

Acoustic Energy Analysis of Vowels in Western Yugur Language

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Abstract: Yugur is a minority with a small population in China. Yugur use two native languages, which are divided into eastern and western parts. It is generally believed that in the western Yugur language, the stress of words does not have the function of distinguishing the meanings of words, but there is stress in polysyllabic words. In this paper, experimental phonetics is used to extract the acoustic energy acoustic parameters of the vowels in the western Yugur language, and the energy distribution characteristics of the vowels in the western Yugur language are obtained.

1. Introduction

There are two kinds of native languages used by Yugur people, one is the Eastern Yugur language, belonging to the Altaic Mongolian language family, the other is the Western Yugur language, belonging to the Altaic Turkic language family, close to Uygur language. Compared with other languages of the same clan, the Western Yugur language has many unique features and occupies a prominent position. In terms of pronunciation, there are more complex vowels in the western Yugur language. The stops and affricates belong to the voiceless, and there are differences between aspiration and non-aspiration[1].

During the pronunciation process of the vowel, the vocal cords will vibrate, the airflow will not be hindered in the vocal organs, and the pronunciation will last for a long time. There are 8 basic vowels in the western Yugur language, namely [ɑ] [ə] [e] [i] [o] [u] [ø] [y]. The basic vowel is divided into a front vowel and a post vowel according to the tongue position. The front vowel includes i e y ø, and the back vowel includes ɑ ə u o. According to the round shape of the lip, it is divided into a round lip vowel and a lip vowel, where i e ɑ ə is a round lip vowel, and y ø u o is a lip vowel[2]. In the western Yugur language, the word stress does not have the function of distinguishing the meaning of the word. In the syllable, the accent is usually expressed on the vowel, such as tu'lum, and the accent is on the vowel u between l and m. The presence of accents causes the pronunciation of the vowel to change.

Accent is expressed in terms of acoustic parameters as energy. This paper will use the method of experimental phonetics to analyze the vowel accent of western Yugur language. By extracting the energy parameters of vowel pronunciation, the energy parameters of different vowels will be analyzed statistically. Finally, the energy distribution characteristics of vowel pronunciation of western Yugur language will be obtained.

2. Experimental Method

In the course of the research, experimental methods of experimental phonetics were mainly used. Develop a vowel vocabulary based on existing research. According to the vowel vocabulary, select the appropriate speaker to collect the speech signal. The speech signal is collected in a professional recording studio, and parameter marking and analysis are performed on the basis of ensuring the acoustic quality. In the parameter analysis, the acoustic energy parameters of the vowels are mainly extracted, and the difference between the energy parameters of different vowels is analyzed by combining the tongue position of the vowels and the roundness of the lips.

2.1. Experimental Equipment.

Experimental equipment includes professional voice microphones, mixers, and Powerlab 16-channel collectors. The software used is LabChart 8 and Praat. The recording frequency is 40KHz when recording, and mono recording is used, 16bit. During the signal acquisition process, the speaker is required to read each of the words in the pronunciation text in a natural tone and speed. Each case is read three times, and the voice signal with good quality is filtered for preservation. The signal is saved in the windows PCM.wav format, which is a lossless compression format that guarantees the quality of the acoustic analysis[3].

2.2. Pronunciation Partner.

The pronunciation partners' mother tongue in this experiment is western Yugur language. Finally, two male and two female pronounciators were identified. Considering the influence of age on pronunciation, the pronounciators is between 30 and 60 years old. Pronunciation cooperation everyone knows more vocabulary in western Yugur language, and can complete the pronunciation of all vowels in the vocabulary.

There are 8 basic vowels in the western Yugur language. In the experiment, when determining the pronunciation text, each basic vowel selects 5 common words containing the vowel and a total of 40 examples. The accents are in the position of the word, such as je'məs, jimə'sək, and the extracted accent is the vowel of the last position syllable, and the remaining vowels in the syllable are not

2.3. Signals and Parameters.

Sound intensity is the physical quantity of sound intensity. The strength of speech depends on the amplitude of the vibration of the vocal cord[4]. The larger the amplitude, the greater the intensity and the stronger the airflow exhaled. The intensity of speech intensity, expressed acoustically as energy, can reflect the energy produced during the pronunciation process, expressed as light and accented. The auditory perception of the sound intensity of the human ear is mainly determined by the magnitude of the loudness[5]. The auditory perception of sound intensity by human ear mainly depends on loudness. The louder the amplitude and energy are, the louder the sound is. Through the energy analysis of speech, we can observe the situation of light and accent in the process of pronunciation, and also observe the accent and loudness distribution characteristics of western Yugur language from the energy distribution.

3. Analysis of Experimental Results

The magnitude of the speech energy is mainly related to the amplitude of the pressure change caused by the sound source signal during the propagation of the sound in the air. For sound, the greater the amplitude, the greater the intensity of the sound. It is characterized by strong accent energy.

There are eight vowels in western Yugur language, namely [ɑ] [ə] [e] [i] [o] [u] [ø] [y]. In this part, the pronunciation methods of eight vowels are described. Through the 3-d spectrogram, the energy and intensity of each unit sound are analyzed. It is hoped that through quantitative analysis, we can have a comprehensive understanding of the unit vowels accent and energy distribution of western Yugur language.

3.1. Energy Analysis.

Catford (2006) pointed out that in stressed syllables, the speed of air flow will accelerate, thus increasing the amplitude of vocal cord vibration[6]. Stress in vowel pronunciation process is mainly manifested in the difference of acoustic energy. Before the parameter extraction, the speech signal is simply marked, and the vowel portion where the accent is present is mainly marked. Parameter extraction was performed using Praat software, and statistical analysis of parameters was performed using SPSS 19.0 software.

