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Synchronic and Diachronic Variation of Cantonese Tone Change in Optimality Theory.

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Abstract

The goal of this thesis is to investigate a hypothesis of linguistic microvariation, which old as it is in its original formulation, seems to perfectly marry with Optimality Theory, which is naturally suited to handle linguistic variation: the hypothesis that linguistic distance correlates with language geographic distance. Of little interest to generative phonology, developed to analyzed the grammar of individual speakers rather than of language communities, the problem has a direct impact on linguistic cognition if cast in the right terms. Fundamental to the developing of a theory of linguistic variation and change in generative grammar are two assumptions: OT is the first theory to my knowledge, which elegantly permits to formalize and numerically quantify the once vacuous concept of 'linguistic distance'; some language changes are determined by a change in the grammar, that is the changes observed are the result of a reorganization of the grammar that happens for reasons that can be entirely explained by observing the grammar itself. The concept, is not new and it was well known in the structuralist tradition (e.g. push-pull chain), but the forces driving the change can now be identified as elements of the grammar itself (i.e. constraints), and operating in accordance with the principles of the theory (as constraint re-ranking). The possibility to measure linguistic distance and to describe language change in formal terms by using the same set of relations and primitives offers a valid tool to investigate not only their nature, but also their relation.

The analysis requires an unusual approach to OT. Typically more oriented to language typologies rather than the description of a language, since to verify the hypothesis it was necessary to compare complete grammars - or subsets of grammars - to measure their distance with an acceptable degree of accuracy, only few related varieties were studied. Tonologies are usually simpler than segmental systems with respect to processes, structural organization and number of elements and interactions. The observation is particularly true for Cantonese, a language famous for its tonal stability, the quasi-absence of tone sandhi,

and most importantly for the extremely limited interaction of its tonal system with other areas of the grammar (intonation, segments, syntax etc.). Cantonese tonology, as a very independent subset of the grammar (mini-grammar), can then be used with an acceptable approximation to verify the hypothesis.

To investigate the thesis, most of the work in the thesis had to be done to flesh out the description and the differences of very closely related grammars. After a brief introduction about the history of China and of its languages (chapter 1), some basic theoretical notions about the theory used and its application to tonology are briefly outlined (chapter 2). The fundamentals of the languages investigated is given in chapter 3, which includes an introduction to the segmental system, and a first analysis of the tonematics of the languages. Central to the developing of the mini-grammar are tonal alternations (tone changes in Cantonese). These are introduced in chapter 4, followed a phonetic analysis of characteristics crucial to their phonology and microvariation (chapter 5). Chapter 6 and 7 conclude the analysis of the mini-grammars and propose an explanation of the change the suffix responsible for the tone change. The rest of the chapter defines the model for the computation of the linguistic distance and relates it to the observed geographic distance.

Acknowledgements

To honor tradition, I will start by thanking my supervisor. It is literally true that without her this thesis would never have begun. Not only did she supervise me, but she was also the responsible party for the project. I received a scholarship, which allowed me to study in Hong Kong for a year, also thanks to her. Upon more than one occasion, she helped me when I truly needed it. In a word, she was amazing.

When I arrived in Asia, I knew nothing about Sinitic languages. It was only through the passion, assistance, and incredible professionalism and knowledge of all the teachers I met there that I was able to complete this work. Dr. Roxana Fung was the first to bring me Bauer's book about the phonology of Cantonese, and basically introduced me to everything I needed to know to get started. She made me feel quite at home and very welcome; and even helped to set me up and introduced me to the group of Cantonese linguists. She really deserves to be on the front page of my thesis. She is one of the smartest and kindest women I have ever had the pleasure to know.

As for Dr. Ken Cheng, my co-supervisor, it is really difficult for me to quantify the contributions he made to this endeavor. He basically taught me everything I need to know to get this work underway and completed. He taught me everything I know about Chinese linguistics; he patiently went through all the Chinese articles I had to read with me; he made crystal clear an amount of material that would have been virtually impossible for me to understand alone; he assisted me along every step of the thesis, and never made me feel bad for something that I didn't understand. I wish I could repay him for all the evenings we spent together working on this project. The work was incredibly difficult, long and complex and if I didn't give up it was because I knew I could always count on him. He is one of the best teachers I have ever had and is an example of supreme patience, humbleness and intelligence for me to follow.

Although I spent most of the time in the library, I also made some friends in Hong

Kong, whom I'd like to thank. Thanks to Ou Jinghua for helping me find an apartment, introducing me to the speakers of Guangzhou Cantonese, and, in general, for being an awesome girl (and linguist). Thanks to my teachers of the Cantonese language, Dr. Yuen and Dr. Ng, as well. Their classes were always fun – and it was due to them that after only one month of struggle I could finally communicate with my favorite 叉烧shop owner; thanks to him as well for being so nice, and, of course, for the delicious food. Many thanks also to 子巽and to all my friends in Guangzhou. Thanks to all my fellows in the program, in particular Francesca, Marco and Enrico. The time we spent together was always great: I am happy to have found such good friends.

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Those who gave you life cannot be forgotten either, so I also thank my parents. Even though I am terribly bad at showing my sentiments for you, never forget that I love you at least as much as you love me.

Alice: You have been the most important thing in my life for three years and you will probably be for much longer. This thesis is for you. Thanks for giving me the best moments and memories of my life. I will never forget you.

Notational Conventions

Symbol	Meaning
T	Tone root
t	Tone
o	underspecified tone
H, M, L	High, Mid and Low tone letters
22, 23, 555	Chao (1930) tone letters (0 lowest, 5 highest)
$+$	Morpheme boundary
μ, σ	mora, syllable
C1 $\gg$ C2	Constraint C1 ranks above C2
c1 $\succ$ c2	Candidate c1 is more harmonic than c2
$*$	Constraint violation
$*!$	Fatal constraint violation
$\alpha > \beta$	Diachronic sound change from α to β
$A \rightarrow B$	Syncrhonic sound change from A to B
☞	winning candidate
hk.	Hong Kong City Cantonese
gz.	Guangzhou City Cantonese
ts.	Taishanese
OC.	Old Chinese
MC.	Middle Chinese

Chapter 1

Historical background

With a history stretching over 3000 years and a territory dominated by a handful of different ethnicities, it is easy to believe that Chinese is but a misnomer of a language that no longer exists. Yet, the term is lively and used to indicate both the 2000-year-old bone shell inscriptions and the official language of ROC (Taiwan) and PRC (China). Its prestigious status, the conservativeness and the opaqueness of its written language as well as the cultural homogeneity of its territories, have made Chinese the potent symbol of a country that, despite all the changes, is still proud and aware of its cultural identity. The evidences of the existence of not mutually intelligible dialects date the Han dynasty, but what their form was and what their differences consisted of is now impossible to tell. Under the lens of the linguist the necessity to differentiate between actually different languages and similar varieties leads to the discovery of all the facets of the complex and heterogeneous linguistic, cultural and historical picture of China. In the first section of this chapter, I will concentrate on the classification of the languages spoken in China today and on the second on the history of China. Section 3 contains a summary of the development of Old Chinese tonal system up to Early Modern Cantonese.

1.1 Dialects of China

Eastern, south-eastern and southern Asia is home to the Sino-Tibetan, the second largest linguistic family in the word for number of speakers after Indoeuropean. Sino-Tibetan includes two major branches: Tibeto-burman and Sinitc. The former comprises about 400 different languages, the most spoken being those who lend the name to the group, the Tibetan (20 million), and the Burmese, spoken in Malaysia by 8 million people. The latter

is usually referred to as Chinese, and includes the vast majority of languages spoken in PRC (People's Republic of China), in culturally Chinese but politically independent regions (Macau, Hong Kong, Taiwan), and by many immigrants scattered around the globe. The tonal phonology, the restrictive phonotactics and the analytical morphology are usually considered the most representative linguistic features of the group. The first classification of Chinese dialects was proposed in 1915 by Zhang Binglin, although a much more influential classification appeared twenty years later by the *Academia Sinita*, which divided all Chinese varities into 7 groups: Wu 吳(Shanghainese), Xiang 湘(Hunan), Gan 贛(Jiangxi), Kejia 客家(Hakka), Yue 吳(Cantonese), Min 闽(Taiwanese) and three Guanhua 官话subtypes (Mandarin). The division was mainly based on the realization of Middle Chinese (MC henceforth) voiced stops (Norman, 1988). Later dialectologists tried to improve Li's classification by using different criteria. In *The Language Atlas of China* for instance, following a proposal by Li (Wurm et al. 1987:A-1, A-2), the Sinitc group is divided into two branches, Mandarin and Southern, with Mandarin further divided into 8 subgroups based on the treatment of Middle Chinese entering tone, and Southern into 9 groups. The groups Jin 晋, Hui 徽and Pinghua 平话were also included, and Hakka proposed to for an independent group. Norman (1988) proposes a division between southern and northern dialect based on various lexical, morpho-syntactic and phonological criteria, thus grouping Min, Keija and Yue together and proposing an Old Southern Chinese ancestor. According to Sagart (2002), despite the controversy in the internal classification of northern and southern groups, the most hotly disputed question in Chinese dialectology is the relationship between Han and Gan dialects. Figure 1 offers a picture of the geographic distribution of the 7 groups of dialect as found in the *The Language Atlas of China*.

The Yue dialects compose the second largest Sinitic branch, counting around 80 million speakers in mainly located in Guangzhou, eastern Guangxi, Hong Kong and Macau. After an intense period of emigration in the 20^{th}century, many Taishanese and Cantonese speaking communities aggregated in the United States, Canada and Australia. Large-scale surveys of Yue dialects were carried out from the Eighties. *A survey of the Dialects in the Pearl River Delta* (SPRD) is one of the most comprehensive documentation works. Published in three volumes, the first volume is a comparative morpheme-syllabary (1987), volume two a comparative lexicon (1988) and volume three a particularly useful synthetic review of the first two volumes (1990). Other reference works are *A Survey of Yue Dialects in North Guangdong* (SNG) (1994) and *A Survey of Yue Dialects in West Guangdong* (SWG)

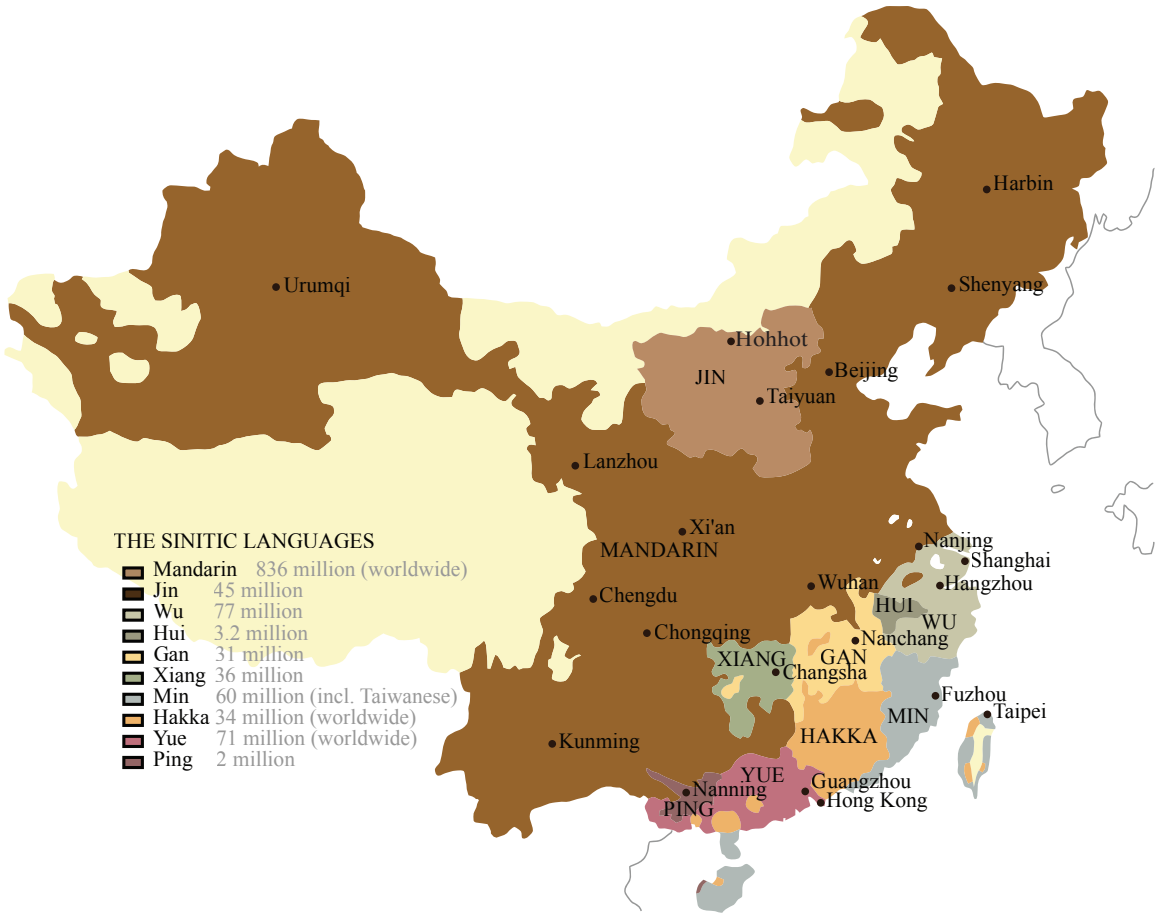

Figure 1.1: Map of Chinese dialects (i.e. sinitic language groups in China) adapted from http://en.wikipedia.org/, 12 March 2012)

(1994), both of them include a comparative morpheme-syllabary, a comparative lexicon and phonological analyses. Recently, *An Outline of Yue Dialects in Guangdong* was published in 2002, that contains data from 10 Yue dialects in the Guangdong region, mostly coinciding with the mentioned books. Unfortunately, Yue dialects spoken in Guangxi are left out in this volume as well.

As for the dialect categorization, there is no total agreement on how the various dialects should be grouped. *The Language Atlas of china* (1987) recognizes five groups in Guangdong (Guangfu, Goulou, Siyi, Gaoyang, Wuhua) and four groups in Guangxi (Guanfu, Goulou, Yongxun, Qinlian). The criteria used for the division are historical-phonological and concern

the realization of MC initial obstruents. Figure 2 shows the geographical distribution of the varieties (for a more detailed explanation, see Chapter 3). Other proposals include Zhan and Zhang (1990) and Zhan (2002:1), who recognize five groups based on MC consonants realizations, and Yue-Hashimoto's (in Yan 2006:195-196) that individuates two major groups (Delta and Siyi-Liang-Yang) that include five subgroups reflecting the settlement pattern of historical Yue speaker migrations.

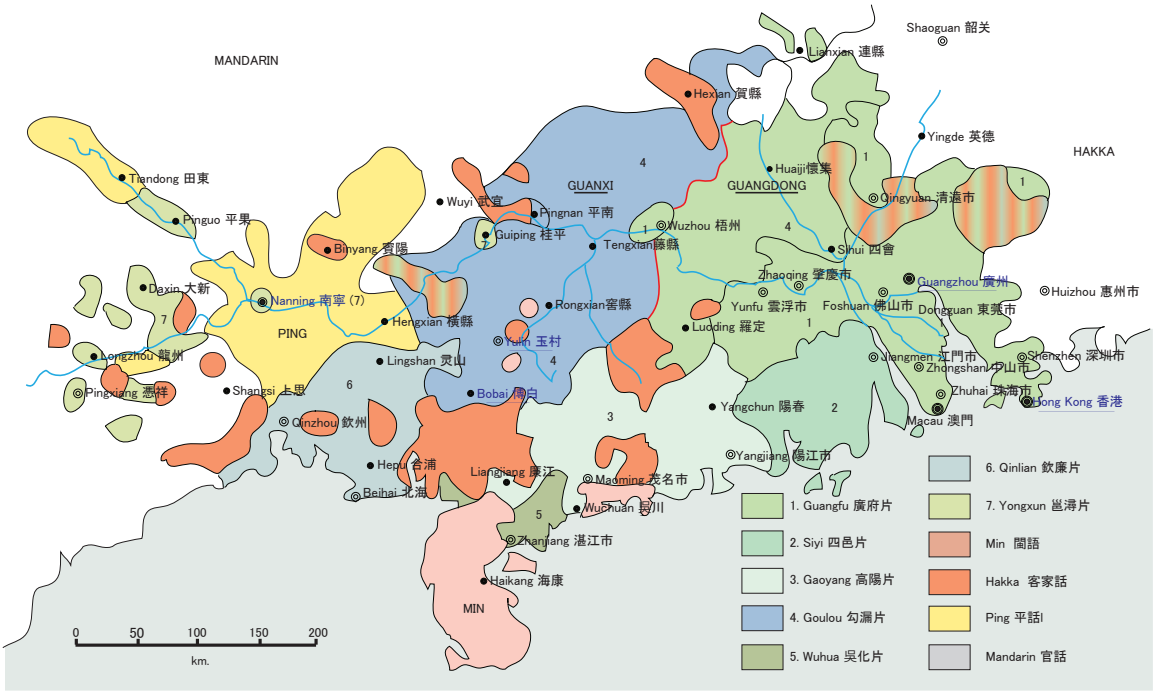

Figure 1.2: Yue dialects geographic distribution (*Language Atlas of China*, 1987, adapted)

Before proceeding, given the ambiguity of the terms adopted so far, it may useful to explicitly establish some conventions. I will use the word Putonghua 普通話for the official language of RPC, Mandarin for the dialect group in northern China and Cantonese 广州话for the specific Yue dialect. The word 'Chinese' will be mostly used as an adjective to refer to the culture, and generally when not talking about a specifying variety or dialect before Middle Chinese. For all cases where the alphabetic transcription is traditionally encountered (book titles, historical figures etc.), I will adopt the official hanyu pinyin spelling used for Putonghua, unless a commonly used English form is accepted (cities, dynasties etc.). For the characters, I will stick to simplified script. Finally, it may be worthy to note that Chinese traditional phonology consistently refers to the syllabic constituents in a notation

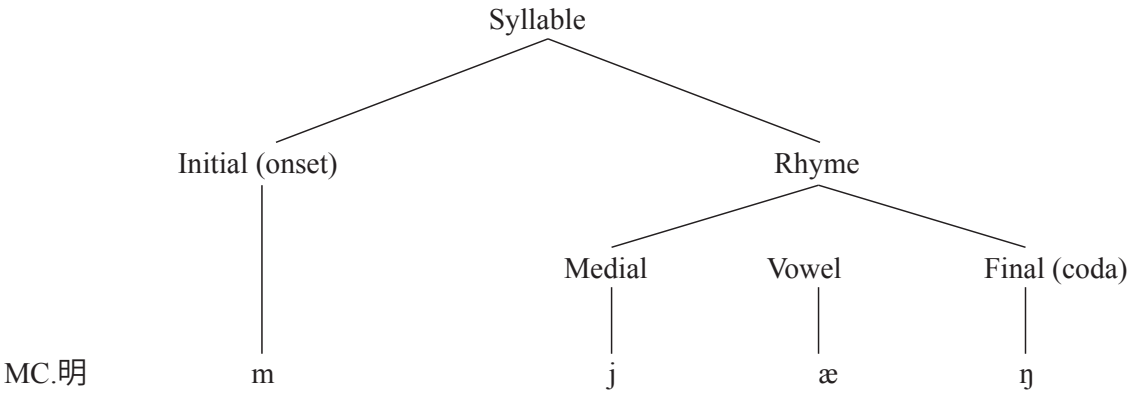

Figure 1.3: Syllabic constituents of 明'bright' according to Baxter (1992) reconstruction)

slightly different from western tradition (figure 3).

1.2 Brief History of China and of its Linguistic Sources

For the convenience of readers unfamiliar with the subject, it may be useful to know in advance that Chinese history is generally divided into periods that reflect the alternation of its ruling dynasties (although other notations are in use). In this section, the most important events of Chinese history will be briefly discussed, with particular emphasis put on the sources that allowed the reconstruction of previous stages of Chinese sound system, the linguistics works and the part of Asia that host Yue dialects[1]. For a brief synthetic review of this section see Appendix A.

The origin of China can be traced back to the **Three Sovereigns and Five Emperors 三皇五帝** era, which is entirely mythological. Only the following **Xia 夏** is the first historical period usually accepted in China.

The first archeological inscriptions date back to the **Shang 商**, a tribe originally settled in the Yellow river valley. The inscriptions mainly consisted of divinatory scripts carved into turtle shells or other bones, and represent the first testimony of the Chinese language in its history. The writing form is logographic, and although short, the texts already contain

[1]This paragraph describes the history of China and of its languages in a very general way and only for introductory purpose. Unless otherwise specified this paragraph is based on: for the history of China on Eberharad, 2005; Wilkinson, 2000; Norman, 1988; Sun, 2006; Chen 1989; for Old and Middle Chinese Pulleyblank 1962, 1964; Baxter, 1992; for Cantonese Yue-Hashimoto, 1972, 1991; Yuan 1989.

a large number of characters, of which only more than a half has been deciphered (Zou et al. 1999:227). Shang influence extended west to the Wei River valley, a region that was occupied by clans known as the Zhou. These clans eventually took over the power and started a new dynasty. The period is usually divided into **Western Zhou 西周** and **Eastern Zhou 東周**, which itself includes the **Spring and Autumn period 春秋時代**, and the **Warring state period 戰國時代**. Despite the political turmoil, Eastern Zhou was a golden age for culture that saw the development and the spreading of the four schools of thought: Confucianism, Legalism, Taoism and Mohism. It is during this time that we find the first recording of the word 'Yue', referring first to a group of people living the coastal area south of the Central plains down to the modern day northen Vietnam (bai-Yue 'one-hundred Yue'), and then to an independent state. The Yue first managed to defeat and annex the Wu, but in 334 B.C. they were ultimately defeated by the neighboring Chu. The language of the Xia and Shang dynasty is thought to be Old Chinese, a Koinè used for communication by people of central states (Henan). Xu Shen, a Chinese philologist of the Han dynasty, observed that even in those states the languages spoken were not mutually intelligible (Sun, 2006). The poetry of the Shijing, countless inscriptions and portions of the Yijing are all written in Old Chinese

Taking advantage of the political fragmentation of the Zhou, the Qin annexed the Zhou territories, creating the first imperial dynasty of China. The **Qin 秦** also annexed most of the southern coastal lands of Guangzhou, Fuzhou and Guilin and sent more than 100,000 prisoners to colonize the area. Three prefectures were estabilished: Nan-Hai (Guangdong, except the southwest), Guilin (Guangxi), and Xiang (southern and western Guangxi and northern Vietnam). The Qin also succeeded in standardizing the writing system, and created the 'lesser seal' 小篆style of calligraphy, which served as a basis for modern script and is still used as a calligraphic form.

The Qin were followed by the Han, which are still today the dominating ethnic group in China and Taiwan. The early **Han 漢** period is characterized by a great economic, political and cultural development with the creation of the Silk Road and the composition of important literary works. The first Chinese dictionary and linguistic work, the glossary EryA (c. 3d c. BCE) was written as an aid to understand the classics. Following the Erya is the Shuowen Jiezi by Xu Shen (c. 58 –c. 147 CE), the first dictionary to organize the characters into radicals (部首) group and to include an analysis of characters structure. Other linguistic works of the time are the Fangyan by Yang Xiong, the first glossary to

document dialectal forms, and the Shiming a dictionary which was used to attest the stage of Chinese between Old and Middle Chinese. All the dictionaries of this period use a method called *du ruo*, which consisted on indicating the pronunciation of characters by grouping them alongside more frequently used homophones. After a short period of independence (100 years *circa*), the Yue area was divided into Ling-nan Dong-dao (Guangdong) Ling-nan Xi-dao (Guangxi) and further colonized. Those terms are still used today in Yue-dong that refers to Guangdong, Yue-xi to Guangxi and Liang-Yue 'two Yue' to both.

A long period of instability and fragmentation followed during the **Three Kingdoms 三國**, and later during the **Jin 晉** dynasty and the **16 Kingdoms 十六國**. At the time, China was roughly divided into two parts: the north dominated by numerous barbarian kingdoms (Wu hu, Wei, etc.), and the south by the Jin. The period was culturally flourishing. After the introduction of Buddhism, Chinese scholars got in contact with Indian linguistic tradition. This event led to the development of the fanqie, a new annotation method that replaced the du ruo homophonic system used in earlier dictionaries. In fanqie, the pronunciation of a character is specified by using two other characters, one that represents the pronunciation of the onset (the initials), and a second indicating the pronunciation of the rhyme and tone. The characters were grouped into scrolls, each scroll containing words pronounced in the same tone, and ordered for their rhymes. Although no dictionary survived from this period, evidences for their existence are found in later works citing them. In the Imperial examination test the dictionaries were mainly used in examinations, where the candidate had to demonstrate the ability to compose and recite poems that strictly followed the rhyming scheme as regulated in that period. The dictionaries then represent the correct pronunciation of literary texts, and not a single language actually spoken at the time. Chinese scholars also borrowed from Sanskrit phonological tradition (*vyakara a*) concepts such as the segment and the place of articulation, which they applied in the creation of the rhyme tables. Rhyme tables offer a precious testimony of Middle Chinese, as they contain the description of the phonological system of the fanqie. Rhymes, medials and tones are tabulated with a rich annotation, but while old dictionaries were limited in indicating the pronunciation of words by recurring to other characters, in rhyme tables the concrete phonetic realization of words is explicitly stated. Rhymes are still not segmented, so their reconstruction is more problematic, but initials were grouped into five points of articulations (labial, lingual, velars, dentals, gutturals). The first discovered exemplars date to the later Song dynasty (1100 circa), but some authors believe that earlier

exemplars were already in circulation during the Tang dynasty (Baxter 1992:41).

After the Jin dynasty failed to conquer the north and to unify China, the Northern Zhou strengthened their position among the other kingdoms. At the peak of his power, a Han official of the Zhou Yáng Jiā n betrayed his ruler and proclaimed himself emperor. Once in command, he abolished all anti-Han policies promulgated by the Zhou, a move which allowed him to strengthen his political position and amass a great army. With the aid of Sichuan aborigens and of other ethnic groups, he managed to conquer the south, and unified China under the flag of the **Sui 隋**. A large-scale immigration brought a number of speakers to the coastal area around modern-day Nanjing. As a result, the languages spoken in the area were deeply influenced or replaced by the variety spoken in central China (Sun, 2006). The Sui also restored the Confucian education and examination system. The earliest surviving rhyme dictionary (the Qiē yùn) and rhyme tables (the Yùnjìng and the Qiyinlüe) found, had a tremendous impact in the reconstruction of Middle Chinese. The language depicted in the texts, as indicated in the preface to the Qiē yùn, represent the pronunciation of North and South together, in particular that of the cities of Yexia and Jinling (Norman, 1988).

The Sui succumbed after a disastrous campaign against Korea, and was replaced by the Tang dynasty. The **Tang 唐** period is considered a golden age for Chinese culture as art and poetry flourished, and important encyclopedic and historical works were written. After the fall of the Tang, a return to political instability and internal division slowed down Chinese cultural spring. In the North, Five dynasties quickly succeed, and in the South twelve independent states were established (五代十國'Five dynasties and ten kingdoms'). The Song 宋dynasty managed to unify China again for more than 150 years, before losing the control of northern China to the Jin, a Jurchen population ancestor of the Manchu. The Jin moved their capital southern, to modern-day Nanjing, a decision which was accompanied by an intense flux of migration of Han people south of the Yangze river. During Song dynasty the gunpowder was discovered, and numerous important discoveries were made. Arts, literature and philosophy also shined again, thanks to the realization of numerous important works, such as the Zizhi Tongjian, a universal history text compiled into 1000 volumes and the Guangyun rhyme book, an expansion of the Qieyun. This rhyme dictionary is actually the first source used for the study of Early Middle Chinese, until a version closer to the original Qieyun was found in 1947. The Tang and the Song dynasties are also a dense period of immigration to the southern area, and of influence of the central plains culture over

the south. The most socially prestigious families in Guangdong came as political refugees at the end of the Song dynasty. Yue-Hashimoto (1987) notes that even today, the pressure to be identified as people from the central plains is reflected linguistically in the fact tha some Yue speakers call themselves Tang people of Tang culture and language.

