PRODUCTION AND PERCEPTION OF ZERO AND NASAL INITIALS IN MALAYSIAN CANTONESE

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PRODUCTION AND PERCEPTION OF ZERO AND NASAL INITIALS IN MALAYSIAN CANTONESE

ABSTRACT

Cantonese zero initial /Ø/ and nasal initial /ŋ/ are allophones in complementary distribution since the Middle Chinese period. However, the phonetic variation of these two initials has been found in contemporary Cantonese in China. The nasal initial /ŋ/ has been frequently replaced by the zero consonant /Ø/. This is considered a "lazy pronunciation" that commonly occurs among the younger generation and is presumed to be influenced by Mandarin, the national language of China. However, previous research pointed out that this "lazy pronunciation" does not seem to occur in Cantonese in Southeast Asia. In light of this, it is worth examining the development of these two initials in Malaysia, a country in Southeast Asia that is well known for its multilingualism. The speech production and perception of Cantonese speakers towards these two initials were investigated to achieve the aim of this study. A total of 20 Cantonese speakers participated in the production task, and 40 Cantonese speakers participated in the perception task. 20 of them participated in both the production task and the perception task. All of them are third-generation and onward Malaysian Chinese from the central region, aged between 20 and 31 years. A list of disyllabic words was used to collect production and perception data. The production of these two initials is analysed using phonetic analysis; the perception of the listeners towards these two initials is investigated using a discrimination task; and the effects of linguistic and non-linguistic factors on production and perception are investigated using the variable rule analysis method. This study reveals that these two Cantonese initials may not be in complementary distribution but rather in free variation in the central region of Malaysia. An opposite situation to Cantonese in China emerged in the central region of Malaysia.

The nasal consonant [ŋ] is the phoneme dominating among these two initials in the central region of Malaysia. Furthermore, the findings in both production and perception suggest that linguistic factors show a more significant effect on phonetic variation compared to non-linguistic factors. The vowel type is the most significant factor constraining the phonetic variation of these two initials.

Keywords: Malaysian Cantonese, production and perception, zero initial /Ø/, nasal initial /ŋ/, phonetic variation

PRODUKSI DAN PERSEPSI AWALAN SIFAR DAN NASAL DALAM KANTONIS MALAYSIA

ABSTRAK

Kantonis awalan sifar /Ø/ dan awalan nasal /ŋ/ adalah alofon dalam penyebaran saling melengkapi sejak zaman bahasa Cina pertengahan. Namun, variasi fonetik kedua-dua awalan tersebut ditemukan dalam bahasa Kantonis kontemporari di China. Awalan nasal /ŋ/ kerap digantikan dengan konsonan sifar /Ø/. Ini dianggap sebagai masalah "sebutan malas" yang umum di kalangan generasi muda, dan dianggap dipengaruhi oleh bahasa Mandarin, bahasa kebangsaan China. Walau bagaimanapun, kajian terdahulu menunjukkan bahawa "sebutan malas" ini nampaknya tidak berlaku dalam bahasa Kantonis di Asia Tenggara. Sehubungan dengan itu, adalah wajar untuk mengkaji perkembangan kedua-dua awalan tersebut di Malaysia, sebuah negara di Asia Tenggara yang terkenal dengan multibahasanya. Produksi dan persepsi penutur Kantonis terhadap kedua-dua awalan tersebut telah dikaji untuk mencapai matlamat kajian ini. Seramai 20 penutur Kantonis mengambil bahagian dalam tugas produksi, dan 40 penutur Kantonis mengambil bahagian dalam tugas persepsi. 20 daripada mereka mengambil bahagian dalam kedua-dua tugas produksi and persepsi. Kesemua mereka adalah generasi ketiga dan seterusnya Cina Malaysia dari wilayah tengah, berumur antara 20 dan 31 tahun. Senarai perkataan dua suku kata digunakan untuk mengumpul data produksi dan persepsi. Produksi kedua-dua awalan tersebut dianalisis menggunakan analisis fonetik; persepsi penutur terhadap kedua-dua awalan tersebut disiasat dengan menggunakan tugas diskriminasi; dan kesan faktor linguistik dan bukan linguistik terhadap produksi dan persepsi disiasat dengan menggunakan kaedah analisis peraturan pembolehubah. Kajian ini mendedahkan bahawa kedua-dua awalan tersebut mungkin bukan dalam penyebaran saling melengkapi tetapi dalam variasi bebas di wilayah tengah Malaysia.

Keaadaan yang bertentangan dengan Kantonis di China muncul di wilayah tengah Malaysia. Konsonan nasal [ŋ] ialah fonem yang mendominasi antara dua awalan tersebut di wilayah tengah Malaysia. Tambahan pula, dapatan dalam kedua-dua produksi dan persepsi mencadangkan bahawa faktor linguistik menunjukkan kesan yang lebih ketara terhadap variasi fonetik berbanding dengan faktor bukan linguistik. Jenis vokal merupakan faktor penting ketara yang mengekang variasi fonetik kedua-dua awalan tersebut.

Kata kunci: Kantonis Malaysia, produksi dan persepsi, awalan sifar /Ø/, awalan nasal /ŋ/, variasi fonetik

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

N	Number of frequencies
%	Percentage
N1	The first nasal formant
N2	The second nasal formant
N3	The third nasal formant
F1	The first formant
F2	The second formant

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

The purpose of this study is to examine the development of Cantonese zero and nasal initials in the central region of Malaysia by observing Cantonese speakers' speech production and perception. This chapter provides a basic introduction to this study, including the profile of the Malaysian Chinese, Malaysian Cantonese, the background of the study, the statement of the problem, the research objectives, the research questions, the significance of the research, the scope and limitations of the study, and the organisation of the dissertation.

1.1 Profile of Malaysian Chinese

Malaysia is a Southeast Asian country. According to its geographical location, Malaysia is separated into two parts by the South China Sea. The eastern part of Malaysia, which is often referred to as "East Malaysia", is located in the northern part of Borneo (Malaysia Central, n.d.). East Malaysia consists of two states, Sabah and Sarawak, and the federal territory of Labuan. While the western part of Malaysia, which is often referred to as "West Malaysia" or "Peninsular Malaysia", is bordered by Thailand in the north and Singapore in the south (Malaysia Central, n.d.). Peninsular Malaysia consists of eleven states and two federal territories. Generally, Peninsular Malaysia can be divided into four regions: the northern region, which consists of Perlis, Kedah, Penang, and Perak; the central region, which consists of Selangor, Kuala Lumpur, Putrajaya, and Negeri Sembilan; the southern region, which consists of Malacca and Johor; and the east coast region, which consists of Kelantan, Terengganu, and Pahang (Lim, 2002; Malaysia Central, n.d.).

Figure 1.1: Map of Malaysia (The Nations Online Project, n.d.)

Malaysia is a country formed by different ethnic groups. The total population of Malaysia in 2020 is estimated at 32.4 million (Department of Statistics Malaysia, 2022). It is made up of Bumiputera (which includes Malays, Orang Asli, and Bumiputera from Sarawak and Sabah), Chinese, Indians, and other ethnic groups (Department of Statistics Malaysia, 2022). Every ethnic group has its own culture and languages, and this has made Malaysia a multicultural and multilingual country.

1.1.1 Chinese Ethnic Group in Malaysia

Over 30 million Chinese people live in Southeast Asia, accounting for more than 70% of overseas Chinese worldwide (Han, 2019). Thailand, Malaysia, and Indonesia are the Southeast Asian countries with the highest concentration of Chinese communities. In Malaysia, apart from the largest ethnic group, Bumiputera (69.4%), the Chinese ethnic groups are the largest minority group, comprising 23.2% of the Malaysian population, estimated at 6.9 million (Department of Statistics Malaysia, 2022). Chinese people mainly settled in Penang (44.9%), Kuala Lumpur (41.6%), and Johor (32.8%).

Table 1.1: Distribution of Chinese ethnic group by states and federal territories (Department of Statistics Malaysia, 2022)

Region	State / Federal Territory	Population of Chinese ethnic group in each state (%)	Total population in each state (N)
Peninsular Malaysia - Northern region	Perlis	7.4	284,885
	Kedah	12.3	2,131,427
	Penang	44.9	1,740,405
	Perak	27.2	2,496,041
Peninsular Malaysia - Central region	Selangor	27.3	6,994,423
	Kuala Lumpur	41.6	1,982,112
	Putrajaya	0.6	109,202
	Negeri Sembilan	21.9	1,199,974
Peninsular Malaysia - Southern region	Malacca	22.1	998,428
	Johor	32.8	4,009,670
Peninsular Malaysia - East Coast region	Kelantan	2.5	1,792,501
	Terengganu	2.1	1,149,440
	Pahang	14.7	1,591,295
East Malaysia	Sabah	9.5	3,418,785
	Sarawak	23.8	2,453,677
	Labuan	11.7	95,120

The ancestors of Malaysian Chinese came from China (Ang, 2005; Chen, 2003; Sim, 2012). In the early nineteenth century, the Chinese came to Malaya (the name of Malaysia before independence) with a wave of immigration and settled here. Today, Malaysian Chinese have reproduced into the fourth and fifth generations. In the process of immigration to Malaysia, they naturally brought over the Chinese culture, customs, and community languages that they spoke (Chen, 2003; Coluzzi, 2017; Sim, 2012).

The ancestors of the majority of Malaysian Chinese are from the southern region of China, particularly Fujian Province and Guangdong Province (Chen, 2003; Coluzzi, 2017; Sim, 2012). Generally, the Chinese people in Malaysia can be divided into seven main dialect groups: Hokkien (*Fujian* 福建), Hakka *(Kejia* 客家), Cantonese

(*Guangdong 广东*), Teochew (*Chaozhou 潮州*), Hainan (*海南*), Guangxi (*广西*), and Foochow (*Fuzhou 福州*) (Voon, 2007). After 2000, data on the Chinese population in Malaysia were not categorised by dialect groups; the dialect group population data in 2000 is considered to be the last officially available dialect group population data. According to the demographic data in 2000 recorded in Voon (2007), among the 5.3 million Chinese people in Malaysia, the majority are Hokkien (37.7%), Hakka (20.4%), and Cantonese (19.9%) peoples (see Appendix A1). Hokkien people are the dialect group that accounts for the largest portion of the Chinese population in each state (except for Perak, Pahang, Sabah, and Sarawak) (see Appendix A2). Most Hokkien descendants settled in Selangor (25.0%), Johor (20.5%), and Penang (14.7%) (see Appendix A3). The distribution of Hakka and Cantonese people in each state is quite similar. Most Hakka descendants settled in Selangor (18.7%), Sarawak (14.8%), Sabah (13.5%), Johor (12.8%), and Perak (12.2%) (see Appendix A4). On the other hand, most Cantonese descendants settled in Selangor (27.1%), Perak (18.9%), and Federal Territories (17.2%) (see Appendix A5). In particular, tin-rich areas such as Kuala Lumpur, Ipoh, Taiping, and Seremban are where the Cantonese people congregate (Chui, 1998). Most of these places (Kuala Lumpur and Seremban, a city in Negeri Sembilan) are located in the central region of Malaysia (Lim, 2002; Malaysia Central, n.d.).

In the past, when the Chinese people first came to Malaysia to earn a living, because of the strange environment and unfamiliar local language, they chose to live in the same village or area with people from the same dialect group (Ang, 2005). For instance, the Hokkien people were the first dialect group to migrate into Malaya and settled mainly in Penang and Malacca; the Cantonese and Hakka people worked in tin mines and plantations and thus settled primarily in tin-rich states such as Selangor, Negeri Sembilan, Perak, and Pahang (Chui, 1998). This has led to the phenomenon of a particular Chinese community language being particularly powerful among the Malaysian Chinese communities of individual states today, for instance, Hokkien in Penang and Cantonese in Kuala Lumpur (Chen, 2003; Coluzzi, 2017).

1.1.2 Chinese Language Varieties in Malaysia

Several studies have claimed that the use of various Chinese community languages in Malaysia is gradually declining because of the rise of Mandarin (Sim, 2012; Sulaiman, 2008). The language policy in Malaysia has changed and developed almost in tandem with the education policy (Wang, 2021). In the early days, education was not widespread in Malaysia, and most Chinese people communicated in the Chinese community languages of their dialect group. It was not until the prevalence of nationalism in China that the education of the Chinese community in Malaysia came into focus (Ridzuan Hasan et al., 2019). Around 1921, many Chinese schools were established in Malaya and started using Mandarin as the medium of instruction (Ridzuan Hasan et al., 2019). This action aims to replace Chinese community languages with Mandarin to unify various dialect groups, as happened in China (Ridzuan Hasan et al., 2019; Sim, 2012). Mandarin continued to be the medium of instruction in Chinese primary schools after the independence of Malaya in 1957 (Wang, 2021). Later in the 1980s, under the influence of Singapore's "Speak Mandarin Campaign", the Malaysian Chinese community was encouraged to speak Mandarin to promote communication among different dialect groups (Wang, 2021).

As a result of public sector policies and private sector promotions, Mandarin has become the most widely spoken language among the Malaysian Chinese community nowadays, and the use of various Chinese community languages in Malaysia has been gradually affected and declined (Sim, 2012; Sulaiman, 2008). According to Wang (2021, p. 119), a language shift is happening in Malaysian Chinese families. The main realisation is that the weaker Chinese community languages shift towards the stronger Chinese community languages or Mandarin. Mandarin has become the lingua franca among the Malaysian Chinese community, and this has had an impact on the choice of the dominant language in Malaysian Chinese families. For instance, several studies have shown that the majority of younger Chinese adults today are moving towards speaking Mandarin rather than their Chinese community languages, such as Cantonese, Hokkien, Hakka, Foochow, and Teochew (Puah & Ting, 2015; Ting, 2010; Wang, 2021).

1.2 Malaysian Cantonese

As mentioned in the previous section, the language usage of Chinese community languages in Malaysia is facing a decline. However, although Cantonese people are not the largest Chinese dialect group in Malaysia, Cantonese still has a certain level of prestige among the Malaysian Chinese community. Wang and Chong (2011) pointed out that Cantonese showed the highest extent of language maintenance among the Chinese community languages in Malaysia. Cantonese was maintained in various public settings, such as coffee shops, restaurants, shopping centres, and clinics. The maintenance of the use of Malaysian Cantonese is highly influenced by Hong Kong's Cantonese entertainment industry (Carstens, 2003; Coluzzi, 2017; Sim, 2012).

According to Coluzzi (2017), in Malaysia, Cantonese scores at level 3 (trade), level 6a (vigorous), and level 6b (threatened) of the Extended Graded Intergenerational Disruption Scale (EGIDS). The levels of "vigorous" and "threatened" both imply that Cantonese is spoken orally by all generations and that it is being learned as a first language by children. However, not all of the Cantonese communities are passing it down to their offspring.

On the other hand, the level of "trade" implies that Cantonese is used by native speakers and non-native speakers for local and regional work. Cantonese is widely spoken and can be considered the local lingua franca in the business sector among the Chinese communities in the central region of Malaysia. There are even some jobs that require candidates to be able to speak Cantonese. Thus, many Malaysian Chinese in the central region of Malaysia started to learn Cantonese after they entered this Cantonese-speaking environment, regardless of their respective dialect groups. According to Ang and Lau (2012), Chinese people in Kuala Lumpur are more likely to speak Cantonese than other Chinese community languages such as Hokkien and Hakka while conversing with other Chinese colleagues. Furthermore, in the industry of Malaysian Chinese broadcast media, the language of interaction is mainly Mandarin. Meanwhile, there are also broadcasts that conduct programmes in Chinese community languages, and Cantonese is the most widely used Chinese community language in radio broadcasting (Commercial Radio Malaysia, n.d.). With the spread of the media and entertainment industries, even other dialect groups will watch Cantonese dramas and listen to Cantonese radio channels (Ong, 2019). These facts reflect that there are not only native Cantonese speakers but also non-native Cantonese speakers in Malaysia.

As can be seen from the above, Malaysian Cantonese is in a delicate situation. It is continuing to be used, but its inheritance is still under threat. This is because Cantonese is learned and used orally; it is usually passed down orally from generation to generation since there is no standard curriculum for it in Malaysia. When acquiring a language orally, it is very common for phonetic changes to occur. However, there is scarce research into the phonetics and phonology of Malaysian Cantonese. Hence, in order to observe the development of Malaysian Cantonese, the study of Cantonese phonetics and phonology is essential.

From the perspective of regional location, as stated in Section 1.1.1, most of the places where Cantonese people congregate are located in the central region of Malaysia (Chui, 1998). Furthermore, the studies on Malaysian Cantonese were mainly focused on

Kuala Lumpur, the capital of Malaysia, which is located in the central region. Therefore, Cantonese in the central region of Malaysia can be regarded as a representative of Malaysian Cantonese.

1.3 Background of the Study

Languages evolve in tandem with society, so they will be gradually improved with the development of society. After Cantonese was brought to Malaysia, it took root and developed in this land along with other local languages and other Chinese community languages. Therefore, it is natural for Cantonese to change phonetically, morphologically, or syntactically over time in Malaysia. It is possible for Cantonese to develop unique variations due to contact with other local languages and Chinese community languages in Malaysia or to develop the same variations as Cantonese in China, even after leaving its place of origin.

In Cantonese, the zero initial and nasal initial /ŋ/ are allophones that are in complementary distribution (Yuan, 2001). The condition of complementary distribution for these two initials is the lexical tone, which refers to the pitch pattern of a syllable. The lexical tone is important in tonal language as it helps in distinguishing the lexical meaning (Lin, 2007). The zero initial, which can be transcribed as /Ø/, occurs initially in syllables with *Yin* tones (high register tones), while the nasal initial /ŋ/ occurs initially in syllables with *Yang* tones (low register tones). These two initials should not appear in the same phonetic environment.

However, a few studies have found phonetic variations of these two initials in Macau, Hong Kong, Shenzhen, and Guangzhou (Botha & Barnes, 2015; Cheung, 2002; Liu, 2019; Peng & Liang, 2008; To et al., 2015). These studies found that sometimes a zero initial /Ø/ syllable will be replaced by a nasal consonant /ŋ/ initially. For example, the zero initial syllable "爱" [ɔi˧], which means "love", will sometimes be pronounced with a nasal consonant as [ŋɔi˧]. While sometimes the situation is the opposite, a nasal initial /ŋ/ syllable will sometimes have its nasal consonant disappear and be pronounced as a zero consonant /Ø/. For example, the nasal initial syllable "饿" [ŋɔ˨], which means "hungry", will sometimes be pronounced as [ɔ˨]. The previous studies mentioned that the phonetic variation from nasal initial /ŋ/ to zero initial /Ø/ occurs more often, and this is known as a type of "lazy pronunciation" (Botha & Barnes, 2015; Cheung, 2002; To et al., 2015), as this is a process of deletion of the initial.

1.4 Statement of Problem

The existing publications on the phonetic variation of Cantonese zero initial /Ø/ and nasal initial /ŋ/ are mainly on Cantonese in China. Peng and Liang (2008) and To et al. (2015) claimed that the zero initial /Ø/ gradually became the dominant initial among these two initials. Liu (2019) claimed that this phenomenon is influenced by Mandarin, the national language of China. This is because the zero initial /Ø/ can occur initially in Mandarin syllables, but the nasal initial /ŋ/ does not (Duanmu, 2007). The replacement of the nasal initial with a zero consonant is also known as "lazy pronunciation", which is often found in the younger generation (Botha & Barnes, 2015; Cheung, 2002; To et al., 2015).

However, Cantonese is not only spoken within China but has also been transmitted throughout the world, including Malaysia. Chen (2003) recorded the Cantonese phonological system in Kuala Lumpur, Malaysia. In her study, some zero initial /Ø/ syllables have been recorded under the nasal initial /ŋ/. This reflects the fact that the phonetic variation of these two initials not only occurs in China but may also occur in Malaysia. It also suggests the possibility that the situation of these two Cantonese initials in Malaysia differs from Cantonese in China. Furthermore, Chen (2014) mentioned that the "lazy pronunciation" of replacing a nasal initial with a zero consonant does not seem to occur in the Cantonese of Chinese communities in Southeast Asia. As one of the Southeast Asian countries, Malaysia is well-known for its multilingualism, as it has many different languages. It is also worth noting that nasal consonants [ŋ] can occur initially in Malay, the national language of Malaysia (Clynes & Deterding, 2011), as well as in other Chinese community languages that are widely spoken in Malaysia, such as Hokkien (Chiew, 2019b), Hakka, and Teochew (Chen, 2003) (which will be explained in Section 2.6.2).

In this case, would Cantonese speakers in Malaysia replace the nasal initial /ŋ/ with the zero consonant /Ø/ more frequently, as Cantonese speakers in China do? Or would the situation be the opposite, with the nasal initial /ŋ/ dominating between these two initials? Unfortunately, the lack of acoustic evidence prevented Chen (2003; 2014) from exploring this phonetic issue more fully and in greater depth. This, in turn, leads to the purpose of this study: to examine the development of Cantonese zero initial /Ø/ and nasal initial /ŋ/ in the central region of Malaysia. The Cantonese speakers involved in Chen's study (2003) were the second and third generations of Malaysian Chinese. In order to further understand the development of Cantonese zero initial /Ø/ and nasal initial /ŋ/ in Malaysia, a study of these two initials among the third-generation and onward Malaysian Chinese is necessary.

Furthermore, the existing research on Cantonese zero initial /Ø/ and nasal initial /ŋ/ only focused on speech production but neglected speech perception. Therefore, this study seeks to examine the development of these two initials by observing both the production and perception of these two initials among Cantonese speakers in the central region of Malaysia. On the other hand, the previously published studies shed light on the effect of non-linguistic factors on the phonetic variation of these two initials but neglected linguistic factors. Both linguistic and non-linguistic factors may influence the phonetic variation. The study of phonetic variations should not only be analysed in terms of non-linguistic factors, but linguistic issues should also bring the focus of research back to the language itself. In light of this, this study seeks to investigate the effects of both linguistic and non-linguistic factors on the production and perception of these two initials.

1.5 Research Objectives

The objectives of this study are as follows:

i. To examine the production of Cantonese zero and nasal initials by Cantonese speakers in the central region of Malaysia.

ii. To investigate the perception of Cantonese zero and nasal initials by Cantonese speakers in the central region of Malaysia.

iii. To examine the effects of linguistic and non-linguistic factors on the production and perception of Cantonese zero and nasal initials in the central region of Malaysia.

1.6 Research Questions

There are four research questions in this study. The first research question is aligned with the first research objective; the third research question is aligned with the second research objective; and the second and fourth research questions are aligned with the third research objective.

i. What are the phonetic realisations of Cantonese zero initial /Ø/ and nasal initial /ŋ/ by Cantonese speakers in the central region of Malaysia?

ii. How do linguistic and non-linguistic factors influence the production of Cantonese zero initial /Ø/ and nasal initial /ŋ/ in the central region of Malaysia?

iii. To what extent do Cantonese speakers in the central region of Malaysia perceive the difference(s) between Cantonese zero initial /Ø/ and nasal initial /ŋ/?

iv. How do linguistic and non-linguistic factors influence the perception of Cantonese zero initial /Ø/ and nasal initial /ŋ/ in the central region of Malaysia?

1.7 Significance of the Research

The main significance of the study is that it deals with a Chinese community language, Cantonese, which is widely spoken in the Malaysian Chinese community but has not received much attention in phonetic research. Thus, this study may contribute to the development of Cantonese phonetics and phonological studies in Malaysia. Moreover, previous studies on Malaysian Cantonese were not only few in number but were generally conducted without the use of instruments, which means they recorded the patterns of sounds perceptually. They usually imitate the features of speech sounds based on their own auditory perception. The present study was conducted as a phonetic analysis, which collects and analyses phonetic data using the appropriate instruments. Therefore, this study may also contribute phonetic data to the Cantonese phonology in Malaysia. By measuring and calculating the phonetic data, the phonetic descriptions can be quantified and made more accurate. It may help to visualise the phonetic phenomenon of Malaysian Cantonese.

Apart from that, this study may also provide references for future studies. Existing publications on this phonetic issue have mainly focused on speech production but neglected the aspect of speech perception. In recent years, phonetic research has not only been limited to production but has also begun to include speech perception as a research point. In light of this, speech perception should also be included in phonetic variation studies in order to break through the previous research mode and get a more comprehensive understanding of the phonetic phenomenon of Cantonese zero initial /Ø/ and nasal initial /ŋ/. Moreover, this study also shows the possible linguistic and non-linguistic influences on these features.

1.8 Scope and Limitations of the Study

The present study may contribute to a better understanding of the Cantonese zero initial /Ø/ and nasal initial /ŋ/ in Malaysia and may provide references for future research. However, as with many studies, there could be some potential limitations to this study. In terms of geographical location, this study only includes Cantonese speakers from the central region of Malaysia, including Kuala Lumpur, Selangor, and Negeri Sembilan, but does not involve Cantonese speakers throughout Malaysia. However, Cantonese is widely spoken in the central region. Thus, it also has a certain representativeness for the population of Cantonese speakers in Malaysia.

In order to investigate the phenomenon of phonetic variations, the present study only focuses on the younger generation, who are more prone to phonetic variation. Moreover, the sample size of this study was relatively small, and the participants were recruited using the snowball sampling technique. It is difficult to apply the snowball sampling technique to a large sample. Furthermore, the perception task involved non-native Cantonese speakers whose home language is not Cantonese. There is no specific and uniform language proficiency test for Cantonese. So it is difficult to determine the proficiency levels of non-native Cantonese speakers. In addition, due to concerns that including too many questions would result in longer completion times for the perception task, the perception task focused primarily on zero initial /Ø/ syllables, which frequently undergo phonetic changes, rather than including all nasal initial /ŋ/ syllables (which will be explained in Chapter 3).

1.9 Organisation of the Dissertation

This thesis consists of seven chapters. Chapter 1 provides an introduction to this research. Chapter 2 introduces Cantonese from the perspective of linguistics and provides a review of the literature on Cantonese phonology, as well as the research variables, Cantonese zero initial /Ø/ and nasal initial /ŋ/. Chapter 3 explains the design of this study. Chapters 4 and 5 present the findings on speech production and perception respectively, and Chapter 6 presents the discussion on the findings. Lastly, Chapter 7 summarises the findings of this study and gives a conclusion to it.

CHAPTER 2

LITERATURE REVIEW

The previous chapter presented the general background of this study. This chapter builds on this by giving a review of the literature related to this study. Firstly, the definitions of "language", "dialect", "regionalect", "topolect", and "regional language" are introduced. Then, an explanation of Chinese varieties from the perspective of Chinese dialectology is provided. An introduction to the phonology of Cantonese is presented, including the structure of Cantonese syllables and the Cantonese phonological system in Malaysia. A literature review on linguistic research on Cantonese and the research variables—Cantonese zero initial /Ø/ and nasal initial /ŋ/—is also elaborated. Other related studies, such as the sociolinguistic approaches in language variation studies, nasal initial /ŋ/ in other languages in Malaysia, and perception studies on nasal consonants, will also be discussed. Lastly, the research gap in the previously published studies is summarised.

2.1 Is Cantonese a Language or Dialect?

There have been many academic debates over the definitions of the terms "language" and "dialect". In order to clarify their distinctions, their definitions are explained in this section. The concepts and definitions of "regionalect", "topolect" and "regional language" are also discussed.

2.1.1 Definitions of Language and Dialect

Max Weinreich, a sociolinguist expert on Yiddish linguistics, pointed out that "a language is a dialect with an army and a navy" (the original speech was in Yiddish)

(Maxwell, 2018). It highlighted how political and social factors can influence a community's view of the status of a language or dialect. According to Coluzzi et al. (2023), "languages" usually enjoy some degree of official protection, have a written form, and are used in certain high domains. In contrast, "dialects" are primarily spoken orally and are used in low domains. "Dialect" is defined as "a regionally or socially distinctive variety of language, identified by a particular set of words and grammatical structures" (Crystal, 2008, p. 142). "Dialects" have always been regarded as subdivisions of "languages".

All of the Chinese varieties are generally considered "*fangyan*" (方言) in Mandarin and "dialect" in English. They are mostly spoken orally and are considered to have a lower status compared to Mandarin, which is also known as the "standard variety" of Chinese. In Malaysia, Mandarin is the ethnic language that is used as the medium of instruction in Chinese government-aided schools. Chinese dialects such as Cantonese, Hokkien, Hakka, Teochew, Foochow, and Hainan are typically passed down orally from generation to generation within the home domain because there is no standard curriculum for them in Malaysia. For this reason, they are also referred to as "heritage languages" (Ong & Ting, 2023). Chinese dialects are also known as "Chinese community languages", as they are used among small Chinese communities (Ong & Ben Said, 2021).

2.1.2 Definitions of Regionalect, Topolect, and Regional Language

There has been controversy about the English translation of the word "*fangyan*" (方言). The word "*fangyan*" is a combination of "*fang*" (方), which refers to "direction, locality, side, place, region, area", and "*yan*" (言), which refers to "speech, talk, language, word, saying". Thus, "*fangyan*" has the meaning of "regional speech" (Tang, 2018, p. 549). "Dialect" has long been regarded as the English translation of "*fangyan*". This is because all the so-called Chinese dialects, such as Mandarin, Cantonese, and Hokkien, share the same written language, which is Chinese characters (*Hanzi 汉字*).

However, some linguistics researchers pointed out that the terms "dialect" and "*fangyan*" are not exactly the same (Tang, 2018). Although "dialect" refers to a variety that is inferior to "language", considered to be of a lower class, less important, more restricted in use, and less well developed than "language", there is another view from strict linguistics. Their primary argument is that even though they are identical in written form, they are mutually unintelligible in their spoken forms. From a strictly linguistic point of view, there is a "mutual intelligibility" concept of differentiating a "language" from a "dialect". The term "dialect" should be avoided for any varieties that are not mutually intelligible with the "language".

It is widely known that the Southern Chinese varieties (which will be explained in Section 2.2.1) are mutually unintelligible to one another (Groves, 2008). Mandarin speakers in non-Southern regions of China do not necessarily understand the Southern Chinese varieties; even speakers of Southern Chinese varieties may not be able to understand each other. This would be inconsistent with the definition of "dialects": varieties of a particular language that are mutually intelligible and can be distinguished by vocabulary, idioms, and pronunciation (Mair, 1991). Thus, the Southern Chinese varieties should not be considered the "dialect" of Chinese, and they may be classified as different languages.

In view of this, DeFrancis (1984) suggested a new term, "regionalect", intentionally encompassing all the ambiguities of "*fangyan*". However, because the term "region" refers to a fairly large area, Mair (1991) further proposed the term "topolect" to maintain a neutral stance on the size of the area. Apart from that, the term "regional language" was also suggested by Wicherkiewicz in 2001 (Coluzzi et al., 2023). Groves (2008) and Coluzzi et al. (2023) pointed out an important argument that "terminology affects attitudes". The role and status that a language variety is permitted to play in society are greatly influenced by attitudes, and language planning is also further impacted. There is an inseparable relationship between them.

