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Phonetic variations and sound changes in Hong Kong Cantonese: Diachronic review, synchronic study and implications for speech sound assessment

CAROL K. S. TO[1], SHARYNNE MCLEOD[2], & PAMELA S. P. CHEUNG[3]

[1]*Division of Speech and Hearing Sciences, Faculty of Education, The University of Hong Kong, Pok Fu Lam, Hong Kong SAR,* [2]*School of Teacher Education, Charles Sturt University, Bathurst, New South Wales, Australia, and* [3]*Department of Health, Child Assessment Service, Kowloon, Hong Kong SAR*

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Abstract
The aim of this article was to describe phonetic variations and sound changes in Hong Kong Cantonese (HKC) to provide speech-language pathologists with information about acceptable variants of standard pronunciations for speech sound assessments. Study 1 examined the pattern of variations and changes based on past *diachronic* research and historical written records. Nine phonetic variations were found. Five in syllable-initial and syllabic contexts: (1) [n-] → [l-], (2) [ŋ-] → Ø-, (3) Ø- → [ŋ-], (4) [k^wɔ-] → [kɔ-], (5) syllabic [m̩] → [m]; and four in syllable-final contexts: (6) [-ŋ] → [-n], (7) [-n] → [-ŋ], (8) [-k] → [-t], (9) [-t] → [-k]. Historical records demonstrated the pattern of variation and changes in HKC across time. In study 2, a large-scale synchronic study of speakers of differing ages was undertaken to determine acceptable phonetic variations of HKC for speech sound assessments. In the synchronic study, single-words were elicited from 138 children (10;8–12;4) and 112 adults (18–45 years) who spoke Cantonese and lived in Hong Kong. Synchronic evidence demonstrated five acceptable variants in syllable-initial and syllabic contexts: (1) [n-] → [l-], (2) [ŋ-] → Ø-, (3) Ø- → [ŋ-], (4) [k^wɔ-] → [kɔ-] and (5) syllabic [m̩] → [m̩] and four incomplete sound changes in syllable-final contexts: (6) [-ŋ] → [-n], (7) [-n] → [-ŋ], (8) [-k] → [-t] and (9) [-t] → [-k]. The incomplete sound changes may still be accepted as variants in speech sound assessments unless related speech problems are indicated.

Keywords: Assessment, cantonese, phonetic variation, sound change, speech articulation test

Phonetic variations and sound change

Sound change occurs in all living languages. For example, Old English was derived from the Germanic language subgroup which in turn stemmed from the Indo-European language family. At present, different varieties of English are spoken in Britain, the United States and other English-speaking speech communities all over the world. They vary in their vowel and consonant systems, for example, post-vocalic [ɹ] is extensively used in the United States but does not occur in most of England. Within each English-speaking speech community, sounds continue to change over time. For example, Labov (1994) reported that post-vocalic [ɹ] was introduced into New York City as a

Correspondence: Carol K. S. To, Division of Speech and Hearing Sciences, Faculty of Education, 7/F Meng Wah Complex, The University of Hong Kong, Pokfulam Road, Pok Fu Lam Hong Kong SAR. Tel: +852-39171591. Fax: +852-25590060. E-mail: tokitsum@hku.hk

prestige variable in the years following World War II. He conducted a survey in three department stores of different social status in New York City in 1962 and found that only some upper middle class speakers used post-vocalic [ɹ] in casual speech while people of lower middle and lower classes used it in more formal speech styles only. Fowler (1986, cited in Labov, 1994) replicated Labov's earlier study and noted there was an increase in the percentage of speakers of all social classes using post-vocalic [ɹ].

Phonetic variations among speakers in a speech community are the key element causing sound changes. The initial basis for sound changes begins from subtle phonetic variability in speech among speakers in a community. These variations can originate from various phonetic factors such as co-articulation, listeners' perception and speakers' intention in varying their speech for different communicative functions, or social factors such as gender. The ''new'' variants may extend across linguistic and social contexts. Once variants are established as commonplace within a speech community and become part of the sound system, sound changes are said to have been completed (Hock, 1991). In other words, synchronic variation is a pre-condition of sound change (Ohala, 1989). Previous studies have revealed consistency between synchronic variations among speakers in a speech community and sound changes manifested in cross-language tendencies in segmental inventories (Ohala, 1989).

Phonetic variations and sound change in Hong Kong Cantonese

Cantonese belongs to the Yue dialect group and is spoken in southern China as well as by many Chinese communities all over the world. Cantonese is the language spoken as the ''usual language'' by 89.5% people in Hong Kong (Census and Statistics Department, HKSAR Government, 2012), a city with a population of 7 million and a land area of 1104 km^2. Different Cantonese or Yue varieties are spoken in places around Hong Kong. In terms of phonology, these varieties differ from each other in the phonemic and tone system to different extents (Zhan & Cheung, 1987). The syllabic structure of Hong Kong Cantonese (HKC) is (C)V(C) with segmental elements of an onset and a rime and a supra-segmental element of tone. There are 19 initial consonants /p-, p^h-, t-, t^h-, k-, k^h-, k^w-, k^{wh}-, ts-, ts^h-, f-, s-, h-, w-, j-, l-, m-, n-, ŋ-/ and six final consonants /-p, -t, -k, -m, -n, -ŋ/. The eight vowels are /i, y, ɛ, œ, a, ɔ, u, ɐ/, and 11 diphthongs are /ai, ɐi, au, ɐu, ei, œy, ɔi, ui, iu, ou, ɛu/. In addition, Cantonese has nine tones: Tone 1 ''High level''; Tone 2 ''Low-mid to high rising''; Tone 3 ''Mid level''; Tone 4 ''Mid-low falling''; Tone 5 ''Mid-low rising''; Tone 6 ''Mid-low level'', Tone 7 ''High stopped''; Tone 8 ''Mid stopped'' and Tone 9 ''Mid-Low stopped'' (To, Cheung, & McLeod, 2013; Zee, 1999a).

In the past century, the speech sounds of HKC have been changing. In a highly densely populated city like Hong Kong, it is not surprising that sound changes can disseminate rapidly through people's close interaction as well as the mass media. Children learn these variants from their parents, peers, television and the internet. Within Hong Kong, there are different opinions and attitudes regarding phonetic variations and sound changes. While the general public is not very aware of the current sound changes in HKC, some educators advocate the use of the standard (dictionary) pronunciations as they consider these changes or variations as a result of ''laziness'' and insist that ''correct pronunciations'' need to be conserved (Ho, 1995). At the same time, some linguists regard sound changes and variations as natural phenomena and are interested in documenting non-standard pronunciations within Hong Kong society.

Importance of documenting acceptable variants for speech-language pathologists

Throughout the world when speech-language pathologists (SLPs) assess children's speech to determine whether or not they have speech sound disorders, they rely on a standard set of

pronunciations of the ambient language, and, consequently, for each language a set of pronunciations are defined. For example, Smit, Hand, Freilinger, Bernthal, & Bird (1990) provided a list of acceptable phonetic variants to the standard pronunciation of General American English in the Appendix to their large normative study of children's speech sound acquisition. An example was the use of glottal stop [ʔ] for word-final /t/, as in *cat* [k^{h}æʔ] in place of /k^{h}æt/.

SLPs working with children in Hong Kong, as well as those working with Cantonese-speaking children in other countries also need to define standard acceptable pronunciations. Traditional speech sound assessments of HKC are based on standard pronunciations as recorded in dictionaries (So, 1993). SLPs working with Cantonese-speaking children have clinical concerns about differentiating speech errors from phonological variants resulting from sound change. Anecdotally, most SLPs in Hong Kong make allowances regarding acceptable variants according to their personal judgment. It is important for SLPs to apply consistent and present-day definitions of speech sound production regarding whether or not realisations can be accepted as phonemic variants or should be recorded as speech sound errors.