Political stability and centralization policies were again enforced, although for short time, during the Mongolian **Yuan 元** dynasty. After ruling the north for some years and having established their capital in Dadu (Beijing), Khublai Khan declared himself emperor of China and, although he kept non-Han people away from commanding position, he adopted the tradition of previous Chinese dynasties. The linguistic resources of that period are particularly rich and diversified. A new vernacular poetry called qu arose, which rhymed according to the current pronunciation of the characters instead of the traditional one. Two rhymes books, Zhongyuan Yinyun was particularly important as they allowed reconstructing an early stage of Modern Chinese as spoken in Beijing. Finally, the Phags-pa script, an alphabet designed for the Kublai Khan, gave some insights on the pronunciation of the time.

Han Chinese got the power back for their last time with the **Ming 明**, one of the longest lasting dynasty in Chinese history. The Ming conquered and renamed Dadu into Beiping, and moved the capital back to Nanjing. The variety spoken in Nanjing soon became the most prestigious, as documented by 16$^{\text{th}}$to 17$^{\text{th}}$century Italian missionaries and by the Hongwu zhengyun - an important rhyme book from this period - even after the capital was moved back to Beijing after the 3rd emperor. The Ming also re-annexed the southern territories and sent almost one million Han settlers to colonize them. According to Yang (1943), the population multiplied for more than ten times and kept on rapidly increasing since then. The cultural impact of the migration was so strong, as the area became an important cultural center, that Miao and Yao aboriginal inhabitants of the province uprose. Similar revolts, a change in the climate which caused a little 'ice age', and a steep increase in the value of silver caused the fall of the Ming dynasty. The texts of the missionaries are utterly important in this period, as not only they describe the sociolinguistic situation, but they also are an early attempt of using the alphabetic writing system to annotate characters pronunciation (an example is the famous Matteo Ricci's Portuguese-Chinese dictionary).

Profiting of the weakness of the Ming, a Jurchen (Tungusic) tribe first gained control of all Manchurians in the north, and then marched into the Han capital, starting the last and non-Chinese dynasty in the continent. Despite the early bloody conflicts with the

Han, the **Qing 清** soon became highly integrated into the Chinese culture. The second part of the Qing period is most important as it is characterized by the irruption in the 18thcentury of Western civilization in Chinese cultural, economic and political life. Russian empire expanded north of China, Indochina was colonized, and Great Britain in numerous occasions tried to establish trade routes with the Qing. The failure of the commercial tractates led to the First and Second Opium wars, both lost by the Qing at a great price. The presence of the foreign nations also had other detrimental consequences. In 1850 a heterodox Christian claimed to be the younger brother of Jesus Christ, and started the Taiping Rebellion, which costed over 20 million deaths and the devastation of the southern territories. Conversely, in the north, a nationalist movement gained popularity and first opposed and then supported by the emperor, organized a revolt which led to another conflict against all the forces which had some interests in China (Japanese, US and Europeans). The Boxer War was won by the Eight-Nation Alliance, which ultimately imposed further vexing conditions on Chinese surrender. Before the collapse of the empire, a late Qing reform instituted a national education system and abolished imperial examinations. An attempt to standardize the language was also made. Despite Beijing dialect was the language used by the officials in the court (the 'mandarins'), no agreement was reached on which language had to be elevated to standard. Among the candidates Nanjing, Wuhan, Shanghai and Beijing were the most prestigious (Sun, 2006). Modern Chinese linguists are from this period: Gu Yanwu (1613-82) and Jiang yong (1681-1726) carried out important studies on Old Chinese; Duan Yucai (1735–1815) made fundamental contributions to the study of Old and Middle Chinese by revealing the importance of the Xieshengzi, the phonetic compound characters, and compiled the monumental philological work Shuowen Jiezi 文解字注; Wang Niansun (1744 –1832) suggested that the linguist should focus his attention "not on the character but on the sound", and was also an important philologist; Zhang Binglin (1868-1936), who made important contribution to the reconstruction of Old and Middle Chinese as well as compiling Wen Shi 文始, the first systematic work on Chinese etymology. The early vernacular literature in Cantonese was also composed in this period.

The Wuchang Uprising ended the Qing period and led to the establishment of the **Republic of China 中华民國** on October 1911. From now on, China is no longer referred to by Chinese historians by the name of its ruling dynasty, but as Zhonghua Minguo Zhu 中華民國. After the revolution, in 1913, a commission representative of all major dialects spoken in the country determined the pronunciation of 6,500 characters and an alphabet

for the alphabetic transcription in the Guoyin Zidian *Dictionary of National Pronunciation* (1919). The new system was a failure: made of as an amalgam of the most prestigious dialects of China and of the traditional rhyme book pronunciation, the language turned out to be artificial and hard to learn even by teachers. The Beijing pronunciation was adopted as a standard in the revised version of Guoyin Zidian in 1923 and henceforth known as Guoyu 國語"national language". During this period, the first classifications of Chinese dialects were proposed (1.1). Karlgren's Ètudes sur la phonologie chinoise (1915-1926) for diachronic studies and Yuen Ren Chao's Mandarin Primer (1948) for the synchronic description of Chinese can probably be considered among the most influential pioneers of Chinese contemporary linguistics.

A long period of intestine wars followed, first between the Nationalist and the Communist parties against the warlord in the north, and then, after the victory of the former, between nationalists and communists. The nationalists managed to gain power, but soon lost it against Mao Zedong after the Sino-Japanese War (which later merged into the World War II). The period following the war was characterized by radical changes in Chinese society. Mao founded the People's **Republic of China 中華人民共和國** (1949) and attempted to eradicate the old Chinese feudal culture with a series of high impact reforms aimed at modernizing China culture and economy. Guoyu was kept as the standard language, the hanyu pinyin was defined as the standard transcription system and the name of the language was decided to be Putonghua "the common speech". China opened its doors to the rest of the world again in 1979, when Prime Minister Deng Xiaoping actuated a series of reforms to convert the state-planned economy into a more market-oriented one. Hong Kong from Britain in 1997, and Macau from Portugal in 1999 were finally returned to China and up to date they retain most of the independence in their economic, social, and judicial systems. Concerning languages, Yue dialects spoken in the mainland mostly followed the same destiny of other dialects in China. Although some media can be found that broadcast using the local dialect, Putonghua is taking over the dialect with its status of official language used in education, media and in all state-related activities. The most notable exception is probably Guangzhou where people have opposed the central government and even rallied against an attempt to impose Putonghua as the primary language of all Guangzhou TV stations (Branigan, 2010). The large-scale immigration from other regions though, drastically increased the number of non-Cantonese speakers in the city in recent times, and Cantonese is less frequently listened in everyday communication. Hong Kong is probably

the only place where Cantonese did not lose ground to Putonghua. Up until 1974, the only official language of the British colony was English, but after some protests the equal status of co-official language was granted to written Chinese [2]. After the handover, Hong Kong Special Administrative Region Government (SAR) policy was of bi-literacy (English, Chinese) and tri-lingualism (English, Cantonese, Putonghua) 兩文三語. Despite the unbalanced promotion policies carried out by SAR, which penalized Cantonese over English and Putonghua (Lee and Leung, 2012), and the increasing immigration, Cantonese is still not only the most spoken language among all age groups in Hong Kong, but it is also gaining ground over its more prestigious competitors.

language	1991	1996	2001	2006
Cantonese	88.7	88.7	89.2	90.8
Putonhua	1.1	1.1	0.9	0.9
other Chinese dialects	7.0	5.8	5.5	4.4
English	2.2	3.1	3.2	2.8
Other	1.0	1.3	1.2	1.1

Table 1.1: Language used by population aged 5 and over (Lee and Leung, 2012).

1.3 From Old Chinese to Yue Dialects

Even a brief treatment of the development of Chinese to modern times would require too much space for an introduction and would appear out of the scope of the thesis. In this historical section I will therefore only discuss the development of the tonal system. Old Chinese is the koinè used by people of central states to communicate during Xia, Shang and Zhou dynasties. During the Old and middle Chinese period a variety of dialects and languages were indeed diffuse, but given the scarce amount of sources it is impossible to determine accurately how these languages were and where they were spoken. The oracle bones inscriptions, the shijing, and the comparation with the Qieyun were the major sources for the study of the language before the comparative method was started being used by Karlgren. Even though the documentation is rich, the absence of rhyme tables and rhyme dictionaries has made the reconstruction of the phonological system a difficult and speculative task. The debate on the Journal of Chinese linguistics between Pulleyblank

[2]Standard written Chinese, that is Putonghua. Some texts in Cantonese are still found in legal proceedings, when the transcriber had to write down the exact testimony of the witness.

and Baxter (1993-1995) provides a good example on the different methodologies used by two prominent figures of the field. Concerning the tonal system, its reconstruction is also controversial, and it is traditionally explained in relation to MC.

Middle Chinese is better understood than OC due to the presence of invaluable resources such as rhyme dictionaries, rhyme tables, folk songs, alphabetic transcriptions of its later stages and of course the closer resemblance with currently spoken dialects. That allowed historical linguists to reconstruct with good accuracy some of its stages and in particular its tonal system on the shape of which, as far as I know, there is a big consensus. As indicated in the Qieyun, MC had four tones 聲, ping 平'level', shang 上'rising', qu 去'departing' and ru 入'entering'. The last is an allotone, as it appears only on syllable ending with coda stops (-p, -t, -k) and as it is more evident in Cantonese, the possibly indicated a context where tonal distinction was simply neutralized. Modern western scholars usually annotate only the rising and the departing tone using two diacritics, as they sufficient to describe the whole system (coda stops always indicate an entering tone, while level is simply not annotated). Given the words Karlgren, for instance, uses : and –for the rising and departing tone, Pulleybank 'ʔ' and 'h' and Baxter 'X' and 'H', symbols the last four chosen to reflect the hypothetical segmental origin of the two tones. In Chinese texts, MC tones are represented as a diacritic (usually an open circle) around the character, which position indicates the tone.

The phonetic realization of these tones is never explicitly given, except for some impressionistic descriptions. For instance, in the Yuanhe yunpu 元和韻譜(Tang period) it is written that "level tone are grieve 哀and stable 安; rising tone are moving 厲and rising 舉; departing tone are clear 清and long 遠; entering tone are straight 直and abrupt 促.[3]"

Given the recent studies on tone perception and phonosymbolism, it is possible, although problematical and hypothetical, to establish a correlation between the impressionistic adjective used in the description with tone shapes actually produced in modern spoken languages. The 'grieve level' tone is probably a low level tone, as a low pitch is associated with sadness, the adjective stable is possibly used to indicate that there is no contour, as contrasted with the two other tones. The rising 'moving and rising' tone probably was a rising contour. The description of the departing 'clear and long' tone indicates the perception of an increased duration, which is perceived with high rising tones, hyphothesis confirmed by the fact that the adjective 'clear' is also associated with high pitch. The term 'straight and abrupt' was

[3]平聲者哀而安, 上聲者厲而舉, 去聲者清而遠, 入聲者直而促.

used to indicate the burst or closure of the final stops. In Cantonese, those syllables are monomoraic, in opposition to all other syllables which are bimoraic (see section 2.2), and therefore shorter. The position of the diacritic in the tone notation also seems to support the perceptive hypothesis, with the lower level tone being in the lower right left of the schema, and rising and the departing in the higher part as to denote their high pitch.

Regarding the origin of MC tones, Haudricourt (1954) , Mei (1970) and Pulleyblank (1962, 1978) argued that the departing tone derived from a final /s/, and the rising tone from a final glottal stop /ʔ/. If that is the case and the level tone really is the toneless unmarked form (see above and section 2.4), given the strong evidence that the entering tone was toneless as well, OC would originally be a non-tonal language (1).

(1.1) OC to MC tonogenesis

	OC	MC		
句	-s > *-h	Rising	kuwH < *k(r)os	kuwH < *k(r)os
馬		Departing	maeX < *mra	'horse'
心	All other cases	Level	nyin < *njin	'heart'
沐	p, –t, –k	Entering	zyet < *Ljat	'tongue'

A fundamental role in the development of MC tonal system in modern languages was played by 'registers'. One influential hypothesis is that in MC, syllables tended to have lower pitch if they had a voiced onset (lower register) and a higher pitch with voiceless onset (higher register)[4]. The two variants were allophonic, but at some stage in the Tang period (Mai, 1970), the voicing distinction was lost and the only remaining phonetic cue that discriminated the minimal pairs remained the pitch contour[5]. In some varieties as Cantonese the distinction is still clear cut (Table 2), although in the majority of Sinitic languages the registers later merged again (for example in Mandarin).

The first sources specifically devoted to Cantonese, and to dialects different from Mandarin, are found only around the 18thcentury. These documents included a peculiar vernacular literature (the second richest Chinese literature is Cantonese) rhyme books, dictionaries, and manuals from Christian missionaries (19thcentury). The two earliest attestations of colloquial Cantonese are 粵謳'Cantonese love songs' (18thcentury) and the rhyme dictionary

[4]Upper and lower registers are also called ying 'upper' and yang 'lower' register.

[5]The picture is complicated by the fact that onset sonorants had the opposite effect in some tonal groups.

Middle Chinese		Cantonese			
Tone name	Onset	Tone name	Chinse	Tone	Example
Even	Voiceless	Upper level	*yin peng* 陰平	55/53	
	Voiced	Lower level	*yang peng* 陽平	21	
Rising	Voiceless	Upper rising	*yin sang* 陰上	35	
	Voiced	Lower rising	*yang sang* 陽上	23	
Departing	Voiceless	Upper departing	*yin qu* 陰去	33	
	Voiced	Lower departing	*yang qu* 陽去	22	
Entering	Voiceless (V)	Upper dark departing		5	
	Voiced (V:)	Lower dark entering		3	
	Voiced	Light entering		2	

Table 1.2: Development of MC tonal categories in Cantonese.

Fenyun cuoyao 分韻撮要by Zhou guanshan (around 1850); the subsequent works by western missionaries are mostly based on the Fenyun (Yue-Hashimoto 1972, 2001). These works are as important as the Fenyun for the reconstruction of the language as they indicate the pronunciation of the characters using an alphabetic script. The first of the kind is a dictionary composed by a missionary: Robert Morrison's *A Vocabulary of the Canton Dialect*, published in 1828. The vocabulary contains a list of characters along with their pronunciation. The author used a transcription system which loosely reflects English spelling, but through the comparison with other dictionaries and knowing the current pronunciation of the words it is quiet easy to determine phonetic correspondences. Unfortunately, the author did not mark the tones. Some decades later, Elijah Coleman Bridgman compiles the phrase book *Chinese Chrestomathy in the Canton Dialect* (1841). Tones are marked as for Middle Chinese tradition, with the difference that the open circle is underlined to indicate lower register tones. In 1956, William Samuel Wells writes *A Tonic dictionary of the Chinese language in the Canton Dialect*, annotating tone, transcription and a translation. The first linguistic description of Cantonese date the 20$^{\text{th}}$century. One of the first and most important for establishing an alphabetization system is probably J. Dyer Ball's *Cantonese Made Easy*, possibly the first textbook of Cantonese ever. The preface describes it as "A book of simple sentences in the Cantonese dialect, with free and literal translation and directions

for the rendering of English grammatical form". And later in the preface, it also makes reference to a tone change process which will be the topic of section 2.3. Four revised versions of the book were published in total, with the first one dating 1888 and the last 1924. Early accurate observations on Cantonese tonal system are made by Daniel Jones and Kwing Tong Woo in 1912. The study of these texts, allowed the reconstruction of the so called early modern Cantonese. The tonal system did not change much, with the only difference being the presence of the High falling tone (53), which later tended to merge into the high level (55), especially in Hong Kong where it no longer exists (2.2). At the segmental level, early modern Cantonese differs from the modern counterpart in various aspects. For instance, high vowels /i/, /u/, /y/ diphtongized in open syllable into /eɪ/, /oʊ/, /øɪ/ and the set of post-alveolar sibilants /ʧ/, /ʧʰ/ /ʃ/ merged into the alveolar series /tsʰ/, /ts/, /s/. These and other changes will be further discussed after the introduction of contemporary Cantonese phonotactics in 2.2. Recently, a speech in Cantonese by Sun Yat-sen dating 1924 was made public[6]. Sun Yat-sen, the first president of the Republic of China, was born in a Guangzhou prefecture in 1866. A phonological analysis is carried out in Cheng (2011) who demonstrates that some sound changes occurred earlier than it was previously thought.

[6] A subtitled version of part of a Cantonese speech recording by Sun Yat-sen can be listened at http://www.youtube.com/watch?v=bN-iP3i2KkA

Chapter 2

An Introduction to Tonology

2.1 Optimality Theory

According to Prince and Smolensky (1993), the goal of SPE linguistics was "to explicate the system of predicates used to analyse inputs —the possible Structural Descriptions of rules —and to define the operations available for transforming inputs —the possible Structural Changes of rules." This approach appeared insufficient after the discovery of the existence of important constraints limiting phonological and morphological structures (Bach and Wheeler, 1981; Broselow 1982; Goldsmith 1990). Hybrid systems, where both rules and constraints ambiguously coexisted were used, but the exact place of these constraints in the grammar and the mechanisms of their interaction often remained dubious.

Prince and Smolensky (1993) are among the first to propose to entirely abandon rule-based and mixed models: "it is impossible for a grammar to narrowly and parochially specify the Structural Description and Structural Change of rules" (ibid.). Constraints are necessary theoretical constructs, while rules are dispensable. For Occam's razor, a model that generalizes both Structural Changes and Structural Descriptions is better than a hybrid system. Second, they abandon the idea that "constraints are language-particular statements of phonotactical truth". Constraints are not arbitrary nor language specific, but universal and of general formulation. A grammar is entirely described as a partially ordered set of constraints. The permutation of all the possible rankings then define the set of all possible human languages, and grammar acquisition can be explained simply as a re-ordering of these constraints. In Prince and Smolensky (1993), the model is schematically represented as follows:

a. $Gen(In_k) \rightarrow Out_i, Out_2, \ldots\ 1 \leq i \leq \infty$
b. $H - Eval(Out_i,) \rightarrow Out_{real}$

Given an input, $Gen(In_k)$ defines the set of all possible candidates by freely applying basic structural resources of the theory. These structures are evaluated by $H - Eval(Out_i,)$, which chooses the optimal candidate based on the violations of the language's constraint ranking. The winning candidate is the one that incurs the fewest number of highest-ranked constraint violation. To paraphrase the above procedure:

1. given an input, a set of possible candidates are generated by GEN, in accordance with the unit representational principles.
2. $H - Eval$ function, based on the set of hierarchically ranked constraints (Con), evaluates each candidate.
3. The optimal candidate is sent to the phonetic interface.

As an example, let us assume an alien faculty of Language, where Con contains only two constraints:

Max
Underlying segments must be parsed

***D**
Don't have the element D

One of the alien speaks a language in which the UR /ABCD/ surface as [ABC].

/ABCD/ → [ABC]

Language specific constraint rankings are represented as a partially ordered set of constraints.

High-ranked ≫ Mid-Ranked ≫ Low-Ranked

The 'much larger than' sign ≫ indicates that a rightward constraint is higher ranked, a comma that the constraints are equally ranked (or that the ranking for the two constraints cannot be determined). The analysis of the *alien language* reveals that the language constraint ranking is the following:

MAX ≫ *D

So, given an input /ABCD/, the computation is formalised with the following *tableau*:

(2.1) **Alien grammar 1**

/ABCD/	MAX	*D
a. [ABC]	*!	
b. ☞ [ABCD]		*
c. [AB]	**!	

The first column indicates the input /ABCD/, the second shows three of the possible candidates [ABC], [ABCD] and [AB]; in the third and fourth columns, the constraints MAX and *D are listed. If a candidate violates a constraint, the corresponding cell is marked with an asterisk (*). If the violation is fatal, that is if excludes the candidate from the winner set, an exclamation mark (!) is added after the asterisk. Shadowed cells are violations non fatal to the choice of optimal candidate. Candidate (a) does not violate *D since does not appear in the candidate, but it incurs violation of MAX. Viceversa, (b) violates *D, but satisfies MAX as no segment is deleted. Candidate (a) then incurs fatal violation, since there is another candidate that violates lower ranked constraints. Since there is no better possible candidate, (a) wins, as indicated by the pointing finger. Tableaux are just a notation to make the analysis more explicit. The set of possible candidates is theoretically infinite, but in the tableaux the process is exemplified to include only the relevant examples.

The study of the alien language revealed that CON is composed by two constraints, so two rankings are possible. An alternative constraint ranking is also possible, with the order of constraints reversed:

*D ≫ MAX

With this ranking, [ABC] will surface instead given the same /ABCD/ input.

(2.2) **Alien grammar 2**

/ABCD/	*D	MAX
a. ☞ [ABC]		*
b. [ABCD]	*!	

The two rankings constitute the set of all possible grammars, which is called a 'factorial typology' (2! = 2). In this case, the theory predicts that there will be only two alien languages, whose differences can be reduced to the different outputs produced by the rankings. Note that the theory also predicts that given an /ABCD/ input, in no alien language the candidate [AB] can win, since no matter what the constraint ranking is, it will always be less harmonic to candidate [ABC] (candidate [AB] is harmonically bounded by candidate [ABC]). What the constraint ranking does does not tell is whether the element E is present in the Language (which is specified in *Gen*) nor how each element is pronounced (which is determined by the phonetics).

The effects of OT on phonological research have been massive, and widely surpassed the initial claims. Even a brief review of the literature, of the development and of the results obtained would take up too much space, so only some of the analytical advantages of the theory will be illustrated in this thesis, with respect to sound change, variation, conspiracy and explicative power. The classical model will be adopted in its most restrictive form, and the analysis will be limited to commonly accepted constraints, already supported by a diversified range of empirical data. The analysis is further restricted to the use of Faithfulness constraints, markedness constraints that can be represented as phonological structure and simple alignment constraints, resulting in a model compatible with the restrictive POT model proposed by Eisner (1998) and recently discussed in de Lacy (2010), a subset itself of classical OT.

The adoption of the simplest model grants some advantages. If additional formal properties are introduced in the analysis - for instance derivation, weighted constraints, etc. - not only the predictive power of the analysis would be reduced, but back-compatibility with more restrictive models would also not be granted. For Cantonese, Classical OT and a simple representation model are sufficient to account for the tonematics and the tonal processes of the language (see chapter 2); no claim are made with respect to other models.

2.2 Tone Languages

The rest of this chapter is an introduction to the phonetics, the structure and the processes of tonal languages, with an eye constantly kept on issues found in Cantonese grammar. Topics irrelevant to this thesis, such as downstep and dissimilation, will not be discussed. For a complete overview of the subject, I refer to the excellent work of Yip (2002), on which the following sections are mostly based on.

Dawner (in Yip, 2002) gives the following definition of tone language: "A language with tone is a language in which an indication of pitch enters into the lexicon realization of at least one morpheme." Tone languages are common. About 60% of world languages are tonal, a group that include languages alive and populous such as Mandarin (850.000 millions) and Yoruba (20 millions). Asia is probably the continent most known for tonal languages, but Sub-Saharian (Niger-Congo is almost all tonal) and Amerindian are also rich groups.

Phonetically, tones are associated with different laryngeal properties, such as breathiness glottalization and Advanced Tongue Root (ATR). The effects are articulatory connected. Advancing the tongue root enlarges the pharyngeal cavity (breathy voice), which may lower the larynx. The second effect may further lower the pitch and encourage voicing. In MC, high tone in upper register in voiceless onsets and low tone in lower register in voiced onsets correspond to the Yin and Yang Category. The correlation of tone with other articulatory features is summarized in table 2.1:

First Register	Second Register
Voiceless onset	Voiced Onset
Modal voice	Breathy Voice
Higher Pitch	Lower Pitch
Retracted Tongue Root	Advanced Tongue Root

Table 2.1: The effects of the two tone registers, in Yip (2002)

Probably because of their almost total absence in Indoeuropean languages, little attention has been given to the study of tonology until the second half of the 20^{th} century. The scenario drastically changed when in the Seventies a series of studies in African languages revealed the peculiar behaviour of tonal processes . The analysis of tonal processes

in African languages led to the development of the autosegmental theory, one of the most influential representation model in generative linguistics (Hyman, 1974; Goldsmith, 1976 etc.). Autosegmental theory provided an adequate model for the description of tonal structure, but the specific computational mechanisms remained a hybrid of SPE rules and Well Formedness Constraint (WFC). Autosegmental theory is primarily a theory of representation, so the basic tenet of the model (multiple independent levels connected by association lines) was naturally integrated into OT computation.

In the thesis, the analysis will not necessarily depend on autosegmental representation and constraints, but their role in theoretical tonology was and still is so central that they will be used at least as a explicate notation to introduce and elucidate processes and structures.

2.3 Tonal Structures

The enquire in the internal organization of tones has developed along the line of the debate on segment representation. The most diffused descriptive notational system used to indicate tones in Asian studies are Chao's (1956) letters, organized in a scale that goes to 1 (lowest pitch) to 5 (highest pitch).

Chao letters are a useful descriptive notation, as they clearly indicate the phonetic shape of tones, but they are not equally convenient in the description of language tonematics. Coarticulation and other phonetic effects may result in different production of the same tonemes. For instance, in Cantonese the high level tone is produced as 55 while in the Chonghua Yue dialect 從化as 44. Phonologically, the tone is the same, but Chao‘s letters reflect the different pronunciation. As for segments, assimilation, dissimilation and other tonal process revelaed that the internal structure of tones is complex and cannot be captured by a single digit.

The organization and the nature of the internal structure of tones was the topic of a number of proposals, most of them critically discussed in Bao (1996). There is some consensus that a the maximum number of tone levels should be four, a number that permits to represent the richest existing tonal systems such as Cantonese. The analysis of dissimilation, spreading and assimilation of single features and the interaction of tonal and segmental effects are central in the discussion. Although unary elements where proposed for tonology by Clements (1981), most models proposals are based on binary features. Wang (1967) and Woo (1969) propose three binary features, High, Low and Modify. To resolve

the over-generation problem resulting from the combination of three features, the authors claim that languages with less than four tones do not use Modify. Yip (1980) substitutes the features High and Low with Register and Tone, and eliminates the third feature. The combinations correctly generate the four necessary levels. Another advantage of the proposal is that in three level tone systems, where mid-tone behaviour cannot be predicted, mid-tone can either represented as [-Tone][+Register] or as [+Tone][-Register].

A central issue in the debate is whether contour tones are composed by levels or are unary entities. Various hypotheses have been proposed, especially in feature geometry, by observing whether register is free to spread, tones can spread as a unit, and contours are free to spread without register. Cantonese constitutes a perfect example for the contour as level hypothesis: in songs 13 and 33 as well as 35 and 55 are interchangeable rhymes, bimoraic syllable contours are made up by the tones found in clipped monoraic syllables (sec. 3.3), and in all processes of tone change contours behave like complex elements (chapter 6 and 7).

Equally convincing evidences can be found in support of the contour as unit hypothesis. Pike (1948) observes that if countours were made of levels, we would expect to find all the levels that supposedly form a contour in a language as independent tones. For example, Mandarin has a complex tone 315, but while 35 is a valid tone 31 only appears after tone sandhi. More striking evidences seems to come from languages were contour spread or copy as unit. Yip (1989) observes for example that in Tianjin identical tones dissimilate, even if both are contours.

Various structures have been proposed in Feature Geometry that formalize each hypothesis. In Duanmu (1990) and Clements (1981) features are dominated by a tonal node, but are independent. For Yip (1989) the register feature is the tonal node, while according to Yip (1980) and Hyman (1993) there is no tone node dominating features.

Up to now, the most convincing models are those that integrate both hypothesis and allow contour to behave both as levels and as units. In Bao (1990) and Snider (1999) register is dominated by a tonal node, and Contour dominate tone features. For example, a high rising tone is represented as in figure 2.1.