Cantonese has long been regarded as one of the Chinese "dialects". But from the above discussion, it can be seen that it should not be called a "dialect", but "regionalect", "topolect", or "regional language". Coluzzi et al. (2023) suggested using the term "regional language" instead of "dialect" for Malaysian Cantonese. "Regional" as an adjective attached to "language" not only conforms to its regional characteristics but also shows the linguistic difference between it and other Chinese varieties. Furthermore, Malaysian Cantonese meets nearly all of the conditions for the ethno- and extra-linguistic features of a "regional language" listed by Wicherkiewicz (Coluzzi et al., 2023, p. 12). Hence, this paper agrees with considering Malaysian Cantonese as a regional language.

2.2 Chinese Varieties from the Perspective of Chinese Dialectology

In order to understand the Chinese varieties, it is necessary to first understand their "parent"—the Chinese language family, which is also known as the Sinitic group. From the perspective of Chinese dialectology, the relationship between "Chinese" and "Cantonese" will then be explained.

2.2.1 Sinitic Group

"Chinese" is a common term for *Hanyu* (*汉语*), but there are inherent ambiguities in this term. Hence, linguistic researchers suggest that "Sinitic" is an academic term that refers to the Chinese languages (Handel, 2015). The Sinitic group is the major group of the Sino-Tibetan language family (Lin, 2007); it is a language group rather than a single language.

There have been many arguments about the classification of Sinitic languages, which also refer to Chinese varieties. Scholars influenced by Western linguistics advocated a hierarchical model of language varieties: family-group-branch-language-dialect-subdialect (Mair, 1991). Li (1990) proposed that Wu, Min, and Yue are independent languages within the Sinitic group. They are not a dialect, but a language branch of the Sinitic group. He argued that Wu, Min, Yue, and Mandarin (with the basis of Northern *fangyan*) have certain differences in the aspects of phonetics, morphology, or even syntax. Thus, these Chinese varieties cannot be regarded as "dialects" of the same language; they should be regarded as different languages.

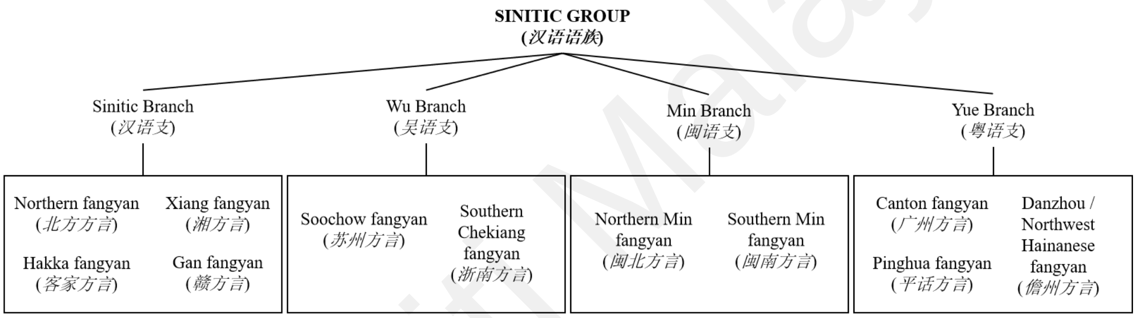

Figure 2.1: Tree diagram of the Sinitic group proposed by Li (1990, p. 62)

However, Chinese experts suggested a multi-layered classification for Chinese varieties: supergroup (*daqu 大区*), group (*qu 区*), subgroup (*pian 片*), cluster (*xiaopian 小片*), and local dialect (*dian 点*) (Tang, 2018). In addition, many Chinese scholars pointed out that Xiang, Hakka, and Gan are also mutually unintelligible with Mandarin. In terms of geographical location, all the Chinese varieties, except the Mandarin, originated in the southern region of China. Xiang, Gan, Hakka, Wu, Min, and Yue are regarded as very different from Mandarin, especially in terms of phonetics and phonology. There is even that argument: Mandarin speakers from northern China do not understand the Chinese varieties of southern China (Coluzzi et al., 2023).

Table 2.1: Classification of Chinese varieties proposed by Yuan (2001)

Region (China)	Chinese varieties	Provinces of China where the Chinese varieties are spoken
Northern	Mandarin (*官话*)	Yunnan, Guizhou, Hubei, Sichuan
Southern	Xiang (*湘*)	Hubei, Hunan
	Gan (*赣*)	Jiangxi
	Hakka (*客家*)	Guangdong, Fujian, Jiangxi, Taiwan, Guangxi, Hunan, Sichuan
	Wu (*吴*)	Jiangsu, Zhejian
	Min (*闽*)	Fujian
	Yue (*粤*)	Guangdong, Guangxi

Thus, another classification was proposed based on two considerations: geographic features and linguistic features (especially phonological evolution) (Handel, 2015; Tang, 2018). The Chinese varieties are classified into seven types of dialect groups (*fangyanqu 方言区*): Mandarin or Northern dialect (*官话* or *北方方言区*), Xiang (*湘方言区*), Gan (*赣方言区*), Wu (*吴方言区*), Hakka (*客家方言区*), Min (*闽方言区*), and Yue (*粤方言*). Due to political factors, some researchers insisted that these Chinese varieties should be regarded as "dialects" rather than languages. As shown in Figure 2.2, all these Chinese varieties (except Min) evolved from Middle Chinese. The Middle Chinese can be regarded as the "parent language" of Chinese varieties; the Chinese varieties are the descendants of the parent language. Middle Chinese refers to the historical variety of Chinese derived from Old Chinese and later evolved into Modern Chinese (Pan & Zhang, 2015). It represents an important stage in the development of the Sinitic group. Compared with Li's (1990) classification, this classification is more comprehensive and detailed. However as discussed in Section 2.1.2, these Chinese varieties should not be called "dialects". Therefore, although this paper agrees with the classification of the seven groups of Chinese varieties, it still has reservations about the use of the English academic term "dialect group".

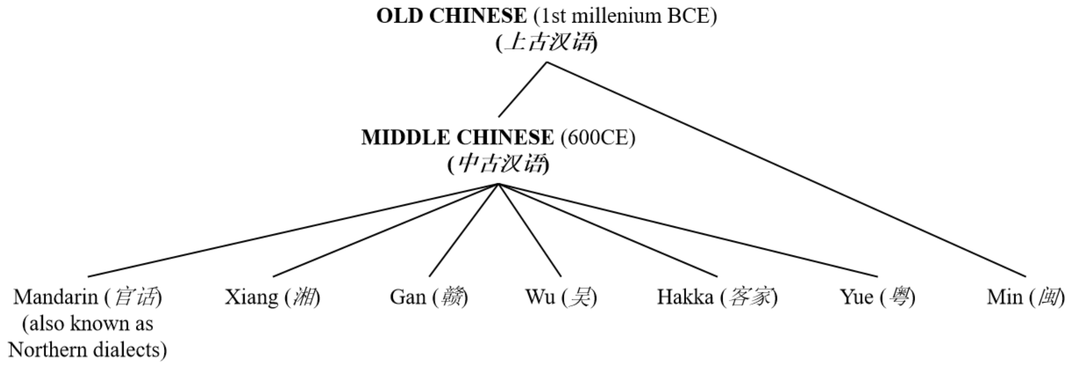

Figure 2.2: Seven dialect groups in the Sinitic group (Handel, 2015, p. 35)

2.2.2 Cantonese from the Yue

The Yue is one of the Chinese varieties. "Yue" (粤) is another name for "Guangdong" (广东), but "*Yue fangyan*" (粤方言) is an academic term and is not synonymous with "*fangyan* of Guangdong Province" (广东方言) (Yuan, 2001). This is because the Yue is not only used in Guangdong Province but is also widely spoken in Guangxi Province, Hong Kong, Macau, and overseas Chinese communities (Hou, 2002). In addition, Chinese varieties that are spoken in Guangdong Province include not only the Yue but also the Hakka (Yuan, 2001).

According to Yue (2015, p. 174), the term "Cantonese" (粤语) was "originally used to designate the language of Guangdong by foreigners", and now it has also been used as a "cover term" for the Yue as well as for any of its varieties. Thus, the term "Guangdong dialect" (广东话) basically refers to "Cantonese". Cantonese is considered the "prestige variety" of the Yue (Duanmu, 2007; Yue, 2015). It can be further divided into six subgroups (*fangyanpian 方言片*): *Guangfu* (广府片), *Siyi* (四邑片), *Xiangshan* (香山片), *Guanbao* (莞宝片), *Gaoyang* (高阳片), and *Guinan* (桂南片) (Hou, 2002). Generally speaking, *Guangfu* is considered a "standard accent" of Cantonese, as it is based on the dialect of Guangzhou city, the capital of Guangdong Province in China (Yuan, 2001).

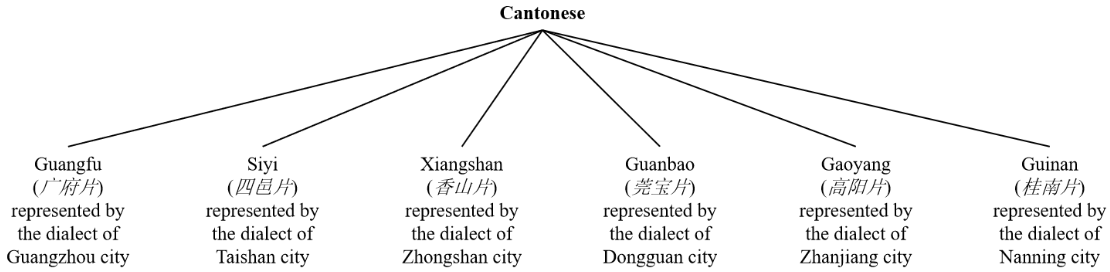

Figure 2.3: Cantonese subgroups and their representative dialects

Cantonese speakers are not only people in China; it has been transmitted all over the world. According to Hou (2002), the number of Cantonese speakers worldwide is estimated to be around 80 million, with Guangdong Province accounting for nearly 40 million, Guangxi Province for nearly 15 million, Hong Kong and Macau for about 7 million, and the overseas Chinese community for 15-20 million. Apart from China, Cantonese speakers are mainly found in North America and Southeast Asia (Bauer & Benedict, 1997; Yue, 2015), including Malaysia (Chen, 2003; Coluzzi, 2017). Chen (2003) pointed out that among the Cantonese speakers in Malaysia, regardless of which Cantonese subgroup their ancestors spoke, they have now shifted to the accent of the *Guangfu* subgroup. Therefore, "Malaysian Cantonese" generally refers to the Cantonese spoken in Malaysia with the accent of *Guangfu*.

2.3 Cantonese Phonology

All the Chinese varieties share the same written language (Lin, 2007). Cantonese is certainly no exception, and it is also written in Chinese characters. As mentioned previously, phonetic and phonological aspects are the main linguistic features used to classify the Chinese varieties. This is the reason why the phonetic and phonological aspects have always been a keen focus of research in Chinese variety studies. Below is an introduction to the structure of Cantonese syllables, followed by an introduction to the Cantonese phonological system in Malaysia.

2.3.1 Structure of Cantonese Syllables

Mandarin can be considered the standardised form of spoken Chinese. Therefore, it is easier to understand the syllable structure of Cantonese by starting with the syllable structure of Mandarin. In Chinese linguistic traditions, a Mandarin syllable consists of two segmental elements: initial and final, and a suprasegmental element: tone (Chao, 1967; Lin, 2007). Tone refers to the pitch pattern of a syllable, and it overrides the entire syllable. The initial is the onset of the syllable; it is usually a consonant (C). The final is the component that followed the initial. The rhyme consists of the nucleus and ending, and the medial is a glide (G) placed between the initial and nucleus. The nucleus is usually a vowel (V), and the ending can be a consonant or vowel.

Table 2.2: Mandarin syllable structure (Lin, 2007, p. 107)

Tone			
Initial	Final		
	Medial	Rhyme	
		Nucleus	Ending
C	G	V	C/V

As one of the Chinese varieties, the structure of Cantonese syllables is basically the same as that of Mandarin syllables. Table 2.3 shows the syllable structure of a Cantonese syllable. It is basically the same as the Mandarin syllable structure (as in Table 2.2), but one special feature of Cantonese syllables is that a syllabic consonant (C_{syl}) can be placed as the nucleus. Furthermore, there is no medial in Cantonese syllables. The ending in a Cantonese syllable, which is also known as the coda, can be a semivowel coda (C_{sv}), a nasal coda (C_{nas}), or a stop coda (C_{stop}). It is worth noting that the stop coda does not appear in the Mandarin syllables. Table 2.4 shows the types of Cantonese syllable structures that can be formed.

Table 2.3: Structure of a Cantonese syllable (Bauer & Benedict, 1997, p. 9)

<table>
<tr><td colspan="3">Tone</td></tr>
<tr><td rowspan="2">Initial</td><td colspan="2">Final</td></tr>
<tr><td>Nucleus</td><td>Coda</td></tr>
<tr><td>C</td><td>V/C_{syl}</td><td>$C_{sv}/C_{nas}/C_{stop}$</td></tr>
</table>

Table 2.4: Types of Cantonese syllable structures (Bauer & Benedict, 1997, p. 14)

Types of Cantonese syllable structure	Example words
V	[a˧] (亚 Asia)
C_{syl}	[ŋ˩˧] (五 five)
CV	[ŋa˨˩] (牙 tooth)
CVC_{sv}	[ŋɐi˩˧] (蚁 ant)
CVC_{nas}	[ŋan˩˧] (眼 eye)
CVC_{stop}	[ŋak˨] (额 forehead)
VC_{sv}	[ɔi˧] (爱 love)
VC_{nas}	[ɔn˧] (按 press)
VC_{stop}	[uk˥] (屋 house)

2.3.2 Cantonese Phonological System in Malaysia

The phonology of Cantonese is more complex than that of Mandarin, as can be seen in the number of initials, finals, and lexical tones. According to Yuan (2001), Cantonese (which refers to the *Guangfu* subgroup or Guangzhou Cantonese) has 20 initials, 53 finals, and 9 lexical tones. Chen (2003) recorded the phonological system of Kuala Lumpur Cantonese. Basically, the initials and finals in Kuala Lumpur Cantonese (see Appendices B1 and B2) had no significant differences with Guangzhou Cantonese. The slight differences are that the finals /ɪŋ/ and /ɪk/ in Guangzhou Cantonese have become /eŋ/ and /ek/ respectively in Kuala Lumpur Cantonese. In addition, Kuala Lumpur Cantonese has another six finals that only appear in loanwords, which are mainly used to transcribe the words borrowed from Malay and English.

Lin (2007, p. 88) mentioned that "tone is manifested by the pitch of the voice". Generally, tone can be divided into lexical tone and grammatical tone (Hyman, 2016). In a non-tonal language (e.g., English), the pattern of pitch changes over a phrase or sentence, which refers to the grammatical tone, conveying only syntactic and contextual information. But in a tonal language (e.g., Chinese), the pattern of pitch changes over a syllable, which refers to the lexical tone, has the function of conveying differences in lexical meanings (Lin, 2007). In the phonology of Middle Chinese, there are four categories of lexical tones: *Ping* (平), which refers to level; *Shang* (上), which refers to rising; *Qu* (去), which refers to departing; and *Ru* (入), which refers to entering. Each tone category can be divided into two registers: *Yin* (阴) refers to the high register, and *Yang* (阳) refers to the low register (Chen, 2000). Based on these classifications, eight tone types can be formed. In addition to these eight tone types (as shown in Table 2.5), based on the length of the vowel, *Yinru* (阴入) tones in Cantonese can be divided into *Shangyinru* (上阴入) and *Xiayinru* (下阴入). Short vowels will be classified as *Shangyinru*, and long vowels belong to *Xiayinru* (Hou, 2002). The nine lexical tones in Kuala Lumpur Cantonese (see Appendix B3) are basically the same as in Guangzhou Cantonese.

Table 2.5: Tone types in Middle Chinese

Tone categories	High register (*Yin*)	Low register (*Yang*)
Level (*Ping*)	*Yinping 阴平*	*Yangping 阳平*
Rising (*Shang*)	*Yinshang 阴上*	*Yangshang 阳上*
Departing (*Qu*)	*Yinqu 阴去*	*Yangqu 阳去*
Entering (*Ru*)	*Yinru 阴入*	*Yangru 阳入*

2.4 Linguistic Research on Cantonese

Language contact with other languages and language variation are key concerns for linguistic research on Cantonese. Multilingualism is prevalent in societies all over the world (Wardhaugh & Fuller, 2015, p. 82); therefore, contact between languages occurs naturally. It is generally believed that the result of language contact is "an inexorable decline in standards" (Meyerhoff, 2018, p. 267), which may also refer to the phenomenon of language variation.

As a regional language, Cantonese is learned orally and passed down from generation to generation. Thus, linguistic research on Cantonese has focused mainly on the fields of phonetics and phonology rather than lexicology, morphology, and syntax. In general, the language varieties that have more contact with Cantonese are other Chinese varieties, particularly Mandarin. But Cantonese shares a written language with Mandarin as well as all other Chinese varieties (Lin, 2007). Thus, the linguistic changes that would occur in terms of morphology and syntax are relatively unlikely. Research on Cantonese lexicology, morphology, and syntax is briefly introduced in this section, followed by phonetics and phonology research on Cantonese.

2.4.1 Research on Cantonese Lexicology, Morphology, and Syntax

Cantonese originated in the southern region of China (as explained in Section 2.2.1). Thus, research on Cantonese mainly focused on several places in China where Cantonese is widely spoken, such as Guangdong Province, Hong Kong, and Macau. Generally, research on Cantonese lexicology, morphology, and syntax in China mainly focuses on the comparison between Cantonese and Mandarin (Cai et al., 2011; Shi et al., 2002; Tsang & Stokes, 2001; Zhang, 1998). The comparison of similarities and differences is usable in teaching to help Cantonese native speakers learn Mandarin effectively.

As mentioned in Section 2.2.2, Cantonese is also transmitted all over the world, especially in Southeast Asia (Bauer & Benedict, 1997; Yue, 2015). However, there is currently a dearth of research on Chinese varieties in Southeast Asian countries. Chen

(2014) is the first publication to discuss Chinese varieties (including Min, Hakka, and Yue) in Chinese communities throughout Southeast Asia. Chen (2014, p. 10) pointed out that in China, Cantonese is the most influential Chinese variety besides Mandarin. This phenomenon has also spread to Chinese communities outside China; even some Americans generally believe that China has only two languages: Mandarin and Cantonese. In addition, in some Chinese communities in Southeast Asian countries, such as Ho Chi Minh City in Vietnam and Kuala Lumpur and Ipoh in Malaysia, Cantonese is regarded as the "community language".

There are fewer studies on Cantonese syntax in Malaysia. Similar to the situation in China, more attention is paid to the influence of Cantonese on Malaysian Mandarin. Ng (2013) pointed out that Cantonese has a greater influence on the grammar of spoken Mandarin in Malaysia compared to Hokkien. Hokkien (*福建话*) is a common term to refer to the variety of southern Min (*Minnan 闽南*) in Southeast Asia. The two main accents of Hokkien in Malaysia are Quanzhou (*泉州*) and Zhangzhou (*漳州*) (Chiew, 2019a).

On the other hand, Chen (2013) pointed out the importance of lexicology research in the study of overseas Chinese varieties. She pointed out that the most significant difference between Chinese varieties in China and overseas (namely outside China) is the creativity and compatibility of overseas Chinese varieties shown in lexicology. This is especially shown in the loan words. Wong (1999, p. 98) mentioned that Chinese varieties in Malaysia "sound different to foreign Chinese ears because of the presence of strange sounding Malay words". For instance, Cantonese in Kuala Lumpur has a large number of special words with unique Malaysian characteristics (Chen, 2003). They are all loan words borrowed from Mandarin, other Chinese varieties (especially Hokkien), English, and Malay. The production and creation of loan words may also bring some changes to the phonological system. Sin (2005) pointed out that, in addition to retaining many of its original features compared to Cantonese in Guangzhou, Cantonese in Kuala Lumpur has borrowed a considerable number of words from Malay after more than a century of interaction between the Chinese and the Malay peoples. As these loan words were borrowed into Cantonese, some unique phonemes were also added to the phonological system of Malaysian Cantonese. As mentioned in Section 2.3.2, there are six finals that only appear in loanwords in Kuala Lumpur Cantonese, which are not found in Guangzhou Cantonese.

Table 2.6: Examples of loan words in Cantonese in Kuala Lumpur (Chen, 2003)

Borrowed from other languages and varieties	**Guangzhou Cantonese**	**Kuala Lumpur Cantonese**
Borrowed from Mandarin: "*青蛙*" [tɕʿiŋ˥ wa˥] (which means "frog")	*田鸡* [tʿin˨˩ kɐi˥]	*青蛙* [tsʿeŋ˥ wa˥]
Borrowed from Hokkien: "*弓蕉*" [kiŋ˥ tsio˧] (which means "banana")	*香蕉* [hœŋ˥ tsiu˥]	*弓蕉* [kuŋ˥ tsiu˥]
Borrowed from English: "law" [lɒː]	*法律* [fat˧ lœt˨]	□ [lɔ˨˩] (There is no Chinese character to represent this pronunciation.)
Borrowed from Malay: "*mata-mata*" [mata mata] (which means "police")	*警察* [keŋ˧˥ tsʿat˧]	*马达* [ma˧ ta˧˥]

2.4.2 Research on Cantonese Phonetics and Phonology

The phonological feature, one of the main linguistic features for the classification of Chinese varieties, has been of great interest to linguists because of its more frequent linguistic changes. The phonetics and phonological studies of Chinese varieties have focused more on phonetic variation. This is because, as mentioned earlier, Chinese varieties are learned orally without a standard curriculum, so it is common for phonetic variation to occur in learning and language use.

The phonetic variations in Cantonese initials and finals are of interest to researchers in China. A few studies have suggested several types of phonetic variations that are commonly found in Cantonese in Macau and Hong Kong (Botha & Barnes, 2015; To et al., 2015). Table 2.7 shows a summary of phonemic variants found in previous studies. The phonemic variants of the nasal initial /ŋ/ and zero initial /Ø/ show a very interesting phenomenon: the replacement of the nasal initial /ŋ/ with a zero consonant /Ø/. This phonetic variation is considered a "lazy pronunciation" that is often found in the younger generation nowadays (Botha & Barnes, 2015; Cheung, 2002; To et al., 2015).

Table 2.7: The phonemic variants of Cantonese found in Macau and Hong Kong

Initials	Finals
/k^{w}-/, /k^{wh}-/ & /k-/	/-m/ & /-n/
/ts-/ &/tʃ-/	/-ŋ/ & /-n/
/n-/ & /l-/	/-p/ & /-t/
/ŋ-/ & /Ø-/	/-k/ & /-t/

There is also scarce research on Cantonese phonetics and phonology in Southeast Asia. Chen (2014) recorded the phonological system of Cantonese in Kuala Lumpur (the capital of Malaysia), Singapore, Jakarta (the capital of Indonesia), Manila (the capital of the Philippines), Ho Chi Minh City (a city in Vietnam), Phnom Penh (the capital of Cambodia), and Bangkok (the capital of Thailand). Their phonological systems are basically the same as Guangzhou Cantonese, but some phonemes are added and only used for the transcription of loan words.

In addition to the unique phonemes brought by loan words, Cantonese phonetics and phonology studies in Malaysia have focused more on the variation of lexical tones. Several studies have discovered the phonetic variation of Cantonese lexical tones in Malaysia. They found that the *Yangshang* (*阳上*) tone has been merged with the *Yinqu* (*阴去*) tone in Seremban, Kuala Lumpur, and Ipoh (Chan, 2021; Shao & Sin, 2004; Weng, 2014). The *Yangshang* tone was originally a rising tone with a pitch value of 13 but has now become a mid-level tone with a pitch value of 33. Meanwhile, the *Yinqu* tone is also a mid-level tone with a pitch value of 33. Hence, it can be said that these two lexical tones have merged, and there are now only eight types of lexical tones in Cantonese in Malaysia.

2.5 Cantonese Zero Initial /Ø/ and Nasal Initial /ŋ/

The phonetic variation of the nasal initial /ŋ/ and zero initial /Ø/, as previously mentioned, exhibits a phenomenon where the nasal initial /ŋ/ is frequently replaced by a zero consonant /Ø/. In order to understand these two research variables of this study, an introduction to Cantonese zero initial /Ø/ and nasal initial /ŋ/ is provided in this section. By reviewing the relationship between these two Cantonese initials, including their evolution from Middle Chinese phonology and their acoustic features, the possibility of their mixing is observed. The previously published studies on the phonetic variation of these two initials are also reviewed.

2.5.1 Evolution of Cantonese Zero Initial /Ø/ and Nasal Initial /ŋ/

As stated in Section 2.2.1, Middle Chinese is an important period in the development of the Sinitic group (Handel, 2015). In order to comprehend the phonological history of Cantonese zero initial /Ø/ and nasal initial /ŋ/, there is a need to understand their evolution from Middle Chinese phonology to Modern Cantonese. According to Chen (2014) and Yuan (2001), Cantonese zero initial /Ø/ and nasal initial /ŋ/ are mainly derived from the initials *Ying* (影) and *Yi* (疑) in Middle Chinese phonology. The evolutions of the initials *Ying* and *Yi* from Middle Chinese to Modern Cantonese are shown in Figures 2.4 and 2.5 respectively. The evolution of these two initials from Middle Chinese to Modern Cantonese shows that the relationship between them is inseparable. In particular, the initial *Yi* in Middle Chinese was a nasal consonant /ŋ/.

However, in modern Cantonese, in addition to retaining the nasal consonant /ŋ/, it has also partly diverged into the zero consonant.

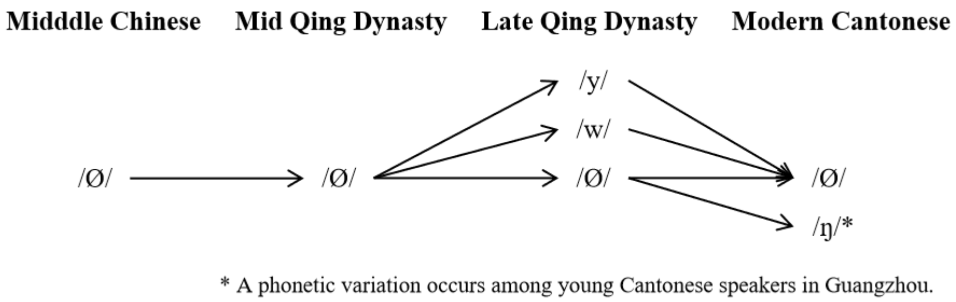

Figure 2.4: The evolution of the initial *Ying* (影) from Middle Chinese to Modern Cantonese (Wu, 2012, p. 82–83)

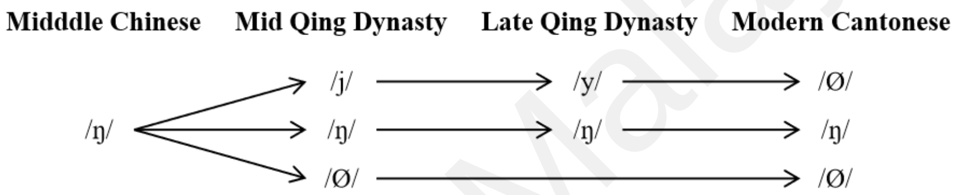

Figure 2.5: The evolution of the initial *Yi* (疑) from Middle Chinese to Modern Cantonese (Wu, 2012, p. 82)

The "Pronouncing Dictionary of Guangzhou Dialect" edited by Zhan (2002), is a pronunciation dictionary based on the Cantonese in Guangzhou, which also refers to the *Guangfu* subgroup. As stated earlier, Malaysian Cantonese now largely follows the accent of the *Guangfu* subgroup (Chen, 2003). Thus, this Cantonese pronunciation dictionary is suitable as a reference for examining the Cantonese zero initial /Ø/ and nasal initial /ŋ/ in Malaysia. All the zero initial /Ø/ and nasal initial /ŋ/ syllables in the dictionary edited by Zhan (2002) were tested on the Rhyme Dictionary Website (n.d.). The Rhyme Dictionary Website (n.d.) is a search tool for Chinese phonology; it can be used to find out which initial, final, and lexical tones a Chinese character belongs to in Middle Chinese phonology. It can be concluded that the zero initial /Ø/ syllables that are more commonly used in modern Cantonese evolved from the initial *Ying* in Middle Chinese, while the Cantonese nasal initial /ŋ/ syllables were evolved from the initial *Yi* in Middle Chinese. This suggests that, from the perspective of Middle Chinese phonology, the distribution of the common-use words with these two initials is even, so that Middle Chinese phonology does not seem to have an effect on their phonetic variation.

As previously mentioned, these two initials are phonemic variants, which means that they belong to a phoneme. Crystal (2008, p. 361) stated that "phones are the physical realisation of phonemes; phonic varieties of a phoneme are referred to as allophones". Sounds are regarded as belonging to the same phoneme if they are phonetically similar. Basically, allophones can be in complementary distribution or free variation. Complementary distribution refers to "the mutual exclusiveness of a pair of sounds in a certain phonetic environment" (Crystal, 2008, p. 93); the allophones in complementary distribution never appear in the same phonetic environment. If the allophones can occur in the same phonetic environment and do not cause a change in meaning, then they are in free variation (Crystal, 2008, p. 198).

According to Yuan (2001), the Cantonese zero initial /Ø/ and nasal initial /ŋ/ are allophones in complementary distribution. Cantonese zero initial /Ø/ occurs initially in words with *Yin* tones (high register tones) (i.e., T1, T2, T3, T7, and T8), while Cantonese nasal initial /ŋ/ occurs initially in words with *Yang* tones (low register tones) (i.e., T4, T5, T6, and T9). However, it is worth noting that several studies have found that the *Yangshang* tone has merged with the *Yinqu* tone in Cantonese in Seremban, Kuala Lumpur, and Ipoh (Chan, 2021; Shao & Sin, 2004; Weng, 2014). This could mean that there are some *Yang* tones merged with *Yin* tones. The variation of tones may have an effect on the variation of initials. If syllables with *Yang* tones have changed to *Yin* tones, then it is also possible that their initials may change from nasal initial /ŋ/ to zero initial /Ø/.

2.5.2 Acoustic Features of Zero Initial /Ø/ and Nasal Initial /ŋ/

As a rule, a zero initial syllable refers to a syllable that is only formed by the final. Its initial slot remains empty, which means the structure of a zero initial syllable will be either “V” or “VC”. The zero initial can be transcribed as /Ø/ (Duanmu, 2007), but it will not be marked in most cases.

