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Differences of Vowel Pronunciation in China English and American English: A Case Study of [i] and [ɪ]

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This paper investigates the differences between vowels [i] and [ɪ] pronounced by Chinese English speakers and American English speakers. Seven people consisting of two natives and five Chinese have read a list of sentences and their voices were recorded. A software program is used to analyze their voices. In spectrograms generated by Praat, the connection between formant values and articulation features is used to investigate how native speakers pronounce these two vowels and what the differences are between native speakers and Chinese speakers. Through this investigation, it is discovered that Chinese speakers have lower tongue position in [i] and their tongues are more forward in [ɪ], thus making it hard to differentiate these two vowels. Moreover, the length of [ɪ] is much shorter than those in American pronunciation, suggesting that Chinese speakers differentiate [i] and [ɪ] largely by length. However, the comparison of Chinese speakers and native speakers proved otherwise.

Keywords: China English, American English, vowel, Praat, formant value

Introduction

While learning English as a foreign language, the pronunciation is usually neither “wrong” or “bad”, rather it is just “less native”. English pronunciation is often more difficult to grasp than vocabulary and grammar. This paper emphasizes the differences of the phonetic features of [i] and [ɪ] between Chinese-spoken English and the native spoken English based on first-hand recordings. These two vowels can be easily mixed up by Chinese students when pronouncing English. ZHOU, SHAO, and CHEN (2010) determined the accuracy rate of Chinese speakers’ perception of vowel [i] to be 96%, and the rate for [ɪ] is only 89%. And this paper aims to discover how American speakers distinguish these two vowels. This thesis will probe deeper in the articulatory differences between China English and American English.

Literature Review

The notion of “China English” was first brought up by GE Chuan-gui (1980) and completed further in the last three decades by many (SUN, 1989; WANG, 1991; DU, 1998; JIANG, 2001). China English is somewhat different from “Chinglish” referred by native speakers. It is “correct” grammatically while being swayed by

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Chinese in pronunciation, syntax, and vocabulary. Most of the previous studies are based on auditory perception and descriptions on segmental features and supra segmental features. Segmental features are related to the phonetic features of vowels and consonants.

In the production of vowel sounds, the articulators do not come very close together, and the passage of the airstream is relatively unobstructed. The targets for vowel gestures can be described in terms of three factors: (1) the height of the body of tongue; (2) the front-back position of the tone; and (3) the degree of lip rounding (Ladefoged, 2009; Lisker, 1989), while this specification is not entirely satisfactory due to its inaccurateness and disregard of tongue shape and pharynx width. Another way is to base vowel diagram or tongue position on the previous theory. This is widely acknowledged and used in describing vowels, but it is still difficult to describe tongue position of a vowel in one's own speech, as found by many phoneticians (Deterding, 1997, 2006; Langstrof, 2009; Berger, 2007). As technology develops, more methods and equipments have been found to describe vowels. The notion of formant was brought out to light. With the help of computer programs, the formants of vowel can be displayed in spectrograms.

Ladefoged (2009) further explained in his textbook that in spectrograms, the first formant frequency is inversely related to vowel height. The second formant frequency is considerably affected by the degree of lip rounding as well as by vowel height. Lip rounding is generally characterized by the lowering of the second and third formants.

Research Methodology

This chapter firstly introduced the equipments and objects of the experimental research on vowels [i] and [ɪ]. Computer, headsets, and software programs were utilized during the research process. Research objects were [i] and [ɪ] articulated in 20 words, which were carried in a sentence structure "Say _ again". Speakers were required to read the sentences once each; their sounds were then recorded and put into Praat for data analysis. In the latter part, data analysis methods were explained in detail. The data needed in this research were mainly formant frequencies values and vowel lengths. According to F1 and F2 value, formant charts were plotted to show vowel qualities visually. Vowel length identified by Praat was also inspected, thus showing the differences between Chinese speakers and American speakers when pronouncing [i] and [ɪ].

