

Study on Stop Pronunciation Airflow of Children's Mandarin Chinese Based on Glottal MS-110

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Abstract: In this paper, we study the airflow data of the seven-year-old children's snoring sounds, and find that the pronunciation length, average airflow velocity, airflow, and peak airflow velocity of the children's air-sounding sounds are greater than the non-aspirating airflow, and the data decreases as the pronunciation part moves backward. It is related to the influence of the pronunciation part; the airflow peak of the same part of the stop sound followed by the round lip vowel is greater than the rear extension lip vowel.

1. Introduction

The term pronunciation is used in the fields of speech science, speech pathology, and vocal diseases to refer to the use of the airflow to produce an audible sound source [1]. The pronunciation of airflow has always been one of the focuses of speech aerodynamics research.

The critical period of childhood growth and development as a child has been widely concerned. After normal children begin to speak, the pronunciation will undergo a development process, and the pronunciation will reach the level of native speakers at the age of about six or seven years old [2]. The pronunciation disorder is also a common condition in children at this stage, and the prevalence of dysphonia in children is 6%-23%. In evaluating the sound parameters, three components can be evaluated: (a) aerodynamic properties, (b) acoustic features, and (c) vocal fold vibration characteristics. In order to assess the efficacy of the treatment program for children with speech impairment, it is necessary to refer to the normative data of the aerodynamic part of the speech assessment [3]. In this paper, the aerodynamic characteristics are used to study the children's Chinese-speaking aspirate and unaspirate stops.

PAS6600 to measure mean age and gender differences. It mainly tested the relationship between intraoral pressure and vocal intensity in children and adults. It was found that the intraoral pressure was increased with the increase of vocal intensity regardless of age. Enhanced [5]. Barbara Weinrich, Susan Baker Brehm et al made full use of PAS6600 to collect the normal voice of 77 children, including air flow, normal vocalization, sound pressure change, voice effect and other 45 PAS parameters to select 13 parameters to compare between gender and age. The distinguishing feature [6]. Annerose Keilmann studied 100 children aged 4-15 years who estimated the glottic pressure during intraoral pressure during the vocalization of the word "ipipi" and found that the sublingual pressure of children with 6 to 10 cm water column seems to decrease with age. Small. The flow rate of young children is between 50 and 150 ml/sec, which seems to increase with age [7]. The earliest research on the airflow pressure signal of Chinese pronunciation is Wu Zongji. He theoretically proved the physiological mechanism of the stop sound and the squeaky sound [8]. Li Yonghong used the vocal aerodynamic system (PAS6600) to collect voices of 10 males and 10 females. Males have higher air pressure, peak airflow and expiratory volume than females. Aspirated consonants have higher sound pressure level (SPL), expiratory airflow duration (EAD), peak airpressure (PAP), peak expiratory airflow (PEA) and EV than their unaspirated counterparts [9]. There are many researches

on the airflow of adult Chinese Mandarin pronunciation, but the research on children's pronunciation airflow is still in its infancy. This article will make a preliminary exploration of the acoustic and airflow mechanisms of children's Chinese Stop.

2. Experimental explanation

2.1 Experimental Materials

The stop sound in Mandarin Chinese has the distinguishing characteristic of [\pm aspiration] to distinguish it, mainly refers to the amount of effluent airflow in the oral cavity during the deblocking phase, and is longer than the unaspiration sound when the acoustic characteristics are viewed in terms of the sound of the aspiration sound. When the sound is blocked, the related tuning organs are completely closed, the airflow cannot pass, and a blockage is formed, and then the airflow breaks the blockage and makes a voice. In order to avoid the influence of different tones on the experimental data, all the syllables are 55-tone. The pronunciation materials selected in this paper are as follows:

Table.1. Stops of chinese

Stops	[pa]/ [p ^h a]	[pe]/ [p ^h e]	[pi]/ [p ^h i]	[pu]/ [p ^h u]
	[ta]/ [t ^h a]	[te]/ [t ^h e]	[ti]/ [t ^h i]	[tu]/ [t ^h u]
	[ka]/ [k ^h a]	[ke]/ [k ^h e]	[ki]/ [k ^h i]	[ku]/ [k ^h u]

[ki]/[k^hi] (There is no such syllable in Chinese.)

2.2 Participants

The main speaker is a 7-year-old first-year boy, standard Mandarin, without any laryngeal disease, good vocal fold conditions, normal hearing ability and normal sound characteristics. All the pronunciation people were trained in pronunciation before the experiment, and they were asked to read each sound five times according to the pronunciation table. This experiment was conducted with the consent of the guardian.

