Experimental Analysis of Monophthongal Vowels Pronunciation Features among College Non-English Majors

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Abstract

Vowels occupy an important place in English phonetics, the pronunciation errors of monophthongs will affect the natural communication. College non-English majors learn less knowledge of English phonetics, so there are always many different problems in their pronunciation. This paper selects 60 non-English majors as subjects, uses the analysis methods of Experimental Phonetics and sound software Pratt to extract relevant parameters and analyse the data. By extracting the value of formant and duration, we conclude that there are the gender difference in pronunciation features of monophthongs among the subjects and the regularity is the same to some researches in related literatures. From the value of formant, male subjects master the position of the tongue better, both male and female subjects can not master the front and back position of tongue well, and female are more likely to use retroflex; from the duration, we find that the pronunciation errors of male and female are more consistent, that is the duration of long vowels is too short.

Keywords: Non-English Majors Monophthongs Pronunciation Experimental Analysis

1. Introduction

From the eighty s began, the domestic began to appear a group of English language training institutions, has a high English phonetics learning, has some scholars contrast and analysis of the voice of the pronunciation system error and the speech articulation of Chinese and English phonetic system was analyzed, and the difference between domestic appeared about the Chinese phonetic system comparison research results, and on this comparison system, but the new theory research mainly in the 2000 years later, the research methods of this theory research on summing up the system, this paper discusses the analysis on how to better the development of English phonetic pronunciation rules and methods, at the same time, according to different theory in the voice of the pronunciation practice and intermediary speech corpus the composition of the system, the research paper more and more, related research also had great development.[1-3]

English pronunciation occupies an increasingly important position in Second Language Acquisition. English IPA is the basis for learning English pronunciation, vowels and consonants is the main components of English IPA, of which vowels play main role in pronunciation learning. Incorrect pronunciation could seriously affect the accuracy of the other sounds in natural communication, for example, one incorrect monophthong or the confusion of long and short vowels will result in the confusion of words, and then cause the sentence misunderstanding or even the passage.

So it is necessary and fundamental to improve the pronunciation of students' monophthongs in order to develop native fluency in spoken English. In this paper, we mainly use the method of Experimental Phonetics and sound analysis software to analyses the pronunciation characteristics among college non-English majors and summarize the characteristics and problems of their pronunciation. The study provides the basis for improving college students' pronunciation of vowels.[4-8]

Speech is sound and meaning and form of this combination with system, this method is the language symbols of the internal structure of the most basic elements, therefore, learn pronunciation well has important significance. First of all, learn pronunciation well can promote students' English skills, second, learn pronunciation well for memorizing words are of great help to learn pronunciation well, again, to cultivate and enhance the sense of English language ability. However, in the actual teaching process, English phonetic pronunciation has been ignored in English professional teachers, especially with the pressure of competition of the university entrance exam incentive, many teachers only pay attention to the grammar and vocabulary teaching, has neglected the English phonetic pronunciation teaching, this led directly to the students to use English in spoken English communication enthusiasm and initiative to reduce.
2. Experimental Methods

2.1. Selection of Corpus and Recording Objects

Based on the new phonetic system that are listed in "Gimson's Pronunciation of English" (6th Edition, 2001) and taking Received Pronunciation (RP) as a reference, we select 11 words containing 11 monophthongs for experiments recording. Here we need to demonstrate that the monophthong /ə/ is not contained, because in the paper we don't consider the different contexts using one phoneme and the formant of /ə/ is unstable in the words, that is its formants will change in different language environments. RP pronunciation is widely applied to English teaching, and the students in non-English speaking countries mainly study RP English in school. The same to the English pronunciation teaching in China, we has been using Jones Phonetics System in the English pronunciation teaching since the liberation of China. And since 1977, the English teaching in different countries in the world compete to use the new Gimson Phonetic System and in China we also begin to use Gimson Phonetic System in recent years.