Table 1 Vowel energy parameter statistics (Unit: dB)

N	Val i d	116.00
	Missi ng	0.00
Mean		72.52
St d. Devi at i on		2.93
Range		15.63
M i n i m u m		63.99
M a x i m u m		79.62

From the data in Table 1, we can see that there are 116 energy parameters for the 8 basic vowels and accent positions. The average energy is 72.52 dB, and the Standard deviation is 2.93, indicating that the data is not discrete and concentrated. The minimum value of the vowel energy is 63.99 dB and the maximum value is 79.62 dB with a variation of 15.63 dB. Although accent does not distinguish between words in words, there are also subtle differences between different vowels. In order to further analyze the difference of energy parameters between the vowels, the vowel energy parameters were averaged and compared.

The energy of the vowel is related to the amplitude and the duration of the pronunciation. In order to compare the difference of different vowel energies, the vowel energy of the same duration is extracted, thereby eliminating the influence of duration on the parameters. The resonance characteristics of vowels are mainly reflected in the formants, mainly related to the frequencies of the first and second formants, and can reflect the changes of the vowels before and after the tongue position.

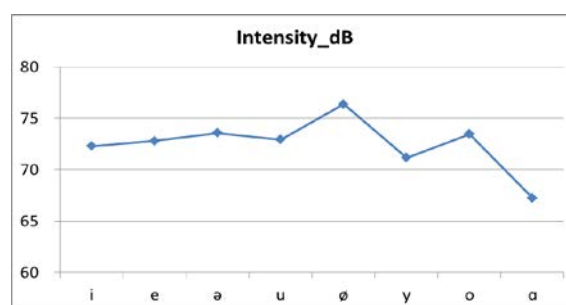


Figure 1. Comparison of vowel energy parameters

As shown in Figure 1, there is little overall difference in the energy parameters of vowels. The energy distribution of vowel [ə] [e] [i] [o] [u] [y] is between 70 and 75 dB, the largest is vowel [ø], and the smallest is [a].

According to the change of the tongue position of vowels, there is no obvious change in the tongue position of vowels. Similarly, there is no difference between rounded lip and extended lip. The higher overall energy [ø] belongs to the front low rounded lip vowel, which can form a single syllable. The vowel can appear at the beginning and end of a word, but not at the end. In polysyllabic words. The lowest energy vowel [a] belongs to the post-low-lip vowel, which can form syllables separately and can appear at the beginning, middle and end of a word. In all vowels, except for [ø], other vowels can be located in all positions of the syllable, only [ø] cannot appear at the end of the word. According to the tendency of energy attenuation in pronunciation, the position of stress often appears in syllables in western Yugur language, which results in a higher energy distribution.

3.2. Energy Distribution.

In order to further observe the distribution of each vowel energy parameter, SPSS19.0 software was used to make the histogram for frequency statistics, and the vowel parts with equal duration were selected.

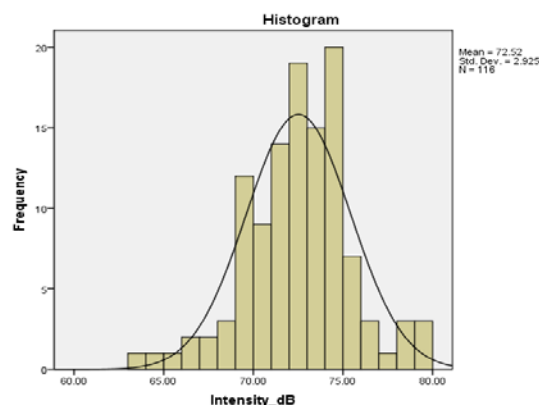


Figure 2. Vowel energy parameter distribution histogram

All parameters are counted according to the frequency of the energy distribution, as shown in Figure 2. In the histogram, the energy is mainly concentrated in the range of 73 dB, which is the same as the vowel distribution in the 70-75 dB distribution, and most of the vowel distribution range is not fixed. The parameters are generally distributed normally, and the concentration trend of vowel energy is mainly related to the distribution of accents in words. In the western Yugur language, the accent of a polysyllabic word is usually on the last syllable, and the vowel of the syllable is affected by the accent, and there is also a trend of energy enhancement. If the word has an additional component, such as an increase in the syllable within the word, the position of the accent will shift back, and the vowel energy is affected by the accent in the last syllable.

The syllables with strong vowel energy are generally considered to be accented syllables, and the energy of vowels in accented syllables is stronger. In some languages, the different positions of the accent have the function of distinguishing the meaning of the word, and the accent of the word in the western Yugur language has no distinguishing effect. However, in the energy distribution of the vowels in the accented syllables, the difference in energy distribution between the different vowels in the accented syllables is not large, but it is related to the distribution position of the vowels in the words.

4. Summarization and Prospect

This paper mainly uses the method of experimental phonetics to make an acoustic analysis of the vowel energy in the western Yugur language phonological section. By extracting the vowel energy of the accented syllables, it is concluded that the energy of the western Yugur language vowels is concentrated in the low frequency region, the energy distribution of the vowels is concentrated, and the difference in energy between the different vowels is small.

From the distribution characteristics of vowel energy. Unlike the vowel formant parameters, the difference in energy parameters is not directly related to the height of the vowel tongue, the front and back, and the roundness of the lip shape. The difference of vowel energy is mainly related to the distribution of stressed syllable vowels in words. Because the energy as a whole shows a high to low attenuation trend during the pronunciation process, the final syllable re-reading will lead to energy enhancement. Therefore, in the western Yugur language, the energy distribution characteristics of vowels can reflect the same characteristics as other Turkic language, and the accented syllables are located at the end of the word.

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