Some researchers, however, claim that the zero initial can sometimes be filled with a unique variation of the initial sound. Lin (2007) proposed that, depending on the following vowel, the zero initial can be pronounced with a glide or a consonant. As stated in Table 2.8, if the following vowel is a high vowel, the initial slot for a zero initial syllable might be filled with the corresponding glide (which is also called an approximant); if the following vowel is a low or mid vowel, the initial slot for a zero initial syllable might be filled with a velar nasal /ŋ/ or a glottal stop /ʔ/.

Table 2.8: Variants of zero initial (Lin, 2007, p. 114)

The following vowel		Variant types of zero initial
High vowel	/i/	Voiced palatal approximant /j/
	/y/	Voiced labial-palatal approximant /ɥ/
	/u/	Voiced labial-velar approximant /w/
Low or mid vowel	/a/	Voiced velar nasal /ŋ/ or glottal stop /ʔ/ (depending on different Chinese varieties).

A nasal initial /ŋ/ syllable refers to a syllable where the nasal consonant /ŋ/ occurs initially, and its structure is “ŋ+V” or “ŋ+VC”. Nasal consonant /ŋ/ is a voiced velar nasal (Ladefoged, 2003). According to Small (2020), nasal consonant refers to the sound produced when two parts of the mouth become obstructed and the velum is lowered. With the lowered velum, the airstream in the oral cavity is completely obstructed, and it can only flow into the nasal cavity and out through the nostrils. All nasal consonants are voiced because, like vowels, they are produced by the vibrating of the vocal folds. The nasal consonant /ŋ/ is articulated with the back of the tongue against the velum.

The performance of nasals on a spectrogram has formants similar to those of vowels, but the formants of nasals are fainter than those of vowels. This is because the amplitude of nasals is lower than that of vowels. Moreover, the nasals have an antiformant that the vowel does not have. Antiformant, also known as antiresonance, is produced at multiple frequencies by the vocal tract's destructive interaction between acoustical reflections from the nasal and oral cavities (Rakerd et al., 2019). Antiformant occurs within non-overlapping frequency ranges (Fujimura, 1962); its performance on a spectrogram is the area of absence of energy.

According to Small (2020), frequency, intensity, and time are three key physical parameters to describe the acoustic features of any speech sound. Formants are the resonant frequencies of the vocal tract (Small, 2020, p. 173); they are the frequencies of sound. It is determined by the length of the vocal tract (Johnson, 2012, p. 45). People with a long vocal tract have lower formants than those with a short vocal tract. The performance of formants is indicated by the dark horizontal bars on a spectrogram. The first three formants of the nasal consonants are named N1, N2, and N3, where N1 indicates the formant with the lowest frequency, and so on. The formant frequencies are usually measured in hertz (Hz). The place of articulation can be identified by investigating the formant frequency (Ladefoged, 2003). Theoretically, all nasals have a low N1 (the first nasal formant), which is around 250 Hz (Ladefoged & Johnson, 2015). Huang (2017) examined the acoustic features of nasals in Guangzhou Cantonese. Table 2.9 shows the nasal formant frequencies of the nasal initial /ŋ/ recorded in Huang's study (2017).

Table 2.9: Nasal formant frequencies of the nasal initial /ŋ/ in Guangzhou Cantonese (by vowel type) (Huang, 2017, p. 8)

Vowel type	Nasal formant frequencies (Hz)		
	N1	N2	N3
/ŋ-a/	430	1650	2560
/ŋ-ɐ/	420	1600	2576
/ŋ-ɔ/	400	1500	2450
/ŋ-o/	410	1700	3000
Average	**357**	**1584**	**2800**

Intensity is also a common parameter used to describe the acoustic features of nasal consonants. Intensity refers to the amplitude of energy (Small, 2020, p. 170); it shows the energy of sound. The more the air molecules move, the more energy is expended and the greater the intensity generated. Loudness is a perceptual correlate of intensity. There is a direct relationship between them: if the intensity of a sound increases, the loudness will also increase. Intensity is indicated by gradients in shading on a spectrogram. For example, the spectrogram performance of sounds with greater intensity is darker than that of sounds with lesser intensity. The intensity is usually measured in decibels (dB).

Besides frequency and intensity, time is also a key physical parameter in describing the acoustic features of nasal consonants. Nasal duration is used to describe the time-acoustic features of the nasal consonant. Nasal duration refers to the length of a nasal consonant, which means the time it took the speaker to produce the nasal consonants. In general, the nasal duration is measured in milliseconds (ms). In Guangzhou Cantonese, the nasal duration of the nasal initial /ŋ/ when the syllables end with a vowel is mostly around 65–120 ms, while it will be significantly shorter, at around 50–90 ms, when the syllables end with a stop coda (e.g., /-p/, /-t/, or /-k/) (Huang, 2017, p. 12). This indicates a tendency for the nasal duration of the nasal initial /ŋ/ to be shorter before stop finals.

According to the Cantonese pronunciation dictionary edited by Zhan (2002), the following phonetic environments of Cantonese zero initial /Ø/ and nasal initial /ŋ/ are similar. They mainly appear before the unrounded low front vowel /a/, near-low central vowel /ɐ/, and rounded low-mid back vowel /ɔ/, with a small portion preceding the rounded high-mid back vowel /o/ and rounded high back vowel /u/. The vowel /o/ only occurs in compound finals /ou/ (see Appendix B2). In addition, there are only a few nasal initial /ŋ/ syllables followed by the vowel /u/, and they are polyphonic and can be pronounced either nasal initial /ŋ/ or zero initial /Ø/. This could mean that in Cantonese, the zero initial /Ø/ and nasal initial /ŋ/ would more often occur before low or mid vowels. As mentioned in Table 2.8, the zero initial before a low or mid vowel might be pronounced with a velar nasal /ŋ/ or a glottal stop /ʔ/. This may offer the possibility for the zero initial to be mixed up with the nasal initial /ŋ/.

2.5.3 Phonetic Variation Studies on Cantonese Zero Initial /Ø/ and Nasal Initial /ŋ/

The previous section provided possible reasons for the mixing of Cantonese zero initial /Ø/ and nasal initial /ŋ/. A review of the existing literature on the phonetic variation study of these two initials is provided in this section. A number of studies have found the phonetic variation of Cantonese zero initial /Ø/ and nasal initial /ŋ/. They found that sometimes zero initial /Ø/ syllables will be pronounced with a nasal consonant /ŋ/, whereas sometimes nasal initial /ŋ/ syllables will be pronounced as a zero consonant /Ø/ syllable. Hou (2002; p. 176) and Yuan (2001; p. 181) pointed out the mixing of these two initials in Guangzhou Cantonese. Botha and Barnes (2015), Peng and Liang (2008), and To et al. (2015) further claimed that the zero initial /Ø/ gradually became the dominant of these two initials in Macau, Guangzhou, and Hong Kong. The replacement of the nasal initial /ŋ/ with a zero consonant /Ø/ is a process of omitting the initial and is usually considered a type of "lazy pronunciation" that often occurs among the younger generation. Liu (2019) claimed that the national language of China, Mandarin, has an impact on the "lazy pronunciation", as zero initials can occur initially in Mandarin syllables but nasal initials /ŋ/ do not.

However, Chen (2014) mentioned that this "lazy pronunciation" does not seem to occur in Cantonese among the Chinese communities in Southeast Asia. It is worth noting that Southeast Asia has a very different language environment from that of China. The previously published research mainly focused on Cantonese in China, including Guangzhou, Hong Kong, Macau, and Shenzhen. But Cantonese speakers are not only found in China; they are also found in overseas Chinese communities. Overseas Cantonese speakers could be an interesting research topic. As mentioned earlier, Malaysia is one of the Southeast Asian countries where Cantonese is widely spoken. Malaysia is a country well-known for its multilingualism and complex language environment. Therefore, how these two Cantonese initials will develop in this complex language environment is worth studying.

In the phonological system of Kuala Lumpur Cantonese recorded by Chen (2003), some zero initial /Ø/ syllables have been classified under the nasal initial /ŋ/. This suggests that the phonetic variation of these two initials occurs not only in China but also in Malaysia. It also suggests that the situation of these two initials in Malaysia may be the opposite of that in China. But sadly, Chen's study (2003) was conducted without the use of acoustic instruments and was only based on her own auditory perception. The lack of acoustic evidence prevented Chen (2003) from further exploring this issue in Malaysia.

Liu (2019) and Peng and Liang (2008) provided some ideas regarding the factors affecting the phonetic variation of Cantonese zero initial /Ø/ and nasal initial /ŋ/. In terms of linguistic factors, Liu (2019) argued that syllable order has a constraining effect on the phonetic variation of these two initials in Shenzhen Cantonese. The replacement of the nasal initial /ŋ/ with a zero consonant /Ø/ occurs more often when it is in the first syllable position, whereas the replacement of the zero initial /Ø/ with a nasal consonant /ŋ/ occurs more often when it is in the last syllable position. In terms of non-linguistic factors, Liu (2019) and Peng and Liang (2008) suggested that age has the strongest constraining effect on the phonetic variation of these two Cantonese initials. In Peng and Liang's (2008) study, the adolescents in Guangzhou with age stages 8–12, 13–19, and 20–25 mixed up these two initials more frequently. Meanwhile, Liu (2019) pointed out that the phonetic variation of these two initials occurs more often among young people aged 20–30 years. The younger generation is the more favourable factor for confusing and mixing up these two initials. This is in line with linguistic theory. Generally, the younger generation is susceptible to novelty and more likely to experience linguistic variation (Kendall & Fridland, 2021; Xu, 2006). In light of this, this study tends to focus on the younger generation, who are more prone to phonetic variation. On the other hand, Liu (2019), Peng and Liang (2008), and To et al. (2015) claimed that there is no significant difference between males and females. It can be argued that gender has no significant constraint on the phonetic variation of the Cantonese zero initial /Ø/ and nasal initial /ŋ/.

2.6 Other Related Studies

Other studies related to this study are explained in this section. The sociolinguistic approaches in language variation studies are explained, and the nasal initial /ŋ/ in other languages in Malaysia is also elaborated. A brief introduction to the perception studies on nasal consonants is also provided.

2.6.1 Sociolinguistic Approaches in Language Variation Studies

Linguistic research on language variation has been predominantly studied from the perspective of sociolinguistics and is known as the field of variationist sociolinguistics (Jannedy & Hay, 2006). Language variation refers to the phenomenon that language users differ from conventional languages when they express or use written language due to the influence of different communicative contexts or because of the need to adapt to the context (Labov, 1994). Thus, phonetic variation refers to the differences in phonetics or accents that people show in the process of oral communication.

Chambers (2013, p. 3) claimed that "dialectology is sometimes viewed as a precursor of sociolinguistics". In the broadest sense, dialectology and sociolinguistics are studies of language variation. Phonetic variation, as one of the language variations, has rarely been studied using the acoustic phonetic method in the past. For instance, most of the previous Cantonese phonetic studies in Malaysia have used the traditional method to record speech sounds without the aid of any tools and only by the researcher's auditory perception.

With the advancement of technology, the study of phonetic variations should not only be analysed from the perspective of sociolinguistics, but it is also important to return the focus of the study to the language itself. With the rise of acoustic phonetics, Labov et al. (1972) introduced acoustic analysis into phonetic variation studies in order to make the phonetic descriptions more scientific and quantitative. In view of this, the study of phonetic variation in Chinese varieties should not only consider the sociolinguistic aspect but also take the phonetic aspect into account. The interdisciplinarity between phonetic studies and sociolinguistic studies should be considered in order to break through the previous research mode and get more accurate and comprehensive findings. Dialectology and sociolinguistic issues can be answered by phonetic methods; phonetic studies should also take into account the methods and results of previous variety studies in order to get a more comprehensive understanding of the linguistic problem.

Generally, linguistic changes are classified as either internally or externally motivated (Thomas, 2011). Saussure (1959) introduced the concept of "structuralism" in linguistics. He suggested that the phonetic changes in language have absolute regularity and pointed out the critical role of internal linguistic factors. He proposed that the condition for the phonetic variation phenomenon is either spontaneous or combinatory. The phonetic change is spontaneous when its cause is the phoneme itself, and it is combinatory when the change is caused by the presence of other phonemes. The principle proposed by Labov (1963), however, opposed Saussure's principle. Labov (1963) emphasised the effects of social factors (e.g., age and gender) on linguistic changes. Labov (1994; 2001) suggested the separation of linguistic factors and social factors and believed that social factors are interrelated, linguistic factors are effectively independent, and linguistic and social factors are also independent of each other. Therefore, these two factors should be examined as separate factors.

Linguistic factors are also known as internal factors, while social factors refer to non-linguistic factors. In this study, the terms "linguistic factors" and "non-linguistic factors" were used to avoid confusion. As stated above, previous research shed light on the effect of non-linguistic factors on the phonetic variation of these two Cantonese initials but neglected linguistic factors. However, both linguistic and non-linguistic factors may have a constraining impact. The analysis of phonetic changes should take account of both linguistic and non-linguistic factors to further the understanding of their impact on the linguistic phenomenon.

2.6.2 Nasal Initial /ŋ/ in Other Languages in Malaysia

Language contact influences language change, which certainly includes phonetic changes. It is possible that different language environments may cause the same variable to be rendered differently. Liu (2019) claimed that the national language of China—Mandarin—has an impact on “lazy pronunciation”, which refers to the replacement of the nasal initial /ŋ/ with the zero consonant. This is because the zero consonant can occur initially in Mandarin syllables but the nasal initial /ŋ/ does not (Chao, 1967; Shao, 2007) (see Appendix B4).

However, Chen (2014) mentioned that this “lazy pronunciation” found in Cantonese in China does not seem to occur in Cantonese among the Chinese communities in Southeast Asia. It is known to everyone that Southeast Asia has a complicated language environment. Malaysia, as one of the countries in Southeast Asia, is well known for its multilingualism. There are many different languages in Malaysia, which also provides the possibility for languages to influence each other.

It is worth noting that the nasal consonant /ŋ/ is also an initial in the phonological system of other Chinese community languages that are widely spoken in Malaysia, such as Hokkien (Chiew, 2019b), Hakka, and Teochew (Chen, 2003) (see Appendices B5, B6, and B7). For example, the syllable “*硬*” [**ŋ**ĩ] (which means “hard”) in Hokkien, the syllable “*热*” [**ŋ**et˥] (which means “hot”) in Hakka, and the syllable “*猫*” [**ŋ**iau˧] (which means “cat”) in Teochew.

Apart from that, the nasal consonant /ŋ/ can also be used initially in standard Malay (Clynes & Deterding, 2011) (see Appendix B8). Clynes and Deterding (2011) mentioned that the consonants of standard Malay in Peninsular Malaysia, Brunei, and Indonesia are basically the same. For example, the nasal consonant /ŋ/ occurs initially in the Malay word “*ngeri*” [**ŋ**əri], which means “horror”. Phoon et al. (2013) mentioned that “it is possible that Malay acts as a filter in the transfer of phonological features from ethnic languages”. As the national language of Malaysia, Malay is a language that every citizen must learn. Therefore, it might be more likely to have an impact on language variation. The difference in language environment may be the reason why the deletion of the nasal initial /ŋ/ in China’s Cantonese does not occur in Malaysian Cantonese.

2.6.3 Perception Studies on Nasal Consonants

Phonetics can be generally divided into speech production and speech perception (Thomas, 2011). Speech production has always been the focus of phonetic research. Although speech perception has received attention in phonetic research in recent years, Thomas (2000) pointed out that speech perception has not received attention in language variation research. Despite the increase in the number of studies on speech perception, they are still significantly fewer than those on speech production.

Regarding the relationship between production and perception, Janson (1983, p. 31) put forward a statement: “Perception seems to lag behind production”. His study examined the relationship between production and perception in the vowel /a:/ in the Stockholm dialect of Swedish. He found that the phonetic changes in the perception of the younger generation were relatively less significant compared to their production. According to his interpretation of this phenomenon, younger generations may produce words in different ways than older generations, but they still need to be able to understand older speakers. As a result, perception should move more slowly than production in phonetic variation. Ziliak’s study (2012) also agreed with this statement and pointed out that production may be more susceptible to change compared to perception.

Previously published research on the phonetic variation of Cantonese zero initial /Ø/ and nasal initial /ŋ/ only focused on speech production but neglected speech perception. It is also vital to consider the point of view of the non-expert, which is a main concern of perceptual dialectology (Preston, 2018). The lack of this aspect is exactly what needs to be filled by relevant research. Thus, speech perception should also be included in the phonetic variation studies in order to gain a more comprehensive understanding of the phonetic issue.

Throughout the research on the perception of nasal consonants in the Sinitic group, the focus is usually on the coda position. The mispronunciation of the nasal codas /n/ and /ŋ/ has always been a topic of academic concern. Chen and Guion-Anderson (2011), Chen et al. (2022), Rochet and Fei (1992), and Wang (2002) believed that the preceding vowels had a certain impact on the perceptual judgement of the nasal codas. This indicates that the perception of the nasal may be influenced to some extent by the phonetic environment, especially the vowel surrounding it. The above studies adopted the identification task, a tool that is commonly used to investigate whether the participants could categorise the stimuli. The data analysis for the identification task was all based on accuracy analysis. However, in the study of phonetic variation, the issue is not about "accuracy", but about whether the listeners perceive two variables to be the same and whether this does not cause a change in meaning. Thus, the discrimination task, a tool that "requires participants to try to tell stimuli apart" (Thomas, 2011, p. 68), is more suitable to adopt in phonetic variation research. Fung and Lee (2019), Law et al. (2013), Mok et al. (2013), and Zhang et al. (2021) adopted the discrimination task to investigate the perception of the merger of Cantonese tones. Cheng et al. (2023) also used this method to investigate the perception of consonants [l] and [n] in Fuzhou Min. These studies show that the discrimination task is suitable for investigating the perception of phonemic mergers in Chinese varieties.

2.7 Summary

In summary, the previously published research on the phonetic variation of Cantonese zero initial /Ø/ and nasal initial /ŋ/ mainly focused on Cantonese in China, including Guangzhou, Hong Kong, Macau, and Shenzhen. The nasal initial /ŋ/ is found to be frequently replaced by a zero consonant. However, based on Chen's (2014) view, the situation of these two Cantonese initials in Southeast Asian countries might be different. Cantonese is widely spoken and enjoys prestige in the Chinese community in Malaysia. Thus, Malaysia is a country that is suitable for exploring this phonetic issue.

Furthermore, the existing studies shed light on the effect of non-linguistic factors on the phonetic variation of these two Cantonese initials but neglected linguistic factors. Phonetic variation research should not only be investigated from a sociolinguistic or phonetic perspective. A phonetic issue should be examined using the acoustic method to visualise the phonetic phenomenon, but it should also include the social aspect to investigate the issue in order to gain a more comprehensive view. Both linguistic and non-linguistic factors should be included to investigate their effects on phonetic variation. Moreover, the previously published studies on this phonetic issue mainly focused on speech production but neglected speech perception. Both speech production and perception are important in phonetic research. Research on phonetic variation should also include speech perception to obtain the personal experience and insight of language users.

CHAPTER 3

RESEARCH METHODOLOGY

The previous chapter presented a review of the existing literature. This chapter provides a detailed explanation of the design of this research. The research design of this study is explained, and the demographics of participants and the materials used are also presented in detail. The data collection and analysis for both Stage 1, the production task, and Stage 2, the perception task, are explained.

3.1 Research Design

Ladefoged (2003, p. vii) pointed out that "if you want to describe how people talk, you have to record some data and then analyse it". Thus, in order to achieve the research objectives (refer to Section 1.5) and answer the research questions (refer to Section 1.6), which aim to describe the sound patterns of Cantonese zero and nasal initials, a phonetic study was conducted. Both speech production and speech perception were included in this study to examine the development of Cantonese zero initial /Ø/ and nasal initial /ŋ/ in the central region of Malaysia.

In terms of production, the acoustic features of these two initials are analysed. Auditory discrimination has a role in determining phonetic variation. This is particularly true for Chinese community languages, which are learned orally without a standard curriculum. Therefore, in terms of perception, the discrimination task, a common tool for testing phonemic mergers in socio-perceptual experiments (Thomas, 2011), is adopted.

In addition, as mentioned in Section 2.6.1, the study of phonetic variation should not only focus on the aspect of phonetics, with the aspect of sociolinguistics also having a certain influence. In order to obtain more comprehensive research findings, the analysis method used in sociolinguistics studies should also be considered. The variable rule analysis (Labov, 1969) is a quantitative analysis method in sociolinguistic studies. It is used to examine the ordering of constraints (linguistic and non-linguistic factors) on the production and perception of these two initials in this study. The predictive linguistic factors in this study are lexical tone, vowel type, final type, and syllable order, and the predictive non-linguistic factors are gender, region, social role, and home language.

Table 3.1: Predictive factors in this study

Type of factors	Factor group	Factors
Linguistic factors	Lexical tone	T1; T2; T3; T4; T5; T6; T7; T8; T9
	Vowel type	/a/; /ɐ/; /ɔ/; /o/; /u/
	Final type	Simple final; Compound final; Nasal final; Stop final
	Syllable order	First syllable; Last syllable
Non-linguistic factors	Gender	Male; Female
	Region	Klang Valley; Negeri Sembilan
	Social role	Student; Worker
	Home language	Speak Cantonese to all family members at home; Only speak Cantonese to specific family members; Do not speak Cantonese at home, but speak it outside of home.

3.2 Participants

This study consists of two stages: Stage 1 is a production task, and Stage 2 is a perception task. Snowball sampling, one of the most commonly used non-probability sampling methods, was used to find the participants in this study. According to Ranjit Kumar (2011), a non-probability sampling method refers to a sampling design that does not follow the probability theory when selecting individuals from the population. It can be used in situations where the number of individuals in a population is unknown or cannot be determined. The latest official population data from the Department of

Statistics Malaysia (2022) only includes the population of each ethnic group and does not indicate the proportion of each dialect group. Due to the fact that the population of each dialect group cannot be accurately determined, the snowball sampling method is often used in research on Chinese community languages.

Moreover, non-probability sampling is commonly used for selecting a predetermined sample size. Based on the inclusion criteria listed in Section 3.2.1, potential participants from the researcher's social network were approached by posting a poster on the Facebook application (see Appendices C1 and C2). The participants were selected based on the order in which they filled out the form. In the beginning, a few individuals from the population (i.e., Cantonese speakers from the central region) were selected. After collecting data from them, the participants were asked to refer other people who met the inclusion criteria to be part of the sample. This process was repeated until the required number was reached.

3.2.1 Inclusion Criteria for Participants in the Present Study

Below are the inclusion criteria for participants in the present study:

1. Cantonese speakers from the central region of Malaysia (i.e., Selangor, Kuala Lumpur, and Negeri Sembilan);
2. the third generation and onward of Malaysian Chinese (at least one of their parents was born in Malaysia);
3. aged between 20 and 31 years.

(a) Region

As previously mentioned, most of the Cantonese ancestors worked in tin mines and thus settled primarily in tin-rich states such as Selangor (particularly in Kuala Lumpur), Negeri Sembilan (particularly in Seremban), and Perak (particularly in Ipoh and Taiping) (Chui, 1998). These states are all the Federated Malay States (*Negeri-negeri Melayu*

Bersekutu), a federation in the Malay Peninsula that was formed by the British government in 1896. This federation was formed to meet British interests to overcome the weaknesses of the residential system, unify administration, guarantee security, and address financial problems in Pahang (Azharudin Mohamed Dali et al., 2018). Hence, nowadays, most Cantonese descendants have settled in Kuala Lumpur, Perak, Pahang, Negeri Sembilan, and Selangor (Voon, 2007).

In terms of regional location, Perak belongs to the northern region; Pahang belongs to the east coast region; Kuala Lumpur, Selangor, and Negeri Sembilan belong to the central region (refer to Table 1.1 in Section 1.1.1). Kuala Lumpur was formerly part of Selangor (Azharudin Mohamed Dali et al., 2018; Mak, 1985). Geographically, Kuala Lumpur is surrounded by Selangor. Kuala Lumpur and the adjoining cities and towns in Selangor (e.g., Gombak, Klang, Petaling Jaya, Shah Alam, and Subang Jaya) are also known as the Klang Valley (Katiman Rostam, 2006). Thus, in this study, Cantonese speakers from Selangor and Kuala Lumpur are considered to be in the same region based on historical and geographical factors and be classified as “Klang Valley”.

Negeri Sembilan is located at the border of the central and southern regions. It is sometimes included in the central region and sometimes in the southern region. In this study, Negeri Sembilan is included in the central region of Malaysia for two reasons. First, regarding the historical factors: Lukut, once part of Selangor and later subsumed into Negeri Sembilan, was the first tin mining town that had a large number of Chinese miners (Azharudin Mohamed Dali et al., 2018; Yen, 1998). As stated earlier, Cantonese ancestors mainly worked in tin mines in the early days. This reflects that there was intercourse between Cantonese people from Selangor and Negeri Sembilan. Second, based on geographical factors, Seremban, the capital of Negeri Sembilan, is located near the Klang Valley, around 80 km away. Therefore, Cantonese speakers from Kuala Lumpur, Selangor, and Negeri Sembilan were included in this study. They were divided into two groups: Klang Valley (i.e., Kuala Lumpur and Selangor) and Negeri Sembilan, in order to investigate the constraints of the region on the occurrence of phonetic changes in Cantonese zero initial /Ø/ and nasal initial /ŋ/.

(b) Age

From the literature reviewed in Section 2.5.3, age is closely correlated with the phonetic variation of the Cantonese zero initial /Ø/ and nasal initial /ŋ/. It mainly occurs among the younger generation. Thus, this study focuses on the younger generation, which is more prone to phonetic changes. Chen (2003) recorded Kuala Lumpur Cantonese among the second and third generations of Malaysian Chinese. In order to investigate the development of the Cantonese zero initial /Ø/ and nasal initial /ŋ/ in the central region of Malaysia, this study only focuses on the production and perception of these two initials by the third generation and onwards of Malaysian Chinese who speak Cantonese. The inclusion criteria of "at least one of their parents was born in Malaysia" was to ensure that participants were at least third-generation Malaysian Chinese.

In order to minimise the age variability, only those aged between 20 and 31 years old were included in this study. This generation (born between 1991 and 2002) has a similar educational background, which is under the National Development Policy, and is also the generation that has been deeply influenced by the "Speak Mandarin Campaign". As mentioned in Section 2.5.3, Mandarin was argued to have an influence on the variation of these two Cantonese initials, which may affect the replacement of the nasal initial /ŋ/ by a zero consonant /Ø/. The younger generation, who was influenced by the "Speak Mandarin Campaign", has a higher usage of Mandarin than the older generation. Thus, the phonetic variation of these two Cantonese initials may occur more often in this young generation.

(c) Gender

Most linguists argue that females use the standard language more frequently than males (Holmes & Wilson, 2017; Meyerhoff, 2018). There are also certain differences between the voices of males and females. Both males and females were included in this study to gain more insight into the constraints of gender on the occurrence of phonetic changes in Cantonese zero initial /Ø/ and nasal initial /ŋ/. Nonetheless, the number balance of males and females was not considered in this study because, as pointed out in Section 2.5.3, gender has no significant constraint on the phonetic variation of the Cantonese zero initial /Ø/ and nasal initial /ŋ/.

(d) Social Role

The present study only focuses on the younger generation. The age range of participants was between 20 and 31 years old, and the interval was only approximately 11 years. Due to the fact that the age range is not large, the division into social classes is not considered. However, this age group is in the transition period when students turn into workers. According to Ong and Ben Said's (2021) research on Penang's Chinese community, Chinese community languages are used a little more frequently in the work domain compared to the education domain. The frequency of language use has the potential to influence the occurrence of phonetic changes. Therefore, in order to investigate whether the work environment may have an effect on causing Cantonese speakers more susceptible to phonetic changes, the social role of the participants is considered one of the predictive non-linguistic factors in this study. The participants were divided into two groups: students and workers.

(e) Home Language

Past studies have found changes in language choice in the home domain among the younger generation of Malaysian Chinese nowadays. The use of Chinese community languages is gradually declining and has also been gradually replaced by Mandarin. As a result, Mandarin became the dominant language in most Malaysian Chinese families. However as mentioned in Section 1.2, one of the EGIDS scores of Malaysian Cantonese is the level of “vigorous” (Coluzzi, 2017). Some families still actively retain the use of Cantonese at home, either by using it with all family members or only for communication with specific family members due to their mixed parentage. For instance, some participants only speak Cantonese with either their mother or father, as their parents are from different Chinese dialect groups. In addition, some participants only speak Cantonese with their grandparents. Although parents are generally regarded as having a dominant position in the choice and use of home language, some studies have pointed out that grandparents also have a crucial influence on their grandchildren’s language use (Xie et al., 2022), and they are also regarded as one of the primary “teachers” of heritage language (Xiang & Makarova, 2021).

The frequency of language use may have an influence on language proficiency and may have an effect on making Cantonese speakers more prone to phonetic changes. Thus, home language is one of the predictive non-linguistic factors in this study. Cantonese speakers who speak Cantonese at home, including those who speak Cantonese with all family members or only speak Cantonese with specific family members, were included in this study.

3.2.1 Production Task

20 Cantonese speakers participated in Stage 1, the production task. All of them are third-generation and onward Malaysian Chinese (at least one of their parents was born in Malaysia), aged between 20 and 31 years (born between 1991 and 2002). The average age of participants in Stage 1 was 24.95. The majority of the participants (18 participants, 90%) have studied in Chinese primary schools (*Sekolah Jenis Kebangsaan (Cina)*), where the medium of instruction is Mandarin. All of them have graduated from

or are enrolled in tertiary education. They have usually learned Cantonese from their parents or grandparents since childhood. Their use of Cantonese is basically in the home domain. Although they do use Cantonese outside the home with Chinese friends, colleagues, and strangers, they still communicate more often in Mandarin outside the home.

Table 3.2 shows the demographics of participants in Stage 1. In terms of region, there are 7 participants from Klang Valley (i.e., Selangor and Kuala Lumpur) and 13 participants from Negeri Sembilan. In terms of gender, there are 6 males and 14 females. In terms of social role, there are 6 university students and 14 workers. In terms of home language, 11 participants mainly used Cantonese to communicate with all family members, while 9 participants only used Cantonese to communicate with specific family members.

