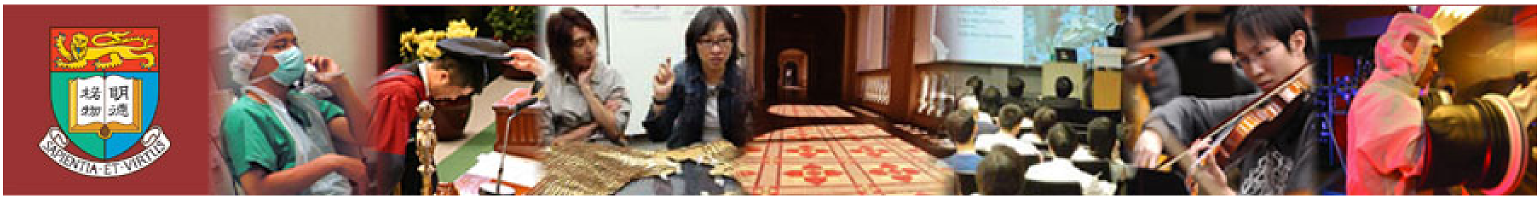

Title	Rating hypernasality: speaker and listener language effect
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Citation	
Issued Date	2005
URL	http://hdl.handle.net/10722/56219
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Rating Hypernasality: Speaker and Listener Language Effect

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A dissertation submitted in partial fulfillment of the requirements for the Bachelor of Science (Speech and Hearing Sciences), The University of Hong Kong, May 6, 2005

Abstract

This study investigated the effects of listeners' language and speakers' language on the perceptual rating of hypernasality. The speakers were six bilingual individuals with normal speech whose ages ranged from 19 to 25 years (mean age 22 years). The listeners were 40 undergraduate students at the University of Hong Kong and the Peking University. The listeners were divided into two groups, according to their native language (Cantonese or Putonghua). The speech stimuli included two sustained vowels (/a/ and /i/), a Cantonese passage and a Putonghua passage. The bilingual speakers simulated varying levels of hypernasality for each of these stimuli. A visual analogue scale (VAS) was used for perceptual rating. The result showed that Putonghua listeners provided significantly higher hypernasality ratings than the Cantonese listeners across the stimuli. Inter-listener reliability and intra-listener reliability were higher in rating passages than vowels across both Putonghua and Cantonese listeners. Possible reasons for the findings are discussed.

Introduction

Hypernasality refers to the perception of excessive amount of nasal resonance during speech production (Boone & McFarlane, 1994). Velopharyngeal incompetence is considered to be the major etiological factor of hypernasality. It is the most defining speech characteristic of cleft palate (Peterson-Falzone, Hardin-Jones & Karnell, 2001).

Most studies of the speech outcomes of individuals with cleft palate focused only on speakers from a single language background. It was due to the difference of phonetic context among languages (Grunwell, 2000) which made the speech outcomes difficult to compare. Only a few studies, such as the Eurocleft Speech Project (The Eurocleft Speech Group, 1993), have investigated speech outcomes across more than one language.

Language background has been considered as a variable similar to age and sex, which might influence the speech outcome. Hence, it should be eliminated by using speech units that were phonetically identical across language for direct comparison of speech outcome following treatment (Hutters & Henningsson, 2004). Currently, increasing numbers of cross-linguistic studies focusing on the speech outcome of cleft palate surgery are being carried out. According to Hutters & Henningsson (2004), it might be necessary to include speakers with different language background in studies of speech outcome following treatment. Speakers of different native languages are involved in these multi-center studies, which aim to investigate if language background is a factor to be taken into consideration.

Hutters & Henningsson (2004) stated that the quality of cleft palate speech is language dependent, determined by the phonetic characteristics of the particular language. As a result, it is vital to investigate how the phonetic characteristics of a particular language influence the speech outcome of cleft palate speakers. As hypernasality is one of the core speech problems experienced by cleft palate speakers, there is a need to investigate if the rating of hypernasality would be influenced by the phonetic characteristics of different languages.

