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Variation in the Production of Alveolar Fricative /s/ in Hong Kong Cantonese

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Abstract

This study aimed to determine the variation in production of alveolar fricative /s/ in contemporary Hong Kong Cantonese as allophonic variation has been reported to occur in this speech sound. A sample of 59 male and 58 female normal subjects were recruited, forming three age groups (14-18; 30-40; 55+). The subjects' productions of alveolar fricative /s/ in word list and passage were recorded and transcribed. Mean percentages of alveolar fricative [s] productions were calculated and analyzed across age, gender groups and vowel contexts. The results showed age and gender effects in the passage and a vowel effect in both word list and passage. Older adults, rather than teenagers, and males, rather than females produced more allophonic variations.

Phonology of a language is the sounds that exist in the language and how they are arranged in a systematic pattern to form strings of sounds which are meaningful (Fromkin & Rodman, 1998). The variation of phonemes as produced at the phonetic level are the allophones and they are phonetically similar. They are produced with similar place and manner of articulation (Lowe, 1994). For example, vowels may be nasalized due to a context of nasal consonants as in the vowel [ĩ] in the word “bin” in English, as compared with the vowel [i] in the word “bit”. The phoneme /i/ in the former word may have been nasalized while that in the latter one is not. As a result, both nasalized [ĩ] and non-nasalized [i] are allophones of the phoneme /i/. There are phonological rules that govern the occurrence of the realizations of phonemes. In the previous example, nasalized [ĩ] will only occur when there is a nasalized consonant in the context (Fromkin & Rodman, 1998).

Two allophones which do not occur in the same phonetic environment are in complementary distribution. On the other hand, free variation occurs when two alternative sounds or alternative realizations of the same sound that do not result in a change of meaning (Ball, Rahilly, & Tench, 1996). Lowe (1994) described that allophones in free variation can be exchanged in a word without changing word meaning. Free variation and complementary distribution of allophones are language dependent (Lowe, 1994).

Sound changes are another phenomenon in the phonology of a language.

Sociophonology is one of the aspects of language variation. Honey (1997) stated that sociophonology is a discipline that studies the differences of pronunciation which are perceived as socially significant. These differences are shared by groups of speakers.

Variation in speech is a function of age, gender, region, social group and situation.

Variations can be instances of phonemic coalescence, in which the contrast between two sounds is lost, or phonemic split, in which a contrast between two sounds is developed (Wardhaugh, 1998). There have been many studies on the variation in the place or manner of articulation of speech sounds in different languages in recent years. For example, the variation of glottalization in American English (Redi & Shattuck-Hufnagel, 2001) and the aspirated and unaspirated allophones of /p/ in English (Whalen, Best, & Irwin, 1997) have been investigated. In Cantonese, there has been observation on the existence of variations in the phonology but there have been limited systematic studies. Matthews & Yip (1994) stated that there is variation between individual speakers, social groups and age groups in many aspects of pronunciation. It was further discussed that variation is striking in Cantonese, partly due to the lack of a widely recognized standard form of the language (Matthews & Yip, 1994).

In Cantonese phonology, there are 19 consonants (Chan & Li, 2000). Chan and Li (2000) included /j/, /w/, and separated alveolar nasal /n/ and alveolar lateral /l/ instead of pooling them together. Matthews and Yip (1994) stated that there are only 16 initial

consonants. The palatal glide /j/ and bilabial glide /w/ were not included as these two sounds were similar to the high front vowel /i/ and high back vowel /u/ respectively.

Matthews and Yip (1994) further discussed that the initial alveolar nasal /n/ was pronounced as alveolar lateral /l/ by younger speakers and by older speakers in less formal speech registers. In contemporary Cantonese, the production of alveolar nasal /n/ as alveolar lateral [l] was perceived as acceptable pronunciation.

A number of observed patterns of variations of consonants in contemporary Cantonese have been reported (Chan & Li, 2000; Matthews & Yip, 1994). Chan & Li (2000) stated firstly that there is a tendency for Cantonese speakers to produce alveolar nasal /n/ as alveolar lateral [l] at word-initial position and this phenomenon occurs particularly in the young population. At single word level, a word with initial alveolar nasal /n/ e.g. /nei23/ 你 ('you') is ambiguous in its meaning if it is realized as [lei23] 李 (Chinese surname 'Lee'). However, at conversational level, the realization of /n/ as [l] usually does not give rise to communication problems as the meaning of the word is supplemented by contextual information. This was also discussed in Matthews and Yip (1994) that this change has been advanced and /n/ is heard primarily in formal registers such as singing and reading of written texts, this phenomenon has been around for several decades.

Another observed pattern of free variation is the realization of word initial

labio-velar stop /kw/ as velar stop [k]. An example is the word /kwɔ̃k3/ 國 ('country'). It had been observed informally that some vowels e.g. /ɔ̃/, /ɛ/ might give rise to such a change. In words like /kwa33/ 掛 ('hang'), /k^hwa55/ 跨 ('cross'), such change does not occur. However, there were no systematic reports on this change. The situation is similar to the unidirectional variation of [n] and [l], with ambiguous meaning at single word level and disambiguated meaning at conversation level with the support of contextual information.

The third pattern is the realization of velar nasal /ŋ/ at word-final position as alveolar nasal [n]. For example, /ts^haŋ5/ 橙 ('orange') is realized as [ts^han35] 鏟 ('spade'). This is commonly labeled as 'lazy pronunciation' in Hong Kong but it has been increasingly accepted in the younger population.

The fourth allophonic variation in contemporary Cantonese is the realization of alveolar fricative /s/ as alveolar fricative [s], alveo-palatal fricative [ç] or palatal fricative [ʃ]. When alveolar fricative /s/ is followed by the high front rounded vowel /y/, the alveolar fricative /s/ may be realized as either an alveo-palatal fricative [ç] or a palatal fricative [ʃ] (Bauer & Benedict, 1997). There has not been any systematic study on the frequency or exact nature of realization of alveolar fricative /s/ before vowel /y/ in Cantonese. Anecdotal reports suggest that this free variation is more prevalent in young population and some suggest that there is a gender effect, with a more prevalent

realization of alveolar fricative /s/ as palatalized alveolar fricative [sʲ] before high front rounded vowel /y/ in females. This free variation does not share the same characteristics with the above mentioned ones. The allophonic variations of alveolar fricative /s/ will not give rise to ambiguous meaning at either single word or conversational level, as there are no palatal fricatives in Cantonese. Pronunciation of alveolar fricative /s/ as either one of the realizations is solely an allophonic variation of it.