Table 3.2: Demographics of participants in Stage 1

Non-linguistic factors		**N (%)**
Region	Klang Valley	7 (35)
	Negeri Sembilan	13 (65)
Gender	Male	6 (30)
	Female	14 (70)
Social role	Student	6 (30)
	Worker	14 (70)
Home language	Speak Cantonese to all family members at home.	11 (55)
	Only speak Cantonese to specific family members.	9 (45)

3.2.2 Perception Task

In total, 40 Cantonese speakers participated in Stage 2, the perception task, including the 20 participants from Stage 1. The perception task generally includes not only the participants in the production task but also increases the number of participants to obtain perceptions from a wider range of language users. Every participant was recorded twice in Stage 1 (which will be explained more in Section 3.4.1), but only answered once in the perception survey in Stage 2. Thus, the quantity of data in Stage 2 was only half of that in Stage 1, which would be inconsistent. In order to make the data from Stage 1 and Stage 2 comparable in quantity, an additional 20 Cantonese speakers were added in Stage 2.

All of them are also third-generation and onward Malaysian Chinese (at least one of their parents was born in Malaysia), aged between 20 and 31 years (born between 1991 and 2002). The average age of participants in Stage 2 was 25.38. The majority of the participants (38 participants, 95%) in Stage 2 have also studied in Chinese primary schools (*Sekolah Jenis Kebangsaan (Cina)*), and all of them have graduated or are enrolled in tertiary education. Table 3.3 shows the demographics of participants in Stage 2. In terms of region, there are 21 participants from the Klang Valley (i.e., Selangor and Kuala Lumpur) and 19 participants from Negeri Sembilan. In terms of gender, there are 10 males and 30 females. In terms of social roles, there are 9 university students and 31 workers.

In terms of home language, apart from Cantonese speakers who speak Cantonese at home, Cantonese speakers who do not speak Cantonese at home but speak it outside of home (generally considered non-native speakers) were also included in the perception task. According to Coluzzi (2017), in addition to the levels of "vigorous" and "threatened", Cantonese is also scoring at the level of "trade" in EGIDS. It implies that Cantonese is not only used by native speakers; non-native speakers are also part of the Cantonese population. They should also be included, as they may also play a role in the use and maintenance of Cantonese. Non-native speakers usually learn Cantonese from their Chinese friends and colleagues, Hong Kong TV shows, local TV and radio shows, Cantonese songs, and social media applications (e.g., Facebook, TikTok, Xiaohongshu, etc.). Their use of Cantonese is essentially in the work domain, usually with Cantonese-speaking colleagues or clients. The reason for not including this group of participants in the production task (Stage 1) is that the proficiency level of non-native speakers' pronunciation is more inconsistent. In order to avoid uncontrollable variability, this group of participants was only included in the perception task. Thus, in Stage 2, 20 participants mainly used Cantonese to communicate with all family members, 13 participants only used Cantonese to communicate with specific family members, and 7 participants do not speak Cantonese at home but speak it outside of the home.

Table 3.3: Demographics of participants in Stage 2

Non-linguistic factors		**N (%)**
Region	Klang Valley	21 (52.5)
	Negeri Sembilan	19 (47.5)
Gender	Male	10 (25)
	Female	30 (75)
Social role	Student	9 (22.5)
	Worker	31 (77.5)
Home language	Speak Cantonese to all family members at home.	20 (50)
	Only speak Cantonese to specific family members.	13 (32.5)
	Do not speak Cantonese at home, but speak it outside of home.	7 (17.5)

3.3 Materials

A list of disyllabic words and phrases was used to collect the production and perception data. Below are the explanations of the materials used in the production and perception tasks.

3.3.1 Production Task

Read speech (e.g., word list) is often used to collect phonetic data, as the tokens collected are more constrained and predictable than spontaneous speech (e.g., conversational speech) (Feagin, 2013; Tagliamonte, 2012; Thomas, 2011). Although almost all syllables in Chinese are words, most words used in modern texts or speech are disyllabic (Duanmu, 2007). Therefore, a list of disyllabic words and phrases was used in the production task.

Each factor from the linguistic factor groups (refer to Table 3.1) was included in the design of the disyllabic word list. In the present study, the predictive linguistic factors that may constrain the phonetic variants are lexical tone, the following phonetic environment (i.e., vowel type and final type), and syllable order. In terms of lexical tone, all nine types of lexical tones were included. The following phonetic environment refers to the phonetic segment that follows the initials. As stated in Section 2.5.2, zero initial /Ø/ and nasal initial /ŋ/ are most commonly found before unrounded low front vowels /a/, near-low central vowels /ɐ/, rounded low-mid back vowels /ɔ/, rounded high-mid back vowels /o/, and rounded high back vowels /u/. Based on these five types of vowels, four types of finals were formed: simple finals, compound finals, nasal finals, and stop finals. Thus, syllables with different vowel types and final types were included. In terms of syllable order, syllables with zero initial /Ø/ and nasal initial /ŋ/ will be placed either at the first or last syllable position.

A total of 42 target syllables were selected, including 22 syllables with a zero initial /Ø/ and 20 syllables with a nasal initial /ŋ/. The number of target syllables was unbalanced because there are only a few zero initial /Ø/ and nasal initial /ŋ/ syllables with the nuclei /o/ and /u/. There is a need to select the words and phrases that are more commonly used to avoid participants not being able to pronounce them. The selected target syllables were used to form common Cantonese disyllabic words and phrases by referring to Zhan (2002) (see Appendix D1). For example, the syllable "*州*" is added after the target syllable "*亚*" to form the disyllabic word "*亚洲*" (Asia), and the syllable "*海*" is added before the target syllable "*岸*" to form the disyllabic word "*海岸*" (coastal).

3.3.2 Perception Task

As mentioned in Section 2.6.3, the discrimination task method is commonly used to investigate the perception of the phonemic merger in Chinese varieties. Thus, the discrimination task is also adopted in the present study in order to investigate the perception of Cantonese zero and nasal initials by Cantonese speakers. An online perception form was used to conduct the perception task. Due to concerns that including too many questions would result in longer completion times for the perception task, Stage 2 focused primarily on initial that frequently undergo phonetic changes. Based on the results from Stage 1 (which will be explained in Chapter 4), the phonetic change occurs more often in the zero initial /Ø/. Thus, Stage 2 was mainly focused on the zero initial /Ø/.

The idea that "perception seems to lag behind production" proposed by Janson (1983, p. 31) is of great research value. In order to examine whether this statement also applies to zero and nasal initials in Malaysian Cantonese, the test words used in the perception task were taken from the disyllabic word list used in Stage 1, because the use of the same target syllables has a relatively higher comparative value. Therefore, a total of 24 words were tested in the perception task, including 22 zero initial syllables (all the zero initial syllables in Stage 1) and 2 nasal initial /ŋ/ syllables (see Appendix D2). According to the result in Stage 1 (which will be explained in Chapter 4), the vowels /o/ and /ɔ/ are more favourable for the presence of phonetic changes in nasal initial /ŋ/ syllables. Thus, the two nasal initial /ŋ/ syllables tested are with these two vowels.

The realisations of Cantonese zero initial /Ø/ and nasal initial /ŋ/ were observed. Basically, there are tokens of zero and nasal consonants for each target syllable that were examined in Stage 1. Therefore, two tokens were randomly selected for each tested syllable in Stage 2, one each for zero and nasal consonants. The zero consonants found in this study can be divided into null initial, glottal stop, and nasalised vowel (which will be explained in Chapter 4). Null initial and glottal stop were chosen randomly for tokens of zero consonant, as they are not significantly different from auditory perception and do not cause a major auditory difference. Nasalised vowels can also be found in some tested syllables. These tokens of nasalised vowels were also added in addition since there is a noticeable auditory difference between them and the null initial and glottal stop. All the stimuli were generated using the audio recording collected in Stage 1.

The selected tokens were extracted from sound files and text grids using Praat (Version 6.2.15) (Boersma & Weenink, 2022) for the making of stimuli. The manipulation of the pitch was performed to minimise differences caused by pitches. Before that, tokens produced by male speakers were also processed by the "change gender" function. All the stimuli were converted from waveform (WAV) audio file format to MPEG Audio Layer 3 (MP3) audio file format using Audacity (Audacity Team, 2020). There were two or three stimuli for each tested word: one with a zero consonant, one with a nasal consonant [ŋ], and one with a nasalised vowel (only for those tested words with the presence of tokens of nasalised vowel).

3.4 Data Collection

This study obtained ethical approval from the Universiti Malaya Research Ethics Committee (UMREC) with the reference number UM.TNC2/UMREC_2302 (see Appendix E1). An online questionnaire was distributed through the Google Forms application to find participants for Stage 1. Participants who met the selection criteria were selected to participate in this study. Before they participated in this study, a consent form and participant information sheet (see Appendices E2 and E3) were provided to the participants to seek their consent. Basic information, language background, and daily language usage are included in the questionnaire (see Appendix E4).

3.4.1 Production Task

Stage 1, the production task, was carried out in January and February 2023. The production of speech sounds was recorded using a digital voice recorder (ICD-UX560F) with a headset microphone. The recordings were conducted in a quiet room in the participants' house, and some were recorded in a quiet classroom in the Faculty of Languages and Linguistics, Universiti Malaya. All data were recorded at a sampling rate of 44.1 kHz and saved in WAV audio file format.

The word list in Chinese characters was presented to the participants in a video. The pictures corresponding to each disyllabic word are also attached as a reference. Each of the two fillers are added at the beginning and end of the word list respectively. The fillers are used to prevent the first word from being pronounced loudly and the last word from being pronounced softly (Zhu, 2013). These fillers were not included in the data analysis. Participants were required to read out the disyllabic words in Cantonese. Each participant was recorded two times. To avoid the participants' reading fatigue, the order of the word list is different for the first and second recordings.

A total of 1680 tokens (20 participants × 2 times × 42 disyllabic words) were recorded, which includes 880 tokens for the zero initial /Ø/ and 800 tokens for the nasal initial /ŋ/. In order to preserve the anonymity of participants, they were named using a unique code. All the information and data collected are not accessible to anyone except the researcher and supervisor.

3.4.2 Perception Task

A discrimination task was conducted in Stage 2. It was conducted online using the Google Forms application and carried out in April 2023. Participants who did not participate in Stage 1 were asked to fill out a questionnaire in order to collect their basic information, language background, and daily language usage (see Appendix E4).

The perception survey was conducted in Mandarin; it consisted of 1 practice question and 24 test questions. The tested Chinese disyllabic word and two to three videos were provided for each question (see Appendix E5). The videos are made of stimuli (audio) and corresponding Chinese characters. Pictures corresponding to each tested word are also attached as a reference. For each question, videos with stimuli of zero and nasal consonants were provided, some also with nasalised vowels. These videos were named "A", "B", and "C" randomly.

Participants were instructed to click on the videos to view and listen to them. They were allowed to playback and listen multiple times. Even though repeated listening has the potential to affect the results, but the random responses resulting from misheard sounds can mostly be avoided. After watching and listening to the videos, participants were asked to discriminate between the Cantonese pronunciation of each word according to their perception and judgement. In addition to the options of "A", "B", "C", and "none of the options are correct", combination options such as "A and B", "B and C", "A and C", and "A, B, and C" also be provided. Participants were asked to select from these options what they believed to be the correct Cantonese pronunciation of the respective Chinese characters. A total of 960 tokens (40 participants × 24 tested words) were collected, which includes 880 tokens for the zero initial /Ø/ and 80 tokens for the nasal initial /ŋ/.

3.5 Data Analysis

Data analysis will be explained separately according to Stage 1 (the production task) and Stage 2 (the perception task).

3.5.1 Production Task

Data annotation was conducted on the data collected in the production task. From the sound files collected in Stage 1 (the production task), text grids were generated for data annotation. Acoustic measurements were then conducted based on the acoustic data extracted from the sound files and text grids. The variable rule analysis was then used to measure the ordering of constraints (linguistic and non-linguistic factors) on the production of Cantonese zero initial /Ø/ and nasal initial /ŋ/.

3.5.1.1 Data Annotation

Data annotation and analysis were conducted using Praat (Version 6.2.15) (Boersma & Weenink, 2022). All the sound files collected were converted to mono. The annotation was conducted by observing the wideband spectrogram, waveform, and auditory perception. The International Phonetic Alphabet (IPA) transcriptions for Cantonese in this study mainly refer to Chen (2003), which recorded the Cantonese phonological system in Kuala Lumpur. Below are the annotation guidelines:

1. All the target syllables were annotated in Tier 1.
   (a) Tier 1 included the entire target syllable. The boundaries start from the start point of the plosive, voicing bar, or vowel formant. The end of boundaries depends on the final types. For simple and compound finals, boundaries end at the endpoint of the vowel formant (the disappearance of F2). For nasal finals, boundaries end at the endpoint of the voicing bar. For stop finals, boundaries end at the endpoint of the plosive.

(b) The annotation contents differed depending on the actual pronunciation.

(i) For the pronunciation matched with the Cantonese pronunciation dictionary, the annotation format is "Chinese character_original initial_coding for target syllable", for example, "亞_Ø_3afF".

(ii) If the pronunciation did not match the Cantonese pronunciation dictionary or the syllable was not read as required, the annotation format is "Chinese character_original initial_coding for target syllable-X", for example, "亞_Ø_3afF-X". These tokens were not analysed.

2. The analysis of the initials of the target syllables was annotated in Tier 2.

(a) Tier 2 only included the initial slot. The boundaries start with the start point of the plosive, voicing bar, or vowel formant and end with the appearance of the vowel formant (the appearance of F2). If the syllable is pronounced without an initial (null initial), the boundaries for Tier 2 are the same as in Tier 1.

(b) The annotation contents were based on an analysis of actual pronunciation compared to the pronunciation in the Cantonese pronunciation dictionary.

(i) If the actual pronunciation of the initial is matched with the Cantonese pronunciation dictionary, it will be annotated as "RU", which refers to remain unchanged.

(ii) If the actual pronunciation of the initial is not matched with the Cantonese pronunciation dictionary, it will be annotated as "PC", which refers to phonetic changes. For phonetic changes, the type of initial change is also included. For example, "PC-ŋ" refers to the initial of the syllable having undergone a phonetic change to become the nasal consonant [ŋ]. "ŋ" refers to nasal consonant [ŋ], "GS" refers to glottal stop [ʔ], "NI" refers to null initial, and "NV" refers to nasalised vowel.

3. The following vowels after the initial were annotated in Tier 3.

(a) Tier 3 only included the nucleus of the target syllables, which also refers to the following vowel after the initial. The boundaries start with the appearance of vowel formants (the appearance of F2) and end with the disappearance of vowel formants (the disappearance of F2). For the compound finals, observation of the waveform and auditory perception were used to identify the endpoint of the nucleus.

(b) The annotation contents were the types of the following vowels, for example, a, ɐ, ɔ, o, and u.

Figures 3.1 and 3.2 present the sample annotations for the target syllables. Figure 3.1 shows the initial remains unchanged, and the actual pronunciation is matched with the Cantonese pronunciation dictionary. Figure 3.2 shows that the initial undergoes phonetic change. The actual pronunciation of this production was not matched with the Cantonese pronunciation dictionary. The initial slot of the zero initial syllable has been replaced by a nasal consonant [ŋ].

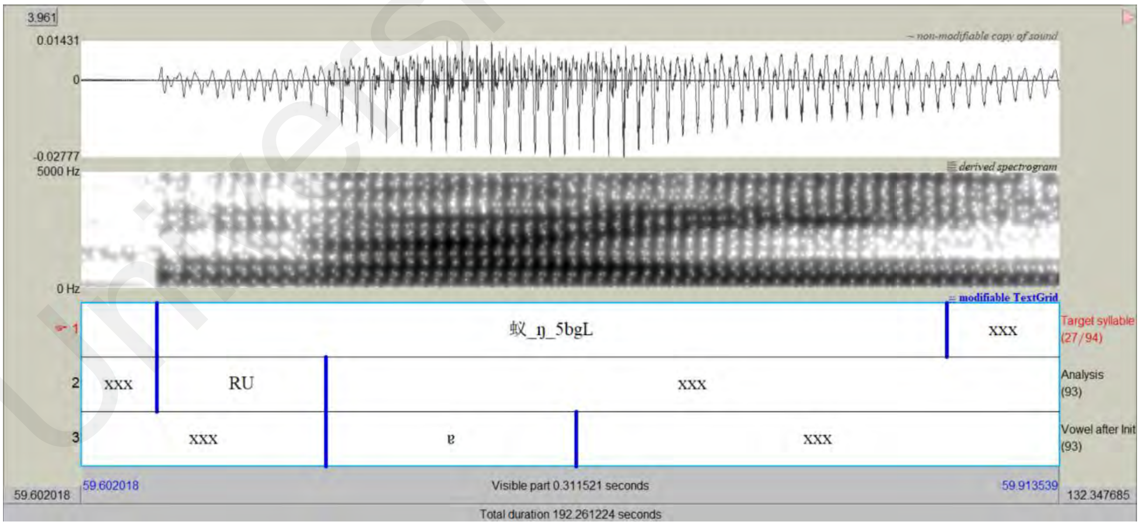

Figure 3.1: Sample annotation for the target syllable "蚁"

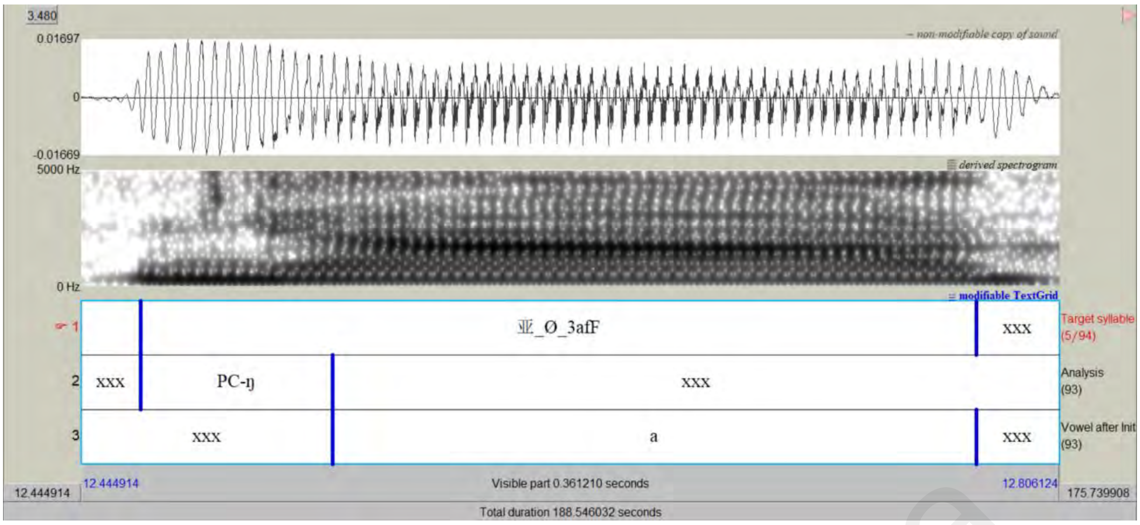

Figure 3.2: Sample annotation for the target syllable "亚"

Table 3.4 shows the coding for linguistic factors, including lexical tone, vowel type, final type, and syllable order. The coding for target syllables (see Appendix F1) was formed by linguistic factors. Take Figure 3.2 as an example: "3afF" is a code for the syllable with T3 (lexical tone); its nucleus (the following vowel after the initial) is /a/, with a simple final, and placed in the first syllable position.

Table 3.4: Coding for linguistic factors

Lexical tone		Vowel type		Final type		Syllable order	
Meaning	**Coding**	**Meaning**	**Coding**	**Meaning**	**Coding**	**Meaning**	**Coding**
T1	1	**/-a/**	a	**Simple finals**	f	**First syllable**	F
T2	2	**/-ɐ/**	b	**Compound finals**	g	**Last syllable**	L
T3	3	**/-ɔ/**	c	**Nasal finals**	h		
T4	4	**/-o/**	d	**Stop finals**	i		
T5	5	**/-u/**	e				
T6	6						
T7	7						
T8	8						
T9	9						

Table 3.5 shows the coding for non-linguistic factors, including gender, region, social role, and home language. The coding for participants (see Appendix F2) was

formed by non-linguistic factors. For example, the first speaker, coded "1_FKWA", is a female from Klang Valley, a worker, and speaks Cantonese to all family members at home.

Table 3.5: Coding for non-linguistic factors

Gender		Region		Social role		Home language	
Meaning	**Coding**	**Meaning**	**Coding**	**Meaning**	**Coding**	**Meaning**	**Coding**
Male	M	Klang Valley	K	Student	S	Speak Cantonese to all family members at home.	A
Female	F	Negeri Sembilan	N	Worker	W	Only speak Cantonese to specific family members.	B
						Do not speak Cantonese at home, but speak it outside of home.	C

In the annotated data, 83 tokens of the production were found for which either the target syllable was not pronounced by the speakers or the pronunciation was not matched with a Cantonese pronunciation dictionary. These tokens were excluded, and only 1597 tokens were presented in the data of production, which includes 760 tokens for the nasal initial /ŋ/ and 837 tokens for the zero initial /Ø/.

3.5.1.2 Acoustic Measurements

In order to visualise the phonetic phenomenon, measurements and calculations on the acoustic data are necessary. By quantifying the phonetic descriptions, the phonetic descriptions can be more accurate. Acoustic data (including formant frequencies, intensities, and durations) were extracted from sound files and text grids using the script from de Haro (2020). The data was collated using the WPS spreadsheet application.

To answer the first research question, the frequencies of realisations for Cantonese nasal initial /ŋ/ and zero initial /Ø/ were measured, and the relevant acoustic measurements were conducted. A spectrogram analysis was used for all the realisations found in this study, including nasal consonant /ŋ/ and zero consonant (which included null initial, glottal stop, and nasalised vowel).

As mentioned in Section 2.5.2, frequency, intensity, and time are three key physical parameters to describe the acoustic features of any speech sound (Small, 2020). Thus, formant analysis, intensity analysis, and duration analysis were used for the analysis of the nasal consonant /ŋ/. In terms of formant analysis, the frequencies of the first three formants of the nasal consonants (N1, N2, and N3) are measured in hertz (Hz). In terms of intensity analysis, the average intensity of the nasal consonant /ŋ/ was measured in decibels (dB). In terms of duration analysis, the nasal duration of the nasal consonant /ŋ/ is measured in milliseconds (ms).

According to Recasens (1999), the formant frequencies of a vowel in a nasal environment will be affected slightly. The analysis of the following vowel can also be used to determine the presence of the nasal initial. Moreover, nasalised vowels were also found in the realisations of Cantonese nasal initial /ŋ/ and zero initial /Ø/ in the central region of Malaysia. A nasalised vowel is produced when the velum is lowered to allow part of the airstream to flow out through the nose (Ladefoged & Johnson, 2015). Take the word [ŋɔ̃] as an example, where the nasal precedes the vowel. The velum is lowered to produce [ŋ] and is not raised until the vowel starts. The vowel is produced with a simultaneous flow of airstream through the nasal cavity (Rogers, 2013). As a result, the vowel following the nasal consonant [ŋ], the vowel [ɔ], is nasalised. In the notation system of the International Phonetic Alphabet (IPA), nasalised vowel is indicated by placing a tilde (~) over the vowel. For example, [ã], [ɐ̃], [ɔ̃], [õ], [ũ], etc.

Ladefoged (2003) pointed out that the F2 frequency of the nasalised vowel is significantly lower than the normal vowel. These statements suggest that vowel analysis could play a role in investigating the acoustic features of nasal consonants and nasalised vowels. Therefore, in order to observe the differences between nasalised vowels and normal vowels, the vowel analysis of the nasalised vowels, normal vowels after the zero consonant and nasal consonant /ŋ/ was also conducted. The first two formants of the vowels are named F1 and F2 respectively, where F1 indicates the formant with the lowest frequency, and so on. The formant frequencies were measured in Hz and Bark. A vowel chart was used to present the tongue position of the nasalised and normal vowels. To present the vowels in a vowel chart, the F1 and F2 of the following vowel were converted from Hz into the Bark scale (Zwicker & Terhardt, 1980). The vowel chart approximates the position of the tongue, with the x-axis representing the F2 and the y-axis representing the F1. F1 frequency is inversely related to the height of the tongue body. A higher F1 frequency represents a low vowel (low tongue body), and a lower F1 frequency represents a high vowel (high tongue body). While F2 frequency is directly relevant to tongue body advancement, which relates to the frontness or backness of the tongue. A higher F2 frequency represents a front vowel, and a lower F2 frequency represents a back vowel (Johnson, 2012; Small, 2020). Below is the analytic expression for the Bark scale (Zwicker & Terhardt, 1980):

$$\text{Bark} = 13 \arctan(0.00076f) + 3.5 \arctan\left(\left(\frac{f}{7500}\right)^2\right)$$

In the general theory of the differences in voice between males and females, adult females are typically regarded as having a higher pitch than adult males (Small, 2020). Thus, the acoustic measurements for males and females were calculated and presented separately.

3.5.1.3 Variable Rule Analysis

Statistical analysis is a common research tool that makes research meaningful by quantifying data. However, Tagliamonte (2006, p. 130) pointed out that statistical methods such as Analysis of Variance (ANOVA) were inappropriate for language data. Tagliamonte (2006, p. 130) believed that an analysis method that "has heterogeneity with contextually conditioned 'order' to it as well as innumerable blank regions" is needed for language variation data. The language variation is systematic and rule-governed rather than random or free, and this is the foundation for "variable rules".

Variable rule analysis is a quantitative analysis method introduced by Labov (1969) into sociolinguistic studies. This analysis method is used to investigate the ordering of constraints on phonetic variation. Although most of the literature stated that the variable rule analysis method was created to study spontaneous speech, it is also applicable to read speech. Kohler and Rodgers (2001) adopted the variable rule analysis method and compared the differences between read speech and spontaneous speech. Although it showed more significant results in spontaneous speech, it also showed that variable rule analysis can be used to analyse the probability of phonetic realisations in read speech. In addition, Liu (2019) also adopted this analysis method to analyse the data on Cantonese zero and nasal initials obtained from read speech.

To answer the second research question, the correlation between linguistic and non-linguistic factors and the production of Cantonese nasal initial /ŋ/ and zero initial /Ø/ were analysed. The Goldvarb X application (Sankoff et al., 2005), a tool to conduct variable rule analysis, was used. In order to compare and ensure the accuracy of the variable rule analysis results, the frequency distributions of phonetic realisations by each predictive factor were also calculated. In the present study, linguistic and non-linguistic factors are the independent variables, while Cantonese nasal initial /ŋ/ and zero initial /Ø/ are the dependent variables. The predictive linguistic and non-linguistic factors (independent variables) are expected to have an effect on the production of Cantonese nasal initial /ŋ/ and zero initial /Ø/ (dependent variables).

According to Tagliamonte (2006), there are two types of variable rule analysis methods: the binomial one-step method and the binomial step-up/step-down method. The binomial one-step method is a method that analyses all groups and all cells at once. It is used to "examine each of the cells and see how much each combination differs from the expected" (Tagliamonte, 2006, p. 139). However, the binomial one-step method is rarely adopted by most researchers because it does not evaluate the statistical significance or the relative strength of the factor groups. Unlike the binomial one-step method, the binomial step-up/step-down method analyses each cell one step at a time with a levelled analysis (Tagliamonte, 2006). It is used to identify groups that significantly change the model when they are added or removed. In this method, each factor group is tested, and the most significant group will be retained by continually adding more groups until no additional additions result in a significant change. In the result of the binomial step-up/step-down method, the statistical significance, the relative strength of the factor groups, and the constraint ranking of factors were provided. All of these are used for interpreting the model of the data. The log-likelihood value is a measurement of the goodness of fit of an analysis. A better model is presented by a value closer to zero. On the other hand, the variable programme evaluates statistical significance at the 0.05 level. The run is considered very significant when the significance level is less than 0.05. In addition, the collection of groups incorporated into the model in this way is known as the "step-up solution" (Tagliamonte, 2006, p. 140).

The groups selected while stepping up are the significant factor groups (Tagliamonte, 2006). Therefore, the factor weights for significant factors were obtained from the best stepping-up run using the binomial step-up/step-down method. On the other hand, the groups eliminated while stepping down are the non-significant factors (Tagliamonte, 2006, p. 251). A non-significant factor refers to a factor that does not have a significant constraining effect on the dependent variable.

3.5.2 Perception Task

The data collected from the discrimination task was also calculated. The variable rule analysis was then used to measure the ordering of constraints (linguistic and non-linguistic factors) on the perception of Cantonese zero initial /Ø/ and nasal initial /ŋ/.

3.5.2.1 Discrimination Task

The frequencies of perception of Cantonese nasal initial /ŋ/ and zero initial /Ø/ were calculated to answer the third research question. There are 21 tokens for the option "none of the options are correct". There was no observable pattern in these responses; they did not cluster around specific tested words or specific tests for a particular participant. Therefore, these tokens were excluded due to their unobservable research significance. As a result, only 73 and 866 tokens were presented for the nasal initial /ŋ/ and zero initial /Ø/ respectively in the perception data.

3.5.2.2 Variable Rule Analysis

In order to answer the fourth research question, the correlation between linguistic and non-linguistic factors and the perception of Cantonese nasal initial /ŋ/ and zero initial /Ø/ were analysed. The Goldvarb X application (Sankoff et al., 2005) is used to conduct the variable rule analysis, and the factors that exerted the strongest conditioning effects on the phonetic variation were detected. The frequency distributions of perception options by each predictive factor were also calculated.

Generally, in the variable rule analysis, the results of the best stepping-up and stepping-down runs should be exactly the same. If they are not identical, it suggests there is some uncertainty regarding the status of the factor groups that were included in one analysis but left out of the other. For example, in the variable rule analysis for the correlation between the non-linguistic factors and the perception of zero initial (refer to Appendix H4), the analysis results of Run #4 (the best stepping-up run) and Run #15 (the best stepping-down run) are not identical. It suggests there is some uncertainty regarding the status of the factor groups that were included in one analysis but left out of the other. Through cross-tabulation (refer to Appendix H5), Factor C in Group 4 (home language) was detected as "0". Therefore, Group 4, the home language, was excluded from the result as it is not a factor that has an influence on the dependent variable. However, this may also be caused by the small sample size.

3.6 Summary

In summary, the present study consists of two sections: production and perception. The production task is conducted in order to answer the first and second research questions, while the perception task is conducted in order to answer the third and fourth research questions. The analysis of the results will be presented in the following two chapters. The results from the production task will be presented in Chapter 4, which aims to answer the phonetic realisations of Cantonese zero and nasal initials (the first research question) and the effects of linguistic and non-linguistic factors on the production of these two Cantonese initials (the second research question). In addition, the results for perception will be presented in Chapter 5, which aims to answer to what extent Cantonese speakers in the central region of Malaysia perceive the differences between Cantonese zero and nasal initials (the third research question) and the effects of linguistic and non-linguistic factors on the perception of these two Cantonese initials (the fourth research question).

