of phonology that manages the arrangement of phonological units in languages. Particularly, it deals with restrictions in a language on the permissible combinations of phonemes and the interaction of phonemes under particular environments. Phonotactics defines permissible syllable structure, consonant clusters, and vowel sequences by means of phonotactic constraints.

Phonotactic constraints are language-specific; that is, each language has its own rules on what is considered as a legitimate sound sequence, and these rules differ

[1]"Phonotactics." *The American Heritage® Dictionary of the English Language,* 4th ed. Boston: Houghton Mifflin, 2000. www.bartleby.com/61/. 6 December 2007.

across languages. For example, /st/ is a permitted sequence in English (/strit/ "street") while it is not permitted in Japanese. Similarly, /sr/ is a permitted sequence in Khmer, the language of Cambodia (/srei/), but certainly seems unlikely in English. However, on closer inspection, whether a particular sequence is or is not allowed also depend on the syllable structures of the language itself; perhaps /sr/ is not allowed at the onset position in English, but co-occurrence of the two sounds are in fact allowed given they are not in the same syllable (/dəs.rə.gɑ:d/, "disregard"). It is the sets of different rules that each language has with regard to sound combinations that help make them universal yet unique in their own rights.

Yet, the study on the phonotactics of the Chinese language, one of the largest language group in the world, has been shockingly disproportionate when compared to languages such as English or even some African tribal languages. The monosyllabic/monomorphemic nature of Chinese has somewhat masked its just-as-interesting facet of phonotactics. In addition, for the relatively few studies on Chinese phonotactics, a large amount has been done on Mandarin or Cantonese.

This thesis aims to therefore discover the regulations governing the syllable structures of a Chinese Dialect other than Mandarin or Cantonese, and Southern Min is chosen for this thesis. We shall be generalizing and explaining the phonotactics of four sub-dialects from the same Dialect group, namely Xiamen, Quanzhou, Zhangping, and Shantou Dialects, by establishing relevant constraints and rankings, and compare their sets of rules to conduct a cross-linguistic restrictions on segmental sequences in the same Dialect group, and through this attempt to discover the general principles that govern phonotactics across the group of Dialects.

1.2 Research Questions and Significance of the Study

There are four main questions which I seek to find an answer to in this thesis: first of all, what are the constraints that govern the syllable structures in each of the four dialects? Secondly, how similar or different are the phonotactics found in the dialects? How, then, will these phonotactics be presented in terms of constraints in the Optimality framework? Finally, how similar or different will the constraint ranking be among the four dialects? The cross-linguistic restrictions on segmental sequences will shed some light on the general principles governing phonotactics across the Southern Min group.

1.3 Scope of the Study

Four variations of the Southern Min Dialects are examined in this thesis, namely the Xiamen (廈門) Dialect, the Quanzhou (泉州) Dialect, the Zhangping (漳平) Dialect and the Shantou (汕頭) Dialect. For the time being, only monosyllables are being examined, as analyzing anything more than a single syllable will involve more complex issues such as assimilation or dissimilation rather than pure intrasyllabic phonotactics. Syllables that do not have corresponding Chinese characters (such as onomatopoeic words) are also taken into consideration as this is part of natural speech and should conform to phonotactic constraints like any other syllables.

Data from the four dialects is collected from dictionaries and language books. If possible, more than one book from each dialect will be consulted to ensure comprehensiveness and minimize bias. Tone will be of little significance in this paper, as only the phonotactic constraints of syllables per se are being considered,

and the effect of tone on well- or ill-formed syllable is not valid here.

1.4 Thesis Organization

This thesis is organized as follows. Chapter 2 presents basic data on the four dialects which is essential in any further phonological analyses. Sections 2.1 and 2.2 present some basic background and the phonemic inventories of each of the four Dialects, which include onsets, nuclei, tones and syllables. Section 2.3 draws attention to some phonotactics which can be observed in each of the four Dialects, especially with regard to labial co-occurrences and nasalization. Section 2.4 concludes the chapter by generalizing the phonotactic observations made in the two areas across the four Dialects.

In chapter 3, previous studies and researches that are relevant to this thesis are reviewed. We begin by introducing basic notions on autosegmental theory, followed by a critical review on a number of previous studies on Chinese/ Southern Min syllables by Yip (1988), Zhang (1991) and Chung (1996), to reinforce some important ideas that will be useful to our analysis later on. At the same time, we expose some inadequacies of these accounts, to justify the need to re-examine the phonotactic issues within an alternative framework, the Optimality Theory (OT). The basic framework of OT is presented in Section 3.2, and we will revisit the labial co-occurrence and nasalization phenomenon in Southern Min with this theory.

The generalizations made in Chapter 2 are analyzed in Chapter 4, using the OT framework. Depending on the phonotactic phenomenon in each the four dialects, I propose relevant constraints to account for the respective phonotactic occurrences,

and customize constraint rankings for each of the dialects.

Finally, with individual rankings for each of the four dialects established, we will develop a Southern Min Typology by comparing the four rankings.

I conclude the thesis in Chapter 5 with a summary and some residual issues are identified. I will also suggest some areas related to this thesis which warrants future research on.

CHAPTER 2 DATA OF FOUR SOUTHERN MIN DIALECTS

2.1 Preamble

The Southern Min Dialect (also known as Minnan Dialect) is a Chinese dialect spoken mainly in southern Fujian province of China and neighboring areas east of the province. Besides Fujian, Min is also spoken in Zhejiang, Jiangxi, Guangdong (Chaoshan region), Guangxi, Taiwan and Hainan.

The Min Dialect group can be categorized into 6 sub-dialect groups: the Southern Min Dialect, the Eastern Min Dialect, the Northern Min Dialect, the Mid-Min Dialect, Qiongwen Dialect, and the Puxian Dialect. Despite being in the same (Min) Dialect group, they are not mutually intelligible[2]. Outside of Fujian, the major branch of the Min Dialect is the Southern Min Dialect.

The Southern Min Dialect itself can also be grouped into smaller different dialect regions. Southern Fujian serves 'home' to three main dialect systems of Southern Min: Xiamen Dialect (also written as Amoy), Zhangping Dialect, and Quanzhou Dialect. A number of Southern Min variants are spoken in Taiwan and they are collectively known as Taiwanese, which contributes one separate dialect system, although it is very similar to the three Fujian systems mentioned above. The variants

[2] As with other varieties of Chinese, there is significant dispute as to whether Southern Min is a language or a dialect. This is not the main concern in this thesis. I will use the word 'dialect' to indicate that Southern Min is the subset of the Min Dialect and the Min Dialect a subset of the Sino-Tibetan language family. For a more in-depth discussion on the idea of 'dialect', please read Chapter 1 'The ideas of Chinese dialect classification' by Branner (1999).

of Southern Min in the Chaoshan region are collectively known as Chaozhou (also written as Teochew). In southwestern Fujian, the Southern Min variants in Longyan and Zhangping form a separate division of Southern Min dialect systems on their own.

Four dialects are chosen for this thesis: the Xiamen Dialect and Quanzhou Dialect from the Southern Fujian branch, the Zhangping Dialect from the southwestern Fujian branch, and the Shantou Dialect from the Chaoshan branch.

2.2 Basic Data of the four sub-dialects

2.2.1 Xiamen Dialect

The Xiamen Dialect is considered the 'representative' of the Southern Min Dialect. As Xiamen is the principal city of southern Fujian, the dialect is considered the most important. The Xiamen dialect have played an influential role in history, especially in the relations of Western nations with China, and was one of the most frequently learned of all Chinese languages/dialects by Westerners during the second half of the 19th century and the early 20th century. It is nowadays commonly spoken in Fujian, Guangdong, Taiwan and Hainan. Also, it serves as a 'lingua franca' among a large number of 'overseas' Chinese, especially in the Southeast Asia region. The Xiamen data used throughout this thesis is based on Zhou (1993)[3].

[3] The data is 'double-checked' with data from Zhang (1996), Zhou & Ouyang (1998) for validity reasons.

2.2.1.1 Xiamen Onsets

There are seventeen onsets (including null onset) in the Xiamen Dialect, listed in (1) (‘ indicates aspiration). There are no complex onsets in the Dialect.

(1)

Onset	Example	Onset	Example
p-	pa 巴	ts-	tsa 查
p’-	p’a 抛	ts’-	ts'a 叉
m-	mã 馬	s-	sa 沙
b-	ba 麻	k-	ka 膠
t-	ta 礁	k’-	k’a 巧
t’-	t’a 他	ŋ-	ŋã 雅
n-	nã 籃	g-	ga 芽
l-	la 蟧	h-	ha 哈
		-	a 鴉

In the Xiamen Dialect, the aspirated and unaspirated onset pairs (e.g. [p] and [p’]) are contrastive, and therefore come from two different phonemes. On the other hand, the phones [m], [n], [ŋ] and [b], [l], [g] are found in complementary distribution: [m], [n], [ŋ] only occurs with nasalized rimes while [b], [l], [g] only occurs with oral rimes. The phonemic onset inventory can be summarized as (2):

(2)

p	p'		m / b
t	t'		n / l
ts	ts'	s	
k	k'		ŋ / g
h	ø		

One point to note is the complementary pair [n]/ [l] (also applicable for the other three dialects). Unlike [b] and [g], [l] is phonetically classified as a liquid and not a stop. Zhang (1996) agreed that there is doubt whether this [l] is a liquid or an alveolar stop [d], but in spite of this he suggested that it should be considered an alveolar stop, since its corresponding 'partners' are stops.

2.2.1.2 Xiamen Rimes

There are eighty-two rimes in the Xiamen dialect[4], including the syllabified nasals [m̩] and [ŋ̍]. Since these two nasals can behave like rimes (they can stand alone, e.g. [ŋ̍] "秧" or combine with an onset, e.g. [hm̩] "媒"), they are also included in the rime inventory. Below are the vowels, charted into six categories according to their codas (following the categorization used by Zhou, 1993) (note that the nasality of Southern

[4] Zhang (1996) has classified 72 rimes, which excluded [ɔ˜], [iu˜], [iau˜], [uai˜], [uẽ˜],[uãi˜], [ãu˜], [iãu˜], [m̩] and [ŋ̍] from those that Zhou (1993; with Ouyang, 1998) has identified. This is due to the divergence in what qualifies as a 'syllable'. As we shall see from the syllable chart in Appendix 1, most, if not all, of these rimes are only used in syllables that do not have corresponding characters or onomatopoeic sounds. It is very likely that Zhang only included syllables that have written counterparts, while Zhou took into account all sounds that are produced by the speakers. I will, at least for now, follow Zhou's (1993) inventory, since being character-less do not reduce the syllables' significance in the language. Moreover, it is reasonable to take onomatopoeic sounds into consideration as well, because if these sounds also comply with our phonotactic constraints, it will further substantiate the sound system of this language.

Min rimes is present in the whole of the rime domain, i.e. onglides and offglides are also nasalized (see Chung 1996). However, simply for the ease of reading, only the nucleus is marked 'nasalized'. The same applies to the other three languages in the subsequent sections.

(3) a. Oral Vowels

	a	ɔ	o	e		ai	au
i	ia		io		iu		iau
u	ua			ue	ui	uai	

b. Nasalized Vowels and Syllabified Nasals[5]

	ã	ɔ̃	ẽ		ãi	ãu	m̩
ĩ	iã			iũ		iãu	ŋ̍
	uã			uĩ	uãi		

c. Oral Vowels with Stops as Codas

	ap		at		ak	ɔk
ip	iap	it	iat	ik	iak	iɔk
		ut	uat			

[5] The nasalization diacritic only appears on the nucleus alone for ease of reading; nasalization in fact spreads to the onglides and offglides also. This applies to all the four dialects examined in this paper.Yip (1994) notes: "The sources show nasalization on the nuclear vowel, not the offglide, but Zhang and Zhu note carefully that the entire rhyme is phonetically nasalized." See Yip for references for the above papers by Zhang, Sheng Yu and Zhu, De-xi.

d. Oral Vowels with Nasals as Codas

	am		an		aŋ	ɔŋ
im	iam	in	ian	iŋ	iaŋ	iɔŋ
		un	uan			

e. Oral Vowels with Glottal Stops as Codas

	a˜	ɔ˜	o˜	e˜		au˜
i˜	ia˜		io˜		iu˜	iau˜
u˜	ua˜			ue˜	ui˜	uai˜

f. Nasalized Vowels with Glottal Stops as Codas

	ã˜	ɔ̃˜	ẽ˜		ãu˜	m̩˜
ĩ˜	iã˜				iãu˜	ŋ̍˜
			uẽ˜	uãi˜		

Both monophthongs and diphthongs are present in the Xiamen Dialect. In the case of diphthongs, an onglide and offglide can both be present with the nucleus, along with a coda, as in the case of [iau˜], [uai˜], [iãu˜] and [uãi˜]. It should be made clear that the rimes are 'decomposed' according to the sonority hierarchy. According to the sonority hierarchy, low vowels are more sonorous than high vowels. The structure of a syllable regulated by a universal principle known as 'Sonority Sequencing': "The sonority profile of the syllable must rise until it peaks, and then fall." (Roca and Johnson, 1999).When both high and low vowels occur within the same rime, it is assumed that the low vowel, which is more sonorous, is the nucleus, and the higher

vowels which surround it are the onglide and/or offglide.

Among the seventeen onsets, the phones [p], [t], [k], [m], [n], [ŋ] can also function as Xiamen codas. An additional glottal stop [˜] also appears in (and only in) the coda position. Again, like the onsets, there are no complex codas.

2.2.1.3 Xiamen Tones

There are seven (monosyllabic) citation tones in the Xiamen Dialect: five tones for open syllables (syllables without stop codas) and two tones for checked syllables (syllables with stop codas).

(4)

Open syllables	55 ˥	pi˥ 悲
	35	pi 脾
	53	pi 比
	21	pi 閉
	11 ˩	pi˩ 避
Checked syllables	11 ˩	pit˩ 筆
	55 ˥	pit˥ 弼

2.2.1.4 Xiamen Syllables

The largest projection of a Xiamen syllable structure is $C_1G_1VG_2C_2$, where C_1 is the onset, C_2 is the coda, G_1 and G_2 are the onglide and offglide respectively, and V is the nucleus vowel. In spite of this, this maximum projection can *only* be achieved when

C_2 is glottal; or else G_2 and C_2 cannot co-exist, that is, a syllable which has an offglide will not have a nasal ([m], [n], [ŋ]) or oral ([p], [t], [k]) coda, and vice versa. Only the presence of a nucleus vowel is obligatory in a well-formed syllable; it may be onset-less, glide-less and coda-less, such as [i]醫.

The full syllable charts of the Xiamen Dialect are included in Appendix A.

2.2.2 Quanzhou Dialect

Quanzhou Dialect is most commonly spoken in the Quanzhou city area. It used to be the 'representative' of the Southern Min Dialect north of Jiulong Jiang in the 19th Century, due to its important economic status as a the heart of transportation to and from China and other countries. Xiamen Dialect gradually gained more popularity over the Quanzhou Dialect in Qing Dynasty, when the Xiamen city took over Quanzhou city's status as leading transportation centre. Nonetheless, the Quanzhou Dialect is still a noteworthy dialect for investigation, since historically the Xiamen Dialect is a 'crossbreed' of the Quanzhou and Zhangzhou Dialects. The Quanzhou data used in this thesis is taken from Lin (1993).

2.2.2.1 Quanzhou Onsets

There are seventeen onsets (including null onset) that appears in the Xiamen Dialect, listed in (5) below (' indicates aspiration). There are no complex onsets in the Dialect.

(5)

Onset	Example	Onset	Example
p-	pa 巴	ts-	tsa 查
p'-	p'a 葩	ts'-	ts'a 差
m-	mã 馬	s-	sa 沙
b-	ba 麻	k-	ka 佳
t-	ta 凋	k'-	k'a 巧
t'-	t'a 塔	ŋ-	ŋã 雅
n-	nã 娜	g-	ga 牙
l-	la 拉	h-	ha 哈
		-	a 阿

Like the Xiamen Dialect, the unaspirated and aspirated onset phones are contrastive, and therefore come from two different phonemes. On the other hand, the phones [m], [n], [ŋ] and [b], [l], [g] are found in complementary distribution: [m], [n], [ŋ] only occur with nasalized rimes while [b], [l], [g] only occurs with oral rimes. Like the Xiamen Dialect, the phonemic onset inventory can be summarized as (2).

The phonetic classification of [n]/ [l] is the same as what has been said in Section 2.2.1.1.

2.2.2.2 Quanzhou Rimes

There are altogether eighty-seven rimes, including the syllabified nasals [m̩] and [ŋ̍].

Since these two nasals can behave like rimes (they can stand alone, e.g. [m̩] "媒" or combine with an onset, e.g. [pŋ̍] "楓"), they are also included in the rime inventory.

(6) a. (Oral) Vowels

	a	ɔ	o	ə	e	ɯ		ai	au
i	ia		io				iu		iau
u	ua				ue		ui	uai	

b. Nasalized Vowels and Syllabified Nasals

	ã	ɔ̃	ẽ		ãi		m̩
ĩ	iã			iũ		iãu	ŋ̍
	uã				uĩ	uãi	

c. (Oral) Vowels with Stops as Codas

	ap		at	ak	ɔk
ip	iap	it	iat	iak	iɔk
		ut	uat		

d. (Oral) Vowels with Nasals as Codas

	am	əm		an		aŋ	ɔŋ
im	iam		in	ian	iŋ	iaŋ	iɔŋ
			un	uan		uaŋ	

e. (Oral) Vowels with Glottal Stops as Codas

	a˜	ɔ˜	o˜	ə˜	e˜	˜	au˜	
i˜	ia˜		io˜				iau˜	iu˜
u˜	ua˜			ue˜				ui˜

f. Nasalized Vowels with Glottal Stops as Codas

	ã˜	ɔ̃˜	ẽ˜		ãi˜	ãu˜	m̩˜
ĩ˜	iã˜			iũ˜		iãu˜	ŋ̍˜
				uĩ˜	uãi˜		

There are both monophthongs and diphthongs in Quanzhou rimes. In diphthongs, an onglide and offglide can both be present with the nucleus, along with a glottal coda, such as [iau˜], [uai˜], [iãu˜] and [uãi˜]. Phones [m], [n], [ŋ], [p], [t], [k], [˜] are permissible codas in this dialect. Codas are all simple codas.

2.2.2.3 Quanzhou Tones

There are seven (monosyllabic) citation tones: five tones for open syllables and two tones for checked syllables.

(7)

Open syllables	55 ˥	pi˥ 比
	33	pi 卑
	22	pi 被
	24	pi 脾
	41	pi 備
Checked syllables	5 ˥	pit˥ 筆
	24	pit 弼

2.2.2.4 Quanzhou Syllables

The largest projection of a Quanzhou syllable structure is $C_1G_1VG_2C_2$, where C_1 is the onset, C_2 is the coda, G_1 and G_2 are the onglide and offglide respectively, and V is the nucleus vowel. In spite of this, this maximum projection can *only* be achieved when C_2 is glottal; or else G_2 and C_2 cannot co-exist, that is, a syllable which has an offglide will not have a nasal ([m], [n], [ŋ]) or oral ([p], [t], [k]) coda, and vice versa. Only the presence of a nucleus vowel is obligatory in a well-formed syllable; it may be onset-less, glide-less and coda-less, such as [i]依.

The full syllable charts of the Quanzhou Dialect are included in Appendix B.

2.2.3 Zhangping Dialect

The Zhangping Dialect is a sub-dialect of the Zhangzhou sub-system, commonly spoken in the Zhangping region, upstream of the Jiulong Jiang in Fujian Province. The Zhangzhou Dialect used to 'share' the Southern Min area with the Quanzhou Dialect, but the Xiamen Dialect gradually prevailed as the dominant Southern Min Dialect in the area, after the opening of the Xiamen city as an international seaport. Nonetheless, the Zhangping Dialect is still a noteworthy dialect for investigation, since historically the Xiamen Dialect is a 'crossbreed' of the Quanzhou and Zhangzhou Dialects. The data of the Zhangping Dialect below is based on Zhang (1992) .

2.2.3.1 Zhangping Onsets

There are seventeen onsets (including null onset) in the Zhangping dialect. The sign ' indicates aspiration. Again, no complex onsets are present in this dialect.

(8)

Onset	Example	Onset	Example
p-	pa 疤	ts-	tsa 齋
p'-	p'a 脬	ts'-	ts'a 斜
m-	mã 媽	s-	sa 紗
b-	ba 馬	k-	ka 加
t-	ta 爹	k'-	k'a 架
t'-	t'a 拖	ŋ-	ŋã 憨
n-	nã 籃	g-	ga 埃
l-	la 來	h-	ha 靴
			a 啞

In Zhangping, the onsets [p] and [p'] are contrastive, and therefore are two separate phonemes. However, for the Zhangping Dialect the status of the pairs [m]~[b], [n]~[l] and [ŋ]~[g] seem to be different from that in Xiamen and Quanzhou. See Section 2.3.2.3 for further elaboration on this.

2.2.3.2 Zhangping Rimes

There are fifty-seven rimes, including the syllabified nasals [m̩] and [ŋ̩]. Since these two nasals can behave like rimes (they can stand alone, e.g. [m̩] "伓" or combine with an onset, e.g. [lŋ̩] "榔"), they are also included in the rime inventory.

(9) a. (Oral) Vowels

	a	o			ai	au	ei	ou
i	ia	io	ie	iu		iau		
u	ua		ue	ui	uai			

b. Nasalized Vowels and Syllabified Nasals

	ã			ãi		ẽi	m̩
ĩ	iã	iẽ			iãu		ŋ̍
	uã		uĩ	uãi			

c. (Oral) Vowels with Stops as Codas

	ap		at		ak	ok
ip	iap	it	iat	ik	iak	iɔk
		ut	uat		uak	

d. (Oral) Vowels with Nasals as Codas

	am		an		aŋ	ɔŋ
im	iam	in	ian	iŋ	iaŋ	iɔŋ
		un	uan		uaŋ	

In the Zhangping rimes, both monophthongs and diphthongs are present. In diphthongs, an onglide and offglide can both be present with the nucleus. However, unlike the other three dialects mentioned in this thesis, there are no glottal codas. Possible codas include [m], [n], [ŋ], [p], [t], [k].

2.2.3.3 Zhangping Tones

There are eight (monosyllabic) citation tones in the Zhangping Dialect: five tones for open syllables and three tones for checked syllables. The symbol (W) stands for *wen*, which means a tone used for syllables in "written form", and (B) stands for *bai*, indicating a tone used for syllables in 'spoken form'. The difference between the two is subtle, and since tone is not the main concern of this thesis, it will not be discussed here.

(10)

Open syllables	24	pi 裨
	11 ˩	pi˩ 牝
	31	pi 比
	21	pi 泌
	53	pi 幣
Checked syllables	(W) 55 ˥	pit˥ 筆
	(B) 55 ˥	pi˥ 擘
	53	pit 白

2.2.3.4 Zhangping Syllables

The largest projection of a Quanzhou syllable structure is C_1G_1VX, where C_1 is the onset, G is the onglide, V is the nucleus vowel, and X is either the offglide or the coda. Since Zhangping does not have a glottal coda, this maximum projection can *either* have an offglide or a coda only; G_2 and C_2 cannot co-exist. Only the presence

of a nucleus vowel is obligatory in a well-formed syllable; it may be onset-less, glide-less and coda-less, such as [i]醫.