Previous studies which compared the speech outcome of cleft palate speakers with different language background, such as the Eurocleft project and the Eurocran project, predominantly focused on the phonological aspect of speech outcome. As compared to the phonological aspect, the impact of speakers' language background on the resonance aspect was less emphasized. As language effect on resonance was not compared in previous studies, it was important to investigate whether resonance was influenced by the phonetic characteristics of different languages.

Cantonese and Putonghua were investigated in this study. Although Putonghua and Cantonese are both tonal languages, they have a number of different phonological aspects. Moreover, Putonghua has become a popular language in Hong Kong since 1997, as more immigrants from Mainland China move to Hong Kong. Hence, investigating the hypernasality of Putonghua speakers can help provide data for future clinical uses in the assessment of hypernasal Putonghua speech. Apart from speakers' language background, investigation of listeners' language background on rating of hypernasality is clinically important.

The consonant inventory and the relative frequency of occurrence of oral and nasal consonants in Putonghua and Cantonese are different. There are 24 consonants in Putonghua, with 21 orals and three nasal consonants. Of the three nasal consonants, the velar nasal /.·˙/ occurs only in the syllable-final position (Lee & Zee, 1994). Moreover, there are no oral finals; but two nasal final endings, /-n / and /-.·˙ / are found in Putonghua. In contrast, there are 19 consonants in Cantonese, with three initial nasal consonants, /m/, /n/ and /.·˙/, as well as three nasal finals, /-m/, /-n/, /-.·˙/ (Lee & Zee, 1994). Furthermore, nasal consonants /m/ and /.·˙/ can also occur as syllabic nuclei, which is bilabial nasal syllabic /m/ and velar nasal syllabic /.·˙□ (Bauer & Benedict, 1997). Apart from nasal final endings, three stop final endings /-p/, /-t/ and /-k/ are found in Cantonese.

In addition to the consonant inventory, the frequency of occurrence of orals to nasals in Putonghua and Cantonese should be considered. Suen (1979) derived the frequency of occurrence of consonant in Putonghua by means of a computational analysis of a very large Putonghua corpus consisting of over 750,000 samples. The data was obtained from Chinese textbooks, newspapers, outside reading and radio broadcasts (Suen, 1979). The frequency of occurrence of consonants in Cantonese is derived from a carefully transcribed spoken Cantonese database, the Hong Kong Cantonese adult language corpus (HKCAC) (Leung & Law, 2001). The database is based on more than 8 hours of recordings of phone-in programs and forums on the radio in Hong Kong. It consisted of speech of total 69 native speakers other than the program hosts, with more than 140,000 syllable-character units (Leung & Law, 2004).

The percentage of nasals out of all phonemes in Putonghua (15.19%) (Suen, 1979) is slightly higher than that of Cantonese (14.39%) (Leung & Law, 2004). Although the difference in frequency of occurrence of nasals might impact the rating of hypernasality, the small difference between Putonghua and Cantonese might not pose an effect on the rating of hypernasality.

Another investigating factor was about the familiarization with a language. The current study would investigate if familiarization with a particular language affected the listeners' perception of hypernasality, compared with vowels (language independent) and an unfamiliar language. Therefore, bilingual speakers who were fluent in both Cantonese and Putonghua, and native Cantonese and Putonghua listeners were included in the study.

Simulated speech samples of varying degree of hypernasality were used to compare the effect of language among Cantonese and Putonghua listeners. In order to reduce the presence of other speech characteristics, such as hyponasality, nasal emission and articulation disorder, which might affect the rating of hypernasality, simulated speech samples were used. Furthermore, the speech characteristics of simulated speech samples were easier to be manipulated. In addition, it is difficult to match the severity of hypernasality across speaker pairs for natural speech samples.