This study aimed to provide an evidence-base to define standard pronunciations that reflects present-day HKC pronunciation. Such up-to-date information would enable SLPs to accurately assess a child's speech sound production ability and allocate therapy resources to those who have true speech sound disorders rather than those who produce acceptable variants.

Study 1: Diachronic review

The aim of this first study was to document historical sound change in HKC using previously published work. Three sources of evidence were available to describe recent phonetic variations in HKC. The first source comprised descriptive records (Ball, 1907; IPA, 1949; Li, Huang, Shi, Mai, & Chen, 1995; Wong, 1941). The second source comprised reviews (Bauer & Benedict, 1997; Cheung, 1972). The third source comprised fieldwork studies on speakers of HKC most of whom were born in Hong Kong (Bourgerie, 1990; Chen, 1999; Lin, 1995; Wong, 2005; Yeung, 1980). In addition, Zee (1999b) provided empirical palatograms and linguagrams data for one 21-year-old speaker of HKC. The findings from these three sources present the progress of variations in HKC in the past few decades. Consideration of these three sources of evidence revealed nine recent phonetic variations in HKC consonants (Table 1) which will be reviewed in the following sections.

Phonetic variation 1: replacement of [n-] with [l-]

The phonemes /n/ and /l/ differ by the presence of nasality and an involvement of the tongue blade for /n/. According to the phonetic description by Zee (1999b, p. 60), [n] is ''apico-laminal denti-alveolar'' while [l] is an ''apical denti-alveolar or apical alveolar''.

Historical records and reviews

The oldest preserved record of Middle Chinese phonology is the rhyme book Guangyun, which was published in 1008 A.D. for standard rhyming in poetry. Both Cantonese and Middle Chinese in Guangyun share a common ancestry (Li et al., 1995) and there is a close relation between the two sound systems. The rhyme book Guangyun distinguished /n-/ and /l-/ in syllable-initial position.

Nine hundred years later, there was still a clear distinction between /n-/ and /l-/ in standard Cantonese (Ball, 1907). Replacing [n-] with [l-] was first mentioned in the early 1940s

Table 1. Evidence of nine phonetic variations in Hong Kong Cantonese.

Sound change or phonetic variation		Context	Examples	Study 1: Diachronic evidence (status)	Study 2: Synchronic study (status)
1.	[n-] → [l-]	Syllable initial position	男 ''boy'' [nam$_4$] → [lam$_4$]	Almost complete	Complete Adult: 94.6% Children: 92.6%
2.	[ŋ-] → Ø-	Syllable initial position	牛 ''cow'' [ŋɐu$_4$] → [ɐu$_4$]	Incomplete	Half-way Adult: 37.5% Children: 71.9%
3.	Ø- → [ŋ-]	Syllable initial position	屋 ''house'' [ʊk$_7$] → [ŋʊk$_7$]	Incomplete	Half-way Adult: 31.3% Children: 7.1%
4.	[k^w-] → [k-] ([k^{wh}-] → [k^h-])	Before /ɔ/	果 ''fruit'' [k^{w}ɔ$_2$] → [kɔ$_2$]	Incomplete	Half-way Adult: 50.9% Children: 42.0%
5.	Syllabic [ŋ̍] → Syllabic [m̩]	Individual syllable	五 ''five'' [ŋ̍$_5$] → [m̩$_5$]	Almost complete	Half-way Adult: 95.5% Children: 99.2%
6.	[-ŋ] → [-n]	Syllable final position	香 (蕉) ''banana'' [hœŋ$_1$] → [hœn$_1$]	Incomplete	Half-way Adult: 24.1% Children: 29.7%
7.	[-n] → [-ŋ]	Syllable final position	乾 ''dry'' [kɔn$_1$] → [kɔŋ$_1$]	Incomplete	Incomplete (rare) Adult: 0.8% Children: 5.0%
8.	[-k] → [-t]	Syllable final position	腳 ''foot'' [kœk$_8$] → [kœt$_8$]	Incomplete	Incomplete (rare) Adult: 2.6% Children: 2.8%
9.	[-t] → [-k]	Syllable final position	渴 ''thirsty'' [hɔt$_8$] → [hɔk$_8$]	Incomplete	Incomplete (rare) Adult: 8.0% Children: 14.5%

by Wong (1941) who regarded the new (non-standard) realisation as a pronunciation error. At this time, the International Phonetic Alphabet (IPA, 1949) recognised a clear distinction between /n-/ and /l-/ words in HKC and did not mention replacement of [n-] with [l-]. In the 1970s, Cheung (1972) noted that replacement of [n-] with [l-] was very common in HKC.

Fieldwork studies of speakers of HKC

In the 1970s, there have been four studies of speakers of HKC that have described the replacement of [n-] by [l-]. Yeung (1980) reported that for 50 participants (aged 12–57 years; i.e. born between the 1920s and 1960s), the replacement of [n-] by [l-] occurred more in males and in younger speakers. In fact, of the youngest group of speakers (born in the 1960s), 100% of their productions had replaced [n-] by [l-]. The speakers' home dialects did not affect the variance.

Bourgerie (1990) also found a significant age gradation in her 49 participants. Replacement of [n-] by [l-] was produced 28.2% of the time by participants aged 46–87 (born between the 1900s and 1940s); however, this figure tripled to 85.4% in the youngest age group of 6–18 years (born in the 1970s and 1980s). Only four out of his 49 informants had pure [n-] productions and they were all in their 80 s (born in the 1900s). The other two 80+-year-old informants had a mixture of [l-] and [n-]. Different from Yeung's (1980) findings, Bourgerie's female speakers used [l-] more than the male speakers, but the gender difference was not significant.

The replacement of [n-] with [l-] occurred more often in more recent studies. For example, Chen (1999) reported that her fourteen 12-year-old female students (i.e. born in the 1980s) produced 92.9% of [n-] words as [l-]. Based on the data from the palatograms and linguagrams by Zee (1999b), the 21-year-old male participant (born in the 1970s) only used [l-] for [n-].

Summary

To summarise, replacing [n-] by the non-standard [l-] in HKC started to grow around the 1900s and [l-] has been adopted by more than 80% of the population born in and after the 1970s. The change correlates with age but gender difference has been inconsistent. Phonemically, the merging of [n-] into [l-] reduces one syllable-initial sound contrast, so that spoken syllables only begin with [l-].

Phonetic variations 2 and 3: replacement of [ŋ-] with zero initial Ø- and replacement of zero initial Ø- with [ŋ-]

In standard Cantonese, [ŋ-] and zero initial Ø- are in complementary distribution. Zero initial Ø- appears in words with mid to high tones, namely, T1, T2, T3, T7 and T8, while [ŋ-] appears in words with low to mid tones, namely, T4, T5, T6 and T9 (Wong, 1941).

Historical records and reviews

Similar to [n-] and [l-] words, Ø- and [ŋ-] words of present-day standard Cantonese have maintained the same initials as in Middle Chinese a thousand years ago (Li et al., 1995; Wang, 1985). One hundred years ago Ø- and [ŋ-] were clearly distinguished in standard Cantonese (Ball, 1907) except that a few colloquial mid- to high-tone syllables adopted [ŋ-] instead of Ø-, for example, [ŋɐp$_7$] *to talk widely*, [ŋɐi$_1$] *to importune*. Low-tone syllables using Ø- were not found.

In the 1940s, Wong (1941) explained that [ŋ-] could be added before Ø- syllables beginning with [a, ɐ, o, ɔ] in standard Cantonese. Subsequently, Cheung (1972) noted that most HKC speakers overused [ŋ-] for Ø- except for a few particles, for example, *particle for exclamation* [ai].