There have been five more variations of sounds in Cantonese which were illustrated in Matthews and Yip (1994). Firstly, initial consonant aspirated velar plosive /k^h/ is realized as glottal fricative [h] in the word /k^hpy23/ 佢 (pronoun for ‘he’, ‘she’ or ‘it’). Secondly, the syllabic velar nasal /ŋ/ is realized as bilabial nasal [m] e.g. /ŋ23/ 五 (‘five’) is produced as [m23]. Thirdly, the initial velar nasal /ŋ/ is realized as a glottal stop [ʔ] e.g. /ŋ23/ 我 (‘I’) is produced as [ʔ23]. Fourthly, the final velar plosive /k/ is realized as alveolar plosive [t] such as when /pŋ5/ 北 (‘north’) is produced as [pŋ5]. Lastly, the final velar nasal /ŋ/ is produced as alveolar nasal [n]. An example is the word /sŋ55/ 生 (‘life’) which is produced as [sŋ55] 身 (‘body’).

There have been many descriptions of Cantonese phonology (Matthews & Yip, 1994) and comparisons between Cantonese and other foreign languages e.g. English (Chan & Li, 2000). However, there have been few systematic studies on the characteristics of the free variation and the distribution of the variation in contemporary Cantonese. This

study will provide information on the allophonic variation of alveolar fricative /s/ in contemporary Cantonese phonology. The effect of age, gender and vowel effect on the pronunciation of alveolar fricative /s/ will be examined. It was hypothesized that the percentage of alveolar fricative [s] productions would be lower in young population and in females (i.e. these groups would produce more allophonic variations). A vowel effect of /y/ which resulted in lower percentage of allophonic alveolar fricative [s] production was also expected.

Method

Subjects

A total of 120 speakers were recruited for this study. They came from three age groups: teenagers (aged 14 to 18), adults (aged 30 to 40) and older adults (aged 55 or above). In each age group, there were a total of 40 subjects. There were 20 male and 20 female within each age group. The subjects were randomly recruited from the family and social circles of the researcher and those of the fellow students.

All subjects were literate. Subjects were excluded from the study if they had articulatory problems/disorders or there was strong dialectal influence.

Materials

A word list, a reading passage and a questionnaire were designed for the study. A total of 80 disyllabic words were included in the word list. The alveolar fricative /s/ at

within-word position was preceded by rounded vowels/non-rounded phonemes or followed by rounded vowels/ unrounded vowels. Some examples are given in the table

below:

Position of alveolar fricative /s/	Vowels	Examples	Lexical Meaning
Within-word	-Preceded by an unrounded vowel -Followed by a rounded vowel	睇書 /t ^h ei35/ /sy55/	Reading books
Within-word	-Preceded by a rounded vowel -Followed by a rounded vowel	圖書 /t ^h ou21/ /sy55/	Books with pictures
Within-word	-Preceded by phonemes other than rounded vowel -Followed by unrounded vowels	唐詩 /tHŋ21//si55/	Chinese poems
Within-word	-Preceded by a rounded vowel -Followed by unrounded vowels	老師 /lou23//si55/	Teachers

Cantonese syllables with alveolar fricative /s/ were framed by the following eight vowel contexts /i/, /e/, /a/, /œ/, /ɛ/, /ɨ/, /y/, /u/. The first four vowels are unrounded while the last four are rounded (Matthews & Yip, 1994). There were 10 disyllabic words with each

vowel context. Among these 10, 5 were preceded by rounded vowels while the other 5 were preceded by phonemes other than rounded vowels. In a comparison of the two high front vowels /y/ and /i/, the /i/ vowel was hypothesized to not lead to a production of palatalized alveolar fricative [s] while the high front rounded vowel /y/ would. That is, the rounding feature of vowel /y/ was predicted to have an effect on the production of alveolar fricative /s/. The rounding feature might affect the production of alveolar fricative /s/ both regressively (the eight vowel contexts /i/, /e/, /a/, /œ/, /ɨ/, /ɪ/, /y/, /u/) and progressively (precedence of rounded vowels versus non-rounded speech sounds). The construction of the word list is shown in Appendix B while the word list which was shown to the subjects during data collection was shown in Appendix C.

The reading passage was based on a story adopted from the internet (http://yikihappy.uhome.net/story_001.htm) with author unknown. It was revised and modified in order to include the target words and shorten the passage. The passage was modified to result in a heavier loading on the high front rounded vowel /y/ as it was widely believed that the production of alveolar fricative /s/ may be palatalized when followed by vowel /y/ (Bauer & Benedict, 1997). All syllables with alveolar fricative /s/ with high front rounded vowel /y/ with different lexical tones were included. The passage which was shown to the subjects during data collection was shown in Appendix D while the phonetic transcription of the passage is shown in Appendix E. Both the word list and

the passage were printed on a piece of white A4 paper with font size 16.

The questionnaire included questions of personal particulars: name, age, gender, first language (mother tongue), dialectal influence and four follow-up questions concerning the subject's awareness of production of alveolar fricative /s/ in him/herself and others (see Appendix A).

Instrumentation

An IBM ThinkPad R51 laptop computer, an Aardvark USB audio interface (24 bit A/D converter, model usb3), a Shure SM48 dynamic microphone, a microphone stand were used in the recording of each speaker's productions of word list and passage. The speech was recorded with a software program Cool Edit 2000 which was installed into the laptop computer, running on a Window XP platform. A sound level meter was used to measure the sound level in the recording room.

Procedures

The dB SPL level was measured with the sound level meter before the recording was performed. Informed consent was firstly obtained from the subjects. The subjects were informed of the purpose of the study and were asked to fill their personal particulars. Then, they were invited to read aloud the word list and the passage in a natural way. The subjects sat at the table with a distance of 3 cm between their mouth and the microphone. The speech samples were then recorded. Four follow-up questions on their self-awareness

of alveolar fricative /s/ pronunciation and awareness of others' pronunciation were asked afterwards. Upon completion, they were invited to leave their contact numbers/ addresses if they would like to know the summary of the study. Each interview, including the word list and passage reading, took approximately 10 minutes.