Several different rating scales have been used for evaluating hypernasality. They are equal appearing interval (EAI) direct module estimation (DME) and visual analogue scale (VAS). Equal appearing interval (EAI) scale was commonly used for evaluating hypernasality (Karnell, Folkins & Morris, 1985; Workinger & Kent, 1991). However, as hypernasality is a prothetic dimension, EAI scale was not a valid method for this dimension (Whitehill, Lee & Chun, 2002; Zraick & Liss, 2000). Therefore, the use of EAI scale was inappropriate in the current study. Another scaling procedure, DME scale has been used in perceptual judgment in hypernasality (Flecher & Bishop, 1970; Jones, Folkins, & Morris, 1990; Redenbaugh & Reich, 1985). However, it had some drawbacks as rating procedure.

It required either a standard speech sample or complicated modulus equalization procedures. Moreover, it is difficult to compare the data across sets by DME (Schiavetti, 1992; Whitehill et al. 2002). Thus, it was not preferred in the current study. Visual Analogue (VA) scale required listeners to assign numbers to stimuli in proportion to their magnitude. It was selected as the rating scale of the current study, as it was a magnitude scaling method, which was found to be favoured for perceptual rating of hypernasality (Radenbaugh and Reich, 1985; Whitehill, Lee and Chun, 2002; Yiu & Ng, 2004).

To sum up, several previous studies have suggested that language is an important factor in the evaluation of cleft palate speech. However, no previous study has systemically compared resonance ratings across languages. Moreover, in cross-linguistic studies, the term ‘cross-linguistic’ has been used to refer to both the speaker’s and listener’s language background (Hutters and Henningsoon, 2004). The listeners’ language background could be either the same (e.g. the Scandcleft Speech Project) or different (e.g. the Eurocleft Project) from that of the speakers’. Thus, the listeners’ language background was another important factor to consider during perceptual rating of hypernasality in cross-linguistics studies (Hutters and Henningsoon, 2004). The listeners’ familiarity with a particular language can also be a possible factor affecting the rating of hypernasality.

The following research question will be addressed in this study:

1. Are there significant differences in the severity of perceptual rating of hypernasality, based on speaker language and listeners' native language?

It was hypothesized that there would be a significant difference in the listeners' ratings of hypernasality. Due to the slightly higher frequency of occurrence of nasals in Putonghua, Putonghua would be assumed to be rated more hypernasal than that of Cantonese. Other than that, it was hypothesized there would be a significant difference among stimuli rated by listeners. Three stimuli were used, with Cantonese passage, Putonghua passage and sustained vowels. While there is language difference between the Putonghua and Cantonese passage stimuli, the vowels can serve as a control condition, in which there is no language component. Hence, it was hypothesized that the language background of the listeners would affect their ratings of the three stimuli.

Method

Subjects

The speakers were six bilingual (native in Cantonese and Putonghua) individuals. Their speech was screened by one native Putonghua speaker and one native Cantonese speaker respectively to ensure they were native in pronunciation of both languages. The ages of the one males and five females ranged from 20 – 25 years (mean age = 22.4, standard deviation = 1.95). The speakers were recruited on a voluntary basis. All speakers had normal speech (articulation, voice and resonance) and normal hearing. They had no neurological disease or syndrome associated with cleft palate.

Two groups of listeners were recruited. They were 20 native Cantonese speakers and 20 native Putonghua speakers. Each group consisted of ten males and ten females. Listeners of the Cantonese speaking group were undergraduate students at the University of Hong Kong, while listeners of the Putonghua speaking group were undergraduate students at the Peking University. Normal hearing abilities are reported by the individuals themselves. They were recruited on a voluntary basis. All of them had no previous exposure to hypernasal speech.

Speech stimuli and data collection

Three speech stimuli were collected. The first was two sustained vowels, /a/ and /i/. The second was a passage read aloud in Cantonese by the speakers while the third was a passage read aloud in Putonghua by the speakers. Each version of the passage was designed to be phonetically balanced with respect to that particular language. The Putonghua version of the passage was designed as having 16.19 % of nasals, while Cantonese version of the passage had 14.68 % of nasals. Please refer to Appendix B for details.