Thus, from the historical records, it appears that Cantonese speakers favoured [ŋ-] for both Ø- and [ŋ-] initial syllables at least until the early 1970s.

Fieldwork studies of speakers of HKC

In the 1970s, there have been five studies of speakers of HKC that have described the replacement of [ŋ-] with zero initial Ø- (phonetic variation 2) and the replacement of zero initial Ø- with [ŋ-] (phonetic variation 3).

Yeung (1980) studied 50 participants aged between 12 and 57 years. For phonetic variation 2, the older participants (aged 20–57, born between the 1920s and 1950s) replaced [ŋ-] with Ø- less than 15% of the time whereas younger participants (aged 12–16, born in the 1960s) replaced [ŋ-] with Ø- 56.8% of the time. Male speakers used Ø- more. However, reverse trends were found in phonetic variation 3 and this change appeared to diminish with time: the older participants aged 20 and over replaced Ø- with [ŋ-] between 26.4 and 28.8% of the time while the younger participants born in the 1960s had this change for 11.8% of the time only. It is apparent that participants born in the 1960s used Ø- more than [ŋ-] no matter the standard form was initial [ŋ-] or Ø-.

Bourgerie (1990) examined phonetic variation 2 in 49 people aged 6–87 years. The older participants (31–87 years, born before 1960) only replaced [ŋ-] with Ø- 9.5–9.9% of the time; whereas, the younger participants (6–30 years, born after 1960) replaced [ŋ-] with Ø- 36.7–66.2% of the time. This phonetic variation was significantly correlated with age and gender (with female having more Ø- realisations), but not with education or place of origin. A similar trend was noted by Lin (1995) who studied phonetic variation 2 in 50 people aged 12–63 years. The older participants (born before the mid-1960s) replaced [ŋ-] with Ø- 0–3.7% of the time; whereas, the younger participants (born after the 1960s) replaced [ŋ-] with Ø- 58.9–62.1% of the time. Lin (1995) also studied phonetic variation 3 in the same 50 people and found the reverse trend that the older participants (born before the mid-1960s) replaced Ø- with [ŋ-] 67.0–86.4% of the time; whereas, the younger participants (born after the 1960s) had the same replacement reduced to 24.8 and 26.8% of the time. Only age but not gender, educational level or occupation was significantly correlated with both phonetic variations. For Chen's (1999) fourteen 12-year-old female participants (born in the mid-1980s), Ø- productions took up 77.4% of the standard [ŋ-] items in phonetic variation 2. Finally, the palatographic and linguagraphic data of the 21-year-old male showed that he produced 66.7% of [ŋ-] items as Ø- (phonetic variation 2) and 34.6% of Ø- items as [ŋ-] (phonetic variation 3; Zee, 1999b).

To summarise, the development of syllable-initial Ø- and [ŋ-] in HKC has changed over the past 100 years. Consistent findings show that in the first half of the twentieth century speakers favoured the production of [ŋ-] for both syllable-initial Ø- and [ŋ-]; however, the simple Ø- has grown in popularity among speakers born after 1960. This means that phonetic variation 2 is growing rapidly while phonetic variation 3 is diminishing. Age has been correlated with these changes but findings regarding the effect of gender are inconsistent.

Summary

In the past 100 years that speakers favoured the production of [ŋ-] for both initials in the first half of the twentieth century but speakers born after the 1960s adopted the more simple Ø-. Age has been correlated with the change but findings in gender are inconsistent. When initial [ŋ-] disappears in HKC, the number of initial consonants will be reduced by one.

Phonetic variation 4: replacement of [k^w-] and [k^{wh}-] with [k-] and [k^h-] before [ɔ]

Unlike the phonetic variations discussed before, the change from [k^w-] to [k-] and [k^{wh}-] to [k^h-] is conditioned phonetically. That is, labial dissimilation occurs when the two labialised velars precede the mid back round vowel [ɔ].

Historical records and reviews

There was no record that [k^w-] and [k^{wh}-] were delabialised before [ɔ] in standard Cantonese a 100 years ago (Ball, 1907) or in the 1940s (IPA, 1949; Wong, 1941). The gradual disappearance of the labialisation of [k^w-] and [k^{wh}-] before [ɔŋ] and [ɔk] was first mentioned by Cheung (1972) in the 1970s.

Fieldwork studies of speakers of HKC

There have been two studies of speakers of HKC that have considered phonetic variation 4. Among the 75 participants of Bauer's (1983) sociolinguistic study undertaken in 1979–1981, the use of the variation from [k^w-] to [kɔ] had a clear age gradation. In spontaneous speech, the older participants (aged 45–75, born between 1905 and 1935) produced the phonetic variation [kɔ] 56.6% of the time; the next age group (aged 31–44, born between 1936 and 1949) produced [kɔ] 68.5% of the time; the next age group (aged 23–30, born between 1950 and 1957) produced [kɔ] 92.6% and the youngest age group (aged 15–22, born between 1958 and 1965) produced [kɔ] 97.7% of the time. Slightly over half of the speakers over the age of 30 (born before 1950) had mixed productions of both the standard and non-standard forms in their speech and only two speakers, aged 68 and 73, in the cohort carefully preserved the standard form in spontaneous speech. Chen (1999) studied fourteen 12-year-old female students (born in the mid-1980s) and found that [k^wɔ] was replaced by [kɔ] 67.9% of the time.

Summary

The historical studies examining phonetic variation 4, the dissimilation of [k^w] and [k^{wh}] before [ɔ], demonstrate that this change appeared in the 1900s and is now widespread in present-day HKC. The change has merged [k^wɔ-] and [k^{wh}ɔ-] words into [kɔ-] and [k^hɔ-] words.

Phonetic variation 5: replacement of syllabic [ŋ̍] with syllabic [m̩]

In Cantonese, syllabic [ŋ̍] and [m̩] can exist alone to represent an entire word; for example, syllabic [m̩] is an adverb meaning *not*. These two nasal syllabics differ in the place of articulation with the bilabial place allowing syllabic [m̩] easier to see and articulate than the syllabic velar [ŋ̍].

Historical records and reviews

In Modern Chinese syllabic [ŋ̍] was suggested to have been developed from the syllable [ŋ̍u] while syllabic [m̩] was only found in the colloquial form of dialects (Wang, 1985). In standard Cantonese, the distribution of syllabic [ŋ̍] and syllabic [m̩] remained unchanged in the first half of the twentieth century (Ball, 1907;Wong, 1941) and syllabic [m̩] only occurred in the syllable [$m̩_4$] which means *not* (Wong, 1941).

Fieldwork studies of speakers of HKC

There have been three studies of speakers of HKC that have considered phonetic variation 5. Bauer (1983, 1986) was the first to mention the replacement of syllabic [ŋ̍] with syllabic [m̩]. He found that there was a clear age gradation in the use of phonetic variation 5 by his 75 participants. Speakers aged 45–75 (born between 1905 and 1935) had a mere 0.5% production of the non-standard [m̩] in spontaneous speech, while those aged 31–44 (born around 1936 and 1949) produced [m̩] 45.7% of the time, those aged 23–30 (born between 1950 and 1957) produced [m̩] 58.5% of the time, and those aged 15–22 (born between 1958 and 1965)

produced [m̩] 86.6% of the time. A gender difference was found in the age group of 31–44 years whereby female participants had a much higher production of syllabic [m̩] in spontaneous speech. Bauer (1986) suggested that the realisation of [m̩] started to appear in the mid-1940s as a phonetically conditioned variant formed by assimilation when the frequently used word *five* occurred next to a bilabial sound; for example, [ŋ̍$_5$ mɐn$_1$] → [m̩$_5$ mɐn$_1$] *five dollars*, [sɐp$_9$ ŋ̍$_5$] → [sɐp$_9$ m̩$_5$] *fifteen*, and later spread to other syllabic [ŋ̍] words through lexical diffusion. A consistent finding was reported by Chen (1999) in which 92.9% of the productions for syllabic [ŋ̍] was pronounced as the non-standard [m̩] by the 14 female participants born in the mid-1980s.