2.3 Instruments

The aerodynamic data acquisition device of this experiment consisted of a circular ventilatory breathometer mask connected to a narrowband pressure sensor (PTL-1) and a separate broadband pressure sensor (PTW-1) (Glottal Enterprises MS 110). The calibration gas flow volume was 1.4 L and the flow rate was 0.5 L/s. The data collection work was carried out in the professional studio of Northwest University for Nationalities. The following figure shows the original airflow pattern collected by the MS110.

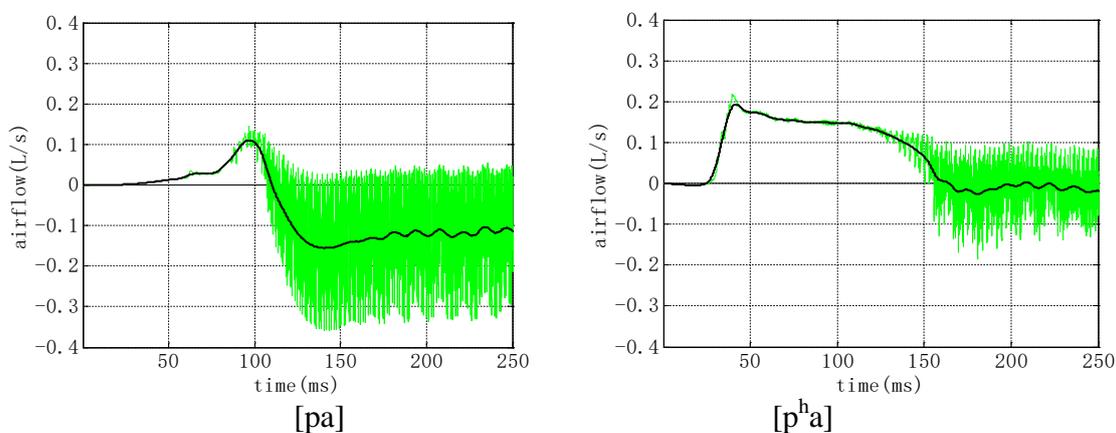


Figure 1. [pa] and [p^ha]

The parameters collected during airflow data analysis are:

Expiratory airflow duration (ms): refers to the length of time that the stops are pronounced in the syllable.

Average airflow speed (ml/s): refers to the change of the velocity of the airflow over time in a relative time.

Total airflow (ml): refers to the total amount of airflow exhaled during the process of pronunciation. The size of the airflow depends on the speed of the airflow and the length of the pronunciation.

Peak Expiratory Airflow (l/s): The airflow signal is the volumetric flow velocity of the airflow as a function of time. The peak velocity of the airflow is the maximum value of the airflow signal during the pronunciation of the stop.

3. Experimental results

Using the vocalization duration and average airflow velocity data to plot a scatter plot of the resulting syllabic airflow data, the difference in the distribution of the values of the vented and unvoiced tones in the graph can be clearly seen.

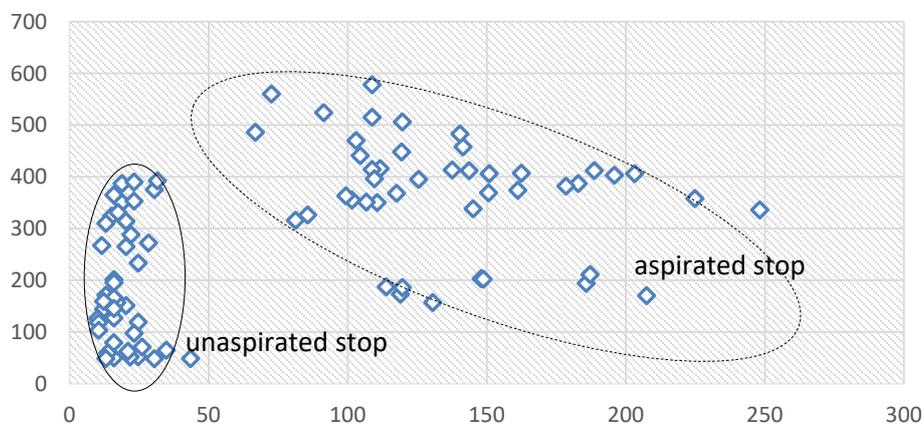


Figure 2. Stop duration and airflow velocity distribution scatter plot

3.1 Analysis of stop duration

The airflow of the stop sound can be detected after the resistance is removed. The duration of the detected airflow is also the duration of the sound removal. The following figure shows the contrast duration box of the unaspiration [p] [t] [k] and aspiration [p^h] [t^h] [k^h] vowels are connected to different vowels.

