VELAR MOVEMENT DURING PRODUCTION OF NASAL AND NON-NASAL VOWELS IN SOUTH MIN DIALECT OF CHINESE

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ABSTRACT

The movement pattern of the velum during the production of words contain nasal and non-nasal vowels in the South Min dialects of Chinese was investigated.

Result showed that when a non-nasal vowel preceded nasals, the velum started falling short after the release for the initial consonant /p/ occurred. This suggests that anticipatory coarticulation for nasals strongly effects the entire part of the vowel in the South Min dialect. Difference which seemed to depend upon the quality and duration of vowels were also observed in the movement pattern of velum. The nature of tones might modify the trajectory of the velar movement.

1. INTRODUCTION

There is a distinction between nasal and non-nasal series of vowels in the South Min dialect of Chinese. Question will arise; whether the domain of nasalization is only the main vowel or the entire part of the vowel in diphthongs of nasal series; whether the vowel in CVN type syllables, like [pan] or [pin], is nasalized or not.

Another question is whether there is any relationship between the nature of tones or quality of vowels and the movement pattern of the velum or not.

2. METHOD

2.1. Subject

The subject was a 31 year old male speaker of the South Min dialect of Chinese from Taiwan.

2.2. Speech Material

An experiment was conducted to investigate whether there was the difference in the movement pattern of velum during the production of nasal and non-nasal vowels in the South Min dialect of Chinese. The list of test words are shown in Table 1. Test words consisted of CV(V)(N), where the initial consonant C was /p/ and V(V)(N) were /ã/, /ĩ/, /iã/, /uã/, /an/, /in/ and /ian/. Some of these words have two different nature of tones for different meanings. These test words were embedded in a carrier sentence [tse^{33} ʃi^{21} ___ dzi^{33}] (This is a character for ___.) and pronounced five times for each by a native speaker of the South Min dialect as naturally as possible.

Table 1 Test Words

[pĩ^{55}]	[pĩ^{21}]
[piã^{55}]	[piã^{21}]
[pin^{55}]	
[pan^{55}]	
[pien^{55}]	[pien^{21}]
[pã^{55}]	
	[puã^{21}]

The numbers following phonetic description correspond to the nature of tones for each test word. For example, [pĩ^{55}] was pronounced in the 1st tone "high level" and [pĩ^{21}] was pronounced in the 4th tone "short low" in the South Min dialects of Chinese. All words in this list are meaning words. However, only [pã^{55}] does not have a corresponding Chinese character, because it is an onomatopoetic word for the sound of horn of automobile.

2.3. Data Recording

Velar movement was monitored and recorded using the Velotrace simultaneously with the acoustic signal. The Velotrace, which had been previously reported, was inserted through the subject's nose with its internal lever resting on the nasal surface of velum so that the movement of the velum could be monitored from outside[1]. The maximum excursion of the velar movement was confirmed using the non-speech gestures such as forced nasal inhalation and dry swallowing. The movement of velum, which was tracked by the internal lever, was converted to the analog electrical signal using an electro-magnetic rotation sensor (see Fig.1). The Velotrace signal was digitized 100 samples per second, and the acoustic signal was digitized at 5000 samples per second. These signals were then stored on a microcomputer for further analysis.

2.4. Data Analysis

Following parameters were extracted from the data (see Fig.2).

1) the acoustical duration of the test word (p-dz)
2) the duration of the downward movement of velum (bV-eV)
3) the interval between the acoustical release of /p/ and the beginning of the downward movement of velum (p-bV)
4) the interval between the acoustical release of /p/ and the end of the downward movement of velum (p-eV)
5) the height of velum at the beginning of the downward movement (hV)
6) the height of velum at the end of the downward movement. (lV)
7) the excursion of the movement of velum (hV-lV)
8) the speed of the downward movement of velum (sV)

3. RESULTS

A part of the results is as follows.

3.1. Single Vowel versus Diphthong

There were no significant differences between [pĩ^{55}] and [piã^{55}], between [pin^{55}] and [pien^{55}] and between [pĩ^{21}] and [piã^{21}] in the p-bV. The p-bV was the second shortest in [piã^{55}]. (The shortest was in [puã^{21}].)