CHAPTER 4

PRODUCTION OF CANTONESE NASAL INITIAL /ŋ/ AND ZERO INITIAL /Ø/

The previous chapter described the process of data collection and analysis. This chapter aims to answer the first and second research questions. In this chapter, the findings of the production of Cantonese nasal initial /ŋ/ (henceforth nasal initial) and zero initial /Ø/ (henceforth zero initial) are presented. In terms of phonetic realisations, the types of realisations and their acoustic features are explained accordingly. A brief comparison of the realisations of Cantonese nasal and zero initials is provided. In addition, the correlations between the linguistic and non-linguistic factors and the production of the Cantonese nasal and zero initials are also presented. The results of speech perception are presented in the next chapter.

4.1 Production of Cantonese Nasal Initial

The production results of Cantonese nasal initial are presented in this section. First of all, the realisations of nasal initial are mainly divided into two categories: nasal consonant [ŋ] and zero consonant. The acoustic measurements of these two groups are presented subsequently.

4.1.1 Realisations of Cantonese Nasal Initial

Table 4.1 shows the frequency distribution of realisations of the Cantonese nasal initial found in this study, with the percentage in parentheses. It shows that the Cantonese nasal initial has remained stable, as 687 tokens (90.4%) are produced as nasal consonant [ŋ]. Apart from that, nasalised vowel (31 tokens, 4.1%), glottal stop (25 tokens, 3.3%), null initial (15 tokens, 2.0%), and nasal [m] (2 tokens, 0.3%) are also found as the realisations of Cantonese nasal initial. The nasal consonant [m] accounts for less than 1%, and it is only produced by the same speaker in the first syllable of the word "乐器" (musical instrument), thus it can be considered an isolated case.

Table 4.1: Frequency distribution of the realisations of Cantonese nasal initial

Realisations of Cantonese nasal initial		**Frequency, N (%)**
Nasal consonant [ŋ]		687 (90.4)
Zero consonant	Null initial	15 (2.0)
	Glottal stop[1]	25 (3.3)
	Nasalised vowel	31 (4.1)
Nasal consonant [m]		2 (0.3)
Total of tokens		**760 (100)**

4.1.2 Acoustic Features of Nasal Consonant [ŋ]

The realisation of the nasal consonant [ŋ] appeared mostly when it was a syllable with T4 (*Yangping* tones), before the vowel [ɐ] and a simple final, and was the last syllable of a disyllabic word (which will be explained in Section 4.4.1). As stated in Section 3.5.1.2, the acoustic features of the nasal consonant [ŋ] can be described in terms of the spectrogram, formant, intensity, and duration. An analysis of the following vowels is also provided.

(a) Spectrogram analysis

Figure 4.1 shows the spectrogram of the production of the first syllable "我" from the word "我哋" (we). According to the Cantonese pronunciation dictionary (Zhan, 2002), "我" is a nasal initial syllable. As mentioned in Section 2.5.2, the spectrogram performance of the nasal is similar to that of the vowel, which consists of formants. But the formants of nasals are fainter than those of vowels due to the lower amplitude. As shown in Figure 4.1, there are fainter formants that occur before the vowel starts (the appearance of F2 is considered the appearance of the vowel formant). There is also an

[1] Glottal stop is considered a type of zero consonant in this study for two reasons. First, as mentioned in Table 2.8 (in Section 2.5.2), the glottal stop is a common variant found in zero initial. Second, the glottal stop and null initial did not have significant differences from the auritory perception, with no sound occurring before the vowel starts (which will be explained in Section 4.1.3).

antiformant (the area of absence of energy) that only appears in the nasal consonants. Furthermore, based on auditory perception, there is a nasal [ŋ] sound that occurs before the vowel starts. Therefore, it can be judged that it was initially produced with a nasal.

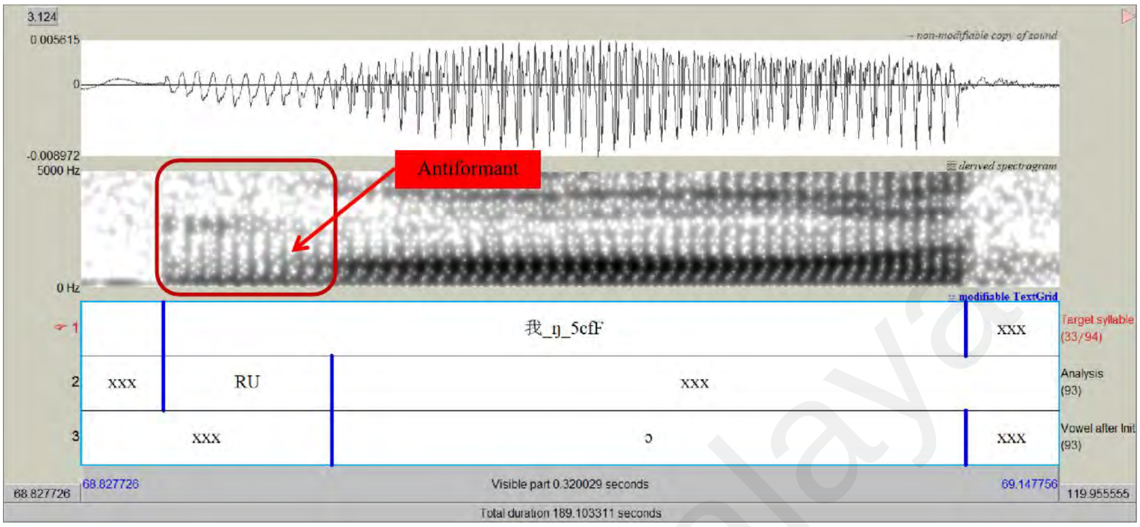

Figure 4.1: Spectrogram of the production of "我" by speaker 2_FNWA

(b) Formant analysis

Table 4.2 shows the average nasal formant frequencies of nasal consonant [ŋ] (henceforth nasal consonant) found in Cantonese nasal initial by vowel type, with the standard deviation in parentheses. Averagely, it has a N1 at 420 Hz, a N2 at 1468 Hz, and a N3 at 2826 Hz for females, and a N1 at 404 Hz, a N2 at 1307 Hz, and a N3 at 2496 Hz for males. The average formant frequencies for males are slightly lower than for females. In terms of vowel type, the formant frequencies of nasal consonants before vowels [a] and [ɐ] are relatively higher than vowels [ɔ] and [o].

Table 4.2: Average nasal formant frequencies of nasal consonant found in Cantonese nasal initial (by vowel type)

Vowel type	Average nasal formant frequencies (Hz)					
	Female			Male		
	N1	N2	N3	N1	N2	N3
[ŋ-a]	471 (125.7)	1621 (321.0)	2830 (215.5)	430 (106.6)	1388 (269.1)	2477 (220.7)
[ŋ-ɐ]	417 (111.1)	1566 (301.4)	2842 (190.9)	416 (117.7)	1416 (308.3)	2486 (251.3)
[ŋ-ɔ]	382 (96.2)	1263 (281.2)	2810 (155.5)	373 (79.4)	1134 (268.5)	2505 (202.9)
[ŋ-o]	381 (102.5)	1241 (298.4)	2805 (120.1)	361 (94.5)	1150 (411.1)	2600 (234.3)
Average	**420 (116.7)**	**1468 (342.4)**	**2826 (184.7)**	**404 (105.1)**	**1307 (317.4)**	**2496 (227.4)**

(c) Intensity analysis

Table 4.3 shows the average intensity of the nasal consonant found in Cantonese nasal initial by vowel type, with the standard deviation in parentheses. Overall, it has an average intensity of 39 dB for females and 46 dB for males. The intensity for males is slightly greater than for females. In terms of vowel type, the nasal consonant before the vowel [o] has the greatest intensity in both females and males.

Table 4.3: Average intensity of nasal consonant found in Cantonese nasal initial (by vowel type)

Vowel type	Average intensity (dB)	
	Female	Male
[ŋ-a]	39 (6.3)	46 (15.2)
[ŋ-ɐ]	39 (6.8)	45 (14.5)
[ŋ-ɔ]	40 (7.1)	46 (14.5)
[ŋ-o]	42 (7.2)	50 (16.6)
Average	**39 (6.8)**	**46 (14.8)**

(d) Duration analysis

Table 4.4 shows the average nasal duration of the nasal consonant found in Cantonese nasal initial by final type, with the standard deviation in parentheses. Overall, it has an average duration of 68.40 ms for females and 86.07 ms for males. The nasal duration for males is relatively longer than for females. In terms of final type, the duration of nasal consonant preceding stop finals is the shortest, with 56.93 ms for females and 78.22 ms for males. The longest nasal consonant occurs before compound finals for females (72.62 ms) and nasal finals for males (88.24 ms).

Table 4.4: Average nasal duration of nasal consonant found in Cantonese nasal initial (by final type)

Final type		**Average nasal duration (ms)**			
		Female		**Male**	
Simple finals	[a]	62.31 (25.5)	66.60 (30.0)	74.21 (38.2)	84.43 (40.4)
	[ɔ]	70.82 (33.5)		94.14 (40.9)	
Compound finals	[ai]	61.16 (34.0)	72.62 (31.5)	65.36 (23.0)	87.19 (41.8)
	[ɐi]	77.36 (29.9)		96.70 (43.9)	
	[ɐu]	65.39 (32.2)		86.74 (50.0)	
	[ɔi]	72.32 (29.0)		76.55 (34.7)	
	[ou]	77.88 (34.3)		97.44 (38.1)	
Nasal finals	[an]	59.32 (27.7)	64.83 (29.1)	63.53 (31.9)	88.24 (56.7)
	[ɐn]	59.61 (26.9)		97.92 (82.4)	
	[ɔn]	91.79 (23.7)		115.24 (51.4)	
	[aŋ]	58.61 (27.2)		79.16 (37.9)	
Stop finals	[ak]	55.50 (20.8)	56.93 (24.6)	65.51 (45.9)	78.22 (56.9)
	[ɔk]	58.99 (29.7)		106.17 (73.9)	
Average		**68.40 (30.5)**		**86.07 (46.1)**	

(e) Following vowel analysis

Table 4.5 shows the average formant frequencies of the vowels that follow the nasal consonant found in Cantonese nasal initial, with the standard deviation in parentheses. Figure 4.2 shows their distribution in a vowel chart. The vowel chart presents an approximate position of the tongue, with the x-axis representing the F2 and the y-axis representing the F1. The distributions of vowels [a], [ɐ], [ɔ], and [o] for females and males are basically consistent. According to Figure 4.2, the vowel [a] is a low front vowel; the vowel [ɐ] is a near-low front vowel; the vowel [ɔ] is a low-mid back vowel; and the vowel [o] is a high-mid back vowel. The distribution of the vowels after the nasal consonant found in Cantonese nasal initial is consistent with the vowel chart in the International Phonetic Alphabet (IPA) (The International Phonetic Association, 1999, p. ix).

Table 4.5: Average formant frequencies of the vowels after nasal consonant found in Cantonese nasal initial

Vowel type		Average formant frequencies			
		Female		Male	
		F1	F2	F1	F2
[a]	Hz	884 (136.9)	1666 (168.5)	751 (94.3)	1483 (100.1)
	Bark	7.74 (1.0)	11.90 (0.7)	6.78 (0.7)	11.12 (0.5)
[ɐ]	Hz	774 (123.8)	1719 (319.9)	659 (87.8)	1528 (312.4)
	Bark	6.95 (0.9)	12.11 (1.3)	6.06 (0.7)	11.32 (1.4)
[ɔ]	Hz	671 (161.2)	1153 (195.0)	593 (75.1)	963 (83.4)
	Bark	6.16 (1.3)	9.44 (1.0.)	5.53 (0.6)	8.27 (0.5)
[o]	Hz	556 (128.7)	1061 (242.1)	508 (60.3)	935 (107.3)
	Bark	5.22 (1.1)	8.89 (1.2)	4.81 (0.5)	8.09 (0.7)

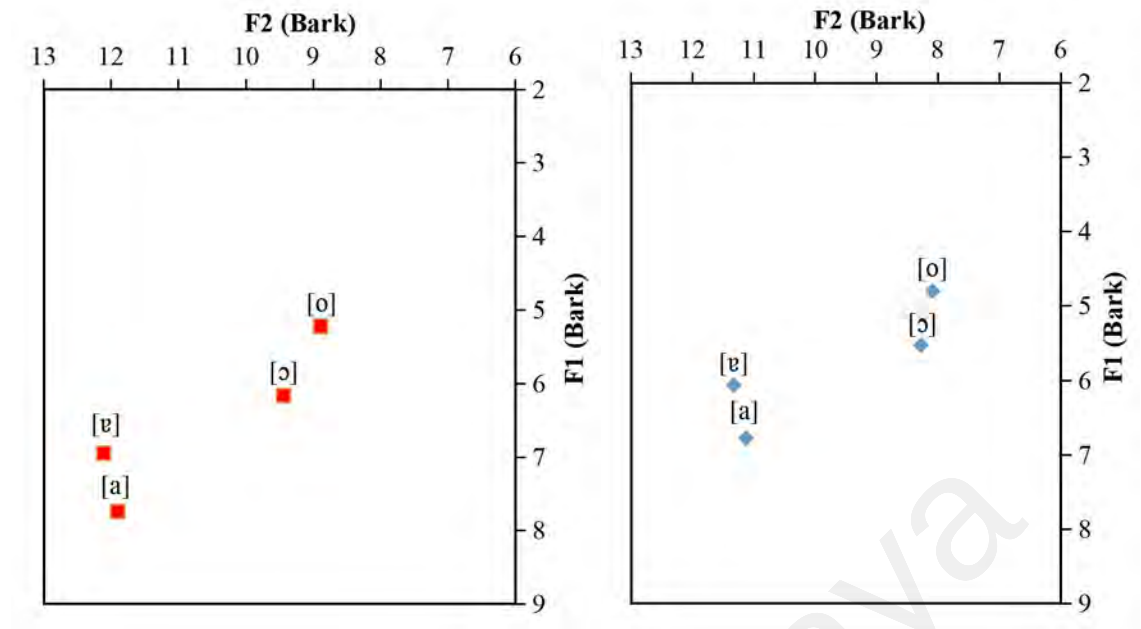

Figure 4.2: Distribution of the following vowels after the nasal consonant found in Cantonese nasal initial by females (left) and males (right)

4.1.3 Acoustic Features of Zero Consonant

Besides the nasal consonant, the zero consonant is also found as the realisation of the Cantonese nasal initial. The zero consonant relatively appeared more frequently when it was a syllable with T9 (*Yangru* tones), before the vowel [o] and a stop final, and was the first syllable of a disyllabic word (which will be explained in Section 4.4.1). Based on the findings of this study, the realisations of zero consonant can be divided into the null initial, glottal stop, and nasalised vowel.

1. Null Initial [Ø]

Null initial is a traditional sense of zero consonant, which refers to a syllable with no initial appearing in the initial position. It was found to be one of the main realisations of zero consonant in the present study.

(a) Spectrogram analysis

Figure 4.3 shows the spectrogram of the production of the first syllable "危" from the word "危险" (danger). According to the Cantonese pronunciation dictionary (Zhan, 2002), the syllable "危" is a nasal initial syllable. But as shown in Figure 4.3, nothing appears before the vowel starts. Based on auditory perception, there is also no sound before the vowel starts. Thus, this can be considered a null initial. Since nothing appears in the initial slot, no acoustic measurements can be further investigated.

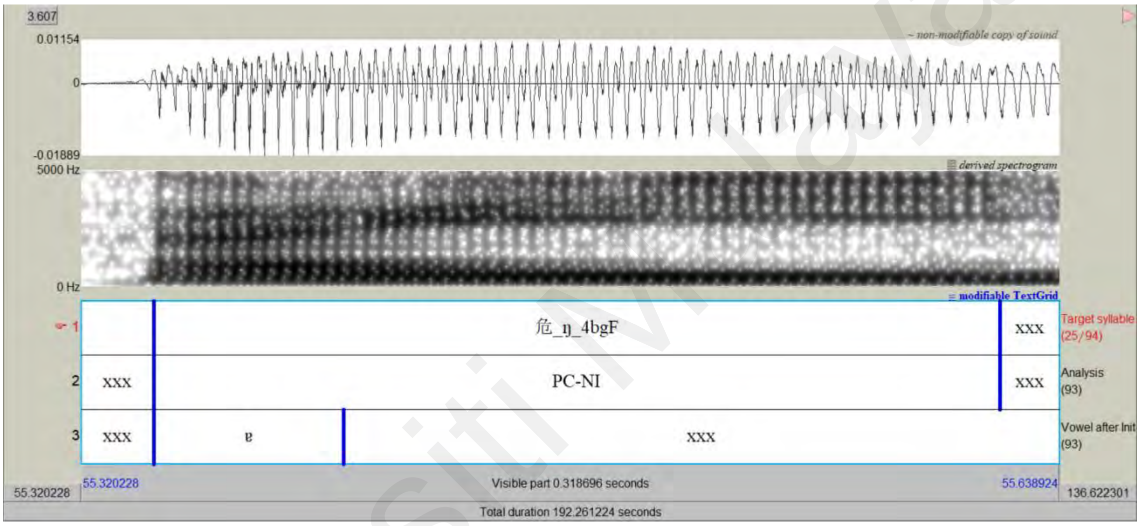

Figure 4.3: Spectrogram of the production of "危" by speaker 8_FNWA

2. Glottal Stop [ʔ]

According to Table 2.8 (in Section 2.5.2), the glottal stop is one of the common variants of the zero initial. It was also found to be one of the realisations of zero consonant in the present study.

(a) Spectrogram analysis

Figure 4.4 shows the spectrogram of the production of the last syllable "岸" from the word "海岸" (coastal). According to the Cantonese pronunciation dictionary (Zhan, 2002), the syllable "岸" is a nasal initial syllable. However, the syllable "岸" has been produced with a glottal stop [ʔ] by some speakers.

As shown in Figure 4.4, the spectrogram performance of the glottal stop is a very short-release burst. From the auditory perception, no particular sound is produced at the initial position of this syllable. Thus, this situation (as presented in Figure 4.4) is considered one of the realisations of zero consonants. The glottal stop is a short burst consonant; thus, its acoustic measurement is not reported because it is of little significance.

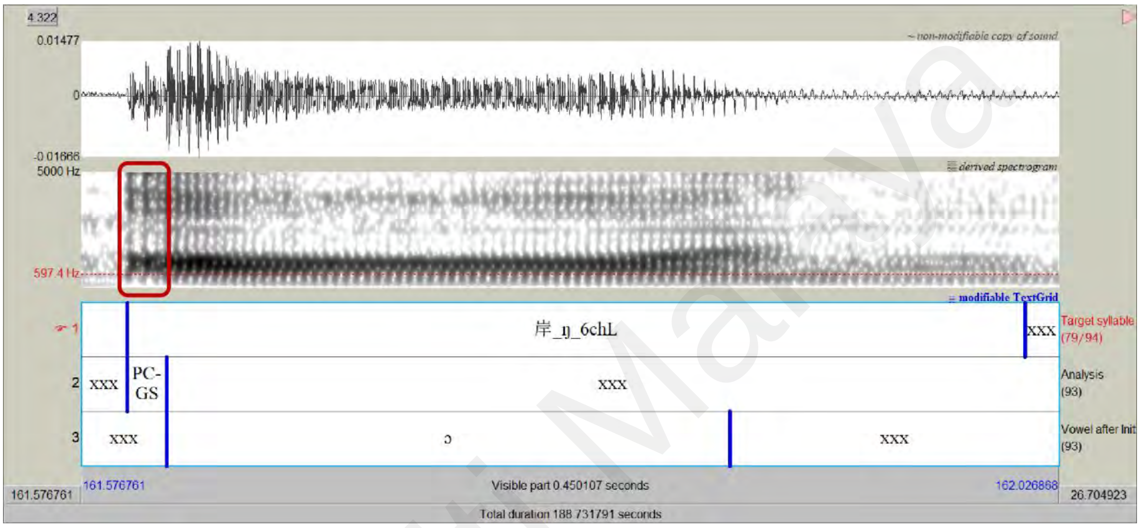

Figure 4.4: Spectrogram of the production of "岸" by speaker 12_FNWB

(b) Following vowel analysis

As mentioned in Section 3.5.1.2, the formant frequencies of the following vowels were measured in Hz and converted into the Bark scale. Table 4.6 shows the average formant frequencies of the following vowels after the zero consonant, and their distribution is shown in Figure 4.5. The following vowels are the vowels after the null initial and glottal stop. There is no token of the vowel [a] found in males, so there is no available data for that.

According to Figure 4.5, all the vowels are relatively consistent with the distribution of vowels in IPA (The International Phonetic Association, 1999, p. ix), except for the vowels [a] and [ɐ] among females. The vowel [a] in females is produced by a more backward tongue body compared to the vowel [ɐ]. The vowel [a] should be a low front vowel, but it is produced by a higher tongue body when it is after the zero consonant, even higher than the near-low central vowel [ɐ]. This may be affected by lip rounding. According to Ladefoged and Johnson (2015), the degree of lip rounding has a possible influence on lowering the F2 frequency, which means that the vowel may become more backward than the standard placement.

Table 4.6: Average formant frequencies of the following vowels after the zero consonant found in Cantonese nasal initial

Vowel type		Formant frequencies (Hz)			
		Female		Male	
		F1	F2	F1	F2
[a]	Hz	559 (-)	1786 (-)	-	-
	Bark	5.24 (-)	12.36 (-)	-	-
[ɐ]	Hz	726 (135.7)	1848 (400.5)	591 (16.7)	1129 (21.7)
	Bark	6.59 (1.1)	12.59 (1.7)	5.51 (0.1)	9.30 (0.1)
[ɔ]	Hz	666 (152.7)	1069 (118.4)	614 (54.3)	984 (91.7)
	Bark	6.12 (1.3)	8.94 (0.7)	5.70 (0.4)	8.41 (0.6)
[o]	Hz	548 (48.8)	928 (185.4)	502 (58.6)	840 (56.4)
	Bark	5.15 (0.4)	8.04 (1.1)	4.75 (0.5)	7.43 (0.4)

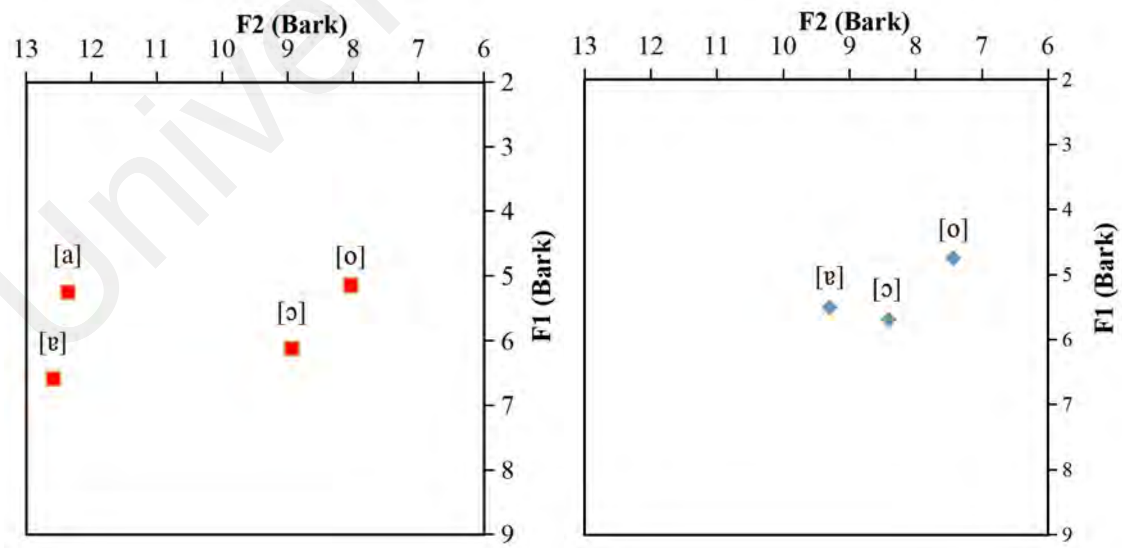

Figure 4.5: Distribution of the following vowels after the zero consonant found in Cantonese nasal initial by females (left) and males (right)

3. Nasalised Vowel

In the present study, the nasalised vowels are also found as one of the realisations of Cantonese nasal initial.

(a) Spectrogram analysis

Figure 4.6 presents the spectrogram of the production of the first syllable "我" from the word "我哋" (we). From the spectrogram, no consonant performance appears before the vowel starts. However, according to auditory perception, there is a nasal sound at the beginning of the syllable. Therefore, this phenomenon may be considered nasalised vowels.

The vowel in a nasal environment becoming nasalised is a normal phenomenon. According to the Cantonese pronunciation dictionary (Zhan, 2002), the syllable "我" is a nasal initial syllable. Thus, the vowel after the nasal initial becomes nasalised is reasonable. But it is worth noting that the findings in this study show that not only the vowel became nasalised, but also the nasal consonant before it was deleted. It means that this realisation is the combination of the deletion of the nasal consonant and the nasalisation of vowels. Thus, this phenomenon is classified as one type of zero consonant, as it has an empty initial slot.

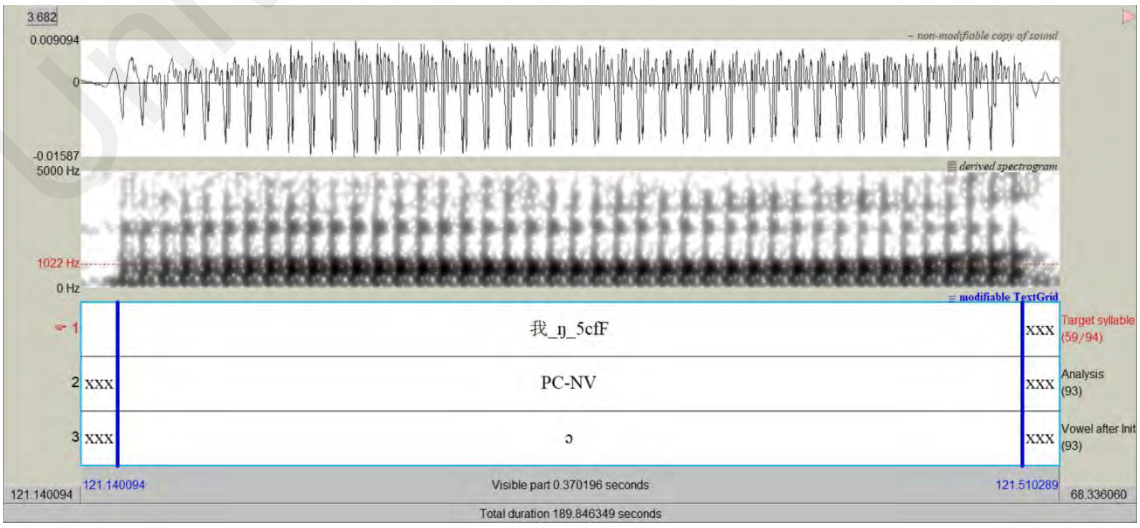

Figure 4.6: Spectrogram of the production of "我" by speaker 3_MNSA

(b) Formant analysis

Table 4.7 shows the average formant frequencies of the nasalised vowels found in Cantonese nasal initial, with the standard deviation in parentheses. Figure 4.7 shows their distribution in a vowel chart. According to Figure 4.7, all the distribution of nasalised vowels is relatively consistent with the vowel diagram in IPA (The International Phonetic Association, 1999, p. ix), except for the vowels [ã] in males. It is produced by a more backward tongue body compared to the standard placement, which means that it has a lower F2 frequency. As mentioned previously, the degree of lip rounding may lower the F2 frequency (Ladefoged & Johnson, 2015). This leads to it becoming more backward than its standard placement.

Table 4.7: Average formant frequencies of the nasalised vowels found in Cantonese nasal initial

Vowel type		Average formant frequencies (Hz)			
		Female		Male	
		F1	F2	F1	F2
[ã]	Hz	820 (225.8)	1673 (140.3)	689 (127.5)	1493 (134.3)
	Bark	7.29 (1.7)	11.93 (0.6)	6.30 (1.0)	11.17 (0.6)
[ɐ̃]	Hz	703 (6.8)	1148 (20.3)	562 (70.5)	1624 (518.8)
	Bark	6.41 (0.1)	9.41 (0.1)	5.27 (0.6)	11.73 (2.2)
[ɔ̃]	Hz	670 (1.8)	1100 (28.3)	569 (71.5)	996 (73.1)
	Bark	6.15 (0.0)	9.13 (0.2)	5.33 (0.6)	8.48 (0.5)
[õ]	Hz	435 (-)	947 (-)	450 (89.3)	950 (9.8)
	Bark	4.16 (-)	8.17 (-)	4.30 (0.8)	8.19 (0.1)

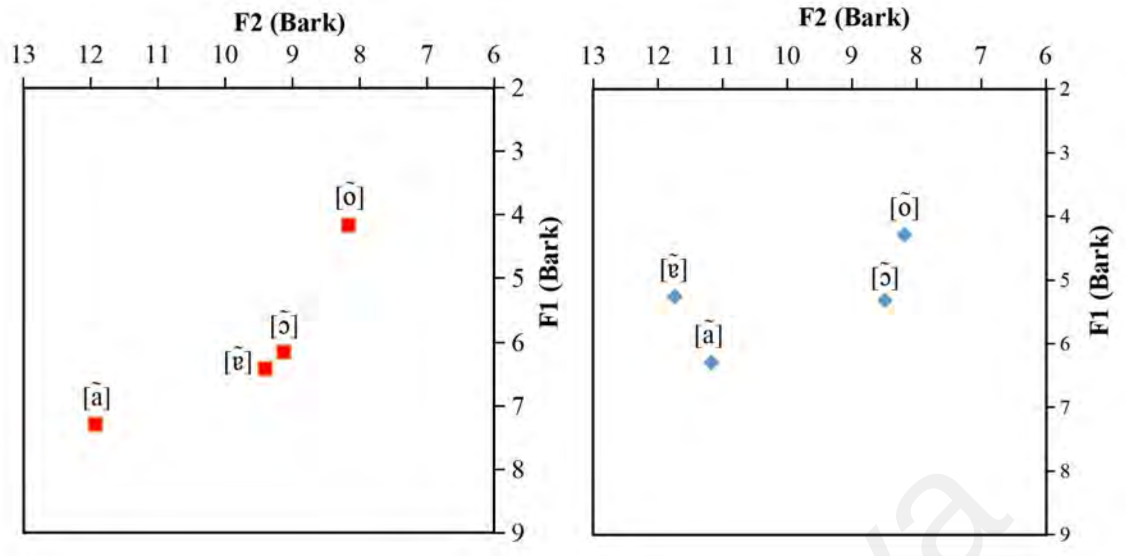

Figure 4.7: Distribution of the nasalised vowels found in Cantonese nasal initial by females (left) and males (right)

4.2 Production of Cantonese Zero Initial

The production results of the Cantonese zero initial are presented in this section. Firstly, the realisations of zero initial are mainly divided into two categories: zero consonant and nasal consonant [ŋ]. The acoustic measurements of these two groups are presented subsequently.