<table>
<thead>
<tr>
<th>Long vowels</th>
<th>[i]</th>
<th>[ɔ]</th>
<th>[ʊ]</th>
<th>[ʌ]</th>
<th>[e]</th>
<th>[æ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>hit</td>
<td>hot</td>
<td>hood</td>
<td>hut</td>
<td>hell</td>
<td>hat</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Short vowels</th>
<th>[i:]</th>
<th>[ɔ:]</th>
<th>[u:]</th>
<th>[æ:]</th>
<th>[ɔ:]</th>
</tr>
</thead>
<tbody>
<tr>
<td>heat</td>
<td>halt</td>
<td>whose</td>
<td>hard</td>
<td>heard</td>
<td></td>
</tr>
</tbody>
</table>

We select 30 male and 30 female sophomans of non-English majors in Northwest University for Nationalities as the recording objects. These students are all Han students with good health and normal vocal organs and start to learn English from middle school. They can complete the task of the experiment, and are willing to participate in the experiment. The standard speakers are 2 male and 2 female British teachers from London speaking RP English and they are teaching spoken English in China.

2.2. Process of Recording and Experiment

Firstly we finish recording according to the corpus. Before recording, the recording students must be familiar with the words and read the corpus, they should learn some new words. The recording begins after the subjects are ready for it. During the recording process the subjects should keep relaxed and natural as far as possible, and there must have been intervals for 1-2 seconds between each word.

We use Audition1.5 software which is highly efficient with high-quality for recording and segmentation. The recording signal is single channel, 16 bit, the sampling frequency is 16 kHz, and then the recording files are saved as "*.wav" files. In addition, we will use other hardware equipments including computer for signal collection and processing, external sound card with high-quality and microphone. The sound analysis software is Pratt which has the functions of sound analysis and data processing and can be used to analyse formant, fundamental frequency and so on. Most of the researchers use it for sound analysis and processing.

2.3. Research Methods

After recording, we use methods of Experimental Phonetics, extract parameters including first formant, second formant (F1, F2, F3) and monophthongs duration using Praat analysis software. Then we need to use Lobanov formula to finish the normalization of the formant: \( Z = (F_n - MEAN_n) / S_n \), in which Z is a normalized value, Fn is the formant, MEANn is the average value of Fn, Sn is the standard deviation of Fn \(^3\). This method can reduce the differences caused by physiological differences. Finally, we use the Excel forms for data processing, and compare the subjects' parameters.
values with the value of the standard speakers to summarize general pronunciation characteristics and problems of vowels among college non-English major.

Vowel tone is mainly determined by the frequency value of formant, in which F1 and F2 is most important and can basically describe the vowel tone. F1 describes the level of vowel tongue, and the value of F1 is smaller, the tongue position is higher; F2 describes the front and back position of tongue before, and the tongue is more forward, the value of F2 is bigger. While F2 can also reflect the situation of rounded lip, F2 of rounded vowels will decrease; F3 is not related to the tongue position, but it is impacted by the activities of tongue tip, that is when the tongue tip raises, the value of F3 will decrease \[^4\].

3. Experimental results and data analysis

Overall, the types of vowels is less than consonants, and the characteristic analysis is also easier, but to consider many other features, the analysis of vowels is not so simple and we also need to deepen the experimental study of vowels. In general, the method of Experimental Phonetics mainly uses formants to distinguish different vowels and duration of vowels to distinguish long and short vowels. The unit of formant is hertz (Hz) and duration is milli-second. He duration is not stable, because it is easily reflected by the speakers' speed of speech and different language environments.

3.1. Formant Analysis of Vowels

In the paper the standard value of formant and duration is the pronunciation of the selected British foreign teachers, and we also consulted the data result of formant measured by Deterding (1990, 1997), and the data is obtained by recording the words and sentences spoken by BBC announcer\[^5\]. The specific experimental data is seen below.