Before the speech data collection, the investigator demonstrated how to simulate varying degrees of hypernasality, with a calibrated Nasometer acting as a visual feedback for their production. After practicing on simulating hypernasality with different severity, the speech samples were collected. Please refer to Appendix A for details.

All speech samples were collected in a quiet room, using a SONY PCM_R300 DAT player and a unidirectional microphone. The microphone was maintained at a mouth-to-microphone distance of 10 cm. The speakers were asked to record several sets of stimuli in vowels, and passages read in Cantonese and Putonghua. They were asked to read the samples with their normal resonance, and then to produce the stimuli by simulating mild, moderate and severe hypernasality. However, some speakers encountered difficulty in simulating particular severity of hypernasality. Therefore, some speakers could only record the samples in normal resonance and simulate one or two level of hypernasality; while others could simulate all level of hypernasality. Speech characteristics, such as hyponasality, nasal emission and articulation errors were avoided during the recording of samples. If they produced speech characteristics other than hypernasality, feedback would be given to the speakers. It was to avoid other factors which might affect the perception of hypernasality. The Nasometer was used to monitor the production of simulated hypernasality so that varying degree of hypernasality could be produced by the speakers. The resulting speech samples were judged using an informal severity rating (‘mild, ‘moderate’, ‘severe’) by two researchers with expertise in resonance disorders. It was to ensure that the samples collected had even distribution in different severities of hypernasality.

The speech samples were low-pass filtered at 22 kHz and digitized using the computer program Cool Edit 2000 with a sampling rate of 44.1 kHz and resolution of 16-bit to a Pentium III 866 desktop computer (Model no: GENIE-IV-533). Each sound file was adjusted to be of similar intensity, in order to avoid differences in judgment of hypernasality due to varying intensity levels (Counihan & Cullinan, 1972; Zraick et.al, 2000). Moreover, all vowels’ lengths were adjusted as five to six seconds, in order to avoid differences in judgment of hypernasality of vowels due to varying sample length. In additions, longer speech samples were presented to the listeners.

Listening Task

All listeners underwent a familiarization session before the listening task, to familiarize them with the concept of hypernasality. The familiarization included introduction of hypernasality, with its definition and causes. Other speech characteristics, such as nasal emission and hyponasality, were introduced. Factors which might affect rating of hypernasality were illustrated in the session as well. A PowerPoint presentation was prepared for both group of listeners and the same handouts were distributed. Audiosamples of varying degree of hypernasality were introduced to the listeners during the familiarization session. The audiosamples used were obtained from the website with permission:

<http://www.acpa-cpf.org/EducMeetings/education.htm>

The duration of the familiarization session was approximately half an hour.

The listening task was carried out in both Beijing and Hong Kong. A written guideline of listening session was given to the experimenter in Beijing to ensure the running of listening sessions in both locations were the same. Each listening session was carried out individually in a quiet room. The speech samples were presented to the listeners through an AKG headphone which was connected to a computer. All listeners started with the vowel task followed by the passage tasks. The passage tasks were balanced such that half the listeners in each location rated the Cantonese passages first, and half rated the Putonghua passages first. Identical verbal and written instructions were provided for all three tasks and all listeners. Visual analogue (VA) scales were used for rating. Listeners were asked to mark a cross on a 10 cm line for each sample, indicating the severity of hypernasality. The end points of the line were labeled “normal” and “very severe” respectively. They were asked to ignore other possible factors such as articulation errors and voice problems, if any, which might affect their rating. They could replay each stimulus once.

In the vowel task, all of the stimuli were repeated once in order to evaluate intra-listener reliability. All stimuli were repeated twice in the passage task. Therefore, listeners heard 61 stimuli (two sustained vowels, one Cantonese passage and one Putonghua passage) from the six speakers, resulting in a total of 148 trials for each listener. The duration of the rating sessions were approximately one hour.