After data collection, the speech samples were transcribed by two transcribers. Only the speech sound alveolar fricative /s/ was transcribed. The transcribers were asked to rate perceptually the pronunciation of alveolar fricative /s/. Four choices: alveolar fricative [s], palatalized alveolar fricative [s^j], palatal fricative [ʃ] and "others" were provided. They were encouraged to phonetically transcribe the productions of alveolar fricative /s/ if it was "others". The percentage of realization of alveolar fricative [s] among age groups, gender groups and different vowel groups were compared.

Transcription

Two transcribers who were final year students of Speech and Hearing Sciences in the University of Hong Kong were recruited. They had background knowledge of Cantonese phonetics and phonology. Prior training was given to ensure reliability between the transcribers. In the training session, the transcribers were briefed about the phonology of Cantonese, the variations of sounds in Cantonese (as mentioned in the introduction above), and the choices they were given in transcription. Samples of alveolar fricative [s], palatalized alveolar fricative [s^j] and palatal fricative [ʃ], the word list and the passage

which were produced by the researcher were given to provide a preliminary understanding of the format of the transcription. Afterwards, they listened to ten played sounds from a laptop computer and rated whether they were alveolar fricative [s], palatalized [s^j], palatal fricative [ʃ] or others, in the same way as the later actual. After these ten trials, their answers were compared. They reached a percentage of 80%. Ten more trials were given and they reached 100% in this round.

Intra-rater and inter-rater reliability were measured in the transcription of the subjects' recordings. A total of 10% (12 speakers) of all the speech samples (4 speakers, 2 male and 2 female from each age group) were selected and both transcribers did transcriptions on these 12 speakers' speech samples (a total of 12 word list and 12 passage recordings) to ensure inter-rater reliability. The inter-rater reliability was calculated by comparing the transcriptions of the two transcribers in these 12 speakers. If the reliability level was high enough, the transcribers would then equally share the remaining speech samples for transcriptions. If the reliability level was low, training would be given again. All the transcriptions of each transcriber were re-transcribed by him/herself one week later to ensure intra-rater reliability.

The inter-rater reliability was above 80%. As it was stated by the transcribers that it was not easy to make a clear distinction between palatalized alveolar fricative /s^j/ and palatal fricative /ʃ/, reliability was calculated in two ways. The first way was to pool

palatalized alveolar fricative [s^j] and palatal fricative [ʃ] together. In other words, if one transcriber transcribed an alveolar fricative /s/ as palatalized alveolar fricative [s^j] and another transcribed it as palatal fricative [ʃ], they were considered as in agreement. The second way of calculating reliability level was to separate palatalized alveolar fricative [s^j] and palatal fricative [ʃ]. The inter-rater reliability levels are shown in Table 1.

Table 1

Inter-rater Reliability in both Word List and Passage Transcriptions

	Pooling [s ^j] and [ʃ] together	Separating [s ^j] and [ʃ]
Word list	93.85%	92.71%
Passage	92.17%	81.91%

Intra-rater reliability was also high. The intra-rater reliability levels of the transcribers were 92.50% and 90.30% respectively for the word list transcription, and 91.67% and 92.21% for passage transcription.

Data Analysis

The mean age, language background and environment and subjects' response to the follow-up questions were summarized. Mean percentages of alveolar fricative /s/ productions across all age groups and gender groups were compared. The main effect of age and gender and the interaction effect of age by gender were analyzed using a 2 (gender)

X 3 (age) Factorial ANOVA. Separate analyses were conducted for the single word and paragraph samples.

Vowel effect was examined in the word list. The percentage of alveolar fricative [s] productions was calculated for each vowel context. The data were illustrated descriptively and analyzed statistically, with the use of t-test and F-test.

Results

The recordings were carried out in rooms with a noise level of 45 dB to 50 dB SPL. The noise level in rooms was consistent throughout the data collection period. Three subjects, two females in the older adult group and one male in the adult group, were excluded due to articulatory errors (lateralization of alveolar fricative /s/, for the male adult) and strong dialectal influence (for the two older adults), whereby the subjects did not have the high front rounded vowel /y/ in their vowel inventory.

Age and Language Environment

The mean age, standard deviation, range and the sample size of the three groups are illustrated in Table 2. Across three age groups, 90.60% of the subjects had Cantonese as their mother tongue. For the remaining 11 (9.40%) subjects, 5 had ChiuChow dialect as their mother tongue, 1 had Hakka dialect, 1 had ToiShan dialect, 1 had Thai and 3 had Mandarin (Putonghua). All these 11 subjects were from the older adult group.

Twenty-nine subjects (24.79%) lived with family members or domestic helpers who spoke other languages. These languages included Hakka, English, ChiuChow and Mandarin.

Table 2

Mean Age (in years), Standard Deviations (SD) and Age Ranges of Each Group

<i>Age groups</i>	<i>Sample Size (N)</i>	<i>Mean Age (years)</i>	<i>SD (years)</i>	<i>Range (years)</i>
Teenagers (14-18)	40	15.98	1.44	14-18
Adults (30-40)	39	35.26	2.75	30-40
Older Adults (55 or above)	38	64.89	7.48	55-78

Word List

The mean percentage of alveolar fricative [s] productions for males and females across the three age groups is shown in Figure 1. The mean percentage of alveolar fricative [s] in the females was 89.22% ($SD = 13.68\%$, range = 33.75% -100%) and the percentage for males was 86.44% ($SD = 16.31\%$, range = 6.25% -100%).

Across three age groups, the percentage for the older adult group was 85.26% ($SD = 17.53\%$, range = 6.25% -100%) while those for the teenage group and adult group were 88.81% ($SD = 14.96\%$, range = 33.75% -100%) and 89.29% ($SD = 12.40\%$, range = 50% -100%) respectively.

The results of the ANOVA revealed no significant main effects for age, $F = 0.744$, $p = .477$, or gender, $F = 1.070$, $p = .303$. However, there was a significant age by gender interaction effect, $F = 4.221$, $p = .017$.