The full syllable charts of the Zhangping Dialect are included in Appendix C.

2.2.4 Shantou Dialect

The Shantou Dialect is spoken in the Shantou city located in the west of Guangdong Province, and is the representative dialect of the Chaoshan branch (a different branch from the above three languages); yet, the Shantou Dialect is similar to the Zhangping Dialect to a certain extent, due to historical and geographical reasons. The data of the Shantou Dialect below is based on Lin and Chen (1996), compared with inventories by Zhang (1996) and Shi (1997)[6].

2.2.4.1 Shantou Onsets

There are eighteen onsets (including null onset) in the Shantou Dialect (‘ indicates aspiration). Again, like the preceding three dialects, there are no complex onsets.

[6] Lin and Chen (1996), Zhang (1996) and Shi (1997) all provided Shantou syllable inventories. However, discrepancy in the rime section is quite big, which are all noted under respective tables. Here we will generally follow the inventory of Lin and Chen (1996), since Lin is a native Shantou speaker. However, in case of extreme discrepancy (i.e. sounds that are only documented in Lin and Chen and not the other two, or sounds that are documented in the other two but not Lin and Chen), then majority will be taken into consideration. It should also be noted that Shi's (1997) inventory was based on informants' production, so in cases where Shi's data deviate from the other two inventories, the possibility of transcription inaccuracy must be taken into account

(11)

Onset	Example	Onset	Example
p-	po 波	ts-	tso 坐
p'-	p'o 抱	ts'-	ts'o 錯
m-	mo 毛	s-	so 梭
b-	bo 無	z-	zɯ 而
t-	to 刀	k-	ko 哥
t'-	t'o 胎	k'-	k'o 戈
n-	no 娜	ŋ-	ŋo 俄
l-	lo 羅	g-	go 鵝
		h-	ho 河
		ø-	o 窩

Aspirated and unaspirated onsets (e.g. [p] and [p']) are contrastive; hence they are phonemic.

One distinct difference concerning Shantou onsets is that, unlike the other three dialects, the phones [m], [n], [ŋ] and [b], [l], [g] are also contrastive respectively (for example, 木[bak˥] vs. 目[mak˥], 勒[lek˥] vs. 肉[nek˥], 獄[gek˥] vs. 逆[ŋek˥]). This will be further dealt with in Section 2.3.2.4.

2.2.4.2 Shantou Rimes

There are eighty-four rimes in the Shantou dialect, including the syllabified nasals [m̩] and [ŋ̍]. Since these two nasals can behave like rimes (they can stand alone, e.g. [m̩] "姆" or combine with an onset, e.g. [hŋ̍] "荒"), they are also included in the rime inventory.

(12) a. (Oral) Vowels

	a	o	e	ɯ		ai	au	oi	ou
i	ia	io			iu		iau		
u	ua		ue		ui	uai			

b. (Oral) Vowels with Nasals as Codas[7]

	am		aŋ	ɤŋ	oŋ	eŋ
im	iam	iŋ	iaŋ		ioŋ	
		uŋ	uaŋ			

c. Nasalized Vowels and Syllabified Nasals[8]

	ã		ẽ		ãi	ãu	õi	õu	m̩
ĩ	iã	iõ		iũ		iãu			
	uã		uẽ	uĩ	uãi				

[7] [ŋ]: Shi's inventory (1997) included the rime [ɯŋ] but not [ɤŋ] (which is present in both Lin and Zhang's inventory), but it may merelybe due to a difference in transcription since the example characters provided in both rimes are the same.
[om]: Shi had [om] but the other two didn't.

[8] [õ]: Shi had [õ] but the other two didn't.
[ ]: Zhang had [ ] but the other two didn't.

d. Oral Vowels with Stops as Codas[9]

	ap		ak	ek	ɤk	ok
ip	iap	ik	iak			iok
		uk	uak			

e. Oral Vowels with Glottal Stops as Codas[10]

	a˜	o˜	e˜	ɯ˜		ai˜	au˜	oi˜
i˜	ia˜	io˜			iu˜		iau˜	
u˜	ua˜		ue˜					

f. Nasalized Vowels with Glottal Stops as Codas[11]

	ɛ̃˜		ãi˜	ãuʔ	m̩˜
ĩ˜		iũ˜		iãu˜	ŋ̍˜
			uãi˜		

[9] [op]: Shi had [op] but the other two didn't.
[ɤk]: Shi's inventory (1997) included the rime [ɯk] but not [ɤk] (which was present in both Lin and Zhang's inventory), but it may be merely a difference in transcription since the example characters provided in both rimes were the same.

[10] [ai˜]: Lin and Zhang both included [ai˜] but Shi didn't.

[11] [ã˜]: Shi had [ã˜] but the other two didn't.
[iã˜]: Shi had [iã˜] but the other two didn't.
[uã˜]: Zhang and Lin had [uã˜] but Shi didn't.
[õ˜]: Shi had [õ˜] but the other two didn't.
[uɛ̃˜]: Shi had [uɛ̃˜] but the other two didn't.
[ɯ̃˜]: Zhang had [ɯ̃˜] but the other two didn't.
[iũ˜]: Shi and Lin had [iũ˜] but Zhang didn't.
[oĩ˜]: Shi had [oĩ˜] but the other two didn't.
[m˜]: Shi and Lin had [m˜] but Zhang didn't.
[ŋ˜]: Shi and Lin had [ŋ˜] but Zhang didn't.
[ŋk]: Zhang had [ŋk] but the other two didn't.
[ãp]: Shi had [ãp] but the other two didn't.

There are both monophthongs and diphthongs in Shantou rimes. In diphthongs, an onglide and offglide can both be present with the nucleus, along with a glottal coda, such as [iau˜], [iãu˜] and [uãi˜]. Phones [m], [ŋ], [p], [k], [˜] can are permissible codas in this dialect. Codas are all simple codas.

2.2.4.3 Shantou Tones

There are eight (monosyllabic) citation tones: five tones for open syllables and three tones for checked syllables.

(13)

Open syllables	33	si 詩
	55˥	si˥ 時
	53	si 死
	35	si 是
	213˨˩	si˨˩ 四
	11˩	si˩ 逝
Checked syllables	2	si˜ 薛
	5˥	si˜˥ 蝕

2.2.4.4 Shantou Syllables

The largest projection of a Quanzhou syllable structure is $C_1G_1VG_2C_2$, where C_1 is the onset, C_2 is the coda, G_1 and G_2 are the onglide and offglide respectively, and V is the nucleus vowel. In spite of this, this maximum projection can *only* be achieved

when C_2 is glottal; or else G_2 and C_2 cannot co-exist, that is, a syllable which has an offglide will not have a nasal ([m], [n], [ŋ]) or oral ([p], [t], [k]) coda, and vice versa. Only the presence of a nucleus vowel is obligatory in a well-formed syllable; it may be onset-less, glide-less and coda-less, such as [i]夷.

The full syllable charts of the Shantou Dialect are included in Appendix D.

2.3 Co-occurrence Patterns

From what can be observed from the syllable charts of the four dialects, there are two very prominent phonotactics involved in the Southern Min syllables –labial co-occurrence restriction and nasalization.

2.3.1 On Labial Co-occurrence

'Labial' here not only indicates labial consonants, but also rounded vowels, since in various proposals regarding Feature Geometry Theory[12], the secondary articulatory feature [round] belong to the node of the primary articulatory feature [labial]. Due to the fact that there are no labiodental or labiovelar consonants in the Dialect, the labial consonants in Southern Min are all bilabial consonants.

It may be worthwhile to clarify at this point that one of the reasons labials are relatively more likely to be subjected to co-occurrence restrictions has to do with the 'harmony scale' proposed by Prince and Smolensky (1993). It is universally that the labial feature is comparatively less 'harmonious' than the coronal feature, in other

[12] More renowned proposals include Clements (1985), Sagey (1986), and McCarthy (1986).

words, labial feature is more marked than coronal feature.

2.3.1.1 Xiamen Labial Co-occurrence

There are four instances of labial co-occurrence in the Xiamen Dialect. Firstly, there are no constraints on the co-occurrence of labial onsets and rounded vowels, which include onglide, nucleus, or offglide[13]. They can occur freely, as in (14):

(14) Labial onset – rounded vowel

[pu] 富	[p'o] 坡
[bɔ] 模	[bua] 磨
[mãu] 毛	[muĩ] 煤

However, co-occurrence of labials between the onset and the coda consonant is prohibited, such as examples shown in (15):

[13] The status of rounded vowels within the Southern Min syllable structure will be further discussed in Section 3.1.2. However, as far as this section is concerned, whether these rounded vowels are considered as glides or part of the nuclei is not relevant; the observations do not seem to make any distinction between rounded vowels in different syllable positions.

(15) *Labial onset – Labial coda

[pat] 八　　*[pam]

[p'it] 匹　　*[p'ip]

*[miãm]

Co-occurrence of labials between rounded vowel and the coda is also forbidden. Rounded vowels (in either the onglide, nucleus and offglide positions) do not appear with labial codas.

(16) *Rounded vowel – Labial coda

[tim] 砧　　*[tom]

[tiap] 諜　　*[tuap]

[tau] 兜　　*[taum]

There are no two rounded vowels occurring in the same rime, like that shown in (17):

(17) *Rounded vowel – Rounded vowel

[tio] 潮　　*[tuo]　　*[tou]

[tiau] 刁　　*[tuau]

2.3.1.2 Quanzhou Labial Co-occurrence

The labial co-occurrence restriction in the Quanzhou Dialect is identical to that in the Xiamen Dialect. First of all, there are no constraints on the co-occurrence of labial onsets and rounded vowels (onglide, nucleus, or offglide), as shown in (18):

(18) Labial onset – Rounded vowel

[pu] 富　　[p'o] 波

[bɔ] 模　　[bua] 磨

[miũ] 謬　　[muĩ] 每

Co-occurrence of labials between the onset and coda consonant positions is prohibited, as shown in (19):

(19) *Labial onset – Labial coda

[pa] 巴　　[pat] 八　　*[pam]

[p'i] 披　　[p'it] 匹　　*[p'ip]

[miã] 名　　*[miãm]

Co-occurrence of labials between rounded vowel and labial coda is also forbidden, as in (20):

(20) *Rounded vowel – Labial coda

[tim] 沈　　*[tom]

[tiap] 輒　　*[tuap]

[tau] 兜　　*[taum]

No two rounded vowels are allowed to occur within the same rime, as in (21):

(21) *Rounded vowel – Rounded vowel

[tio] 兜　　*[tuo]　　*[tou]

[tiau] 刁　　*[tuau]

2.3.1.3 Zhangping Labial Co-occurrence

Like the Xiamen and Quanzhou Dialect, Zhangping also has no constraints on the co-occurrence of labial onsets and rounded vowels (onglide, nucleus, or offglide):

(22) Labial onset – Rounded vowel

[pu] 富　　[p'o] 菠

[bau] 卯　　[bua] 磨

[miãu] 描　　[muã] 毛

Also, co-occurrence of labials between onset and coda is prohibited:

(23) *Labial onset – Labial coda

[pa] 疤　　[pak] 剝　　*[pam]

[p'i] 披　　[p'it] 匹　　*[p'ip]

[miã] 名　　*[miãm]

Co-occurrence of labials between rounded vowel and labial coda is also forbidden:

(24) *Rounded vowel – Labial coda

[tim] 沈　　*[tom]

[tiam] 砧　　*[tuam]

[tau] 兜　　*[taum]

However, with regard to the co-occurrence of rounded vowels, there is one (but only

one) rime in Zhangping where two rounded vowels are allowed occur together: [ou].

(25) ? Rounded vowel – Rounded vowel

[pou] 鋪　　[t'ou] 塗

[sou] 蘇　　[gou] 吳

2.3.1.4 Shantou Labial Co-occurrence

Again, like the aforementioned three dialects, no constraints are placed on the co-occurrence of labial onsets and rounded vowels (onglide, nucleus, or offglide):

(26) Labial onset – Rounded vowel

[pu] 富　　[p'o] 叵

[muã] 幔　　[bua] 磨

[mou] 牟

Co-occurrence of labials between onset and coda is also prohibited in the Shantou Dialect:

(27) *Labial onset – Labial coda

[pa] 巴　　[pak] 北　　*[pam]

[p'i] 披　　[p'ik] 匹　　*[p'ip]

[miã] 名　　*[miãm] [14]

Co-occurrence of labials between rounded vowel and labial coda is also forbidden:

[14] This is a special case. See also Section 2.3.2 on co-occurrence of nasals..

(28) *Rounded vowel – Labial coda

[tim] 沉　　*[tom]

[tiam] 玷　　*[tuam]

[tau] 逗　　*[taum]

For the fourth observation concerning co-occurrence of rounded vowels in a rime, Shantou slightly deviates from Xiamen and Quanzhou. There are two rimes (but only two) where two rounded vowels occur together: [ou] and [õu] (but not [uo] or [uõ]!)

(29) Rounded vowel – rounded vowel

[toi] 堤 [tou] 都　　*[tuo]

[hõi]還 [hõu]虎　　*[huõ]

[tiau] 刁 *[tuau]

2.3.1.5 Southern Min Labial Co-occurrence: A Summary

It is evident that all four dialects are very similar in terms of labial co-occurrence. To briefly recap, all four dialects allow free co-occurrences between labial onsets and rounded vowels. However, all four dialects do not permit combinations of any labial onsets or rounded vowels with the labial coda consonants. Co-occurrences of rounded vowels are prohibited in Xiamen and Quanzhou, but even in Zhangping and Shantou Dialects where labial vowel combinations can be found, only the sequence [ou], but not [uo], is permitted.

Below is a chart that summarizes the observations made in the previous sections.

(C: consonant; V: vowel; [+lab]: labial (feature); [+rnd]: round (feature))

(30)

	Xiamen	**Quanzhou**	**Zhangping**	**Shantou**
C_{ONSET}[+lab] + V[+rnd] (e.g. po)	Yes	Yes	Yes	Yes
C_{ONSET}[+lab] + C_{CODA}[+lab] (e.g.pap)	Never	Never	Never	Never
V[+rnd] + V[+rnd] (e.g. ou)	Never	Never	Yes (but only one instance)	Yes (but only two instances)
V[+round] + C_{CODA}[+lab] (e.g. top)	Never	Never	Never	Never

It should also be noted that, in the cases of allowed rounded vowel combinations (which only occurs in Zhangping and Shantou Dialects), only the sequence [ou], but not [uo], is permitted.

2.3.2 On nasalization

The nasalization feature is very rich and very prominent, in the Southern Min Dialect. In fact the nature of nasality has been one of the most interesting topics for research

in Southern Min phonology.

2.3.2.1 Xiamen Nasalization

The nasal onsets and their oral counterparts ([m], [n], [ŋ] and [b], [l], [g]) are from the same phoneme: [m], [n], [ŋ] only occurs with nasalized rimes while [b], [l], [g] only occurs with oral rimes

From what is shown in the syllable charts in Appendix A, Xiamen nasal consonants and nasalized vowels behave in an asymmetric manner. Nasalized vowels are productive in the Xiamen Dialect; they are able to, and readily so, combine with non-nasal onsets, and the nasalized vowels and their oral counterparts are contrastive in nature, a substantiation of the rich-nasalization characteristic of the dialect:

(31) (Voiceless) Oral onset – oral/ nasalized vowel

[pĩ] 鞭	[pi] 悲
[t'uã] 灘	[t'ua] 汰
[kĩu] 薑	[kiu] 求
[sĩ˜] 閃	[si˜] 薛
[hẽ˜] 嚇	[he˜] 赫
[ts'ŋ] 倉	

In contrast, the nasal onsets [m], [n] and [ŋ] can only join with nasalized rimes, such as that shown in (32):

(32) Nasal onset – nasalized vowel

[mã]馬　　*[ma]

[niãu] 猫　　*[niau]

[ŋ ˜] 挾　　*[ŋe˜]

In addition to the asymmetry described above, we can also see that nasalized rimes almost never occur with non-nasal voiced onset:

(33) *Voiced oral onset – nasalized vowel

[pĩ]平　　[p'ĩ]篇　　[mĩ]棉　　*[bĩ]

[tuã]單　　[t'uã]炭　　[nuã]攤　　*[luã]

[kuãi]關　　*[luãi]

Furthermore, nasalized vowels never occur with nasal or oral consonant codas, with an exception for the glottal [˜]:

(34) *Nasalized vowel – nasal/oral coda

[sã] 三　　[sã˜] 跺

*[sãm]　　*[sãt]　　(but [sam] 杉, [sat] 薩)

[hia˜] 兄　　[hiã˜] (to hold with hand)

s*[hiãŋ]　　*[hiãk]　　(but [hiaŋ] 響)

Since in (32) nasal onsets must occur with nasalized vowels but in (34) nasalized vowels never combine with nasal codas, it can be derived that nasals onsets never combine with nasal (and oral) codas except [˜]:

(35) *Nasal onset – Nasal coda

*[mim][15] *[man]

*[naŋ] *[niam]

*[ŋuan] *[ŋɔŋ]

The generalizations made about co-occurrences of Xiamen nasals in the above are tabulated below:

(36)

	Oral Vowel	Nasalized Vowel	
Voiceless Oral Onset	Yes	Yes	
Voiced Oral Onset	Yes	No	complementary distribution
Nasal Onset	No	Yes	
Nasal or Oral Coda	Yes	No	

2.3.2.2 Quanzhou Nasalization

In the Quanzhou Dialect, the nasal onsets and their oral counterparts ([m], [n], [ŋ] and [b], [l], [g]) are from the same phoneme: [m], [n], [ŋ] only occurs with nasalized rimes while [b], [l], [g] only occurs with oral rimes.

Like the Xiamen Dialect, nasalized vowels and their oral counterparts are contrastive in Quanzhou:

[15] The non-existence of this particular syllable, among these examples, may have to do with more than the behavior of nasals; the co-occurrence of labials might play a part also. Refer back toSection 2.3.1.

(37) (Voiceless) Oral onset – oral/ nasalized vowel

[pĩ] 邊 - [pi] 卑

[t'uã] 攤 - [t'ua] 拖

[sĩ˜] 閃 - [si˜] 薛

[kĩu] 薑 - [kiu] 求

On the other hand, the nasal onsets [m], [n] and [ŋ] must occur with nasalized vowels:

(38) Nasal onset – Nasalized vowel

[mã]罵 *[ma]

[nĩu]兩 *[niu]

[ŋãu˜]嗷 *[ŋau˜]

Nasalized vowels never occur with oral voiced onsets:

(39) *Voiced oral onset - Nasalized vowel

[pĩ]平 [p'ĩ]篇 [mĩ]棉 *[bĩ]

[tuã]單 [t'uã]攤 [nuã]欄 *[luã]

[kŋ]缸 [k'ŋ]糠 *[gŋ]

Nasalized vowels never occur with nasal or oral codas except the glottal [˜]:

(40) *Nasalized vowel – nasal/oral coda

[sã]衫 [sã˜] (to hug)

*[sãm] / *[sãt] (but [sam]杉)

[hiã] 兄 [hiã˜] (to get clothes etc.)

*[hiãŋ] / *[hiãk] (but [hiaŋ] 響)

Combining the observations in (38) and (40), nasal onsets cannot co-occur with nasal (and oral) codas except [˜] (also see labial co-occurrence regarding bilabial nasals):

(41) *Nasal onset – Nasal coda

*[mim]

*[man]

*[niaŋ]

The table in (42) is a small summary of the nasality co-occurrence observations of Quanzhou.

(42)

	Oral Vowel	Nasalized Vowel	
Voiceless Oral Onset	Yes	Yes	
Voiced Oral Onset	Yes	No	complementary distribution
Nasal Onset	No	Yes	
Nasal or Oral Coda	Yes	No	

2.3.2.3 Zhangping Nasalization

The relationship between the nasal onsets and their oral counterparts ([m], [n], [ŋ] and [b], [l], [g]) are less distinct in Zhangping than in the previous two dialects. Generally speaking, the nasal onsets [m], [n], [ŋ] occur with nasalized rimes while [b], [l], [g] occur with oral rimes, which appear to be non-phonemic. However, (43) presents a number of exceptions where nasal onsets can combine with oral vowels, such as [mue]糜. Moreover, the pairs [m] ~ [b], [n] ~ [l] and [ŋ] ~ [g] are 'phonemic' (the pairs in (a) have the same tones, thus are minimal pairs; the pairs in (b) do not have the same tones, so they are only near-minimal pairs):

(43) a. [mu]母 – [bu]武 [nu]二 – [lu] [ŋoㄐ]俄 – [goㄐ]鵝

[moㄐ]摹 – [boㄐ]慕 [noㄐ]奴 – [loㄐ]羅

[mauㄐ]矛 – [bauㄐ]謀 [nau]腦 – [lau]老

b. [ŋau] 藕 – [gauㄐ]豪

However, it should be noted that for the oral rimes that allow such combinations (*u*, *o* and *au*), there is no nasalized counterparts in the inventory (i.e. no *ũ*, *õ* and *ãu*).

Nasalized vowels and their oral counterparts are contrastive in nature:

(44) (Voiceless) Oral onset – Nasalized/ oral vowel

[pĩ] 邊 - [pi] 裨

[t'uã] 灘 - [t'ua] 大

[kũi]光 - [kui] 規

However, nasalized vowels never occur with voiced oral onsets:

(45) *Voiced oral onset – nasalized vowel

[pĩ]邊	[p'ĩ]篇	[mĩ]麵	*[bĩ]
[tuã]單	[t'uã]灘	[nuã]欄	*[luã]
[kŋ̃]缸	[k'ŋ̃]糠		*[gŋ̃]

Like Xiamen and Quanzhou, the Zhangping Dialect does not allow nasalized vowels to co-occur with nasal or oral codas, but Zhangping does not have the glottal coda [ˉ] in the inventory, like the previous two dialects do.

(46) *Nasalized vowel – Nasal/ Oral coda

[sã]衫	*[sãm] / *[sãt]	(but [sam]杉; [sat]殺)
[hiã]兄	*[hiãŋ] / *[hiãk]	(but [hiaŋ] 香; [hiak]學)

Combining the observations in (44) and (46), it can be inferred that nasal onsets cannot co-occur with nasal (and oral) codas (also see labial co-occurrence regarding bilabial nasals):

(47) *Nasal onset – nasal coda

*[mim]	*[man]	*[niaŋ]

The table in (48) is a small summary of the nasality observations of Zhangping.