For the study of Cantonese tonology, four tone levels and the assumption of the contour as levels hypothesis are essential, while the hierarchical organization of tonal features as well as the integration of tone with laryngeal features less relevant. The simplest system of two binary feature bundle linked to the TBU is therefore sufficient for the description

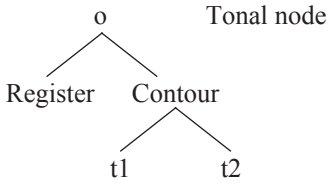

Figure 2.1: Tonal structure of a contour tone according to Bao (1990) and Snider (1999).

of Cantonese tonology. The abstract representation of a contour tone in Cantonese is illustrated in the following picture using Yip features:

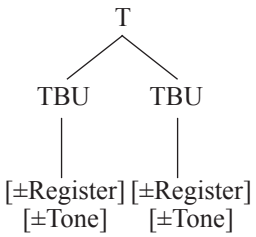

Figure 2.2: Structure of a contour tone in Cantonese.

To abstract even more, and make the analysis more representation-agnostic, feature bundles will be associated to a letter and never directly referred to, but in the description of the tonematics. As for the OT models, by assuming the simplest subset of compatible theories, the representation is flexible enough to be adapted to more sophisticated systems if deemed necessary.

2.4 Constraints in Tonology

Yip (2002) lists the following categories of tonal processes: assimilation, dissimilation, countour formation, countour simplification and downstep. With the exception of downstep that will not be discussed, the following constraints are sufficient to exemplify all these processes. Some examples of their application will follow.

***Assoc**
Do not create association lines.

***Disassoc**
Do not delete association lines

NoContour
Every TBU is associated with at most one tone.

NoLongT
Every tone is associated with at most one TBU.

SpecifyT
Every TBU must be associated with at least one tone.

***Float**
Every tone must be associated with at least one TBU.

Generally speaking, Alignment constraints higher ranked than Faithfulness constraints or than *Assoc and *Disassoc, will cause tone spreading or shifting depending on the relative position of *Assoc and *Disassoc. The following constraint rankings describe two tone spreading mini-grammars.

Align, *Assoc $\gg$ *Disassoc (tone shift)
Align, SpecifyT, *Assoc $\gg$ *Disassoc, NoLongT (tone spread - one to many)

In the first ranking, *Assoc is higher ranked and causes a tone shift. In the second, SpecifyT $\gg$ NoLongT allows the tone to spread, even if a one to many configuration is created by the spreading rule. The following ranking results in tonal stabiltiy:

*Float, Max[Tone] $\gg$ *Assoc, NoContour

Toneless TBU candidates surface if markedness constraints overrank faithfulness constraints.

*H ≫ SpecifyT, Max[T]

In this case, depending on the position of SpecifyT and on the tonematics of the language, the resulting TBU can be left toneless or filled in with the most unmarked tone in the language for that position.

Chapter 3

The Languages Investigated

3.1 Segments

Since segmental issues are marginal to this thesis, Cantonese segmental system will only be briefly mentioned. A commonly accepted consonant system is given in table 3.1[1].

The velarized labial is a complex segment. Phonetically, the velar stop and the approximant are pronounced simultenously. Phonologically, the approximant cannot be part of the onset, as Cantonese does not tolerate complex onsets, nor of the nucleus, as the labialized

[1]For those familiar with Mandarin, Cantonese has a poorer inventory as it does not have retroflex segments and the palatal fricative, but a more permissive phonotactics as it allows the series of obstruents [-p, -t, -k] in coda position and nasal syllabic segments.

manner/place		bilabial	labio-dental	alveolar	palatal	velar	lab. velar	glottal
stop	unaspirated	[p] *b*		[t] *d*		[k] *g*	[k^w] g^w	
	aspirated	[p^h] *p*		[t^h] *t*		[k^h] *k*	[$k^{w\ h}$] g^w	
fricative			[f]	[s]	[ʃ]			[h]
affricate	unaspirated			[ʦ]	[ʧ]			
	aspirated			[$ʦ^h$]	[$ʧ^h$]			
nasal		[m]		[n]		[ŋ]		
lateral				[l]				
glide					[j]	[w]		

Table 3.1: Cantonese consonant system.

velar can also be found in heavy syllables:

(3.1)

a. $g^w ɐn^{55}$ 'army' 军

b. $g^w ɔk^3$ 'country' 國

c. $g^w ɐn^{55}$ 'shine' 光

In onset position, [n] is often realised as [l], but only in a finite set of words, thus suggesting a lexical diffusion process (Cheng, ?). Etymological or underlying [l] is never realized as [n].

(3.2)

a. nɛɪ → lɛɪ 'you' 你

b. nøi → løi 'woman' 女

Stops in coda position are unreleased:

(3.3)

a. jɐt˺ 'one' 一

b. sɐp˺ 'ten' 十

c. bak˺ 'white' 白

Sibilant palatalization may be found before round vowels.

(3.4)

a. sœŋ → ʃœŋ 'to want' 想

b. sy → ʃy 'book' 書

c. tsy → ʧy 'pearl' 珠

The velar nasal [N] may weaken to [m] in informal speech or be completely neutralized in onset position.

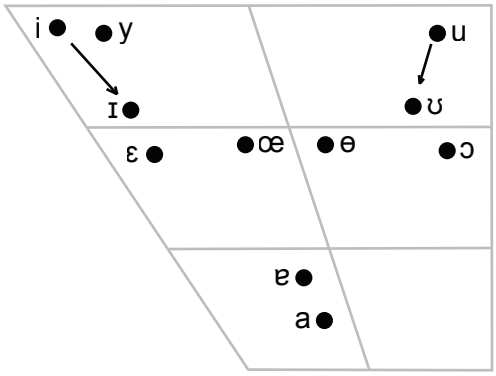

Figure 3.1: Vowel chart of Cantonese.

(3.5)

a.	ŋɔ	→	ɔ	'I'	我
b/	ŋ	→	m̩	'five'	五

The vowel system in figure 3.1 is typically assumed for Cantonese. Phonologically long vowels are never found in clipped syllables. Short vowels are shorteri n duration, lower and more centralized, and do not occur as independent rhymes in open syllables (Li, 1995). In the chart the arrows indicate short vowels and their long counterpart.

Traditional Chinese grammars always include so called rhyme sets, that is the list of possible segment combination that may form a rhyme in the language (also chapter 1 for a historical perspective). Different Rhyme sets have been proposed for Cantonese, the minimal and maximal sets are reported in tables 3.2 and 3.2 (Bauer, 1997:39). The two sets differ in the way they consider phonemic contrast and in the inclusion/excluision of loanwords and colloquial rhymes.

3.2 Syllabic Stucture and Tones

Syllable in Cantonese are (C)V(C), with onsetless syllables often epenthesized and codas limited to nasals and stops. In coda position, the aspirated/unaspirated distinction is neutralized, though, since stops becomes unreleased.

Syllables can be of two types: long or clipped. Long syllables contain a long vowel, a

/a/		/i/		/ɛ/	/y/		/œ/	/u/		/ɔ/		-
/ai/	/ɐi/		/ei/			/eoi/		/ui/		/ɔi/		-/i/
/au/	/ɐu/	/iu/		(/ɛu/)					/ou/			-/u/
/am/	/ɐm/	/im/		(/ɛm/)							/m/	-/m/
/an/	/ɐn/	/in/		(/ɛn/)	/yn/	/øn/		/un/		/ɔn/	/n/	-/n/
/aŋ/	/ɐn/	/ɪŋ/	/eŋ/	/ɛn/			/œn/		/ʊŋ/	/ɔŋ/		-/ŋ/
/ap/	/ɐp/	/ip/		(/ɐp/)								-/p/
/at/	/ɐt/	/it/		(/ɐt/)	/yt/	/ot/	(/œt/)	/ut/		/ɔt/		-/t/
/ak/	/ɐk/	ɪk	/ek/	/ɛk/			/øk/		/ʊk/	/ɔk/		-/k/

Table 3.2: Cantonese Maximum Rhyme set.

/a/		/i/	/ɛ/	/y/	/œ/	/u/	/ɔ/		-
/ai/	/ɐi/		/ɛi/		/œi/	/ui/	/ɔi/		-/i/
/au/	/ɐu/	/iu/					/ɔu/		-/u/
/am/	/ɐm/	/im/						/m/	-/m/
/an/	/ɐn/	/in/		/yn/	/œn/	/un/	/ɔn/	/n/	-/n/
/aŋ/	/ɐn/	/ɪŋ/	/ɛŋ/		/œŋ/	/ʊŋ/	/ɔŋ/		-/ŋ/
/ap/	/ɐp/	/ip/							-/p/
/at/	/ɐt/	/it/		/yt/	/œt/	/ut/	/ɔt/		-/t/
/ak/	/ɐk/	/ɪk/	/ek/		/œk/	/uk/	/ʊk/		-/k/

Table 3.3: Cantonese Minimun Rhyme set.

vowel + a glide or a nasal, they are phonetically long and can license contour tones and long level tones. Clipped syllables are composed of a short vowel followed by [-p][-t][-k], are very short, and only surface with a short level tone[2].

Such distribution, together with the fact that every syllable in Cantonese has a number of tones which varies depending only on syllable constituents, indicate that the TBU is either segmental or moraic. Contours are found both on syllables with no coda and in syllabic segment.

(3.6) Contour tones in open syllables.

a. ma^{23} 'horse' 馬

b. m^{21} 'not' 唔

c. $lɔ^{35}$ 'take' 攞

These syllables only have one segment in the rhyme. If the TBU was the segment, they would not be able to license a contour. Since syllables and segments cannot be the TBU, mora is the only possible tone-bearing unit.

This conclusion is confirmed by the direct relationship between tone and length, expressed lexically by the clipped/long syllable distinction and by some cases of TC that cause syllable lengthening (sec. 6.7).

The correspondence between morae and tones is expressed by the interaction of two pairs of well attested constraints. In one pair, the two constraints *Float and SpecifyT are violated when a TBU (a mora) is not linked to a tone, and when a tone is not linked to a TBU, that is when a tone is left floating. In the other pair, constraints are violated when there is not a one-to-one correspondence between morae and tones: NoContour is violated when more than one tone is linked to one TBU, NoLongT when more than one TBU are linked to one tone.

These constraints are very high ranked in Cantonese. The result is that most generally, lexically clipped syllables are always associated with one tone, long (bimoraic) syllables with two. The only exemptions are the cases of changed tone, as discussed in chapter 4, 5 and 6.

[2]There is an exception to this general rule for changed tones, where closed syllables can surface with a contour tone and lengthen. This peculiar configuration will be explained in sec. 6.6

Crucially, NoLongT ≫ OCP, so a sequence of two identical tones is not realized as one tone associated to two TBU, but as two distinct tones.

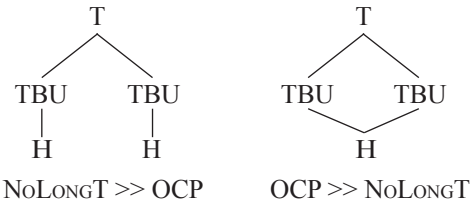

Figure 3.2: OCP *versus* NoLongT preferred structure on two adjacent tones.

3.3 Tonematics

Cantonese tone system can be most easily devised by observing clipped syllables. Clipped syllables cannot license contours lexically and so they constitute a good context for studying tone levels. In clipped syllables, three levels are found, the same that form contours in long syllables (Chao, 1974, Cheung 2007).

(3.7) The three level tones in clipped syllables

Level	clipped		bimoraic	
High	5	H	55	HH
Mid	3	M	33	MM
Low	2	L	22	LL

Almost all tone combinations are found in contours. The only impossible contours are those including L and H under the same TBU. Rising tones and falling tones are only allowed if they are a combination of adjacent tones (L with M and M with H, never LH).

(3.8) Cantonese tonal inventory

Nuclear	H	M	L
H	HH	HM	*HL
M	MH	MM	ML
L	*LH	LM	LL

The constraint *LH bans sequences of a low tone followed by a high tone in the same T(one root). The constraint is phonetically grounded as the it is violated when the pitch needs to rise or fall from the two opposite extremes of the pitch range in the same syllable[3].

***LH**
L and H cannot be associated to the same T.

Two recent issues in Cantonese phonology are tone mergers and the symmetric inventory hypothesis. As for the former, two kind of mergers have been observed. One is phonetically more evident Some tone pairs are not distinguished by groups of native speakers: low falling tone is confused with the low level, while the mid-rising is merged with the high rising tone. Some of the speakers may produce the tone pairs differently, but still fail to perceive the differences. (Fung and Wong, 2011). The mergers are listed in the following tables:

(3.9) Tone mergers

low merge	rising merge	high levels (no merge)
ML/LL	MH/LM	HH
		MM

One important aspect has to be stressed, which will be recurrent in Cantonese phonology, no merge or tone sandhi process ever change a high tone: the low merge does not affect high tones at all; the rising merge changes the low rising contour to high rising; the high falling tone change and the Guanzhou Cantonese tone sandhi both change the M tone in a HM sequence to H; in the analysis on TC, H will always be preserved.

A more subtle case of near mergers concerns the distinction between lexical and changed high rising contour. As in the case above, some speakers fail to differentiate the two tones in perception, but systematically distinguish them in production. (Yu, 2007) Both cases are an effect of a sound change: low tone merge is discussed in the next paragraphs, changed tone near mergers is the topic of section 6.6.

The symmetric inventory hypothesis is about a new tone inventory was proposed for Cantonese. In some speakers, the low falling tone is realized phonetically as 11, especially in Hong Kong Cantonese. The resulting inventory has four levels, two rising and no falls. I indicate with the letter B(ottom) the lowest tone.

[3]A similar constraints in found in Yip (2002).

(3.10) Hong Kong Cantonese symmetric inventory

levels		clipped		rising	
55	HH	5	H		
33	MM	3	M	35	MH
22	LL	2	L	23	LM
11	BB				

Clipped syllables are not the result of a synchronic process, but derive from MC *ru* tone. Since B is newly created and not historically derived, it has no clipped correlate. Also note that the low rising tone is described as 23, where 3 is associated with an M-tone. As said, a phonological form of a contour does not necessarily imply an exact correspondence with the phonetic content. I could not verify whether this phonetic mismatch is maintained in the symmetric system or if the end point of the low rising contour is actually lower than the end of the mid tone level.

The following table shows how features are assigned to each tone. Whether we name the features [tone] and [register] or use the more phonetic Duanmu feature names is unimportant here as features will not be referred to in the analysis. The readers may then adapt the α and β to their favourite model.

(3.11) Feature values in the symmetric inventory

Chao	lett.	α	β
5	H	[+]	[+]
3	M	[+]	[-]
2	L	[-]	[+]
1	B	[-]	[-]

Unlike the neat symmetric system, feature assignment of standard *hkc.* is more problematic. In particular, the mid-tone features are vacuous, although the symmetric system seems to suggest that the register (α) of the mid-tone is high.

(3.12) Feature values for traditional Cantonese tone inventory

Chao	lett.	α	β
5	H	[+]	[+]
3	M	[+]	[-]
2	L	[-]	[+]

Tone mergers and the symmetric inventory are connected. Both starts from Hong Kong Cantonese and both goes towards the elimination of the falling tones. The change will be described as an effect of the promotion of the constraint *NoFalling in Hong Kong Cantonese's grammar (see sec. 7.3 for a complete account of the change).

***NoFalling**
Ban falling contours

The following table shows the possible tonal structures and the notational convention that will be used in the thesis:

IPA	Chao	jyutping	example	gloss	extended	letters
˥/˩˥	55/53	si1	思	'to think'	High Level/Falling	HH/HM
˧˥	25	si2	史	'history'	High (Mid) Raising	MH
˧	33	si3	試	'to test'	Mid Level	MM
˨˧	23	si5	市	'city'	Low Rise	LM/BL
˨	22	si6	事	'fact'	Low Level	LL
˩˧/˩	21/11	si4	時	'time'	Low Falling/B-Level	ML/BB
˥	5	sik1	式	'style'	High Clipped	H
˧	3	sik3	刺	'to stab'	Mid Clipped	M
˨	2	sik6	食	'to eat'	Low Clipped	L

Table 3.4: Notation for Cantonese tonal structures

3.4 Tonal Alternations

Cantonese tonology is peculiar for its high number of tones, but also for its tonal rigidity. The high rank of faithfulness constraints and of SpecifyT results in a tonology that is almost immutable. Each TBU is linked to one tone; tonal processes such as tone sandhi,

reassociation, dissimilation, contour formation and dissimilation are never or almost never found. So, more often than in most other tonal languages, the surface forms is identical to the input.

In four cases, though, the expected tonal output of a word does not match the underlying form or the expected structure. One of them, is a form of tone sandhi that targets HM contour, and so it is only found in Guanzhou Cantonese. The process is as simple as strange, HMH sequnces surface as HHH (Chao 1947:26)

(3.13) Guanzhou Cantonese tone sandhi

a. /gou$^{5\mathbf{3}}$ san^{55}/ → /gou$^{5\mathbf{5}}$ san^{55}/

b. /gou$^{5\mathbf{3}}$ ʧ^{h}ɔk^{5}/ → /gou$^{5\mathbf{5}}$ ʧ^{h}ɔk^{5}/

Tone Change (TC) is a tonal alternation in Cantonese not reducible to tone sandhi, where the tone that surfaces on a syllable is different either from its underlying representation or from its expected historical outcome. Three different TC processes change an underlying contour into high rising, high level or low falling:

(3.14) The tree Cantonese TC

a.	/g^{w}ɐi^{33} g^{w}ɐi^{33} dɛi^{35}/	→	[g^{w}ɐi ^{33} g^{w}ɐi$^{\mathbf{35}}$ dɛi ^{35}]	'very expensive'	贵贵哋
b.	/jy^{23} lɐu^{21}/	→	[jy^{22}] [lɐu$^{\mathbf{55}}$]	'raincoat'	雨褸
c.	/ba^{55}/	→	[ba^{21} ba^{55}]	'father'	爸爸

Chao (1956:1) early proposed that the high rising TC could be regarded as a 'a non-syllabic and non-segmental suffix'; following analyses confirmed his intuition. All other TC processes have been traditionally considered as allomorphemic or diachronic. TC will be the discussed at length in chapter 4,5 and 6.

3.5 Weitou

The northern area of Hong Kong is known as New Territories (NT). Despite the name, which reflects the later inclusion of the territory in the British colony, NT is the area where the first Chinese inhabitants of Hong Kong settled. (Cameron, 1991) Fleeing as political refugees from Jishui 吉水, in Jiangxi 江西, the five clans Tang 鄧, Hau 候, Pang 彭and Liu

廖and Man 文settled in an area which, despite its recent development, remained relatively dangerous for centuries. (Sagart, 1982) To protect against external menaces the villages were built inside walls, from which the name of the language the speaker themselves call Weitou 圍頭話cant. [wai ^{35} tɐu ^{35} wa ^{21}] 'language of the walled villages'. Weitou is similar to Cantonese, so that describes it as a dialect of Cantonese. Although the original inhabitants of the area migrated from the Jianxi province, Sagart (1982) argues that Weitou has nowadays no link with any dialect group but Yue (Sagart, 1982), and that the language can be classified as a dialect of Cantonese. Not having found anything that could prove the contrary, I will keep his stand.

Five informants were consulted during the research. Two brothers, Mr. Lau J. D. and Mr. Lau H. D. (德), both in their mid-40, who grew up in Tsung Pak Long village 松柏塱, near Sheung Shui 上水in the N.T. and her mother, Mrs. Lau. The woman is monolingual, and so used Weitou as the primary language of communication with their children. The two brothers are instead bilingual. Both studied in the N.T. and worked in Hong Kong (Kownloon), in a Cantonese speaking environment, but used Weitou as primary language at home and in the village.

The other two speakers are also in their forties. Mrs. Hau is from Ho Sheung Heung 河上鄉village and is a primary school teacher working in Kowloon. Mr. Man 文is from San Tin 新田. Both informants speak Weitou with their kins and the villagers in daily life. The map indicate the location of the villages in the new territories.

A first interview was made based on the questionnaire for tonal sytstems proposed in the Fangyan Diaocha Zibiao 方言调查字表(1981:x), a reference book in Chinese dialects survey, and on an extract of a spontaneous conversation held by Mr. Lau H. D. As for Cantonese, the segmental inventory was not investigated when not relevant to the language tonology. As observed by Sagart (1982), who actually reports about the Kat Hing Wai village's dialect, the segmental phonology of Weitou is not much different from Cantonese. In Weitou -n/-t in -ŋ/-k merge in coda position (finals) (as also observed in Sagart, 1982).

(3.15) Coda velar merge

7	往日	in the past	wɔŋ^{23} jat^{2*}	jak^{2*}
9	重新	again	tsʰuŋ^{5} san^{55}	saŋ^{55}
26	父親	father	fu^{22} tsʰan^{55}	tsʰaŋ^{55}
41	手襪	gloves	sau^{35} mat^{2*}	mæk^{2*}

Figure 3.3: Map of the Weitou informants' villages.

The absence of Cantonese diphtongization in for a Old Cantonese */-i, -ue, -oo/.

(3.16) Cantonese diphtongization in Weitou

71	玻璃	glass	bɔ^{55} lɛi^{21*}	li^{21*}
72	拉尾	last; tail	lai^{55} mɛi^{23*}	mi^{55*}
88	時摩	hair	si^{21} mɔu^{21*}	mɔ^{55*}

The tone inventory of Weitou is reported in the following table, with the etymological MC category of each tone and the corresponding Cantonese outcome.

The data set needs to be expanded to include more data, but some major differences with Cantonese can still be acknowledged with a sufficient degree of accuracy. The absence

	Register	Even	Rising	Departing	Entering
Cantonese	Upper	HH [55]	MH [35]	MM [33]	H [5] / M [3]
	Lower	ML [21]	LM [23]	LL [22]	L [2]
Weitou	Upper	44/55 HH	25 MH	55/44 HH	24 MH
	Lower	21 LL	44/55 HH	33 MM	2 L

Table 3.5: Development of MC tonal categories in Weitou and Cantonese.

of falling tones reflects the Cantonese system, but Weitou is further simplified as it seems to lack a low-rising tone. Another interesting difference lies in the absence of the split of the *ru* MC category, typical of Cantonese. Although the absence of the split is very common in Yue dialects, the outcome is peculiar. Of the 30 dialects listed in SPRD, SWG and SNG, only another dialect seems to show a similar configuration Huizhou 惠州, while in all other case, either the split is found, or the category outcomes are the high or low level tones. As in other Yue dialects, a contour tone is found in clipped syllables, which may result from a lower ranked NoLongT or from the fact that even clipped syllables are bimoraic, that is the final obstruents did not lost their weight. Unfortunately, the lack of precise phonetic description in the atlases, in particular about the duration and phonological behaviour of clipped syllables, and the necessity of an analysis of the tonologies of these dialects, makes any kind of conclusion hazardous.

(3.17) Weitou tonal system

Nuclear T	H	M	L	∅
H	HH	*	*	(MH)
M	MH	MM	*	
L	*	*	LL	L

To my knowledge, tone change and tone sandhi are not attested in the literature of Weitou, but during the preliminary interviews some cases of TC emerged. With the help of Mr. Lau J. D. and Mr. Lau H. D. a specific survey was written to verify the contexts and shape of tone change. The results showed that Weitou has TC, and that it is similar Cantonese's (see chapter 5 for the survey and further details).

Chapter 4

Introduction to Tone Change

4.1 High Rising TC Alternations

The high rising TC is the most studied and well known tonal process in Cantonese, especially in formal phonology. The high rising TC changes all tonal configuration to a tone similar or identical to the lexical high rising contour, with the exception of high tones, which are claimed to remain unchanged.

(4.1) High rising TC
/g^{w}ɐi^{33} g^{w}ɐi^{33} dɛi^{35}/ → [g^{w}ɐi^{33} g^{w}ɐi$^{\mathbf{35}}$ dɛi^{35}] 'It's very expensive' 贵贵哋
/a^{33} tsiu^{22}/ → [a^{33} tsiu$^{\mathbf{35}}$] 'Chiu (voc)' 阿赵
/a^{33} lɐm^{21}/ → [a^{33} lɐm$^{\mathbf{35}}$] 'Lam (voc)' 阿林
/a^{33} tsɛ^{22}/ → /a^{33} tsɛ$^{\mathbf{35}}$] 'Zee (voc)' 阿谢

(4.2) High rising TC blocked by high tones.
/a^{33} ʧœŋ$^{\mathbf{55}}$/ → [a^{33} ʧœŋ$^{\mathbf{55}}$] 'Cheng (voc)' 阿张
/tɐn^{35} **tɐn$^{\mathbf{35}}$** dzɐn^{33}/ → [tɐn^{35} **tɐn$^{\mathbf{35}}$** dzɐn^{33}] 'shivering' 腾腾震

Clipped syllables also appear with the CT. The tone contour is high rising, and the syllable can be either longer than lexical clipped syllables but shorter than the lexical high rising contour, or as long as the lexical high rising contour.

(4.3)
/a^{33} mɐk^{3}/ → [a^{33} mɐk^{35}] 'Mak' 阿麦
/lɐp^{2} lɐp^{2} lyn^{33}/ → [lɐp^{2} lɐp^{35} lyn^{33}] 'messy' 立立乱
/bɔk^{2} bɔk^{3} dɛi^{35}/ → [bɔk^{2} bɔk^{35} dɛi^{35}] 'a little bit' 薄薄哋

Some authors (Bauer and Benedict, 1997) argue that tone change is blocked by MH and HH syllables. At least for the case of high rising tone, the process is argued to be blocked because of the similarity between the two forms. However, the two representations have not always been identical, even in Hong Kong. In the 1940's (Benedict, 1942:27; Chao 1947:34), it was noted that there was a phonetic difference between regular MH tones, and the MH CT, the latter being described as starting slightly lower (2 vs. 3) and ending slightly longer than the former (25: vs. 35). Even today, in some Yue dialects the difference is particularly evident, and for some speakers of Cantonese, as demonstrated by Yu (2007) and in the phonetic analysis (sec), a microphonetic difference can still be measured.

In Taishanese 台山話, a Yue dialect spoken in the southern Guangdong, the TC is obtained with the addition of a high tone on the right margin of the stem, resulting in the following alternations (Cheng, 1973)

(4.4) Taishan tone inventory.

Basic	Changed
66	-
22	226/227
32	327
21/31	316/317

Taishan tone change is found in word derivation and in the final syllable of locative, both found in Cantonese, although with a different distribution.

In Bobai 博白, a county under the administration of Yulin city 玉林, in western Guanxi, Wang-Li (1932) describes two dialects: the Bobai of the town (old Bobai), which is argued to be older and more conservative, and the dialect of the foreigners (new Bobai). In New Bobai the TC is obtained with the nasalization of the final homorganic consonant if the syllables ends with a stop. In all other cases, the Cantonese pattern is followed (Wang -Li, 1932).

(4.5)

/hak^{1}/ 'guest' → [han^{25}] 'small guest' 客
/ts^{h}ok^{2}/ 'chisel' → [ts^{h}oŋ^{25}] 'small chisel' 鑿
/meo^{44}/ 'cat' → [meo^{25}] 'kitten' 貓
/gao^{33}/ 'dog' → [gao^{25}] 'puppy' 狗

In old Bobai 博白, the same derivation is obtained with the suffixation of a [-ŋin MH] diminutive (Wang 1932:84-87).

(4.6)

/kæ^{44}/ 'chicken' → [kæ^{44} ŋin^{25}] 'chick' 雞

/ma^{45}/ 'horse' → [ma^{21} ŋin^{25}] 'small horse' 馬

As today, it is unclear to what extent TC is used as a word derivation mechanism. The array of meanings denoted by the high rising TC has probably shrug and expanded in the historical development of Cantonese, as the functions that the TC may have had as a derivational process have left numerous and diversified traces in the lexicon. It is evident, though, that the high rising TC was one of the most productive process in Cantonese word formation, and numerous semantic analyses have been attempted (Kam, 1977, 1980; Whitaker, 1956; Wong, 1982; Jurafsky, 1988; Bauer and Benedict, 1997).

TC is or was used to derive noun from verbs and verbs from noun, and generally as a morphological derivation process to change word meaning; the changes usually include a meaning modification of familiarity, endearment, ridicule, emphasis, surprise. Some of the CT forms are opaque, while other still maintain a certain degree of transparency (APPENDIX B).