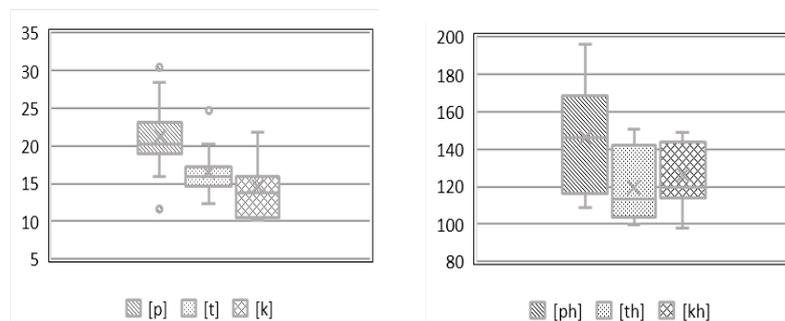


Figure 3. Comparison of the duration of the aspiration and unaspiration sounds (ms)

Comparing the aspiration stop sound with the unaspiration stop sound length box shape comparison in Fig.3. It can be seen that the sound length of the aspiration stop sound is much longer than the unaspiration stop sound, and the sound length of the unaspiration stop sound is about 10ms-30ms, and the pronunciation duration of the aspiration stop sound is about Between 98ms and 195ms. This is mainly because the pronunciation methods of the two are different. The aspirating sound needs to accumulate more airflow when the pronunciation is blocked, so it is longer than the unaspirating sound when the sound is blocked after the blasting.

Secondly, from the pronunciation part, the pronunciation length of [p][t][k] is shortened, and the pronunciation length of [p^h][t^h][k^h] is shortened. This is mainly because the pronunciation parts of [p] and [p^h] are in the lips, the pronunciation parts of [t] and [t^h] are at the tip of the tongue, and the pronunciation parts of [k] and [k^h] are at the base of the tongue. Since only the pronunciation part of [i] in the following vowel [a][e][i][u] is forward, the consonant behind the pronunciation part is shorter when transitioning to the target vowel.

3.2 Analysis of average airflow speed

The average airflow velocity of the stop is the change in the volumetric flow velocity of the airflow over time. The figure below shows the average airflow velocity comparison box for the unaspiration stops [p] [t] [k], and the aspiration stops [p^h] [t^h] [k^h].

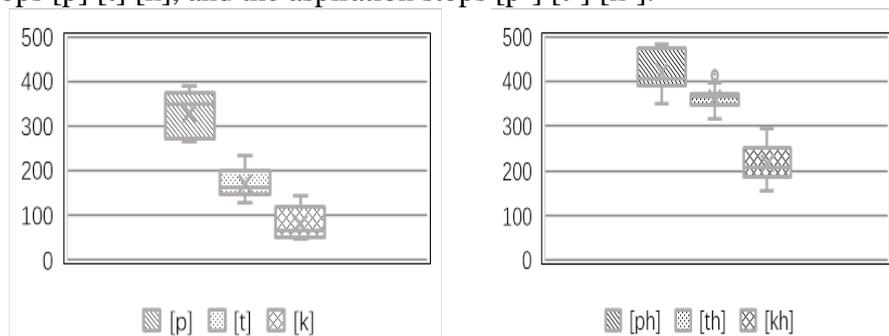


Figure 4. Comparison of the average airflow speed of the aspiration and unaspiration sounds (ml/s)

By comparing the aspiration stops with the unaspiration stops average air velocity box (Fig. 4), it can be seen that the average airflow speed of the aspiration stops is slightly larger than the unaspiration stops, and the average airflow speed of the unaspiration stops is about 48ml/s-390ml/s, the average airflow rate of the air supply plug is about 157ml/s and 482ml/s. From the pronunciation method, the aspiration stops accumulates more airflow when it is blocked, and the air pressure increases, and the airflow speed is relatively large when the sound is blasted.

Secondly, from the pronunciation part, the average airflow velocity of [p][t][k] is slower, and the average airflow velocity of [p^h][t^h][k^h] is slower.

3.3 Analysis of the total airflow data

The air flow of the stop sound is the air flow generated when the sound is pronounced. The figure below (Fig.5) is a comparison box diagram of the airflow when the unaspiration stops [p] [t] [k], aspiration stops [ph] [th] [kh] are connected to different vowels of expiratory airflow duration of blocking sound, the length of the aspiration stop of the same pronunciation part is longer than that of the unaspirated stop. This is mainly because the air flow of the aspiration stop is large, and it is necessary to collect more airflow, so it is long when the resistance is blocked. The duration of the blocking of the lip and the tip of the tongue is longer than the duration of the tongue plug. The main reason is that the mouth of the tongue is lower, and the cavity for storing the airflow is smaller, so the length of the resistance is shorter.