(48)

	Oral Vowel	Nasalized Vowel
Voiceless Oral Onset	Yes	Yes
Voiced Oral Onset	Yes	No
Nasal Onset	Yes (?)	Yes
Nasal or Oral Coda	Yes	No

2.3.2.4 Shantou Nasalization

Like all three dialects above, nasalized vowels and their oral counterparts are contrastive like the preceding three dialects:

(49) [pĩ] 辮 - [pi] 碑

[t'uã] 灘 - [t'ua] 拖

[ĩ˜] - [i˜] 浥

[hĩu] 裘 - [hiu] 休

[hẽ˜] - [he˜] 嚇

However, in terms of nasal onsets, the Shantou Dialect is more like Zhangping, since it also displays evidence that the nasal onsets and their voiced oral counterparts ([m], [n], [ŋ] and [b], [l], [g]) are not from the same phonemes, i.e. they are contrastive:

(50) 墨[bak] vs. 目[mak]

綠[lek] vs. 肉[nek]

玉[gek] vs. 逆[ŋek]

Nasal onsets [m], [n] and [ŋ] can occur with nasalized vowels as well as oral vowels[16]. A few examples are listed in (51):

(51) Nasal onset – Oral/ nasalized vowel

[mĩ]棉 - [mi]眯

[nã]籃 - [na]拿

[nak]諾

[ŋeŋ]迎

Given that nasal onsets can combine with both oral and nasalized vowels, the same cannot be said about oral voiced onsets[17]: they cannot co-occur with nasalized vowels.

(52) *Voiced oral onset - Nasalized vowel

[pĩ]辮	[p'ĩ]鼻	[mĩ]棉	*[bĩ]
[tuã]單	[t'uã]灘	[nuã]欄	*[luã]
[kẽ]缸	[k'ẽ]庚	[ŋẽ]硬	*[gẽ]

[16] This 'irregularity' has posed difficulties to our analysis in Chapter 4. An unsubstantiated suggestion of how this may be resolved will be presented in Section 4.2.

[17] With one exception only: [ziõ]廂. Since this combination is so 'rare', in order to capture the system holistically, I will put this irregularity aside for now. There can be different reasons why this syllable exists but I am not in the place to explain in this paper.

Nasalized vowels never occur with nasal or oral codas except [ ]:

(53) *Nasalized vowel – Nasal/ oral coda

[sã]衫 *[sãm] / *[sãk] (but [sam]杉, [sak]虱)

[hiã] 兄 *[hiãŋ] / *[hiãk] (but [hiaŋ]顯, [hiak]蝎)

Another aspect Shantou Dialect diverges from the other three dialects concerns nasal codas. Nasal codas do occur together with nasal onset (with the exception of bilabial nasal [m] onset and coda pair – the prohibition of such a pair may have to do with labial co-occurrence):

(54) Nasal onset – Nasal/ oral coda

[miŋ]民

[nam]南 [n ŋ]軟

[ŋen]迎 [ŋiaŋ]妍

The table in (55) is a small summary of the nasality observations of Shantou.

(55)

	Oral Vowel	Nasalized Vowel	Nasalized/ Oral Coda
Voiceless Oral Onset	Yes	Yes	Yes
Voiced Oral Onset	Yes	No	Yes
Nasal Onset	Yes	Yes	Yes
Nasal or Oral Coda	Yes	No	

2.3.2.5 Southern Min Nasality: A Summary

The four dialects exhibit interesting similarities and differences in terms of nasality in Southern Min.

With regard to the relationship between onset and vowels, all four dialects allow voiceless oral onset – nasalized vowel combinations. Nasal onset – nasalized vowel combinations are also permitted, but interestingly, the oral (voiced) counterparts of these nasal onsets cannot combine with nasalized vowels; they are in complementary distribution. However, the dialects are less consistent in nasal onset – oral vowel combinations, where Xiamen and Quanzhou completely prohibit their occurrences, Zhangping does allow them to a limited extent, and Shantou allows a relatively free occurrence.

On the other hand, when codas (whether they are nasal codas or oral codas) are involved, nasality seems to be highly restricted. With the exception in the Shantou Dialect, codas block co-occurrences with either nasal onsets or nasalized vowels. Shantou tolerates nasal onset – nasal (or oral) coda combinations, but also disallows nasalized vowel – nasal (or oral) coda combinations.

Below in (56) is a chart that summarizes the observations made in the previous sections. (C: oral consonant; N: nasal consonant; V: oral vowel; Ṽ: nasalized vowel)

(56)

	Xiamen	Quanzhou	Zhangping	Shantou
N_{ONSET} + $\tilde{V}$ (e.g. mĩ)	Yes	Yes	Yes	Yes
N_{ONSET} + V (e.g. mi)	Never	Never	Yes (although occurrence quite limited)	Yes
C_{ONSET} [-vce] + $\tilde{V}$ (e.g. pĩ)	Yes	Yes	Yes	Yes
C_{ONSET} [+vce] + $\tilde{V}$ (e.g. bĩ)	Never	Never	Never	Never
$\tilde{V}$ + C/N_{CODA} (e.g. ĩt/ ĩn)	Never	Never	Never	Never
N_{ONSET} + C/N_{CODA} (e.g. min)	Never	Never	Never	Yes

2.4 Generalizing the Southern Min Phonotactic Observations

In the preceding sections we have tried to generalize some phonotactic observations present in the four Dialects, specifically with regard to labial co-occurrences and nasalization. We shall review these generalizations again in this section.

(57) <u>On labial co-occurrences:</u>

1. Labial co-occurrences restrictions are found in all four languages.
2. Labial can occur in the onset position (as labial onsets), in the nucleus/ onglide/

offglide position (as rounded vowels), and in the coda position (as labial codas).

3. Labial co-occurrence restriction is least robust with labial onsets. It can co-occur with a rounded vowel, either in the onglide, nucleus, or offglide position.
4. Co-occurrences of rounded vowels (e.g. rounded onglide + rounded nucleus, or rounded nucleus or rounded offglide, or rounded onglide + rounded offglide) are prohibited in Xiamen and Quanzhou. Zhangping and Shantou do allow this type of co-occurrences, but instances are extremely rare.
5. Labial co-occurrence restriction is most robust with labial codas. Labial codas cannot co-occur with any [+lab] or [+round] segments within the syllable. This is true in all four languages

(58) <u>On nasalization:</u>

1. Nasal onsets occur with nasalized vowels freely in all four dialects.
2. However, they never occur with oral vowels in Xiamen and Quanzhou Dialects. Zhangping and Shantou Dialects allow nasal onset-oral vowel combinations but occurrences are rare in both languages.
3. Nasal onsets in Xiamen, Quanzhou and Zhangping Dialects cannot co-occur with oral or nasal codas. Shantou Dialect, however, allows free co-occurrences between nasal onsets and oral or nasal codas.
4. In all four languages, nasalized vowels occur freely with voiceless oral onsets and nasal onsets, but never with voiced onsets.
5. Nasalized vowels REJECT non-glottal codas altogether in all four languages (i.e. all syllables with nasal onsets or nasalized vowels are open syllables).

From the above generalizations, a number of questions arise:

Why do labial co-occurrence restrictions differ according to their positions of occurrence in a syllable?

Why do nasalization restrictions differ according to their positions of occurrence in a syllable?

Do the above features differ underlying in consonants or vowels?

Do these two phenomena have anything in common? If yes, what are they?

These questions would be addressed one by one in the subsequent chapters. It is apparent, though, that the answers lie in two aspects: assimilation and dissimilation. In the next chapter important notions regarding Southern Min phonology and previous studies concerning similar issues will be reviewed.

CHAPTER 3 PREVIOUS STUDIES ON CHINESE/MIN PHONOTACTICS

3.1 Autosegmental Phonology

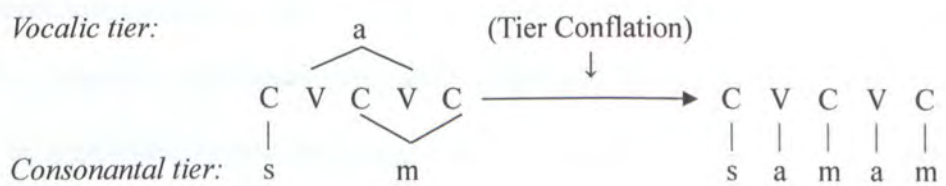
Autosegmental phonology (Goldsmith, 1976) was a modification of the 'classical' generative phonology. Classical generative phonology is based on the SPE (the Sound Pattern of English) model introduced by Noam Chomsky and Morris Halle in 1968, which posits a linear model where segments form a sequence, and each segment represented by a '(distinctive) feature bundle'. It assumes two different levels of phonological representation: an underlying representation, which is the most basic (abstract) form of a word before any phonological rules have been applied to it, and the surface representation, which is the word actually spoken and heard by people.

Such representation is problematic, as pointed out by Goldsmith (1976). The Absolute Slicing Hypothesis posed problems to some features that seem to overlap over a number of segments. On the other hand, the internal representations of segments may not be adequately refined, which poses difficulties with contour segments in which a particular sequence of feature values is crucial in a single segmental position. Goldsmith provided evidence against the SPE model, such as the representation of contour tones, tone stability regardless of segment deletion, melody levels, floating tones, and automatic spreading (for more in-depth arguments see Goldsmith 1976). He suggests a model where, for example, the tone is in fact 'separate' from other features of a segment, and that phonological processes on tone

may extend beyond individual segments, as opposed to a binary representation of high tone/ low tone bundled up within a particular segment. Goldsmith (1976) writes: "Each [tier] is independent in its own right; hence the name, *auto*segmental phonology".

Autosegmental Phonology is a non-linear approach that allows phonological processes, such as tone and vowel harmony, to be independent of and extend beyond individual consonants and vowels. As a result, any phonological processes may influence more than one vowel or consonant at a time. Unlike the feature bundles in generative phonology, the framework treats phonological representations as a collection of parallel tiers (multi-dimensional). Tones and segments constitute different tiers (consonants and vowels also make up different tiers, for that matter). Each tier contains individual segments which represent certain features of speech. The tiers are linked to each other by association lines that indicate how the segments on each tier are to be 'produced' at the same time. Surface structures of words and/or syllables are derived only after multiple tier conflations. For example, the Arabic word '*samam*' (poisonous) can be represented as in (59):

(59)



One important consequence of such an account is the 'adjacency' of phonemes. Although on the surface [s] is adjacent to [a], but 'adjacency' of the phonemes is not perceived linearly but depends on the tiers the phonemes are lying on (McCarthy, 1986), that is, [s] is in fact adjacent to [m] instead of [a] in (59) before tier

conflation.

In Chapter 2, we have discovered a number of phonotactics among the four Southern Min Dialects; sequences involving co-occurring elements within a syllable, in particular the labial feature and nasal feature, seem to be avoided; a principle in the autosegmental theory, called the Obligatory Contour Principle (OCP) might play a role. We shall now review some of the important notions of the OCP discussed in previous studies which will pave way for our analysis in Chapter 4.

3.1.1 Obligatory Contour Principle (OCP)

The Obligatory Contour Principle (OCP) is a phonological hypothesis that states that sequences of consecutive identical elements are banned in underlying representations. The OCP was first proposed by Leben (1973, 1978), which was initially formulated to deal with the tonal phenomena and later extended to contend with segments and features. In McCarthy's (1986) words, "[a]t the melodic level, adjacent identical elements are prohibited". In other words, the OCP requires adjacent phonemes to be contrastive. OCP operates as a morpheme structure constraint (MSC): this means that morphemes cannot violate OCP in their underlying representations. Therefore, in (60a), identical tones cannot occur underlyingly, and identical tones on the surface must be represented by one tone associating to two skeletal slots. The same applies to segments in (60b).

(60) (from Yip 1988)

a. ($: tonal slot)

b. (C: consonantal slot)

For example, it is commonly assumed in phonology that no two consecutive low tones are allowed underlyingly; therefore the representations in the last two diagrams in (60a) are out. If two consecutive low tones appear on the surface adjacent to each other within a morpheme, one possibility is that the two slots are doubly-linked to one single underlying L tone (represented by the second diagram in 60a), or one of the tones are underlyingly not L but is changed by certain relevant rules. The same goes for segmental features such as (60b). The insight of such a postulation is that it is in fact possible to find surface representations that disobey this principle.

The principle was later extended to play a role in the course of a phonological derivation. McCarthy (1986) proposes that the OCP can actively block or repair phonological rules, while Yip (1988) extends the role of the OCP to trigger rules as well. An illustration for OCP operating as a rule blocker is the *Rendaku* phenomenon in Yamato Japanese (as shown in (61), taken from Itô and Mester 1998), where given a compound word, the initial obstruent of the second morpheme becomes voiced (see 61a), unless the second morpheme already contains a voiced obstruent (see 61b):

(61)

a.	/natsu + sora/	→ natsuz̲ora		'summer sky'
	/kawa + hata/	→ kawab̲ata		'river bank'
b.	/ ima + hebi/	→ imah̲ebi	(* ima + b̲ebi)	'island snake'
	/mori +soba/	→ moriṣoba	(*mori + z̲oba)	'soba serving'
	/onna + kotoba/	→ onna kotoba	(*onna + g̲otoba)	'women's speech'

Such voicing rule is blocked by something called *Lyman's Law*, which states that "[s]tems must not contain more than one voiced obstruent" (cited from Itô and Mester 1998:24). This is understood as when the second compound member already has the [+voice] feature, then *Rendaku* (the voicing process which adds [+voice] to the initial obstruent of the second compound member) will be blocked, thus will not be carried out. OCP prohibits two [+voice] features occurring together.

As for OCP as a rule trigger, as Myers (1994:2) puts it, "if a violation of the OCP arises in the derivation through morphological or syntactic concatenation, some rule or operation must intervene to "repair" the violation". One common example is the plural morpheme '-s' in English. In English, adjacent sibilant sequences are prohibited. Therefore, when words that end in sibilants merge with the plural morpheme /s/, OCP will be violated. Thus OCP triggers a 'repair' strategy, that is, schwa ellipsis in these cases:

(62)	*'Classes'* → *'classes'*	/klæs + s/ → [klæsə̲z]
	'Age' → *'ages'*	/e + s/ → [e ə̲z]

3.1.1.2 OCP and Labial Co-Occurrence in Chinese Syllables

Data in Chinese seem to offer support for OCP, the most well-known being Third Tone Sandhi in Mandarin Chinese (see Cheng 1973; Shih 1986; Hung 1987; Zhang Z. 1988; Zhang N. 1997; Lin 2000, 2001, 2004a; amongst others). On the other hand, the first OCP regarding segments in Chinese was labial dissimilation, which was first pointed out by Light (1977, as cited in Chung 1996), but it was Yip who first brought the issue into the autosegmental framework.

Yip (1988) uses Cantonese as an example to illustrate OCP effects involving multiple labials (which is very similar to the labial co-occurrence restrictions found in the Southern Min Dialects), arguing that the principle operates as a general well-formedness condition in the grammar, acting simultaneously as Morpheme Structure Condition (MSC), rule blocker and rule trigger in a single language. According to her, there are three types of labial co-occurrence restrictions in Cantonese. The first and strongest type of prohibition holds within the rime: the combination of a rounded vowel (front or back) and a labial coda (e.g. *[tup], *[kym]) is completely impossible. The second (weaker) constraint holds between the onset and the nucleus. Labial onsets cannot co-occur with front rounded vowels (e.g. *[py], *[m ŋ]) but are allowed to combine with back rounded vowels (e.g. [puk] *to predict*, [fu] *husband*). The third MSC involves the nonadjacent onset and coda pair, where labial onsets and codas cannot co-occur (e.g. *[pim], *[fap]) (with a few violations in onomatopoeic words). Zhang (1991) added a fourth constraint, which was brought up by Yip but never quite discussed, regarding labialized onsets and

labial codas[18]: labialized velar onsets cannot co-occur with back rounded vowels and labial codas (e.g. *[k au], *[k im]).

Yip notices that the tolerance of front and back rounded vowels in Cantonese labial co-occurrence is different. According to Clements (1985) and Sagey (1986)'s feature system, the secondary articulatory feature [round] is dominated by the labial node (primary articulatory feature), which implies that when a sound is [+round], it is also [+labial] (hence a 'redundancy' to specify [+round] segments as [+labial]). In light of this, Yip (1988) proposes that "only front rounded vowels are underlyingly marked labial"; back non-low rounded vowels do not, yet, have the [+labial] feature[19]. In other words, the labial feature is underspecified in back non-low rounded vowels; it is only specified after a redundancy rule.

Based on Steriade's (1982) syllable-structure building rules, Yip proposes the following order for Cantonese, as listed in table (63a):

[18] The labiovelar /w/ is assumed to be a suprasegmental feature rather than an onglide by Zhang (1991), but he did not explain the rationale behind such assumption.
[19] This perhaps has to do with the common assumption that roundness is considered marked in front vowels but unmarked in back vowels (see Chomsky & Halle 1968).

(63) a.

Rules	**Effects**
(i) Create onset	Prohibits co-occurrences of labial onsets and rounded (labial) non-low front vowels, e.g.*[p], but allows co-occurrences of labial onsets and rounded non-low back vowels, e.g. *[po]*
(ii) Apply redundancy rule for [+round]	Rounded (labial) non-low back vowels get their [+round], [labial] feature
(iii) Create codas[20]	Prohibits co-occurrences of labial codas and labial onsets and/ or rounded (labial) vowels e.g. **[up] *[pap]*

According to Yip (1988), the OCP will first come into effect after the creation of onset. At this point, only front rounded vowels are marked [+round], [labial] whereas back vowels are still underspecified for this feature. OCP will block combinations such as *[p] but allow combinations like [po]. After this, all rounded vowels will get their [+round], [labial] feature by the redundancy rule, and at the third step where the coda is to be attached, any labial codas will be banned from co-occurring with all labial onsets and/ or rounded vowels.

However, she did not take the labialization into her account, and labialized onsets in

[20] Cantonese has a simple three-slot structure (onset nucleus offset, Zhang 1991), in which that means the last slot is either empty, taken up by an offglide (e.g. [pau]), or taken up by a coda (e.g. [pan]). Offglide and coda are mutually exclusive, thus Zhang has treated the offglide as being on an altogether different tier than the onset or the nucleus. The biggest syllable projection in Southern Min, on the other hand, involves both an offglide and a (glottal) coda, so it is not too senseless to assume, at least for now, that the offglide is closer to the nucleus and not act as the coda.

Cantonese indeed provide evidence that the rules she proposed above are slightly problematic. Under the current syllable-structure building rules, [k^w] would have behaved the same as other labial onsets such as [p] and [m] (with a [labial] feature), whereas in reality, *[k^wau] would be prohibited whereas [pau] and [mau] are allowed. Some adjustment on Yip's rules is certainly needed to discriminate labial onsets and labialized onsets.

In response to Yip's (1988) proposal, Zhang (1991) revised Yip's rules and modified the application of redundancy rule in Cantonese by putting forward the concept of "trigger element", i.e. the redundancy rules is applied according to its trigger element[21]. The OCP will then take effect at different stages, according to different trigger elements. In summary, if the trigger element is a primary articulatory feature, the redundancy rules will be applied after the creation of onsets but before the creation of coda, and OCP would come into effect before the application of the redundancy rules; if the trigger element is a secondary articulatory feature, then the redundancy rules will be applied after the creation of coda, and OCP would come into effect after the redundancy rules. The revised syllable-structure building rules for Cantonese are listed in (63b):

[21] Given OCP concerns at least two segments, Zhang (1991) defines 'trigger element' as the first segment in a linear sequence, whilst the second segment is defined as a 'target element'.

(63) b.

Cantonese Syllable-Structure Building Rules (Revised)	**Effects**
(i) Create onset	Prohibits co-occurrences of labial onsets and rounded (labial) non-low front vowels, e.g.*[p], but allows co-occurrences of labial onsets and rounded non-low back vowels, e.g. *[po]*
(ii) Apply redundancy rules for [+round] (only if trigger element is a primary articulatory feature, i.e. labial)	Rounded (labial) non-low back vowels get their [+round], [labial] feature after labial onsets
(iii) Create codas	Prohibits co-occurrences of labial codas and labial onsets and/ or rounded (labial) vowels e.g. **[pap] *[mop]*
(iv) Apply redundancy rules for [+round] (only if trigger element is a secondary articulatory feature, i.e. round)	Prohibits co-occurrences of labialized onsets and labial codas/ rounded offglides e.g. **[k^wau] *[gom]*

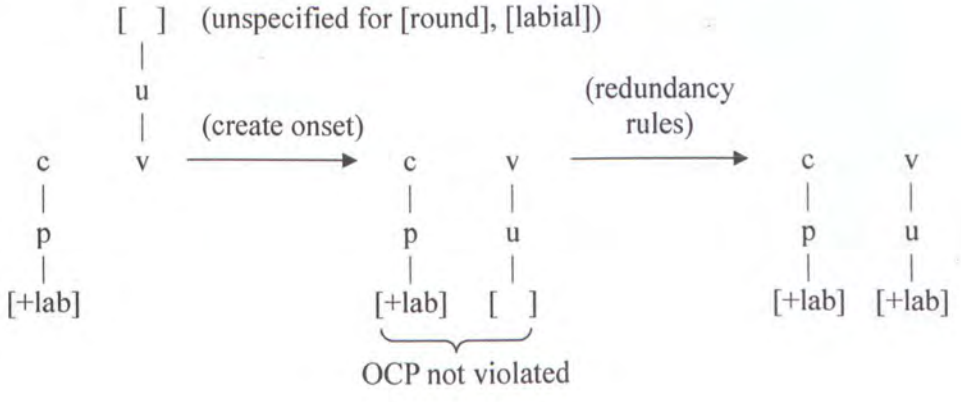
It must be noted that Zhang's suggestion (1991) still does not satisfactorily solve the Cantonese labial phenomenon, as in reality, Cantonese allows syllables such as [k^wo] (過, 'to pass') and [k^{hw}oŋ] (礦, 'mine'). In these cases the 'trigger element' should have been a secondary feature, and according to Zhang, the redundancy rules should have applied before OCP takes effect, banning these combinations altogether. This is subject to further investigation and analyzing, but is out of this paper's scope of

study.

3.1.1.3 Application of OCP in Southern Min Dialects

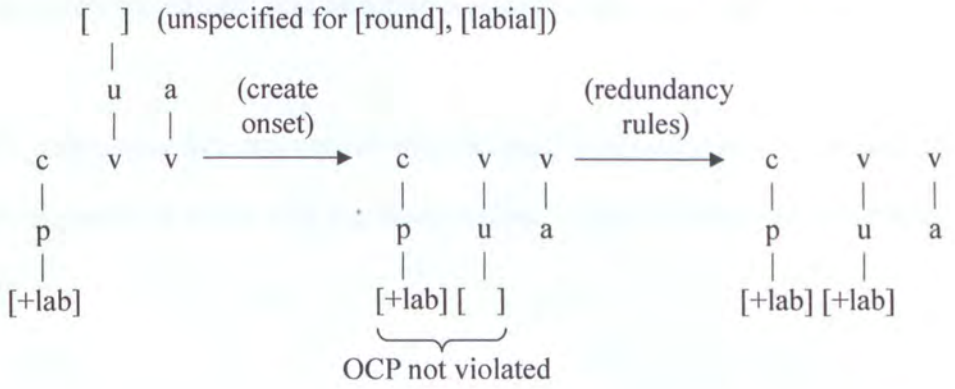
Having laid a simple review of OCP, we shall now attempt to explain a number of labial co-occurrence restrictions observed in Chapter 2 with the use of the OCP order described in Section 3.1.1.2.