Data Analysis

The arithmetic mean of each listener's judgment of each type of stimuli (vowels, Cantonese passage and Putonghua passage) was calculated. The mean and standard deviation of the scores for each type of stimuli of the two groups of listeners (Cantonese and Putonghua) were then computed. A factorial 2 x 3 ANOVA was performed to determine if there was a statistically significant difference in the ratings between the two groups of listeners and for the three different stimuli.

Reliability

For calculating the intra-listener reliability, the raw visual analogue scores instead of the mean visual analogue scores were used to determine the consistency of rating within each individual listener. Pearson-Moment Correlation Coefficient was calculated between each listener's first and second rating of the same speech sample in all three stimuli (vowels, Cantonese passage and Putonghua passage). The means and standard deviations of the correlation coefficients across listeners were calculated.

The intra-listener reliability indicated whether the each stimulus was rated consistently by the same listener.

Inter-listener reliability revealed the relationship of rating of hypernasality across listeners, with each listener group. Pearson-Moment Correlation Coefficient was calculated across different listeners for three stimulus types, within each listener group. The reliability calculated showed which listener group (Cantonese or Putonghua) rated the stimuli more reliably, and which stimuli (vowels, Cantonese or Putonghua passage) were rated more consistently.

Results

Figure 1 shows the mean hypernasality severity ratings and standard deviations of rating among the three stimuli (vowels, Cantonese and Putonghua passages) and between the two listener groups (Cantonese and Putonghua).

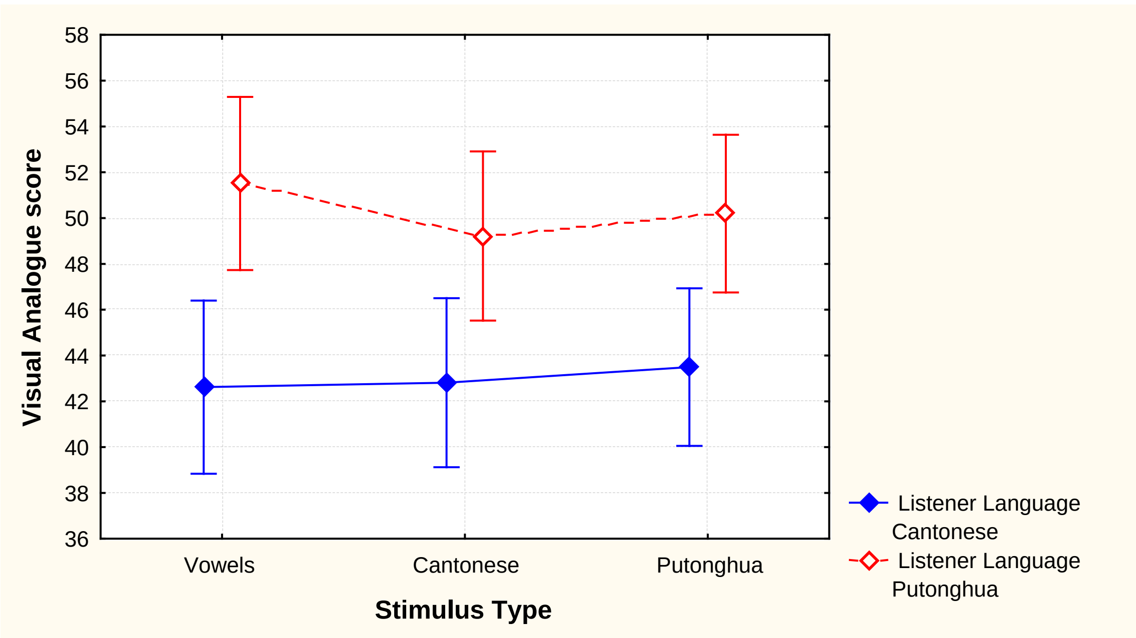

Figure 1. Mean hypernasality severity ratings and standard deviations of ratings for three stimuli and two listener language groups.