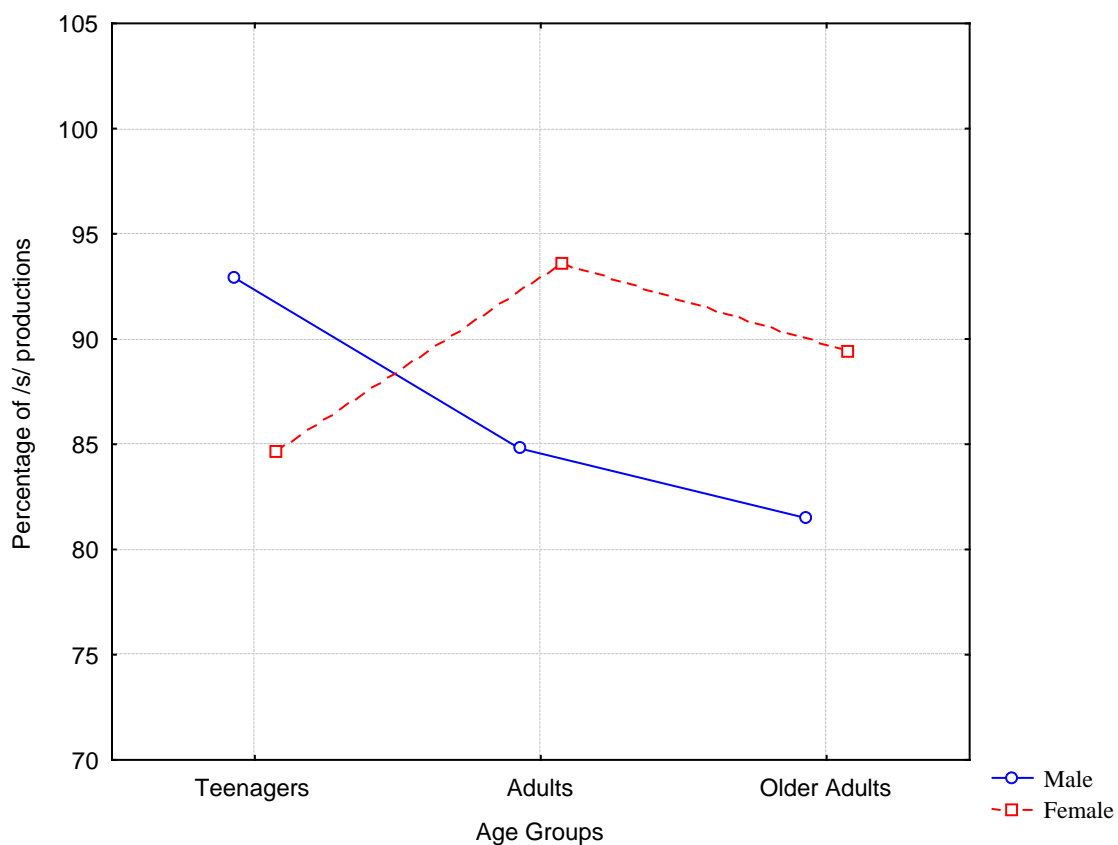


Figure 1. The percentage of alveolar fricative [s] productions for males and females, across three age groups, in the word list.

Passage

The mean percentage of alveolar fricative [s] productions for males and females across the three age groups is shown in Figure 2. The mean percentage of alveolar fricative [s] productions in the females was 77.88% ($SD = 26.82\%$, range = 23.4% -100%), and that in males was 65.39% ($SD = 25.62\%$, range = 25% -100%).

Across three age groups, the percentage of alveolar fricative [s] productions in the teenage group was 79.90% ($SD = 24.33\%$, range = 25% -100%), while those in the adult and older adult group were 70.81% ($SD = 26.28\%$, range = 25% -100%) and 63.61% ($SD = 28.03\%$, range = 23.4% -100%) respectively.

The result of the ANOVA revealed significant main effects for age, $F = 3.9543$, $p = .022$ or gender, $F = 7.1890$, $p = .008$. A statistically significant age by gender interaction effect, $F = 3.5019$, $p = .034$, was also revealed.

Post-hoc comparisons were carried out with the use of Tukey's HSD test. It was found that the teenage and older adult groups differed significantly, $p < .05$.

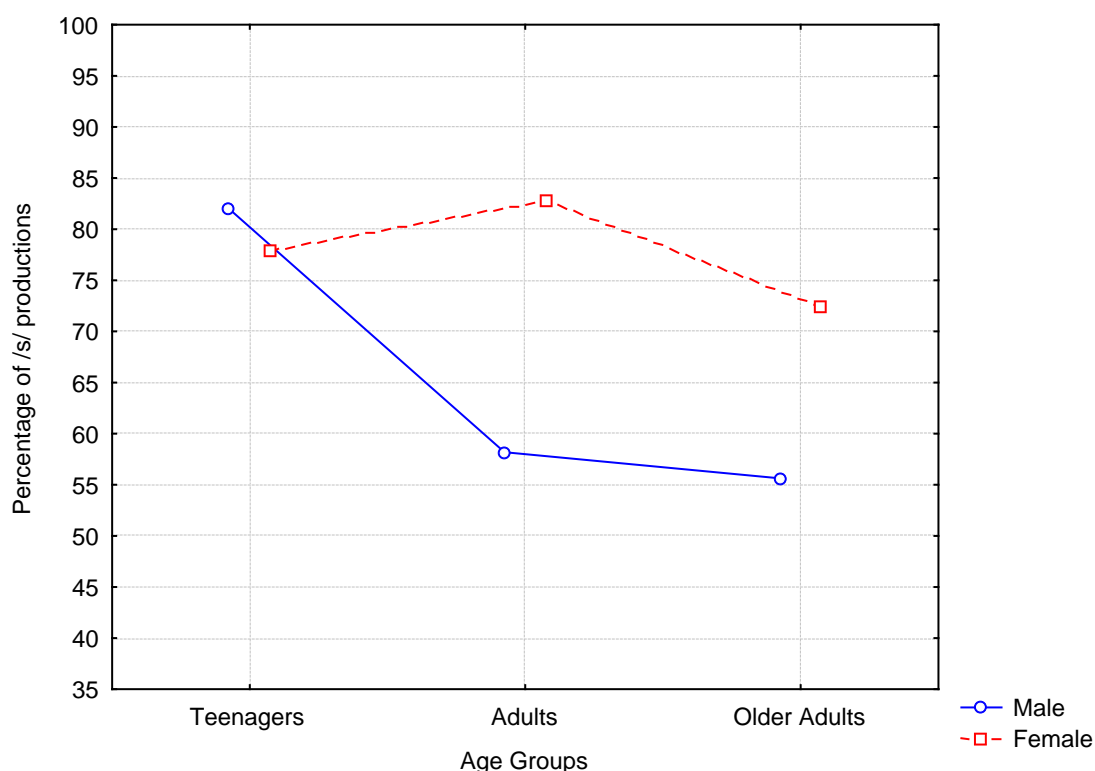


Figure 2. The percentage of alveolar fricative [s] productions for males and females, across three age groups, in the passage.