A semantic analysis was attempted by Jurafsky (1988) using the cognitivist framework. Following Lakoff (1987), Jurafsky proposes that the array of semantic shifts provoked by TC can be captured only if understood as a network of connected meaning. The core of the network, from where all other ramification departs, is the diminutive form. Other functions and connected meanings are devised as represented in figure 4.1.

High rising TC is the only one which is found after some cases of syllable elision and reduplication in Cantonese. TC from syllable elision is triggered by a limited number of functional words, usually found in weak syntactic position:

(4.7)

/jɐt H/	一	'one'
/tsɔ MH/	咗	'perfective aspect'
/hɐi MH/	喺	'in/on/at'

In most cases, elision is found in fast speech and informal register, but in some constructions the elided form is always preferred. For instance, the construction 'A jɐt^{5} A' is

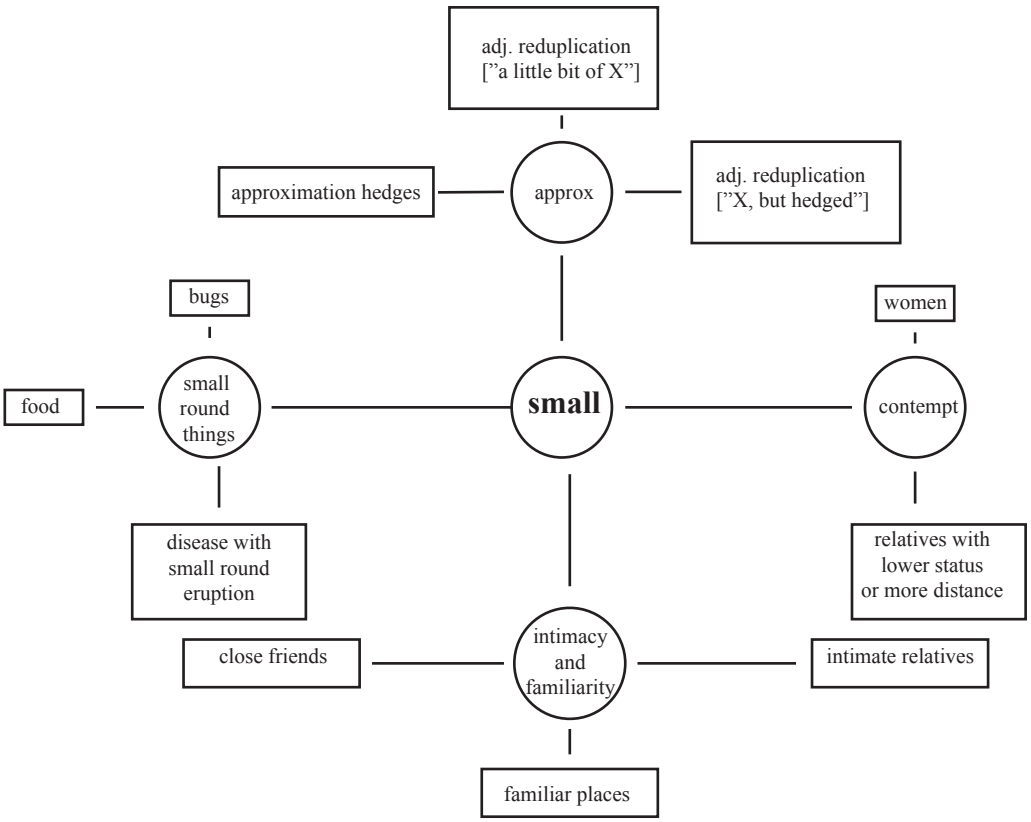

Figure 4.1: The network of meaning connected with the CT, from Jurafsky (1987).

used to indicate that the action expressed by the verb A is repeated once or for a while. In such constructions, the syllable is usually dropped, triggering a TC in the preceding syllable (Wong, 1982; Whitaker, 1956).

(4.8)

/si^{33} jat^{5} si^{33}/ 'to try' → [si$^{\mathbf{35}}$ si^{33}] 'to try once' 試(一)試
/ŋɐu^{23} jat^{5} ŋɐu^{23}/ 'to bite' → [ŋɐu$^{\mathbf{35}}$ ŋɐu^{23}] 'to take a bite' 坐(一)坐
/juŋ^{22} jat^{5} juŋ^{22}/ 'to try' → [juŋ$^{\mathbf{35}}$ juŋ^{22}] 'to use for a while' 用(一)用

4.2 Other Changed Tones

High level TC is less frequent than high rising TC in functions, lexical items, and contexts it appears in,. It is mostly found in word derivation, in a way similar to the high rising

TC, but with a slightly different semantics. The best examples come the words where three alternations can be found: the original stem, the high rising CT and the high level CT. In these cases, High level TC involves a more complex change, as it acts as an attenuative of the diminutive[1] (Whitaker, 1956).

(4.9)

/hɐai^{22} hou^{35} jyn^{23} ge^{33}/ 'it's quite far away' 係好遠嘅

/mou^{23} gei^{35} jyn$^{\mathbf{35}}$/ 'it's not very far' 冇幾遠

/mou^{23} gei^{35} jyn$^{\mathbf{55}}$/ 'it's actually quite near' 冇幾遠

(4.10)

/hɐi^{22} hou^{35} ʧ^{h}œN^{22} ge^{33}/ 'it is very long' 係好長嘅

/hɐi^{22} hou^{35} gei^{35} ʧ^{h}œN$^{\mathbf{35}}$ ge^{33}/ 'it is not very long' 係冇幾長嘅

/hɐi^{22} gɐm^{33} ʧ^{h}œN$^{\mathbf{55}}$ tsa^{33}/ 'it is just this long' 係咁長咋

The low falling TC changes all tones to a 21 contour. It is the least numerous in the lexicon and it is only found in two types reduplicated forms: kinship terms and onomatopeic neologism. In Cantonese (and Chinese in general), the kinship terms repertory is particularly rich. Mother and the father side of the family are distinguished lexically and the same relation can be usually expressed with different words. After the cultural revolution and the one-child policy, though, the diffusion of the nuclear family model may have led to the lost of some of these distinctions (Cheng, 1990). The most informal of these forms, in a way that is very common typologically, is obtained by reduplicating the kinship term, with the reduplicant surfacing in the low falling CT:

(4.11)

[ma^{21} ma^{55}] 'mom' 媽媽

[ba^{21} ba^{55}] 'dad' 爸爸

[gɔ^{21} gɔ^{55}] 'elder brother' 哥哥

Some neologisms were created in Cantonese by mean of a reduplicated onomathopeic syllable. The first syllable has a low falling contour, the second a high rising or a low falling contour. The contours are analyzed by Bauer (1987) as the result of a low falling and a high rising TC and by Yu (2010) as resulting from two alignment constraint operating only in this specific reduplicated forms.

[1]The three forms are seldom found in Cantonese.

(4.12)

[sa^{21} sa^{35}/^{21} sɛŋ^{35}] 'raining sound'

[tik^{2} tik$^{35/2}$ sɛŋ^{35}] 'dipping sound'

[kok^{2} kok2$^{35/2}$ sɛŋ^{35}] 'knocking sound'

4.3 The Diffusion of Tone Change

A preliminary analysis of the word list compiled in various sources (Whitaker (1995); Kam 1977, 1980; Bauer and Benedict, 1979; etc.) revealed that some of the words were not accepted in their CT anymore, some were archaique, and other did not exist either in gz. or hk., or in both of them. Before the phonetic experiment, it was then necessary to compile an updated list of words in CT.

First, a complete list of all bisyllabic words in high rising or high level TC forms in was collected from the various sources (*ibid.*). The list was then checked by native speakers of the two varieties (a university teacher of Cantonese linguistics for hk. and a student of linguistics for gz.) and the forms considered no longer in use or non-existent were taken out the list. The resulting list was then used to create three surveys. The first one included high rising CT indicated as obligatory in the sources; the second one optional high rising CT and high level CT; the third was compiled based on the phonological shape of the words, as it was later used for the survey on the phonetic of the TC (see chapter 5). To have more control over the sample, the online surveys were not made public, but individually submitted by other participants or by myself to potential subjects. The sample can be extended for further sociolinguistics research. The sample composition is reported in table 4.1.

variable	value and number of sujects		
age	<18: 0	18>25: 15	>40: 0
education	university: 12	high school: 3	
variety	Hong Kong: 9	Guangzhou: 4	other: 2
parents' variety	Hong Kong: 8	Guangzhou: 3	other: 4
sex	M: 8	F: 7	

Table 4.1: Online survey sample composition.

A first section served to collect information about the participant. Each participant was then given a list of bisyllabic words and asked to indicate which word rhymed with the

syllable in bold (that is in CT), and to pay particular attention to the tone. The options always included a rhyme which matched the CT, another that matched the original tone, one option for "None", and one for "Don't know/There is a mistake". For example, the 1st questions looked like this (the English translation was not included in the original test):

二**胡** (target word) 請選擇一個符合的選項(Please, select an option)

- 狐(matches original tone)
- 滸(matches CT)
- 皆為正確(Both are correct)
- 皆為錯誤/不知道(There is a mistake/Don't know)

The instructions, the first section of the test, a list of the words and of their rhymes as well as the number of the responses given for each options are given in Appendix B. Optional indicates whether according to Wong (1982), the tone change is optional or obligatory. Transparent indicate whether or not the derived meaning is related to the lexical base. This value is subjective and based solely on my judgement. The column Type indicates if the CT is high rising or high level.

4.4 AAA: Allophonic or Allomorphemic Alternation?

The contexts in which TC appears are heterogeneous, sometimes unpredictable, and a high degree of variation is found, both within and among speakers of different varieties. Diatopy and diachrony also play a major role, and the output that results from their interaction is often fuzzy. Those listed are usually considered the conditions for a phenomenon to be considered allomorphemic, and therefore outsourced in the lexicon.

Morphological derivation is often responsible of ambiguous, non-systematic cases, and more restrictive theories heavily relied on outsourcing to deal with it. A classical example is the palatalization triggered by English derivation suffix -*ity*, as in the pair *electri*[*k*] ∼ *electri*[*s*]*ity*. Indexed constraints in OT is, in my knowledge, the only theory that have codified an internal mechanism to deal with any number of non systematic cases (exceptions) in a language. The approach led to both advantages and disadvantages: the more the generative power of the theory augments, the less space is left for explanatory power and

prediction. Most dangerously, as there is no formal way to limit the number of indexes, indexed constraints may potentially allow analysis similar to those of Lightner (1978), where SPE rules were used to explain even cases of clearly historical sound change (*dental* → *tooth*, *heart* → *cardiac*, *sweet* → *hedonism*). This is a possible scenario in OT, where the constraint set is universal, if nothing prohibits that the same constraints that encoded Ancient Greek $s > h$ or Grimm's Law are indexed to lexicon entries that were once subject to the change. The problem, as in Lightner's works, is not that such analyses exist or not in the literature, but that the introduction of such mechanisms, if unconstrained, makes such analyses potentially possible and the theory unable to rule them out.

If low falling and high level TC are ambiguous with respect to their allomorphemic nature. As it will be shown, as the analysis will show, the three processes are different. The high rising CT is more easily reducible to a phonological process. First, The phonetic output is determined by the phonological context, with no exceptions. Second, in the neutralization case, high tones block the process, while in the long H the syllable is lengthened. Third, the quantity of the alternating forms is remarkable. Whitaker (1955), for example, compiled a list of hundreds forms. Although one could argue that such a diffusion in the lexicon is the result of a process no longer active in the phonology of the language, such an objection would do nothing more than pushing the issue back in the time, without actually resolving it. Fourth, the familiar vocative prefixes, some cases of reduplication and elision, seems to synchronically trigger TC. In chapters 6 and 7 the analysis of geographic variation, and the systematic behaviour of the CT will further prove the morphophonological nature of the process.

Chapter 5

The Phonetics of the Changed Tone

5.1 Introduction

Conflicting data and observations are found in the literature on the phonetics of changed tones. A phonetic experiment was carried out to verify the exact phonetic shape of the CT. The experiment addresses four questions:

1. Is there any phonetic difference between the lexical and the high rising CT?
2. Are the lexical and high level CT tone different?
3. What is the shape of the CT in clipped syllables?
4. How is the CT in Weitou?

Some authors argued that the high rising CT is no different than that of the lexical tone, while others have observed that the CT may be longer or higher. The difference between the two tones is more evident in other Yue dialects, where it is reported that the CT rises much higher in pitch than the lexical high rising tone, as in the Shun Tak 顺德dialect, spoken in Foshan 佛山district (1990). Yu (2007) demonstrates that even in Hong Kong Cantonese, for some speakers CT ends up with a pitch slightly higher than its lexical counterpart. The current experiment will confirm Yu's assertion.

If high rising tone is different from the lexical tone one would expect to have a similar result for the high level CT as well. But it seems that the high level CT has always been assumed to be identical to 55.

For the closed syllables, the context is even more intriguing. Some refernces are found, for instance in Wong (1982), that the tone is high rising, but there is no analysis of the consequences of the change, which results in the creation of a contour in a clipped syllable. It is also not stated whether the changed tone is as long as a high rising tone, as a clipped syllable or something in-between.

Finally, original data on Weitou TC are reported. The survey was divided into two parts, one containing a reading list of words, and another a list of phrases and sentences in contexts supposed to trigger high rising TC, such as syllable elision, reduplication and vocative forms.

5.2 Word List

The third list was compiled specifically for the recording task, so one priority has been to make the set as phonetically homogeneous as possible: some norms have been imposed so that each form could be compared with a sufficient number of unchanged and changed words. The criteria were chosen to include the highest number of forms possible, so to allow the collection of a set large enough to represent all experiment variables. For instance, /a/ was chosen instead of /œ/ because it was the most frequent nucleus in the list. The words were chosen that preferably satisfied the following criteria:

1. the CT had to be in the rightmost position.
2. word rhyming in /-at/, /-ok/, /-œk/, /-ak/ and -œt, that is all clipped syllables containing low vowels, with the exclusion of final /-p/
3. /a/ nuclear vowel and a nasal or a high vowel (/i/ or /u/) word-final for long syllables.

The resulting survey was further refined to cover all the necessary contexts, and to keep the experiment within a reasonable time limit (around 15 minutes for both parts). The final word list is reported in Appendix B. The list to be read by the participants only included the Chinese words and an English translation of the word, and was divided in three pages.

The questionnaire includes 77 bimoraic words that undergo high rising TC (three words from the original set were excluded because some participants had troubles recognizing the characters.). The bimoraic high rising TC group is the most represented, as a pilot study indicated that to obtain a significant difference between lexical and high rising CT

	Bimoraic		Clipped	total
tone	MH	HH	All	
CT	43	14	30	87
control	10	10	10	30
total	53	24	40	117

Table 5.1: Number of words in the first word list.

more data was required because of the less predictable application of TC and for the small phonetic difference at stake. For clipped syllables, 35 possible targets where included. Three sets of 20 control words where finally added to the list: two groups included long syllables, one with high rising tone and the other with the high level, and the other clipped syllables in high tone (as both high rising and high level CT corresponds to high closed syllables). Table 5.1 summarizes these numbers.

5.3 Mixed List

In the first word list it was impossible to include underlyingly high rising or high level tone, since TC is argued to be blocked in those contexts and so no word list included them. Context sensitive TC allows instead to test if TC actually applies to these forms by using high tone words in TC context and measuring if any difference can be measured. The mixed list was organized in two groups, one of 32 words in non-high tone, another of 36 words in high tone. Three TC sensitive contexts were considered: reduplication, vocative and syllable elision. For each context, in the non-high tone group four words were long syllables and four clipped; The high tone group was further divided as for whether the lexical tone was rising or level, thus giving three groups of three words (HH, MH and H tones). The complete list is reported in Appendix D. Table 5.2 indicates the number of words in each category.

5.4 Sampling

In total, 8 participants were recruited for the experiment. To be selected, each participant had to be born and raised in Guangzhou city (gz.), Hong Kong city (hk.) or Hong Kong New

	¬H	H	MH	total
clipped	10	7		17
bimoraic	9	4	7	21
total	19	11	7	37

Table 5.2: Number of words in the mixed word list.

Territories (wei.), and had to show native fluency in his/her variety. With the exception of N=3 and N=5 all participants parents also satisfied the above criteria. The Chinese correspondent of a high school diploma was required as minimum education requirement. All participants had no visual, hearing or cognitive impairments. The list of subjects is given table 5.3 (age is approximated to the closest five).

N	Name	Sex	Age	City	District
1	WI	M	70	Hong Kong	Kowloon
2	PA	M	40	Hong Kong	New Territories
3	LA	F	25	Hong Kong	Kowloon
4	NG	M	45	Hong Kong	Kowloon
5	ZH	M	25,	Guangzhou	Downtown
6	CA	F	25	Guangzhou	Downtown
7	AL	M	45	Weitou	Ho Sheung Heung
8	TE	F	45	Weitou	San Tin

Table 5.3: Participants gender, age ad location.

5.5 Material and Procedure

The speakers were recorded using a Shure SM81-LC cardiod condenser microhpone at 10 cm from speaker's mouth. Frequency range of the microphone is 20-20,000 Hz with a nearly flat response (figure 5.1); self-noise 16 dB typical.

For recording it was used the softare Audacity 1.2.6 at a 44100 sample rate on a laptop equipped with a Conextant 20671 sound card supporting 24 bit resolution, connected to a 24 bit Audiobox22VSL pre-amplifier. A short 0.5 meters cable with 100% shielding factor was used for the connection.

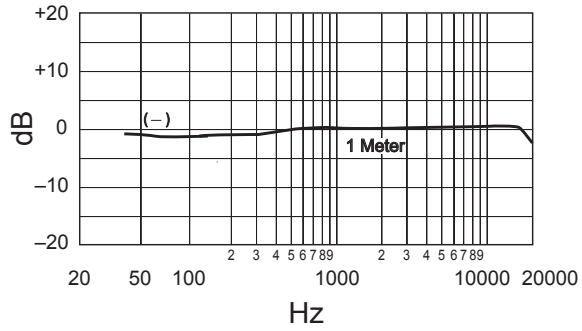

Figure 5.1: Frequency response of the microphone used for the recording (adapted from the original SM81-LC spec sheet).

The recordings were conducted in a calm and silent environment in the High quality Audio-Visual Laboratory at the Hong Kong Polytechnic University, in the silent room of the Laboratory of Phonetics in Guangzhou at the Jinan University 暨南大学, and in an open environment for the Weitou speakers. In order to optimize the environmental conditions, for the comfort of the participants and to avoid any external conditioning factors (peer pressure, background noise, operator disposal, etc.) the participants were tested one at a time, assured confidentiality and given the opportunity to decline to participate in the study. Between each reading page, the participants were allowed a short pause of some seconds. The first list was read once, the second list twice. The purpose of the study was stated only after the experiment was concluded.

5.6 Data Extraction

Pitch contours were manually extracted using the option *pitch listing* in Praat v. 5.3.18. Pitch range settings were 75-300 Hz for man, and 100-500 Hz for women, that gives a good visual result of the language tone contours. This approach was preferred to a semi-automatic extraction because it allowed a better control over the selection of the contour.

The analysis had to be carried out on high rightward tones, so a preliminary study verified the presence of any linking effect between high rising or high level tone and any other tone preceding them. The high tones of interest were M (MH) and H (HH, H), the possible preceding tones could be any tone between 1 and 5: 1 (low falling, 21), 2 (low level,

22), 3 (mid-level, 33), 4 (mid-rising, 24) and 5 (high level, high rising).

Two cases can be distinguished: the contexts where the first syllable ends with a phonetically continuous segment in the coda (nasals and vowels) and the following word onset is also continuous, and all other cases, that is where there is the airflow is interrupted at the word boundary. The easiest cases is the latter, as the two tones are clearly distinguished. As shown in fig. 5.2 and fig. 5.3, the passage from one word to the other is evident at the tonal level. The contours have little or no co-articulation effect, no matter the tone combination.

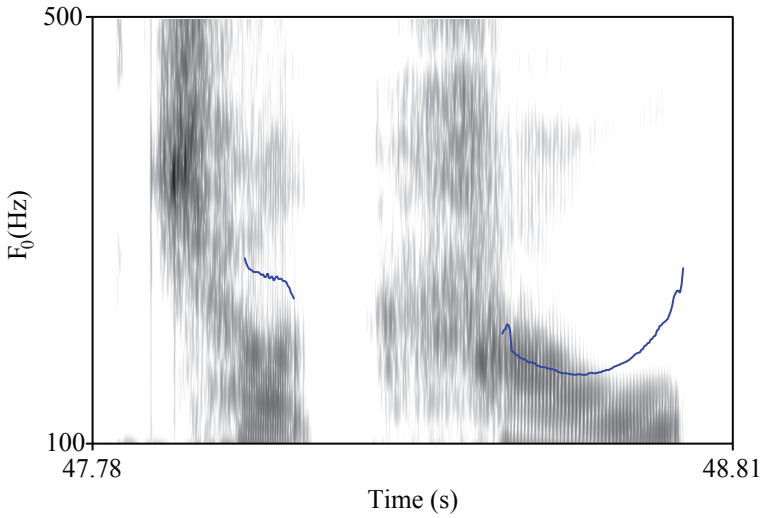

Figure 5.2: A linked high rising tone in the word [ts^{h}ɔt^{5} hau^{35}] 出口'exit', using the extraction settings.

Normally, the high rising tone start with a small rise, slightly falls and then rises again, reaching its highest pitch at the end of the contour. The highest peak in the first part, the lowest fall and the highest tone in the final part were measured. But it is not always possible to measure the three points. In fast speech, the pitch usually just rises without the initial fall, while for adjacent continuous segments, it is impossible to determine the starting point (fig.5.4 and fig.5.5). In these cases, the initial point was not measured.

The high level tone usually have two small rises, one at the beginning and another the end of the contour (fig. 5.6), although sometimes one of the two rises is not realized (fig. 5.3). The high level tone was then divided into three parts, and an arithmetic mean of the middle portion was calculated. If the shape did not allow for the selection of one of these points, the word was not included in the analysis.

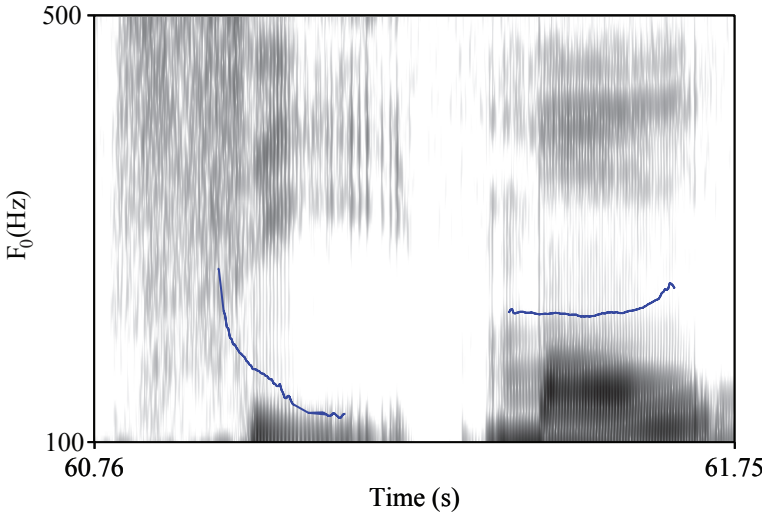

Figure 5.3: A linked high level CT tone in the word /si^{21} mɔu^{21}/, 時摩'hair'

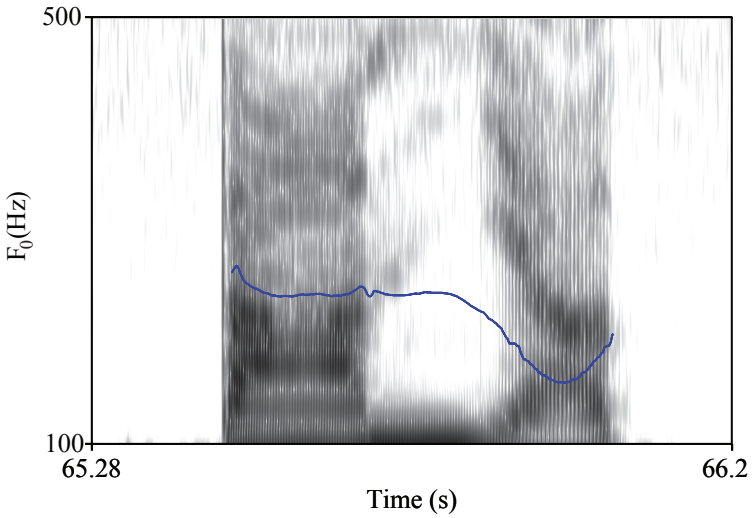

Figure 5.4: Word showing the more evident linking effect of continuant at syllable margin

5.7 Results and Discussion

Data was analyzed and parsed using python 2.7 numpy library for descriptive statistics, and R for the inferential statistic analysis. To determine whether the lexical high rising tone was different from the changed tone, the z-value of the two contours were calculated at each of the three points discussed above (inital rise, mid-fall, final peak). To calculate

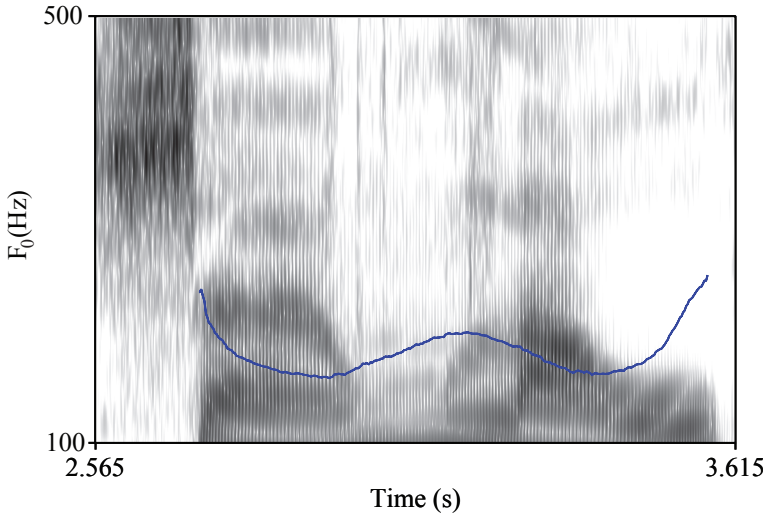

Figure 5.5: Low rising + high rising in a continuant context.

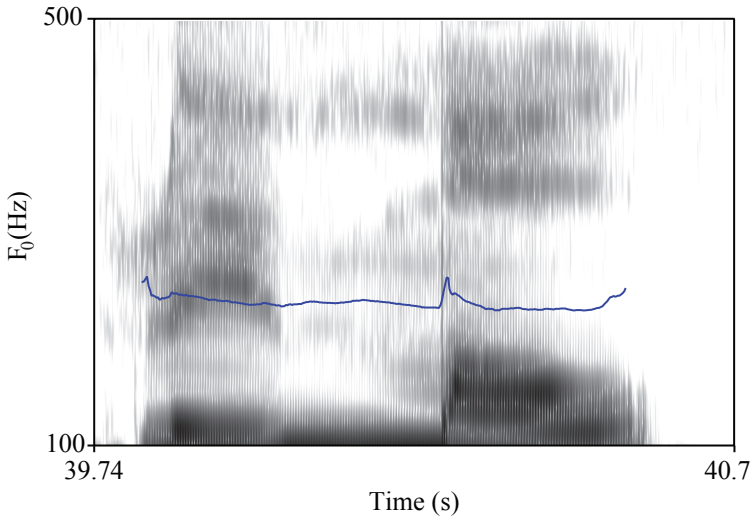

Figure 5.6: Two high level tones in a continuant context. Note the two short rising at the end and at the beginning of the syllable.

the z-value the following formula was used (Zhu, 2010):

$$z_i = \frac{\log_{10} x_i - \frac{1}{n}\sum_{i=1}^{n} \log_{10} x_i}{\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(\log_{10} x_i - \frac{1}{n}\sum_{i=1}^{n} \log_{10} x_i\right)^2}} \tag{5.1}$$

To calculate duration a simple delta value of the beginning and of the end of the tone was computed. High rising changed tone was found to be different from the lexical high rising contour in f0 for the speakers LA ($p<0.001$), and in both f0 ($p=0.02$) and duration (0.03) for the oldest speaker WI, as shown in table 5.4.

	dur			pitch		
	lex	tc	p-value	z-value(lex)	z-value(tc)	p-value
ZH	0.995	0.985	0.9932	0.981	1.066	0.7753
LA	0.449	0.482	0.9624	0.814	0.997	**<0.001**
NG	0.215	0.217	0.9024	1.046	1.142	0.5213
WI	0.237	0.276	**0.0332**	0.885	0.980	**0.0237**

Table 5.4: Lexical and changed tone duration and pitch values.

	lex			tc			
	mean	N	stdev	mean	N	stdev	p-value
ZH	0.995	13	0.653	0.985	32	0.840	0.9932
LA	0.449	14	0.047	0.482	24	0.141	0.9624
NG	0.215	16	0.029	0.217	36	0.0067	0.9024
WI	0.237	16	0.028	0.276	12	0.0570	**0.0237**

Table 5.5: Lexical and changed tone duration values.

	lex				tc			
	zval1	zval2	zval3	zval1	zval2	zval3	p-value(f0)	pvalue(d)
ZH	-0.248	-0.6	1.066	-0.681	-1.056	0.981	0.7753	0.9932
LA	-0.0851	-1.093	0.997	0.224	-1.072	0.814	**<0.001**	0.9624
NG	-0.450	-0.721	1.142	-0.789	1.0	1.046	0.5213	0.9024
WI	-0.475	-0.603	0.980	-0.348	-0.295	0.885	**0.0332**	**0.0237**

Table 5.6: z-values of the initial rise, mid-fall and final peak changed and lexical tones.