Summary

In HKC, adopting the simpler syllabic [m̩] for syllabic [ŋ̍] has had its growth since the 1940s and is used frequently in present-day speech. Age and gender have found to be correlated with this phonetic variation. The number of syllabic phonemes is reduced from two to one as a result of phonetic variation 5.

Phonetic variations 6–9: replacement of [-ŋ] with [-n] and [-n] with [-ŋ], and replacement of [-k] with [-t] and [-t] with [-k]

There are only six syllable final consonants in Cantonese but phonetic variations have been reported in four of them. They are the replacement of [-ŋ] with [-n] (phonetic variation 6), [-n] with [-ŋ] (phonetic variation 7), [-k] with [-t] (phonetic variation 8) and [-t] with [-k] (phonetic variation 9). These phonetic variations appeared to be mediated by the preceding vowel.

Historical records and reviews

In Middle Chinese syllable-finals, /-n/, /-ŋ/, /-t/ and /-k/ were distinctive phonemes (Wang, 1985) which are still present in the present-day standard Cantonese (Li et al., 1995). These four syllable-finals were recorded a hundred years ago (Ball, 1907) and in the 1940s (IPA, 1949; Wong, 1941).

Fieldwork studies of speakers of HKC

The first study to report syllable-final phonetic variation was Bauer (1979) who reported the alveolarisation (fronting) of syllable-final [-ŋ] to [-n] (phonetic variation 6) in a young female speaker born in Hong Kong. The female produced a complete change for syllable-final [aŋ] and [ɐŋ], almost complete change for [ɛŋ], occasional change for [ɔŋ] and [œŋ] and no change for [ɪŋ] and [ʊŋ]. Yeung (1980) studied 50 people aged 12–57 and only found alveolarisation of the syllable-final consonants (phonetic variations 6 and 8) in those under 27 years of age (born in and after the 1950s) with a variant production of 10% at most. Yeung reported phonetic variation 6 in words having rimes [ɪŋ] and [ɐŋ], and phonetic variation 8 in words having rimes [ɪk] and [ɐk]. No gender difference was found in the change. Yeung suggested that three out of the four speakers who produced these phonetic variations could have been affected by their Hakka and Gan dialects.

Zee (1999b) provided palatographic and linguagraphic data to demonstrate phonetic variations 6 and 8 in a native 21-year-old male HKC-speaker who realised 33.3% of the [aŋ] items as [an], 51.7% of the [ɐŋ] items as [ɐn], 53.1% of the [ak] items as [at] and 85.7% of the [ɐk] items as [ɐt] while other [-ŋ] and [-k] rimes remained unaffected.

Similar findings were reported by Chen (1999) who studied 40 participants aged 13–65 (born between the 1930s and 1980s). For phonetic variation 6, alveolarisation of [-ŋ] was most frequently found in the vowel contexts [ɐŋ] and [aŋ] and least found in [ʊŋ] and [ɪŋ], and this

varied according to the age of the participants. The variants increased with the decrease of age and it ranged from 2.6% in the oldest group (aged 40–65) to 20.5% in the youngest group (aged 13–18). For final [-k] (phonetic variation 8), there was also an age gradation with the youngest group (aged 13–18) having the most alveolarisation (13.5%) and the oldest group (aged 40–65) having the least (1%). Similar to [ŋ] in phonetic variation 6, the most common vowel context for phonetic variation 8 was [ɐk] and [ak] and the least were [ɪk] and [ʊk]. There was little gender difference in the overall variant productions in phonetic variations 6 and 8.

Wong (2005) examined syllable-final [-ŋ] (phonetic variation 6) in her 40 participants aged between 16–48 (born between the 1950s and the 1980s). Similar to the previous studies phonetic variation 6 occurred least (4.9%) in the older participants (aged over 41) and most (24.1%) in the younger participants (aged 11–20). It appeared more frequently in the vowel contexts [ɐŋ] and [aŋ] and least in [ɪŋ] and [ʊŋ]. No gender difference was found.

Phonetic variations 7 and 9 refer to the process of velarisation (backing) of [-n] to [-ŋ] and [-t] to [-k]. These phonetic variations were only reported by Zee (1999b) in the palatographic and linguagraphic data of his 21-year-old participant (i.e. born in the 1970s). He realised 71.4% of [ɔn] items as [ɔŋ] (phonetic variation 7), 31.3% of [at] items as [ak] and all [ɔt] items as [ɔk] (phonetic variation 9) while all other [-n] and [-t] rimes remained unchanged.

Summary

Compared with other phonetic variations in HKC, alveolarisation of [-ŋ] to [-n] and [-k] to [-t] started to grow at a later time of around the 1950s and the reverse process of velarisation of [-n] to [-ŋ] and [-t] to [-k] was first reported in a participant born in the 1970s (Zee, 1999b). No gender difference has been mentioned and the changes seem to occur more frequently in certain vowel contexts. Finally, it is interesting to note that the two contrasting processes of alveolarisation and velarisation occur together in HKC.

Study 2: Synchronic study

The diachronic study reported in study 1 revealed nine phonetic variations as emerging in previous historical records and review studies (Table 1). This study 2 aimed to determine whether these nine emerging phonetic variations noted in the diachronic study were complete or still emerging in the speech of adult and child speakers in Hong Kong.

Methods

Participants

The adult group included 112 participants who came from a variety of professions. There were 53 males and 59 females aged between 18 and 45 (born between 1960 and 1987; Table 2). The inclusion criteria for the adult participants were that they were born in Hong Kong in or after 1960, spoke HKC as their mother-tongue, had parents who spoke HKC without another Chinese dialect or non-Chinese background (as reported by the participants), and had no previous training in Cantonese phonology to avoid deliberate or careful production of HKC during the testing. This age range was chosen to ensure that the participants spoke the present-day variety of HKC. The influx of Chinese immigrants ceased after the 1950s; therefore, the adult group represented the Hong Kong-born generations who were brought up and educated locally, and spoke HKC since birth. The age range spanned over two decades to capture as many variations as possible encountered within the community for defining the acceptable variants in present-day Cantonese. The child participant group included 138 Cantonese-speaking students who came from three

Table 2. Distribution of age and gender of the participants.

		Mean age		*N*		
Age range (year; months)	Year born	Male	Female	Male	Female	Total *N*
10;8–12;4	1993–1994	11.26	11.25	70	68	138
18–45	1960–1987	–	–	53	59	112
Total				123	127	250

primary schools and were aged between 10;8 and 12;4. There were 70 boys and 68 girls (born between 1992 and 1993). They represented the generation who grew up in the internet era when multimedia were easily accessible. The parents were requested to fill out a questionnaire on demographic information including the language use with parents and the household income. All the parents for the child participants reported that they communicated with their children in Cantonese. Household income was indicated by three levels according to the census data (Census and Statistics Department, 2007), namely, ''<HK$10 000'', ''HK$10 000–HK$30 000'' and ''>HK$30 000'' and the percentage distribution was 25, 53 and 19% respectively.

Materials and procedures

Speech samples were elicited using the beta version of the HKCAT (Cheung, Ng, & To, 2006), a picture naming format with 42 familiar words represented as colour photos bound into a stimulus book. In this study, a total of 27 items were selected for the examination of the phonetic variations in HKC. The selected stimuli were elicited as single words which were mono-, di- or tri-syllabic.