Research Equipments and Objects

Recording devices were computers and regular headsets. Speakers were required to read the materials in medium speed and volume. All the recordings were carried out in an anechoic chamber in the school's radio station and the sound files were produced by recording software in Microsoft Win7 system. The average sampling frequency of the seven speakers was 44100 Hz and all the speech recordings were stored in medium fidelity. Editing of sound waves and data analysis were completed by software Praat.

This research focused on vowels. However, there are altogether 20 vowels in English and it is impossible to cover them all in an undergraduate paper, so the objects were limited to one pair of vowels—[i] and [ɪ]. The structure of each word was "consonant + vowel + consonant". In choosing these word structures, two principles were followed: (1) The words should be minimally contrasted in vowels; and (2) The choice should all be neighboring consonants and avoid nasal consonants such as glides (Ladefoged, 2003). Considering all the above

guidelines, the final word lists contained 20 short words which consisted of 10 minimally compared pairs.

Data Collection

There are seven speakers in this research, five are Chinese and the other two are Americans. In order to reach the maxim consistency in variables, Chinese speakers are limited within the following range: Firstly, they are all college undergraduate students major in either English or French. Thus, they are equally educated in English speaking, culture, etc.. Secondly, they are all male. The voices of males are lower, hence their formants are lower and easy to recognize. Other two native speakers are both American form Connecticut.

The speakers are required to read the listed words in carrying sentence once each, following the sequence of contrasting pairs, for example: beat, bit, heat, hit, and so on. Their voices are recorded into computers through headsets. And the sound files are then analyzed by the software "Praat".

Data Analysis

Formant Measures and Plotting

F1 and F2 values of the points within the time intervals were measured automatically by Praat. The sum of time points of each vowel ranged between 10 and 25. In order to make these data comparable, the first, middle, and ending points were chosen to work out the mean value, representing the formant value of each word. Phoneticians usually use formant charts to visually express vowel qualities. In this thesis, all formant values were presented in formant charts, where the zero frequencies were placed at the right corner of the figure and formant frequencies were inversely related to the traditional articulatory parameters. Consequently, this arrangement allowed us to represent vowels in the way that people have become accustomed to seeing them in traditional articulatory descriptions. Each formant chart contained 20 dots, half of them were [i] articulated in 10 words, and the other half were [ɪ] articulated in other 10 words. All the dots were distinguished by two different colors, representing two vowels; hence it is easier to see the differences of these two vowels in articulations.

Figures 1-7 are formant charts of American speakers and Chinese speakers.