4.2.1 Realisations of Cantonese Zero Initial

Table 4.8 shows the frequency distribution of the realisations of Cantonese zero initial, with the percentage in parentheses. It shows that 279 tokens (33.3%) are zero consonant, including 161 tokens (19.2%) of glottal stops, 91 tokens (10.9%) of null initials, and 27 tokens (3.2%) of nasalised vowels. The most interesting finding is that more than half of the tokens show that the Cantonese zero initial underwent phonetic changes; it became mainly a nasal consonant [ŋ], which accounts for 550 tokens (65.7%).

The semi-vowel [w] was also found as one of the realisations of the Cantonese zero initial, which accounts for 8 tokens (1.0%). The semi-vowel [w] is a voiced labial-velar approximant. It was only produced by two speakers in the syllable "屋" [uk]. According to Table 2.8 in Section 2.5.2, [w] is a variant of the zero consonant that is often found before the vowel [u]. Semi vowels [w] appear before vowels [u], which is quite common when there is more tension in the facial muscles and obstruction in the mouth before sound production. Apart from that, a conjecture is also suggested, related to the influence of other Chinese community languages. By referring to the language background information collected from participants, a similar language background has been found in these two speakers who produced the syllable "屋" as [wuk]: they can speak Hakka. In Hakka, the pronunciation of "屋" is [vuk]; [v] is a voiced labiodental fricative with weak friction (Chen, 2003; Luo et al., 2004). The production of [w] and [v] has similarities; both are voiced sounds with a lip (labial) as one of the articulators. Therefore, it is proposed that the speakers who pronounce "屋" with a semi-vowel [w] might be influenced by the Hakka. However, due to its small proportion, which only accounts for 1.0%, this can also be considered an isolated case.

Table 4.8: Frequency distribution of the realisations of Cantonese zero initial

Realisations of Cantonese zero initial		**Frequency, N (%)**
Zero consonant	Null initial	91 (10.9)
	Glottal stop	161 (19.2)
	Nasalised vowel	27 (3.2)
Nasal consonant [ŋ]		550 (65.7)
Semi vowel [w]		8 (1.0)
Total of tokens		**837 (100)**

4.2.2 Acoustic Features of Zero Consonant

The realisation of the zero consonant appeared mostly when it was a syllable with T1 (*Yinping* tones), before the vowel [o] and a compound final, and was the first syllable of a disyllabic word (which will be explained in Section 4.4.3). A syllable with an empty slot for the initial position can be called a zero consonant. A zero consonant, as the name implies, is usually known as a null initial. However, as stated earlier, the zero initial can sometimes be filled with a unique variation, and the glottal stop is one of the common variants. Moreover, the nasalised vowel is also found in the realisations of Cantonese zero initial in this study.

1. Null Initial [Ø]

The null initial is a traditional sense of zero consonant.

(a) Spectrogram analysis

Figure 4.8 shows the spectrogram of the production of the first syllable "爱" from the word "爱情" (love). Based on the spectrogram, it can be seen that there is no other performance of any consonant appearing before the vowel starts. Furthermore, according to auditory perception, there is no sound before the vowel either. Therefore, this can be considered a null initial.

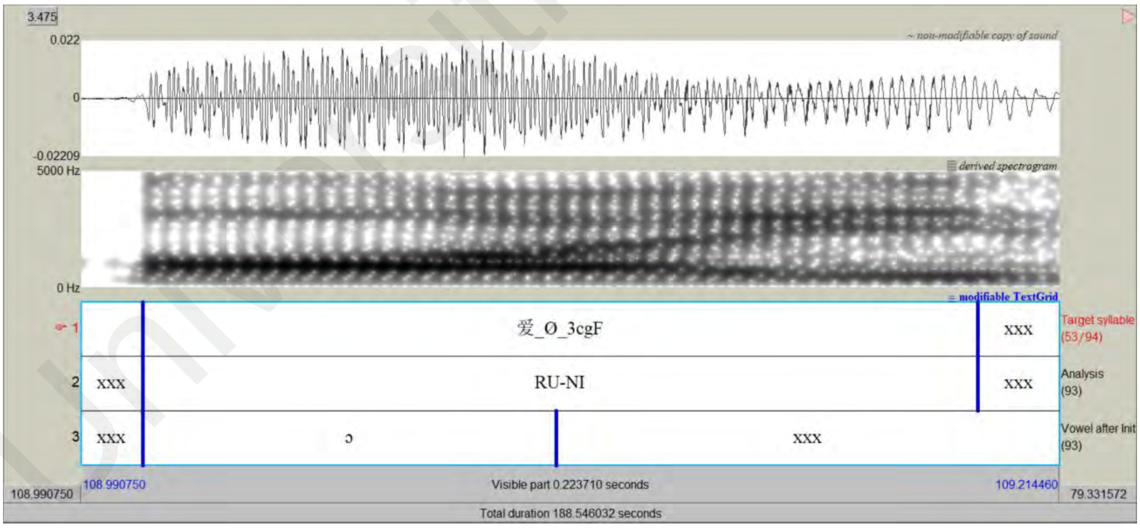

Figure 4.8: Spectrogram of the production of "爱" by speaker 1_FKWA

2. Glottal Stop [ʔ]

The glottal stop is a common variant of the zero consonant.

(a) Spectrogram analysis

Figure 4.9 also shows the spectrogram of the production of the first syllable "爱" from the word "爱情" (love). The spectrogram shows a short-release burst of glottal stop at the beginning of the syllable. However, based on auditory perception, there is no sound before the vowel starts. Therefore, this is considered a type of zero consonant.

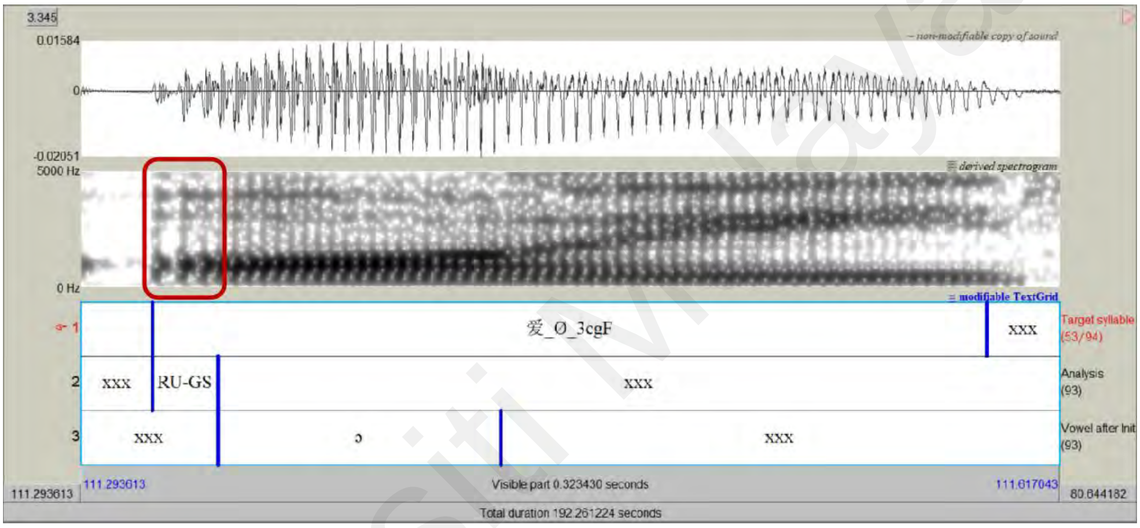

Figure 4.9: Spectrogram of the production of "爱" by speaker 8_FNWA

(b) Following vowel analysis

The formant frequencies of the following vowels were measured in Hz and Bark. Table 4.9 shows the average formant frequencies of the following vowels after the zero consonant, and their distribution is shown in Figure 4.10. The following vowels are the vowels after the null initial and glottal stop.

According to Figure 4.10, the distribution of vowels after the zero consonant is relatively consistent with the vowel chart in IPA (The International Phonetic Association, 1999, p. ix). The vowel [a] is a low front vowel; the vowel [ɐ] is a near-low front vowel; the vowel [ɔ] is a low-mid back vowel; the vowel [o] is a high-mid back vowel; and the vowel [u] is a high back vowel. However, the vowel [u] in females is produced by a lower tongue body compared to the vowel [o], which is inconsistent with the IPA vowel chart.

Table 4.9: Average formant frequencies of the following vowels after the zero consonant found in Cantonese zero initial

Vowel type		Average formant frequencies (Hz)			
		Female		Male	
		F1	F2	F1	F2
[a]	Hz	905 (140.7)	1524 (172.1)	740 (176.9)	1425 (117.7)
	Bark	7.88 (2.2)	11.31 (0.8)	6.69 (1.4)	10.85 (0.5)
[ɐ]	Hz	783 (122.4)	1247 (210.4)	661 (99.9)	1140 (237.1)
	Bark	7.02 (0.9)	9.96 (1.0)	6.08 (0.8)	9.36 (1.3)
[ɔ]	Hz	695 (162.4)	1143 (111.1)	627 (71.5)	1011 (82.1)
	Bark	6.35 (1.3)	9.38 (0.6)	5.81 (0.6)	8.58 (0.5)
[o]	Hz	502 (74.1)	862 (86.2)	511 (62.4)	843 (70.7)
	Bark	4.75 (0.6)	7.59 (0.6)	4.83 (0.5)	7.45 (0.5)
[u]	Hz	576 (74.7)	985 (74.5)	490 (57.7)	891 (36.5)
	Bark	5.38 (0.6)	8.41 (0.5)	4.65 (0.5)	7.79 (0.2)

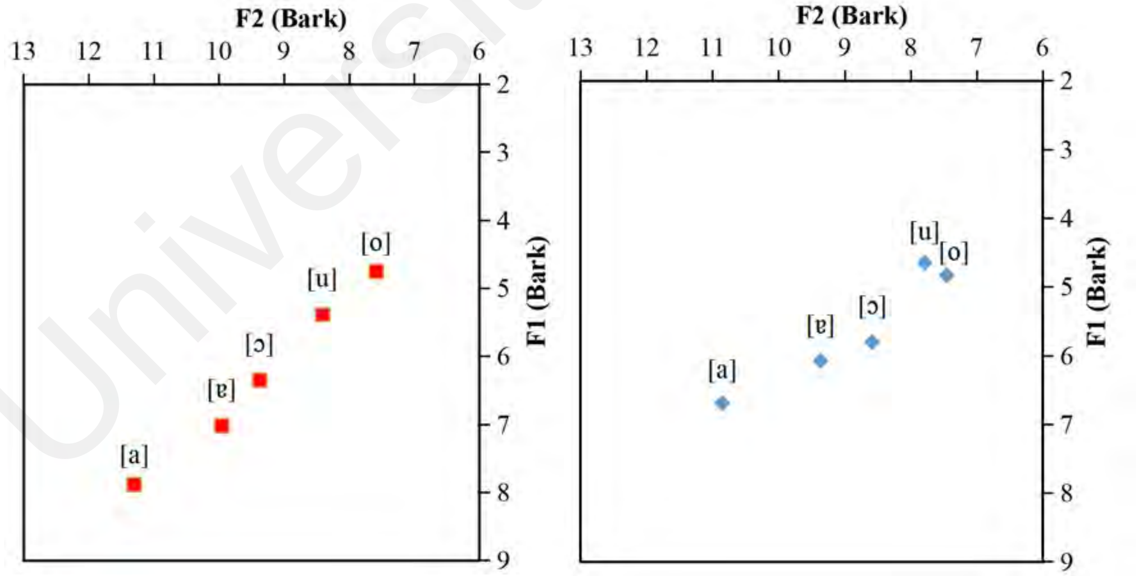

Figure 4.10: Distribution of the following vowels after the zero consonant found in Cantonese zero initial by females (left) and males (right)

3. Nasalised Vowel

The nasalised vowel is not only found in Cantonese nasal initial; it is also found in the realisations of Cantonese zero initial in this study.

(a) Spectrogram analysis

Figure 4.11 shows the spectrogram of the production of the first syllable "爱" from the word "爱情" (love). Based on auditory perception, there is a nasal sound at the beginning of the syllable. However, no nasal performance appears in the spectrogram. This spectrogram performance is similar to the spectrogram for a nasalised vowel presented in Figure 4.6.

According to the Cantonese pronunciation dictionary (Zhan, 2002), the syllable "爱" is a zero initial syllable. The occurrence of nasalised vowels in a non-nasal syllable seems unusual. Thus, this study proposes a more reasonable speculation: the nasalised vowel found in Cantonese zero initial may have evolved from the nasal consonant [ŋ]. The realisation of nasalised vowels in Cantonese zero initial may have evolved from zero consonant to nasal consonant, and further to the nasalisation of vowels and the deletion of nasal consonant. Thus, although nasalised vowels are classified under the zero consonant, this type of occurrence is also considered a variant of the Cantonese zero initial that underwent phonetic changes.

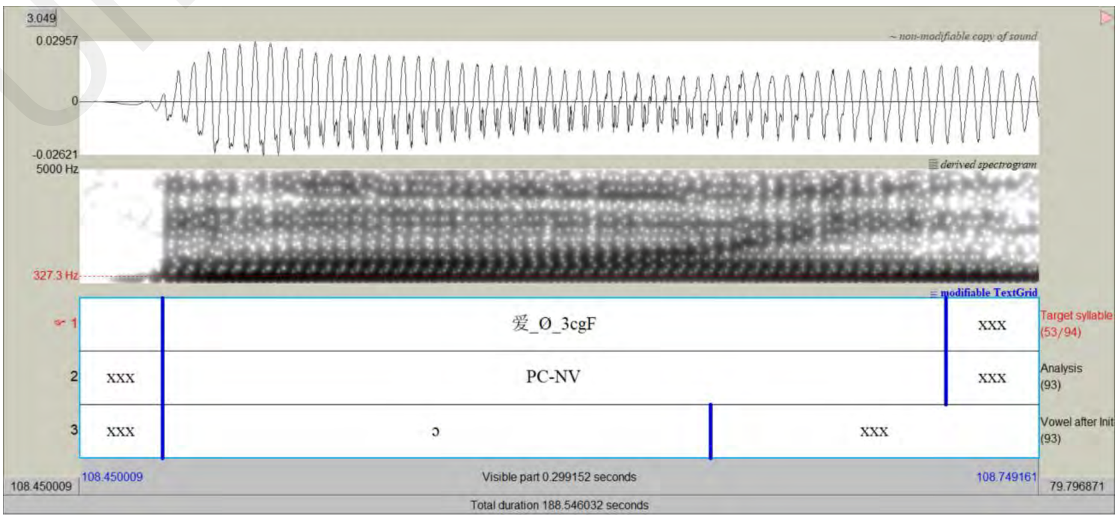

Figure 4.11: Spectrogram of the production of "爱" by speaker 2_FNWA

(b) Formant analysis

Table 4.10 shows the average formant frequencies of the nasalised vowels found in Cantonese zero initial, with the standard deviation in parentheses. The value of the standard deviation is not shown if there is only one token found. The distribution of the nasalised vowels is shown in Figure 4.12. According to the findings, there are only vowels [a], [ɔ], and [u] nasalised by females, and vowels [a], [ɐ], and [ɔ] nasalised by males. The distribution of nasalised vowels found in Cantonese zero initial is relatively consistent with the IPA vowel chart (The International Phonetic Association, 1999, p. ix).

Table 4.10: Average formant frequencies of the nasalised vowels found in Cantonese zero initial

Vowel type		Average formant frequencies			
		Female		Male	
		F1	F2	F1	F2
[ã]	Hz	868 (82.6)	1669 (145.5)	742 (150.7)	1492 (85.2)
	Bark	7.63 (0.6)	11.91 (0.6)	6.71 (1.2)	11.16 (0.4)
[ɐ̃]	Hz	-	-	606 (99.7)	1265 (422.5)
	Bark	-	-	5.63 (0.8)	10.05 (2.1)
[ɔ̃]	Hz	390 (120.4)	1018 (81.6)	530 (86.8)	1001 (33.4)
	Bark	3.76 (1.1)	8.62 (0.5)	5.00 (0.7)	8.52 (0.2)
[õ]	Hz	-	-	-	-
	Bark	-	-	-	-
[ũ]	Hz	331 (-)	997 (-)	-	-
	Bark	3.21 (-)	8.49 (-)	-	-

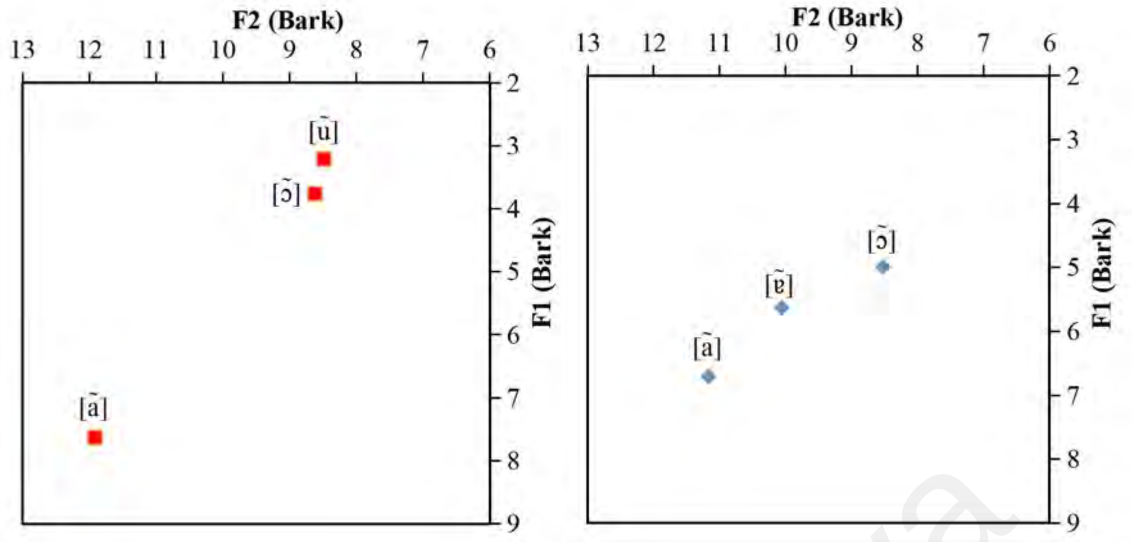

Figure 4.12: Distribution of the nasalised vowels found in Cantonese zero initial by females (left) and males (right)

4.2.3 Acoustic Features of Nasal Consonant [ŋ]

The nasal consonant [ŋ] is the most frequent realisation in Cantonese zero initial. The realisation of the nasal consonant [ŋ] appeared mostly when it was a syllable with T8 (*Xiayinru* tones), before the vowel [a] and a simple final, and was the last syllable of a disyllabic word (which will be explained in Section 4.4.3). Its acoustic features are presented below.

(a) Spectrogram analysis

Figure 4.13 shows the spectrogram of the production of the first syllable "爱" from the word "爱情" (love). It shows that there are fainter formants that appear before the vowel starts. This spectrogram performance is the same as the spectrogram performance of nasal consonant shown in Figure 4.1 (refer to Section 4.1.2). The formants of nasal consonants are fainter than vowels, and they also have an antiformant. Furthermore, according to auditory perception, it was initially produced with a nasal consonant [ŋ].

This performance on the spectrogram is sufficient to show that the initial position of the zero initial syllable has been replaced with a nasal consonant. To further evidence that it is velar nasal [ŋ], the acoustic features of these nasal consonants are also presented in terms of formant, intensity, and duration. An analysis of the following vowels is also provided.

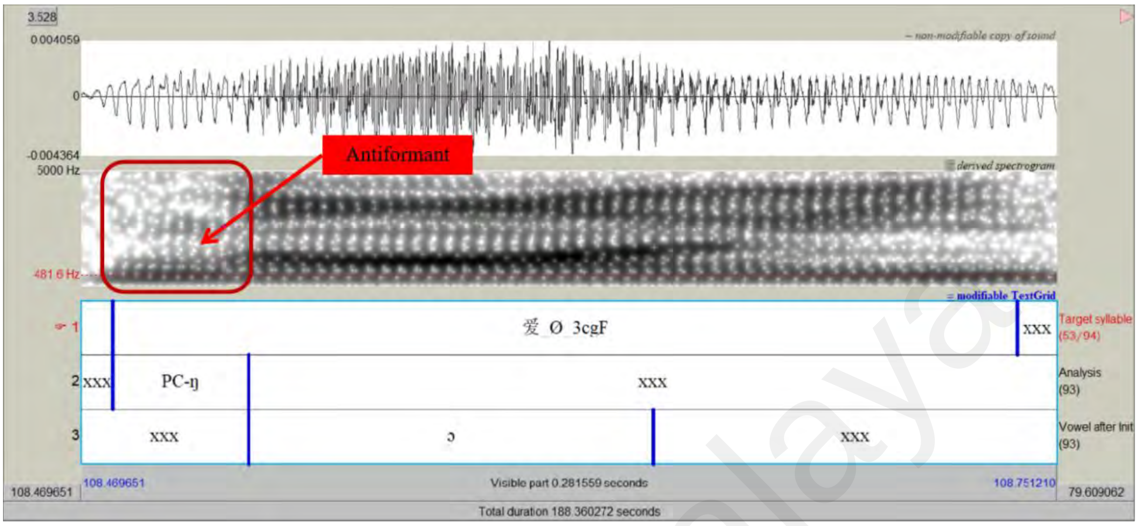

Figure 4.13: Spectrogram of the production of "爱" by speaker 4_FNWA

(b) Formant analysis

Table 4.11 presents the average nasal formant frequencies of the nasal consonant found in Cantonese zero initial by vowel type, with the standard deviation in parentheses. Averagely, it has a N1 at 402 Hz, a N2 at 1395 Hz, and a N3 at 2822 Hz for females, and a N1 at 413 Hz, a N2 at 1269 Hz, and a N3 at 2438 Hz for males. The nasal formant frequencies for males are slightly lower than for females. In terms of vowel type, the nasal consonant before the vowel [a] has the highest N1, N2, and N3, regardless of whether it is produced by a female or a male.

Table 4.11: Average nasal formant frequencies of nasal consonant found in Cantonese zero initial (by vowel type)

Vowel type	Average nasal formant frequencies (Hz)					
	Female			Male		
	N1	N2	N3	N1	N2	N3
[ŋ-a]	430 (115.5)	1516 (300.9)	2836 (176.3)	431 (129.8)	1377 (277.4)	2469 (247.9)

Table 4.11, continued

Vowel type	Average nasal formant frequencies (Hz)					
	Female			Male		
	N1	N2	N3	N1	N2	N3
[ŋ-ɐ]	408 (102.0)	1385 (238.0)	2807 (144.0)	404 (86.9)	1265 (234.4)	2387 (251.4)
[ŋ-ɔ]	377 (88.8)	1308 (276.7)	2820 (144.5)	398 (89.8)	1161 (257.0)	2449 (213.4)
[ŋ-o]	377 (85.2)	1229 (451.8)	2798 (161.5)	344 (76.3)	945 (83.2)	2422 (20.8)
[ŋ-u]	355 (92.5)	1298 (261.3)	2835 (216.7)	415 (87.6)	1077 (322.4)	2469 (249.5)
Average	**402 (104.7)**	**1395 (299.4)**	**2822 (160.7)**	**413 (107.0)**	**1269 (278.0)**	**2438 (237.5)**

(c) Intensity analysis

Table 4.12 shows the average intensity of the nasal consonant preceding different vowel types, with the standard deviation in parentheses. Overall, it has an average intensity of 39 dB for females and 48 dB for males. The intensity for females is lower than for males. The nasal consonant has the greatest intensity before the vowel [o] in females and before [u] in males.

Table 4.12: Average intensity of nasal consonant found in Cantonese zero initial (by vowel type)

Vowel type	Average intensity (dB)	
	Female	Male
[ŋ-a]	39 (6.4)	45 (14.0)
[ŋ-ɐ]	40 (7.0)	48 (15.8)
[ŋ-ɔ]	39 (6.9)	51 (18.0)
[ŋ-o]	41 (6.4)	41 (3.1)
[ŋ-u]	39 (6.4)	60 (17.8)
Average	**39 (6.7)**	**48 (15.9)**

(d) Duration analysis

Table 4.13 shows the nasal duration of the nasal consonant preceding different final types, with the standard deviation in parentheses. It has an average duration of 70.82 ms for females and 76.21 ms for males. Males have a longer average nasal duration compared to females. The longest nasal consonant occurs before stop finals for both females (78.19 ms) and males (83.75 ms). The nasal consonant preceding simple finals is the shortest in females (61.57 ms), while it is the shortest when preceding nasal finals in males (66.24 ms).

Table 4.13: Average nasal duration of nasal consonant found in Cantonese zero initial (by final type)

Final type		**Average nasal duration (ms)**			
		Female		**Male**	
Simple finals	[a]	61.57 (27.5)	61.57 (27.5)	77.74 (37.7)	77.74 (37.7)
Compound finals	[ɐi]	94.18 (27.6)	73.16 (28.3)	77.66 (34.8)	75.34 (36.4)
	[ɐu]	66.32 (27.0)		60.83 (37.6)	
	[ɔi]	73.26 (26.7)		88.32 (34.3)	
	[ou]	62.54 (23.4)		64.96 (33.0)	
Nasal finals	[an]	52.57 (22.3)	63.74 (27.3)	61.27 (53.9)	66.24 (37.6)
	[ɐm]	66.58 (28.2)		70.96 (31.8)	
	[ɔn]	65.29 (27.5)		63.82 (35.2)	
Stop finals	[ap]	63.47 (21.8)	78.19 (31.7)	74.82 (49.0)	83.75 (39.2)
	[at]	95.14 (24.5)		94.52 (30.1)	
	[ak]	78.71 (35.7)		79.87 (52.1)	
	[ɔk]	87.03 (27.9)		81.01 (39.7)	
	[uk]	64.57 (36.2)		85.39 (27.3)	
Average		**70.82 (29.6)**		**76.21 (37.9)**	

(e) Following vowel analysis

Table 4.14 shows the average formant frequencies of the vowels that follow the nasal consonant, with the standard deviation in parentheses. Their distribution is shown in Figure 4.14. The distribution of the vowels is relatively consistent with the IPA vowel chart (The International Phonetic Association, 1999, p. ix). But the vowel [o] in males shows a difference: it is higher than the vowel [u].

Table 4.14: Average formant frequencies of the following vowels after the nasal consonant found in Cantonese zero initial

Vowel type		Formant frequencies (Hz)			
		Female		Male	
		F1	F2	F1	F2
[a]	Hz	882 (151.1)	1695 (230.8)	752 (97.3)	1472 (73.4)
	Bark	7.73 (1.1)	12.02 (0.8)	6.78 (0.7)	11.07 (0.3)
[ɐ]	Hz	749 (122.7)	1453 (245.5)	636 (96.0)	1324 (197.5)
	Bark	6.76 (0.9)	10.99 (1.1)	5.88 (0.8)	10.36 (0.9)
[ɔ]	Hz	668 (163.8)	1181 (145.1)	595 (73.0)	1024 (71.5)
	Bark	6.13 (1.3)	9.60 (0.8)	5.54 (0.6)	8.66 (0.4)
[o]	Hz	560 (107.7)	1032 (238.7)	452 (0.9)	902 (70.1)
	Bark	5.25 (0.9)	8.71 (1.2)	4.31 (0.0)	7.86 (0.5)
[u]	Hz	537 (112.4)	987 (71.4)	498 (96.5)	889 (58.1)
	Bark	5.06 (1.0)	8.43 (0.5)	4.72 (0.8)	7.77 (0.4)

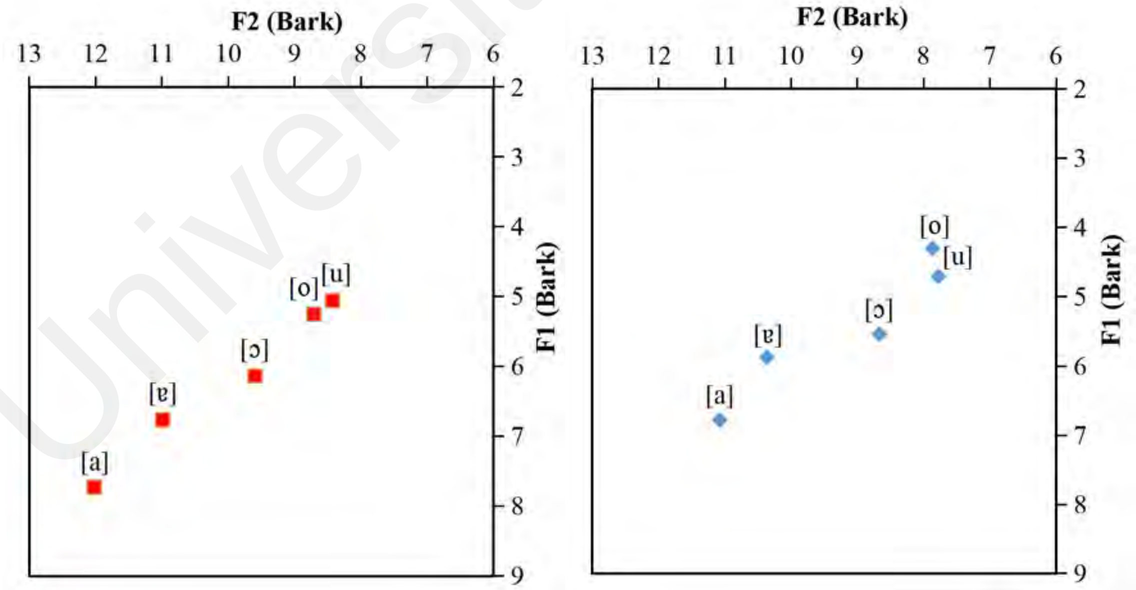

Figure 4.14: Distribution of the following vowels after the nasal consonant found in Cantonese zero initial by females (left) and males (right)

4.3 Production of Nasal and Zero Realisations

In this study, both the realisations of nasal and zero consonants are found in Cantonese nasal and zero initials. By comparing the spectrogram performance and acoustic features of nasal consonants found in Cantonese nasal and zero initials (refer to Sections 4.1.2 and 4.2.3), it can be argued that they are the same consonant—the nasal consonant [ŋ]. The detailed comparison of nasal consonants found in Cantonese nasal and zero initials will then be presented in Section 6.1.