The elicited stimulus to examine phonetic variation 1 ([n-] → [l-]) was [nam$_4$ tsɐi$_2$] ''boy'', phonetic variation 2 ([ŋ-] → Ø-) was [ŋɐu$_4$] ''cow'', phonetic variation 3 (Ø- → [ŋ-]) was [ʊk$_7$] ''house'', phonetic variation 4 ([k^{w}ɔ-] → [kɔ-]) was [p^{h}ɪŋ$_4$ k^{w}ɔ$_2$] ''apple'' and phonetic variation 5 (syllabic [ŋ̍] → [m̩]) was [ŋ̍$_5$] ''five''. The item [k^{wh}ɔ-] was not included as [k^{wh}ɔ-] words are scarce and not easily presented by pictures. As more stimuli with different vowels followed by [-ŋ] and [-n] were available in the articulation test, phonetic variation 6 ([-ŋ] → [-n]) was examined using the following six words: [p^{h}ɪŋ$_4$ k^{w}ɔ$_2$] ''apple'', [ts^{h}i$_4$ kɐŋ$_1$] ''spoon'', [t^{h}ɔŋ$_2$] ''candy'', [k^{h}ʊk$_7$ k^{h}ei$_4$ pɛŋ$_2$] ''cookie'', [hœŋ$_1$ tsiu$_1$] ''banana'' and [ts^{h}aŋ$_2$ sɪk$_7$] ''orange colour''. To obtain a complete set of Cantonese [-ŋ] rimes for the [-ŋ] stimuli in which [ʊŋ] was lacking, the child participants' production of the non-word [p^{h}ʊŋ$_1$] was added from the non-word repetition test with pseudo-syllables (NRTP; T'sou et al., 2006). In the NRTP, each participant was asked to imitate the non-word after listening to a pre-recorded model. The NRTP was administered only to the child participants and not to the adult participants. Phonetic variation 7 ([-n] → [-ŋ]) were examined with seven words which contained a complete set of Cantonese [-n] rimes and they were [lai$_1$ lin$_2$] ''zipper'', [jyn$_4$] ''round'', [tan$_2$] ''egg'', [k^{wh}ɐn$_4$] ''dress'', [sɵn$_3$] ''letter'', [mun$_4$] ''door'' and [kɔn$_1$] ''dry''. Phonetic variation 8 ([-k] → [-t]) was examined via [ts^{h}aŋ$_2$ sɪk$_7$] ''orange colour'', [kœk$_8$] ''feet'', [ʊk$_7$] ''house'' and [lɔk$_9$ jy$_5$] ''raining''. Phonetic variation 9 ([-t] → [-k]) was examined via [jit$_9$] ''hot'', [sœ$_4$ wɐt$_9$ t^{h}ɐi$_1$] ''slide'', [hɔt$_8$] ''thirsty'' and [jɐt$_7$] ''one''. The number of items used to examine the phonetic variations in this synchronic study was restricted as only a single test word was used for each of the first five phonetic variations and 4–7 items were used for the variations related to final consonants. We acknowledge that it is an important limitation of this study but the data still provided a preliminary picture about the sound variation situation in HKC.

The participants were tested individually in a quiet place by 11 qualified SLPs with training on the standardised administrative procedures of the HKCAT and the NRTP. Each speaker was

requested to say the target words once clearly. The samples were recorded on a minidisk recorder (either Sony MZ-B100 portable MD recorder or Sharp MD-MT290H(S) MD recorder) using an external microphone (either ECM-DS70P Sony electret condenser microphone or RP-VC200 Panasonic stereo microphone) placed about 15 cm away from the mouth of the participant. Each participant's identity and speech productions were recorded on separate tracks. The SLPs transcribed the target production on-line using narrow transcription for phonemes that were produced differently from the targets and marked the transcription on a separate recording form for each participant.

Analysis

After the testing, two of the 11 SLPs with over 10 years of experience in assessing child speech and language re-transcribed and scored all the speech samples with narrow transcription based on the on-line transcription of the recording form. If there was a discrepancy between the on-line transcription and the recorded speech, either one of the experienced SLPs made the final decision with reference to the recorded speech. The mean percentage of the nine non-standard variants of [n-], [ŋ-], Ø-, [k^wɔ], syllabic [ŋ], [-ŋ], [-n], [-k] and [-t] was computed for both the child and the adult groups. In addition, productions by the two genders within each age group were also examined. Chi-square tests with Yate's correction were conducted to investigate whether the differences observed between the groups were significant. The patterns were compared and discussed with reference to the previous study in the diachronic study.

Reliability

In order to determine the inter-rater reliability between the two transcribers, samples from 10 children and 10 adults (8.0% of the speech samples) were randomly selected and independently scored by both transcribers. The total number of phonemes and tones under examination were 4900. Point-to-point agreement between the two transcribers was 98.3%.

Results

Table 3 summarised the occurrence of phonetic variations produced by the adult and child groups which were also stratified by gender.

Phonetic variation 1: replacement of [n-] with [l-]

Over 90% of the participants in the child group (94.2%) and adult (94.6%) realised [n-] as [l-]. The difference between the two age groups did not achieve statistical significance as shown in the chi-square tests. Both genders produced more than 90% of the non-standard form [l-] and no significant gender difference was found in the two age groups. The results of this variation were consistent with previous studies (Bourgerie, 1990; Chen, 1999; Yeung, 1980; Zee, 1999b) and the change appears to be close to completion.

Phonetic variations 2 and 3: replacement of [ŋ-] with zero initial Ø- and replacement of zero initial Ø- with [ŋ-]

For phonetic variation 2 ([ŋ-] → Ø-), 37.5% of the adults produced Ø- and the figure significantly raised to 65.0% in the child group. The adult pattern was similar to previously reported trend that participants born after 1960 replaced [ŋ-] with Ø- from 37% to 66% of the time (Bourgerie, 1990; Lin, 1995; Yeung, 1980). The younger group in this study was also similar to the patterns observed in the young participants in Chen (1999) and Zee (1999b) who produced more than 60% of the standard [ŋ-] as Ø-. For the phonetic variation 3 (Ø- → [ŋ-]), 31.3% of the adults and only 5.8% of children produced this realisation and the difference was significant. The adult figure was similar

Table 3. Mean percentage in producing the non-standard forms by male and female speakers in the adult and child groups.