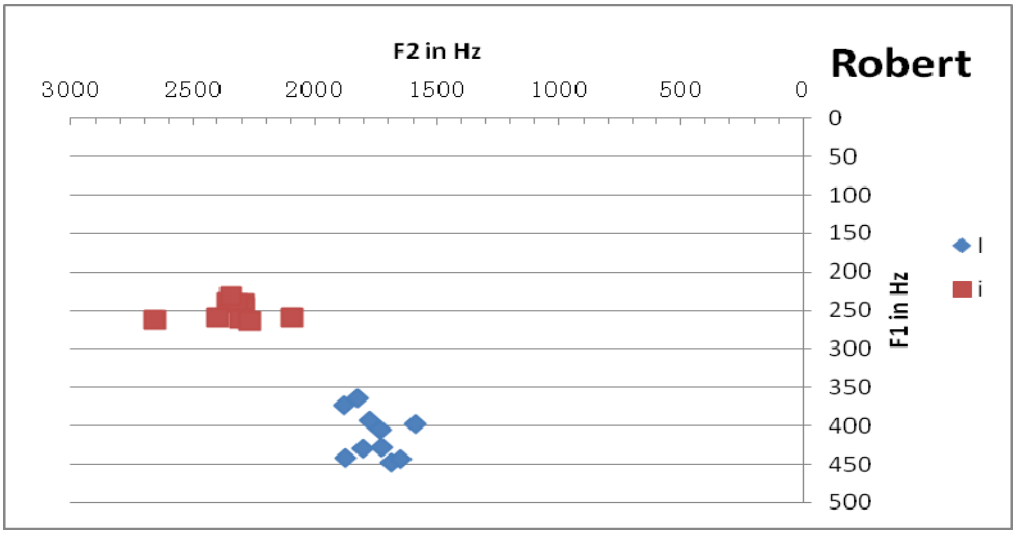

Figure 1. Formant chart of Robert.

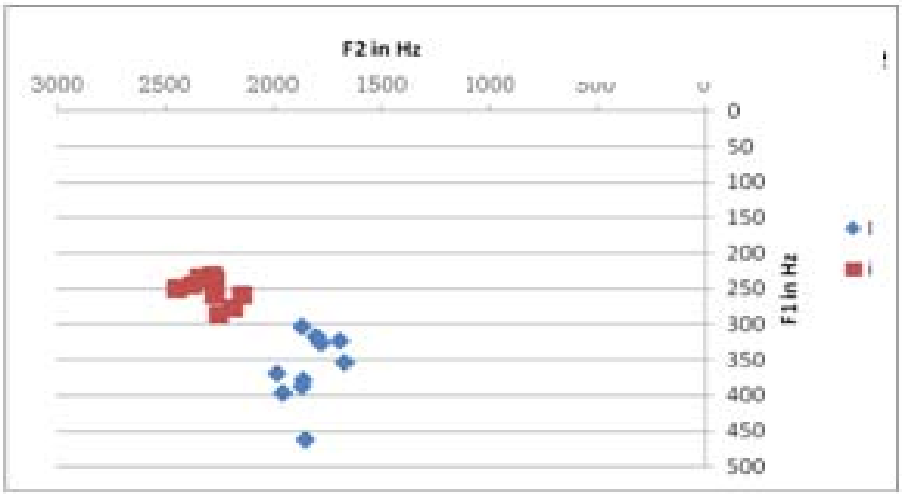

Figure 2. Formant chart of Victor.

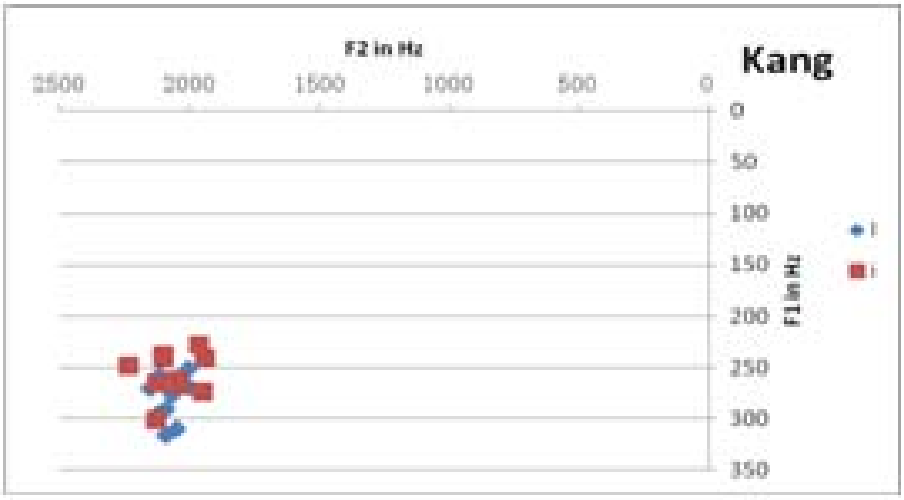

FIgure 3. Formant chart of KANG.