(64) Allowed co-occurrence of labial onset and rounded nucleus, e.g. [pu]

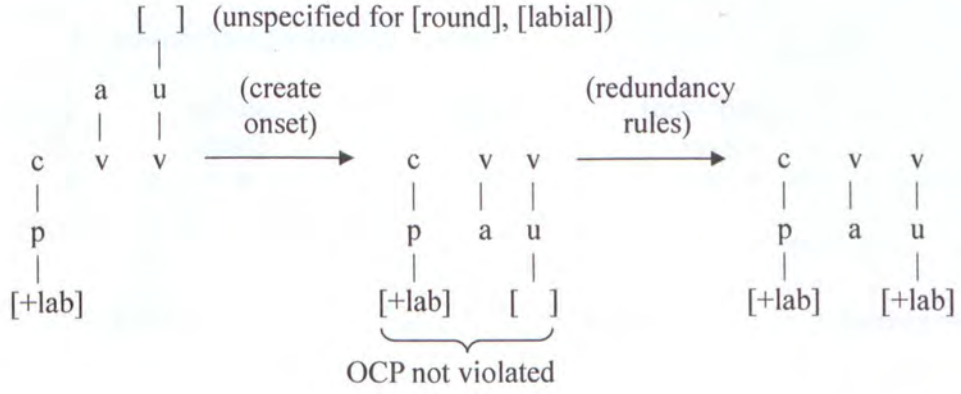


The onset [p] and the nucleus vowel [u] initially lie on different tiers. After creating onset, the two tiers are conflated. Nevertheless, [u] is still unspecified in the labial feature, therefore OCP is not violated. After redundancy rules are applied, the high back vowel [u] has acquired its [+lab] feature, but OCP has already carried out its 'inspection' and does not re-apply here. Thus, [pu] is an allowed combination. We now turn to a rounded vowel in the position of offglide:

(65) Allowed co-occurrence of labial onset and rounded onglide, e.g. [pua]

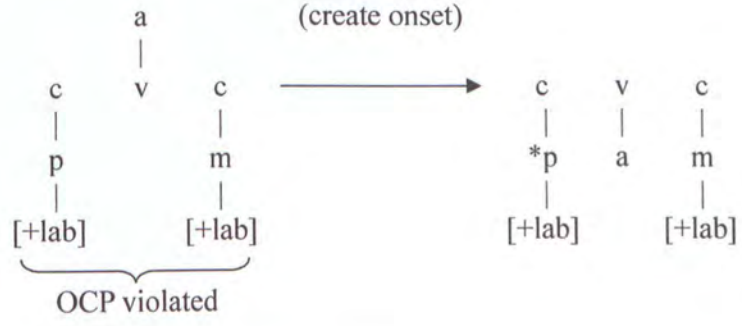


(66) Allowed co-occurrence of labial onset and rounded offglide, e.g. [pau]



The prohibition of co-occurring labial onset and labial coda can also be captured in the same way.

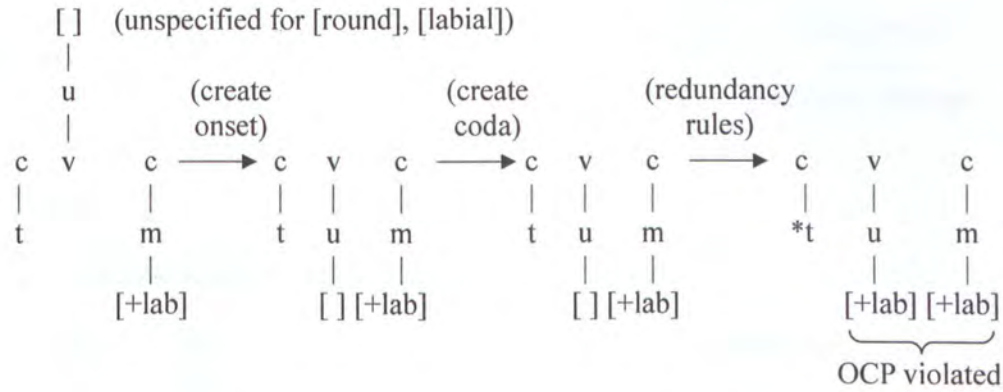
(67) Prohibited co-occurrence of labial onset and labial coda, e.g.*[pam]



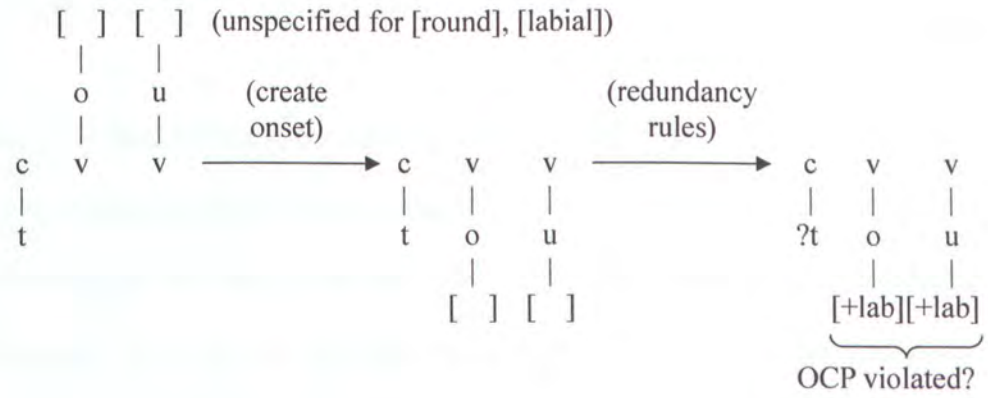
OCP is immediately violated in (9), since both the onset and coda consonants lie on the same (consonantal) tier, and therefore considered adjacent to each other.

In (68), redundancy rules are applied after the creation of coda, since in this case, the trigger element is a vowel with the round feature, which is a secondary articulatory feature.

(68) Prohibited co-occurrence of rounded vowel (onglide, nucleus or offglide) and labial coda e.g.*tum



(69) Prohibited co-occurrence of rounded vowel (onglide, nucleus or offglide) and labial coda e.g.*tou

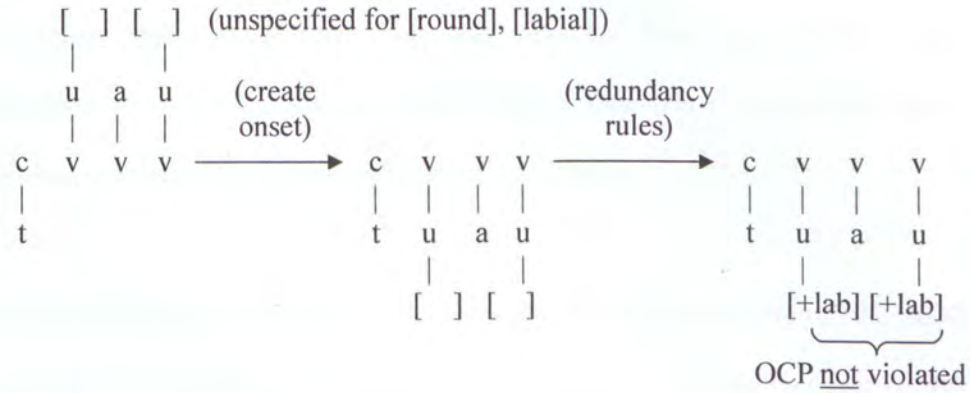


The co-occurrence in (69) is correctly avoided in the dialects in Xiamen and

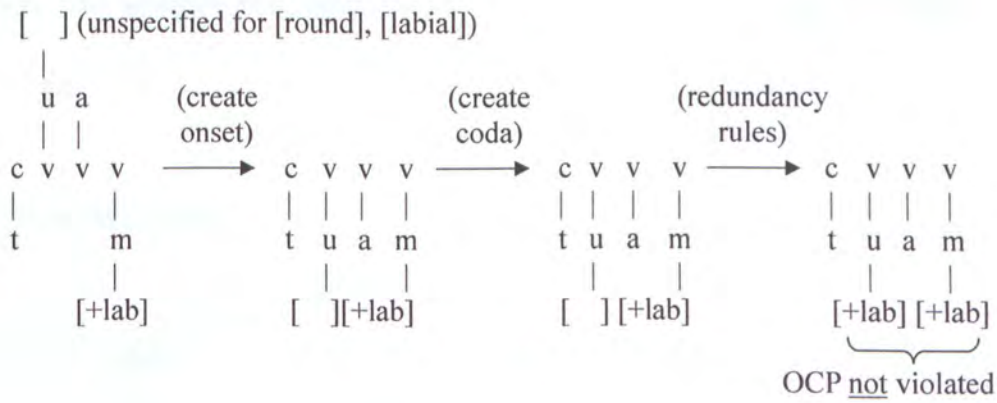
Quanzhou, but such combination is in fact allowed in Zhangping and Shantou. Things are made more difficult with what happens in examples (70a) and (70b):

(70) Prohibited combinations (but not ruled out by OCP)

a. *[tuau]



b. *[tuam]



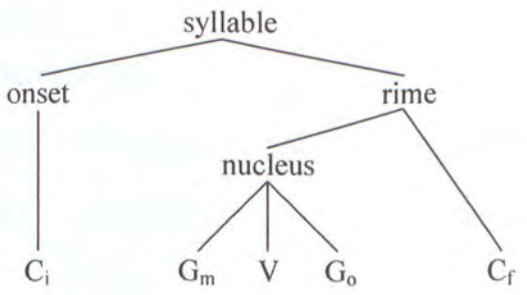
Without any modifications, considering OCP on a linear basis as in the examples above will allow the above 2 combinations. The combinations of a labial onglide and a labial offglide or a labial coda like [tuau] and [tuam] seem to be a permissible combination, since they are not adjacent to each other even after tier conflation. However, this combination in reality does not exist. Therefore we shall now turn to another analysis: the effects of OCP with regard to syllable constituency.

3.1.2 Syllable Theory in Chinese and Southern Min

Let us also examine the OCP effects in connection with the internal structure of a Southern Min syllables. Chinese syllables have been widely studied in different phonological frameworks. The traditional view on the Chinese syllable structure, known as the *fanqie* system, is that the syllable is divided into two main parts: an initial (onset) and a final (rime), and this view has been supported by many phonologists. However, the internal structure of the final (rime) leaves much room for discussion, depending on different dialects of Chinese.

The constituency of Southern Min syllables has also been studied (Bao 1994, 2000, Chung 1996, 1997). Below in (71) is the syllable structure proposed by Chung (1997) and Bao (2000) after studying cases in Taiwanese and Chaoyang, both Southern Min Dialects. The structure they proposed echoes the traditional structure in Chinese phonology:

(71) (From Bao, 2000)



G_m: onglide;
G_o: offglide

A number of studies support such a proposal for the structure of Southern Min syllables. Li (1985) investigated one of the secret languages (SL) in Southern Min called *La-mi*, which involved reduplicating the source vowel into two new syllables. The template for the secret language involves the first syllable retaining the source's

vowel preceded by an onset [l], and the second copying the base syllable's onset followed by a vowel [i]. The basic rule can be conceived as (72):

(72) General Rule for *La-mi* SL

#IF# → #lF + Ii#

a. be˥ ts'ai˩ → le˥ bi˥ lai ts'i˩ 'head'

b. e˩ hiau → le˩ i˩ liau˥ hi 'able'

Li observed that from his data, the medial glide (onglide) always followed the nucleus instead of the onset; Chung (1996) stated that, in fact, "everything following the glide constitutes a single rime". The data in (73) and (74) illustrates that the onglides *u* and *i* is always reduplicated along with the rest of the rime, but not with the onset ([pue] is recreated as [lue pi] rather than *[le pui]. They also shows that the offglide is reduplicated along with the nucleus vowel as well, supporting the treatment of the offglide, nucleus vowel and the offglide together as one constituent. :

(73) (From Chung 1996)

a. iau13 → liau33 i13 'crumpled'

b. uai55 → luai33 i55 'not straight'

(74) (From Li 1985)

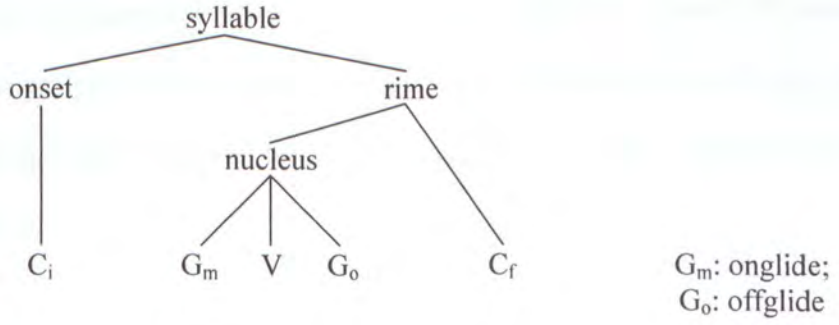
a. pue kuan → lue pi luan kin 'to fly high'

b. ts'iu˥ siɔk → liu˥ ts'i˥ liɔk˩ sit 'procedures'

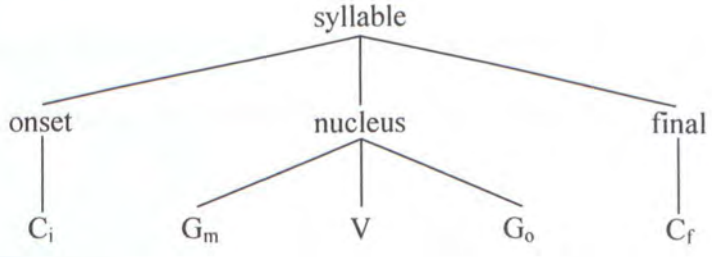
The data in above seem to support the constituency of G_m, V and G_o. Where the coda belongs in the syllable structure is still up for debate now. Firstly, in Chapter 2, we have already seen that the coda is somehow complementary with the offglide, so there is an option in which we can treat the offglide and the coda as generated in the same 'slot'. However in (74b), we see that the offglide in [ts'iu] is retained only in the first syllable but the coda in [siɔk] is both present in the first and second syllable. Such an asymmetry confirms the need for treating the offglide and coda differently[22]. For the time being, we can represent the possible structures as (75a) or (75b):

(75) Possible Southern Min Syllable Structures

a. (=71)



b.



Bao (2000) used partial reduplication of onomatopoeic 'phrases' to support his

[22] For more evidence relating to the different structures of offglide and coda, see Chapter 4 'Syllable Structure' in Chung (1997).

proposed syllable structure. He employed examples from Yuan et al (1960)[23] to illustrate his point, shown in (76a). Assuming the third syllable is the 'base' syllable, he then derived his four-syllable onomatopoeic word like that shown in (76b):

(76) a. p'i li p'iak liak (sound of breaking)

b.

Base:	p'iak			
Copy:	p'iak	p'iak	p'iak	p'iak
Replace C_i:	p'iak	l'iak	p'iak	l'iak
Replace R:	p'i	l'i	p'iak	l'iak

(as cited in Bao 2000)

He concluded that since in Replace R the nucleus and the coda are replaced altogether, this is substantiation that N and C_f form a constituency, namely R (rime). However, this analysis cannot explain cases of 'base' syllables with nasal codas. He did acknowledge such problem, but did not provide any further explanations or amendments.

Coming back to the analysis of labial co-occurrence, Chung (1997) and Bao (2000) both attempted to account for the dissimilation phenomenon using the syllable structure. Chung proposed a Domain Definition Rule and a One-feature Constraint Rule, which is represented in (77) and (78) (copied from Chung 1997):

(77) Domain Definition

ONC → (ON) (C)

O = onset

N = nucleus

[23] Yuan, J.H. et al. 1960. *Hanyu fangyan gaiyao* [An introduction to Chinese dialects]. Language Reform Press, Beijing.

C = coda

(78) One-feature Constraint

σ = syllable

*[( ) ( )]σ
  | |
  F F

( ) = feature domain (as shown in (77))

F = feature

According to Chung's proposal, syllables like [pu] and [pua] are allowed since the labials in question are in the same domain, and the two segments are underlyingly linked to one single [+labial] feature, therefore abiding to the OCP and not violating the One-feature Constraint (see (21a-b)). Conversely, syllables such as *[pam] and *[tum] are prohibited, since both the ON Domain (pa-) and the C Domain (-m) have a [+labial] feature, and the One-feature Constraint is violated (see (79c-d)).

(79) Illustration for Chung's labial dissimilation proposal

a. [(p u) ( )]σ
  ∨
  [labial]

b. [(p u a) ( )]σ
  ∨
  [labial]

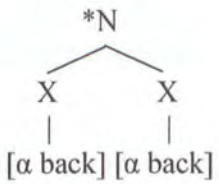
c. *[(p a) (m)]σ
  | |
  [labial] [labial]

d. *[(t u) (m)]σ
  | |
  [labial][labial]

For syllables such as [pau], where a vowel lies between two segments bearing a labial feature, Chung argued that since the low vowel [a] is the only possible option in such an environment, this can be accounted 'by assuming that the low vowel *a* is

underspecified for the [labial]" (Chung 1996:238). He did mention that syllables such as [piu] is also possible but only in onomatopoeic structures. There is not enough data in this thesis to verify or falsify such claims, but structures like [piau] is rather productive and Chung never addressed situations where two vowels lie between the relevant labial segments. Another problem with Chung's proposal concerns rimes such as [ou]. In Taiwanese, [ou] is a prohibited combination, which is also true in the Xiamen and Quanzhou Dialect. Since the above proposal would have allowed such combination (the two vowels lie in the same domain and could have shared one single labial feature instead), Chung proposed another constraint: the Dissimilatory Constraint as in (80):

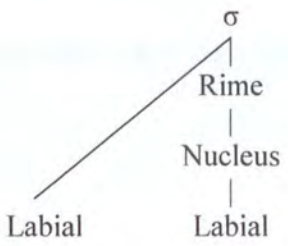
(80) Dissimilatory Constraint



This constraint excludes combinations like [ou] (and also combinations like [iVi] and [ie], which is also not present in Taiwanese, Xiamen and Quanzhou Dialects). On the other hand, Zhangping and Shantou Dialects do allow rimes like [ou] and [ie], and although such cases are limited, this already posed a challenge to Chung's proposal.

Bao, alternatively, accounted for the labial co-occurrence phenomenon by the notion of 'sufficient embedding'. He proposed that 'labial co-occurrence is tolerated just in case one labial is sufficiently embedded' (dominated by two nodes), as in (81).

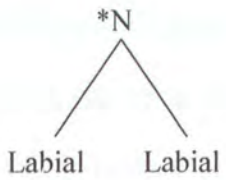
(81)



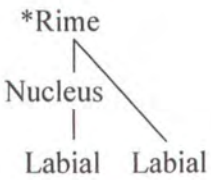
Labial which are insufficiently embedded, such as the configurations shown in (82), will not be tolerated:

(82)

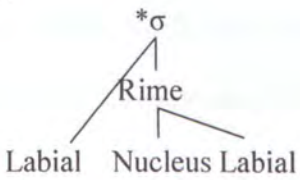
a.



b.



c.



In the above examples the labials are either "… immediately dominated by a common node […], or they are dominated by a common node, and one labial is immediately dominated by one and only one node which does not dominate the other labial" (Bao, 2000). He generalized the above labial co-occurrence as (83):

(83) Labial Co-occurrence Restriction (LCR)

*[… Labial_1 … Labial_2…]$_\sigma$

Except when Labial_1 is the onset, and Labial_2 is the nucleus.

The generalization above seems to be quite makeshift. Besides, it faces the same challenges as Chung's (1996) account: how can it account for the occurrence of [ou]

in both the Zhangping and Shantou dialects? Both accounts by Chung and Bao demonstrated the sensitivity of OCP to intrasyllabic configurations, but they do not seem to be able to give a good account for some minor dissimilarity among different dialects.

3.1.3 Nasality in Southern Min

As the data in Chapter 2 shows, Southern Min has a very rich nasality characteristic. Nasality can be present in onsets, vowels, and codas. However, also in Section 2.3.2 it is observed that nasals behave in a particular manner. In this section we shall investigate the nature of nasality in Southern Min Dialects. Specifically, this dissertation employs the view brought forward by Yip (1994, 1997) and Chung (1996) that nasality in the four dialects is in fact a property of the morpheme, which is 'floating in essence' (Chung 1996).

3.1.3.1 Nasal Consonants

First of all, we shall explore nasal consonants in Southern Min. As previously observed, the nasal onsets [m-], [n-], and [ŋ-] in the dialects of Xiamen and Quanzhou are in complementary distribution with voiced stop onsets [b-], [l-], [g-], which justifies the treatment of these onsets as allophones of the same phonemes. This is agreed by most (if not all) scholars researching on Southern Min Dialects. Tung's (1967, as cited in Lien 1998) remarks that initially, chronology-wise, there were only onsets [b-] [l-] [g-] and no [m-] [n-] and [ŋ-], and there were no nasalized vowels either. Hence it is reasonable to assume here that the voiced oral onsets are the underlying phonemes while the nasal onsets are the allophones.

We now come to nasal (consonantal) codas. There are altogether seven allowed codas in the four dialects described in Chapter 2: [-m], [-n], [-ŋ], [-p], [-t], [-k] and [-˜] (Xiamen and Quanzhou have all seven; Zhangping does not have [-˜] and Shantou only has [-p], [-k], [-m], [-ŋ]). In previous literature, nasal codas [-m], [-n], [-ŋ] had been analyzed as allophones of the phonemic voiceless stops [-p], [-t], [-k] (see Tung 1957, Ting 1985 and Chiang 1992). Chung (1996), however, thought otherwise, and he provided some interesting evidence of how a voiceless stop coda spreads to the suffix 'a' (tones are omitted here):

(84) a. ap 'box'

/ap + a/ → [ap ba] 'box'

b. tik 'bamboo'

/tik + a/ → [tik ga] 'bamboo'

c. ts'at 'thief'

'/ts'at + a/ → [ts'at la] 'thief'

When the onsetless 'a' is suffixed to the preceding closed syllable with a voiceless stop coda, it acquires an onset which is the voiced counterpart of the coda. There are two equally likely account, one being that the stop codas are underlyingly voiceless, and undergo a voicing process intervocalically, a view maintained by scholars like Tung 1957, Ting 1985 and Chiang 1992 (cited in Chung 1996), or stop codas are underlyingly voiced, and goes through devoicing (Kager 1999). Kager explains: "Devoicing of coda consonants and intervocalic voicing of consonants are both processes which are frequently attested in the languages of the world. Also, both are natural states of affairs from an articulatory point of view." (Kager 1999:325) Chung

(1996) argues against the first proposal, claiming that such analysis stipulates nasals to be mutually exclusive with voiced stops in onset position but voiceless stops in coda position, which means that two distinct nasal features are required, which is uneconomical and incoherent. On the other hand, if the voiced stops are assumed to be the underlying phoneme, as in the latter proposal, it is '...at least superior in having a unified assumption: nasals are allophones of voiced stops, either in the onset or in the coda position." (Chung 1996:38) This view will also coincide with the view this thesis will be adopting: that all nasal consonants in Southern Min are in fact derived by realizing, to different extents, a floating nasal feature that attaches itself to an underlying morpheme. As a simple illustration, syllables with nasal consonant codas like [ban] may be represented underlyingly by /bal/ and the coda is only derived by undergoing certain processes, which will be discussed in greater detail in Section 3.2.2.