On the other hand, a comparison of the spectrogram performance and acoustic features of zero consonants found in Cantonese nasal and zero initials (refer to Sections 4.1.3 and 4.2.2) was observed. It also preliminary confirms that they are the same, and there are three types of zero consonants in Malaysian Cantonese: null initial [Ø], glottal stop [ʔ], and nasalised vowel (e.g., [ã], [ɐ̃], [ɔ̃], [õ], and [ũ]).

The nasalised vowels are found in the realisations of Cantonese nasal and zero initials. It has an empty initial slot; hence, it was classified as a zero consonant. Nonetheless, as the nasalised vowels neither retain the nasal consonant [ŋ] nor are the zero initial in the traditional sense, they are considered a phonetic change in both nasal and zero initials in the present study. The discussion on the nasalised vowels will also be presented in Section 6.1.

Apart from that, a comparison of vowels in the same following phonetic environment was made. Figure 4.2 (in Section 4.1.2) and Figure 4.5 (in Section 4.1.3) were compared for the vowel distribution after nasal and zero consonants found in Cantonese nasal initial, while Figure 4.10 (in Section 4.2.2) and Figure 4.14 (in Section 4.2.3) were compared for the vowel distribution after zero and nasal consonants found in Cantonese zero initial. The vowels after a nasal consonant are produced by a slightly more forward tongue body compared to the vowels after a zero consonant. This is consistent with Recasens's (1999) claim that the formant frequencies of vowels are slightly affected in the nasal environment.

4.4 Effects of Linguistic and Non-Linguistic Factors on the Production of Cantonese Nasal and Zero Initials

The variable rule analysis is conducted to investigate the correlation between the independent variables (the linguistic and non-linguistic factors) and the dependent variables (the Cantonese nasal initial and zero initial). To ensure the accuracy of the variable rule analysis results, the frequency distributions of production by each factor group were also reported. The factor weights for significant factors obtained from the variable rule analysis were presented following it.

4.4.1 Effects of Linguistic Factors on the Production of Cantonese Nasal Initial

Table 4.15 represents the frequency distribution of the production of Cantonese nasal initial by linguistic factors (i.e., lexical tone, vowel type, final type, and syllable order). The percentage is indicated in parentheses. In order to observe the effects of linguistic factors on the production of Cantonese nasal initial, the following analysis mainly focuses on the realisation that occurs in phonetic change, that is, other realisations excluding nasal consonant.

In terms of lexical tone, other realisations excluding nasal consonant occur slightly more often in syllables with T9 (*Yangru* tone), which accounts for 14.3%, followed by T6 (*Yangqu* tone) (11.0%), T5 (*Yangshang* tone) (9.0%), and T4 (*Yangping* tone) (6.0%). In terms of vowel type, other realisations excluding nasal consonant occur slightly more frequently preceding [o], which accounts for 26.0%, followed by [ɔ] (11.1%), [a] (7.1%), and [ɐ] (5.5%). In terms of final type, other realisations excluding nasal consonant occur slightly more frequently preceding stop finals and nasal finals, which account for 14.3% and 12.2% respectively, followed by compound finals (8.8%) and simple finals (6.9%). In terms of syllable order, other realisations excluding nasal consonant occur relatively more frequently when it is the first syllable of a disyllabic word, which accounts for 12.9%, compared to when it is the last syllable position, which accounts for 6.3%.

Table 4.15: Frequency distribution of the production of Cantonese nasal initial (by linguistic factors)

Linguistic factors		Nasal consonant, N (%)	Other realisations excluding nasal consonant, N (%)	Total, N (%)
Lexical tone	T4	172 (94.0)	11 (6.0)	183 (24.1)
	T5	181 (91.0)	18 (9.0)	199 (26.2)
	T6	274 (89.0)	34 (11.0)	308 (40.5)
	T9	60 (85.7)	10 (14.3)	70 (9.2)
Vowel type	[-a]	210 (92.9)	16 (7.1)	226 (29.7)
	[-ɐ]	223 (94.5)	13 (5.5)	236 (31.1)
	[-ɔ]	200 (88.9)	25 (11.1)	225 (29.6)
	[-o]	54 (74.0)	19 (26.0)	73 (9.6)
Final type	Simple finals	148 (93.1)	11 (6.9)	159 (20.9)
	Compound finals	342 (91.2)	33 (8.8)	375 (49.3)
	Nasal finals	137 (87.8)	19 (12.2)	156 (20.5)
	Stop finals	60 (85.7)	10 (14.3)	70 (9.2)
Syllable order	First syllable	330 (87.1)	49 (12.9)	379 (49.9)
	Last syllable	357 (93.7)	24 (6.3)	381 (50.1)

The factors that exerted the strongest conditioning effects on the phonetic variation were detected by using the variable rule analysis. According to the best stepping-up run for the correlation between the linguistic factors and the production of nasal initial (see Appendix G1), the log-likelihood value is -217.973 and the significance level is 0.026. According to the analysis results, lexical tone is eliminated.

The groups eliminated are the non-significant factors. This suggests that lexical tones do not have a significant constraining effect on the phonetic changes of the Cantonese nasal initial.

Table 4.16 shows the factor weights of the linguistic factors affecting the production of the Cantonese nasal initial. The constraining effect of a factor group is shown by its range. The range is the subtraction of the highest and lowest factor weights in each factor group, but it does not appear with a decimal. With the comparison among the ranges of each factor group, the factor group with the highest range identifies itself as having the strongest constraint on phonetic changes, while the factor group with the lowest range has the weakest constraint on phonetic changes.

Among the linguistic factors, vowel type has the strongest constraint on affecting the production of the Cantonese nasal initial. It has the highest range, which is 483. In terms of vowel type, the factor weights for [-o] and [-ɔ] are 0.860 and 0.586 respectively. A factor weight of more than 0.5 means that the factor favours the presence of phonetic changes (other realisations excluding nasal consonant). Thus, [-ɐ] and [-a], which have factor weights of 0.399 and 0.377, are less favourable for the presence of phonetic changes. This is largely consistent with the frequency distribution results presented earlier.

The final type and syllable order have a weak constraint, with a range of 267 and 209 respectively. In terms of final type, nasal finals (0.684) and stop finals (0.596) are the more favourable factors for the other realisations excluding nasal consonant compared to simple finals (0.465) and compound finals (0.417). In terms of syllable order, the first syllable position (0.605) is more favourable to the other realisations excluding nasal consonant than the last syllable position (0.396).

Table 4.16: Factor weights of the linguistic factors affecting the production of Cantonese nasal initial

Vowel type (Range: 483)		Final type (Range: 267)		Syllable order (Range: 209)	
[-a]	0.377	**Simple finals**	0.465	**First syllable**	0.605
[-ɐ]	0.399	**Compound finals**	0.417	**Last syllable**	0.396
[-ɔ]	0.586	**Nasal finals**	0.684		
[-o]	0.860	**Stop finals**	0.596		

4.4.2 Effects of Non-Linguistic Factors on the Production of Cantonese Nasal Initial

Table 4.17 represents the frequency distribution of the production of Cantonese nasal initial by non-linguistic factors (i.e., gender, region, social role, and home language). The percentage is shown in parentheses. The following analysis mainly focuses on the realisations that underwent phonetic change, that is, other realisations excluding the nasal consonant, in order to observe the effects of non-linguistic factors on the production of Cantonese nasal initial.

In terms of gender, other realisations excluding nasal consonant occur slightly more often among males, which account for 15.8%, compared to females, which account for 7.1%. In terms of region, other realisations excluding nasal consonant occur slightly more frequently among Cantonese speakers in Negeri Sembilan, which account for 11.3%, compared to Cantonese speakers in the Klang Valley, which account for 6.4%. In terms of social role, other realisations excluding nasal consonant occur slightly more frequently among students, which account for 11.8%, compared to workers, which account for 8.6%. In terms of home language, other realisations excluding nasal consonant occur relatively more frequently among Cantonese speakers who speak Cantonese to all family members, which accounts for 10.5%, compared to Cantonese speakers who only speak Cantonese to specific family members, which accounts for 8.4%.

Table 4.17: Frequency distribution of the production of Cantonese nasal initial (by non-linguistic factors)

Non-linguistic factors		Nasal consonant, N (%)	Other realisations excluding nasal consonant, N (%)	Total, N (%)
Gender	Male	187 (84.2)	35 (15.8)	222 (29.2)
	Female	500 (92.9)	38 (7.1)	538 (70.8)
Region	Klang Valley	248 (93.6)	17 (6.4)	265 (34.9)
	Negeri Sembilan	439 (88.7)	56 (11.3)	495 (65.1)
Social role	Student	201 (88.2)	27 (11.8)	228 (30.0)
	Worker	486 (91.4)	46 (8.6)	532 (70.0)
Home language	Speak Cantonese to all family members.	383 (89.5)	45 (10.5)	428 (56.3)
	Only speak Cantonese to specific family members.	304 (91.6)	28 (8.4)	332 (43.7)

According to the best stepping-up run for the correlation between the non-linguistic factors and the production of nasal initial (see Appendix G2), the log-likelihood value is -226.463 and the significance level is 0.020. Home language is eliminated from the analysis results; it is a non-significant factor in the production of the Cantonese nasal initial.

Table 4.18 shows the factor weights of the non-linguistic factors affecting the production of the Cantonese nasal initial. Among the non-linguistic factors, the region has the strongest constraint on affecting the phonetic changes of the Cantonese nasal initial. It has the highest range, which is 316. In terms of region, Negeri Sembilan

(0.613) is more favourable than Klang Valley (0.297) for the other realisations excluding nasal consonant.

Gender and social role have weak constraints, with a range of 208 and 201 respectively. In terms of gender, males (0.646) are a more favourable factor compared to females (0.438). In terms of social role, students (0.640) are the more favourable factor compared to workers (0.439).

Table 4.18: Factor weights of the non-linguistic factors affecting the production of Cantonese nasal initial

Gender (Range: 208)		**Region** (Range: 316)		**Social role** (Range: 201)	
Male	0.646	**Klang Valley**	0.297	**Student**	0.640
Female	0.438	**Negeri Sembilan**	0.613	**Worker**	0.439

4.4.3 Effects of Linguistic Factors on the Production of Cantonese Zero Initial

Table 4.19 represents the frequency distribution of the production of Cantonese zero initial by linguistic factors (i.e., lexical tone, vowel type, final type, and syllable order). The percentage is shown in parentheses. The following analysis mainly focuses on the realisations in which phonetic change occurs, that is, other realisations excluding the zero consonant (null initial [Ø] and glottal stop [ʔ]). The nasalised vowel is also categorised as a realisation that underwent phonetic changes, as it is not the common realisation of a zero consonant.

In terms of lexical tone, the phonetic changes (other realisations excluding the zero consonant) occur more often in syllables with T8 (*Xiayinru* tone), which accounts for 93.9%, followed by T2 (*Yinshang* tone) (76.7%), T3 (*Yinqu* tone) (65.0%), T7 (*Shangyinru* tone) (62.0%), and T1 (*Yinping* tone) (60.3%). In terms of vowel type, the phonetic changes occur more frequently preceding [a], which accounts for 91.7%, followed by [ɔ] (69.5%), [ɐ] (66.7%), [u] (47.4%), and [o] (34.3%). In terms of final type, the phonetic changes occur more frequently preceding simple finals, which account for 93.8%, followed by stop finals (78.4%), nasal finals (65.1%), and compound finals (61.1%). In terms of syllable order, the phonetic changes occur more frequently when it is the last syllable of a disyllabic word, which accounts for 85.3%, compared to when it is in the first syllable position, which accounts for 55.3%.

Table 4.19: Frequency distribution of the production of Cantonese zero initial (by linguistic factors)

Linguistic factors		**Zero consonant, N (%)**	**Other realisations excluding zero consonant, N (%)**	**Total, N (%)**
Lexical tone	T1	62 (39.7)	94 (60.3)	156 (18.6)
	T2	37 (23.3)	122 (76.7)	159 (19.0)
	T3	105 (35.0)	195 (65.0)	300 (35.8)
	T7	41 (38.0)	67 (62.0)	108 (12.9)
	T8	7 (6.1)	107 (93.9)	114 (13.6)
Vowel type	[-a]	19 (8.3)	209 (91.7)	228 (27.2)
	[-ɐ]	77 (33.3)	154 (66.7)	231 (27.6)
	[-ɔ]	71 (30.5)	162 (69.5)	233 (27.8)
	[-o]	44 (65.7)	23 (34.3)	67 (8.0)
	[-u]	41 (52.6)	37 (47.4)	78 (9.3)
Final type	Simple finals	5 (6.2)	75 (93.8)	80 (9.6)
	Compound finals	119 (38.9)	187 (61.1)	306 (36.6)
	Nasal finals	80 (34.9)	149 (65.1)	229 (27.4)
	Stop finals	48 (21.6)	174 (78.4)	222 (26.5)
Syllable order	First syllable	192 (44.7)	238 (55.3)	430 (51.4)
	Last syllable	60 (14.7)	347 (85.3)	407 (48.6)

According to the best stepping-up run for the correlation between the linguistic factors and the production of zero initial (see Appendix G3), the log-likelihood value is -400.965 and the significance level is 0.000. Lexical tone and final type are eliminated from the analysis results; they are not significant for the presence of the phonetic changes in the Cantonese zero initial.

Table 4.20 shows the factor weights of the linguistic factors affecting the production of the Cantonese zero initial. Among the linguistic factors, vowel type has the strongest constraint on affecting the phonetic changes of Cantonese zero initial. It has the highest range, which is 678. Vowel [-a] (0.823) has the strongest constraint on the presence of phonetic changes (other realisations excluding the zero consonant), compared to [-ɔ] (0.453), [-ɐ] (0.410), [-u] (0.208), and [-o] (0.145). This is largely consistent with the frequency distribution results presented earlier. On the other hand, a small but significant effect is exerted by syllable order (with a range of 416): the last syllable position (0.713) is more favourable than the first syllable position (0.297) for the other realisations excluding the zero consonant.

Table 4.20: Factor weights of the linguistic factors affecting the production of Cantonese zero initial

Vowel type (Range: 678)		**Syllable order** (Range: 416)	
[-a]	0.823	**First syllable**	0.297
[-ɐ]	0.410	**Last syllable**	0.713
[-ɔ]	0.453		
[-o]	0.145		
[-u]	0.208		

4.4.4 Effects of Non-Linguistic Factors on the Production of Cantonese Zero Initial

Table 4.21 represents the frequency distribution of the production of Cantonese zero initial by non-linguistic factors (i.e., gender, region, social role, and home language). The percentage is shown in parentheses. The following analysis mainly focuses on the realisations in which phonetic change occurs, that is, other realisations excluding the zero consonant (null initial [Ø] and glottal stop [ʔ]). The nasalised vowel is also classified as one of the realisations that underwent phonetic changes.

In terms of gender, the phonetic changes (other realisations excluding zero consonant) occur frequently among both females (73.2%) and males (61.9%), with females being slightly more frequent. In terms of region, the phonetic changes occur frequently among Cantonese speakers in both Klang Valley and Negeri Sembilan, which account for 73.5% and 68.0% respectively, with Cantonese speakers from Klang Valley being slightly more frequent. In terms of social role, phonetic changes occur frequently among both workers and students, which account for 71.1% and 67.1% respectively, with Cantonese speakers who are workers being slightly more frequent. In terms of home language, the phonetic changes occur frequently among both Cantonese speakers who speak Cantonese to all family members and those who only speak Cantonese to specific family members, which account for 70.5% and 69.1% respectively.

Table 4.21: Frequency distribution of the production of Cantonese zero initial (by non-linguistic factors)

Non-linguistic factors		Zero consonant, N (%)	Other realisations excluding zero consonant, N (%)	Total, N (%)
Gender	Male	94 (38.1)	153 (61.9)	247 (29.5)
	Female	158 (26.8)	432 (73.2)	590 (70.5)
Region	Klang Valley	76 (26.5)	211 (73.5)	287 (34.3)
	Negeri Sembilan	176 (32.0)	374 (68.0)	550 (65.7)
Social role	Student	82 (32.9)	167 (67.1)	249 (29.7)
	Worker	170 (28.9)	418 (71.1)	588 (70.3)
Home language	Speak Cantonese to all family members.	139 (29.5)	332 (70.5)	471 (56.3)
	Only speak Cantonese to specific family members.	113 (30.9)	253 (69.1)	366 (43.7)

According to the best stepping-up run for the correlation between the non-linguistic factors and the production of zero initial (see Appendix G4), the log-likelihood value is -501.770 and the significance level is 0.039. Home language is eliminated from the analysis results; it is a non-significant factor in the phonetic changes of the Cantonese zero initial.

Table 4.22 shows the factor weights of the non-linguistic factors affecting the production of the Cantonese zero initial. Among the non-linguistic factors, the region has the strongest constraint on affecting the phonetic changes of Cantonese zero initial. It has the highest range, which is 168. In terms of region, Cantonese speakers from Klang Valley (0.610) are more favourable for the presence of phonetic changes (other realisations excluding zero consonant) compared to Cantonese speakers from Negeri Sembilan (0.442).

Gender and social role have weak constraints, with a range of 127 and 117 respectively. In terms of gender, females (0.538) are a more favourable factor compared to males (0.411). In terms of social role, workers (0.535) are the more favourable factor compared to students (0.418).

Table 4.22: Factor weights of the non-linguistic factors affecting the production of Cantonese zero initial

Gender (Range: 127)		**Region** (Range: 168)		**Social role** (Range: 117)	
Male	0.411	**Klang Valley**	0.610	**Student**	0.418
Female	0.538	**Negeri Sembilan**	0.442	**Worker**	0.535

4.5 Summary

In short, the nasal and zero consonants are the main realisations found in Cantonese nasal and zero initials in this study. The nasal consonant found in both the Cantonese nasal and zero initials is acoustically consistent. It can be preliminarily concluded that a phonetic change has occurred in these two Cantonese initials in Malaysia; it mostly occurs in the zero initial. The zero initial is relatively frequently replaced by the nasal consonant. Regarding the constraints on the production of these two Cantonese initials, linguistic factors, especially the vowel types, show a stronger constraining effect compared to non-linguistic factors.

CHAPTER 5

PERCEPTION OF CANTONESE NASAL INITIAL /ŋ/ AND ZERO INITIAL /Ø/

The previous chapter answered the first and second research questions. This chapter aims to answer the third and fourth research questions. In this chapter, the findings for the speech perception of Cantonese nasal and zero initials will be presented. The perception task is conducted based on the results of production. From the findings presented in the previous chapter, it can be seen that the zero initial is more likely to have a phonetic change. Thus, the perception task was conducted with more attention on the zero initial, while not all the syllable structures were included in the perception of the nasal initial (the task design for perception may refer to Sections 3.3.2 and 3.4.2). As mentioned in Section 4.4, vowel type shows significant constraints on the production of these two initials. Thus, the perception frequencies of these two initials were presented by vowel types. However, the frequency distributions by vowel type are scattered, and the regular patterns are difficult to observe. Therefore, variable rule analysis is used to observe the constraining effect of linguistic and non-linguistic factors on the perception of nasal and zero initials more clearly. The discussion of the findings will be presented in the next chapter.

5.1 Perception of Cantonese Nasal Initial

From the speech production results (as presented in Chapter 4), it was shown that the Cantonese nasal initial is mostly well maintained, with the nasal consonant [ŋ] as its main realisation. Based on Section 4.4.1, the strongest constraint linguistic factor affecting the production of the Cantonese nasal initial is vowel type. The nasal initial preceding the vowels [o] and [ɔ] is relatively more likely to undergo phonetic changes and be replaced with a zero consonant. In order to further determine which of these two vowels has the strongest constraint on phonetic changes, the perception task of nasal initial is mainly focused on both of them. Thus, about the perception of the nasal initial, only two disyllabic words were tested, one target syllable with the nucleus (following vowel) [o] and another with [ɔ].

Table 5.1 shows the perception frequencies of Cantonese nasal initial by vowel types; the percentage is shown in parentheses. 43 tokens (58.9%) show that the nasal consonant is being considered as the correct pronunciation for the Cantonese nasal initial. On the other hand, 9 tokens (12.3%) consider zero consonant to be the correct pronunciation for the Cantonese nasal initial. It is worth noting that 11 tokens (15.1%) believe that both nasal and zero consonants are the correct pronunciation for the Cantonese nasal initial. In terms of vowels, the findings on the vowel [ɔ] are relatively concentrated compared to the vowel [o]. Up to 73.5% of the listeners considered the nasal consonant to be the correct pronunciation for the Cantonese nasal initial when it preceded the vowel [ɔ].

Table 5.1: Perception frequencies of Cantonese nasal initial (by vowel types)

Options for the correct pronunciation	**Frequency, N (%)**		
	[-o]	**[-ɔ]**	**Total**
Nasal consonant	18 (46.2)	25 (73.5)	43 (58.9)
Zero consonant	5 (12.8)	4 (11.8)	9 (12.3)
Nasalised vowel	3 (7.7)	-	3 (4.1)
Nasal consonant and zero consonant	6 (15.4)	5 (14.7)	11 (15.1)
Nasal consonant and nasalised vowel	5 (12.8)	-	5 (6.8)
Zero consonant and nasalised vowel	-	-	-
Nasal consonant, zero consonant, and nasalised vowel	2 (5.1)	-	2 (2.7)
Total	39 (100)	34 (100)	**73 (100)**

5.2 Perception of Cantonese Zero Initial

Table 5.2 shows the perception frequencies of Cantonese zero initial by vowel types; the percentage is shown in parentheses. 269 tokens (31.1%) show that the nasal consonant is considered the correct pronunciation of the Cantonese zero initial. It is even slightly more frequent than the zero consonant (including the null initial [Ø] and glottal stop [ʔ]), which accounts for 229 tokens (26.4%). Similarly, a portion of listeners believe that both the zero and nasal consonants are the correct pronunciation of the Cantonese zero initial, which accounts for 181 tokens (20.9%).

Table 5.2: Perception frequencies of Cantonese zero initial (by vowel type)

Options for the correct pronunciation	Frequency, N (%)					
	[-a]	**[-ɐ]**	**[-ɔ]**	**[-o]**	**[-u]**	**Total**
Zero consonant	27 (11.4)	84 (35.4)	43 (18.2)	41 (53.9)	34 (42.5)	229 (26.4)
Nasal consonant	80 (33.8)	64 (27.0)	89 (37.7)	23 (30.3)	13 (16.3)	269 (31.1)
Nasalised vowel	9 (3.8)	4 (1.7)	2 (0.8)	-	-	15 (1.7)
Zero consonant and nasal consonant	59 (24.9)	37 (15.6)	54 (22.9)	12 (15.8)	19 (23.8)	181 (20.9)
Nasal consonant and nasalised vowel	36 (15.2)	32 (13.5)	23 (9.7)	-	5 (6.3)	96 (11.1)
Zero consonant and nasalised vowel	3 (1.3)	4 (1.7)	5 (2.1)	-	1 (1.3)	13 (1.5)
Zero consonant, nasal consonant, and nasalised vowel	23 (9.7)	12 (5.1)	20 (8.5)	-	8 (10.0)	63 (7.3)
Total	237 (100)	237 (100)	236 (100)	76 (100)	80 (100)	**866 (100)**

5.3 Effects of Linguistic and Non-Linguistic Factors on the Perception of Cantonese Nasal and Zero Initials

The variable rule analysis is also conducted to investigate the correlation between linguistic and non-linguistic factors and the perception of Cantonese nasal and zero initials.

5.3.1 Effects of Linguistic Factors on the Perception of Cantonese Nasal Initial

The production and perception results of Cantonese nasal initial showed it was mostly well maintained in the central region of Malaysia. Vowel types show the strongest constraint effect on the production of Cantonese nasal initial (refer to Section 4.4.1). The vowels [o] and [ɔ] are more favourable for the other realisations excluding nasal consonant. This suggests that the nasal initial preceding these two vowels [o] and [ɔ] is relatively more frequently replaced with a zero consonant. Thus, only these two vowels were tested in the perception task. The variable rule analysis for the perception of nasal initial is primarily concerned with further investigating these two vowels in order to find out which vowel has a more constraining effect.

Table 5.3 represents the frequency distribution of the perception of the Cantonese nasal initial by vowel type. The percentage is shown in parentheses. Other options excluding the nasal consonant were considered to be correct more frequently when they were followed by a vowel [o]. It accounts for 21 tokens (53.8%) compared to the vowel [ɔ], which accounts for only 9 tokens (26.5%).

Table 5.3: Frequency distribution of the perception of Cantonese nasal initial (by vowel types)

Vowel types	Correct pronunciation considered by the listeners		Total, N (%)
	Nasal consonant, N (%)	Other options excluding nasal consonant, N (%)	
[-ɔ]	25 (73.5)	9 (26.5)	34 (46.6)
[-o]	18 (46.2)	21 (53.8)	39 (53.4)
Total			**73 (100)**

According to the best stepping-up run for the correlation between the linguistic factors and the perception of the nasal initial (see Appendix H1), the log-likelihood value is -46.567 and the significance level is 0.017. Table 5.4 shows the factor weights of the linguistic factors affecting the perception of Cantonese nasal initial. As presented in this table, the vowel type has a range of 285. Vowel [o] (0.633) is a more favourable factor compared to [ɔ] (0.348). The vowel [o] is more likely to influence the listeners to choose other options excluding the nasal consonant as the correct pronunciation for the Cantonese nasal initial.

Table 5.4: Factor weights of the linguistic factors affecting the perception of Cantonese nasal initial

Vowel type (Range: 285)	
[-ɔ]	0.348
[-o]	0.633

5.3.2 Effects of Non-Linguistic Factors on the Perception of Cantonese Nasal Initial

According to the best stepping-up run for the correlation between the non-linguistic factors and the perception of nasal initial (see Appendix H2), the log-likelihood value is -49.436. All four factor groups, including gender, region, social role, and home language, are eliminated from the analysis results. It shows that these factors are not significant factors affecting the perception of the Cantonese nasal initial. This may also be due to the control of the number of words tested.

5.3.3 Effects of Linguistic Factors on the Perception of Cantonese Zero Initial

Table 5.5 represents the frequency distribution of the perception of the Cantonese zero initial by linguistic factors (i.e., lexical tone, vowel type, final type, and syllable order). The zero consonant included the null initial [Ø] and the glottal stop [ʔ]. The percentage is shown in parentheses. In terms of lexical tone, other options (excluding the zero consonant) were considered to be correct more frequently for syllables with T8 (*Xiayinru* tone), which accounts for 84.0%, followed by T2 (*Yinshang* tone) (79.1%), T3 (*Yinqu* tone) (76.6%), T7 (*Shangyinru* tone) (69.7%), and T1 (*Yinping* tone) (57.0%). In terms of vowel type, other options (excluding the zero consonant) were considered to be correct more frequently when they preceded [a], which accounts for 88.6%, followed by [ɔ] (81.8%), [ɐ] (64.6%), [u] (57.5%), and [o] (46.1%). In terms of final type, other options (excluding the zero consonant) were considered to be correct more frequently when they preceded simple finals, which account for 92.4%, followed by stop finals (76.9%), nasal finals (72.9%), and compound finals (66.8%). In terms of syllable order, other options (excluding the zero consonant) were considered to be correct more frequently when they were in the last syllable position, which accounts for 82.4%, compared to when they were in the first syllable position, which accounts for 64.7%.

Table 5.5: Frequency distribution of the perception of Cantonese zero initial (by linguistic factors)

Linguistic factors		Correct pronunciation considered by the listeners		Total, N (%)
		Zero consonant, N (%)	Other options excluding zero consonant, N (%)	
Lexical tone	T1	68 (43.0)	90 (57.0)	158 (18.2)
	T2	33 (20.9)	125 (79.1)	158 (18.2)
	T3	73 (23.4)	239 (76.6)	312 (36.0)
	T7	36 (30.3)	83 (69.7)	119 (13.7)
	T8	19 (16.0)	100 (84.0)	119 (13.7)
Vowel type	[-a]	27 (11.4)	210 (88.6)	237 (27.4)
	[-ɐ]	84 (35.4)	153 (64.6)	237 (27.4)
	[-ɔ]	43 (18.2)	193 (81.8)	236 (27.3)
	[-o]	41 (53.9)	35 (46.1)	76 (8.8)
	[-u]	34 (42.5)	46 (57.5)	80 (9.2)
Final type	Simple finals	6 (7.6)	73 (92.4)	79 (9.1
	Compound finals	104 (33.2)	209 (66.8)	313 (36.1)
	Nasal finals	64 (27.1)	172 (72.9)	236 (27.3)
	Stop finals	55 (23.1)	183 (76.9)	238 (27.5)
Syllable order	First syllable	153 (35.3)	281 (64.7)	434 (50.1)
	Last syllable	76 (17.6)	356 (82.4)	432 (49.9)

According to the best stepping-up run for the correlation between the linguistic factors and the perception of zero initial (see Appendix H3), the log-likelihood value is -427.831 and the significance level is 0.001. The final type is eliminated from the analysis results; it is a non-significant factor in the perception of Cantonese zero initial /Ø/.

Table 5.6 shows the factor weights of the linguistic factors affecting the perception of Cantonese zero initial. Among the linguistic factors, vowel type has the strongest constraint on affecting the perception of Cantonese zero initial. It has the highest range, which is 560. Vowel [a] (0.710) is a more favourable factor compared to [ɔ] (0.621), [ɐ] (0.391), [u] (0.242), and [o] (0.150). The vowel [a] is more likely to influence the listeners to choose other options (excluding zero consonant) as the correct pronunciation for the Cantonese zero initial.

Lexical tones and syllable order exerted a small effect, with a range of 249 and 221 respectively. In terms of lexical tone, T3 (0.584) is the most favourable factor, followed by T7 (0.558), T2 (0.540), T8 (0.394), and T1 (0.335). In terms of syllable order, the last syllable position (0.611) is a more favourable factor compared to the first syllable position (0.390).

Table 5.6: Factor weights of the linguistic factors affecting the perception of Cantonese zero initial

Lexical tone (Range: 249)		**Vowel type** (Range: 560)		**Syllable order** (Range: 221)	
T1	0.335	**[-a]**	0.710	**First syllable**	0.390
T2	0.540	**[-ɐ]**	0.391	**Last syllable**	0.611
T3	0.584	**[-ɔ]**	0.621		
T7	0.558	**[-o]**	0.150		
T8	0.394	**[-u]**	0.242		

5.3.4 Effects of Non-Linguistic Factors on the Perception of Cantonese Zero Initial

Table 5.7 represents the frequency distribution of the perception of the Cantonese zero initial by non-linguistic factors (i.e., gender, region, social role, and home language). The percentage is shown in parentheses. In terms of gender, other options (excluding the zero consonant) were considered to be correct frequently among both females (74.8%) and males (69.8%), with females being slightly more frequent. In terms of region, participants from both Negeri Sembilan and Klang Valley also believed that other options (excluding the zero consonant) were considered correct pronunciation, which account for 75.6% and 71.7% respectively, with listeners from Negeri Sembilan being slightly more frequent. In terms of social role, both workers and students also believed that other options (excluding the zero consonant) were considered correct pronunciation, which account for 75.7% and 66.3% respectively, with listeners who are workers being slightly more frequent. In terms of home language, listeners from all categories of home language believed that other options (excluding the zero consonant) were considered correct pronunciation, which account for 69.7%, 76.0%, and 80.1% respectively, for people who speak Cantonese to all family members, those who only speak Cantonese to specific family members, and those who do not speak Cantonese at home but speak it outside of home.