The 2 X 3 factorial design revealed a significant main effect for the listener group, F (1, 19) = 13.18, $p < 0.01$. That is, Putonghua listeners provided significantly higher hypernasality ratings than Cantonese listeners. The detailed results of VA scores could refer to Appendix C.

No significant main effect was found among the three stimuli type, F (2, 38) = 0.34, $p > 0.05$. The result indicated no statistically significant difference among the rating of vowels, Cantonese passage and Putonghua passage by all listeners. There was no significant difference between vowels and the two stimuli, too ($p > 0.05$).

There was no significant interaction effect between stimulus type and listener language, F (2, 76) = 0.51, $p > 0.05$. Although vowels appeared to be rated even more severely hypernasal than the other stimuli by the Putonghua listeners (Figure 1), the difference was not significant ($p > 0.05$).

Pearson-Moment Correlation Coefficient

Inter-listener reliability was calculated for each stimulus type and for the two groups of listeners. The result was summarized in table 1. For the Cantonese listeners, vowels scored the lowest coefficient in reliability ($r = 0.47$, $p < 0.05$). Cantonese passage yielded the highest coefficient ($r = 0.70$, $p < 0.001$) of inter-listener reliability.

For the Putonghua listeners, Cantonese passage yielded the highest correlation coefficient (r = 0.73, p < 0.01), while vowels scored the lowest one (r = 0.52, p < 0.05). For both Cantonese and Putonghua listeners, the correlation coefficients across all stimuli were of similar values. Cantonese listeners scored r = 0.72, p < 0.01; while Putonghua scored r = 0.73, p < 0.01.

Table 1

Result of inter-listener reliability for three stimuli and two listeners groups

	Cantonese listeners (n=20)	**Putonghua listeners (n=20)**
Vowels	r = 0 47, p < 0.05	r =0.52, p <0.05
Cantonese passage	r =0.74, p < 0.01	r =0.73, p <0.01
Putonghua passage	r =0.70, p < 0.01	r =0.7, p <0.01
Mean for all stimuli	r =0.72, p < 0.01	r =0.73, p <0.01

Intra-listener reliability was calculated by comparing each listener’s first and second rating of the same sample. The result was illustrated in table 2. Generally, the intra-listener reliability for two groups of listeners across all stimuli (vowels, Cantonese passage and Putonghua passage) were high. Vowels scored the highest mean of correlation coefficient for both Cantonese (r = 0.98, p < 0.01) and Putonghua (r = 0.99, p < 0.01) listeners. For the Putonghua listeners, Cantonese passage yielded the coefficient (r = 0.95, p < 0.01), while Putonghua scored a mean (r = 0.88, p < 0.05). For Cantonese listeners, Cantonese passage yielded a mean (r = 0.96, p < 0.01), while Putonghua passage yield a mean ($r = 0.88$, $p < 0.05$).

Table 2

Intra-listeners reliability across three stimuli (vowels, Cantonese Passage and Putonghua Passage)

	Cantonese listeners (n=20)	**Putonghua listeners (n=20)**	**Mean**
Vowels	r = 0 98	r = 0.99	r = 0.99
Cantonese passage	r = 0.96	r = 0.95	r = 0.96
Putonghua passage	r = 0.88	r = 0.88	r = 0.88

All correlations were significant at $p < 0.001$ level

Discussion

The first aim of the study was to investigate if there was a significant difference in perceptual ratings of hypernasality among listeners with different language backgrounds. The result showed that the hypernasality ratings made by Putonghua listeners were significantly more severe than the Cantonese listeners for all stimulus types ($p < 0.01$). That is, the Putonghua listeners appeared to perceive the speech samples to be more hypernasal than their Cantonese listener counterparts.

One possible explanation concerns the language specific difference in the native language of two groups of listeners. Moreover, as Putonghua only has nasals as final consonants, while Cantonese has both nasals and stop final consonants, Putonghua speaker might be more sensitive in production of final nasal consonants.