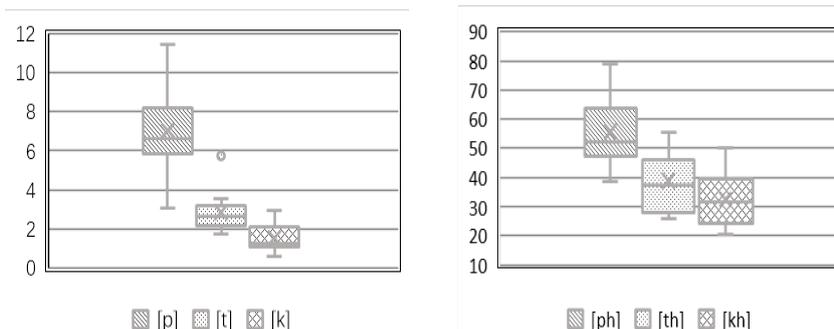


Figure 5. Comparison of the total airflow of the aspiration and unaspiration sounds (ml)

Comparing the aspiration stops sound with the unaspiration stops air flow box type map. It can be seen that the air flow of the aspiration stops is greater than the unaspiration stops, wherein the average air flow rate of the unaspiration stop is about 0.6ml and 11.4ml, and the air flow of the aspiration stop is probably about 20.5ml and 78.9ml. The air flow is the product of the length of the pronunciation and the average airflow velocity. Therefore, the airflow is also closely related to the pronunciation part and the pronunciation method of the stop sound. The flow rate of the airflow is consistent with the length of the pronunciation and the average airflow velocity according to the decreasing tendency of the pronunciation.

3.4 Analysis of peak airflow velocity data

The peak airflow velocity is the maximum value of the airflow signal during the pronunciation of the stop. The figure below (Fig. 6) is a bar graph of the peak airflow velocity when the unaspiration stop [p] [t] [k], aspiration stop [p^h] [t^h] [k^h] are connected to different vowels.

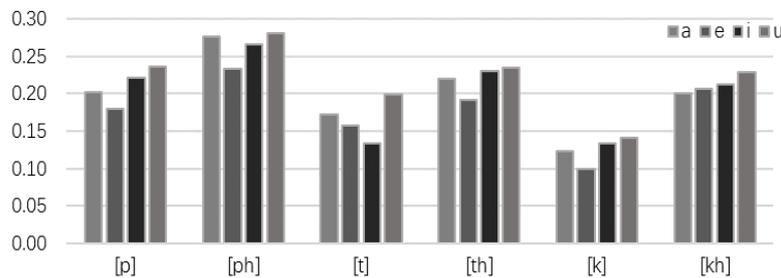


Figure 6. Comparison of the peak airflow speed of the aspiration and unaspiration sounds (l/s)

It can be seen from the above figure that the peak airflow velocity of the air supply plug sound is greater than the airless plug sound of the same part. The peak airflow velocity of the airless plug is approximately between 0.13 l/s and 0.23 l/s, and the peak airflow velocity of the air supply plug is approximately between 0.19 l/s and 0.28 l/s. From the perspective of different pronunciation parts, the peak airflow velocity is consistent with the average airflow velocity according to the decreasing trend of the pronunciation portion. From the perspective of different vowels, since [a][e] is the central vowel in Chinese Mandarin, [i] is the pre-vowel, and [u] is the post-vowel and round-lip vowel, which can be found in The peak velocity of the airflow when the stop is followed by [u] is greater than that of the subsequent [i], which is mainly due to the effect of lip radiation when the circular vowel is pronounced (the lip radiation is increased by 6 decibels per octave) (10).

4. Conclusion

In this paper, we study the airflow data of the seven-year-old children's snoring sounds, and find that the pronunciation length, average airflow velocity, airflow, and peak airflow velocity of the children's air-sounding sounds are greater than the non-aspirating airflow, and the data decreases as the pronunciation part moves backward. It is related to the influence of the pronunciation part; the airflow peak of the same part of the stop sound followed by the round lip vowel is greater than the rear extension lip vowel. These findings provide a standard for airflow parameters for children's vocalizations. From the perspective of distinguishing features, it provides evidence for the distinguishing feature of [\pm aspiration] of children's vocalization. This paper is the basic research on the aerodynamics of Chinese-speaking Mandarin for children, and further analysis is needed in the future.

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