3.1.3.2 Nasalized Vowels

The status of nasalized vowels also requires some examination. There are two possible treatments of nasalized vowels, one being that nasalized vowels are actually derived from oral vowels associating with the nasal feature. Tung (1957, as cited in Chung 1996:34) suggests that: "[t]he vowels following *m, n, ŋ*, except for some syllabic nasals, are entirely nasalized vowels. If we assume that *m, n, ŋ* and *b, l, g* are all phonemes, then nasalized vowels are not phonemic. In other words, the nasal for nasalized vowels can be taken from its preceding nasal consonants. In so doing, there is a specific advantage for Southern Min, because no nasalized vowels are necessary." In this view, nasalized rimes are derived from oral rimes, the requirement being that nasalized vowels are not phonemic, which contradicts with what has been

assumed so far. A more plausible view is that that nasalized vowels are in fact phonemic in nature, which entails that nasal onsets actually obtain their nasality from the following nasalized vowels. This view is 'preferred' by the data in Southern Min, in which onsetless oral and nasalized vowels are actually contrastive, such as [i]醫 and [ĩ]嬰.

3.1.3.3 Derivation of Nasality in Southern Min

Lin (1989, as cited in Chung 1996:172) claims that "[t]he nasal feature of a nasalized vowel and a nasal consonant in Taiwanese should have different properties, which we claim are due to their different underlying representations, floating versus linked respectively." It is observed that the nasality of the vowel assimilates the onset regressively, while nasality of the coda remains solely within the coda domain, as in (85):

(85) a. /liãu/ → [niãu] 'cat'

b. /bin/ → [bin] 'face' (from Chung 1996:172)

This substantiates that nasalized vowel and nasal consonants call for different analysis in the same (nasality) aspect. Chung argues that differentiating the two is unnecessary. Consider (86), where nasalized vowels and nasal codas both spread nasality to the suffix (tones are omitted here):

(86) a. /muã + a/ → [mũã ã] 'sesame'

/ĩ+a/ → [ĩ ã] 'dumpling'

b. /paŋ+a/ → [paŋ ŋã] 'board'

/kim + a/ → [kim mã] 'gold' (from Chung 1996:173)

Chung (1996:173) contends that, "if the nasality of a nasalized vowel differs from that of a nasal consonant, there should be two distinct rules for the corresponding spreading processes displayed in (86). This suggests that there is no such sharp difference between nasalized vowels and nasal consonants".

The goal now is to determine how nasality is derived in the Southern Min language. One option is that nasality is purely a segmental feature linked to the nasalized vowel, but Li (1985) provided insight against such assertion. He discovered that in the *La-mi* SL formation (as briefly described in Section 3.1.2), there is a certain 'Nasal Rule' at work: if final contains nasalized vowel, n- substitutes l- in first syllable and vowel –i in second syllable is nasalized (recall the general rule for SL formation in (72)):

(87) sũã k'aʔ → nũã sĩ la k'iʔ 'foot of mountain'

What is so intriguing about such data is that the feature of nasality in syllable in source language is actually carried over into both syllables in secret language. If the nasality in [suã] is only specified in the rime (specifically, if the nasal feature is only specified in the nucleus vowel), there should not be any trace of nasality in the second syllable since only the onset is copied. Therefore, the feature of nasality in Southern Min is suggestive of being a property of the entire syllable rather than specific segments.

In fact, Yip (1994) has proposed in her analysis of Chaoyang syllables that nasality is a morphemic feature (Chung (1996) also agrees with this view regarding Taiwanese syllables). At this point, we are faced with a question: what is the difference between nasality as a morphemic feature and nasality as a syllable feature? In the Chinese Dialect the syllable and morpheme 'generally coincide […], [thus] the constraint can be stated over either domain' (Kenstowicz, 1993:535). Yip (1994) also said that in the Chinese language, "morphemes are overwhelmingly mono-syllabic. Any specification at the level of the morpheme will thus surface somewhere within that single syllable". Fudge (1969) also admitted that "[it] is… impossible to say whether syllable-structure formulae for Chinese are syllable-relevant or morph-relevant (since these two units are indistinguishable in Chinese)." Therefore, Yip and Chung describe nasality as morphemic only intending to distinguish it from a segmental feature. This view may be true to a very large extent, however, one may still find common Chinese morphemes, albeit rarely, that are disyllabic and monomorphemic, for example 喇叭 '*trumpet*' and 葡萄 '*grape*'. Nevertheless, since the scope of this thesis is restricted to single syllables, any of such examples shall be excluded here for the for the benefit of simplicity. This in no way undercuts the significance of studies on the effect of nasality on disyllabic monomorphemic words.

Now let us first digress to codas in Southern Min. Back in Chapter 2, we see that the glottal coda can co-occur with offglide while oral and nasal codas cannot. Some scholars such as Luo (1981), Tung (1957, 1960) and Hung (1994) (as quoted by Chung 1996) consider the glottal stop as a full segment, because sounds like [a] and [a˜] (for example, 阿 and 押 in the Xiamen Dialect respectively) are distinctive.

However, if the glottal coda is to be treated on a par with these codas, then we cannot explain the absence of rimes like *[aim] and *[auk]. Also, rimes with oral and nasal codas cannot co-occur with nasalized vowels while glottal codas can. Li (1985) and Chung (1996) note that in Taiwanese, the glottal stop [-˜] is dropped if followed by another syllable (but retained if followed by a pause), as in (88a) (tones are omitted here). This is also observed in the secret language formation, shown in (88b).

(88) a. (from Chung 1996)

/lua˜ + a/ → [lua a] (*[lua˜ ˜a]) 'comb'

b. (from Li 1989)

i. /tsio + kiã/ → [tsio kiã] 照鏡 'to look in the mirror'

ii. /tsio˜ + kiã/→ [tsio kiã] 借鏡 'to learn from (something)'

c. (from Li 1985)

ho͘l k'e˜ → lo͘l hi͘l le ki˜ 'good guest'

Examples in (88) provide two pieces of evidence for the different status of the glottal stop. Firstly, when comparing (88a) to (84) and (86b), where both the oral and nasal coda spreads to the onset position of the suffix, the glottal coda never does. Second, the glottal stop seems to only be present when words are pronounced individually; in connected speech, the glottal stop is dropped. In (84b), when the basically distinctive words /tsio/ and /tsio˜/ are combined with /kiã/, both will be identically pronounced as [tsio kiã]. In addition, in SL formation, the coda position is present in both the first

and the second syllable; see (74b)[24]. It is clear that the distribution and behavior of the glottal 'coda'[25] is very different from nasal and oral codas in Southern Min; these are all evidence to support that the glottal 'coda' indeed has a different status than oral and nasal codas.

In addition, Li (1989) also gave evidence that the glottal coda should be treated differently from other oral and nasal stop codas with regard to rhyming. Li (1989) and Chang (1986) both did investigations into rhyming in Southern Min, and their conclusions indicate that syllables with glottal stops can freely rhyme with their open-syllable counterparts (e.g. [ka] vs. [ka˜], [tsu] vs. [tsu˜]). He consequently argues that the distinctive function of the glottal stop can be eliminated by assuming it as a tonal feature, a view which is also supported by Chung (1996). Li concluded that if the glottal stop should be considered a full segment (specifically, as a coda), this would imply that a particular sound is only allowed in the coda position but not the onset position, and this would somehow violate the language universals.

By 'tonal feature', the glottal stop becomes a feature of what Chung (1996) refers to as an 'E-tone' (entering tone, i.e. checked syllable tones): so in theory, [ka] vs. [ka˜] will be segmentally identical with a difference in tone (the former is associated with a non-E tone whilst the latter gets a glottal coda by being associated with an E-tone). Similarly, the difference between checked syllables like [ban] and [bat] also lies in their different tones: Chung (1996) computes a 'Glottalization' rule, where the

---

[24] In Taiwanese SL, whenever the base syllable has a coda, it is retained exactly as it is with the first SL syllable (along with the nucleus) and the second syllable, but in the second syllable it is essentially an alveolar ([t] if the base coda is an oral coda, [n] if the base coda is a nasal coda). Li (1985) suggests that this may have to do with the heavier functional load of dental sounds in Taiwanese, but this is not part of our aim to provide evidence for or against this view.

[25] The word 'coda' here is put in quotation marks as now we have reason to doubt the status of the glottal sound as compared to more common nasal and oral codas.

phonemically a voiced coda of a syllable with an E-tone becomes glottalized, hence it is 'perceived' as voiceless. In addition, he also adds a 'Nasal Coda Licensing' constraint to limit the occurrence of nasal codas to only syllables with a non-E tone. To put it in another way, an E-tone licenses glottalization of the coda whereas a non-E tone licenses a nasal coda.

This glottalization feature would be revisited when we later examine the status of oral and nasal codas in Southern Min that Yip (1994, 1997) proposes; however, as far as the glottal stop is concerned, it would be safe to assume, for now, that it is a tonal feature rather than a segmental feature, and need not be included in the scope of study of this thesis unless necessary later on.

Returning to the derivation of nasality in Southern Min Dialects, Chung (1996) once again applied his Domain Definition rule which he used for labial co-occurrence (as outlined in (77)) along with three other nasal-specific rules to account for nasalization phenomenon in Southern Min: Nasal Association, Percolation Convention, and Nasal Spreading:

(89) (=77) Domain Definition

ONC → (ON) (C)

This rule groups the onset and nucleus as a doamain, and coda as a separate domain for the [nasal] feature.

(90) Nasal Association

$[(\ )(\ )]_{\sigma} \rightarrow [(\ )(\ )]_{\sigma}$

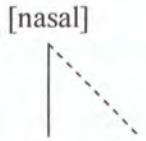
[nasal] [nasal]

Nasal Association requires that the floating [nasal] feature is associated with the rightmost domain of a syllable.

(91) Percolation Convention

When linkages are assigned to or removed from a node N, the assignments and deletions are autosegmentally carried over to all nodes dominated by N.

(92) Nasal Spreading[26]



$\{[(\ )]_{\sigma}[(\ )]_{\sigma}\}_{pwrd}$ (pwrd= prosodic word)

Within a prosodic word, the nasal of a domain spreads to the adjacent domain *if and only if* the domains are different syllables. The spreading is bi-directional.

The following table in (93) is Chung's (1996) illustration of how these rules explain the derivation of nasality in Taiwanese Min:

(93) (from Chung 1996:192)[27]

	a. mũã$_{13}$ 'sesame'	b. ban$_{33}$ 'slow'	c. bat$_{\underline{31}}$ 'to know'
UR	bua [nasal]	bal [nasal]	bal [nasal]

[26] Since nasal spreading is an inter-syllabic interaction, this will be irrelevant to this thesis. Nevertheless, this is included here for a more comprehensive review of Chung's proposal.

[27] In 93c, the underlining of the tone 31 is an indication that it is an E-tone.

Domain **Definition**	(bua) [nasal]	(ba) (l) [nasal]	(ba) (l)
Nasal **Association**	$[(bua)]_{\sigma}$ | [nasal]	$[(ba)\ (l)]_{\sigma}$ | [nasal]	$[(ba)\ (l)]_{\sigma}$
Percolation	$[(bua)]_{\sigma}$ ⩛ [nasal]		
Glottalization			bat
Surface	$mũã_{13}$	ban_{33}	bat_{31}

It is easy to comprehend the validity of syllables like [muã] or [nĩ] under this conjecture. Conversely, the prohibition of syllables such as *[bĩ] or *[nãk] can also be explained since the former violates Percolation Convention by having unharmonized nasal value within the same ON domain and the former disobeys Nasal Association by not associating the nasal feature with the rightmost domain, i.e. the coda. However, similar to what has been discussed under labial co-occurrence, this method cannot seem to exclude the permitted exceptions, such as [ŋo] 'Russia' (in Zhangping), [na] 'to take' and [miŋ] 'civilian' (in Shantou). More importantly, the above proposal simply does not allow combinations of oral (voiceless) onsets and nasalized vowels like [pĩ]:

(94)

	a. pĩ 'whip'
UR	pi [nasal]
Domain **Definition**	(pi) [nasal]
Nasal **Association**	$[(pi)]_{\sigma}$ | [nasal]
Percolation	$[(pi)]_{\sigma}$ ⋁ [nasal]
Glottalization	
Surface	* ?[mĩ]

Although it is uncertain how the nasal feature will surface after being associated to a voiceless oral onset, the fact remains that the above rules cannot seem to satisfactorily exclude these syllables from undergoing the derivational rules and surface as it should have.

3.1.4 Inadequacies of Autosegmental Framework

In Sections 3.1.1 through 3.1.5, we have reviewed a number of analyses proposed within the autosegmental framework with regard to labial and nasal restrictions in Southern Min, and have also brought to light some issues that these analysese did not, or could not, answer.

Of course, we must do these analyses justice, as they are in fact useful to a large extent in accounting for certain phenomenon, such as the OCP. However, as also shown previously, the formulation of OCP has also created a number of problems. Earlier in this chapter, both linear representations and syllable constituency are used to try to explain the OCP effect; however, this principle relies heavily on the notion of adjacency, but so far, adjacency has not been well-defined in either theory.

On a related note on syllable constituency, Chung (1996) has unfortunately displayed inconsistency with his account for syllable structure. On one hand, in the Chapter regarding syllable structures, he has advocated a structure such as in (71), which separates a Southern Min syllable into an onset and a rime, and then the rime branches out to a nucleus (which includes the onglide, vowel, and offglide) and a coda. This is actually in-line with the traditional view on the Chinese syllable constituency and would not have been problematic, but when justifying his analyses for labial dissimilation and nasalization, Chung (1996) proposes a 'Domain Definition' rule which arranges the onset and nucleus into one domain and the coda into another domain (see (77)). Not only does this contradict with his proposal earlier, but this definition of domain is also unusual and unnatural. This casts doubts on the reason the analyses would require a different 'structure' of the syllable for analysing phonotactics; it would certainly make one wonder if this is only an attempt to self-justify his theory.

One might also extend this question to a more fundamental concern: is it the internal structure of a syllable really essential in analyzing phonotactics? Let us suppose that a particular analysis adequately explains certain phenomenon of Dialect A within the

autosegmental framework. Then suppose another dialect (more specifically, another closely-related dialect from the same hypothetical language family), Dialect B, shows slight differences in the same aspect, such as what we have observed in Chapter 2. The previously etablished theories for Dialect A cannot simply be applied to Dialect B directly; in this case, is a different syllable structure necessary in order to account for such differences, or will modifications to the previous analysis be needed in order to explain this? In other words, in order to capture the differences, we may either need a different syllable structure or a different analysis; there will be no unified way to account for differences in similar dialects.

There has long been strong opposition against OCP as a constraint in phonological theory. Odden (1986, 1988), one of the leading challengers of OCP, argued that Shona, an African dialect, reveals counter-examples to OCP, which has always been maintained as universal and should be inviolable. He also pointed out that not all languages show avoidance of identical elements (as observed by Fukazawa 1999). This inconsistency could not be explained if the OCP were a principle of UG. Odden finally rejected treating OCP as a part of universal grammar, and claimed that it "plays no role as a formal constraint on possible grammars".

Myers (1994) was also skeptical about OCP as a UG. He 'pessimistically concludes' that only the passive interpretation of the OCP is universal, since it is not possible to generalize the active instantiations of OCP. Myers found this conclusion unsatisfactory because this interpretation misses the fact that when OCP is violated, something always happens. Myers (1994:3) subsequently noted that "... [o]ne cannot predict on any general basis how the OCP violation will be resolved [...]; one can

only predict that it will be. It is very common for authors to say that a rule of dissimilation is 'triggered' by the OCP, but nobody has yet shown what this means."

Bearing all these in mind and understanding that OCP will trigger something, we thus need a framework that also determines 'what' will happen when a certain 'input' violates the rules. In light of this, we turn to another theoretical framework: Optimality Theory (OT).

3.2 Optimality Theory (OT)

Optimality Theory (hereafter referred to as OT) is a relatively new linguistic model first proposed and presented by Prince and Smolensky in 1991 (although the manuscript did not appear until 1993; see also McCarthy and Prince 1993).

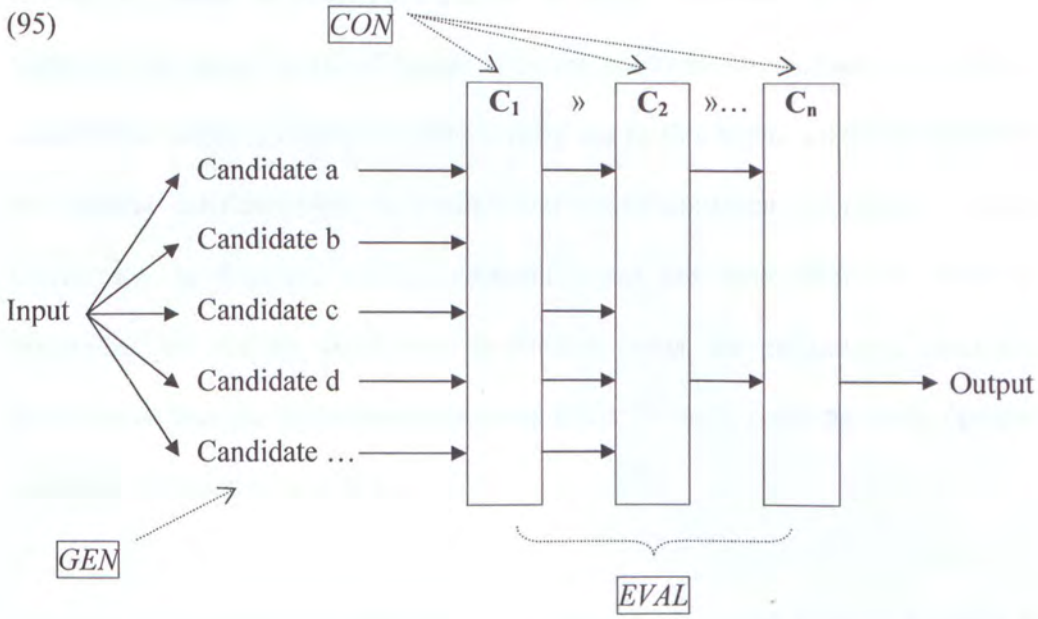
Optimality Theory is considered "a development of Generative Grammar, a theory sharing its focus on formal description and quest for universal principles, on the basis of empirical research of linguistic typology [...]" (Kager 1999). In order to capture universality in languages, an idea which has long been the main concern of many analyses, OT assumes a set of universal, violable constraints; however, although constraints are universal, rankings of the same set of constraints are language-specific. "At the heart of OT is the notion that grammars of individual languages instantiate general ranking schemata of constraints of different types" (Kager 1999:43).

Constraints can be categorized into 'markedness' constraints and 'faithfulness' constraints. 'Marked' structures are generally avoided by all languages over

'unmarked' structures, but are useful in creating contrast. 'Faithful' structures, on the other hand, are preferred since they preserve lexical contrast. These two ideas are inherently conflicting; when lexical contrast is to be preserved, 'neutralization' of a structure must be sacrificed; and vice versa, if marked structures were to be avoided, some contrastive structures must be 'neutralized'. Thus, any logically possible output will necessarily violate some constraints.

Each violation of the constraints is generally to be avoided, but some violations of the constraints will be more fatal than others. Kager (1999) explaines that "evaluation takes place by a set of hierarchically ranked constraints (C_1» C_2»…C_n) until a point is reached at which only one output candidate survives". OT, as an output-based grammar, consists of three functions, GENERATOR (*GEN*), CONSTRAINTS (*CON*) and EVALUATOR (*EVAL*). *GEN* produces an (infinite) set of possible outputs for any given input, and *EVAL* checks all possible outputs of the input against a set of constraints *CON*, and determines which output best satisfies those constraints. The schema in (93), based on that by Kager (1999:8), depicts the mechanism of OT:

(95)



The output that violates the least fatal constraints, in other words, the most 'harmonic' choice, will be selected as the 'optimal' output, hence the name Optimality Theory. The tableaux in (96) and (97), taken from Pulleyblank (1997), further illustrates how the OT works by putting it in context:

(96) English: general faithfulness to input voicing

/sad/ 'sod'	Faith [Voice]	ContrastiveCoda	Obs/Voi
☞ a. sad		*	*
b. sat	*!		

(97) Russian: neutralization of voicing in codas

/sad/ 'garden'	ContrastiveCoda	Faith [Voice]	Obs/Voi
a. sad	*!		*
☞ b. sat		*	

In English, voiced obstruents are attested in codas. Therefore faithfulness of the output to the input is ranked higher than the markedness constraint in order to preserve the contrast. Candidate (96b) is ruled out by this higher constraint although the 'optimal' candidate (96a) violated a lower ranked constraint CONTRASTIVECODA. Conversely, in Russian, voiced obstruent codas are impossible. In order to 'neutralize' the voicing distinctions in Russian codas, the markedness constraint ranks higher than the faithfulness constraint FAITH [VOICE], resulting in the optimal candidate (97b) rather than (97a).

One of the main differences between OT and the autosegmental framework is that in OT, " [...] there is no need to appeal to level ordering or cyclicity" which is often necessary in derivational theories (Kothari 2004:1). She continues to justify her adopting of OT in her paper on Bengali vowel hiatus by commenting that the cyclic account not only fails to capture the occurrence of some of her core examples, but has in fact introduced some unwanted complexity into the analysis. OT, on the other hand, has adequately accounted for her data and also "reveals how different forces operating in a language can exert their influence and produce optimal outputs that satisfy as many of these forces as possible", and for that reason the optimal candidate is the one that violates the least constraints among other possible candidates of output.

A more important difference between the autosegmental theory and OT (and perhaps a fundamental advantage of OT) is the concept of universality. To recap, in autosegmental theory, universals like OCP are considered absolute, and no syllables should violate these constraints. Nevertheless, the fact that data which obviously

violate OCP can be found in many languages 'exposes' the principle to much debate against it. In contrast, in OT, universals are what Goldsmith termed "soft universals" (as quoted by Fukazawa 1999), in the sense that languages tend to avoid these configurations whenever possible, but the principles are in effect violable if there are other higher-ranked constraints that take precedence over them in a particular language.

This concept is very important, especially with reference to OCP, in resolving the dispute between proponents' assertion that OCP is a principle of UG and criticisms on OCP (such as that of Odden 1986, 1988) that attested language-particular violations of OCP are proof elsewise.

Consequently, by addressing phonotactic constraints of four similar sub-dialects in OT, we do not need to assume 'differing underlying forms, nor [...] different sets of phonological rules, but solely [...] different rankings of a universal set of violable constraints' (Yip 1997:163). This would resolve the argument on the universality of OCP presented in Section 3.1.4. In the next two sections we shall look at some previous studies on the notions of OCP and nasalization within the OT framework which will be crucial to our analysis on Southern Min syllables in Chapter 4.

3.2.1 Revisiting OCP in OT

In the autosegmental framework, the OCP is expressed as a single feature-specific constraint that prohibits sequences of identical elements in the underlying representations. In OT, however, there have been discussions whether OCP should be re-interpreted as a local self-conjunction of a markedness constraint (Alderete 1997,

Itô & Mester 1998, Keer 1999, among others).

Keer (1999) accounts for OCP in his dissertation by positing that output markedness constraints universally prefer single segments over pairs. However, as Alderete (1997:1) explains that a simple OCP constraint, "[...] as a bald declarative statement, says nothing about the markedness of the elements involved. To account for the correlation between activity in a dissimilatory process and the markedness of target and trigger, adjunct theories of feature specification are required. These theories, however, have been shown to have many unsatisfactory consequences, essentially because unmarked segments can be active in ways that do not involve the OCP".