The changed tone, for the speakers that distinguish it, starts lower and ends higher than the lexical tone (figure 5.7). Figure y shows the difference in duration between the two tones.

No statistically significant difference was instead found for the high level changed tones (table 5.7).

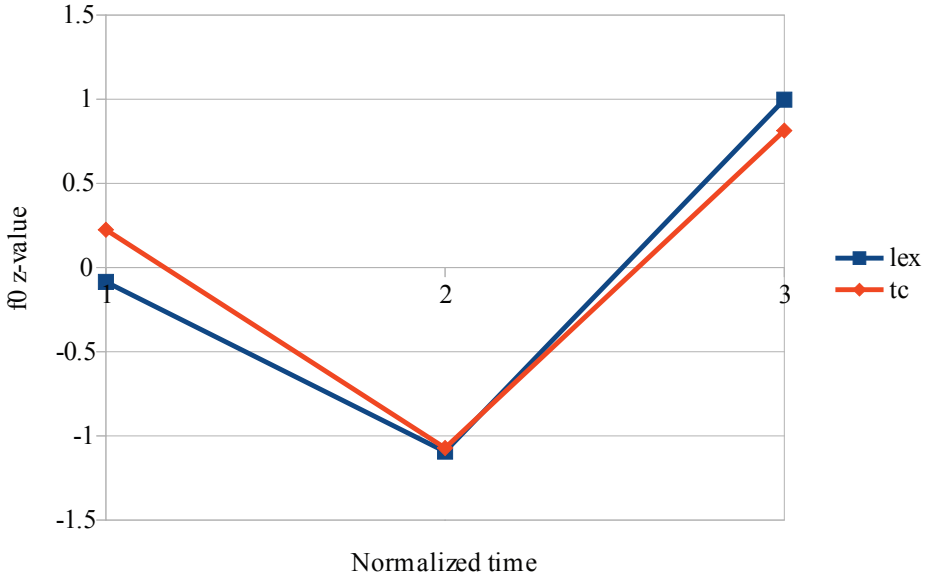

Figure 5.7: Lexical and changed high rising tone in LA (young female speaker) average normalized pitch curve.

	mean	stdev	mean	stdev	p-value
ZH	0.241	0.16	0.335	0.13	0.250
LA	0.55	0.204	0.664	0.217	0.2673
NG	0.284	0.125	0.458	0.2	0.323
WI	0.270	0.112	0.237	0.063	0.487

Table 5.7: Duration of the changed and lexical high level tones.

Finally, the duration was calculated for changed tones in clipped syllables (table 5.8). In most Cantonese cases the syllables lengthened. WI, the oldest Cantonese speaker in the group, the length of the changed tone was much longer than lexical clipped syllables, but not significantly different from the lexical high rising contour. For the Weitou speakers no significant difference was found with respect to the equivalent lexical high rising clipped tone.

Figure 5.9 shows that there is a statistically significant difference between the three tones for most Cantonese speakers, as in the scale *clipped lexical* < *clipped changed* < *lexical long*.

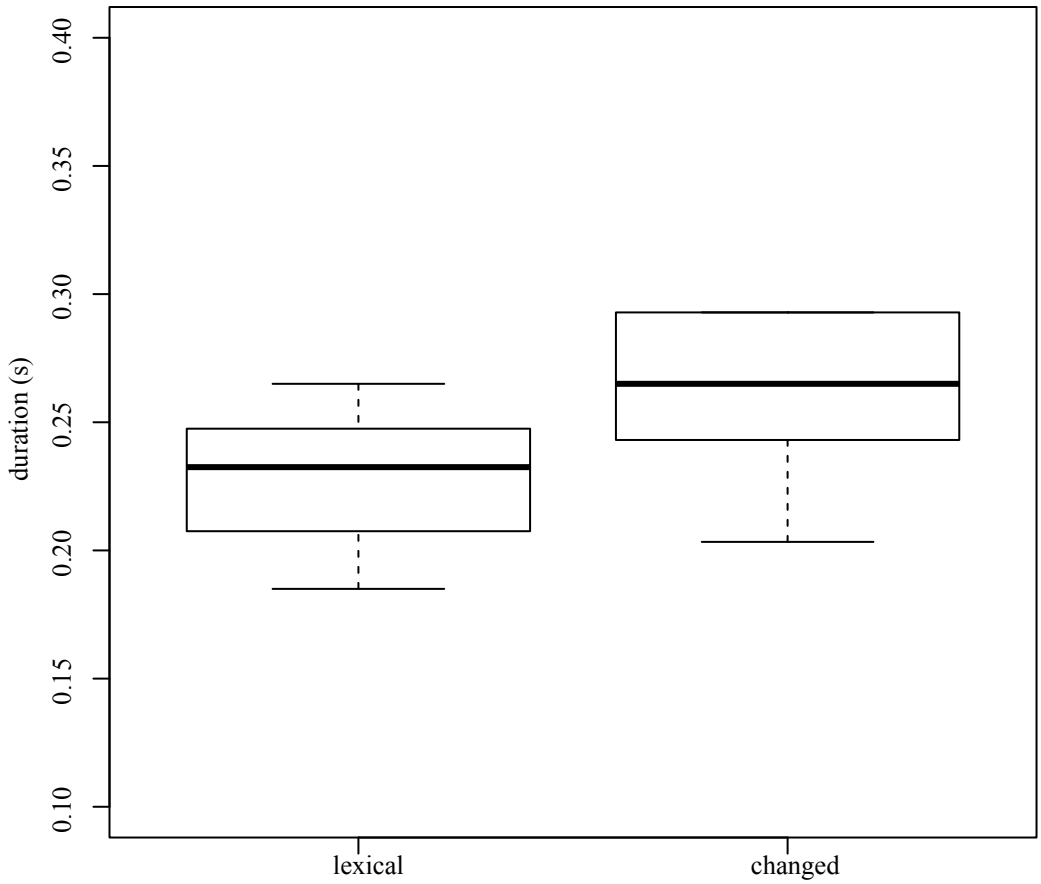

Figure 5.8: Lexical and changed high duration difference in WI (adult male speaker) average normalized pitch curve.

	clipped	tc	p-value	lex	pvalue
ZH	0.114	0.174	0.002	0.229	0.0021
LA	0.161	0.278	0.008	0.449	0.001
NG	0.0941	0.217	0.001	0.237	0.0076
WI	0.115	0.177	**0.001**	0.194	**0.1074**

Table 5.8: Lexical, changed clipped syllables, and lexical long duration values.

5.8 Conclusion

In the experiment, three questions were investigated on the relationship between the phonetic of lexical and changed tones. As for the high rising tone, the difference observed at

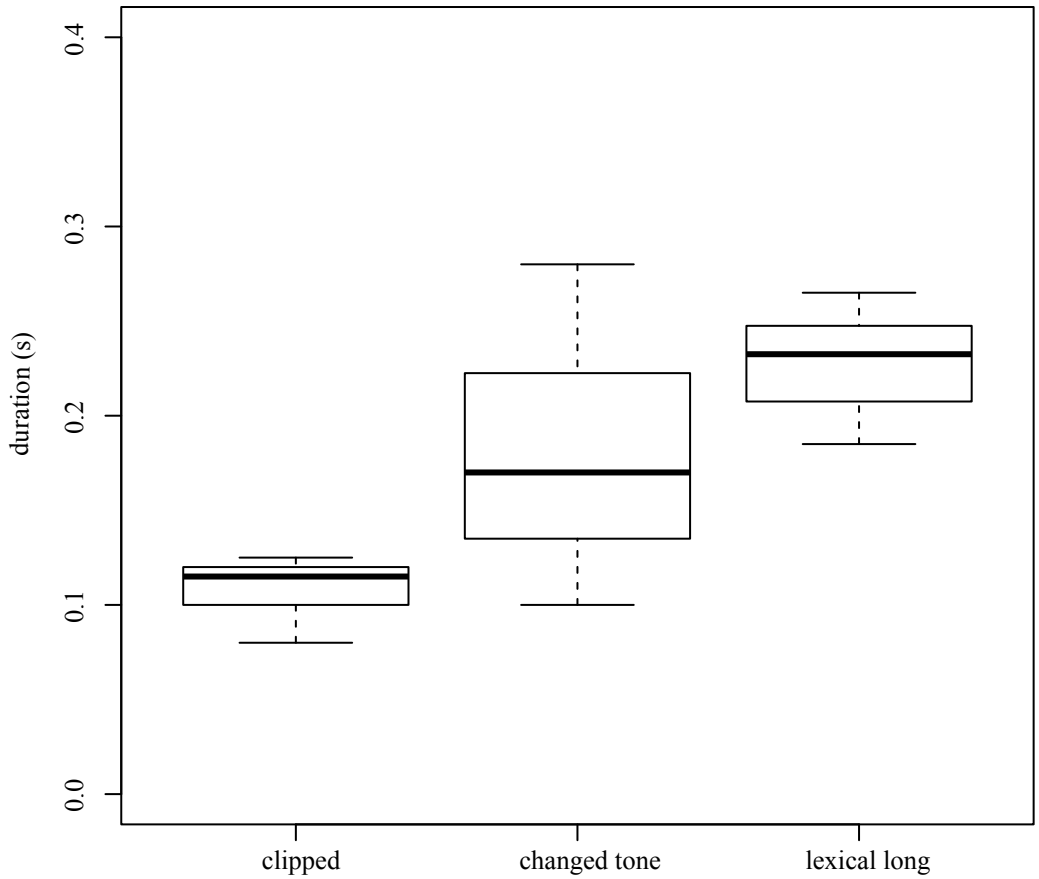

Figure 5.9: The tone lengthening scale *clipped lexical* < *clipped changed* < *lexical long* for the young female *hk.* speaker LA.

the end of the contour by Yu (2007) was confirmed in the experiment for two speakers. In addition to this, it was found that the attach point of changed tone is lower than the lexical tone, and that for one speaker, a systematic lengthening in the changed tone syllable is also observed.

For clipped syllables TC, the length of lexical clipped syllable, changed clipped syllables and lexical long syllables was compared. The following lengthening scale was found: *clipped lexical* < *clipped changed* < *lexical long.* For one speaker though (WI), the same that distinguished the length changed high rising tone from the lexical in duration, the duration of the changed clipped tone and of the lexical high rising tone was the same.

No significant difference was found for the high level changed tone.

Chapter 6

High Rising Tone Change

6.1 Previous Analyses

In generative phonology, a first analysis of the high rising TC was given in Wong (1977). The author's approach is typically SPE-based. A rule changes any non-high tone to a high rising tone in TC triggering contexts.

$$[\text{-high}] \longrightarrow \begin{bmatrix} \text{+high} \\ \text{+rising} \end{bmatrix} \Big/ \overset{(M_i)}{\begin{bmatrix} \text{——} \\ M_i \end{bmatrix}} \begin{bmatrix} M \\ \text{+high} \\ \text{+tone change} \\ \text{trigger} \end{bmatrix} (M_i)$$

Another rule eventually deletes the trigger in the case of TC from deletion.

$$\begin{bmatrix} M \\ \text{+high} \\ \text{+tone change} \\ \text{trigger} \end{bmatrix} \longrightarrow \emptyset$$

A non-generative description of the phenomenon is mentioned in Yu (2007) that uses exemplar based theory. The analysis does not go into details for the mechanism of the TC, but mainly notes that an OT approach cannot explain for the case of merger experimentally obtained.

First account of TC were descriptive, although Chao (1956) proposed that TC might be caused by suffixation. His brilliant intuition was also adopted by Yip (1980), who uses the autosegmental framework to describe the process as a tone re-association phenomenon. The

rightmost tone is de-associated to include the suffixal H. A repair mechanism eventually changes LH, ill-formed in Cantonese, to MH.

The commonly accepted OT analysis of TC refines Yip's analysis by using markedness constraints to replace the repair mechanism and explain the re-association as caused by thr high ranked *Float constraint (Yip, 2002; Chen, 2004) interacting with NoComplexC, FaithNTone and Max[Tone]. All necessary constraints have been already introduced in the thesis, with the exception of FaithNucleaurTone which is defined as follows.

FaithNuclearTone
Parse and do not change nuclear tones.

The entire constraint ranking is not given, so it is unclear how the right output can be chosen. It is made evident that NoComplexC is high ranked to avoid the creation of a complex contour. But if a complex contour does not surface and the suffixal H has to be included, then there two options: the winning candidate will have to have the second tone either unparsed or left floating. Given the constraint set, no matter what the ranking, such a candidate will always be harmonically bound by the one that leaves the suffix unparsed or floating, since it will not violate any faithfulness constraints in the input and *Assoc and *Disassoc[1]. For example, in the case where $MM \rightarrow MH$ in *hk.*:

(6.1) /gap M gɐi **MM** + **H**/ → [gap M gɐi **MH**] 夾計"to cooperate on a plan"

[1]For the sake of clarity, in the following tableaux I will assume that a tonal root T is always licensed by a bimoraic syllable, unless otherwise specified. For instance [MH] indicates a high raising tone in a bimoraic syllable such as [gɐu MH] 九'nine'. The word is bimoraic and therefore can license two tones (H and M). In addition to this, I will include unparsed elements in the tableaux between angled brackets and floating tones in italics (e.g. <H> indicates that the H tone is not parsed, *H* indicates that it is floating).

(6.2) ***Float chooses the wrong candidate.**

	/[MM] + H/	*NoComplexC	*Float	Max(T)	*Assoc	*Disassoc
a.	[MMH]	*!			*	
b.	[M*M*H]		*!		*	*
c.	[M<M>H]			*	*!	*
d.	[MH*H*]		*!			
e. ☞	[MM<H>]			💣		

The *Float analysis predicts the wrong output for the case of contour syllable deletion. If the elision of a the clipped [jɐt] results in the same configuration as the floating tone suffixation, this is not true when a bimoraic syllable is elided. For instance, in the case of [hɐi MH] elision, two tones left floating, and given this constraint ranking only markedness constraints can determines which of the two tones are to be selected.

The unparsed tone would then be [H], and not [M]. Since H_{suff} is always the rightward tone, Align-R(T, stem) ≫ Max[tone] prefers candidate that include the suffixal tone at the cost of leaving other tones unparsed.

Before starting the analysis, it is possible to make one important simplification. *Assoc and *Disassoc are violated every time a tone is de-associated and a new association line is created to link H_{suff} in the stem. But in Cantonese, if not connected to the TBU, the floating tones have no effect on the surface. Derivation is refused, so the effects of the floating tones must be surface true to make a difference. The de-association of a tone has the effect of leaving the tone unparsed. The two structures are identical for the computation of TC, as one will always violate *Disassoc, the other Max(Tone).

While Max(Tone) is determinant in some areas of Cantonese phonology and is a commonly accepted constraints, *Assoc and *Disassoc are theory specific and redundant in

the current analysis. It is then possible to keep it more representation agnostic, and simplify the process by eliminating any reference to autosegmental tiers, both in constraints and in structure representation. Since I will be using this ranking throughout the analysis, all other contexts will be demonstrated to be compatible as well.

6.2 Positive Conspiracy

In section 4.1, it was argued that the CT can result from either a derivational mechanism or segment deletion. The two phenomena are usually treated as the same (Wong, 1977; Bai, 1989; Yip, 2002; etc.), although similar in their effects, the two main contexts were the high rising CT appears are very different in nature Chen (2004) also briefly note it by saying: "The term tone change (bianyin) is extended, improperly in my opinion, to cover secondary tonal modification arising out of segmental deletion".

But the alternations on the surface form are not just incidentally the same. The underlying tone of the words that causes TC by the elision of their segmental content are /jɐt H/, /tsɔ MH/ and /hɐi MH/, all high tones. The derivation is obtained through the suffixation of an H to the stem. Both processes regards high tones.

External evidence shows that high tones have a peculiar state in Cantonese: tone mergers tend to preserve only H tones (see section 3.3, Fung and Wong, 2011; high tones are usually marked in tonal languages (Odden, 1995), but Yip (1995) advances the possibility that the H tone is unmarked in Cantonese; tones targeted by tone change are all the tones of Cantonese, with the exception of HH and MH.

In OT, where the grammar is responsible for all possible generated forms, the fact that it generates identical output for different processes, that Cantonese tonal alternations are so limited in number, that they all regards one element can hardly be reduced to a coincidence.

A classical constraint that would preserve the H tone from being deleted or change is be MAX(H). If we replace the ALIGN-R(T, STEM) or *FLOAT with MAX(H)[2], the grammar will choose the correct winning candidate:

[2]An alternative solution is to redefine *FLOAT as *FLOAT-H: cross-linguistically, in fact it is only H that is usually not left floating; L triggering downstep in African languages can then be contrasted as satisfying a MAX-L constraint, while H reassociation as due to *FLOAT-H. The asymmetric behavior of floating L and H is then explained as resulting from the interaction of two different constraints.

(6.3) **Max(H) choose the correct candidate.**

	/[MM] + H/	FaithNTone	*NoComplexC	Max(H)	Max(T)
a.	[MMH]		*!		
b. ☞	[M<M>H]				*
c.	[MM<H>]			*!	
d.	[<M>MH]	*!			*

Note that candidate (d) has the same surface form of the winning candidate. The ranking of FaithNTone has not been determined yet, so it will be assumed for now that it is ranked high enough to rule it out. In section 6.4 the exact position and form of the constraint will be determined. The same result is obtained with syllable elision, both with clipped and long syllables.

(6.4) **TC by syllable elision**

	/[MM] + (M)H/	*NoComplexC	Max(H)	Max(T)
a.	[MMMH]	**!		
b. ☞	[M<MM>H]			*
c.	[MMM<H>]		*!	*
d.	[M<M>MH]	*!		*
e.	[MM<MH>]		*!	**

TC is not an effect of a constraint on floating tone nor of right Alignment, but of a high ranked faithfulness constraint in the high tone. TC is also a clear case of conspiracy. A high ranked Max(H) together with the tonal rigidity of Cantonese, causes the set of alternations on the surface forms to be identical for different processes. Unlike traditional *conspiracy*, where a set of rules operated to avoid some structures to surface, the constraint set does not conspire against a particular structure, but instead aim at preserving a particular element in the surface. It is, in some sense, a *positive conspiracy* that can then explain the peculiar

status of H in Cantonese grammar (for which even more evidence will be given in the next section), and why only syllables with an H tone can be deleted and trigger TC.

6.3 Guangzhou Lengthening

For some speakers of gz. if the closing tone of the stem is high, then in TC contexts the syllable lengthens to form a complex contour. Complex contour tones surfaces, but only if the stem ends with an H tone (tH), that is there is no other option available but lengthening (constraints on the moraic level will be introduced in section 6.6). The lengthening case is the result of a demotion of the constraint NoComplexC.

(6.5) **Guangzhou Cantonese tH *TC.***

	/[MH] + H/	FaithNTone	Max(H)	*NoComplexC	Max(T)
a.	[M<H>H]		*!		*
b. ☞	[MHH]			*	
c.	[<M>HH]	*!			*

In the case of H tones, a violation of NoComplexC is preferred to a violation of Max(H). The candidate that leaves the nuclear tone unparsed is ruled out by FaithNTone. If the tone is not H, though, Max(H) is not violated by the candidate that does not parse the middle tone, and so it is preferred to candidate (b), that violates NoComplexC. Again, Align-R(T, stem) and *Float are tone-agnostic and so cannot choose the right candidate.

In Taishanese, TC results in the juxtaposition of the H tone to the stem, which always creates a complex contour. Since Max-tone overranks NoComplexC, no tone is left unparsed.

(6.6) **Taishan TC**

/[MH] + H/	FaithNTone	Max(H)	*NoComplexC	Max(t)
a. [M<H>H]		*!		*
b. ☞ [MHH]			*	
c. [<M>HH]	*!			*

Note that the difference between hk., ts. and gz. with respect to TC is then entirely determined by the different ranking of NoComplexC, which is ranked lower than Max(Tone) in Taishanese and highest in hk.

6.4 Ident([register])

In the case where the head tone in the stem is L (LL and LM) the current grammar would produce an LH contour, which is ill-formed in Cantonese[3]. The output form is instead MH, as shown in the following example:

(6.7) /a: MM tse LL + **H**/ → [a: MM tse **MH**] 阿谢"Zhe [voc.]"

To account for this case, a standard Ident constraint was proposed that applies to the tone register.

Ident([register])
Correspondent tones are identical in register

In section 3.3, it was observed that the register features of L and M are [-low], while H is [+high]. An input L realized as H will then violate the constraint Ident-Reg. The constraint captures well how an input L is rather changed into M than into H, but fails to determine which tone is changed. Candidates changing the nuclear tone will be harmonically bounded to candidates changing the suffixal tones, as the former violates Ident(t) and FaithNTone together. FaithNTone would then favour candidates that do not change

[3]We refer to the notion of ill-formedness as defined in Prince and Smolensky (2004:208): "A structure *phi* is (absolutely) ill-formed with respect to a given grammar iff there is no input which when given to the grammar leads to an output that contains *phi*.

the nuclear L tone, but those that change H to L, thus resulting in the LL candidate to be the winner, instead of MH.

The issue is solved by splitting FaithNTone into the more common IdentNTone and Max(NTone) constraints. Max(NTone) is ranked in the same position of FaithNTone, while Ident(NTone) will be ranked below Ident(H), but indeed above Ident(tone). Since the violation of Ident(NTone) are a subset of the violations of Ident(tone), the inverse ranking would make the constraint ineffective. Max(NTone) prevents the nuclear tone to be left unparsed, as in the previous cases did FaithNTone, while the relative ranking of Ident(H) ≫ Ident(NTone) favors a change in the nuclear tone rather than a change in the floating H. The tonematics constraints Spec(T) and *LH introduced in section 3.3 are highest ranked and avoid the creation of the ill-formed contour or the selection of a candidate with a toneless TBU.

(6.8) **Resolving LH configuration**

/LL/ + /H/	Spec(T)	*LH	NoComplexC)	Max(NTone)	Max(H)	Ident(H)	Ident(NTone)	Max(T)	Ident(T)
a. L<L>H		*!						*	
b. ☞M<L>H							*	*	*
c. <L>MH				*!				*	*
d. LL<H>					*!			*	
e. L<L>M						*!		*	*
f. <LL>H	*!			*				**	
g. LMH			*!	*					*

Faithfulness constraints on H tones are again the constraints that make the candidate with H_{suff} parsed and unchanged to win. The preservation of high tones is more important than the preservation of the nuclear tone itself.

6.5 MParse in Bobai

The MAX(H) analysis is original and alignment constraints are a typical OT device, so the majority of the authors did not consider tone change as either an effect of alignment or MAX(H). It is implicit in non-OT works that the authors who proposed or adopted the suffix hypothesis, assumed that tone change occurs for expressing new meaning. This intuition has not be rejected, as it is part of TC and will also shed some light on an interface phenomenon.

Prince and Smolensky (1993) uses MPARSE as the interface constraint that is violated when a morpheme in the input is not parsed in the candidate (or not included into a PrWrd).

MParse
all morphemes must be realized phonetically

For example, a violation is of the constraint is avoided by the inclusion of a segmental feature in van Oostendorp (2006). But MPARSE does not necessarily requires that it is the segment content that has to be parsed Indeed, segments are expected to be the most common form, trivially because tones are limited to a subset of possible languages, but in principle, there is no apparent reason to consider segments as the only legit element that can satisfy MPARSE.

Bobai phonotactics is similar to that of Cantonese and other Yue dialects. Syllables can be closed by either a glide, a nasal or a stop. If the syllable is closed by a stop, the diminutive is expressed through the nasalization of the consonant, otherwise by the usual tone change.

(6.9) /meo^{44}/ 'cat' → [meo^{25}] 'kitten' 貓

Vowels cannot be nasalized due to phonotactic restrictions (nasal vowels never surface in the language).

***$\tilde{\text{V}}$**
Ban nasalized vowels.

The other case is that the syllable ends with a nasal segment, in that case MPARSE is violated since the feature cannot be realized phonetically, distinguished, or assimilated to

the stem (depending on theoretical assumption on representation). Since the surface derived form have either a nasalized consonant and a tone change, we can assume that the suffix is a feature [nasal] linked to a high rising tone (fig. 6.1).

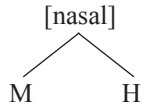

Figure 6.1: Bobai TC suffix.

The contour of the CT then is determined as in Cantonese. A high rising tone is indicated as suffix to demonstrate, as in the case of syllable elision in Cantonese, that the mid-tone is never parsed in the surface form.

(6.10) **TC in Bobai**

[ma MM]	*$\tilde{V}$	MPARSE	TC	IDENT(F)
a. [ma MM]		*!		
b. [mã MM]	*!			*
c. ☞[ma MH]			*	

(6.11) **Nasalizationin Bobai**

/mip MM/	*$\tilde{V}$	MPARSE	TC	IDENT(F)
a. [mip MH]		*!	*	
b. ☞[min MH]			*	*

The analysis demonstrates that in Bobai there is no allomorphy, but a floating nasal feature linked to a high level tone that behaves like H_{suff}. This peculiar suffix constitutes the missing intermediate stage between -ŋin suffixation and H_{suff} in Cantonese and Taishan. The underlying mid-tone is never realized phonetically since the Bobai stage, which shows when and how the mid-tone was lost in the suffix change.

6.6 Effimerous Near mergers and Weightless Suffixation

Labov *et al.* (1973) define near mergers as classes of sounds that speakers consistently report to be the same, yet differentiate at better than chance level. Explanation for near mergers has been various: they can be due to orthographic influences, variation in speaking style, sociolinguistics.

Yu demonstrates by a perception experiment that the microphonetic difference between a high rising and the changed tone is not perceived by speakers, not even by those who consistently distinguish it in production. Consistent differences in representation are found in forms that are supposed to be identical. Incomplete neutralization is context dependent, but near mergers are found at the lexical level or morphological level, and therefore are context free.

The super high tone is nothing new, as it is found in other Yue dialects and it was attested for Hong Kong Cantonese in some older analyses. If such differences are found in two forms, either the speakers at some point could perceive a difference - probably during acquisition when they were more sensible to microphonetic difference - and therefore created two different representations - or they are generalizing a process[4]. In the first case, OT and exemplar-based theory do not differ much . Since the input is different, the OT grammar creates a different underlying representation, i.e. a different lexical entry for the two forms, the second a different cloud. The problem here is phonological. One could in principle postulate the existence of an independent super high tone, call it H^+, which would be the tone of H_{suff}. When attached to the stem, the result would be [MH^+], different from the lexical [MH] contour. However, the inventory would result in a five level system, which is incompatible with four level inventory and with the generalizations about high tone in Cantonese so far observed. The limited context of the CT further discourages the introduction of a new tone in the inventory. The fact that the tone is never lexical and its presence in those specific contexts suggest that the difference between MH and MH^+ contour cannot be found in the internal structure of the H tone, but is caused by the process itself.