Vowel Context

Percentages of alveolar fricative [s] productions followed by eight vowel contexts were calculated and the average percentages are illustrated in Figure 3. The mean percentage of alveolar fricative [s] productions when target /s/ was followed by rounded vowels was 80.68% ($SD = 22.11\%$, range = 10% -100%) while the mean percentage of alveolar fricative [s] productions when target /s/ was followed by unrounded vowels was 95.34% ($SD = 12.80\%$, range = 30% -100%). The t-test revealed that the difference between the percentage of alveolar fricative [s] in two contexts was statistically significant, $t = 6.55, p = .000$.

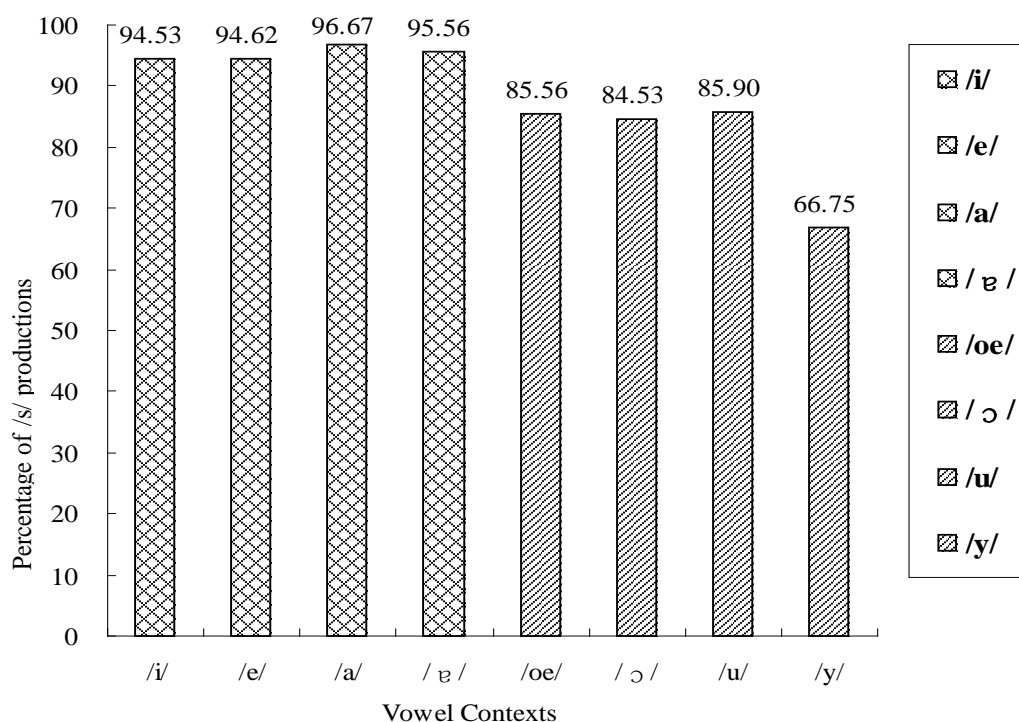


Figure 3. Mean percentage of alveolar fricative [s] productions followed by eight vowel contexts.

Among the rounded vowels, the mean percentage of alveolar fricative [s] production for the vowel context /y/ was 66.75%. The mean percentage of alveolar fricative [s] production followed by the other rounded vowels /ɨ/, /ɔ/, /u/ was 85.33% ($SD = 20.05\%$, range = 13.33% -100%). A comparison of the means of percentage of alveolar fricative [s] production across three groups of vowel contexts i.e. rounded vowels /ɨ/, /ɔ/, /u/ (mean = 85.33%), rounded vowel /y/ (mean = 66.75%) and unrounded vowels /i/, /e/, /a/, /ɐ/ (mean = 95.34%) showed that the differences were statistically significant ($F_{2, 232} = 34.97$, $p = .000$). Post-hoc comparisons were carried out. The results showed that the difference between rounded vowels /ɨ/, /ɔ/, /u/ and rounded vowel /y/ was statistically significant, $p < .05$, and that between rounded vowels /ɨ/, /ɔ/, /u/ and unrounded vowels /i/, /e/, /a/, /ɐ/ was also statistically significant, $p < .01$. Unrounded vowels /i/, /e/, /a/, /ɐ/ and rounded vowel /y/ also differed significantly, $p < .01$.

Vowel context was also analyzed for the preceding speech sounds. It was hypothesized that the rounding feature preceding would also have an effect on the variation of alveolar fricative /s/. The mean percentage of alveolar fricative /s/ productions with a preceding rounded vowel was 86.24% ($SD = 15.71\%$, range = 20% -100%) while that with a preceding unrounded vowels was 89.38% ($SD = 13.24\%$, range = 35% -100%). This difference was statistically significant, $t = 4.37$, $p = .000$.