**Table 2. The experimental results of monophthongs formant**

<table>
<thead>
<tr>
<th>monophthongs</th>
<th>F1 male</th>
<th>F1 female</th>
<th>F2 male</th>
<th>F2 female</th>
<th>F3 male</th>
<th>F3 female</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ɪ/</td>
<td>355</td>
<td>540</td>
<td>2093</td>
<td>2155</td>
<td>2660</td>
<td>3096</td>
</tr>
<tr>
<td>/ɒ/</td>
<td>600</td>
<td>544</td>
<td>931</td>
<td>1003</td>
<td>2506</td>
<td>3022</td>
</tr>
<tr>
<td>/ʊ/</td>
<td>547</td>
<td>567</td>
<td>1517</td>
<td>986</td>
<td>2972</td>
<td>3176</td>
</tr>
<tr>
<td>/ʌ/</td>
<td>704</td>
<td>779</td>
<td>1280</td>
<td>1306</td>
<td>2672</td>
<td>2571</td>
</tr>
<tr>
<td>/e/</td>
<td>476</td>
<td>588</td>
<td>1919</td>
<td>2157</td>
<td>2513</td>
<td>3153</td>
</tr>
<tr>
<td>/æ/</td>
<td>876</td>
<td>740</td>
<td>1641</td>
<td>1801</td>
<td>2418</td>
<td>2829</td>
</tr>
<tr>
<td>/i:/</td>
<td>336</td>
<td>526</td>
<td>2148</td>
<td>2251</td>
<td>2639</td>
<td>3134</td>
</tr>
<tr>
<td>/ɜ:/</td>
<td>563</td>
<td>595</td>
<td>1416</td>
<td>1456</td>
<td>1949</td>
<td>2919</td>
</tr>
<tr>
<td>/ɔ:/</td>
<td>531</td>
<td>725</td>
<td>982</td>
<td>1309</td>
<td>2828</td>
<td>2854</td>
</tr>
<tr>
<td>/a:/</td>
<td>384</td>
<td>619</td>
<td>979</td>
<td>1053</td>
<td>2757</td>
<td>3340</td>
</tr>
<tr>
<td>/ɑ:/</td>
<td>740</td>
<td>822</td>
<td>1230</td>
<td>1335</td>
<td>2786</td>
<td>2809</td>
</tr>
</tbody>
</table>

From the statistical data shown in Table 2, we can find that there are gender differences of formants, and the formants value of female are all significantly greater than that of male. This characteristic is consistent with the experimental data of RP speakers. That is because the value of formant is related to the length of channel and the females' sound channel is shorter than male's \[^6\]. The characteristic of gender difference in the experiment is consistent with the research in some other literatures, which explains the experimental data is accurate. It also provides a reliable basis for the pronunciation errors analysis of vowels. We compare male and females' experimental data with the RP speakers' data and get the following comparison chart:
From the above chart, we can see that in all the parameters, males' value of F1 is the most consistent with the RP speakers, which shows that our male students can better grasp the level of tongue position, only /ʊ/, /e/ and /æ/ is not pronounced right. The differences of F1 between the subjects and RP speakers are more than 80Hz, of which the F1 value of /ʊ/ and /æ/ is too large, indicating that the tongue position is too low; the F1 of /e/ is too small, indicating the tongue is too high. The comparison curve of F2 values indicates that there are larger differences between the RP speakers and the subjects, indicating that subjects can not grasp the front and back position of tongue, of which /ʊ/ is pronounced worst, and the tongue is too forward, then followed by /ɔː/, /aː/, /ʌ/, /ɪ/ and /æ/. these sound differences of the F2 value between subjects and RP speakers are all more than 100Hz, the tongue of /ʊ/, /ɔː/, /aː/, /ʌ/, /ɪ/ and /æ/ are all too forward, and the tongue position of /u:/ is too far back.

When F2 decreases, the sound is rounded, so from the value of F2, we can know that the students can grasp the rounded /u:/ more accurately, the rounding of /ɔː/, /aː/ and /ɪ/ is not enough. From the data of F3, we can see that male subjects may retroflex the tongue when pronounce the sound /ɔː/, /æ/, /e/, /ɪ/, /ɜːːr/ and /u:/, in which the retroflection of /ɪ:/ and /ɜːːr/ is the most obvious compared with the RP speakers.

Note: MC refers to the male subjects; MRP refers to the male RP speakers

### Figure 2
The comparison chart of females and RP speakers' monophthongs formant

Note: FC refers to the female subjects; FRP refers to the female RP speakers
The above figure shows that the female subjects' values of F1 are basically similar to that of RP speakers', but the tongue position of some monophthongs is not right, such as the formant value difference of /ʊ/, /æ/, /i:/, /ɔ:/, /u:/ and /ɪ/ between the female subjects and RP speakers is more than 100Hz, in which the F1 of /æ/ is lower than RP and similar to F1 of /e/, indicating that the tongue of subjects' /æ/ is too high and easily confused with /e/. From tongue position we know that both /e/ and /æ/ are the high vowels, but the tongue position of /æ/ is in a semi-high state and /æ/ is in a half-state, so the tongue position of /æ/ should be slightly lower than /e/, and usually the duration of /æ/ should be longer than other short vowels, so also longer than /e/, /ɪ/, /i:/, /ʊ/ and /u:/ are front-high vowels, which means that the tongue position of them is higher. While the female subjects' F1 values of /ɪ/, /ʊ/, /i:/, /ɔ:/ and /u:/ are all higher than RP, indicating that the female subjects' tongue is too low when pouncing these vowels, and they can not grasp the high vowels well.