3.2. High Vowel versus Low Vowel

There were significant differences between [pĩ^{55}] and [pã^{55}] in the hV and the lV. The trajectories of the velar movement were always higher in case of [pĩ^{55}] than [pã^{55}]. There was same tendency in the case compared [pin^{55}] with [pan^{55}], however, statistically significant difference was only seen in the lV. There was no significant difference in the hV-lV and the sV for either pairs.

3.3. Influence from Difference of Tones

Although very few parameters were statistically significant, systematic difference was observed in the pairs compare the different natures of tones. For example, the hV's were higher in the cases of [pĩ^{55}], [piã^{55}] and [pien^{55}] than in the cases of [pi^{21}], [pia^{21}] and [pien^{21}]. The sV's were faster in the cases of [pĩ^{55}], [piã^{55}] and [pien^{55}] than in the cases of [pĩ^{21}], [piã^{21}] and [pien^{21}].

The bV-eV's were longer in the cases of [pĩ^{55}],[piã^{55}] and [pien^{55}] than in the cases of [pĩ^{21}], [piã^{21}] and [pien^{21}].

4. DISCUSSION

Result showed that when a non-nasal vowel preceded a nasal consonant, the velum started falling short after the release for the initial consonant /p/ occurred. This suggests that anticipatory coarticulation for nasals effects the entire part of the vowel in the South Min dialect. Differences which seemed to depend upon the quality and duration of vowels were also observed upon the movement pattern of velum. In the case of test word contained low vowel, the trajectory of the velar movement was higher than in the case of word contained high vowel. This suggests that there might be some physical (either aerodynamic or mechanical) interaction between tongue and velum. Also, differences which were observed in the pairs compare the different natures of tones suggest the possible interaction between the position of larynx and velum via the root of tongue.

5. REFERENCE

[1] HORIGUCHI, S. & BELL-BERTI, F. (1987), "The Velotrace: A Device for Monitoring Velar Position", Cleft Palate Journal, 24, 104-111.

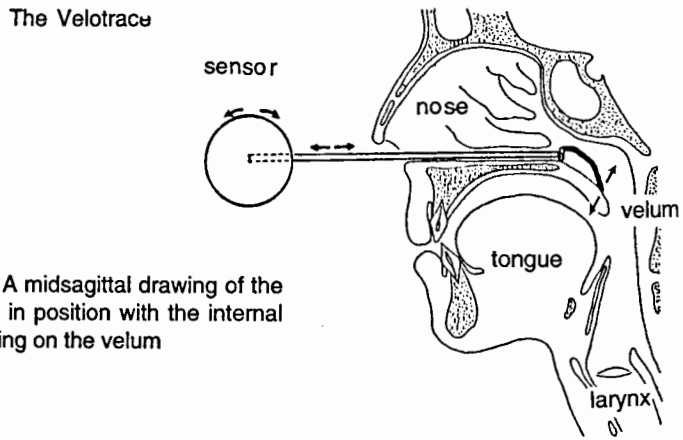

Figure 1 A midsagittal drawing of the Velotrace in position with the internal lever resting on the velum

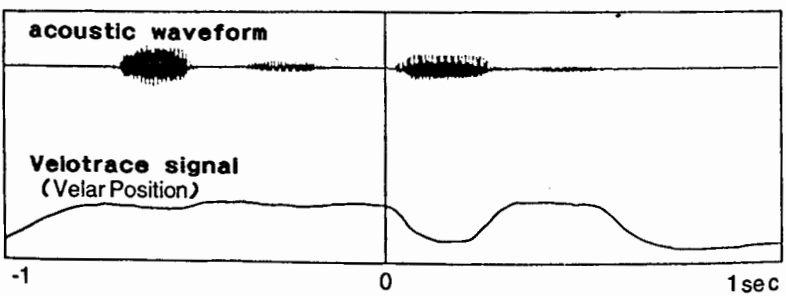

Figure 2 The time function for one token is shown with the acoustic waveform at the top and the Velotrace signal below. Zero on the abscissa indicates the reference point which the release for the initial /p/ occurred.