Fukazawa (1999) also points out the broader empirical coverage of considering OCP as a self-conjunction of constraint and argued against the one-constraint view using Lyman's Law in Yamato Japanese. Consider again the illustration of the Rendaku phenomenon in (59) in Section 3.1.1. The constraint governing the phenomenon, or the Lymans's Law, maintains that "[s]tems must not contain more than one voiced obstruent". It would only be straight-forward to hypothesize, then, that the blocking of the Rendaku voicing within the second morpheme is triggered by prohibiting a double occurrence of voiced obstruents, hence a self-conjoined constraint.

Another advantage of this approach, he maintains, is the ability to account for OCP effects on elements other than those on the same autosegmental tier. Alderete (1997) investigates vowel length dissimilation in the Cushitic language Oromo, and observed that in the language, there cannot be a sequence of two consecutive syllables; one of the two long syllables must be shortened, as illustrated in (98):

(98) (from Alderete 1997:8)

Length alternation in plural marker: *-oota* ~ *-ota*

a.	nama 'man, person'	→	nam-oota
	harree 'donkey'	→	harr-oota
	k'ottuu 'farmer'	→	k'ott-oota
	fardda 'horse'	→	fardd-oota
b.	gaala 'camel'	→	gaal-ota
	loomi 'lemon tree'	→	loom-ota
	ʔadaadaa 'aunt'	→	ʔadaad-ota
	adaammi 'cactus'	→	adaamm-ota

In (98a), all word stems end with a short vowel and word stems in (98b) end with a long vowel[28]. Alderete (1997) assumes the plural marker is underlyingly long and explains why it surfaces differently with a locally-conjoined markedness constraint NOLONGVOWEL$^2_{SA}$ (where SA stands for 'syllable adjacency' which was a notion proposed by Odden in one of his 1994 papers; refer to Alderete 1997 for further reference on this): 'in adjacent syllables, avoid two vowels each dominated by more than one mora'. According to him, the OCP would not have been able to derive results like this because moras do not figure in the representations worked on by the OCP, and so it cannot generalize to these cases.

[28] Data provided by Alderete (1997) actually appear opposite to his description, like *harree* and *k'ottuu* in (96a) and *gaala* and *loomi* in (96b). Unfortunately, he did not provide further explanation on the data, so we can only assume here that the ending vowel on the surface is also another marker, possibly a singular marker.

In view of the foregoing, Itô and Mester (1996) and Alderete (1997) finds it superfluous to create a constraint specifically for OCP because the effects of the OCP can be accounted by self-conjunction of general markedness constraints in a particular local domain. As Itô and Mester (1998:4) puts it: "... *there is no Obligatory Contour Principle* per se: Universal Grammar is not concerned about adjacent identicals qua identicals. Rather, OCP-effects arise when markedness constraints are violated more than once."

This 'self-conjunction of general markedness constraints in a particular local domain' is also known as 'Local Conjunction' (Smolensky 1993). The Local Conjunction Constraint (LCC) is derived by conjoining two lower-ranked constraints, e.g. constraint A and constraint B, into one higher-ranked constraint A&B. This constraint A&B is violated if and only if both constraints A and B are violated within the specified domain. It can be represented by the schema $[A \& B]_{\delta} \gg A, B$.

To illustrate, they examined the phenomenon of German coda devoicing. German syllables allow voiced obstruents in the onset position, but the obstruents get 'neutralized' to its voiceless counterpart if it occurs in the coda position. On the contrary, voiceless obstruents remain voiceless regardless of their position within the syllable:

(99) (originally from Vennemann 1978, copied from Itô and Mester 1996:12)

'wheel (gen., nom., dim.)':

Rades [.ra:.d̲əs.] Rad [.ra:t̲.] Rädchen [.rɛ:t̲.çən.]'

(cf. 'council (gen., nom.)': Rates [.ra:.t͡əs.] Rat [.ra:t̲.])

'motive (pl., sg., gen.)'

Motive [.mo .ti:.v̲ə.] Motiv [.mo.ti:f̲] Motivs [.mo.ti:f̲s.]

(cf. 'deep (attr., pred.)': tiefe [.ti:.f̲ə.] tief [.ti:f̲.])

'read (inf., imp.); readable'

lesen [.le:.z̲en.] lies [.li:s̲.] lesbar [.le:s̲.ba:r.]

(cf. '(they, he) ate': aßen [.a:.s̲ən.] aß [.a:s̲.])

Itô and Mester (1996:11) concluded that, "... [v]oiced obstruents are marked elements, and syllable codas are marked positions. The phonology of German permits both, insisting on faithful parsing of the input. What is ruled out, however, is *the marked in a marked position*: a voiced obstruent as a coda. Here input voicing yields to the combined power of two markedness constraints", namely the NO-CODA constraint, which disprefer occurrence of codas, and the VOP (Voiced Obstruent Prohibition) constraint, which disprefers voiced obstruents. These two constraints, on their own, are not significant in the language, as both codas and voiced obstruents are commonly found in German; nevertheless, when they conjoin, they form a robust constraint which restricts the coda and voiced obstruent constraints being violated together, that is to say, the conjoined constraint NO-CODA $\&_{\delta}$ VOP restricts occurrence of voiced obstruent codas in German.

Tableau (100) demonstrates the effect of the said constraints with regard to voiced obstruent in the coda position and in the onset position repectively:

(100) a.

/li:b/ *lieb* 'dear, pred.'	NO-CODA &$_{\delta}$ VOP	IDENT[F]	VOP	NO-CODA
.li:b.	*!		*	*
.li:p.		*		*

b.

/li:bə/ *liebe* 'dear, attr.'	NO-CODA &$_{\delta}$ VOP	IDENT[F]	VOP	NO-CODA
.li:.bə.			*	
.li:.pə.		*!		

The concept of OCP is expressed in a similar fashion, only instead of having two distinct constraint A and constraint B, there is only one constraint P, which self-conjoins to form the LCC [P P], which can be abbreviated as $[P]^2$.

Back in Section 3.1.1., we discussed the Lyman's Law in Yamato Japanese (see (61)), where *Rendaku*, the voicing of the initial obstruent of the second morpheme is blocked if there is already a voiced obstruent within the morpheme (regardless of adjacency, which is also one of the advantages of OT over autosegmental framework, refer to (61b)) In OT, this can be accounted for by the self-conjoined conjunction of VOP^2, "No co-occurrence of voiced obstruency with itself" (see Itô and Mester 1996:227):

(101) (copied from Kager 1999)

Input: /gagi/	VOP^2_δ	IDENT[F]	VOP
a. gagi	*!		*
b. kagi		*	
c. gaki		*	
d. kaki		**!	

There is no single optimal candidate in tableau (101); the point is that the constraint excludes the co-occurence of two voiced obstruents within a domain like candidate (a). The significance of LCC is that there is no need for an entirely new constraint for OCP; there is, in essence, just one (or two) basic markedness constraint(s).

3.2.2 Nasalization in OT

Whilst examining the glottal coda in Chaoyang, Yip (1994) noted that in Chinese, "final (oral) stops are usually unreleased and frequently accompanied by glottal closure". To be exact, according to Yip, syllables with final (oral) stop codas e.g. [tak] can be transcribed narrowly as [tak˜]; she even went to the extent to state that "[u]nlike final vowels and glides, which may or may not be glottalized, final oral stops appear to get glottalization obligatorily" (Yip 1994:2).

On the contrary, nasal codas never co-occur with glottal stops, i.e. nasal stop codas are in complementary distribution with oral stop codas. Yip (1997) then suggests that nasal codas are in fact not phonologically nasal: 'the contrast between nasal and oral codas can be reduced to the presence or absence of [c.g.], and nasality and voicing

are predictable from the absence of [c.g.]'. [c.g.] here stands for [constricted glottis], and is a syllabic/morphemic feature rather than a segmental feature. Since final oral (voiceless) stops appear to be always accompanied by the glottal stop, presence of [c.g.] implies lack of [voice] and [nasal], and vice versa. In other words, Southern Min codas consists of only a [+cons] root node with a set of relevant place features, underspecified in [voice] and [nasal] by default, and the surface representation will depend on whether this [c.g.] feature (and the entailed [voice] and [nasal] features) is present. Morphemes will be categorized into either having [nasal] specification or not having [nasal] specification in the underlying representation. This in fact coincides to what has been previously discussed in Section 3.1.3.3 on the glottalization of codas.

Yip (1997) remarks that in Chaoyang, nasality surfaces differently in different syllable types:

(102)

UR	**PR**	**Position of [nasal] in PR**
tau [nasal]	tãũ	entire rhyme
lau [nasal]	nãũ	entire syllable
tak [nasal]	tak	does not surface
lak [nasal]	nak	onset only

She further proposes a number of constraints within the Optimality Framework in order to account for the various nasal occurrences found in Southern Min Dialects[29].

[29] Yip's 1994 paper forcuses on the Chaoyang Dialect while her 1997 paper has expanded the scope

These will be discussed again in the next section, but for ease of understanding, she suggests that the concerned constraints are:

- NASVOI: [nasal] ⊃ [voice]

  the presence of [nasal] implies the presence of [voice];

- RHYMEHARMONY

  all segments in the rhyme must share any nasal specification;

- SYLLABLEHARMONY

  all segments in the syllable must share any nasal specification;

- MAXNASAL

  nasality must be realized if possible.

Yip also proposes a number of rankings for different 'types' of Southern Min Dialects, two of which are relevant to this study:

(103) Ranking for Dialects including Xiamen, Quanzhou and Zhangping

NASVOI , ALIGN R&L » RHYMEHARMONY, ALIGN-R » MAXNASAL » *NASALVOWELS, ALIGN-L

(104) Ranking for Dialects including Xiamen, Quanzhou and Zhangping

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of study to groups of Southern Min Dialects including Chaoyang, Jieyang, Shantou, Tatouba, Xiamen, Jinjiang, Longxi, Quanhou and Chaozhou.

NASVOI , ALIGN R&L » RHYMEHARMONY » MAXNASAL » ALIGN-R » *NASALVOWELS, ALIGN-L

Her hierarchy does a rather good job of capturing the slight differences of nasality between the Dialects. How these constraints actually interact and distinguishes the dialects will be futher discussed in the coming chapter.

CHAPTER 4 AN OPTIMALITY ANALYSIS OF THE SOUTHERN MIN PHONOTACTICS

4.1 On labial co-occurrence

Let us review the generalizations of Southern Min labial co-occurrences made in Chapter 2:

(105) (=(30))

	Xiamen	**Quanzhou**	**Zhangping**	**Shantou**
C_{ONSET}[+lab] + V[+rnd] (e.g. po)	Yes	Yes	Yes	Yes
C_{ONSET}[+lab] + C_{CODA}[+lab] (e.g.pap)	Never	Never	Never	Never
V[+rnd] + V[+rnd] (e.g. ou)	Never	Never	Yes (but only one instance)	Yes (but only two instances)
V[+rnd] + C_{CODA}[+lab] (e.g. top/ puap)	Never	Never	Never	Never

As already generalized in (57), labial codas are the most restricted in Southern Min Dialects: both combinations of 'labial onset – labial coda' and 'rounded vowel – labial coda' are prohibited. However, 'labial onset – rounded vowel' is completely

acceptable. How can we account for this asymmetry?

By first considering 'labial onset – rounded vowel' combination, it may be proposed that the labial onset be treated differently from the rounded vowel, presupposing that we disregard the redundancy rule [+round] implies [+labial] in 3.1.1.2. One may even go as far as maintaining that the rounded vowels are in fact underspecified for the feature [labial].

This would of course explain why syllables like [po] or [pok] are acceptable and [pam] or [bap] are not, as the former syllables simply contain one [+labial] feature and the latter syllables contain two [+labial] features; however, the non-occurrence of syllables involving rounded vowels and labial codas like *[tom] or *[kup] cannot be correctly deduced by this postulation. In light of this, we must assume that there is at least some 'trace' of [labial] in rounded vowels.

Alternatively, if [+round] is considered to entail [+labial], all rounded vowels will be

now [+labial] like labial consonants, and we may be able to demonstrate why syllables like [pam], [bap], [tom] or [kup] are ill-formed, since there will be two [+labial] features within the same syllable. However, this suggestion will at the same time ban the permissible 'labial onset – rounded vowel' combination like [bo] and [pu].

A second, more moderate proposal would be to consider the status of rounded vowel as is: that it is simply [+round], and not 'fully' labial (to illustrate, [labial] can be considered of a value of 1 and [round] of a value of 0.5 on an arbitrary scale). This will again explain why syllables like [po] and [pok] are acceptable, since the labials are not 'fully' in conflict; but under such treatment, it is puzzling why co-occurrence with labial codas like *[tom] and *[kup] would be prohibited all the same!

At this point, we are left with one remaining hypothesis that labial onsets and labial codas are in fact different in terms of its [labial] feature; in fact, the idea of analyzing labial codas differently would at first sight be the logical path to take because whenever C_{CODA}[+lab] is involved, no co-occurrences with any other [lab] segment is allowed. Following this line of reasoning, one may consider both labial onsets and rounded vowels (which are also considered labial) as having values of less than 0.5 and labial coda a 1 on the same arbitrary scale. Any total of over 1 within a sylalble would be considered a violation. The main objective is that the labial feature can be the only labial feature when it occurs in the coda position, whereas it can co-occur in other positions[30]. This would correctly account for the permissibility of labial onset co-occurring with rounded vowels, and also the prohibition of labial codas co-occurring with any other labial segments within the syllable. It goes without saying that such treatment is unacceptable, as it is not only uneconomical to consider the [labial] in onsets and codas differently, but this is also a baseless postulation.

[30] This is not entirely true, as rounded glides cannot co-occur within all four dialects, and in Xiamen and Quanzhou Dialects no two rounded vowels can occur at all (the other two allows [ou] combinations.) This will unfortunately not be analyzed in this thesis. For reasons, please refer to the paragraphs regarding repair below.

Given the above, it would be very tempting to resort to explaining the co-occurrence restriction by way of syllable structure; however, this would have defeated the grounds for our applying OT in Southern Min phonotactics. Yip (2003), who investigated labial co-occurrence in Mandarin in her paper, is also aware of this dilemma, and suggests that the 'co-occurrence' may lie in the 'relative influences of degrees of similarity, and degrees of proximity' of the segments involved.

Yip's proposal is that the co-occurrence of labial segments per se is not essentially the main concern; rather, illicit combinations arise from co-occurrences of segments which are most similar and in closest proximity. She based the similarity of segments on the degree of closure, and explained the mechanism with the table below (shaded cells are the non-occurring sequences in Mandarin):

(106) (from Yip 2003:21)

(w: labial medial glide; V: any non-labial vowel, X: any non-labial segment, or zero; Dash ('-'): sequence that cannot arise for reasons of syllable structure, such as [wXXw], where two segments separate two glides.)

Degree of Dissimilarity	Ø	1	1	1	2	2
# of intervening segments	ww	wu uw	mw	pw	mu	pu
0	-	*XwuX * Xuw	* mwVX	* pwVX	muX	puX
1	*XwVw	-	mVw	pVw	myuX	pyuX

2	-	-	myVw	pyVw	-	-

As seen in Table (106), dissimilarity increases from left to right, and proximity/ closeness between the relevant segments decreases from top to bottom: therefore, the pairs of labial segments to the top left should be the most restricted co-occurrences and pairs of labial segments to the bottom should be able co-occur relatively freely.

Mandarin has no labial codas, so the co-occurrence of labial codas is not taken into account. If we apply Yip's (2003) proposal to Southern Min, this must be added into the table as well. However, the above table does not distinguish the relative positions of the segments, and [pu] is treated no differently from [-up], which is clearly not the case. Yip was also aware of such asymmetry, but contended that constituency is still not necessary because this can be attributed to the perception of place constrasts in coda position. In Cantonese, for example, final consonants are not released. Labial consonants are hardest to perceive in coda position and especially after a labial vowel (refer to Yip 2003 for a more detailed explanation). With this in mind, we may give labial co-occurrence in Southern Min an alternative description: syllables like [pap] and [tup] are not necessarily 'prohibited', but they are in fact so poorly perceived within the phonological system of the Dialects that they do not seem to occur, possibly because they will be 'overshadowed' by other similar syllables.

Before continuing on establishing relevant constraints, we must first digress for a moment and resolve a very important issue: what is the repair for any input that violates the labial co-occurrence ranking?

In his study of the Hakka dialects, Chung (2006) mentioned that in Siyen Hakka, labial co-occurring syllables like [fam] 犯 and [fap] 法 used to exist, but due to an increasingly robust labial co-occurrence restriction, 犯 and 法 are now pronounced as [fan] and [fat] respectively. Steriade (2001:3) suggested that such transformation was due to the concept of 'minimal modification'. She writes, "The diagnosis for the problem encountered [...] starts with the observation that of all the input-output pairs [...], the one judged most similar is the pair [chosen]. The aim, in any departure from the UR, is to change it minimally to achieve compliance with the phonotactics". Therefore, the observation in Hakka will, at the very least, suggest that given an input like /pap/ which is ill-formed as an output, the minimal modification would be to change the labial coda to a coronal coda, whilte retaining all other features such as [nasal]. Other responses to the violation such as feature changing, deletion or epenthesis are unattested responses in this case.

Here, the question becomes why [pat] is chosen over [tap] as the repair for /pap/, when both candidates only differ in the location where the dissimilation takes place. Beckman (2004:107) explains this tendency by positional faithfulness (Selkirk 1994; Padgett 1995; Urbanczyk 1996; Beckman 1997, 1999; Casali 1997; Walker 1997;Lombardi 1999, 2001; Alderete 1999, 2001, as cited from Beckman 2004): "According to proponents of positional faithfulness, onset/coda asymmetries exist not because place features are prohibited in codas, but rather that they are preferentially preserved in onsets, and less zealously guarded in other positions". This is also much in line with what we have discussed earlier in this section. It is not too far-fetched, then, to claim that ill-formed input with labial codas will be rescued

by changing the coda into its coronal correspondent, i.e. /pap/ → [pat], /tup/ → [tut]. Labial codas will remain contrastive if it is the only segment with [labial] within the syllable, like [tap].

Unfortunately, unlike the example [fam] →[fan], there are no empirical evidence of how the prohibited combinations of /ou/ in Xiamen and Quanzhou Dialects and /uo/ in all four dialects are repaired. We can, of course, make guesses and assumptions, but this may adversely affect our analysis below. It would thus be best to work on what has been established, and not to include the co-occurrence asymmetry of rounded vowels in this thesis. Notwithstanding, its non-occurrences are duly noted.

We shall now try to develop constraints to account for labial co-occurrences, basing largely on Fukazawa's (1999) proposal on coronal co-occurrence restrictions.

We have already previously mentioned that labials are considered a marked feature and is therefore generally dispreferred, especially when they co-occur, hence the need for OCP[LAB][31]; however, cross-dialectally, we can see a variability with the extent co-occurrences of labials are dispreferred. Nevertheless, when one of the labial feature involved is present in the coda position, co-occurrence of labials within the syllable domain will be banned altogether. Kager (1999:94) mentioned that codas are avoided universally, which can be expressed as NO-CODA. This is quite similar to the German Coda Devoicing phenomenon discussed in Section 3.2.1, where a marked feature in a marked position is strongly unfavorable. In our case, given the 'dispreferene' arise not in a coda with a labial feature within the syllable, but in the

[31] Fukazawa (1999) also uses OCP[F] to refer to the self-conjunction *[F][F]. It is used in this thesis purely for the sake of clarity.

co-occurrence of labials in the syllable where one of it occurs in the coda position, I will hereby propose a an LCC, [OCP[LAB] & NO-CODA], to express the above dispreference.

In order to prevent dissimilation by segmental deletion, we also have to specify the MAX-IO constraint. UNIFORMITY [lab] is to prevent 'curing' the OCP violation by singly-linking the two segments to one [lab] feature in the underlying representation, which is still a bad candidate in this case.

(107) **OCP[LAB]**

No co-occurrence of the [labial] feature within the syllable domain.

(108) **NO-CODA**

Syllables must not end with a coda.

(109) **[OCP[LAB] &$_{\delta}$ NO-CODA]**

Syllables must not have co-occurring [labial] features and codas at the same time.

(110) **MAX-IO**

Every segment of the input has a correspondent in the output ('no deletion').

(111) **UNIFORMITY [LAB]**

No feature of the output has multiple correspondents in the input.

I also make use of IDENT$_{Onset}$ (Pagett 2002) to preserve the onsets in cases where there is conflict with the codas.

(112) **IDENT$_{Onset}$ (place)**

An output segment in the onset of a syllable and the segment's input correspondent must have identical Place specifications.

We also need another constraint to prevent 'delabializing' (change of place of articulation or unrounding) of any [labial] segments in permissible syllables like [pu] or [bo].

(113) **IDENT-IO[F]**

Correspondent segments have identicdal values for feature [F] (no featural changes).

This can be ranked lower in the hierarchy, but must dominate over OCP[LAB] for reasons shown in tableau (114).

(114)

Input: /pu/	OCP[LAB] & NO-CODA	IDENT$_{Onset}$	IDENT-IO[F]	OCP[LAB]
a. [pu]				*
b. [pɯ]			*!	
c. [tu]		*!	*	

Tableau (114) shows an input with co-occurring labial featurs which is deemed acceptable in all four languages. We will therefore need to rank the two IDENT constraints higher than the OCP[LAB] to rule out any unnecessary deletion of labial feature like candidates b and c.

With reference to co-occurrence of labial codas, the ranking used in tableaux (115) and (116) illustrates how the optimal candidates are chosen.

(115)

Input: /t u p/	OCP[LAB] & NO-CODA	MAX-IO	UNIFORMITY [lab]	IDENT Onset
a. [tup] || [lab][lab]	*!			
b. [tut]				
c. [put]				*!
d. [tu]		*!		

(116)

Input: /p a p/	OCP[LAB] & NO-CODA	MAX-IO	UNIFORMITY [lab]	IDENT Onset
a. [pap] || [lab][lab]	*!			
b. [pap] \ / [lab]			*!	
c. [pat]				
d. [tap]				*!
e. [pa]		*!		

Both inputs /tup/ and /pap/ are clearly ill-formed. Since we have already previously mentioned that labial codas do not co-occur with either labial onsets or rounded vowels, ruling candidates a out in both tableaux by OCP[LAB] & NO-CODA. In (116) the new candidate (b) avoids violation of OCP by a (labial) feature fusion (cf Fukazawa 1999) but the surface representation of [pap] is still disallowed so this will have to be ruled out by the uniformity constraint. Repair is certainly necessary, but deletion of segments (as in candidate e) or segmental reversal (as in candidate d) is not as optimal. However, at this stage there is no need to distinguish between the hierarchy of the relevant constraints MAX-IO , UNIFORMITY [lab] , $\text{IDENT}_{\text{Onset}}$.

After setting the different tolerability of co-occurrence of rounded vowels among the four Dialects, we can see that they are very similar, if not identical, in labial co-occurrence restrictions. We may simply express the constraints in one general ranking, as stated in (117).