Questionnaire

Four follow-up questions were asked. For the first question “Have you noticed that some people pronounce alveolar fricative /s/ differently?” (the researcher demonstrated a palatalized alveolar fricative [s^j] to the subject), 59.83% of the subjects responded that they had noticed such a phenomenon. For the second question “Do you know whether you pronounce the alveolar fricative /s/ like that?”, only 41.03% (48/117) of the subjects mentioned that they produced alveolar fricative /s/ “differently”. Among these subjects, they were asked under what circumstances they would pronounce alveolar fricative /s/ “differently” and they were encouraged to give examples. Twenty-two of them believed that they would produce alveolar fricative /s/ “differently” when they spoke in a fast speech rate, six of them said that it was their habitual speech, while seven of them thought that it was due to their inattentiveness to own speech. For the remaining subjects, they considered dialectal influence, anxiety, and the manner of speaking (e.g. playful) would affect alveolar fricative /s/ productions. The last question was able whether the subjects knew anyone who pronounces alveolar fricative /s/ “differently”. Sixty-seven subjects (57.26%) responded that they had friends and/or family members who produced alveolar fricative /s/ “differently”. Thirty-one of them answered that the teenage population had a higher incidence of producing the alveolar fricative /s/ “differently”, while six perceived that the children produced the alveolar fricative /s/ “differently” and eight perceived that

adults produced the alveolar fricative /s/ “differently”. Twenty-five subjects believed that females produced alveolar fricative /s/ “differently” (i.e. females had higher variation of the alveolar fricative /s/) more than males. Only 11 of them believed that males did so.

Discussion

This study aimed to characterize the allophonic variations in the production of alveolar fricative /s/ in Cantonese. Variations according to age and vowel effect were also investigated. It was hypothesized that the percentage of alveolar fricative /s/ productions would be lower in young population and in females. A vowel effect for /y/ was also expected. Several findings emerged. Firstly, the percentages of alveolar fricative [s] were the lowest in older adult groups (i.e. produced more palatalized alveolar fricative [s^j], palatal fricative [ʃ and “others”]) in both word list and passage reading, which was opposite to the hypothesis that the percentages would be lower in young population. Secondly, males in general had a lower percentage of alveolar fricative [s] productions (i.e. produced more palatalized alveolar fricative [s^j], palatal fricative [ʃ and “others”]), which was again opposite to the hypothesis that the females had lower percentages. Thirdly, the high front rounded vowel /y/ in particular and rounded vowels in general did have an effect on the percentage of alveolar fricative [s] productions. Percentages of alveolar fricative [s] were lower when the alveolar fricative /s/ was followed by the high front rounded vowel /y/ and rounded vowels. This matched the stated expected result.

Previously, there were only observations of the variations with no systematic reports. This study provided new information on regarding alveolar fricative /s/ productions in Cantonese in Hong Kong society.

Across age groups, the percentages of alveolar fricative [s] productions were found to be the lowest in older adult groups although this was only statistically significant in the passage. The low percentages of alveolar fricative [s] productions in older adults group may have been due to the influence of dialect. It was mentioned in the result that 11 subjects did not have Cantonese as their mother tongue. They had their first 25 to 30 years speaking other language(s). It is hypothesized that dialectal influence occurs to be one of the factors of allophonic variation in alveolar fricative /s/ productions. On the other hand, as they had other dialects as their first language, it is possible that their second language (Cantonese) learning was mainly through daily communication with neighbors, colleagues and/or friends or through the mass media. As the allophonic variation occurs in contemporary Hong Kong Cantonese, there may be a tendency for these older adults to learn from others' speech.

Across gender groups, males had lower mean percentages of alveolar fricative [s] productions in both word list and passage reading, but this is only statistically significant in passage reading. The result did not confirm with the hypothesis that females had lower mean percentages of alveolar fricative [s] productions. According to Wodak and Benke

(1997), women of all classes and ages use more standard variants than men. Women may have been more aware of pronunciation and strived to achieve the most accurate pronunciation (Wodak & Benke, 1997). This might account for the result that females had higher mean percentages of alveolar fricative [s] productions than males.

The observation that females produced alveolar fricative [s] differently may be affected by the task design. The subjects could have read the word list and the passage in a more serious, formal and less natural way than a natural, daily conversation because they were asked to read the printed words one by one. It would be possible that they produced less alveolar fricative [s] during natural speech.

The high front rounded vowel /y/ and rounded vowels had an effect on alveolar fricative /s/ productions. The findings matched with the hypothesis. The difference between the mean percentages of alveolar fricative [s] in two contexts was statistically significant, in which the mean percentage of alveolar fricative [s] productions was lower when it was followed by rounded vowels. The alveolar fricative /s/ is produced with tongue tip at the alveolar ridge and airflow out of the oral cavity forming frication noise. The variations of alveolar fricative /s/ were the palatalized alveolar fricative [s^j] and palatal fricative [ʃ]. The tongue position had been moved posterior so that palatalized alveolar fricative [s^j] and palatal fricative [ʃ] resulted, when compared with alveolar fricative /s/. On the other hand, the high front rounded vowel is also produced with an

anterior position of the tongue and is maintained at a high position in the oral cavity. The alveolar fricative /s/ and high front rounded vowel /y/ share similar place feature (tongue moving anterior and maintaining at higher position). It was hypothesized that the rounding feature in the high front rounded vowel affected the production of alveolar fricative /s/. The rounding feature affected the production of alveolar fricative /s/ both progressively and regressively. The rounding feature is likely to be an articulatory factor of allophonic variation of alveolar fricative /s/.

The subjects were interviewed with the help of a questionnaire. When the subjects were asked about whether they knew family and/or friends who produced alveolar fricative /s/ differently, 57.26% responded that they had friends and/or family members who did so. Thirty-one of them answered that the teenage population had a higher incidence of producing the alveolar fricative /s/ differently while only six and eight perceived that the children and adults produced the alveolar fricative /s/ differently respectively. This may imply that as most of the older adults had dialectal influences and the general public had not paid much attention to their speech problems and some articulation errors have been perceived as acceptable. As a result, variations in production of speech sounds were comparatively more obvious in teenager population.

Among the sixty-seven subjects (57.26%) who responded that they had friends and/or family members produced alveolar fricative /s/ differently, twenty-five of them

believed that female produced alveolar fricative /s/ differently more than males. Only 11 of them believed that males produced alveolar fricative /s/ differently. The responses from subjects in this study and previous observation had been consistent.