Another explanation was with regards to the sociolinguistic variation in Cantonese. Firstly, it would be the deletion of velar nasal initial /-.·˙/ in Cantonese. Many speakers in Hong Kong, especially younger individuals, tend to drop initial /-.·˙/ from words which have this initial consonants (Bauer and Benedict, 1997). Therefore, many Cantonese speakers tend to replace CVC syllable with initial nasal consonant by VC syllable only; such as 我 /.·˙□□ → [□]. They are not aware of the presence of velar nasal initial consonant /.·˙□□□-/. Secondly, it was about the confusion on realization of initial consonant /l-/ and /n-/. Cantonese speakers would replace /n-/ by /l-/ in causal conversation (Bauer and Benedict, 1997). These two sociolinguistic variations in Cantonese suggest that the distinction of nasals from other consonants in Cantonese is not as important as Putonghua. On the contrary, as Putonghua phonemically distinguishes /n-/ from /l-/, and there is no velar initial nasal consonant /.·˙□□□-/, the sociolinguistic variation in Cantonese does not happen in Putonghua. Therefore, Putonghua speakers, compare with Cantonese speakers, might show stronger distinction ability in contrasting nasal consonants from other consonants.

Another possible explanation was the speaker effect. Although the production of simulated hypernasaltiy was monitored by the Nasometer in order to obtain samples with various degrees of hypernasality, the nasalance values might not agree with perceptual judgment (Bressmann et al. 2000; Nellis et al. 1992; Watterson et al. 1993). Nellis et al. (1992) could not find a significant correlation between nasalance values and the nasality rating of ten listeners, which indicated that there might be differences between the perceptual ratings and the nasalance scores. Moreover, Whitehill (2001) reported that the test-retest reliability of nasalance scores obtained could vary. The nasalance score could vary up to 4 to 5 points. Therefore, even with the monitor of Nasometer, the perception of severity of hypernasality of the speech samples might not correspond closely to the nasalance score obtained.

Although there were differences in rating among the three stimuli, the differences were not statistically significant. A possible explanation concerns the difference in phonetic context between the two languages. The frequency of occurrence of nasal consonants in Putonghua (15.19%) was similar to that of Cantonese (14.39 %). As the two passage stimuli were designed according to the phonetic context of that particular language, the passages were phonetically balanced in terms of ratio of nasal to oral consonants. Therefore, the similar frequency of occurrence of nasals in both Putonghua and Cantonese passage might account for the insignificant difference found in stimuli.

No significant interaction effect was found between listeners' language and stimulus type. There were several explanations accounting for this comparison. First, it concerned about the sociolinguistic aspects. After the handover of Hong Kong in 1997, Putonghua was more promoted in Hong Kong as standard form of Chinese. Moreover, there was more contact between Putonghua and Cantonese speakers for different purposes. Therefore, Cantonese and Putonghua were both used in Hong Kong and in China, which meant Putonghua might not be totally naïve towards Cantonese listeners, and vice versa. Both groups of listeners were not completely unfamiliar towards the other group of listeners. They might have different degree of exploration towards the other languages. Hence, individual's familiarization of both languages became a potential variable in the current study. The effect on familiarization of language could be further investigated by adding a group of listeners with another language background, for example native English listeners.

Moreover, by comparing the listeners' rating among vowels and passages, it revealed that Putonghua listeners tend to rate vowels as more hypernasal than the passages. As vowels are language independent, while the two passages are language dependent, rating vowels more hypernasal by the Putonghua listeners supported the fact that there was listener effect but not language effect on rating of hypernasality.