	Overall				Adult				Child			
Elicited syllable	Adult ($n=112$)	Child ($n=138$)	χ^2	p	Male ($n=53$)	Female ($n=59$)	χ^2	p	Male ($n=70$)	Female ($n=68$)	χ^2	p
Phonetic variation 1: [n-] → [l-]												
男 [nam] ''male''	94.6%	94.2%	0.03	0.87	96.2%	93.2%	0.08	0.78	91.3%	97.1%	2.06	0.15
Phonetic variation 2: [ŋ-] → Ø-												
牛 [ŋɐu] ''cow''	37.5%	65.0%	18.64	<0.01**	45.3%	30.5%	2.01	0.16	73.9%	55.9%	4.89	<0.03**
Phonetic variation 3: Ø- → [ŋ-]												
屋 [ok] ''house''	31.3%	5.8%	28.12	<0.01**	24.5%	37.3%	1.56	0.21	4.3%	7.4%	0.59	0.44
Phonetic variation 4: [k^wɔ] → [kɔ]												
果 [k^wɔ] ''fruit''	50.9%	37.7%	4.39	0.04*	50.8%	50.9%	0.00	1.00	44.3%	30.9%	2.64	0.10
Phonetic variation 5: syllabic [ṅ] → syllabic [m̩]												
五 [ṅ] ''five''	95.5%	98.6%	2.07	0.15	100%	91.5%	0.92	0.09	97.1%	100%	1.97	0.16
Phonetic variation 6: [-ŋ] → [-n]												
[p^hʊŋ][a]	–	0%	–	–	–	–	–	–	0%	0%	0	1.00
蘋 [p^hɪŋ] ''apple''	0%	0%	0	1.00	0%	0%	–	–	0%	0%	0	1.00
糖 [t^hɔŋ] ''candy''	11.6%	13.1%	0.13	0.72	15.1%	8.5%	0.64	0.43	7.2%	19.1%	4.23	<0.04*
餅 [pɛŋ] ''biscuit''	25.9%	33.6%	1.72	0.19	30.2%	22.0%	0.59	0.44	30.90%	36.4%	0	1.00
羹 [kɐŋ] ''spoon"	33.9%	37.0%	0.25	0.62	35.8%	32.2%	0.04	0.84	31.4%	42.6%	≤1.86	0.17
橙 [ts^{h}aŋ] ''orange''	35.7%	40.9%	0.69	0.41	32.1%	39.0%	0.32	0.57	27.1%	55.2%	11.17	<0.01**
香 [hœŋ] ''banana''	37.5%	51.9%	4.88	0.03	34.0%	40.7%	0.26	0.61	43.5%	60.6%	3.96	0.05**
Average:	24.1%	25.2%										
Phonetic variation 7: [-n] → [-ŋ]												
鏈 [lin] ''zip''	0%	0.7%	0.83	0.36	0%	0%	–	–	0%	1.5%	1.04	0.31
圓 [jyn] ''circle''	0%	0.7%	0.82	0.37	0%	0%	–	–	0%	1.5%	1.02	0.31
門 [mun] ''door''	0%	0%	0	1.00	0%	0%	–	–	0%	0%	0	1.00
信 [sən] ''letter"	0.9%	2.2%	0.67	0.41	1.9%	0%	0	0.96	4.4%	0%	3.07	0.08
裙 [k^{wh}ɐn] ''dress''	0%	1.5%	1.65	0.20	0%	0.0%	–	–	2.9%	0%	2.06	0.15
蛋 [tan] ''egg''	0.9%	0.7%	0.02	0.89	0%	1.7%	0	1.00	1.5%	0%	1.07	0.30
乾 [kɔn] ''dry''	7.1%	21.9%	10.37	<0.01**	7.5%	6.8%	0	1.00	16.2%	27.5%	2.58	0.11
Average	1.3%	4.0%										

Phonetic variation 8: [-k] → [-t]												
色 [sɪk] ''colour''	0%	0.8%	0.35	0.87	0%	0%	–	–	0%	1.6%	1.07	0.30
屋 [ʊk] ''house''	0%	0%	0	1.00	0%	0%	–	–	0%	0%	0	1.00
腳 [kœk] ''feet''	8.0%	6.6%	0.20	0.66	7.5%	8.5%	0	1.00	4.3%	8.8%	1.12	0.29
落 [lɔk] ''drop''	20.9%	14.5%	1.76	0.19	17.6%	23.7%	0.61	0.43	10.0%	19.1%	2.31	0.13
Average	7.2%	5.5%										
Phonetic variation 9: [-t] → [-k]												
熱 [jit] ''hot''	0%	0.7%	0.83	0.36	0%	0%	–	–	0%	1.5%	1.07	0.30
滑 [wat] ''smooth''	0%	0.7%	0.82	0.37	0%	0%	–	–	0%	1.5%	1.04	0.31
渴 [hɔt] ''thirsty''	24.1%	38.7%	6.0	0.01*	28.3%	20.3%	0.58	0.45	39.1%	38.2%	0.01	0.91
一 [jɐt] ''one''	10.7%	11.6%	0.05	0.83	7.5%	13.6%	1.06	0.30	11.4%	11.8%	0.00	0.95
Average	8.7%	12.9%										

[a]Results of /pʰʊŋ/ were collected from the non-word repetition test with pseudo-syllables administered on the same group of children.
*$p < 0.05$; **$p < 0.01$.

to Lin's cohort born after the 1960s (24.8–26.4% of the time). The findings suggested that the null realisation (Ø-) is progressively gaining popularity and the tone rules governing the use of [ŋ-] and Ø- no longer hold. The occurrence of both variations was not associated with gender in the adult group while in the child group, significantly more boys used Ø- for [ŋ-] than girls.

Phonetic variation 4: Replacement of [k^w-] with [k-] before [ɔ]
Half of the adults (50.9%) in the present study showed dissimilation of [k^w] to [k] before [ɔ] and significantly fewer children (37.7%) used the variant. No gender difference was observed in either the child or adult groups. The percentages reported in previous studies observed in the cohorts born between 1960 and 1980 producing the delabialised non-standard form were higher than the figures in this study [97.7% in Bauer (1983); 67.9% in Chen (1999)].

Phonetic variation 5: replacement of syllabic [ŋ̩] with syllabic [m̩]
The majority of the adults (95.5%) children (98.6%) produced the non-standard form [m̩] and no gender difference was observed in either group. The figures were generally consistent with Bauer (1983) and Chen (1999) who reported that their cohorts born after 1950s produced syllabic [m̩] for standard [ŋ̩] more than 85% of the time. This variation appeared to be close to completion.

Phonetic variations 6–9: replacement of [-ŋ] with [-n] and [-n] with [-ŋ], and replacement of [-k] with [-t] and [-t] with [-k]
The phonetic variation 6 ([-ŋ] → [-n]) ranged from 0% to 37.5% in the adult group and 0% to 51.9% in the child group. The changes were dependent on the vowel context as found in previous studies. The rise in the percentage of the non-standard form of [-n] follows the vowel order of ʊ = ɪ < ɔ < ɛ < ɐ < a < œ in both the adults and children. For phonetic variation 7 [-n] → [-ŋ], there were only average percentages of 1.3 and 4.0% of [-ŋ] production in the adult and child groups, respectively, and the change was much milder when compared to [-ŋ] → [-n]. Both the adult and the child groups tended to preserve the standard form [-n]. The vowel context of [ɔ] elicited the highest rate of velarisation with 7.1 and 21.9% in the adult and child groups, respectively. There was no gender difference in either group.

Similar to [-ŋ] → [-n], alveolarisation of [-k] to [-t] (phonetic variation 8) rarely occurred before [ɪ] and [ʊ] in all participants. More non-standard productions were observed in the contexts of [ɔ] (20.9 and 14.5%) and [œ] (8.0 and 6.6%) in the adult and child groups respectively. For the reverse pattern of [-t] → [-k] (phonetic variation 9), [-t] in [ɔt] were more prone to be velarised to [-k] with 24.1% of the adults and 38.7% of the children producing the non-standard form.

Overall discussion

As estimated, based on historical analysis (study 1), the HKC phonetic variations in [n-] (phonetic variation 1) and [k^w-] and [k^{wh}-] before [ɔ] (phonetic variation 4) were first noticed among speakers born around the 1900s, syllabic [ŋ̩] (phonetic variation 5) in the mid-1940s, [-ŋ] (phonetic variation 6) and [-k] (phonetic variation 8) in the 1950s, Ø- and [ŋ-] (phonetic variations 2 and 3) in the 1960s and [-n] and [-t] (phonetic variations 7 and 9) probably in the 1970s. From the current synchronic study (study 2), the first five sound changes were frequently used by the locally born HKC speakers while the last four were emerging and had increased in use by the young generation in general. These variations have appeared and progressed quickly within the past century. Three out of the 19 initial Cantonese consonants (Ø- is counted as an allophone of [ŋ-]), four out of the six final consonants and one out of the two syllabic nasals have undergone

different degrees of changes. What is happening to the language so that the variations in the sound system can occur quietly but rapidly over the past century? The changes can be both externally and internally motivated.

External factors

External motivation for phonetic variation and sound change may include contact with other languages and dialects as well as gender differences.