In a classical generative theory of lexical organization, stems and suffixes are stored as different entries in the lexicon and concatenated by morphophonological processes. The speaker learns about the suffix and applies it to all contexts, even in those that perceptively

[4]The influence of ortography is for obvious reasons to be excluded in the case of Chinese

are not prominent enough to be distinguishable. For example, in the case of tone change, the speaker may not hear the difference between the lexical and the changed high rising contour, but they have indeed generalized the process as a form of suffixation because of more evident alternations, such as those resulting from [MM] → [MH] or in closed syllables [M] → [MH], and can apply it systematically to generate the changed tone.

For the sake of simplicity I have so far ignored the moraic level and limited the discussion to tone change occurring in bimoraic syllables. The CT and the lexical tone were then both represented as [MH] and thus supposed to be pronounced identically. If the moraic level is inclued in the representation, it is more evident where the two contours differ in the grammars that distinguish them.

In Taishanese and in the Long H grammar of Guangzhou Cantonese, H_{suff} is always moraic, as demonstrated by the lengthening of suffixed syllables. If we consider the case of high rising suffixation, for instance, the addition of H_{suff} results in the creation of complex $[MHH]_{\mu\mu\mu}$ syllables, which is indeed different from the lexical $[MH]_{\mu\mu}$ form. But the inclusion of H_{suff} may change the shape of a tone even if a complex contour is not created. In near merger grammars, the inclusion of H_{suff} in the stem adds a third mora to the syllable, thus giving a $[MH]_{\mu\mu\mu}$ contour. The CT syllable is phonetically different from both the complex $[MHH]_{\mu\mu\mu}$ contour and the lexical $[MH]_{\mu\mu}$, for one is longer, while the other is realized with a sharper rise in the pitch, and is for some speakers is longer in duration. MAX(μ) has to be ranked higher than NOLONGT to avoid mora deletion. Tableau 6.12 shows the computation of the TC in grammars with the moraic suffix.

(6.12) **Super high CT.**

/LL/$\mu\mu$ + /H/μ	MAX(μ)	NOCOMPLEXC	NOLONGT
a. [M<M>H]$\mu\mu$	*!		
b. ☞[M<M>H]$\mu\mu\mu$			*
c. [MMH]$\mu\mu\mu$		*!	

Note that candidate (c) is the winner in Taishenese as NOCOMPLEXC is lower ranked in the language. Not all grammars distinguish CT and lexical tones. In these grammars TC has the same contour as the lexical high rising tone. As in previous cases of microvariation, there are two possibilities: the change is determined by a change in the constraint ranking or by a change in the UR. As for the former, the promotion of the constraint NOLONGT above MAX(μ) makes the candidate with one tone spread across two TBU (mora) to loose.

One mora is unparsed, which results in the contour $[MH]_{\mu\mu}$ for CT to be the winning candidate. MAX(TONE) is ranked above MAX(μ) to avoid tone epenthesis. Such ranking gives a grammar where TBU not linked to a tone are deleted. This is not the case for Cantonese. Being the mora the TBU, the undominated constraints which govern syllable weight and faithfulness constraints on segments are also violated if there is a segment or a syllabic position which is not assigned a mora (see section 3.2). Trimoraic syllables then do not violate such constraints, as all segments or syllabic positions are linked to a mora, but candidates where morae are fewer than available positions are ill-formed (for instance, *[gau MH]$_{\mu}$). Mora deletion can then be a legitimate strategy in trimoraic syllables; filling in the TBU with epenthetic tones will always be preferred in the other case (see section 7.2).

The difference might also be due to the fact that H_{suff} is a weightless suffix. The mora left floating by the lexical tone licenses H_{suff} without violating NOLONGT and $[MH]_{\mu\mu}$ is the winning candidate, which is identical to the lexical contour. The case of weightless suffixation corresponds to another stage of the suffix change ($[H]_{\mu} \rightarrow [H]$). In Yu's (2007) study and mine, the two varieties are found among speakers of about the same age and area. The minimal difference between the two suffixes and the fact that the constraint rankings are the same explain why such differences can be found in homonogenous groups. For Labov *et al.* (1973), the difference between near mergers is a matter of sound change and has to be maintained by the contact with a language that maintains the difference. This is exactly the case: the alternation is found even among speakers of the same variety and age group (so the contact is indeed maintained) and is the result of a sound change, that is suffix lenition or constraint re-ranking.

6.7 Clipped Syllables

Evidence for one of the two hypotheses about discriminative grammars come from the analysis of the behaviour of TC in clipped syllables. Lexically, no contour tone is found in clipped syllables, since final stops are weightless and cannot license a tone, but in TC context clipped syllables surface with an MH contour. While it is impossible to prove one or another hypothesis for the merger grammars - because in bimoraic syllables the winning candidates are the same - in clipped syllables context, weightless suffix or constraint re-ranking result in two different output.

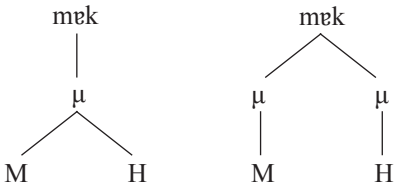

Figure 6.2: Multiple licensing *versus* syllable lengthening in clipped syllable CT.

Empirically, both grammars have been observed. The difference in duration found in CT clipped syllables in section 5.7 are the effect of these two different forms. In one case, the duration of the CT is no different from that of a lexical high rising contour; in the other grammar the vowel is still shorter than a VV, VG or VN syllables, but longer than the lexical clipped syllable.

The two grammars depend on the type of suffix used for TC and in constraint ranking. There are three logical possibilities: for the shorter syllables, MAX(H) and MAX(NTONE) are higher ranked, and thus avoid the deletion of the nuclear tone and of the suffixal tone. Since clipped syllable are monomoraic, the winning candiate will violate NOLONGT, which has to be lower ranked than MAX(μ) to avoid mora epenthesis.

(6.13) **TC in clipped syllables.**

	/M/μ + H	MAX(NTONE)	MAX(H)	DEP(μ)	NOSHORTT	MAX(T)
a. ☞	[MH]μ				*	
b.	[M<H>]μ		*!			*
c.	[<M>H]μ	*!				
d.	[MH]$\mu\mu$			*!		*

In longer syllables, the two morae can license the contour tone without violating NOSHORTT. The mora is can be brought in by the suffix, but there is also the possibility that, again, the difference is the result of constraint reranking. In the case of a promotion of DEP(μ) above NOSHORTT, even if the suffix is weightless, the candidate d. that epenthesize the morae rather than have a TBU to license a contour would win.

6.8 Lenis Diffusion

Table 6.1 summarizes all the types of TC discussed so far.

name	varieties	changed tone	comments
neutralization	gz. and hk.	MH	blocked by H
super high tone	gz. and hc.	MH^+	
lengthening	gz.	THH or MH	high tone lengthening
postposition	Taishanese	TTH	all tones
mixed	new Bobai	MH^+ and/or nasalization	
-ŋjin suffixation	old Bobai	-ŋjin suffix	

Table 6.1: Changed tone hierarchy in Yue dialects.

Western Guanxi dialects present the first stages of the lenition process, which is complete in the Hong Kong area, on the eastern border of the Yue region. The directionality of the lenition is evident: a process of diffusion from H_{suff} to -ŋjin is not possible as it would require the postulation of numerous unjustified and unattested process of segmental epenthesis. For this same reason, the suffix must have been already present in the area when the change started. The suffix lenition started in Guangzhou, favoured by the language tendency towards bisyllabicity, and kept on going for the reason so far explained. The fact that Cantonese was the most prestigious dialect in Guangdong facilitated the propagation of the change to neighboring dialects. The process lost its strength with the distance, and was weakened by the growing influence of Mandarin in west Guanxi and in north Guangdong.

Nowadays, suffix lenition is still an ongoing change, as demonstrated by its high degree of variation and its transitional nature. The exact shape of the suffix may vary, and cases of near mergers are diffused in homogenous speaker groups. These might be the signs that in the future TC will conclude its cycle and completely stop being syncrhonic. Its presence will be reduced to the status of a relic in the lexicon, indistinguishable by the speakers from other forms that followed the normal language development.

6.9 The Karstic Cycle

Most if not all languages use morphological derivation to create new lexemes. Word formation is obtained with various strategies: affixation, reduplication, composition, derivation and stress change are all well attested. In Sinitic languages composition and reduplication

are preferred to affixation, while stress change is never found. The reasons are phonological. Stress change is not an option, as in most, if not all sinitic languages, stress is not distinctive. Segmental affixation is limited by the restrictive phonotactics of the languages. Grammars such as Yue also severely limit the possibilities of tonal affixation because of their restrictive tonologies. In Cantonese, which will be argued to have started the change, there is a further phonological tendency that goes against syllabic suffixation. In previous chapters, it was observed a preference for bisyllabicity in many area of the language: almost every word is bisyllabic, an empty syllable /a/ is used in the vocative when the name is monosyllabic, children deliberately create reduplicated bysillabic forms, etc. A syllabic suffixation on a bisyllable would create a trisyllabic word.

Diminutive suffixation appears and disappears in different shapes through Chinese history. For instance, a derivative process of tone change, derived itself from segment suffixation, was argued to be already active in Classical Chinese (Downler, 1959), where it worked in a way very similar to Cantonese TC. Suffixes with a similar functions are also active in modern Chinese dialects, as in the case of the /-r/ 子suffix in Mandarin. Direct transmission from Classical Chinese TC to modern dialects suffixation is unrealistic: there is no documentation attesting intermediate forms, the time span is long, and most importantly the outcomes are unpredictable.

Classical Chinese derivation is argued to derive from a segmental suffix, which later developed into tone change and then disappeared completely. This development is the exact mirror of the latest stages of TC. The functional load is first taken up by a word, which then starts to be used as a suffix (ŋin → -ŋin; oldc. ? → -r). The suffix is hardly tolerated by the grammar, which rejects it for the phonological restrictions discussed below. The suffix undergoes a lenition process until its effects become transparent and finally disappears completely. At this point, the suffix is lost and the functional load of the derivational process has to be taken over by another strategy. Given similar premises, the change may start over again, thus becoming cyclic.

Note that in all cases the suffix changes for some phonological reason. Segment deletion avoid the violation of constraints against trisyllabic word (probably feet), segment deletion is pushed by the ban against complex syllables, and similarly moraic suffixation create marked trimoraic syllables. TC then creates little phonological monsters in the intolerant Cantonese grammar, that may cause the suffix to be simplified. This kind of explanation, as in all cases of sound changes, is not deterministic, but formalize what the internal reason for

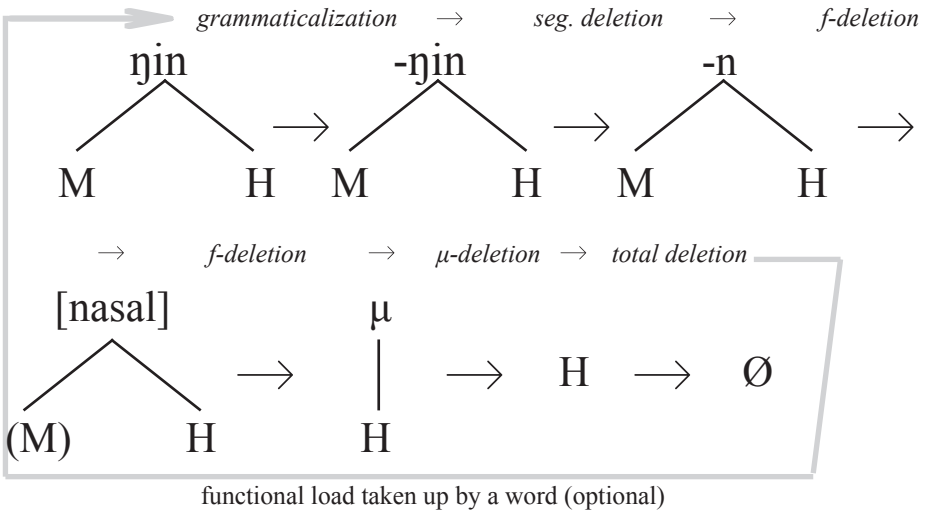

Figure 6.3: The functional load of a diminutive is taken up by a word, which becomes a suffix, lenites and eventually disappers, freeing the functional load again.

the change are, which in OT can be expressed and measured using constraints. In section 7.4, a model of geographic variation in OT will be proposed that will be argued to reflect the historical sound change. The change in constraint ranking will then be shown to parallel the correlation between historical change and geographic variation.

Chapter 7

Other TCs and Linguistic Variation

7.1 The Unmarked Tone

Yu (2010) argues that classical reduplication model of OT cannot account for the low falling TC. He proposes instead an analysis based on Inkelas and Zoll (2005) and the interaction of complex alignment constraints. To sum up, a separate co-phonology determine the tonal output of the reduplicative vocative stem formation according to the following constraints:

AlignR-T1-2
The right edge of a PrWd mustbe aligned with the right edge of a syllable with T1 or T2.

AlignL-T4
The left edge of a PrWd must be aligned with the left edge of a T4 syllable.

Ident-AssocIO
If there is an association between x and tone T in the input, then there is an association between x' and T' in the output, where x' and T' are the correspondents of x and T respectively.

(7.1) **Low falling TC according to Yu (2010)**

po4, po4	AlignR-T(1-2)	AlignL-T4	Max(Tone)
a. ☞ [po4po2]$_{PrWd}$			*
b. [po4po4]$_{PrWd}$	*!		*
c. [po2po4]$_{PrWd}$	*	*!	*

Even if the current analysis is not assumed, and the treatment of clipped syllables is forgiven to be left unexplicited, this analysis still have some shortcomings. The constraint set proposed is at least unusual, if we exclude the necessary faithfulness constraint. Cantonese contour tones are treated as elements that can be argument of alignment constraints without a discussion on why this approach is better than the one commonly found in the literature, where Cantonese contour tones are treated composed of two separate tones. Tonal contours, if the richness of the base is accepted, are generated by the grammar, especially in Cantonese where evidence have been shown to be abundant, so unless we assume a model where all possible tonal configurations are innate, monastic, and so can constitute a possible argument of align, such constraints should at least be assumed with caution. Furthermore, there seems to be no interaction of such constraints in any other area of the grammar, or in any other language.

Another doubt is raised by the particular evaluation of the alignment constraints. Alignment constraints are commonly violated when the argument of the alignment is separated by other elements from an edge. It is therefore unclear how [po4po4] can violate textscAlignR-T1-2 as no T1 or T2 appears in the candidate. Similarly, the same candidate should violate textscAlignL-T4, since one T4 is not aligned to the left edge of the prosodic word.

Another problem is purely theoretical. The analysis requires two grammars with two different rankings and two different inputs to be postulated, one that is specifically argued for for this particular limited phenomenon. The idea of having different co-phonologies it is not erroneous *per se*, but it has to be somehow restrained. For instance, in Anttila's model of variation (2007), only a limited set of adjacent constraints can vary, which generate a set of output argued to be proportional to the number of alternating forms found a the language. The proposed co-phonology seems instead unrestrained and arbitrary. This assumption together with the powerful alignment constraints leads to a situation where there is no way to limit or predict the possible output of the co-phonology, since by changing the argument

of the constraints and the input any output can be generated.

The analysis is in the end no more explicative than one that treats the changed tone form as lexical. The context of low falling TC is restricted to a limited set of words, and the process is not productive, so the lexical hypothesis is possibly even better as it does not require all the articulate theoretical constructions necessary for the former. Actually, if the first syllable is argued to be a low falling tone underlyingly, which fails to explain why the tone is low falling, a faithfulness constraint together with one alignment constraint for the high rising tone would already have sufficed.

The most natural alternative to the analysis is to suppose that the tone in RED is unmarked: in reduplication, the copy is total at a segmental level, but the tonal material is not copied in the RED, so **The Emergence of The Unmarked** (TETU, McCarthy and Prince 1994, Alderete et al. 1999). The possibility that the low falling tone is unmarked, and therefore TETU hypothesis are refuted in the article itself, on the basis of the following three arguments.

First, it is said that the constraint set proposed cannot choose the right candidate. However, the constraint set used to demonstrate it is not only unusual, but also incomplete. Only two markedness constraints are used, while any other common markedness constraint on tones is ignored. Paradoxically, the constraints seems to be created with the sole scope being proven wrong. The argument is circular: an uncommon and incomplete constraint set is proposed and, once demonstrated insufficient, it is used to draw the conclusion that no other constraint ranking exists that can choose the right candidate.

The second argument is that the low falling tone is not the most frequent tone in Cantonese, and thus cannot be unmarked. I do not know whether frequency has ever been considered a decisive proof of unmarkedness, as no reference is given, but the assertion is at least controversial in OT, where it is the grammar that generates the unmarked elements, independently of the lexicon. An unmarked element may have more chance to appear in the surface, but this does not logically implies that the resulting form is going to be the most frequent in a lexicon or in corpora. The question is further complicated in a language like Cantonese, where the presence of unmarked tones is cast into doubt by the paper itself, and if proven would be limited to a small, sizeable set of words. Cantonese is also a bad candidate for defending such kind of positions because as it constitutes one of the few examples of how present day tonal system can be almost exceptionlessy be derived by MC tonal categories. Saying that a tone is not frequent is like saying that *yang peng* words were

less frequent in MC or less likely to be transmitted to Cantonese than *yang soeng*. To cast further doubt on the argument is the fact that the source the article refers to is based on the number of words present in a language corpus, which, no matter how big and balanced, does not guarantee to be representative of the language.

Finally, it is argued that in loanword adaptation, it is the low tone that behaves like the unmarked. First, there is logical contradiction. The low level tone is not the most frequent tone either in the corpus that was used as proof of the low falling tone non unmarkedness. The author then refers to a study of Silverman (1992). Data in the article are extremely scarce, and loanwords are to be taken with caution as perceptive biases may easily derail intuitions. Of the six examples proposed, only the following two are relevant to the topic of unmarkedness:

(7.2)

break → [bik^{2} lik^{5}]
fluke → [fu^{22} luk^{5}]

These two examples are crucial because a vowel is epenthesized to simplify the ill-formed consonant cluster. The segmental content is assimilated from the following vowel, but tonal copying or assimilation seems to fail. However, those are not the only example of epenthetic vowels. In the much older [mit^{5} si^{21}] the epenthetic vowel assimilates and takes a low falling contour. In [fɛi^{55} lɐm^{35}] 菲林the epenthetic syllable is realized with a low rising tone. The final vowel does not even assimilate and surfaces as /a/. In the dictionary the word is recorded as [fɛi^{55} lɐm^{21}], with a low falling final tone pronunced as a CT. Paradoxically, a dictionary lookup[1] reveals that in all sources the first contour is low falling, not a low level. The data was confirmed by my informants as I could not find a native speaker of Hong Kong or Guanzhou which pronounced [fu^{21} luk^{5}] with a low level tone.

The problem with the other word is methodological, again due to the unusual representation of contour tones in Cantonese. This assumption in theoretical works on Cantonese is unique in my knowledge and was never demonstrated by the author to be superior than the traditional assumption that consider contour tones as not unary. Since in the paper, tone contours are considered single entities, [bik^{2} lik^{5}] is transcribed using single tone digits. Usually used in historical work and in romanization system, this notation is hardly

[1]For instance 粵語審音配詞字庫(2009) accessible online at: http://humanum.arts.cuhk.edu.hk/Lexis/lexican/

found in work on tonology as it does indicate the shape of the tone at all and may lead to interpretation mistakes. This is in fact the case. the first tone in [bik^2 lik^5] is not a contour, but a low tone (L), as clearly indicated by the tone letter or the Chao's letter notation, that necessarily occurs in clipped syllables. The same problem is found in the analysis of onomoatopeic reduplicated forms. The strange configuration of toneless + changed tone resulting in a 'T4 T2' ([ML MH]) configuration may have lead to postulate the complex alignment constraints proposed in the analysis.

The low level tone, appears though in some other cases of epenthetic vowels, together with the low falling contour. In the next section it will be shown that the loanword situation is more complicated, and an explanation in line with the current analysis will be proposed to account for the apparently conflicting data found.

The three arguments against the non-unmarkedness of the low falling tone are therefore contradicting, derived from wrong assumptions or based on unattested data. There is though one arguments that the author does not make, but that I retain may add up to the discussion. The fourth tone is a falling tone, and is universally marked for two reasons: it is contour tone and it is falling.

7.2 Low Falling Tone Change

The low falling differs from the high rising TC in all the characteristics that make the latter peculiar: it is sporadically attested, it is limited to reduplication, and it does not seem to have a historical correlate. There are also phonological evidence that low falling TC is different from the others, even from the high level one (discussed in sections 7.1 and 7.2). The tone involved is low, while for the other two cases is high, a difference particularly important given the status of H in the grammars of Cantonese. The current constraint ranking predicts that only H tone can be realized as affixes. These hints suggest that the process involved is probably very different from what has been discussed so far.

Least marked structures are found in epenthetic segments and, in tonology, in toneless syllables (when no other process is able to assign them a content). Low falling CT surfaces in two contexts: childish kinship reduplicated terms (more formal expressions are not hit) and onomathopeic neologisms. If we think about the phonology of Cantonese, where toneless syllables are never found underlyingly, and there is almost no epenthesis of mora bearing segments, the only place where unmarked tonal structure may surface is syllables were no

tonal content can be assigned: that is neologism not derivable from previous lemmas (for instance through composition). This particular situation occurs when the speaker have to create a new syllable, and only segmental content is available.

Throughout the thesis, the majority of commonly accepted constraints have been used for the description of Cantonese tonology. Few of them were left out as they do not directly affected the processes studied, and OCP(T) was just demonstrated to be lower ranked with respect to NoLongT, but not given an exact position in the ranking. Because of the universality of Con these constraints are ranked lowest in the grammar. The constraints left out are:

***H**
Ban H tones

OCP(t)
Two adjacent tones cannot be identical

***Hd/L** $\succ$ ***Hd/M** $\succ$ ***Hd/H** *alias* ***Hd/L**
In head position L is most marked, H lowest marked

***¬Hd/H** $\succ$ ***¬Hd/M** $\succ$ ***¬Hd/L** *alias* **¬*Hd/H**

In non-head position H is most marked, L lowest marked. For the current analysis, the old notation will be kept, but note that head tones in Cantonese may be considered what so far have been called nuclear tone. It may then be possible that the faithfulness constraints on nuclear tones are more general constraint on head tone. The final constraint ranking for Guangzhou tonology is as follows:

Cantonese

Ident(H)	Ident(Hd)	**NoShortT**	Max(T)	**OCP(t)**
Dep(μ)		***Falling**	Ident(T)	***Hd/L**
			NoLongT	***H**

In bold are the constraints which can be violated by an epenthetic tone, all others can be ignored in the following examples. In kinship term reduplication, the leftward syllable (BASE) segmental content is reduplicated (RED), but the tonal content is not copied.

Morae are assigned as usual, as no change as occurred at the segmental level. As an example, let us take the following case of reduplication:

(7.3) /ba HH/ → [ba ML ba HH] 爸爸

All segmental or syllabic positions are assigned a mora according to the normal constraint evaluation. For the base, the rest of the computation proceeds normally and the underlying tone surfaces with no change. The situation is slightly more complicated for RED. Candidates not ruled out by constraint on mora assignation result with two free TBU (remember copy is partial and so BASE's tones are not copied). Since SpecT is high ranked in Cantonese (section 3.3), all TBU must be linked to a mora. No input tone is given, so the choice of the contour is based solely on the markedness constraints listed above. Those are OCP[T], that excludes (LL, MM and HH) (7.4:b), *Head/L (7.4:a) violated by LM, and finally *H that eliminates all H tones (7.4:c) (HH, MH, HM) (¬*Hd/H is irrelevant)[2]. The winning contour is ML.

(7.4) **Unmarked tonal structure in reduplication.**

$\mu\mu$	NoShortT	NoLongT	OCP(T)	*Head/L	*H	*Falling
a. [LM]$\mu\mu$				*!		
b. [MM]$\mu\mu$			*!			
c. [MH]$\mu\mu$					*!	
d. ☞ [ML]$\mu\mu$						*
e. [M]$\mu\mu$	*!					
f. [MMM]$\mu\mu$		*!	*	**		

The input is toneless for the two syllables so it gets the epenthetic tones [LL] assigned; is aligned to the right because of ALign-R and so the tone is linked to the last TBU, which does not require to be epenthesized; since the last syllable would result in [LH] configuration, which is dispreferred by the more harmonic MH, as shown in sec; note that L is epenthetic and does not violate any Ident constraint.

[2]One may claim that level tone are then realized as one tone linked to two TBUs. Remember, though, that this structure was ruled out since OCP[T] is lower ranked than NoLongT in Cantonese

One problem is left, the loanwords, where the low level contour seems to be the most recurrent tone, although older loanwords uses the low falling. The difference between gz. and hk. explains why both low tones behave like unmarked. The main difference between the two varieties is that gz. tolerate falling tones, while hk. does not: 51 becomes 55 and 21 becomes 11 (the explanation of this change in the next section).

ML was the winning candidate for gz. because LL violated OCP(T), which was higher ranked than *FALLING. In hk., which barely tolerates falling tones, the promotion of *FALLING rules out [ML] and therefore [LL] wins.

Loanwords are a special area of the lexicon, and are critically related to hk. Most of recent loanwords were borrowed through hk., as demonstrated by the fact that many did not make it to mainland and are only found in the Hong Kong variety, where the English influence is one of the strongest in Asia. Guangzhou Cantonese has been the most prestigious varieties for centuries in Guangdong, but hk. has started having a strong influence after the economic and cultural growth of the 20th century. The kinship terms and the onomatopeic neologisms have been recorded for long time in Cantonese. Loanword adaption instead, is an ongoing processes. Since the both the borrowing and the neologisms are created using the unmarkedness device, but then lexicalized with the tone generated at that historical moment, only the old Guangzhou form is found in the first two cases, while in loanwords both contours are observed. Older loanwords such as [mit^{5} si^{21}] will then have the low falling tone, while in more recent borrowings the low level tone might be found as well, thus reflecting the different grammars from which they were generated.

7.3 The High Falling Tone

Now that the difference between Cantonese tonologies are clear, it is possible to understand another sound change, which has been left unexplained from section 3.3. Empirically, three tonematics have been discussed as far the tonematics is concerned:

- mcant. which has both high falling and low falling tone;
- cant. which has the distinction between high falling and high level;
- scant. which has no falling tone at all.

The difference between the grammars is caused by the promotion of *FALLING. The exact position of the constraint is the following:

Modern Cantonese					*oldest*
IDENT(H)	IDENT(HD)	NOSHORTT	MAX(T)	OCP(T)	***Falling**
DEP(μ)		IDENT(T)	*HD/L		
		NOLONGT	*H		

Cantonese					
IDENT(H)	IDENT(HD)	NOSHORTT	MAX(T)	OCP(T)	(*FALLING)$_{mcant.}$
DEP(μ)		***Falling**	IDENT(T)	*HD/L	
			NOLONGT	*H	

Symmetric Cantonese				*newest*	
IDENT(H)	IDENT(HD)	NOSHORTT	MAX(T)	OCP(T)	(*FALLING)$_{mcant.}$
DEP(μ)		(*FALLING)$_{cant.}$	IDENT(T)	*HD/L	
***Falling**			NOLONGT	*H	

In the newest grammar, the promotion of *FALLING would eliminate 53. The limited recurrence of HM contours excludes HH to change into HM, which makes HH the only possible outcome of HM if *FALLING is promoted.

The elimination of the low falling tone leads instead to an ambiguous state since, contrary to the two levels of the high tones (M and H), low register were only specified for one level (L). Two solutions are possible. One is to create a new low level contour, as in the case of the symmetric inventory speakers. The other is the merge of the two categories, as in the case of high tones. But contrary to HM, both ML and LL are richly represented in the lexicon, so the merge has the disadvantage of drastically reducing the number of tonal distinctions in the grammmar. This is the low tone merger, where speakers confounds the low falling and low level tones systematically. The following tableau shows how falling tones change are the result of the proposed ranking. Note that the position of other constraints was independently argued.