(117) Constraint ranking for Labial Co-occurrences in all four Dialects (final)

OCP[LAB] & NO-CODA » MAX-IO , UNIFORMITY [lab] , $\text{IDENT}_{\text{Onset}}$, IDENT-IO[F] » OCP[LAB]

4.2 On nasalization

Let us first recap the Southen Min nasalization generalizations made in Chapter 2:

(118) (=56)

	Xiamen	**Quanzhou**	**Zhangping**	**Shantou**
N_{ONSET} + $\tilde{V}$ (e.g. mĩ)	Yes	Yes	Yes	Yes
N_{ONSET} + V (e.g.mi)	Never	Never	Yes	Yes
C_{ONSET} [-vce] + $\tilde{V}$ (e.g. pĩ)	Yes	Yes	Yes	Yes
C_{ONSET} [+vce] + $\tilde{V}$ (e.g. bĩ)	Never	Never	Never	Never
$\tilde{V}$ + C/N_{CODA} **(e.g.** ĩt/ ĩn)	Never	Never	Never	Never
N_{ONSET} + C/N_{CODA} **(e.g.** mak/ min)	Never	Never	Never	Yes

It is important to reiterate our conjecture that the nasal is a floating feature that attaches to a morpheme. The analysis on nasality in the following section essentially follows that by Yip (1994, 2000).

The table in (118) shows that nasality can surface in open syllables with voiceless oral onsets, e.g. [pĩ] (Yip 2000). At the same time, while the voiceless oral onset is rejects association to [nasal], contrast between [pĩ] and [pi] is always preserved. In other words, any floating [nasal] feature should be parsed wherever possible, but alternatively, if there is no floating [nasal] feature, no [nasal] should surface in the output at all. This is true in all four dialects. *NASALVOWEL is in place to prevent

nasalized vowels from surfacing from underlying representations that does not have [nasal] morphemes assigned.

(119) NASVOI: [nasal] ⊃ [voice]

If segment is [-voice], then it can never be [+nasal].

(120) MAXNASAL

Input specifications for [nasal] must have a correspondent in the output.

(121) *NASALVOWEL

No nasalized vowels.

In contrast, the combination of voiced oral onsets and their nasal counterparts are in complementary distribution, that is, voiced oral onsets only occur with oral vowels but not with nasalized vowels. The nasalized vowels will occur with the nasal counterparts of the voiced oral onsets. Given the underlying representation /bi/, the entire syllable gets nasalized if the floating [nasal] morpheme is present, as the voiced onset licenses association with nasal. However, in order to correctly account for [mĩ] as the correct surface representations of /bi/ associated with [nasal], we need another constraint, SYLLABLEHARMONY, to ensure that both the onset and rime is nasalized.

(122) SYLLABLEHARMONY

All segments in the syllable must share any nasal specification.

NASVOI mshould be ranked highest to avoid nasals being incorrectly parsed to voiceless oral onset, so that contrast is preserved. MAXNASAL must dominate over *NASALVOWEL because nasalized vowels do exist in Southern Min and ranking *NASALVOWEL over MAXNASAL will neutralize all nasalized vowels in the dialects. SYLLABLEHARMONY should rank over *NASALVOWEL but under MAXNASAL, to prevent partial-association of [nasal] within the syllable.

(123)

Input: /pi/	NASVOI	MAXNASAL	*NASALVOWEL
a. [pi]			
b. [pĩ]			*!

(124)

Input: /pi, [nasal]/	NASVOI	MAXNASAL	*NASALVOWEL
a. [pi]		*!	
b. [pĩ]			*
c. [mĩ]	*!		*

In tableau (123), since /pi/ without an associated nasal morpheme should surface as is, we must have *NASALVOWEL to exclude the unwarranted nasalization of the vowel. NASVOI will also rule out any nasalization of the voiceless onset. However, when the input /pi/ is associated with a nasal morpheme, as in tableau (124), the nasal must be parsed to the vowel. MAXNASAL will ensure that the nasal morpheme is realized on the surface. Candidate (c) [mĩ] is naturally out since the voiceless/p/ cannot be parsed with the nasal.

(125)

Input: /bi/	NASVOI	MAXNASAL	*NASALVOWEL
a. [bi]			
b. [bĩ]			*!
c. [mĩ]			*!

(126)

Input: /bi, [nasal]/	NASVOI	MAXNASAL	SYLHARM	*NASVOWEL
a. [bi]		*!		
b. [bĩ]			*!	*
c. [mĩ]				*
d. [mi]			*!	

In tableaux (125) and (126), we have the input /bi/ without and with a nasal morpheme respectively. Since [bi] is a permissible output, *NASALVOWEL will again exclude any unwarranted nasalization.

On the other hand, in order to ensure the nasal gets realized in the latter case while maintaining the validity (*[bĩ] is a prohibited syllable in all four dialects), we need SYLLABLEHARMONY to have both the onset and the vowel nasalized.

At this point, a primary ranking of NASVOI » MAXNASAL » SYLLABLEHARMONY » *NASALVOWEL is established. However, this ranking is now under serious challenge. As far as our data is concerned, Zhangping and Shantou Dialects seem to allow, to a certain extent, combinations of nasal onsets and oral vowels, and these can be contrastive with its nasalized vowels. Under the current proposed ranking, the contrast between [mi] and [mĩ] would have been neutralized as in (126). Since this occurs within the same Dialect, the constraints or the ranking would be irrelevant in this case. It follows that if an explanation must be provided, this would certainly require a revision on either the derivation of nasality among the four Dialects, or an in-depth investigation on the underlying representations of the two syllables, both of which are too uneconomical for this thesis.

In fact, Yip (1997) has done a generalization on the nasality in a number of Southern Min Dialects (see Yip 1997, Section 1.1). As per her summary, the Shantou Dialect does <u>not</u> allow N_{ONSET}+V combinations. Yet, she also notes that the Chaozhou Dialect, which is very close to the Shantou Dialect, allows N_{ONSET}+V combinations but not N_{ONSET}+Ṽ combinations. Due to the proximity of the dialects, it is very likely that a certain degree of 'integration' has taken place. With limited literature that comprehensively examines the phonological inventory of the Shantou Dialect, we shall, albeit reluctantly, view the co-occurrence of syllables like [mi] and [mĩ] as two

separate dialect systems.

Nonetheless, we shall also see how [mi] surfaces in Chaozhou and how it is different from the ranking proposed in Shantou, even though Chaozhou is not exactly in our scope of study.

(127) (following the ranking by Yip 1997:176)

Input: /bi, [nasal]/	RHYME HARMONY	MAX NASAL	*NASAL VOWELS
a. [mi]			
b. [mĩ]			*!

The ranking between the two systems are largely similar, with only a slight ranking difference of the constraint *NASALVOWELS. Since the nasal is surfaced within the syllable but the rhyme remains oral, it is clear that the Dialect rejects nasalized vowels rather strongly, hence the discrepancy.

We shall now extend our ranking development to the issue of codas. Referring back to the discussion in Section 2.3.2., it is apparent that the presence of codas restricts nasality within the syllable significantly. All four dialects reject nasalized vowels in closed syllables (whether the coda is oral or nasal), and Xiamen, Quanzhou and Zhangzhou Dialects also reject nasal onsets in closed syllables.

To account for the above in the three mentioned dialects, Yip (1997) proposes the ranking as: NASVOI , ALIGN R&L » RHYMEHARMONY, ALIGN-R » MAXNASAL » ALIGN-L.

Two new constraints are introduced here: ALIGN-L and ALIGN-R. Yip (1997) proposed that this pair of alignment constraints, when conjoined together to form an LCC ALIGN-L&R, will replace SYLLABLEHARMONY in defining the local domain of the syllable. We shall further discuss the reasoning behind this substitution.

(128) ALIGN-L(nasal, σ)

Align left edge of featural span for [nasal] with left edge of σ.

(129) ALIGN-R(nasal, σ)

Align right edge of featural span for [nasal] with right edge of σ.

Now consider tableau (130):

(130) Xiamen, Quanzhou and Zhangzhou Dialects

Input: /bak, [nasal]/	NASVOI	R-HARM	ALIGN-R	MAXNAS	ALIGN-L
a. [bak]				*	
b. [bãk]		*!			*
c. [bãŋ]	*!				
d. [mãk]		*!			
e. [mak]			*!		

In Xiamen, Quanzhou and Zhangzhou Dialects, an input of /bak, [nasal]/ will undoubtedly yield an output of [bak], where the [nasal] does not surface at all, because of the voiceless coda. The [nasal] is only suppressed throughout the syllable if the [nasal] is aligned to the right. Therefore ALIGN-R » MAXNASAL. An input of /pa, [nasal]/, on the contrary, will yield [pã]; the rime is nasalized even though the voiceless onset do not license nasalization. Therefore MAXNASAL » ALIGN-L. This asymmetry cannot be explained simply by SYLLABLEHARMONY, which merely

'demands' that all segments in the syllable must share any nasal specification, but does not specify alignment of the nasal morpheme. In these three dialects, the ranking (or the distinction) or R-HARM and ALIGN-R is not important.

As for the Shantou Dialect, an input of /bak, [nasal]/ will generate the output [mak]. The constraint ranking used for the other three languages thus needs to be fine-tuned. Since [nasal] is realized at the onset position even when a voiceless coda is present, MAXNASAL must dominate over ALIGN-R. This can be tabulated as in (131):

(131) Shantou Dialect

Input: /bak, [nasal]/	NASVOI	R-HARM	MAXNAS	ALIGN-R	ALIGN-L
a. [bak]			*!		
b. [bãk]		*!			
c. [bãŋ]	*!				
d. [mãk]		*!			
e. [mak]				*	

From tableaux (130) and (131), we can see that the constraint ALIGN-R is crucial in distinguishing the four dialects, where in Xiamen, Quanzhou and Zhangping, nasals will not surface at all when a voiceless coda is present, whereas in Shantou, the nasal will surface in the onset position when a voiceless coda is present.

So far, the constraint rankings for the four dialects are as follows:

(132) Constraint ranking for Nasalization in Xiamen, Quanzhou and Zhangping (provisional)

NASVOI » RHYMEHARMONY, ALIGN-R » MAXNASAL » ALIGN-L

(133) Constraint ranking for Nasalization in Shantou (provisional)

NASVOI » RHYMEHARMONY » MAXNASAL » ALIGN-R » ALIGN-L

The table in (102) actually misses one nasal occurrence which is present in the four languages: the nasal coda.

Now let us consider tableaux (134) and (135), which seems to illustrate incorrect derivations in Xiamen/ Quanzhou/ Zhangping and Shantou respectively:

(134) Incorrect (?) derivation in the Xiamen/ Quanzhou/ Zhangping Dialects

Input: /sab, [nasal]/	NASVOI	R-HARM	ALIGN-R	MAXNAS
a. [sap]				*!
b. [sam]		*!		
c. [sãm]				
d. [nãm]	*!			
e. [nam]	*!			

(135) Incorrect (?) derivation in the Shantou Dialect

Input: /sab, [nasal]/	NASVOI	R-HARM	MAXNAS
a. [sap]			*!
b. [sam]		*!	
c. [sãm]			
d. [nãm]	*!		
e. [nam]	*!		

Using the proposed rankings, [sãm] emerges as the optimal candidate in both languages; however, in reality, not only is [sãm] not optimal, [ãm] is in fact a prohibited combination that is cross-dialectally absent. In order to resolve this conflict, recall the views on nasal codas by Yip (1994, 1997) discussed in Section 3.2.2.: she argued that "[…] nasal codas are not phonologically nasal, but simply codas that lack [c.g.]. Thus despite surface appearances to the contrary, both the non-existent [ãm] and [ãp] would be disharmonic for nasality" (Yip 1994). Thus, it is actually candidate [sãm], and not [sam], that violates the RHYMEHARMONY constraint, as the coda [m] is, in essence, not nasal. As a result, the violation asterisk * under RHYMEHARMONY should be put under [sãm] instead:

(136) Derivation in the Xiamen/ Quanzhou/ Zhangping Dialects

Input: /sab, [nasal]/	NASVOI	R-HARM	ALIGN-R	MAXNAS
a. [sap]				*!
b. [sam]				
c. [sãm]		*!		
d. [nãm]	*!			
e. [nam]	*!			

(137) Derivation in the Shantou Dialect

Input: /sab, [nasal]/	NASVOI	R-HARM	MAXNAS
a. [sap]			*!
b. [sam]			
c. [sãm]		*!	
d. [nãm]	*!		
e. [nam]	*!		

Putting aside the unsolved issues in Zhangping and Shantou, the last step now is to rank *NASALVOWELS into these rankings. It has already been established that *NASALVOWELS must be ranked lower than MAXNASAL; the positions of *NASALVOWELS and ALIGN-L is not important as ALIGN-L only concerns the leftmost boundary of a syllable. What is left for our consideration at this point is where *NASALVOWELS stand with regard to ALIGN-R in the Shantou ranking. The purpose of *NASALVOWELS is to avoid the universally marked nasalized vowels;

however, nasalized vowels obviously exist in Southern Min under certain contexts. Therefore, *NASALVOWELS must be placed under ALIGN-R, so that vowels that are associated with [nasal] get the opportunity to surface as [nasal] whenever possible.

We now come to the final constraint rankings for the four dialects, three of which share the same ranking. The hierarchies are given below in (138a) and (138b):

(138) a. Constraint ranking for Nasalization in Xiamen, Quanzhou and Zhangping Dialects (final)

NASVOI » RHYMEHARMONY, ALIGN-R » MAXNASAL » *NASALVOWELS, ALIGN-L

b. Constraint ranking for Nasalization in Shantou Dialect (final)

NASVOI » RHYMEHARMONY » MAXNASAL » ALIGN-R » *NASALVOWELS, ALIGN-L

4.3 Summary: a Southern Min 'Typology'

To summarize, the tables in (139) and (140) is a typological representation of the constraint rankings of the four Dialects in the labial co-occurrence and nasality aspects:

(139) Southern Min labial co-occurrence: Typology

	Constraint Ranking					
Xiamen **Quanzhou** **Zhangping** **Shantou**	OCP[LAB] & NO-CODA	MAX-IO	UNIFORMITY [lab]	$\text{IDENT}_{\text{Onset}}$	IDENT-IO[F]	OCP[LAB]

(140) Southern Min nasality: Typology

	Constraint Ranking					
Xiamen **Quanzhou** **Zhangping**	NASVOI	RHYME HARMONY	ALIGN-R	MAX NASALS	*NASAL VOWELS	ALIGN-L
Shantou			MAX NASALS	ALIGN-R		

CHAPTER 5 CONCLUSION

5.1 Conclusion

This thesis attempts to show that dialects in the same language are not only similar because of similar phonetic inventories from a layman's point of view, but also because they are governed by very similar phonological constraints, by examining phonotactic constraints in four Southern Min Dialects. The Optimality Theory framework has captured the phonotactic constraints observed across the four Dialects in a systematic manner with a set of universal constraints. By changing the rankings of constraints, slight differences between dialects can be easily accounted for, which certainly is an advantage over the autosegmental phonology.

The thesis starts with presenting some background and inventories of four Southern Min Dialects. The syllables are closely examined with reference to labial co-occurrence and nasalization and some phonotactic observations are found: a) labial co-occurrences restrictions are found in all four languages; b) labial codas cannot co-occur with other labial segments in all four dialects; c) labial onsets occur freely with rounded vowels; d) co-occurrences of rounded vowels vary among the four dialects. Also, e) there is asymmetry of the co-occurrence of nasal onsets and nasalized vowels with other nasal segments, nasal onsets can only co-occur with nasalized vowels (with exception found in Zhangping and Shantou), nasalized vowels can co-occur with oral voiceless or nasal onsets; f) voiced onset do not co-occur with nasalized vowels; g) nasal (and oral) codas may not co-occur with any other nasal segments (except in Shantou Dialect), i.e. any syllable with nasalized segments must be open syllables.

With the generalizations in hand, we then review some related previous studies, especially those within the autosegmental framework. By applying the CV and syllable theories onto the phonotactic observations that have been generalized earlier, it is obvious that they are unable to fully account for some observations or explain the relationship between observations in different dialects. Also, a number of issues remain unexplained under this framework, such as the definition of adjacency, the representation of syllable structure, and whether this is necessary at all. The need and efficiency to formulate another (new) rule for some slight differences between the dialects is also questioned. This strengthens our argument that an alternative framework be used to establish the phonotactic constraints in these Dialects.

In Chapter 4, we attempt to formulate relevant constraints to address different phonotactic occurrences, and set up the relevant rankings for each Dialect. It is obvious that the four dialects are very similar in rankings of constraints that govern co-occurrences, and with a relatively limited subset of constraints, the co-occurrences observed in Chapter 2 can be satisfactorily accounted for to a large extent. Lastly, we compare the rankings for each of the dialects and develop a ranking typology, and through this cross-linguistic study, our understanding of universal principles of syllable phonotactics is greatly enhanced.

5.2 Residual Issues and Future Research

Naturally, there are some issues that have not been resolved in this thesis, and these certainly call for further attention in order to develop a much more complete constraint ranking typology. For example, the co-occurrence of rounded vowels within a syllable is not touched upon, although it is clearly systematic. Also, the

inconsistency of some of the data presented here also limited our ability to capture the phonotactics at a higher rate of accuracy (such as the [mi]/[mĩ] problem in Shantou). Furthermore, it has been briefly mentioned that there are in fact some other phonotactic restrictions in Southern Min like vowel combinations pertaining to vowel height, but we have not included this in our discussion here.

I propose that a field trip will certainly contribute to developing some answers for the above issues. I am also interested in seeing that other Southern Min sub-dialects be analyzed and incorporated into the framework. It would be most interesting, and maybe more significant, to study a relatively different Southern Min sub-dialect and compare the rankings to the four dialects examined here. This can be greatly extended to other dialects and possibly other languages, and this will certainly help us in understanding our languages as well as the universal principles that goven them.

Appendices

Appendix A – Xiamen Syllable Chart

Appendix B – Quanzhou Syllable Chart

Appendix C – Zhangping Syllable Chart

Appendix D – Shantou Syllable Chart

The characters in the cells of the above appendices are examples of the respective syllable combinations. Cells in grey are combinations which do not exist. Cells with an asterisk (*) denote that the syllables exist, but they do not have appropriate characters, if any, to represent the syllable. Cells with a pound (#) denote onomatopoeic syllables. Shaded columns are rimes that are 'controversial', but are included in the charts for comprehensiveness.

Appendix A – Xiamen Syllable Chart

(a) Onsets with Oral Rimes (no coda)

	i	u	a	ia	ua	ɔ	o	io	e	ue	iu	ui	ai	uai	au	iau
p	悲	富	巴		簸	布	褒	標	飛	杯	彪	肥	排		包	表
p'	披	浮	抛		鋪	鋪	坡	瓢	胚	批	*	屁	否		跑	飄
m																
b	微	浮	麻		磨	模	無	描	迷	買	謬	微	眉		卯	苗
t	池	推	礁	爹	汰	都	刀	潮	低	題	丟	追	獃		兜	刁
t'	黐	儲	他		拖	偷	拖	挑	推	釵	抽	梯	體		偷	超
n																
l	離	儒	蟧	惹	籮	爐	囉	撩	黎	犁	溜	鐳	來		樓	聊
ts	芝	朱	楂	遮	抓	租	遭	招	渣	齊	周	錐	栽	*	糟	釗
ts'	鰓	趨	叉	車	蔡	粗	搓	笑	妻	初	秋	崔	猜		操	抄
s	詩	輸	傻	賒	沙	酥	梭	燒	紗	梳	收	雖	西		嗽	消
k	基	居	膠	崎	歌	姑	膏	橋	家	瓜	求	規	該	乖	交	嬌
k'	欺	區	骹	奇	誇	呼	科	竅	稽	溪	丘	虧	開	快	口	蹺
ŋ																
g	疑	愚	芽	鵝	我	五	餓	*	芽	外	牛	危	涯		勢	堯
h	稀	虛	哈	靴	花	狐	河	靴	灰	回	休	非	海	淮	囂	梟
Ø	醫	淤	鴉	爺	娃	烏	阿	腰	鍋	煨	幽	威	哀	歪	喉	妖

(b) Onsets with Nasalized rimes (no coda)

	ĩ	ã	iã	uã	ɔ̃	ẽ	iũ	uĩ	ãi	uãi	ãu	iãu	m	ŋ
p	鞭		抨	搬					跛					方
p'	篇	冇	坪	潘					否					
m	棉	馬	名	幔	摸	妹		煤	買		毛			毛
b														
t	甜	擔	庭	單			張		宰					當
t'	天	他	聽	灘										湯
n	奶	籃	娘	攔	努		娘		乃		腦	猫		瓤
l														
ts	爭		精	煎			槳		前					磚
ts'	青	*	清	癬			槍							倉
s	生	三	聲	山			箱			樣				酸
k	庚	監	驚	肝			薑	慣		關				光
k'	坑	坩	輕	寬			腔	快	*					康
ŋ	硬	巖			吳				艾		藕	蟯		
g			迎											
h	獻	哄	兄	歡	火		鄉		哼	橫			媒	昏
Ø	嬰	含	纓	安	惡	嬰	鴦	橫		彎			梅	秧

(c) Onsets with Oral Rimes (oral coda)

	ip	ap	iap	it	ut	at	iat	uat	ik	ak	iak	ɔk	iɔk
p				筆	不	八	憋	撥	壁	腹	逼	北	
p'				匹	刜		撇	潑	霹	覆	*	博	
m													
b				密	物	八	滅	抹	默	木		木	
t		答	諜	得	突	達	哲	輟	德	觸	*	督	築
t'		榻	帖		凸	踢	撤	脫	斥	剔		托	蓄
n													
l	入	納	聶	日	黜	力	列	劣	慄	落		樂	略
ts	執	雜	接	質	卒	節	浙	拙	責	齪		作	祝
ts'	輯	插	妾	七	出	漆	切	撮	粟	戳		簇	促
s	濕	霎	澀	失	戌	薩	設	雪	色	*	*	速	宿
k	級	鴿	峽	訖	骨	割	潔	訣	革	角		各	腳
k'	吸	恰		乞	窟	渴	揭	缺	刻	殼		哭	曲
ŋ													
g	屹		夾	屹	訖		齧	月	玉	岳		腭	玉
h	翕	欱	協	迄	忽	喝	血	法	黑	蓄		福	旭
Ø	邑	壓	揖	乙	鬱	遏	謁	斡	億	沃		惡	約

(d) Onsets with Oral Rimes (nasal coda)

	im	am	iam	in	un	an	ian	uan	iŋ	aŋ	iaŋ	ɔŋ	iɔŋ
p				賓	分	班	鞭	搬	冰	邦	#	幫	
p'				乒	潘	攀	偏	潘	烹	芳	*	滂	
m													
b				民	文	蠻	棉	瞞	鳴	忙		摸	
t	砧	擔	甜	珍	敦	丹	田	端	登	東		東	忠
t'	琛	貪	添	趁	吞	蟶	天	湍	汀	通		湯	倀
n													
l	林	南	拈	磷	輪	鱗	連	鸞	寧	膿	亮	囊	良
ts	浸	簪	尖	真	尊	曾	煎	專	鐘	棕	漳	宗	章
ts'	侵	參	簽	親	春	餐	千	川	千	蔥	橙	蔥	娼
s	心	杉	尋	新	孫	刪	仙	宣	生	鬆	雙	霜	商
k	金	甘	兼	緊	巾	奸	堅	捐	弓	公	疆	公	薑
k'		堪	謙	輕	坤	看	牽	寬	筐	空	彊	康	姜
ŋ													
g	吟	癌	嚴	凝	銀	顏	言	原	迎	*	仰	昂	仰
h	欣	蚶	嫌	興	薰	韓	掀	番	興	烘	響	方	兇
Ø	音	庵	閹	因	溫	安	煙	彎	英	翁	央	汪	央