Language contact

The population in Hong Kong has expanded dramatically within the past one and a half centuries from several 1000 to 7 million. Hong Kong has received continuous influxes of immigrants speaking different Cantonese varieties as well as other Chinese dialects. The figure shown in the 2006 Hong Kong population by-census that 5.7% of the total population over 5 years of age used Cantonese as ''another language/dialect'' reflects the situation that 1 in 17.5 residents did not speak Cantonese as their mother tongue but had learned this language for communication (Census and Statistics Department, HKSAR Government, 2007). Together with residents who speak other Cantonese varieties (they usually claim that they speak Cantonese as their mother tongue), these non-HKC Cantonese speakers may produce speech which has retained different variants that sound close to HKC. Most of the phonetic variations discussed here have already existed in other Cantonese varieties in regions near Hong Kong (Zhan & Cheung, 1987; Zee, 1999b) as well as in other Chinese dialects (Beijing University, 1989). Therefore, local Hong Kong born HKC speakers may also be influenced by non-HKC speakers. With frequent trade and migration, sound variations in Hong Kong can transmit very rapidly within a short period of time.

Another example of the influence of language contact on language variation occurs with school children in Hong Kong. Over the last decade, the Education Bureau has advocated the policy of trilingualism (i.e. Cantonese, Putonghua and English) and biliteracy (i.e. Chinese and English) in primary and secondary schools. When comparing the performance of the children and adults in the current study, it is interesting to find that the child group produced a similar percentage of standard form [n-] in [nam] (phonetic variation 1) as the adult group and had significantly more occurrences of the standard form [k^{w}] in [$k^{w}ɔ$] (phonetic variation 4) than the adult group. In other words, adults used the variant forms more often than the children. The trends of the two variations appear to have slowed down than expected. The distribution of Cantonese initial consonants [n-] and [l-] in the reading pronunciations of the standard Chinese characters is generally the same as in Putonghua where they are also contrastive phonemes representing the identical set of vocabulary as in Cantonese. For example, the word ''male'' in both Cantonese [nam_4] and Putonghua [nan] have the same [n-] while ''blue'' in Cantonese [lam_4] and Putonghua [lan] have the same [l-]. By the same token, Cantonese initial consonant [k^{w}-] and [k^{wh}-] have similar distribution in Putonghua corresponding to [ku-] and [k^{h}u-], in which the vowel [u] also contains a lip-rounding feature similar to [^{w}]. For example, ''fruit'' is [$k^{w}ɔ_2$] in Cantonese and [kuo] in Putonghua. As Putonghua and its Pinyin system has been taught more extensively in kindergartens to secondary schools for more than a decade and internal school assessment on its proficiency is required, this national language of China may have facilitated school children to make a distinction between Cantonese [n-] and [l-], as well as to maintain the lip-rounding element [^{w}] in Cantonese [$k^{w}ɔ$-] and [$k^{wh}ɔ$-] syllables. Consequently, the rate of change might have been slightly reduced (Bauer & Benedict, 1997). However, this speculation will require stronger evidence.

Gender differences

Previous studies have reported inconsistent results for gender differences of sound variations in HKC and no gender took the lead. In study 2, there was no significant gender difference in the results of the adult group for all the phonetic variations under examination. In the child group, there was a significant gender difference only in [ŋ-] → Ø- and final [-ŋ] following [ɔ, a, œ] (phonetic variations 2 and 6) such that boys demonstrated the more non-standard form Ø- while girls had more variations in [-ŋ]. As both genders in the past few decades have shared equal educational and job opportunities in Hong Kong, the social environment should not induce any impact on speech sound acquisition and learning. As a result, even though a mild significant gender difference was shown in some of the variant productions, neither gender took the lead.

Internal factors

Internal motivations for the phonetic variations are those that originate within a dialect due to phonetic factors such as co-articulation, listeners' perception, lexical obsolescence, morphological or syntactic structures or the nature of the writing system. The findings from this study mainly shed light on the role of phonetic factors.

Phonetic factors

By analyzing the patterns of the nine sound variations in HKC, the principle of the maximum ease of articulation may provide account for some of the more preferential use of the variant forms which involve less articulatory effort. According to Ladefoged and Johnson (2011), ''(t)he main way to reduce articulatory effort is by using co-articulations between sounds as a result of co-articulations, languages change'' (p. 284). Speakers tend to under-articulate and conserve articulation effort in producing speech sounds when they are speaking casually. Based on this reasoning and by considering the vowel features, the context-specific alveolarisation process noted in final consonants [-ŋ] and [-k] (phonetic variations 6 and 8) might be accounted for by the process of co-articulation. The alveolarisation to [-n] and [-t] may be facilitated by a preceding mid-front or central vowel, that is, [ɛ, œ, ɐ, a]. With reference to the vowel backness, after the production of these vowels, the tongue moves less when the front part is raised towards the alveolar region for [-n] and [-t] than when it is backed and raised to the velar region to produce the standard [-ŋ] and [-k]. On the other hand, the movement of the tongue from the back vowel [ɔ] or high back vowel [ʊ] to the high back velar position of [-ŋ] and [-k] is less than to [-n] and [-t], which holds back alveolarisation. In addition to the front–back dimension, tongue height or closeness may also play a role in co-articulations. The vowel [ɪ] is a high vowel. During the production of this vowel, the tongue is close to the palate. This tongue contour would be closer to the contour for [-ŋ] and [-k] than the alveolar [-n] and [-t] where the tip (and blade) of the tongue is raised and tongue root is lowered. As a result, alveolarisation may be held back. This logic also holds in explaining the velarisation of [ɔn] to [ɔŋ] and [ɔt] to [ɔk] (phonetic variations 7 and 9). It is easier for the back of the tongue to be raised slightly from the mid back position of [ɔ] to produce the non-standard [-ŋ] or [-k] than moving up and forward to produce the standard [-n] and [-t] at the alveolar position.

The syllabary of Cantonese along with assimilation also provides an explanation for some of the vowel-specific variations related to final consonants. Phonetic variations 7 ([-n] → [-ŋ]) and 9 ([-t] → [-k]) only exist in relation to the [ɔ] vowel. That is, phonetic variation 7 exists in [ɔn] syllables: [ɔn, ŋɔn, hɔn, kɔn] while phonetic variation 9 exists in [ɔt] syllables: [kɔt] and [hɔt].

The back position of [ŋ-, h-, k-] and initial Ø- (i.e. glottal stop [ʔ]) together with the back vowel [ɔ] facilitate progressive assimilation to the final consonant within a syllable (though this is not legal in Cantonese). Although alveolarisation and velarisation are two opposite processes, these two variations occur at the same time in HKC and are favoured by the younger generation who produced significantly more non-standard forms than the adults not only in [ɛŋ, ɐŋ, aŋ, œŋ] (phonetic variation 6) but also in [ɔn] (phonetic variation 7) and [ɔt] (phonetic variation 9). These might exist as a complimentary distribution of [ɪ, ʊ, ɔ] combining with final [-ŋ] (and [-k]) and the other vowels combining with [-n] (and [-t]) in future development. To investigate this, a *post-hoc* analysis was conducted to examine the within speakers' pattern of the six items ending in [-ŋ]. Of the speakers who had three or more instances of alveolarisation of [-ŋ] to [-n] (i.e. ≥50%), 20% of the adults and 25% of the children also had velarisation of [ɔn] substituted by [ɔŋ] in [kɔn] (phonetic variation 7) but did not display alveolarisation of [-ŋ] in [t^hɔŋ] (phonetic variation 6). Thus, for these participants, the complimentary pattern was observed reflecting the influence of vowel contexts influencing the phonetic variations.

In terms of articulatory gestures, syllabic [m̩] is more easily produced than syllabic [ŋ̍] (phonetic variation 5). The non-standard [m̩] only requires keeping the tongue and the lips at rest positions while when producing the standard form [ŋ̍], one needs to raise the dorsal part of the tongue and drop the lower jaw. Another possible factor that may contribute to the fast transmission among speakers of the variation is that bilabial closure provides salient visual cues for the listeners making the phoneme easier to perceive.