(7.5) ***Falling promotion effects on Cantoese tonematics**

Input	Language	*FALLING$_{scant}$	IDENT(HD)	*FALLING$_{cant}$	IDENT(T)	OCP(T)	*HD/L	*H	*FALLING$_{mcant}$
	mcant.								
/HM/	a. ☞[HM]							*	*
	b. [HH]				*!	*		**	
/ML/	a. ☞[ML]								*
	b. [LL]		*!		*	*	*		
	cant.								
/HM/	a. [HM]			*!				*	
	b. ☞[HH]				*	*		**	
/ML/	a. ☞[ML]			*					
	b. [LL]		*!		*	*	*		
	scant.								
/HM/.	a. [HM]	*!							
	b. ☞[HH]				*	*		**	
/ML/	a. [ML]	*!		*					
	b. ☞[LL]		*		*	*	*		

7.4 The Geographic Distance Postulate.

In chapters 6 and 7, *Geographical variation* was proven to be a good heuristic means to analyse closely related languages. We now use the analysis of the mini-grammars of three dialects to revise and test the validity of the *Geographic distance postulate.*

Geographic distance postulate. The (geographic) linguistic distance between two dialects of a language system equals the geographical distance between those dialects in a topological way. (van Oostendorp, 2011)

The linguistic distance between languages is traditionally calculated by comparing the number of quasi-equivalent lemma present in a set of languages, the phonetic distance between common underlying forms, a sound change which differentiates the dialects from a common ancestor, and some synchronic or historically active phonological processes. These differences (or similarities) between related languages are usually intuited by dialectologists, although a formal mathematical approach, based on linguistic *atlas* data, has also been put forth in *dialectometry* (Goebl, 1982; Bauer 2005). Based on van Oostendorp (2011) I will propose a model which is complementary to this approach: a method to numerically calculate distances by comparing internal grammars. To my knowledge, OT is the only theory that permits such calculations - as it will be illustrated in this section - and therefore that can eventually prove linguists' intuition. **Con**, the universal constraints set, is defined in OT as a fixed set of constraints.

Definition. Let **Con** be the set of all constraints C:

$$\mathbf{Con} = \{C_1, C_2, ..., C_k, ..., C_n\} \tag{7.6}$$

Each language grammar then is a partially ordered set of constraints from **Con**.

Definition. Let **CH** be a set of partially ordered constraints $C \in \mathbf{Con}$ such that:

$$\mathbf{CH} = \{(C_1 \gg C_2) \vee (C_1, C_2) \mid C_i \in \mathbf{Con}, i \in \mathbb{N} \quad \text{for } 1 < i < \mathbf{Con}\} \tag{7.7}$$

It is useful to assign to each constraint an index that overtly indicates its position in the ranking. If n constraints are not ordered, their index will be an integer comprised of

the position of the previously ordered constraint and the position of the final non-ordered constraint. Note that this index does not always coincide with the position of the constraint in the set.

Definition. Let $i \in \mathbb{N}_1$ be an index that indicates the position (i.e. the ranking) of each element $C \in \mathbf{CH}$ (i.e. of each constraints) with $1 < i < n$ Let 1 be the index of the highest ranked constraint in $C \in \mathbf{CH}$ and $n-1$ be the index of the lowest ranked constraint $C \in \mathbf{CH}$. A language grammar **CH** can then be constructed as a partially ordered set of elements $C \in \mathbf{Con}$ so that:

$$\mathbf{CH} = \{(C_{1;j} \gg C_{2;j+1}) \vee (C_{1;1\leq j\leq n}, ..., C_{i;1\leq j\leq n}, ..., C_{n;1\leq j\leq n}) \mid C_i \in \mathbf{Con} \text{ for } 1 < i, j < n\} \tag{7.8}$$

Example. The mini-grammar of hk. can be rewritten as:

$$hk = {*}\mathrm{LH}_1, \mathrm{NoComplexC}_2, \mathrm{MParse}_3 ... {*}\mathrm{Disassoc}_{6-7}, {*}\mathrm{Assoc}_{6-7} \tag{7.9}$$

Let now define a set $\mathbf{\Theta}$ consisting of the constraint hierarchies we want to compare.

Definition. Let $\mathbf{\Theta}$ be a set of n elements **CH** with $1 < m < n!$ [3]:

$$\mathbf{\Theta} = \{\mathbf{CH}_1, \mathbf{CH}_2, \mathbf{CH}_3, ..., \mathbf{CH}_m, ..., \mathbf{CH}_{n!}\} \tag{7.10}$$

Postulate. For each element of the set $\mathbf{\Theta}$, there is a tuple $\phi \doteq (\sigma, \gamma, \upsilon)$, where σ is a set $\mathbf{CH}_m \in \mathbf{\Theta}$, γ a constraint $C_i \in \mathbf{CH}_m$, and υ the index i of the constraint $C_i \in \mathbf{CH}_m$, which entirely and uniquely identifies a constraint-index pair (C, j) in a grammar **CH**.

$$\mathbf{\Phi} = \{\phi \doteq < \sigma, \gamma, \upsilon > | \sigma \doteq \mathbf{CH}_m \in \mathbf{\Theta}, \gamma \doteq C_i \in \mathbf{CH}_m, \upsilon \doteq i\} \tag{7.11}$$

with $1 < m < n!$

[3] Classical OT assumes that **CH** is a permutation of the set **Con**. In other words every grammar contains all constraints in **Con** and therefore | **Con** | = | C |. Some models, though, will not explicitly assume a fixed **Con** or **CH**, but some kind of constraint generation mechanisms. I will take the classical position since it is easier to quantify distances and movements between grammars when the dimension of the sets are fixed and equivalent. Whether the model is equally valid in a theory where | **Con** |$\neq$| **CH** | remains an open question and will not be discussed in this thesis.

Example. The constraint *Assoc in hc. is uniquely identified by the tuple (hk, *Assoc, 6), where hk is the language constraint set, *Assoc the constraint, and 6 the position of the constraint *Assoc in the constraint set ranking.
It is now trivial to calculate constraint distances. Given the same constraints in two languages, one can calculate their distance simply by computing their $\Delta\upsilon$ value.

Constraint distance formula. Let $\alpha, \beta \in \mathbf{\Phi}$. The distance between α and β is the absolute value of the difference of their υ-values:

$$\text{dist}(\alpha, \beta) = \sqrt{(\upsilon_\alpha - \upsilon_\beta)^2} \tag{7.12}$$

with $1 < \text{dist}(\alpha, \beta) < n$.
Calculating the movement or the range of one constraint within a grammar (i.e. intra-speaker variation) can also be done easily with a similar formula.

Movement formula. Let $\alpha, \beta \in \mathbf{\Phi}$. For any given constraint ranking **CH**, the distance between α and β is the difference of their υ-values:

$$\text{mov}(\alpha, \beta) = \upsilon_\alpha - \upsilon_\beta \tag{7.13}$$

Example. The demotion of the constraint *DORSAL, where the constraint is promoted from position 6 to position 5:

$$\text{mov}((hk, *\text{DORSAL}, 5), (hk, *\text{DORSAL}, 6)) = 5 - 6 = -1 \tag{7.14}$$

It is possible to generalise the *Constraint distance formula* to compute any number of constraints in two grammars by summing up all the distances of each constraint in the two languages. If the distance is calculated over two complete grammars the *language distance formula* will compute the linguistic distance between two languages. To obtain a distance value that does not heavily depend on the set size, we modify the original formula to use the mean of the summation.

Language distance formula. Let $\mathbf{A}, \mathbf{B} \in \mathbf{\Theta}$. Let $\alpha, \beta \in \mathbf{\Phi}$. Let z be the dimension of the biggest set **A** or **B**. The total distance between **A** and **B** is the mean of the summation

of the distances of every constraint $C_k \in \mathbf{A}$ to $C_k \in \mathbf{B}$:

$$\text{ldist}(\mathbf{A}, \mathbf{B}) = \sqrt{\frac{\sum_{i=1}^{z}(\text{dist}(\alpha_i, \beta_i))^2}{z}} \; where \; \gamma_\alpha = \gamma_\beta \tag{7.15}$$

We can further generalize the *Constraint distance formula* to calculate the distance between any number of constraints in any number of languages. At the current state of art, there are not enough comparable complete OT grammars of closely related languages. To exemplify this method and provide the basis for its falsification, we simulate a system by using a pre-generated virtual set of data. An experiment on real grammars may then empirically test the validity of the model proposed here. The simulation was set up as follows. First, 3 different grammars of 150 constraints were generated and assigned a randomized ranking using a Mersenne Twister core generator. The three grammars were then used as seeders for the generation of 45 more grammars - 15 for each group - by randomly switching $1 < n < 10$ constraint-pairs in each set at a $1 < |m| < 10$ distance (7.13). Of the 48 final constraints rankings, then, there were 3 the seeders and 45 derived grammars. The results can then be plotted on a three-dimensional Cartesian system[4], where each axis represents the result of the function *ldist* applied to the grammar for each seeder[5] (figure 7.1).

[4] An alternative to this approach consists on representing the position of grammar, not as relative to other grammars, but in an absolute way as a point in a n-dimensional plane. The coordinates of each grammar are the ranking value of each constraint in that grammar and n is the number of the constraints in the largest set. Various techniques can then be used to reduce the number of dimensions, possibly considering the fact that lowest ranked constraints are ininfluential, and higher ranked constraints most important. Clustering techniques might also be useful in both systems, for example to group grammars or to calculate centroids.

[5] Note it is not necessary to use seeders as the axis, any grammar will work.

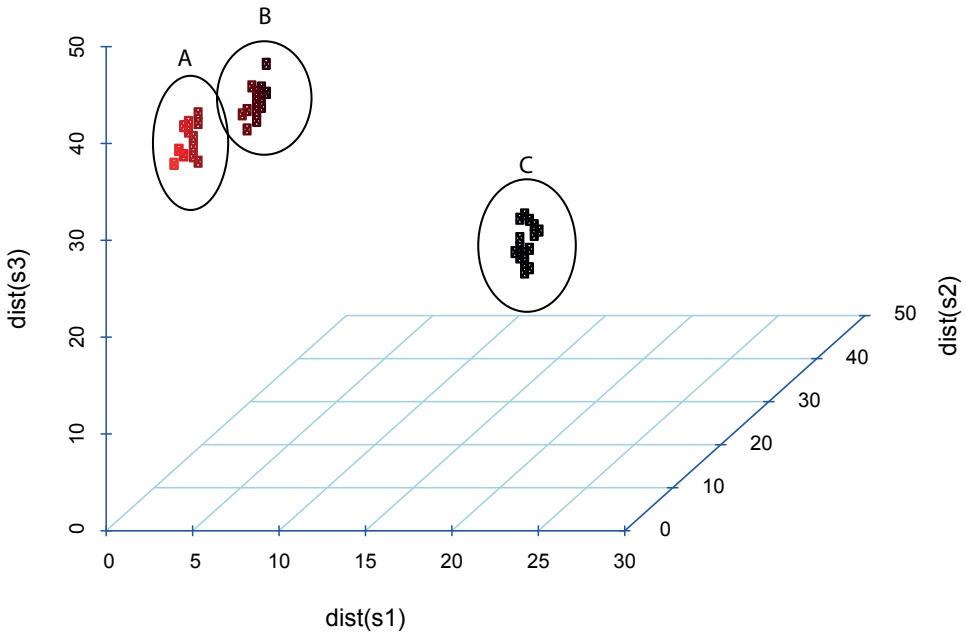

Figure 7.1: Three randomly generated groups of grammars. Each axis indicates the distance of the grammar from each seeder.

7.5 Conclusions

It is now possible to test the model on a real life example, and see what challenges it faces and what prediction it makes. Taishanese, Guangzhou Cantonese, Hong Kong Cantonese and Weitou will be used as data for the analysis.

For small grammars with a limited number of constraints - as in this case - it is possible to plot the constraint rankings in a two dimensional Cartesian system by using the tuples defined in 7.11 as the coordinates for each constraint. Figure 7.2 plots all constraints proposed for the *binyam* in *ts., gz. Weitou* and hk. The x-axis indicates the constraint ranking of the languages ($\mathbf{\Theta}_m$), *f(y)* the ranking j of the constraint ($\mathbf{CH}_i$).

We can get the distance value chart of the four tonologies by applying the *Grammar distance formula*. The result is shown in the following table.

(7.16) Distance factor in ts., gz. hk. and *Weitou* iteratively calculated by *The constraint distance formula* on all four dialects combinations and 17 constraints.

	gz.	hk.	Weitou
ts.	0.352	0.588	0.647
gz.	0	0.294	0.294
hk.	0	0	0.118

We can plot this graph over a geographical map to see how geographic and linguistic distances are interacting. As shown in 7.3, Van Oostendorp's hypothesis seems to be partially borne out: ts. is relatively distant from the other Cantonese dialects, which group together; meanwhile Weitou is closer to hk. than it is to gz.

Geographically, though, wei. should be closer to ts. than it is to hk., closer to hk. than to gz and gz. to wei. rather than hk. The reason for these apparent discrepancies derive from the correct interpretation of the word *geographically*. Socio-economical and political factors are far more important than any geographical distance, as was already known by geolinguists in the '800. Consider for example that a literal interpretation of the principle could paradoxically lead us to consider American English closer to Navaho, than to British English. Big centers like Hong Kong have stronger bonds with other connected cities, while peripherals languages like Weitou will be more isolated. The influence of controlling centers will be proportionally increased, while distance with other locations is increased. The linguistic distance calculated reflects this rather simple and well known observation in

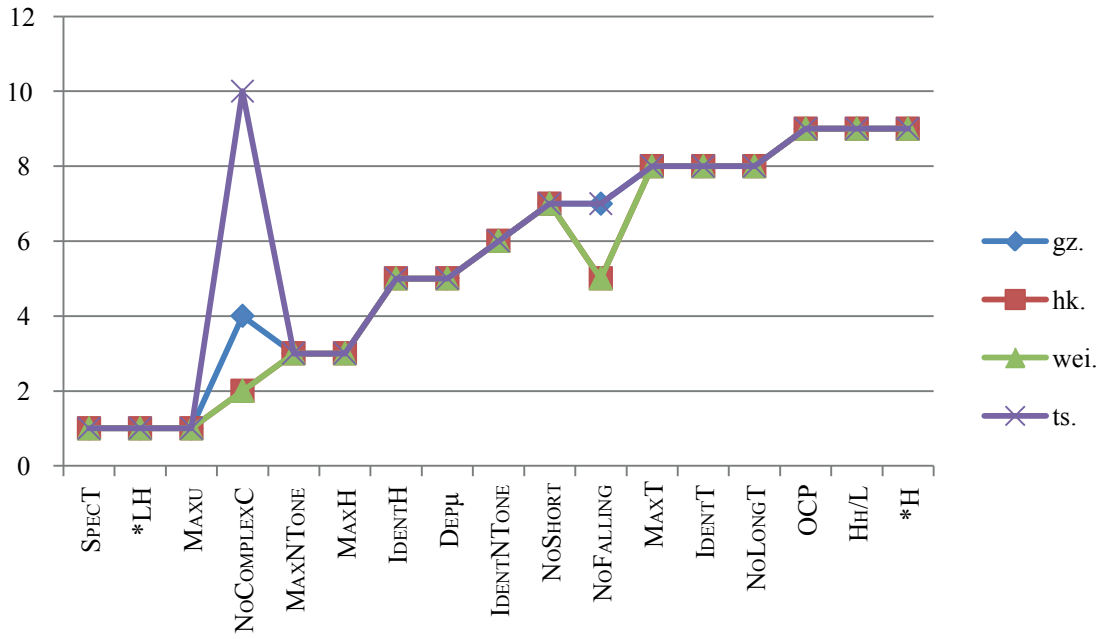

Figure 7.2: Constraint ranking variation line chart for three similar tonologies. The x-axis indicates the constraint, the y-axis the ranking of the constraint in the language.

language contact studies. In term of this model, the distance might be measured from any other point to center first (hk.), and then to the peripheral node (wei.).

The model seems to naturally arise from grammar-internal mechanisms, but it should not to be mistaken as such, since it includes both grammar internal and extra-linguistic elements such as the concept of geographic distance. More subtle critics may derive from the fact that grammars are not directly transmitted from one generation to another, but are learned from the output of the grammar itself. Learners only have access to the output of the grammars produced by the speakers so that a difference in the transmission process may eventually lead to the construction of a grammar that is different from that of the source. Similarly, changes in the grammar do not propagate as such. Rather, they are derived, and it is possible that a change by diffusion, as much as a change in transmission, may lead to an unpredictable number of movements. Mini-grammars, related to specific aspect of the phonology, such as those in the example, can be completely re-organised, but not an entire grammar[6] cannot, and the *geographic distance postulate* applies to grammars, not to their subsets. Given the high number of constraints in a language constraint ranking, any re-organisation (due to innovation, for instance) of a mini-grammar, will affect the total distance score only relatively, since the *language distance* will be levelled by the similarities present in the rest of the grammars.

[6] A dialect, for instance, may be innovative in its phonotactics, or present a particular segmental alternation, or have a different stress pattern, but not all those things together.

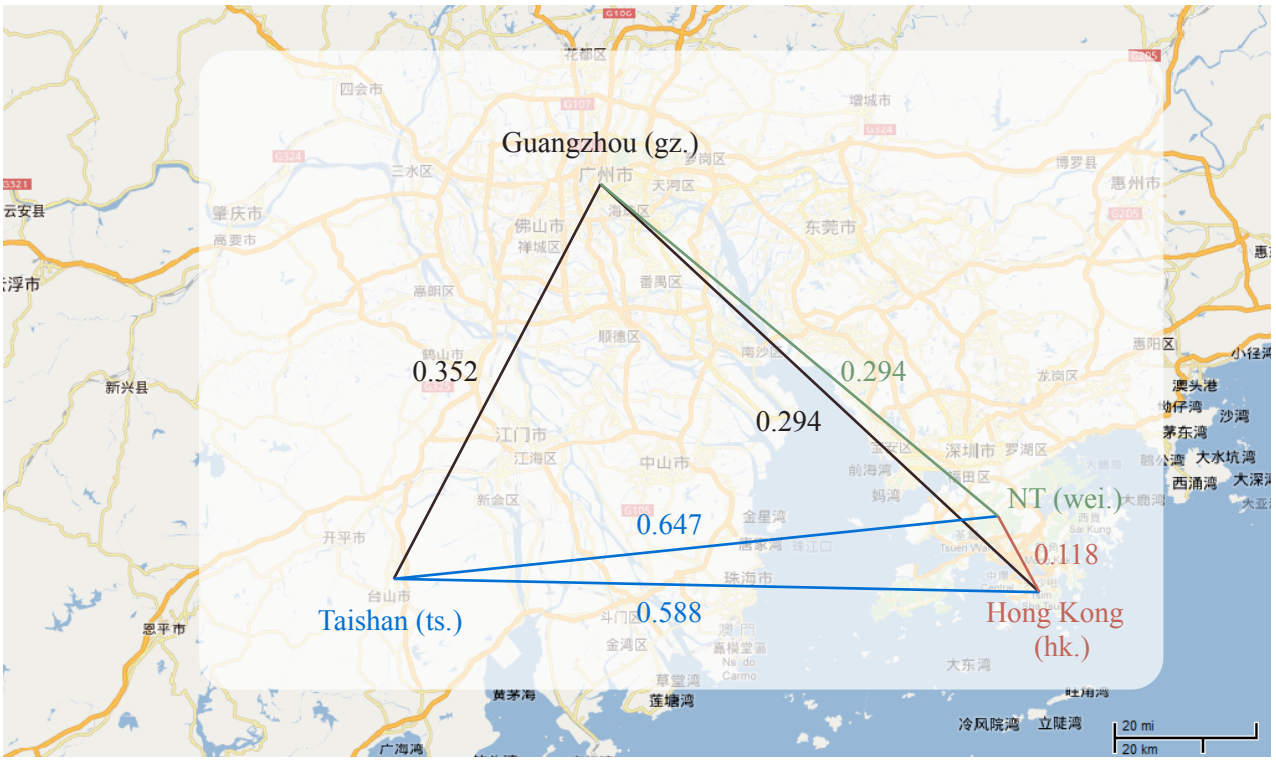

Figure 7.3: Linguistic and geographic distance of three dialects.

Chapter 8

Conclusions

Empirically, fresh data is introduced with respect to tone change for Weitou, an under-documented language very similar to Cantonese, that was claimed to show no tonal alternation. The study also provides new phonetic facts on tone change, confirming the observation that there is no phonetic difference between the high level lexical tone and changed tone, and observes a length scale for changed tone duration in clipped syllables (*clipped lexical* < *clipped changed* < *lexical long*). The phonetic analysis also extends previous findings on the high rising TC, by showing that the changed tone may differ from the lexical high rising contour not only because it ends higher in pitch, but also because it starts lower and by is longer in duration.

Theoretically, the thesis attempts to provide a unified analysis of Cantonese tonologies in OT. It improves on previous analyses by integrating TC with observations about the tonematics of the language and the variation found across speakers and closely related varieties. The suffix hypothesis is defended and proven to be capable of explaining micro-variation and the high rising TC near merger. Such analysis permits to shed further light on the historical origin of the suffix, in particular on how it changed. The suffix is lenited through successive steps, which are explained as being caused by the systemic pressure of the grammar for creating less marked structures. The contrasting forces active synchronically are intimately related to those that lead to sound change, or at least to a subset of these. The conflicts are resolved by two means: a constraint re-ranking or a change in the UR form, both found in Cantonese.

Crucially, the sound changes are assumed to reflect the geographic distribution of the languages analyzed by the application of a norm well known to dialectologists and historical

linguists. The synchronic analysis of closely-related grammars and of their variation, is then intended as the mirror of the changes that occurred within one grammar. As mentioned above, OT is a perfect tool to analyse the two planes simultaneously, as it naturally formalizes the grammar as a system of conflicting forces. This permits both a quantitative and qualitative comparison of the two planes by making explicit the elements of the change and those of the variation. Diachronic and geographic variation can indirectly provide important insights for the understanding of individual grammars as cognitive systems, especially in relation with phenomenon of language change, traditionally less studied in the generative tradition.

The theory relies heavily on the study of diachronic and diatopic variation, and broadens our understanding of these areas, by providing a model to measure the traditionally vacuous concept of 'linguistic distance' and a system to formalize internal conflicting forces operating in the grammar (a topic fundamental to the structuralist tradition, but neglected in early generative phonology).

Appendix A

Synoptic Table of Chinese History

dinasty	**date**	**events**
Xia Dynasty 夏朝	ca. 21st-16th c.	
Shang Dynasty 商朝	ca. 1600-1045	bone shells inscriptions
		bronze inscriptions
		portions of the Yijing
Western Zhou Dynasty 西周朝	1045-771	poetry of the Shinjing
		Bai-Yue tribe (?)
Eastern Zhou Dynasty 東周朝	770-256	Yue as a state
Qin Dynasty 亲朝	221-206	first language standardization
		lesser seal script
		first colonization of Guangzhou
Han Dynasty 漢朝	202 BC-AD 220	Erya
		Fangyan
		Shiming
		Ling-nan Dong-dao (Guangzhou)
		Ling-nan Xi-dao (Guangxi)
Three Kingdoms 三國朝	220-589	imperial examination test

Continue on the next page...

dinasty	**dinasty**	**events**
Jin Dynasty 晉朝	265-420	Buddhism became popular
Northern and Southern Dynasties 南北朝朝	420-589	fanqie (unattested)
Sui Dynasty 隋朝	581-618	Qieyun
Tang Dynasty 唐朝	618-907	
Five Dynasties 10 Kingdoms 五代十國	902-979	Yunjing
Song Dynasty 宋朝	960-1279	Zizhi Tongjian
		Qieyun expanded
		Guangyun
		Qiynlue
		refugees flee in Guangdong
Liao Dynasty 遼朝	916-1125	
Jin Dynasty 金朝	115-1234	
Xia Dynasty 夏朝	1038-1227	
Yuan Dynasty 元朝	1279-1368	Qu poetry
		Zhongyan Yinyun
		Phags-pa script
Ming Dynasty 明	1368-1644	Hongwu Zhengyun
		texts of Christian missionaries
Qing Dynasty 清	1644-1912	Quyan
		Jiyo
		Duan
		Zhan
		vernacular literature
		new national education system
		linguistic texts for Cantonese
Republic of China 華民國	1912-1949	Guozidian

Continue on the next page...

dinasty	**dinasty**	**events**
		Chao Yuen Ren
		Li Fang Kuei
		Karlgren
People's Republic of China 共產黨	1949-present	hanyu pinyin

Appendix B

Online Survey Word List

The instruction page

你好！我們正在進行一項語音研究。在測試中,你要讀出已被粗體的詞或詞語,然後選擇該詞或詞語的聲調。(請按照你慣常的讀法來選擇答案,請不要查字典) 如:”金魚”

- 餘;
- 傴;
- 皆為正確;
- 皆為錯誤/不知道;

按照A先生的讀法, 他習慣把金魚的魚讀成第二聲, 與答案中的”比”同聲調, 故他會選舉答¿案A。

各位可以根據自己的意願或情況來選擇完成多少項題目。當你再次進行此項測試時, 題目不會重複,你可以繼續完成餘下題目。這項研究需要你的支持! 希望大家可以盡量完成較多的題目, 謝謝大家!

word	**ob.**	**Ch.**	**meaning**	**or. meaning**	**sem.**	**ct**	**lex**	both
ha^{22} ŋɔk^{2}*◦	n	下顎	lower jaw	jaw	t	100	0	0
guŋ^{55} jin^{21}*	n	公然	publicly	correct	o	100	0	0
lan^{21} hɔ^{21}*	n	欄河	fence	river	o	100	0	0
ts^{h}in^{55} miŋ^{21}*	n	清明	tomb sweeping festival	bright	o	66.7	33.3	0
ʧœŋ^{22} ŋa^{21}*	n	象牙	ivory	tooth	o	100	0	0
ts^{h}uŋ^{21} jœŋ^{21}*	n	重陽	double ninth festival	sun	o	33.3	0	33.3
ŋau jau^{21}*	n	黃油	butter	oil	o	100	0	0
ʧuŋ^{55} man^{21}*	n	中文	Chinese	language	t	33.3	33.3	33.3
ts^{h}øt^{5} ŋa^{21}*	n	出芽	sprouting	sprout	t	100	0	0
san^{55} man^{21}*	n	新聞	news	to hear; news	t	33.	33.3	33.3
duk^{2} lau^{21}*	n	毒瘤	malignant tumor	tumor	t	33.3	0	0
bak^{2} lan^{21}*	n	白蘭	white orchid	orchid	t	100	0	0
sek^{2} lau^{21}*	n	石榴	pomegranate	pomergranate	t	33.3	66.6	0
jiŋ^{55} man^{21}*	n	英文	English	language	t	33.3	33.3	33.3
ts^{h}a^{21} lau^{21}*	n	茶樓	tea house	building floor	t	66.7	0	0
dau^{22} ŋa^{21}*	n	豆芽	bean sprout	sprout	t	100	0	0
lun^{21} lau^{21}*	n	輪流	to take turn	flow	t	33.3	66.7	0
hat^{5} ji^{21}*	y	乞兒	beggar	son; offspring	o	11.1	78	11.1
ji^{22} wu^{21}*	y	二胡	stringed fiddle	from abroad	o	0	100	0
pin^{21} ji^{21}*	y	便宜	petty gains	correct	o	66.6	0	11.1
laŋ^{21} mun^{21}*	y	冷門	unexpected winner	door	o	22.2	44.4	0
ts^{h}at^{5} jou^{21}*	y	漆油	paint	oil	o	11.1.1	77.8	0

word	ob.	Ch.	meaning	or. meaning	sem.	ct	lex	both
mun^{21} wan^{21*}	y	門環	door ring	ring	t	100	0	0
kai^{33} dai^{22*}	n	契弟	bastard	younger brother	o	88.9	11.1	0
ga^{55} juŋ^{22*}	n	家用	household expense	use	o	44.4	0	0
si^{55} ha^{22*}	n	私下	privately	below	o	88.9	0	0
bun^{33} je^{22*}	n	半夜	midnight	night	t	22.2	11.1	11.1
bun^{33} lɔu^{22*}	n	半路	half way	road	t	66.7	11.1	11.1
gap^{3} ŋaŋ^{22*}	n	夾硬	do by brute force	hard	t	0	44.4	0
tsi^{35} mui^{22*}	n	姊妹	sisters	younger sister	t	77.8	11.1	11.1
wɔŋ^{21} si^{22*}	n	王氏	the Wong clan	clan	t	100	0	0
g^{w}ɔ^{33} je^{22*}	n	過夜	to spend the night	night	t	22.2	11.1	11.1
fan^{22} ŋɔi^{22*}	y	分外	especially	outside	o	66.7	11.1	11.1
g^{w}u^{35} wun^{22*}	y	古玩	antiques	to play	o	11.1	77.8	11.1
tsɔ^{35} jau^{22*}	y	左右	approximately	right	o	77.8	0	22.2
jau^{23} liu^{22*}	y	有料	knowledgeable	ingredients	o	0	88.9	11.1
dim^{35} jœŋ^{22*}	y	點樣	how	appearance	o	0	44.4	0
siu^{55} mai^{22*}	y	燒賣	a steamed dumpling	to sell	o	11.1	33.3	0
wui^{22} wa^{22*}	y	會話	conversation	to speak	t	0	100	0
ts^{h}yn^{21} wa^{22*}	y	傳話	interpreter	to speak	t	44.4	22.2	0