Vowels resulted in the lowest inter-listener reliability, for both groups of listeners. Several listeners reported that they found it most difficult to rate hypernasality of a single vowel, which is short and without any phonetic context to help them in identifying the degree of hypernasality. Putonghua listeners achieved a higher inter-listener reliability than Cantonese listeners. It might be due to the inter-individual variation in Cantonese listeners were larger than the Putonghua listeners. One possible explanation is that Cantonese listeners' variation in familiarization towards Putonghua and Cantonese might be larger than the Putonghua listeners, since Putonghua is more commonly used in Hong Kong than the fact that Cantonese is commonly used in Beijing.

The inter-listener reliability was higher for the two passages. This supported the findings that judging longer speech stimuli yielded a higher reliability than shorter samples, i.e. sustained vowels (Spriesterbach & Powers, 1959). It might be the acoustics cues associated with non-nasal consonants that help the listeners' perceptual judgment of hypernasality (Westlake & Rutherford, 1966, cited in Counihan & Cullinan, 1970). Therefore, listeners tended to judge passages more reliable than that of vowels, as they relied on comparing the acoustics cues among consonants and vowels in connected speech samples. The use of connected speech samples is suggested for future research in order to achieve higher inter-listener reliability.

Result for intra-listener reliability was generally high for all stimuli. It reflected that the listeners were generally consistent in rating of hypernasality.

The scores for inter listener reliability were around 0.47- 0.7 only. The reliability was not high, which could be accounted for by the listener's inexperience with resonance disorder which might influence their reliability in rating of nasality (Bradford et al., 1964; Fletcher, 1976; Lewis, Watterson, Houghton, 2003). Moreover, the individual's varying degree of familiarization of Putonghua and Cantonese would also affect their reliability in rating of nasality.

One point should be considered in interpreting the present results. Concerning the vowels stimulus, there was no standard nasalance score for production of sustained vowels /a/ and /i/ in individual of varying degree of hypernasality. Therefore, there might be inter-individual variations in speakers' production of /i/. To minimize the individual difference, the vowels were screened by two professionals experienced in resonance disorder and monitored by the Nasometer.

Further Suggestion

The current study compared severity ratings of simulated hypernasality by listeners of two different language backgrounds, Cantonese and Putonghua. Cantonese and Putonghua have many differences, in phonetic inventory. Nevertheless, they are both Chinese tonal languages. It would be interesting to compare rating of hypernasality across two even more dissimilar languages, such as Cantonese and Japanese, or Putonghua and English.

Conclusion

To summarize, the aim of the current study was to investigate the effects of speakers' and listener's language on rating of simulated hypernasal speech. The hypernasal ratings provided by Putonghua listeners were significant higher than those of Cantonese listeners, across three stimuli (vowels, Cantonese passage, Putonghua passage). There was no significant difference in severity ratings among three different stimuli, across listener group.

The inter-listener reliability appeared numerically higher for the Putonghua and Cantonese passages than for vowels, for both Putonghua and Cantonese listeners. The intra-listener reliability appeared to be high for all stimuli across both Putonghua and Cantonese listeners. The listeners were found to be consistent in their rating of hypernasality.

The findings of this study suggested that Putonghua listeners were more sensitive to perceiving hypernasality compared with Cantonese listeners. This is possibly related to the difference in phonetic inventory between Putonghua and Cantonese, regarding the difference of final consonants in these two languages. Another explanation was the sociolinguistic variations in Cantonese, which made the distinction between nasals and other consonants less important in Cantonese than

Putonghua. Longer speech stimuli (passage) rather than vowels are suggested to be used in rating hypernasality, due to its higher reliability of judgment across listeners (Spriesterbach & Powers, 1959).

Acknowledgements

I would like to express my sincere gratitude to Dr. Tara Whitehill, for her guidance and support throughout the process of the study. I would also like to thank Professor Lian Ma, Dr. Leung Mak Tak, Dr. Law Sam Po and Ms. Joyce Chun for their help and advice in the development of this study. Special thanks to the technicians, Raymond Wu and Donald Chan of the Division of Speech and Hearing Sciences, HKU for their technical advice and assistance throughout the collection of data. Finally, I would like to thank all the subjects who participated in my study.

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