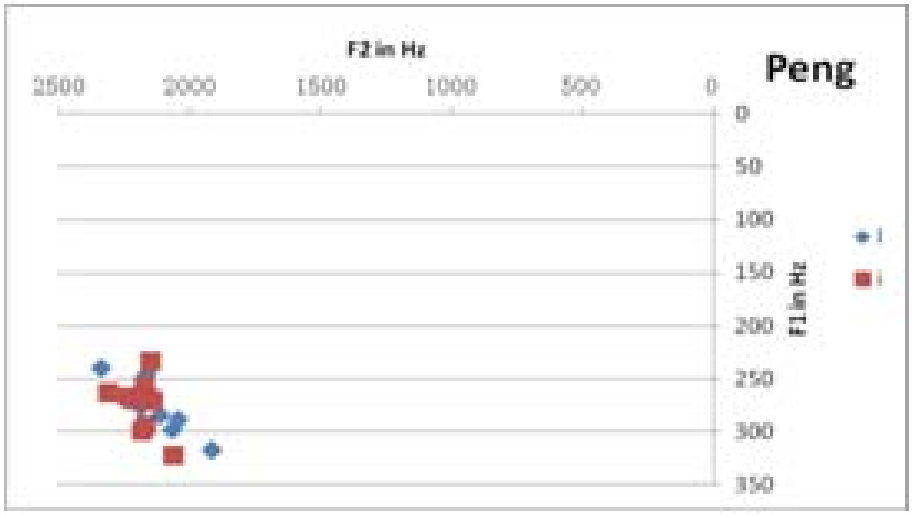

Figure 4. Formant chart of PENG.

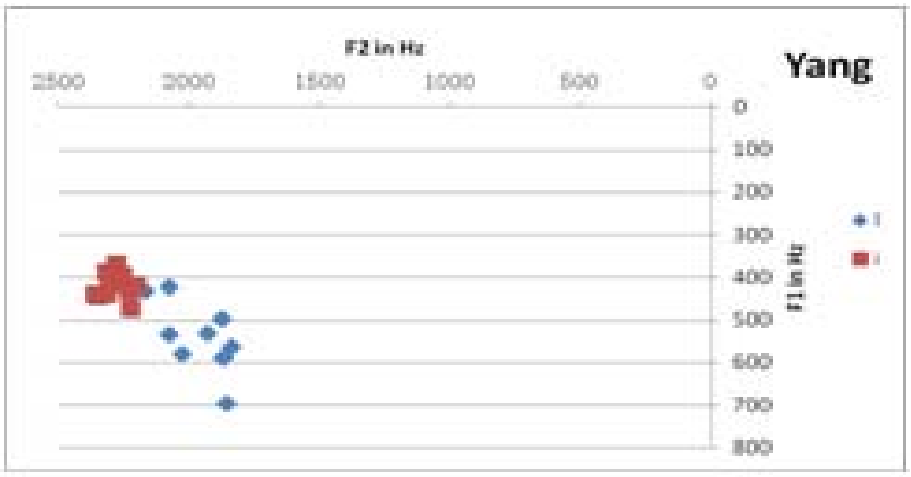

Figure 5. Formant chart of YANG.