This study has research implications on the production and perception of alveolar fricative /s/ in Hong Kong Cantonese. It was included in the inter-rater reliability section that it was difficult to distinguish palatalized alveolar fricative [s^j] from palatal fricative [ʃ]. Additional research could include acoustic studies on the production of alveolar fricative /s/, palatalized alveolar fricative [s^j] and palatal fricative [ʃ]. Perceptual judgment studies, e.g. subjective ratings of speech productions can also be done to collect information about the subjects' perceptual qualities e.g. whether people produce speech with palatalized alveolar fricative [s^j] and/or palatal fricative [ʃ] are erroneous, cute etc. A follow-up study could also research on variations of alveolar fricative /s/ in Hong Kong Cantonese in other age ranges e.g. 18-30, 40-55 etc.

As some of the differences across age groups and gender groups were found to be significant, there were clinical implications that Hong Kong Cantonese is encountering language changes. Upon completion of further studies, it can be concluded that certain phonological behavior represents certain age groups, or certain gender groups. On the other hand, it aroused an issue that whether the palatalized alveolar fricative [s^j] and palatal fricative [ʃ], such allophonic variation is an acceptable phenomenon in Hong Kong.

In clinical settings when assessment is carried out on clients with phonological/phonetic delay and/or disorders, it is essential to know the normal variation in the production of certain speech sounds in contemporary Cantonese, as backing is in fact a process which occurred when the alveolar fricative /s/ was realized as palatal alveolar fricative [s^ɰ] and palatal fricative [ʃ].

With reference to the complementary and free variations mentioned in the first part of the study, the variation of alveolar fricative /s/ is a free variation. In contemporary Hong Kong Cantonese, there are two alternative realizations of alveolar fricative /s/ that do not result in a change of meaning. Ball, Rahilly, and Tench (1996) mentioned this as free variation. Lowe (1994) stated that free variation is language dependent. At the time of this study, the allophonic variation of alveolar fricative /s/ was only observed and investigated in contemporary Hong Kong Cantonese.

To conclude, this study provided information on the variation of alveolar fricative /s/ in Hong Kong Cantonese. Age, gender and vowel context had effects on the production of alveolar fricative /s/ in passage reading and there was age by gender interaction effect. In word list reading, there was only an interaction of age by gender effect. The findings were consistent with previous report. The study provided preliminary normative data and recommendations for follow-up research or studies.

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Appendix A

The Format and the Content of the Questionnaire

Background information:

- i. Name
- ii. Age
- iii. Gender
- iv. Is Cantonese your mother tongue?
- v. - If not, your mother tongue is : _____
 - When did you start learning Cantonese?
- vi. - Do the people living with you speak other languages/ dialects?
 - If yes, what are those languages/ dialects?

2. Follow-up questions

- i. Have you noticed that some people pronounce alveolar fricative /s/ differently?
 (with an example of /sy55/ 書 demonstrated by the researcher)
- ii. Do you know whether you pronounce alveolar fricative /s/ like that?
- iii. Under what circumstances you will pronounce alveolar fricative /s/ like that? Any examples?
- iv. - Do you know anyone who pronounces alveolar fricative /s/ like that?
 - If yes, who are they?

3. Summary of study:

If you are interested to receive a summary of the results of the study after completion, please leave your contact information below.

Phone number: _____

Email address: _____

Mailing address: _____

Appendix B

Construction of the Word List

Vowel context /i/

Within word Preceded by unrounded speech sounds	Within word Preceded by rounded vowels
唐詩 /tHŋ21//si55/	老師 /lou23//si55/
叉燒 /tsʰa55//siu55/	老少 /lou23//siu33/
提升 /tʰœ21//siŋ55/	球星 /kʰœ21//siŋ55/
認識 /jɿŋ22//sik5/	教識 /kau33//sik5/
攻城 /kUN55//siŋ21/	護城 /wu22//siŋ21/

Vowel context /e/

Within word Preceded by unrounded speech sounds	Within word Preceded by rounded vowels
一些 /jœ55//se55/	有些 /jœ23//se55/
壞死 /wai22//sei35/	老死 /lou23//sei35/
大石 /tai22//sek2/	無錫 /mou21//sek2/
大寫 /tai22//se35/	冇寫 /mou23//se35/
血腥 /hyt3//seŋ55/	好腥 /hou35//seŋ55/

Vowel context /a/

Within word Preceded by unrounded speech sounds	Within word Preceded by rounded vowels
鑊沙 /tsʰan35//sa55/	豆沙 /tœ22//sa55/
解散 /kai35//san33/	雨傘 /jy23//san33/
槍殺 /tsʰŋ55//sat3/	屠殺 /tʰu21//sat3/
行山 /haŋ21//san55/	高山 /kou55//san55/
食晒 /sik2//sai33/	夠晒 /kœ33//sai33/

Vowel context /œ/

Within word Preceded by unrounded speech sounds	Within word Preceded by rounded vowels
五十 /ŋ23//sœ2/	九十 /kœ35//sœ2/
恨愁 /hœ22//sœ21/	憂愁 /jœ55//sœ21/
鬼神 /kwai35//sœ21/	早晨 /tsou35//sœ21/
人蔘 /jœ21//sœŋ55/	有心 /jœ23//sœŋ55/

熱身 /jit2//sɔ̃55/	求新 /kɔ̃21//sɔ̃55/
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Vowel context /ɛ/

Within word Preceded by unrounded speech sounds	Within word Preceded by rounded vowels
撞傷 /tsɔ̃22//sɛ̃ N55/	膠箱 /kau55//sɛ̃ N55/
理想 /lei23//sɛ̃ N55/	好想 /hou35//sɛ̃ N55/
剝削 /mɔ̃k5//sɛ̃ k3/	刀削 /tou55//sɛ̃ k3/
經常 /kiN55//sɛ̃ N21/	補償 /pou35//sɛ̃ N21/
皇上 /wɔ̃N21//sɛ̃ N22/	主上 /tsy35//sɛ̃ N22/

Vowel context /ɔ̃/

Within word Preceded by unrounded speech sounds	Within word Preceded by rounded vowels
木梳 /mUk2//sɔ̃55/	教疏 /kau33//sɔ̃55/
門鎖 /mun21//sɔ̃35/	補鎖 /pou35//sɔ̃35/
大傻 /tai22//sɔ̃21/	好傻 /hou35//sɔ̃21/
剪鯉 /tsin35//sɔ̃155/	魚鯉 /jy21//sɔ̃155/
哭喪 /hUk5//sɔ̃N55/	孝喪 /hau33//sɔ̃N55/