From the value of F2, female subjects' F2 is quite different from the RP speakers', and the tongue position is easily confused when pouncing /ʊ/, /i:/, /ɔ:/, /u:/ and /ɪ:/, The value differences of F2 between the subjects and the RP speakers are more than 150Hz, where the F2 value of /ʊ/, /i:/, /u:/ is smaller than RP speakers, indicating the tongue is too back and the value of /ɔ:/ and /ɪ:/ is greater than RP speakers, indicating that the tongue is too forward. In addition the F2 values of /ɪ/, /ʊ/, /æ/ and /ɛ/ are all lower than RP and the differences are more than 100Hz, indicating that the tongue of these sounds are too forward. From the value of F3 the female subjects' values are mostly lower than the RP, and compared with the value of male, also indicating that female use retroflexion more.

3.2. Analysis of vowel duration characteristics

In English duration has the function of distinguishing meaning. This paper mainly studies segmental phonemes and this is not related to the impact of context, so the data of monophthong duration is relatively stable and the study of it is significant. Wells' test results got by the experiment of London University students and teachers reading English words is referred to the following RP speakers' duration data, the specific experimental data is shown below[7].

![Figure 1. The duration comparison between male subjects and RP speakers](image)

![Figure 2. The duration comparison between female subjects and RP speakers](image)
Comparing Figure 3 With Figure 4, we can see that females' monophthong duration is greater than male subjects and the data also reflects the characteristics of gender differences, which is the same to other conclusions and findings in some literatures, indicating that the experimental data is solid[8].

From the male duration data in Figure 3 we can see that the male subjects' duration of /ɪ/ is similar to the RP speakers', indicating male can grasp /ɪ/ well and except the duration of /ʊ/ is too long, the duration of the other monophthongs is too short indicating the subjects can not grasp the characteristics of duration. From the RP speakers' data we can see that the duration of long vowels is longer one time than that of short vowels. But the male and female subjects' duration of long vowels is obvious too short and lacks of loudness, indicating subjects can not grasp the characteristics of duration and they may confuse long vowels with short vowels.

From Figure 4, comparing the duration of male subjects' with RP speakers' we can see that the female subjects' characteristics of duration is similar to the males' and female can master the duration of short vowels better than male. Except the duration of /ɔ/ and /æ/ is too short, the other short vowels is similar to the RP speakers, but the duration of long vowels is obviously too short. This is mainly due to the negative transfer of Chinese. In Chinese there is no distinction between the long and short vowels, but in English the pronunciation length can distinguish different phonemes and meanings such as the difference of beat and bit is determined by the pronunciation length of /ɪ/. The confusion of long and short vowels can affect the understanding of some words and even the understanding of the whole sentence and communication.

4. Conclusion

According to the above experimental analysis of college non-English majors' monophthongs pronunciation features, we get the following conclusions:

First, the college non-English majors can not master the tongue position of vowels and duration characteristics. This is related to the negative transfer of Chinese, usually we have preconceived habits in the process of learning a language, so we easily apply the pronunciation methods and techniques of Chinese into learning English. According to the above experimental analysis of data we can find that most students pronounce /ɪ/ into Chinese "y"(yi). In fact Chinese "y"(yi) is rounded sound, while /ɪ/ is unrounded sound. when pronouncing "y"(yi), the front of the tongue should touch the hard palate, and when pronouncing "y"(yi), the front of the tongue is lower and does not contact with the hard palate.
The characteristics of vowel duration are affected obviously by the Chinese negative transfer, and there is no the duration differences in Chinese, resulting in many students' duration of long vowel is too short and they usually confuse the long and short vowels.

From the formant value, there are gender differences and females' formant value is obviously larger than males', which is because the different pronunciation channels. And the characteristics of gender differences in the experimental data are consistent with the RP speakers and are also in line with the relevant research literatures. From the duration of monophthongs, females' duration is greater than males' and the duration of long vowels are all too short.

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6. References


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