Table 5.7: Frequency distribution of the perception of Cantonese zero initial (by non-linguistic factors)

Non-linguistic factors		Correct pronunciation considered by the listeners		Total, N (%)
		Zero consonant, N (%)	Other options excluding zero consonant, N (%)	
Gender	Male	65 (30.2)	150 (69.8)	215 (24.8)
	Female	164 (25.2)	487 (74.8)	651 (75.2)
Region	Klang Valley	129 (28.3)	327 (71.7)	456 (52.7)
	Negeri Sembilan	100 (24.4)	310 (75.6)	410 (47.3)
Social role	Student	66 (33.7)	130 (66.3)	196 (22.6)
	Worker	163 (24.3)	507 (75.7)	670 (77.4)

Table 5.7, continued

Non-linguistic factors		Correct pronunciation considered by the listeners		Total, N (%)
		Zero consonant, N (%)	Other options excluding zero consonant, N (%)	
Home language	Speak Cantonese to all family members.	131 (30.3)	301 (69.7)	432 (49.9)
	Only speak Cantonese to specific family members.	68 (24.0)	215 (76.0)	283 (32.7)
	Do not speak Cantonese at home, but speak it outside of home.	30 (19.9)	121 (80.1)	151 (17.4)

According to the best stepping-up run for the correlation between the non-linguistic factors and the perception of zero initial (see Appendix H4), the log-likelihood value is -496.954 and the significance level is 0.011. Table 5.8 shows the factor weights of the non-linguistic factors affecting the perception of Cantonese zero initial. As presented in this table, only the factor group of social role was detected by the best stepping-up run. It has a range of 113, which is not very significant to the perception of Cantonese zero initial. The workers (0.526) are relatively more frequently considering other options (excluding the zero consonant) as the correct pronunciation for Cantonese zero initial compared to the students (0.413).

Table 5.8: Factor weights of the non-linguistic factors affecting the perception of Cantonese zero initial

Social role (Range: 113)	
Student	0.413
Worker	0.526

5.4 Summary

In short, the nasal consonant is still the most frequently considered to be the correct pronunciation of the Cantonese nasal initial. But at the same time, the nasal consonant is also frequently considered the correct pronunciation for the Cantonese zero initial. In addition, it is important to note that some participants believed that both the nasal and zero consonants were the correct pronunciations for Cantonese nasal and zero initials. It means that they believed that both of them referred to the same word. This suggests that both initials are considered correct by Cantonese speakers, and both of them do not result in perceptual changes in meaning. Similarly to the speech production results, linguistic factors, especially the vowel types, show a stronger constraining effect on the perception of these two Cantonese initials compared with the non-linguistic factors.

CHAPTER 6

DISCUSSION

Chapters 4 and 5 presented the findings on the speech production and perception of the Cantonese nasal and zero initials. A discussion of the findings is provided in this chapter. It begins with a discussion on speech production, followed by a discussion on speech perception, and a discussion on the factors that influence the production and perception of these two Cantonese initials. The conclusion of this study is presented in the next chapter.

6.1 Production of Cantonese Nasal and Zero Initials

The production of Cantonese zero and nasal initials by Cantonese speakers in the central region of Malaysia was examined in this study. The result of speech production shows that the Cantonese nasal initial in the central region of Malaysia is still frequently produced as the nasal consonant [ŋ]. In addition, the acoustic features of nasal realisation found in Cantonese nasal initial in this study are basically the same as those found in Guangzhou Cantonese by Huang (2017) (refer to Section 2.5.2). On the other hand, there are three realisations found in the zero initial in this study: null initial, glottal stop, and nasalised vowel. A null initial is a zero initial in the traditional sense: no other sound appears before the vowel (namely the nucleus) starts, either in the spectrogram performance or in auditory perception. The glottal stop is a common variant of zero initial (refer to Table 2.8 in Section 2.5.2). It shows a short-release burst in the spectrogram but has no sound in auditory perception.

The nasalised vowels are an interesting discovery. Their spectrogram performance starts with a vowel, and no consonant appears before them. But from the auditory perception, there seems to be a nasal sound before the vowel. The nasalised vowels found in the Cantonese nasal initial not only show the nasalisation of vowels but also the deletion of the nasal initial, which means that it has nothing in its initial slot. Thus, nasalised vowels were classified as belonging to the zero consonant in this study. On the other hand, the nasalised vowels found in the Cantonese zero initial also show the same phenomenon: nasalisation of vowels and an empty initial slot. A conjecture was made: the nasalised vowels found in the Cantonese zero initial may have evolved from the nasal consonant, which means the evolution may be from zero consonant to nasal consonant, and further to the deletion of nasal consonant and nasalisation of vowels.

The distributions of nasalised vowels and normal vowels (after nasal and zero consonants) in the same phonetic environment are compared. Figure 4.2 (in Section 4.1.2), Figure 4.5 (in Section 4.1.3), and Figure 4.7 (in Section 4.1.3) were compared as vowels in Cantonese nasal initial syllable, while Figure 4.10 (in Section 4.2.2), Figure 4.12 (in Section 4.2.2), and Figure 4.14 (in Section 4.2.3) were also compared as vowels in Cantonese zero initial syllable. From these figures, it can be observed that there is no significant difference between nasalised vowels and normal vowels. The nasalised vowels found in this study did not have a significantly lower F2, which is different from what Ladefoged (2003) proposed. It might be due to the fact that the tokens of nasalised vowels obtained are relatively few, so it is difficult to carry out a more in-depth analysis of nasalised vowels.

The most interesting finding is that more than half of the data shows the phonetic changes occur in Cantonese zero initial. The phonetic changes of the zero initial are mainly into a nasal consonant. Compared to Table 4.2 (in Section 4.1.2) and Table 4.11 (in Section 4.2.3), the average nasal formant frequencies of nasal consonant [ŋ] found in Cantonese nasal and zero initials are relatively consistent. Gender is one of the independent variables in this study (refer to Section 3.1). The acoustic features for males and females were presented separately. The findings on nasal formant frequencies are in agreement with the theory of human physiology. Males have a longer vocal tract compared to females, with adult males having a vocal tract of approximately 17 cm and adult females having a vocal tract of approximately 14 to 15 cm (Small, 2020, p. 45). People with a longer vocal tract have lower formants. Thus, males generally have lower formants than females. In the present study, the nasal consonant [ŋ] has a N1 at around 402-420 Hz, a N2 at around 1269-1468 Hz, and a N3 at around 2438-2826 Hz.

The average intensity (refer to Table 4.3 in Section 4.1.2 and Table 4.12 in Section 4.2.3) and average nasal duration (refer to Table 4.4 in Section 4.1.2 and Table 4.13 in Section 4.2.3) of the nasal consonant found in Cantonese nasal and zero initials are also largely consistent. The intensity for males is slightly greater than for females, while the nasal duration for males is relatively longer than for females. The average duration of the nasal consonant found in Cantonese nasal initial is consistent with Guangzhou Cantonese. As shown in Figure 6.1, the average nasal duration of the nasal consonant before a stop final is the shortest (56.93 ms for females and 78.22 ms for males). Syllables with a stop final are short syllables; they end with a stop consonant that makes the syllable abrupt and short. This might be the reason for the nasal consonant that precedes stop finals being shorter than other final types. The longest average nasal duration for the nasal consonant is before a compound final for females (72.62 ms) and a nasal final for males (88.24 ms). Both compound finals and nasal finals contain more phonemes than the simple finals, which may result in longer nasal consonant preceding them. However, as shown in Figure 6.2, the longest nasal consonant found in zero initial is when preceded by stop finals (78.19 ms for females and 83.75 ms for males). The shortest nasal appears preceding simple finals among females (61.57 ms) and preceding nasal finals among males (66.24 ms). There is currently no suitable explanation for this difference. In Guangzhou Cantonese (Huang, 2017, p. 12), the nasal duration of the nasal consonant before a vowel will be around 65–120 ms, while it will be 50–90 ms before a stop final (as mentioned in Section 2.5.2). Overall, the results of the present study are consistent with this description, and the nasal consonant [ŋ] has a nasal duration of around 68–86 ms.

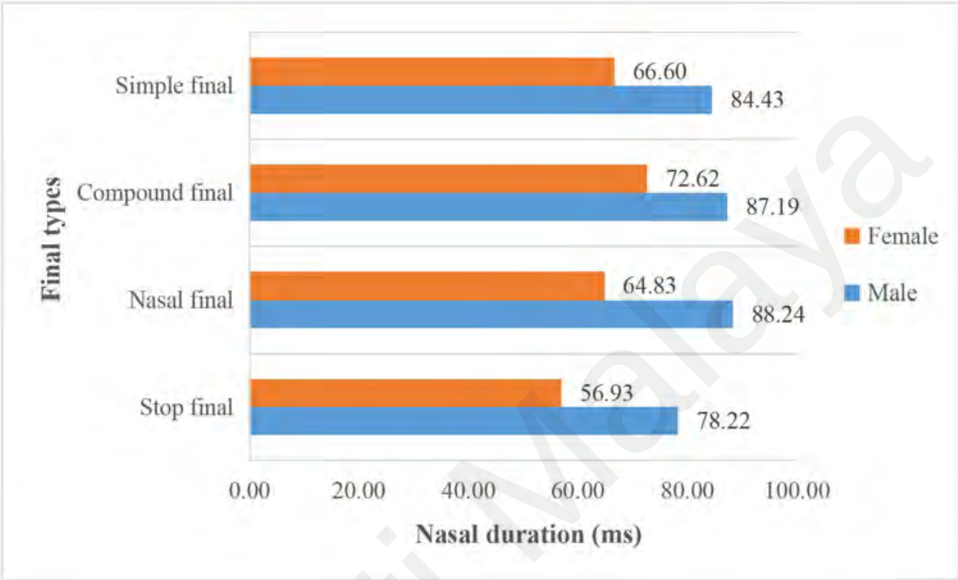

Figure 6.1: Average nasal duration of the nasal consonant found in Cantonese nasal initial (by final type)

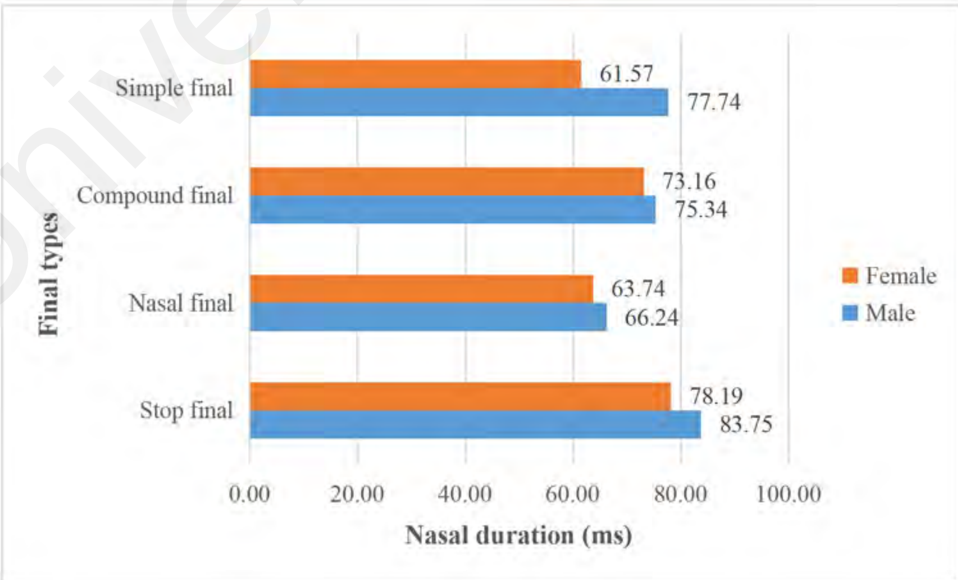

Figure 6.2: Average nasal duration of the nasal consonant found in Cantonese zero initial (by final type)

The comparison of acoustic features stated above further evidence that the nasal consonant found in the Cantonese zero initial is a nasal consonant [ŋ]. As previously mentioned, Cantonese zero and nasal initials are allophones in complementary distribution, which means these two initials should not appear in the same phonetic environment. However, the findings on speech production suggest that the Cantonese zero and nasal initials in the central region of Malaysia can now appear in the same phonetic environment. For instance, take Figure 4.9 (in Section 4.2.2) and Figure 4.13 (in Section 4.2.3) as examples. The phonetic environment of these two productions is the same; both of them are the productions of the first syllable "*爱*" from the disyllabic word "*爱情*" (love). But one was initially produced with a zero consonant, while another was initially produced with a nasal consonant. This suggests that nasal and zero consonants can appear in the same phonetic environment and refer to the same syllable, which could mean that they may no longer be in complementary distribution. The findings of this study also revealed that the nasal consonant [ŋ] is the phoneme dominating among Cantonese nasal and zero initials, as it is produced more frequently compared to the zero consonant.

This phenomenon of mixing Cantonese nasal and zero initials does not only occur in Malaysian Cantonese. As mentioned in Section 2.5.3, this phonetic phenomenon also occurs in other Cantonese-speaking areas such as Guangzhou, Hong Kong, Macau, and Shenzhen. However, it is worth noting that previous studies claimed that in these areas of China, the nasal initial is more frequently replaced with a zero consonant. This is in contrast with the findings of the present study, which reveal that the nasal consonant [ŋ] occurs more often among Cantonese nasal and zero initials. The results of the present study also further agree with the observation of Chen (2014): the deletion of nasal consonant [ŋ] does not seem to occur in Southeast Asian Cantonese.

As one of the Southeast Asian countries, Malaysian Cantonese is indeed in line with this phonetic phenomenon.

6.2 Perception of Cantonese Nasal and Zero Initials

The perception of Cantonese zero and nasal initials by Cantonese speakers in the central region of Malaysia was also investigated in this study. The perception results for Cantonese nasal and zero initials are largely consistent with the production results. This is inconsistent with Janson's statement (1983, p. 31) that "perception seems to lag behind production". This is likely because in the early stages of phonemic mergers, the phonetic changes in perception may be relatively slower than phonetic changes in production because both production and perception are still in the adaptation period. However, when both production and perception exhibit consistency, this phonemic merger may not be a new phenomenon.

The perception result also shows that the Cantonese nasal initial is relatively well maintained in the central region of Malaysia. As shown in Table 5.1 (in Section 5.1), more than half of the tokens (58.9%) show that the nasal consonant [ŋ] is still considered the correct realisation for the Cantonese nasal initial. Interestingly, the nasal consonant [ŋ] is also being considered the correct realisation for Cantonese zero initial frequently (31.1%), even slightly more than its original realisation, the zero consonant (26.4%) (refer to Table 5.2 in Section 5.2).

It is worth noting that a number of listeners believed that both the nasal consonant [ŋ] and the zero consonant were the correct pronunciation for the Cantonese zero and nasal initials. For instance, the majority believed that both realisations of [ak˥] and [ŋak˥] were the correct pronunciation for the syllable "握" (hold). It means that they believed both realisations were referring to the same word, and both realisations are being considered correct. This further suggests that these two initials may now be in free variation, as they can occur in the same phonetic environment and do not cause a change in meaning perceptually.

Furthermore, as mentioned in Section 2.5.3, Hou (2002; p. 176) and Yuan (2001; p. 181) pointed out the mixing of these two initials in Guangzhou Cantonese. The present study investigated these two initials in the central region of Malaysia and found a similar situation that agrees with their statement. However, previously published studies have suggested the zero initial is dominant between the Cantonese nasal and zero initials in Guangzhou, Hong Kong, Macau, and Shenzhen. The findings in the present study were not consistent with this argument. In the present study, the nasal consonant was found to be produced more frequently and to be considered the correct pronunciation more often than the zero consonant. Therefore, it can be argued from the present study that the nasal consonant [ŋ] is the phoneme that dominates among Cantonese nasal and zero initials in the central region of Malaysia.

6.3 Factors that Influence the Production and Perception of Cantonese Nasal and Zero Initials

The effects of linguistic and non-linguistic factors on the production and perception of Cantonese zero and nasal initials in the central region of Malaysia were examined in this study. The variable rule analysis is used to investigate the constraining effects of linguistic and non-linguistic factors on the production and perception of Cantonese nasal and zero initials. A discussion of the variable rule analysis results is presented below according to non-linguistic and linguistic factors. Apart from that, another factor—language contact—is also proposed.

6.3.1 Non-Linguistic Factors

Overall, non-linguistic factors present weak effects on affecting the phonetic changes of Cantonese nasal and zero initials in this study, regardless of the perspective of speech production or perception. As shown in Table 4.18 (in Section 4.4.2), Table 4.22 (in Section 4.4.4), and Table 5.8 (in Section 5.3.4), all the ranges of the non-linguistic factor groups are relatively low, which means they only show a weak constraint on the presence of phonetic changes. Moreover, the range of non-linguistic factor groups on the perception of nasal initial is not applicable since all of them are eliminated in the variable rule analysis (as stated in Section 5.3.2). Referring to Tables 4.18 and 4.22, the region, relatively speaking, has a more constraining effect among the four non-linguistic factors tested. Speakers from Negeri Sembilan are slightly more frequent for the realisation of zero consonant, while speakers from Klang Valley are slightly more frequent for the realisation of nasal consonant.

The division of social role and home language was to investigate the relationship between the frequency of language use and the occurrence of phonetic changes (as stated in Section 3.2). However, the variable rule analysis results indicate that there is no direct relationship between them. Previous studies pointed out that gender has no significant constraint on the phonetic variation of these two Cantonese initials (Liu, 2019; Peng & Liang, 2008; To et al., 2015). The findings in this study are consistent with this statement because there is no significant difference in the frequency of phonetic changes between males and females.

As reviewed in Section 2.5.3, age is the non-linguistic factor that has the strongest constraining effect on the phonetic variation of Cantonese zero and nasal initials in Shenzhen and Guangzhou (Liu, 2019; Peng & Liang, 2008). The younger generation is more favourable to the presence of phonetic variation. This study only focused on the younger generation, and no other non-linguistic factors were found to have a strong effect on the phonetic variation of these two Cantonese initials. Thus, perhaps as previous studies have shown, age remains the most constraining non-linguistic factor in the phonetic variation of Cantonese zero and nasal initials. Further research in the future is needed to validate this.

6.3.2 Linguistic Factors

On the contrary, the linguistic factors show a stronger constraint on affecting the production and perception of Cantonese nasal and zero initials in this study. In Section 2.5.3, it was stated that Liu (2019) argued that the syllable order, one of the linguistic factors, has a more constraining effect on the phonetic variation of these two initials in Shenzhen Cantonese. However, according to Table 4.16 (in Section 4.4.1), Table 4.20 (in Section 4.4.3), Table 5.4 (in Section 5.3.1), and Table 5.6 (in Section 5.3.3), among the linguistic factors tested, the vowel type has the highest range in the production and perception of both Cantonese nasal and zero initials. It indicates that the vowel type shows a strong constraint on the presence of phonetic changes. To some extent, this is consistent with previous research reviewed in Section 2.6.3, that is, vowels may have an impact on the perception of nasal consonants.

Among the vowel types, the vowel [o] has the greatest factor weight in affecting the production and perception of nasal initial (as shown in Tables 4.16 and 5.4). The frequently occurring phonetic change found in nasal initial is into a zero consonant. Thus, this indicates that the vowel [o] is more favourable for the realisation of the zero consonant. On the other hand, according to Tables 4.20 and 5.6, the vowel [a] has the greatest factor weight in affecting the production and perception of zero initial. The main phonetic change that occurs in the zero initial is that it is replaced by the nasal consonant [ŋ]. Therefore, it suggests that the vowel [a] is more favourable for the realisation of the nasal consonant.

Previously, Cantonese nasal and zero initials were contextual variants, and the phonological rule constraining their distribution was the lexical tones. But now, in the central region of Malaysia, these two allophones may become free variants. In addition, the vowel type shows a significant effect on constraining the production and perception of these two Cantonese initials. The tongue position of the following vowel, which refers to the height and advancement of the tongue body, has an impact on the realisation of the initial. It can be said that the nasal consonant [ŋ] occurs more frequently before the low and front vowels (which have a lower and more forward tongue body) (e.g., [a]), while the zero consonant occurs more frequently before the high and back vowels (which have a higher and more backward tongue body) (e.g., [o]).

The relation between the vowel height and the degree of velum lowering is interdependent (Kunay et al., 2022). A high vowel is produced with a higher velum, and a low vowel is produced with a more lowered velum. The nasal consonant [ŋ] is also produced with a lowered velum. Thus, an initial position that precedes a low vowel filled with a nasal consonant is reasonable. According to the principle of articulation, alteration in phoneme production due to the phonetic environment is considered "the assimilatory process" (Small, 2020, p. 383). For example, a vowel with a lowered velum is also preceded by the choice of a sound with a lowered velum, which will make the articulation easier. It might be said that the vowel height of the following vowel, or specifically the height of the tongue body, has an impact on the realisation of the consonant before it. Based on the findings, a regular pattern was observed. The lower the tongue body (low vowel) of the following vowel (e.g., [a]), the more frequently it is that the nasal consonant [ŋ] will be produced and considered to be the correct pronunciation. Conversely, the higher the tongue body (high vowel) (e.g., [o]), the more frequently it is that the zero consonant will be produced and considered to be the correct pronunciation.

6.3.3 Other Factors

The present study partly agrees with the previous studies on the phonetic variation of Cantonese zero and nasal initials. The mixing of these two Cantonese initials does occur in the central region of Malaysia. However, the situation of zero consonant dominating between these two initials, which was suggested in previously published studies (in Cantonese in Guangzhou, Hong Kong, Macau, and Shenzhen), does not occur in the present study. Conversely, the nasal consonant was found to be produced more frequently and to be considered the correct pronunciation more often compared to the zero consonant in the present study. This is in line with Chen's (2014) description that the deletion of nasal consonant does not seem to occur in Southeast Asian Cantonese. So why is the situation in Southeast Asia, or more specifically, Malaysia, different from China? One of the obvious differences is the language environment of the Chinese community in the two countries. Malaysia has a relatively more complicated language environment compared to China. A complex language environment provides more opportunities for contact between languages and thus has the probability of leading to language variation.

As previously mentioned in Section 2.6.2, the phonetic variation of Cantonese nasal and zero initials might be influenced by other local languages through language contact. Based on the online questionnaire survey results, not every participant in this study can speak other Chinese community languages (such as Hokkien, Hakka, or Teochew). Therefore, it would be difficult to say that the phonetic variation of these two Cantonese initials might be influenced by other Chinese community languages. It is because not everyone acquires Cantonese and other Chinese community languages at the same time, so not everyone is likely to cause language contact between Cantonese and other Chinese community languages.

However, Malay is a language that every Malaysian has to acquire since it is the national language of Malaysia. All the participants in this study can speak Malay. Phoon et al. (2013, p. 7) mentioned that "the role of Malay needs to be considered in the development of Chinese-influenced Malaysian English". They further suggested that the transfer of phonological features from ethnic languages may be filtered through Malay. As reviewed in Section 2.4.1, there are a few studies that have investigated the language contact between Malay and Cantonese. Although their main concern is about the Malay loan words in Cantonese, they not only pointed out that there is some vocabulary borrowed from Malay into Cantonese, but also that some unique phonemes have been introduced into the Cantonese phonological system in Malaysia (Sin, 2005). This also suggests that Malay has a certain impact on the Malaysian Cantonese phonological system. Thus, Malay may also have a certain influence on the phonetic phenomenon of Cantonese zero and nasal initials in Malaysia. However, more research is needed to prove this speculation.

CHAPTER 7

CONCLUSION

The previous chapter presented a discussion on the findings of speech production and perception. Based on the findings obtained from the present study, this chapter answers the research questions stated in Chapter 1 in order to determine how the objectives of this study were achieved. Lastly, the implications of this study are concluded, and some recommendations for future research are also provided.

7.1 Summary of Findings

The research objectives of this study are to examine the production and perception of Cantonese zero and nasal initials by Cantonese speakers in the central region of Malaysia (refer to Section 1.5). This study set out to answer the four research questions mentioned earlier in Section 1.6. In the following, the findings are answered and explained in light of these four research questions in order to show that the research objectives were achieved.

7.1.1 Research Question 1

The first research question is, "What are the phonetic realisations of Cantonese zero initial /Ø/ and nasal initial /ŋ/ by Cantonese speakers in the central region of Malaysia?" The results of speech production show that Cantonese nasal initial is relatively well maintained in the central region of Malaysia. It is essentially free of phonetic changes, as it is still produced frequently as the nasal consonant [ŋ]. In addition, the acoustic features of nasal initial found in this study are basically the same as those found in Guangzhou Cantonese (compared to the findings by Huang, 2017).

The three realisations of Cantonese zero consonant found in this study are null initial, glottal stop, and nasalised vowel. In addition, more than half of the data shows the phonetic changes of the Cantonese zero initial in the central region of Malaysia. The phonetic changes of the zero initial are mainly into a velar nasal. The situation found in this study is different from the Cantonese in Guangzhou, Hong Kong, Macau, and Shenzhen, which indicated that the nasal initial is more frequently replaced by a zero consonant. Through analysis and comparison of acoustic features, the nasal consonant found in the Cantonese zero initial was identified as the nasal consonant [ŋ]. This provides preliminary confirmation that Cantonese zero and nasal initials in the central region of Malaysia may not be in complementary distribution, as they can now appear in the same phonetic environment.

7.1.2 Research Question 2

The second research question is, "How do linguistic and non-linguistic factors influence the production of Cantonese zero initial /Ø/ and nasal initial /ŋ/ in the central region of Malaysia?" All of the non-linguistic factors tested in this study show weak effects on the production of Cantonese zero and nasal initials. In contrast, the linguistic factors show a stronger constraint on affecting the production of these two Cantonese initials. The vowel type shows the strongest constraint on the presence of phonetic changes. The realisation of the nasal consonant occurs more frequently before the vowel [a], while the realisation of the zero consonant occurs more frequently before the vowel [o].

7.1.3 Research Question 3

The third research question is, "To what extent do Cantonese speakers in the central region of Malaysia perceive the difference(s) between Cantonese zero initial /Ø/ and nasal initial /ŋ/?" The perception result also shows that the Cantonese nasal initial is relatively well maintained in the central region of Malaysia. The nasal consonant [ŋ] is still frequently considered the correct pronunciation for Cantonese nasal initial. Additionally, it was surprising that the nasal consonant [ŋ] was also considered the correct pronunciation for Cantonese zero initial, even more frequently than the zero consonant.

It is also worth noting that there are a number of listeners who consider both the realisations of zero and nasal consonants to be the correct pronunciation for Cantonese zero and nasal initials. This indicates that these two initials can be used to refer to the same word, regardless of whether they originally were a zero initial syllable or a nasal initial syllable. This further suggests that these two initials may currently be in free variation in the central region of Malaysia because they not only appear in the same phonetic environment but also do not cause any change in meaning perceptually.

7.1.4 Research Question 4

The fourth research question is, "How do linguistic and non-linguistic factors influence the perception of Cantonese zero initial /Ø/ and nasal initial /ŋ/ in the central region of Malaysia?" Similarly to the constraints on speech production, non-linguistic factors also did not exert any strong effects on the perception of Cantonese nasal and zero initials. While vowel type is also the linguistic factor that has the strongest constraint on the perception of the Cantonese zero and nasal initials. The variable rule analysis results for speech production and perception are consistent. The nasal consonant is considered to be the correct pronunciation more frequently before the vowel [a], while the zero consonant is considered to be the correct pronunciation more frequently before the vowel [o].

7.2 Implications of the Study

The present study examined the development of Cantonese zero and nasal initials in the central region of Malaysia and contributes to Cantonese phonetic research in Malaysia. This study reveals that the phonetic variation of these two Cantonese initials does occur in the central region of Malaysia. In addition, this study also reveals that these two Cantonese initials may not be in complementary distribution but rather in free variation. Chen's (2014) statement that the deletion of nasal consonant [ŋ] does not seem to occur in Southeast Asian Cantonese is further proved by the present study. As Malaysia is one of the Southeast Asian countries where Cantonese is widely spoken, this study may also contribute to Cantonese phonetic variation research in Southeast Asian countries.

As a regional language, Cantonese shows the highest extent of language maintenance among the Chinese community languages in Malaysia. However, phonetic changes had been found in Cantonese in the central region of Malaysia. Changes in phonetics are indeed force majeure. But precisely because of this reason, phonetic research on Chinese community languages is particularly important. In addition to exploring the essence of the language from the perspective of phonetics, it can also be regarded as a kind of documentation.

7.3 Recommendations for Future Research

As stated in Section 1.8, there are certain limitations to this study. In terms of geographical location, this study only included Cantonese speakers from the central region of Malaysia (i.e., Kuala Lumpur, Selangor, and Negeri Sembilan). Furthermore, this study had a rather limited sample size, with only 20 participants in the production task and 40 participants in the perception task. Thus, future research is recommended to take these considerations into account: include Cantonese speakers from different regions in Malaysia and use a larger sample size.

Moreover, this study investigated the phonetic variation of Cantonese zero and nasal initials by using read speech, which only included the disyllabic words. Previously published studies also mainly used disyllabic words to investigate this phonetic issue. Thus, future research could consider using short texts to look at the effect of spontaneous speech on this phonetic variation. The comparison of production between read speech and spontaneous speech is also worth studying.

In addition, some recommendations can also be made on the control of non-linguistic factors. It can be argued that, compared with the non-linguistic factors tested in the present study, age, as proposed in the previous studies, is still the most constraining non-linguistic factor in the phonetic variation of Cantonese zero and nasal initials. Unfortunately, the present study only focused on the younger generation. Thus, future research could also include Cantonese speakers from different generations or different age groups to further support this claim.

On the other hand, nasalised vowels were found in the realisations of Cantonese zero and nasal initials in this study. It not only shows the nasalisation of vowels but also the deletion of the nasal consonant. However, due to the fact that the data on it was relatively small, it is difficult to draw a conclusive conclusion about the nasalised vowels. Future research can therefore explore the nasalisation of vowels in Malaysian Cantonese to get a greater depth and comprehensiveness of understanding of it.

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