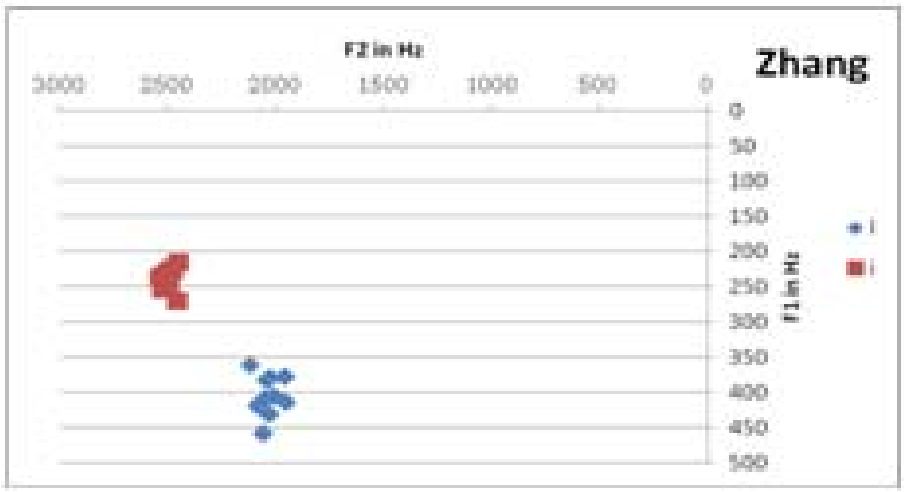

Figure 6. Formant chart of ZHANG.

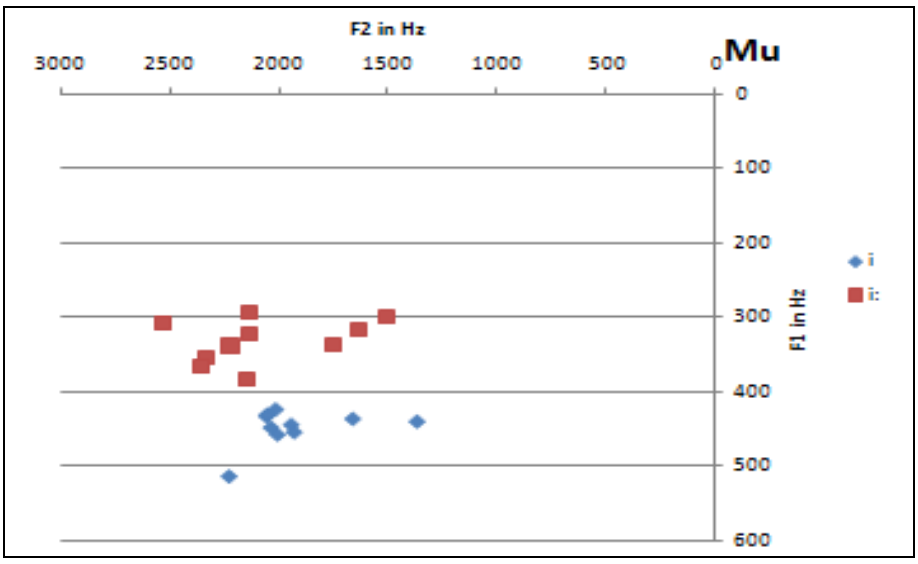

Figure 7. Formant chart of MU.

Vowel Length Measurement

When Chinese English speakers contrast vowel [i] and [ɪ], they consider length as their only difference. They tend to pronounce [i] longer, and [ɪ] shorter, with little distinction in quality. This perception is claimed "wrong" by many phoneticians, so in this thesis, the lengths of these two vowels were also investigated, as shown in Figures 8-9 below. The way of measuring vowel length was to identify a steady time scale, leaving out the beginning and ending of consonants. All the vowel lengths in the 20 words articulated by seven speakers were recorded. The comparison of vowel lengths helps to see the length difference between these words articulated by the native speakers and EFL (English as a Foreign Language) speakers.

	beat	heat	deep	deed	bead	peed	peep	lead	keep	team	average
VIctor	0.1	0.14	0.1	0.21	0.17	0.2	0.17	0.23	0.13	0.18	0.163
Robert	0.11	0.11	0.13	0.2	0.2	0.24	0.08	0.18	0.08	0.18	0.151
Zhang	0.14	0.12	0.13	0.21	0.19	0.2	0.14	0.2	0.13	0.2	0.166
Mu	0.14	0.1	0.12	0.14	0.16	0.11	0.08	0.12	0.1	0.09	0.116
Yang	0.14	0.18	0.14	0.19	0.2	0.16	0.08	0.22	0.15	0.16	0.162
Peng	0.09	0.1	0.07	0.11	0.12	0.07	0.07	0.14	0.07	0.09	0.163
Kang	0.07	0.08	0.08	0.12	0.08	0.07	0.05	0.12	0.06	0.07	0.151