(e) Onsets with Oral Rimes (glottal coda)

	i?	u?	a?	ia?	ua?	ɔ?	o?	io?	e?	ue?	iu?	ui?	uai?	au?	iau?
p	鱉	*	百	壁	撥		博		擘	八		拔		暴	
p'	蹙	涕	拍	癖	潑		粕							雹	
m															
b	篾		肉		抹				要					*	
t	滴	*	搭	摘	*		桌	擢	啄		*			*	
t'	鐵	托		拆	屜		*	糴	澈						
n															
l	裂		臘	迹	捋		落	略	裂	笠				落	
ts	接		扎	食	*		作	借	仄	節	*		*		*
s'	砌		插	赤	擦			尺	冊	切					
s	薛	嗍	煠	錫	煞		索	惜	雪	楔	*				
k	*		甲	揭	割		擱	腳	郭	鍥	*	刮		*	*
k'	缺	*	較	隙	閣			*	客	瞎					*
ŋ															
g	*			揭				譴	月						
h			合	赫	喝		鶴	歇	赫			血		*	*
Ø		*	鴨	益	活	#	惡	約	呃	狹		挖			

(f) Onsets with Nasalized Rimes (glottal coda)

	ĩ˜	ã˜	iã˜	ɔ̃˜	ẽ˜	uẽ˜	uãi˜	ãu˜	iãu˜	m˜	ŋ˜
p											*
p'											#
m	物			膜	脈			*			
b											
t											
t'											
n	揑	凹									
l											
ts											
ts'											嗆
s	閃	趿					#				*
k											
k'											
ŋ					挾	挾			*		
g											
h		喝	*		嚇			*		*	哼
Ø							#				

Appendix B – Quanzhou Syllable Chart

(a) Onsets with Oral Rimes (no coda)

	i	u	a	ia	ua	ɔ	o	io	ə	e	ue	ɯ	iu	ui	ai	uai	au	iau
p	卑	富	巴		簸	布	玻	標	飛	爬	杯		彪	肥	排		包	表
p'	披	浮	葩		破	鋪	波	飄	坯		批			屁	否		跑	漂
m																		
b	微	無	麻		磨	模	無	謀	微	迷	買		繆	微	埋		卯	苗
t	池	蛛	凋	爹	舵	都	刀	兜	鎚	低	題	豬	丟	追	呆		兜	刁
t'	黐	躇	□		拖	滔	拖	挑	推	堤	釵	鋤	抽	梯	胎		偷	挑
n																		
l	里	儒	拉	惹	偌	奴	囉	樓	螺	黎	犁	驢	溜	鐳	來		撈	料
ts	之	珠	查	遮	抓	租	糟	招	坐	渣	齊	資	周	錐	栽	跩	糟	焦
ts'	鰓	趨	差	車	蔡	粗	臊	笑	吹	差	初	鼠	秋	催	猜		臭	抄
s	詩	輸	傻	賒	沙	蘇	搜	燒	垂	紗	衰	私	修	雖	獅	摔	梢	宵
k	基	龜	佳	寄	歌	姑	膏	橋	果	家	瓜	居	求	歸	該	乖	交	嬌
k'	欺	區	骸		夸	箍	柯	扣	科	稽	溪	去	邱	虧	開	快	口	蹺
ŋ																		
g	宜	牛	牙	鵝	我	五	遨	偶	□	牙	倪	語	牛	危	崖		□	堯
h	希	夫	呵	靴	花	乎	禾	靴	灰	瘕	回	虛	休	非	海	懷	囂	曉
Ø	依	雨	阿	爺	娃	烏	歐	腰	鍋	兮	鞋	余	休	威	哀	歪	喉	妖

(b) Onsets with Nasalized Rimes (no coda)

	ĩ	ã	iã	uã	ɔ̃	ẽ	iũ	uĩ	ãi	uãi	iãu	m	ŋ
p	邊	叭	抨	搬					*				楓
p'	篇	怕	坪	潘				佩					烹
m	棉	罵	名	幔	摸	妹	謬	每	邁				毛
b													
t	纏	打	庭	單			張	店	呔				當
t'	天	他	聽	攤				睇					湯
n	奶	拿	娘	欄	挪	奶	兩	蓮	耐		貓		郎
l													
ts	精	蘸	正	煎			章	前	怎				裝
ts'	青	□	清	閂			槍	千	*				倉
s	生	衫	聲	山			箱	先					霜
k	更	監	京	肝			薑	關					缸
k'	坑	坩	輕	寬	考		腔	快					糠
ŋ	硬	雅	迎		俄			龍			蟯		
g													
h	硯	烚	兄	歡	好	□	香	惠	哼				哼
Ø	嬰	涵	纓	安	惡		鴦	偎	唉	彎	貓	媒	秧

(c) Onsets with Oral Rimes (oral coda)

	ip	ap	iap	it	ut	at	iat	uat	ak	iak	ɔk	iɔk
p				筆	不	八	鱉	拔	剝	逼	駁	
p'				匹	*		撇	潑	覆	碧	噗	
m												
b				蜜	物	密	滅	抹	木		莫	
t	蛰	答	轄	得	突	值	哲	綴	逐	竹	督	築
t'		榻	帖	佚	黜	踢	徹	脫	讀	惕	托	畜
n												
l	立	塌	聶	日	律	力	列	劣	落	勒	樂	六
ts	執	汁	接	質	卒	實	節	拙	則	賊	族	祝
ts'	緝	插	妾	七	出	察	切	撮	測	策	簇	促
s	濕	圾	澀	失	述	剎	設	說	索	室	束	叔
k	急	鴿	劫		骨	結	潔	決	角	擊	國	菊
k'	吸	恰	怯	乞	屈	克	揭	缺	確	刻	哭	卻
ŋ												
g			夾		兀		蝎	月	岳		鰐	玉
h	翕	合	協	迄	忽	轄	血	發	學	黑	福	旭
Ø	揖	壓	葉	乙	聿	遏	謁	挖	沃	益	惡	育

(d) Onsets with Oral Rimes (nasal coda)

	im	am	iam	əm	in	un	an	ian	uan	iŋ	aŋ	iaŋ	uaŋ	ɔŋ	iɔŋ
p					賓	分	班	邊	般	兵	邦	砰		幫	
p'					乒	潘	攀	翩	潘	評	蜂	蘋		蓬	
m															
b					民	文	蠻	棉	瞞	猛	忙			亡	
t	沉	耽	砧		珍	敦	丹	顛	端	丁	冬			黨	中
t'	琛	貪	添		滕	吞	癱	天	湍	汀	桶			通	衷
n															
l	林	南	拈		鄰	輪	蘭	連	亂	靈	聾	涼		農	良
ts	浸	針	尖	箴	真	尊	曾	煎	專	貞	棕			宗	從
ts'	侵	參	簽	參	親	春	餐	千	川	清	蔥	槍		創	充
s	心	杉	蟬	森	新	孫	珊	仙	宣	省	送	*		爽	相
k	金	甘	兼		緊	軍	奸	堅	關	景	江	僵		狂	供
k'	欽	堪	謙		輕	昆	刊	牽	寬	卿	空	彊		礦	恐
ŋ															
g	吟	岩	嚴		凝	銀	顏	言	原	鉠		鋼		昂	仰
h	欣	蚶	嫌	欣	眩	婚	韓	掀	煩	興	杭	鄉	風	奉	凶
Ø	音	庵	閹		因	溫	安	煙	彎	英	翁	漾	*	王	容

(e) Onsets with Oral Rimes (glottal coda)

	i?	u?	a?	ia?	ua?	ɔ?	o?	io?	ə?	e?	ue?	ɯ?	iu?	ui?	au?	iau?
p	鱉	哱	百	壁	跋		博		□	伯	八		澎		暴	
p'	□	浡	拍	癖	潑		粕		垡	帕			澎	呸	鞄	
m																
b	篾	□	覓		抹		膜		卜	麥						
t	滴	挨	搭	摘	掇		桌	擢	啄	蜇			搯		篤	
t'	鐵	托	塔	拆	屜		踱		撏	宅	替			*		
n																
l	裂	□	臘	迹	捋		落	略	□	裂	笠		溜		落	*
ts	接	跕	扎	食	泄		昨	石	絕	仄	節	漬	啾			
ts'	切	擉	插	赤	掣		□	尺	啜	冊	切	□	觸		漕	悄
s	薛	嗍	煠	削	煞		索	惜	說	*	揳		□			
k	*	*	甲		割		閣	腳	郭	格	鍥	鋸	掬	刮	瀫	攪
k'	缺	跼	卡	隙	闊			扱	缺	客	狹	缺	*		銬	*
ŋ																
g				額				譴	月		筴			刮		撓
h	嘻	*	合	額	喝		鶴	歇	豁	嚇	□		*	血		妥
Ø	胰	煦	押	頁	活	嘔	學	約	噁	穢	划			挖	拗	

(f) Onsets with Nasalized Rimes (glotta coda)

	ĩ	ã	iã	ɔ̃ʔ	ẽ	iũ	ũi	ãi	uãi	ãu	iãu	m	ŋ
p													*
p'													*
m	物			膜	咩		蜢			耆			物
b													
t								*					*
t'													團
n	揑	凹	*							*			
l													
ts													旋
ts'													嗆
s	閃	*		*					*	*			嗆
k													*
k'									*				
ŋ										噭	*		
g													
h		暍	*		*	*		嗐		彀	*	默	
Ø	嚶		贏		唉			唉	*	*		嘸	嗯

Appendix C – Zhangping Syllable Chart

(a) Onsets with Oral Rimes (no coda)

	i	u	a	ia	ua	o	io	ie	ue	ei	ui	ai	uai	au	iau	ou	iu
p	裨	富	疤	爬	跋	褒	標	杯		排	肥	牌		包	表	鋪	
p'	披	浮	脬	帕	葩	菠	票	坯		稗	屁	派		拋	標	譜	
m		母				摹			糜					矛			
b	未	無	麻	馬	磨	慕	募	煤		賣		楣		卯		模	
t	豬	堆	焦	爹	大	刀	潮	袋		抵	追	台		兜	雕	都	紂
t'	啼	推	塔	宅	拖	拖	挑	胎		提	梯	態		偷	超	塗	抽
n		二				奴								腦			
l	你	擂	撈	來	瀨	羅	尿	腡		黎	鐳	來		樓	繞	爐	硫
ts	朱	芝	早	齋	蛇	曹	椒	坐		際	椎	栽		糟	招	租	周
ts'	蛆	此	差	斜	蔡	搓	*	吹		妻	催	猜		操	臭	粗	秋
s	死	師	賒	紗	沙	唆	燒	衰	衰	西	雖	獅	衰	酥	消	蘇	收
k	居	姑	胶	加	瓜	哥	橋	郭	棵	街	規	該	乖	猴	嬌	孤	糾
k'	區	枢	骸	架	可	科	竅		盔	溪	逵	楷	快	烤	僑	枯	丘
ŋ						俄								藕			
g	疑	牛	*	埃	我	窩	腰	月	餵	藝	唯	艾	歪	豪	姚	吳	幽
h	虛	敷	呵	靴	花	號	許	歇	恢	蟹	非	海	淮	吼	囂	呼	休
Ø	醫	污	拗	啞	倚	阿		矮		挨		哀	*	喉		烏	

(b) Onsets with Nasalized Rimes (no coda)

	ĩ	ã	iã	uã	iẽ	ẽi	uĩ	ãi	uãi	iãu	m	ŋ
p	邊		丙	搬		肖	飯	擺				
p'	篇	□	坪	判				痞				
m	麵	媽	脉	毛			門	□		描		
b												
t	纏	胆	呈	單		櫈	*	蒂				當
t'	天	他	程	灘				*				湯
n	尼	籃	嚀	爛		*	軟	耐		貓		
l												榔
ts	爭	正	精	煎		前	磚					裝
ts'	青	查	清	閂		千	川					倉
s	生	衫	羨	山		先	算			*		桑
k	庚	監	行	肝		筧	光					缸
k'	坑	鼾		寬		啓	勸	*		*		糠
ŋ	硬	憨	影	換		*	黃	呆	外	藕		
g												
h	稀	粘	兄	歡	哼	還	荒			*	茅	方
Ø	嬰	暗				閑		#	*	*	伢	秧

(c) Onsets with Oral Rimes (oral coda)

	ip	ap	iap	it	ut	at	iat	uat	ik	ak	iak	uak	ok	iok
p				筆	撥	八	鱉			剝			卜	
p'				匹	刜	拍	撇	潑		仆			仆	
m														
b				蜜	末	密	滅	末		沐			穆	
t		答	貼	得	術	達	哲	奪		逐			鐸	築
t'		塌	帖	撤	突	遢	鐵	脫		讀			托	
n														
l	立	納	粒	日	律	力	列	劣		落			洛	綠
ts	執	雜	汁	質	卒	實	浙	拙		捉	嚼		燭	足
ts'	緝	插	妾	七		漆	切	*		鑿	雀		粟	促
s	濕	澀	涉	薛	戌	殺	設	說		揀	削		速	肅
k	給	蛤	劫	急	骨	結	潔	決		覺			國	菊
k'	吸	磕	怯	乞	屈	刻	*	缺		殼			擴	曲
ŋ														
g			業	逆	斡		閱	斡		岳	約	*	鰐	育
h	翕	合	協	或	忽	緒	血	法		蓄	學		福	畜
Ø		壓		乙		抑				沃				

(d) Onsets with Oral Rimes (nasal coda)

	im	am	iam	in	un	an	ian	uan	iŋ	aŋ	iaŋ	uaŋ	oŋ	ioŋ
p				兵	分	班	鞭	叛		幫	*		磅	
p'				拼	盆	盤	編	攀		芳	*		朋	
m														
b				民	文	蠻	眠	*		忙			摸	
t	沉	担	砧	亭	敦	丹	顛	端	張	銅	張		冬	轉
t'	*	貪	添	挺	吞	彈	天	團		窗	暢		童	蟲
n														
l	淋	南	廉	奶	輪	蘭	連	戀	娘	儂	良		籠	隆
ts	浸	南	尖	真	尊	曾	氈	專	妝	棕	將	裝	宗	踪
ts'	深	摻	簽	親	村	餐	錢	川	槍	昌	槍		穿	從
s	心	杉	閃	新	孫	刪	仙	宣	箱	送	商	桑	庸	松
k	金	甘	兼	緊	軍	奸	捐	觀	姜	江	姜	光	攻	宮
k'	襟	嵌	謙	輕	坤	看	權	環	腔	康	腔	狂	空	恐
ŋ														
g	音	癌	嚴	人	溫	顏	言	完	羊		殃	旺	渾	絨
h	欣	蚶	嫌	形	婚	韓	掀	番	鄉	虹	香	慌	風	胸
Ø		庵		恩		安				翁			翁	

Appendix D – Shantou Syllable Chart

(a) Onsets with Oral Rimes (no coda)

	i	u	a	ia	ua	o	oi	ou	io	e	ue	ɯ	iu	ui	ai	uai	au	iau
p	碑	富	巴		播	波	*	埔	鏢	爬	杯		彪	肥	排		包	表
p'	披	芙	脬		破	叵	批	鋪	票	帕	皮		*	呸	痞		跑	標
m	眯		媽		麻	饃		牟			每			微	埋		矛	苗
b	米	巫	貓		磨	無	買	戊	廟	碼	枚			痺	眉		卯	
t	池	蛛	打	爹	舵	刀	堤	都	潮	茶	兌	豬	丟	追	呆		逗	刁
t'	黐	徒	他		拖	胎	釵	土	挑	#	頹	鋤	抽	梯	台		頭	挑
n	尼		拿		*	娜		奴			餒		繆		乃		鬧	嬲
l	厘	魯	拉		籮	羅	犁	鹵	*	*		驢	溜	鐳	來		褸	料
ts	止	朱	渣	遮	蛇	糟	齊	租	招	姐	罪	之	舟	醉	宰		遭	昭
ts'	痴	取	差	車	蔡	挫	粞	粗	笑	查	罪	蛆	秋	崔	猜		臭	悄
s	時	須	傻	邪	沙	唆	洗	蘇	燒	裟	衰	祠	收	雖	獅		騷	肖
z	兒	如	*	惹					橈	*	挼	而	柔	維			*	饒
k	機	龜	咬	寄	柯	哥	雞	姑	橋	家	瓜	居	球	歸	階	乖	交	嬌
k'	其	區	骹	騎	夸	戈	溪	箍		骼	科	渠	丘	虧	凱	快	考	敲
ŋ	宜		牙	雅		俄		午							涯		熬	堯
g	疑	牛	*	玡	外	鵝	藝	吳		牙		語		魏	礙		#	
h	希	符	哈	靴	華	呵	蟹	篌		蝦	灰	虛	休	非	海	懷	浩	曉
Ø	依	污	亞	爺	蛙	窩	鞋	烏	腰	啞	鍋	余	優	爲	哀	挖	喉	妖

b) Onsets with Nasalized Rimes (no coda)

	ĩ	ã	iã	uã	õ	iõ	e	uẽ	ũ	iũ	uĩ	ãi	uãi	iãu	ãu	õi	õu	m	ŋ
p	辮		兵	搬			棚									斑			
p'	鼻	怕	坪	潘			彭												
m	棉		名	幔	摸		罵												
b																			
t	纏	淡	掟	單		張	錚						彈			殿			
t'	天		呈	灘			撐									睇			
n	年	籃	領	爛	挪	娘	冷	*								蓮			
l																			
ts	支		正	泉		漿	爭									前			
ts'	耻		且	閂			星									千			
s	扇	衫	聲	山		槍	省						□			先			
z						廂													
k	見	柑	驚	官		姜	庚	果			跪					肩			
k'	□			寬		腔	坑									*			
ŋ					俄		硬				僞					研			
g																			
h	弦		兄	歡		鄉	*	橫		裘	毀	*		掀	好	還	虎	*	荒
Ø	丸	掊	影	鞍	*	鴦	桁			幼	畏	愛	*	*	*	閑		姆	秧

c) Onsets with Oral Rimes (oral coda)

	ip	ap	op	iap	ik	uk	ak	iak	uak	ok	iok	ek	ɤk	ɯk	ŋk
p					必	不	北	別	拔	卜		迫			
p'					匹		博	*	*	扑		辟			
m					滅	沒	目		末			陌			
b					蜜	吻	木								
t		答		諜	直	咄	靼	侄		獨		竹			
t'		塌		貼		脫	踢	彻			畜	剔			
n		納		涅			諾					肉			
l	立	*		粒		捋	力	列	劣	涤		勒			
ts	執	汁		接	疾	卒	扎	即	*	足		燭			
ts'	緝		*	窃	七	出	察	切	茁	促		斥			
s	濕	卅		澀	失	戌	虱	設	朔	束		熟	*		
z	入				日			若	悅	辱					
k	給	鴿	*	劫	吉	骨	角	潔	決	谷	掬	革	*	*	
k'	級	瞌			*	屈	叩	卻	孑	酷	克	擊	乞	乞	
ŋ				業	*		岳	瘧				逆	吃	吃	
g								*				獄			
h	#	盍	*	俠		忽	學	蝎	法	福	旭	核			
Ø	邑	盒	*	炎	乙	兀	惡	跃	曰	屋	育	溢			

(d) Onsets with Oral Rimes (nasal coda)

(d)	im	am	iam	om	iŋ	uŋ	aŋ	iaŋ	uaŋ	oŋ	ioŋ	eŋ	ɤŋ	ɯŋ
p					品	楓	班	邊	叛	乓		炳		
p'					貧	奔	旁	偏	胖	蓬		拼		
m					民	門	芒	綿		蒙		明		
b						文			亡					
t	沉	耽	玷		塵	敦	丹	顛	端	忠		丁	當	當
t'		貪	添		陳	吞	倘	填	湍	統		廷	湯	湯
n	啉	南	念				人						軟	軟
l	林				鄰	忍	蘭	涼	暖	農		鈴		
ts	浸	針	尖	箴	真	尊	層	疹	專	宗		貞	磚	磚
ts'	深	參	簽	參	親	春	殘	昌	川	從		清	村	村
s	心	杉	森	森	身	孫	爽	仙	宣	聳		升	酸	酸
z	刃		冉		仁	允		然	亂	戎		仍		
k	今	甘	兼		緊	軍	工	堅	倦	公	恭	弓	斤	斤
k'	欽	堪	謙		輕	昆	康	虔	匡	空	恐	莖	糠	糠
ŋ	吟	岩	嚴				言	妍	元			迎	銀	銀
g														
h	欽	蚶	嫌	欣	眩	昏	韓	顯	番	豐	凶	亨	欣	欣
Ø	音	庵	淹		因	溫	紅	央	彎	嗡	容	英	恩	恩

(e) Onsets with Oral Rimes (glottal coda)

(e)	iʔ	uʔ	aʔ	iaʔ	uaʔ	oʔ	ioʔ	eʔ	ueʔ	ɯʔ	iuʔ	aiʔ	auʔ	iauʔ	oiʔ
p	鱉	*		壁	跋	駁		伯			*		*		八
p'	*	*	拍	癖	潑	粕		*	#						
m	乜					麼			物				*		
b	篾				抹			麥							
t	蒂	*	搭	摘	叱	桌	著	*	*				*	*	
t'	鐵	腆	塔	拆	獺	托		宅		*					*
n	鑷		*			*			*					*	
l	裂	*	臘	掠	辣	落	略	歷					落	*	笠
ts	折	嘬	閘	食	*	絕	石	績			*			雀	截
ts'	#	*	插	赤	*	撮	尺	冊		*	*			*	*
s	薛	*	煠	錫	殺	索	惜	*	說					*	#
z	廿				熱		若	*							
k	砌	*	甲	揭	割	閣	腳	格	郭	*	*		*	*	挾
k'	缺	窟	笕	隙	闊	*	挈	客	缺	乞	*		*	*	*
ŋ						愕							樂	*	
g								*	月						
h		*	合	歇	喝	鶴	頁	嚇	血				*		*
Ø	浥	*	押	益	活	學	約	厄	划	*	*	*	*	約	狹

(f) Onsets with Nasalized Rimes (glottal coda)

	ĩʔ	ãʔ	iãʔ	uãʔ	õʔ	ẽʔ	uẽʔ	ɯ̃ʔ	iũʔ	ãiʔ	uãiʔ	ãuʔ	iãuʔ		m̩ʔ	ŋ̍ʔ
p																
p'																
m						脉	物									
b																
t																
t'																
n		#				*	*									
l																
ts																
ts'																
s																
z																
k																
k'																
ŋ						*										
g																
h	*		*			*					*	*	*		*	
Ø	*	*		活					*	*	*	*				兜

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