Continue on the next page...

word	ob.	Ch.	meaning	or. meaning	sem.	ct	lex	both
gam^{33} nɔi^{22*}	y	咁耐	just this long	long (duration)	t	88.9	0	0
tɔu^{21} wa^{22*}	y	圖畫	picture	painting	t	11.1	77.8.	0
tsi^{22} wa^{22*}	y	字畫	calligraphy and painting	painting	t	0	77.78	0
siu^{55} je^{22*}	y	宵夜	to have a night snack;	night	t	0	44.4	0
lap^{2} mei^{22*}	y	拉面	preserved meats	classifier	t	88.9	11.1	0
ŋai^{21} je^{22*}	y	捱夜	to work all night	night	t	0	44.4	0
ts^{h}e^{55} wai^{22*}	y	車位	parking space	position	t	22.2	44.4	0
fu^{55} jan^{23*}	n	夫人	mrs; madam	person	t	100	0	0
ŋat^{3} wan^{23*}	n	押韻	to rhyme	rhyme	t	100	0	0
saŋ^{55} ŋau^{23*}	n	生藕	fresh lotus root	lotus root	t	66.7	0	33.3
ha^{55} mai^{23*}	n	蝦米	dried shrimp	rice	t	33.3	0	0
siu^{35} jan^{23*}	n	衰人	villain	person	t	100	0	0
tsi^{22} gei$^{35\circ}$	n	自己	self	self	t	33.3	0	0
g^{w}u^{55} tse^{35*}	y	姑姐	father's younger sister	young woman	t	0	100	0
mau^{55} ji$^{21\circ}$	y	貓兒	kitten	son; offspring	o	100	0	0
ma^{23} lau$^{21\circ}$	y	馬餾	monkey	monkey	t	0	100	0
pɔ^{55} lei$^{21\circ}$	y	玻璃	glass	transparent	t	0	100	0
leŋ$^{33\circ}$ tsa i^{35}	y	靚仔	young guy	pretty	o	0	0	66.7

Continue on the next page...

word	ob.	Ch.	meaning	or. meaning	sem.	ct	lex	both
liu$^{21\circ}$ gɔ^{55}	y	了哥	parrot	parrot	t	0	100	0
gam^{55} man$^{23\circ}$	n	今晚	tonight	night	t	0	33.3	66.6
tiŋ^{55} man$^{23\circ}$	n	聽晚	tomorrow night	night	t	0	100	0
lai^{55} mei$^{23\circ}$	y	拉尾	last	last	t	33.3	66.7	0
mei$^{23\circ}$ ji^{35}	y	尾二	second last	last	t	33.3	33.3	0
sau^{55} mei$^{23\circ}$	y	收尾	finally	last	t	33.3	33.3	33.3
dai^{22} mei$^{23\circ}$	y	第尾	last	last	t	0	66.7	0
ly^{55} mɔu$^{21\circ}$	y	攣毛	curly hair	hair	t	33.3	66.67	0
si^{21} mɔu$^{21\circ}$	y	時摩	fashionable	hair	o	0	66.7	0
g^{w}ai^{35} mui$^{22\circ}$	y	鬼妹	foreign girl	younger sister	t	33.3	66.7	0
maŋ^{21} mui$^{22\circ}$	y	盲妹	blind girl	younger sister	t	33.3	33.3	0
mui$^{22\circ}$ tsa i^{35}	y	妹仔	maid	younger sister	t	66.7	0	0
nim$^{21\circ}$ tɔu^{35}	y	粘土	clay	to glue on	o	0	66.7	0
si^{21} pai$^{33\circ}$	y	新派	fashionable	style; school	t	33.3	66.7	0
kam^{33} ts^{h}œŋ$^{21\circ}$	y	咁長	so short	long	t	100	0	0
sœŋ^{22} ŋɔk$^{2\circ}$	n	上顎	upper jaw	palate; jaw	t	100	0	0
sau^{35} mat$^{2\circ}$	n	手襪	gloves	socks	t	66.7	33.3	0
ŋaŋ^{22} ŋɔk$^{2\circ}$	n	硬顎	hard plate	jaw	t	100 0	0	0

Continue on the next page...

word	**ob.**	**Ch.**	**meaning**	**or. meaning**	**sem.**	**ct**	**lex**	**both**
jœk^{3} mɔk$^{2\circ}$	y	約莫	approximately	not	o	0	66.7	0
ji$^{23\circ}$ mɔk^{2}	y	耳膜	ear-drum	membrane	t	33.3	0	0
gɔk^{3} lɔk$^{2\circ}$	y	角落	corner	whereabouts	t	33.3	33.3	33.3
jyn^{23} ŋɔk$^{2\circ}$	n	軟顎	soft plate	palate	t	100	0	0

Words not included in the survey

word	**ob.**	**Ch.**	**meaning**	**or. meaning**	**sem.**
dan^{35} bak^{2*}	n	蛋白	protein	white	o
ʧ^{h}œk^{3} jœk^{2*}	n	草藥	herbaceous peony	medicine	o
hau^{22} løt^{2*}	n	效率	efficiency	rate	o
jat^{5} løt^{2*}	n	一律	altogether	regulation	o
ts^{h}iu^{55} ŋak^{2*}	n	超額	exceeded quota	capacity	t
gai^{33} lat^{2*}	n	芥辣	hot mustard	peppery hot	t
mun^{23} ŋak^{2*}	n	滿額	filled to capacity	capacity	t
sau^{35} mat^{2*}	n	手襪	gloves	socks	t
wɔŋ^{23} jat^{2*}	n	往日	in the past	day	t
diŋ^{22} ŋak^{2*}	n	定額	quota	capacity	t
sœŋ^{55} jat^{2*}	n	雙日	per two days	day	t
jan^{21} mat^{2*}	n	人物	figure	thing	t
jœk^{3} mɔk^{2*}	y	約莫	approximately	no; not	o
hau^{21} wat^{2*}	y	喉核	adam's apple	pit; seed	o
ji^{22} wak^{2*}	y	兩劃	sergeant	a stroke	o
sam^{55} wak^{2*}	y	三劃	staff sergeant	a stroke	o
jat^{5} wak^{2*}	y	一劃	corporal	a stroke	o

Continue on the next page...

word	**ob.**	**Ch.**	**meaning**	**or. meaning**	**sem.**
gɔk^{3} lɔk^{2}*	y	角落	corner	to go down;	t
tsi^{22} lœk^{2}*	y	粗略	approximately	brief	t
lœk^{2} lœk^{2}*	y	略略	a little bit	brief	t
hɔu^{35} jat^{2}*	y	好日	good day	day	t
je^{22} hɔk^{2}*	y	夜學	night school	to learn	t
daŋ^{55} tap^{3}*	n	燈塔	lighthouse	pagoda	o
mɔu^{23} fat^{3}*	n	冇法	no choice	way	t
hei^{35} ʧɔk^{3}*	n	喜鵲	magpie	magpie	t
dai^{22} jœk^{3}*	n	大約	approximately	approximately	t
huŋ^{35} ʧœk^{3}*	n	孔雀	peacock	bird	t
siu^{55} ŋap^{3}*	n	燒鴨	roast duck	duck	t
ʧy^{55} gœk^{3}*	n	豬腳	pig's feet	foot	t
bak^{2} gap^{3}*	n	白鴿	pigeon	pigeon	t
ŋ^{23} ʧɔk^{3}*	y	仵作	coroner	to do	o
gan^{33} ts^{h}ek^{3}*	y	間尺	ruler	ruler	t
fɔŋ^{55} gak^{3}*	y	方格	square	square	t
ŋa^{21} ts^{h}at^{3}*	y	牙刷	tooth brush	to brush	t
kau^{21} pak^{3}*	y	球拍	a racquet	to hit	t
ji^{23} wat^{3}*	y	耳挖	pin	to dig	t
hai^{21} ts^{h}at^{3}*	y	鞋刷	shoe	to brush	t
ma^{21} ʧœk^{3}*	y	麻雀	sparrow	bird	t
wu^{21} lɔu^{21}*	n	葫蘆	bottle gourd	reed	o
gan^{22} lɔi^{21}*	n	近來	recently	to come	o
si^{22} tau^{21}*	y	事頭	boss	head	t
dai^{22} ŋan^{21}*	y	大銀	dollar coin	silver	t
bat^{5} lau^{21}*	y	布帘	all along	to stay	t

Continue on the next page...

word	**ob.**	**Ch.**	**meaning**	**or. meaning**	**sem.**
muk^{2} tsœŋ^{22*}	n	木匠	carpenter	craftsman	t
tiŋ^{55} man^{23*}	n	聽晚	tomorrow night	night	t
nai^{21} nai^{23*}	y	奶奶	mother in law	milk	o
ŋuk^{5} gei^{23*}	y	屋企	home	to stand	o
k^{w}ai^{55} jan^{23*}	y	歸隱	to retire	hidden	o
ts^{h}an^{21} jan^{23*}	y	殘忍	cruel	to bear	o
huŋ^{21} jan^{23*}	y	熊人	bear	person	o
nœi^{23} jan^{23*}	y	女人	woman	person	t
mui ^{21} jan^{23*}	y	媒人	matchmaker	person	t
sy^{55} jau^{23*}	y	室友	classmate	friend	t
nam^{21} jan^{23*}	y	男人	man	person	t
bak^{2} lam^{23*}	y	白欖	olive	olive	t
ts^{h}ɔu^{35} naŋ^{23*}	y	草蜢	grasshopper	grasshopper	t
sau^{35} sœn^{33*}	n	手信	small gift	letter	o
sau^{35} tɔu^{33*}	n	手套	gloves	to enclose	o
mak^{2} pin^{33*}	n	麥片	oatmeal cereal	a slice	o
ts^{h}in^{21} sai^{33*}	n	前世	former life	generation	t
nøy^{23} sai^{33*}	n	女婿	son in law	son in law	t
bak^{2} jin^{33*}	n	白燕	white swallow	swallow	t
man^{55} tsœŋ^{33*}	n	蚊帳	mosquito net	curtain	t
sɔu^{22} gøy^{33*}	n	造句	to make up sentences	sentence	t
faa^{55} dan^{33*}	y	花旦	female character	daybreak	o
ji^{21} hei^{33*}	y	演戲	not serious	play	o
sœŋ^{35} ga^{33*}	y	相架	picture frame	to shelf	o
sœŋ^{33} pin^{33*}	y	相片	photo	a slice	o
dɔu^{35} se^{33*}	y	倒瀉	to spill	to pour out	t

Continue on the next page...

word	**ob.**	**Ch.**	**meaning**	**or. meaning**	**sem.**
huk^{5} sɔŋ^{33}*	y	哭喪	to cry at a funeral	to die	t
biŋ^{35} sœŋ^{33}*	y	影相	to take a photo	appearance	t
sy^{55} ga^{33}*	y	書架	shelf	to shelf	t
hau^{22} løt$^{2\circ}$	n	效率	efficiency	rate	o
wu^{55} jiŋ$^{21\circ}$	y	蒼蠅	fly	fly	t
jy^{23} lau$^{21\circ}$	y	雨褸	raincoat	front of a jacket	t
jat^{5} løt$^{2\circ}$	n	一律	altogether; totally	regulation	o
si^{55} mat$^{2\circ}$	n	絲襪	stockings	socks	t
jan^{21} mat$^{2\circ}$	n	人物	figure; personage	thing	t
tsy^{22} tsœk$^{2\circ}$	y	住宅	residence	residence	t
hau^{21} wat$^{2\circ}$	y	喉核	adam's apple	pit; seed	o
løt$^{2\circ}$ si^{55}	n	律詩	regulated verse	regulation	t
fuŋ^{55} lœt$^{2\circ}$	y	板栗	chestnut	chestnut	t
hei^{33} tek$^{2\circ}$	n	溪笛	steam whistle	flute	t
tsyn^{33} sek$^{2\circ}$	n	鑽石	diamond	stone	t
wɔŋ^{21} tsœk$^{2\circ}$	y	王宅	wong's residence	residence	t
lœk^{2} lœk$^{2\circ}$	y	略略	a little bit	slightly	t
tsi^{22} lœk$^{2\circ}$	y	粗略	approximately	slightly	t

Appendix C

Derivation Questionnaire

id	word	translation	Cantonese	Weitou
1	白鶴	white crane	bak^{2} hɔk^{2*}	hɔk^{2*}
2	粗略	approximately	tsɔu^{55} lœk^{2*}	lɔk^{2*}
3	喉核	adam's apple	hau^{21} wat^{2*}	wat^{2*}
4	單一	only; single	sin^{21} jat^{5}	jak^{35}
5	角落	corner	gɔk^{3} lɔk^{2*}	lɔk^{2*}
6	住宅	residence	tsy^{22} tsœk^{2*}	tsæk^{2*}
7	往日	in the past	wɔŋ^{23} jat^{2*}	jak^{2*}
8	中心	center	ts^{h}uŋ^{55} sam^{55}	sam^{55}
9	重新	again	ts^{h}uŋ^{5} san^{55}	saŋ^{55}
10	茶樓	tea house	ts^{h}a^{21} lau^{21*}	lau^{21*}
11	芍藥	chinese herbaceous peony	ts^{h}œk^{3} jœk^{2*}	yɔk^{2*}
12	上顎	upper jaw	sœŋ^{22} ŋɔk^{2*}	ŋɔk^{2*}
13	烏蠅	fly	wu^{55} jiŋ^{21*}	jiŋ^{21*}
14	效率	efficiency	hau^{22} lɔt^{2*}	lak^{2*}
15	綠豆	green bean	luk^{2} tau^{22*}	dau^{22*}
16	石榴	pomegranate	sɛk^{2} lau^{21*}	lau^{21*}

Continue on the next page...

id	word	translation	Cantonese	Weitou
17	佛偈	buddhist chant	fat^{2} gai^{22}*	gik^{2}*
18	夜學	night school	jɛ^{22} hɔk^{2}*	hɔk^{2}*
19	記得	to remember; to recall	gɛi^{33} dak^{5}	dak^{35}
20	原則	principle	jyn^{21} tsak^{5}	tsak^{35}
21	夾計	to cooperate on a plan	kap^{3} gai^{33}*	gai^{55}*
22	貓兒	kitten	mau^{55} ji^{21}*	ji^{21}*
23	了哥	parrot	liu^{21}* gɔ^{55}	gɔ^{55}
24	攣毛	hair	ly^{55} mɔu^{21}*	mau^{21}*
25	盲妹	younger sister	maŋ^{21} mui^{22}*	mui^{22}s*
26	父親	father	fu^{22} ts^{h}an^{55}	ts^{h}aŋ^{55}
27	新派	style; school	si^{21} pai^{33}*	bai^{55}*
28	騎樓	balcony	kɛ^{25} lau^{21}*	lau^{21}*
29	出口	exit	ts^{h}ɔt^{5} hau^{35}	hau^{35}
30	汽笛	steam whistle	hɛi^{33} tɛk^{2}*	dɛk^{2}*
31	約莫	approximately	jœk^{3} mɔk^{2}*	mɔk^{2}*
32	資金	funds	tsi^{55} gam^{55}	gam^{55}
33	獲得	”to gain, to obtain”	wɔk^{22} dak^{5}	dak^{35}
34	馬騮	monkey	ma^{23} lau^{21}*	lau^{21}*
35	是否	yes or no	si^{22} fau^{35}	fau^{35}
36	產品	goods	ts^{h}an^{35} bau^{35}	baŋ^{35}
37	規則	rules	g^{w}ai^{55} tsak^{5}	tsak^{35}
38	牛油	butter	ŋau^{21} jau^{21}*	yau^{21}*
39	契弟	bastard	kai^{33} tai^{22}*	tai^{22}*
40	好吃	delicious; tasty	hɔu^{35} hɛk^{3}	hɛk^{35}
41	手襪	gloves	sau^{35} mat^{2}*	mæk^{2}*
42	雙日	per two days	sœŋ^{55} jat^{2}*	jak^{22}*

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id	word	translation	Cantonese	Weitou
43	到底	after all	dɔu^{33} dai^{35}	dai^{35}
44	不嬲	all along; always	bat^{5} lau^{21}*	niu^{55}*
45	孔雀	peacock	huŋ^{35} tsœk^{3}*	tsɔk^{2}*
46	蠶豆	lima beans	ts^{h}an^{21} tau^{22}*	dau^{22}*
47	前世	former life	ts^{h}in^{21} sai^{33}*	sai^{55}*
48	人口	entrance	jan^{21} hau^{21}	hau^{35}
49	損失	to lose; a loss;	syn^{35} sat^{5}	sak^{2}
50	大約	approximately	tai^{22} jœk^{3}*	jɔk^{2}*
51	車位	parking space	ts^{h}ɛ^{55} wai^{22}*	wai^{22}*
52	紅豆	red bean	huŋ^{21} tau^{22}*	dau^{22}*
53	尾二	last; tail	mɛi^{23}* ji^{35}	ji^{55}
54	雨褸	raincoat	jy^{23} lau^{21}*	lau^{55}*
55	身體	body	san^{55} tai^{35}	tai^{35}
56	人體	human body	jan^{21} tai^{35}	tai^{35}
57	東西	east-west	duŋ^{55} sai^{55}	sai^{55}
58	值日	daily duties	tsik^{2} jat^{2}*	jak^{2}*
59	整體	whole	tsiŋ^{35} tai^{35}	tai^{35}
60	聲音	sound	siŋ^{55} jam^{55}	jam^{55}
61	鉆石	diamond	tsyn^{33} sɛk^{2}*	sɛk^{22}
62	下顎	lower jaw	ha^{22} ŋɔk^{2}*	ŋɔk^{22}*
63	母親	mother	mɔu^{23} ts^{h}an^{55}	ts^{h}aŋ^{55}
64	掌握	to grasp	tsœŋ^{35} ak^{5}	æk^{35}
65	徒弟	apprentice	t'ɔu^{21} tai^{22}*	dai^{22}*
66	表弟	cousin	biu^{35} tai^{22}*	dai2^{2}*
67	左近	near	tsɔ^{35} gan^{22}*	gaŋ^{22}*
68	自己	self	tsi^{22} gɛi^{35}*	gi^{35}*

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id	word	translation	Cantonese	Weitou
69	洋樓	western style building	jœŋ^{21} lau^{21}*	lau^{21}*
70	對手	rival	dɔi^{33} sau^{25}	sau^{35}
71	玻璃	glass	bɔ^{55} lɛi^{21}*	li^{21}*
72	拉尾	last; tail	lai^{55} mɛi^{23}*	mi^{55}*
73	商品	merchandise	sœŋ^{1} ban^{2}	baŋ^{2}
74	好日	good day (for marriage etc.)	hɔu^{35} jat^{2}*	jak^{2}*
75	第一	first	dai^{22} jat^{5}	jak^{35}
76	姑姐	father's younger sister	g^{w}u^{55} tsɛ^{35}*	tsɛ^{35}*
77	臺北	Taipei	tɔi^{21} bak^{5}	bak^{35}
78	一律	altogether; totally	jat^{5} lɔt^{2}*	lak^{2}*
79	不久	before long	bat^{5} gau^{35}	gau^{35}
80	不僅	not only	bat^{5} gan^{35}	gaŋ^{35}
81	熊人	bear	huŋ^{21} jan^{23}*	jaŋ^{21}*
82	輪流	to take turn	lun^{21} lau^{21}*	lau^{21}*
83	氣質	temperament	hɛi^{33} tsat^{5}	tsak^{35}
84	麻雀	sparrow	ma^{21} tsœk^{3}*	tsɔk^{35}*
85	亞洲	Asia	a^{3} tsau^{55}	tsau^{55}
86	弟弟	younger brother	tai^{21} tai^{22}*	tai^{22}*
87	時刻	moment	si^{21} haak^{55}	hæk^{35}
89	覺得	"to think, to feel"	gɔk^{3} dak^{5}	dak^{35}
90	糯米	glutinous rice	nɔ^{22} mai^{23}*	mai^{55}*
91	單日	per day	tan^{55} jat^{2}*	yak^{2}*
92	物質	matter	mat^{22} tsat^{55}	tsak^{35}
93	傾偈	to chat	kiŋ^{55} gai^{22}*	gik^{35}*
94	漆油	paint	ts^{h}at^{5} jau^{21}*	jau^{21}*
95	毒瘤	malignant tumor	tuk^{2} lau^{21}*	lau^{21}*

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id	word	translation	Cantonese	Weitou
96	硬顎	hard plate	ŋaŋ^{22} ŋɔk^{2*}	ŋɔk^{2*}
97	團體	group	tyn^{21} tai^{35}	tai^{35}
98	具體	specific	gɔi^{22} tai^{35}	tai^{35}
99	醬油	soy sauce	tsœŋ^{33} jau^{21*}	yau^{21*}
100	即使	although	tsik^{5} si^{35}	si^{35}
101	指出	to point out; to indicate	tsi^{25} ts^{h}ɔt^{55}	ts^{h}ak^{35}
102	略略	sligthly; a little bit	lœk^{35} lœk^{2*}	lɔk^{2*}
103	夫人	mrs; madam	fu^{55} jan^{21*}	jaŋ^{21*}
104	上樓	to go upstairs	sœŋ^{23} lau^{21*}	lau^{21*}
105	絲襪	stockings	si^{55} mat^{2*}	mæk^{2*}
106	事頭	boss	si^{22} tau^{21*}	tau^{21*}
107	豬腳	pig's feet	tsy^{55} gœk^{3*}	gɔk^{35*}
108	間尺	ruler	kan^{33} ts^{h}ɛk^{3*}	ts^{h}ɛk^{35*}
109	喜鵲	magpie	hɛi^{35} tsɔk^{3*}	tsɔk^{35*}
110	王宅	wong's residence	wɔŋ^{21} tsœk^{2*}	tsæk^{2*}
111	行駛	to travel	haŋ^{21} sai^{35}	sai^{35}
112	原因	cause	jyn^{21} jan^{55}	jaŋ^{55}
113	食品	food	sik^{22} ban^{35}	baŋ^{35}
114	左右	approximately	ts^{h}ɔu^{35} jau^{22*}	jau^{35}
115	擔心	worry	dam^{55} sam^{55}	sam^{55}
116	進口	important	tsɔn^{33} hau^{35}	hau^{35}
117	二樓	second floor	ji^{22} lau^{21*}	lau^{21*}

Appendix D

Mixed Questionnaire

id	type	word	translation	transcription	weitou
1	dei	得得咄	perhaps	dɐk^{5} dɐk^{5} dɛi^{35}	
2	dei	滑滑咄	It's very slippery	wat^{2} wat^{2} dɛi^{35}	
3	dei	细细咄	It's very small	sɐi^{33} sɐi^{33} dɛi^{35}	
4	dei	薄薄咄	a little	bɔk^{2} bɔk^{2} dɛi^{35}	
5	dei	贵贵咄	It's very expensive	gʷɐi^{33} gʷɐi^{33} dɛi^{35}	
6	dei	黑黑咄	It's very black	hɐk^{5} hɐk^{5} dɛi^{35}	
7	dei	厚厚咄	It's very thick	hɐu^{23} hɐu^{23} dɛi^{35}	
8	elision	我会守呢度	I will guard here	ŋɔ^{23} sɐu^{35}* hɐi^{35} li^{33} dɔ^{33}	✓
9	elision	我会投呢度	I will cast here	ŋɔ^{25} tɐu^{23}* hɐi^{35} li^{33} gɔ^{33}	
10	elision	我住呢度	I live here	ŋɔ^{23} zyu^{35}* hɐi^{35} li^{33} dɔ^{33}	
11	red1	腾腾震	shivering	tɐn^{35} tɐn^{35}* dzɐn^{33}	✓
12	red1	禽禽青	in a hurry	kɐm^{35} kɐm^{35}* tsɛŋ^{23}	✓
13	red1	立立乱	messy	lɐp^{2} lɐp^{2}* lyn^{35}	
14	red2	香喷喷	very frangrant	hɔɛŋ^{55} pɐn^{33} pɐn^{33}*	✓
15	red3	黑沉沉	dark and cloudy	hak^{5} tsɐm^{21} tsɐm^{21}*	✓
16	red4	黑麻麻	pitch dark	hɐk^{5} mɐ^{55} mɐ^{55}*	✓

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id	type	word	translation	transcription	weitou
17	red5	白雪雪	snow-white	bak^{2} syt^{5} syt^{5}	
18	red^{33}	瘦猛猛	very thin	sɐu^{33} maŋ^{35} maŋ^{35}*	✓
19	vocative	阿林	Lam	a^{33} lɐm^{21}	✓
20	vocative	阿薛	Sit?	a^{33} sit^{3}	✓
21	vocative	阿李	Lei (Lee)	a^{33} lɛi$^{2\ 3}$	✓
22	vocative	阿赵	Chiu	a^{33} tsiu^{22}	✓
23	vocative	阿谢	Zee	a^{33} tsɛ^{22}	✓
24	vocative	阿叶	Yip	a^{33} jip^{2}	✓
25	vocative	阿麦	Mak	a^{33} mɐk^{2}	✓
26	vocative	阿张	Cheng	a^{33} ʧœŋ^{55}	✓
27	vocative	阿蔡	Choi	a^{33} tsɔi^{33}	✓
28	vocative	阿郭	Kwok	a^{33} k^{w}ɔk^{3}	✓
29	elision	我劈咗呢个	I chopped this	ŋɔ^{23} pɛk^{3} ʧɔ^{35} li^{33}gɔ^{33}	
30	elision	我得咗呢个	I got this	ŋɔ^{23} dɐk^{5} ʧɔ^{35} li^{33}gɔ^{33}	
31	elision	我批咗呢个	I permit this	ŋɔ^{23} pɐi^{55} ʧɔ^{35} li^{33}gɔ^{33}	
32	elision	我收咗呢个	I received this	ŋɔ^{23} sɐu^{55} ʧɔ^{35} li^{33}gɔ^{33}	
33	elision	我毁咗呢个	I destroyed this	ŋɔ^{23} wɐi^{35} ʧɔ^{35} li^{33}gɔ^{33}	
34	elision	我洗咗呢个	I washed this	ŋɔ^{23} sɐi^{35} ʧɔ^{35} li^{33} gɔ^{33}	
35	elision	我甩咗呢个	I lost it	ŋɔ^{23} lɐt^{5} ʧɔ^{35} li^{33} gɔ^{33}	
36	elision	我罚咗呢个	I punished this person	ŋɔ^{23} fɐt^{2} ʧɔ^{35} li^{33} gɔ^{33}	
37	elision	我读咗呢个	I have read this	ŋɔ^{23} duk^{2} ʧɔ^{35} li^{33} gɔ^{33}	

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