Vowel context /y/

Within word Preceded by unrounded speech sounds	Within word Preceded by rounded vowels
睇書 /tɔ̃35//sy55/	圖書 /tɔ̃u21//sy55/
特殊 /tɔ̃22//sy21/	布殊 /pou35//sy21/
白雪 /pak2//syt2/	早說 /tsou35//syt2/
凱旋 /hɔ̃35//syn21/	救船 /kɔ̃33//syn21/
破損 /pɔ̃H33//syn35/	勞損 /lou21//syn35/

Vowel context /u/

Within word Preceded by unrounded speech sounds	Within word Preceded by rounded vowels
輕鬆 /hiN55//sUN55/	較鬆 /hiN/sUN55/
歡送 /fun55//sUN33/	煮餸 /tsy 35//sUN33/
尊崇 /tsyn55//sUN21/	九崇 /kɔ̃35//sUN21/

未熟 /mei22//sUk2/	煮熟 /tsy35//sUk2/
緊縮 /kOɿ35//sUk5/	投宿 /tHOɿ21//sUk5/

Appendix C

The Word List which was shown to the Subjects during Data Collection

唐詩	老死	大傻	高山	破損
叉燒	無錫	剪鯉	夠晒	圖書
提升	冇寫	哭喪	五十	布殊
認識	好腥	教疏	恨愁	早說
攻城	撞傷	補鎖	鬼神	救船
老師	理想	好傻	人蔘	勞損
老少	剝削	魚鯉	熱身	輕鬆
球星	經常	孝喪	九十	歡送
教識	皇上	鏟沙	憂愁	尊崇
護城	膠箱	解散	早晨	未熟
一些	好想	槍殺	有心	緊縮
壞死	刀削	行山	求新	較鬆
大石	補償	飲晒	睇書	煮餸
大寫	主上	豆沙	特殊	九崇
血腥	木梳	雨傘	白雪	煮熟
有些	門鎖	屠殺	凱旋	投宿

Appendix D

The Passage which was shown to the Subjects during Data Collection

從前有一棵樹，她愛一個男孩。男孩會爬上樹幹玩耍，在樹蔭下看書，睡覺。男孩的每一個暑假也是這樣度過。男孩長大了，樹好孤單。有一天樹對男孩說：「在我的樹蔭下玩耍，看書！」男孩說：「我要買東西，我要錢。妳可以給我一些錢嗎？」樹回答說：「真抱歉，請饒恕我，我沒有錢。我只能送你我所有的蘋果和薯仔，拿去賣，你就會有錢了。」男孩好久沒有來，樹心很酸。但她相信男孩會再回來的。有一天男孩回來了，樹很高興地說：「孩子，在樹下看看書！」「算吧，我沒時間。」男孩說：「我想要一間房子，一隻船，我想要妻子和小孩，你能給我嗎？」樹回答：「我沒有房子，森林就是我的房子，不過你可以砍下我的樹枝去蓋房子，這樣你就會快樂了。」於是男孩選擇了砍下她的樹枝，把樹枝帶走。

Appendix E

Phonetic Transcription of the Passage

/tsHUN21//tsHn21//jOE23//jOE5//f□35//sy22//tH55//□33//jOE5//k□33//nam21//hai21/
 /nam21//hai21//wui23//pH21//sǎ N23//sy22//k□33//wun22//sa35//ts□22//sy22/
 /jOE33//ha22//h□33//sy55//sPy22//kau33//nam21//hai21//tik5//mui21//jOE5//k□33/
 /sy35//ka33//ja23//si22//tse35//jǎ N22//tou22//kw□33//nam21//hai21//tsǎ N5//tai22/
 /liu23//sy22//hou35//ku55//tan55//jOE23//jOE5//tHn55//sy22//tPy33//nam21//hai21//syt3/
 /ts□22//N23//tik5//sy22//jOE33//ha22//wun22//sa35//h□33//sy55//nam21//hai21/
 /syt3//N23//jiu33//mai23//tUN55//sOE55//N23//jiu33//tsHn35//nei23//h□35//ji23//kH□5/
 /N23//jOE5//se55//tsHn35//ma55//sy22//wui22//tap3//syt3//tsOE55//pHu23//hip3/
 /tsHNB5//jiu21//sy33//N23//N23//mUt2//jOE23//tsHn35//N23//tsi35//nOE21//sUNB3/
 /nei23//N23//s□35//jOE23//tik5//pHN21//kw□35//w□21//sy21//tsOE35//na21//hPy33/
 /mai22//nei23//tsOE22//wui23//jOE23//tsHn35//liu23//nam21//hai21//hou35//kOE35/
 /mUt2//jOE23//l□21//sy22//sOE55//hOE35//syn55//tan22//tH55//sǎ N55//sPh33//nam21/
 /hai21//wui23//ts□33//wui21//l□21//tik5//jOE23//jOE5//tHn55//nam21//hai21//wui21/
 //l□21//liu23//sy22//hOE35//kou55//hiNB3//tei22//syt3//hai21//tsi35//ts□22//sy22//ha22/
 //h□33//h□33//sy55//syn33//pa22//N23//mUt2//si21//kan33//nam21//hai21//syt3/
 //N23//sǎ N55//jiu33//jOE5//kan55//f□N21//tsi35//jOE5//tsek3//syn21//N23//sǎ N55//jiu33/
 //tsH□55//tsi35//w□21//siu35//hai21//nei23//nOE21//kH□55//N23//ma55//sy22//wui22/
 //tap3//N23//mUt2//jOE23//f□N21//tsi35//sOE55//lOE21//tsOE22//si22//N23//tik5//f□N21/
 //si35//pOE5//kw□33//nei23//h□35//ji23//hOE35//ha22//N23//tik5//sy22//tsi55//hPy33/
 //kHi33//f□N21//tsi35//tse35//jǎ N22//nei23//tsOE22//wui23//fai33//l□k2//liu23//jy55/
 //si22//nam21//hai21//syn35//tsak2//liu23//hOE35//ha22//tH55//tik5//sy22//tsi55//pa35/
 //sy22//tsi55//tai33//tsOE35/