For [k^wɔ] (phonetic variation 4), labial dissimilation to [kɔ] occurs when speakers retain the round nuclear vowel [ɔ] and drop the labialised feature of [w]. The same process also applies to the aspirated counterpart [k^{wh}ɔ]. In fact, one of the most distinctive features in Cantonese phonotactics is the strong tendency in labial dissimilation constraint that ''precludes the combination of labially-articulated initial and final consonants and vowels within the same syllable'' (Bauer & Benedict, 1997, p. 281).

Besides production, other researchers also have examined sound changes and phonetic variations from the perspective of perception and proposed that listeners' misperception is the primary source of sound changes. For example, Ohala (1986) regarded dissimilation as a form of hypercorrection by the listeners. In order to extract essential phonetic information, listeners may assign a phonetic feature from a sequence of segments to one single segment. That means listeners may wrongly assume a single phonetic source for several surface sound patterns. In this case, we speculate that the round feature which is characterised by the labialised feature of [k^w, k^{wh}] and [ɔ] is interpreted by the listener as from a single segment [ɔ]. The result of this monosegmental assignment leads to labial dissimilation of [k^w] to [k] in the condition of [ɔ] vowel. Similarly, for phonetic variations 8 ([-k] → [-t]) and 9 ([-t] → [-k]) which involved the alveolar and velar final stops, evidences have shown that even normal native Cantonese listeners did not show perfect performance and exhibited confusion when identifying final alveolar and velar stops (Khouw & Ciocca, 2006; Law, Fung, & Bauer, 2001). Such confusion may be the result of similar acoustic characteristics of these two phonemes (Khouw & Ciocca, 2006) and the formant transition with the preceding vowels. However, the limited scope and data of this synchronic study cannot provide further evidence to support the perceptual claim.

A logographic language

The writing system of Chinese may indirectly reinforce the sound change process in HKC. Unlike English which is an alphabetic language with letters carrying clear phonological information, Chinese script is composed of characters and is a logographic writing system. Unlike alphabetic languages, each Chinese character does not represent individual sounds that make up the spoken

form of that character; therefore, limited cues are carried for pronunciation. HKC speakers can read Chinese words in Cantonese pronunciation. However, the component parts of the logographic written language do not provide any phonetic information to alert HKC speakers that the new realisations are different from the standard pronunciations (e.g. [n-] and [l-]).

In China, there is a *Pinyin* system (i.e. standard Romanisation for modern Chinese words) for Putonghua and students start to learn Pinyin at seven years of age when they enter school. In Hong Kong, students do not need to learn the pronunciation of HKC through a Romanisation system. In fact, the Linguistic Society of Hong Kong has developed a Romanisation system for Cantonese called *Jyut Ping* which has been widely adopted by linguists in Hong Kong in addition to the IPA system. While educators have put a lot of efforts to alleviate the ''lazy pronunciation'' problem and promote ''proper pronunciation'' via developing teaching materials and TV programs (Ho, 2001), introduction of a Romanisation system like *Jyut Ping* into the school syllabus may directly assist students' perception and production of the speech sounds if they can visualise the pronunciation of Cantonese alphabetically.

Implications for speech sound assessments

Analysis of diachronic records (study 1) and synchronic variations of HKC (study 2) have provided clear directions for identifying acceptable variants in Cantonese speech production for use during assessments and interventions. Typical language learners acquire sounds from the environment and are different from individuals with speech sound disorders who lack an ability to produce the conventional forms with reference to appropriate models. Therefore, in an unbiased speech assessment tool, these popular variants identified in the current paper should be taken into account when assessing a speaker's phonological skills.

To summarise, the first five synchronic variations (in syllable-initial and syllabic contexts) can be used as acceptable productions in speech sound assessment of HKC: (1) [n-] → [l-], (2) [ŋ-] → Ø-, (3) Ø- → [ŋ-], (4) [k^{w}ɔ-] → [kɔ-] and (5) syllabic [ŋ̍] → [m̩]. The four syllable-final sound changes are not yet used by the majority of the population and so can be accepted as variants but with caution: (6) [-ŋ] → [-n], (7) [-n] → [-ŋ], (8) [-k] → [-t] and (9) [-t] → [-k]. Some specific vocabulary items relevant to sound changes 6–9 have high adoption by local speakers. For example, one third of the adults and many more of the children substituted [-ŋ] by [-n] in [kɐŋ] ''spoon'', [ts^{h}aŋ] ''orange'' and [hœŋ tsiu] ''banana''. The children also assimilated [kɔn] ''dry'' to [kɔŋ] and [hɔt] ''thirsty'' to [hɔk] at an accelerating rate. Speakers may have learned these realisations from the ambient language. When speakers demonstrated the variants of (6)–(9), SLPs should further examine if the patterns are general to all vowel contexts. If these variants are specific to certain vowel contexts as illustrated in this study, it is more likely that these non-standard productions are the results of these ongoing sound changes and not an indicator of speech sound disorders.

In addition to these phonetic variations, linguists have documented mergers of the two contrastive tones (high rising and low rising tones) in speakers born in the 1990s (Fung & Wong, 2011). For example, the high rising tone ''Tone 2'' (25) was found to be merging with the mid-low rising tone ''Tone 5'' (23) (Bauer, Cheung & Cheung, 2003; Fung & Wong, 2011). It is therefore expected that the sound system of HKC will continue to change within the speech community.

SLPs need to be sensitive towards phonetic variants and to differentiate between productions reflecting sound changes versus clinical speech errors. In clinical assessments, SLPs should not treat variants as ''error'' tokens if they exist within the regional standard. On the other hand, for clients who have fronting and backing errors for initial consonants and even vowels, SLPs should analyse more carefully whether alveolarisation or velarisation in final consonants has the same clinical root as the initial consonants.

Limitations and future studies

While studies 1 and 2 provide the first comprehensive and integrated data on phonetic variation and sound change in HKC, there are some limitations that need to be considered. First, the data collected in the synchronic study (study 2) were restricted by the limited number of test items in HKCAT. This is not enough for a detailed investigation as the phonetic environment of a syllable may play a part in determining the readiness or resistance of the changes. A more extensive study with a sufficiently large number of lexical words of different frequencies of occurrence, different meanings, different syllable structures and with different tones on speakers with finer age group differentiation would provide greater details about the rate and extent of the use of phonetic variations. In addition, picture labelling in the synchronic study (study 2) might have elicited words in a style that encouraged formal speech compared with the spontaneous speech style. It is expected that formal speech may elicit fewer non-standard forms than spontaneous speech as shown in Bauer (1983) and Wong (2005). On the other hand, Chen (1999) found that formality of speech style did not have a significant impact on the productions of her participants. During the synchronic data collection, it was interesting to find that some adults were unable to produce the standard forms even when taught explicitly afterwards. As the sound changes in HKC can be considered as an unconscious change, some speakers may not show much production difference between the conversational or careful reading styles. It would be worthwhile to have empirical data on the variation of sound changes in casual and formal speech and the difference may reflect how much public awareness there is for the standard sounds.

Summary

The current paper provides an overview of literature (study 1) and data from 250 participants (study 2) to document phonetic variation and sound change in HKC. A summary of the sound changes to be considered by SLPs during assessment of Cantonese-speakers is found in Table 1. Phonetic variations are continuously emerging in HKC and sound change is an ongoing process. In addition to the nine variants described above, Tone 2 and Tone 5 have been documented to be merging in HKC though this pattern was not observed in the current data set. Future studies using stimuli with minimal pairs and with the help of acoustic analysis in addition to perceptual judgment may reveal new variation patterns.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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