Figure 8. Vowel length of [i] in all words articulated by seven speakers; measured by Praat.

	bit	hit	dip	did	bid	pid	pip	lid	kip	Tim	average
Victor	0.15	0.73	0.08	0.13	0.18	0.12	0.1	0.15	0.08	0.11	0.183
Robert	0.09	0.1	0.1	0.18	0.18	0.16	0.05	0.14	0.05	0.12	0.117
Zhang	0.06	0.06	0.08	0.06	0.1	0.1	0.06	0.11	0.05	0.07	0.075
Mu	0.1	0.05	0.09	0.08	0.11	0.11	0.06	0.12	0.07	0.11	0.09
Yang	0.08	0.09	0.09	0.11	0.14	0.09	0.07	0.14	0.08	0.1	0.099
Peng	0.06	0.05	0.06	0.77	0.1	0.06	0.05	0.12	0.05	0.09	0.141
Kang	0.09	0.08	0.06	0.08	0.04	0.12	0.09	0.08	0.04	0.07	0.075

Figure 9. Vowel length of [ɪ] in all words articulated by seven speakers; measured by Praat.

From the above figures, it can be seen that the vowel lengths of [i] of two native speakers are 0.15s and 0.16s; the length of [ɪ] is about 0.13s (average value). There does exists a length difference in these two vowels, however it is relatively mild. For the five Chinese speakers, similarly, the average vowel length of [i] is around 0.15s and 0.16s, however, while the length of [ɪ] tells a different story. The average length of [ɪ] is between 0.07s and 0.09s, almost half the length of [i].

The above analysis indicates that Chinese speakers have no difficulty in mastering the length of [i], but they tend to deliberately shorten the length of vowel [ɪ]. This is because most Chinese speakers consider these two vowels as a similar pair and see length differences as the most important, or the only way, to distinguish [ɪ] from [i].

Research Findings

The analyses were firstly made in native speakers and Chinese speakers respectively and then they were put together for comparison. Then differences in vowel length are also evident: Chinese speakers' pronunciations of [ɪ] only last half the time of [i], while American speakers pronounce them in relatively similar length. These phenomena all point to the fact that when Chinese speakers pronounce [i] and [ɪ], they are less aware of the quality differences and consider length as their biggest distinction.

Natives Differentiate Qualities of [i] and [ɪ] in Vowel Height and Backness

In Figure 1, the majority of [i] rest within the range of 200-300 Hz for F1, and 2000-2500 for F2, while most of [ɪ] rest within 300-450 Hz for F1 and 1500-2000 for F2. As mentioned above, F1 is inversely linked with vowel height: As F1 value increases, the vowel becomes lower; and F2 is linked with front-backness: as the tongue moves from the front to the back, F2 value increases. So when Americans pronounce [ɪ], their tongue is higher and more forward than [i]. It is also clear that the dot cluster of these two vowels is entirely separated with each other with no intersections, which proves that the qualities of [i] and [ɪ] are actually different and it is easy for native speakers to separate these two.

In Figure 2, vowel [i] rests within 200-300 Hz for F1 and 2000-2700 for F2. [ɪ] rests between 350-450 Hz for F1 and 1500-2000 for F2. Value ranges of F1 and F2 in both vowels are almost the same with Figure 1. The differences of formant values between these two vowels are also identical with Figure 1, representing the same vowel qualities. Though formant values differ slightly from Figure 1, the distinctions are too small to make a difference in vowel quality. It can be interpreted as individual differences caused by age, vocal condition, etc.. What worth noticing is that though a same vowel pronounced by different people has different formant values, the relative positions of F1 and F2 always remain relatively stable, unless it is mistakenly pronounced. Both Figures 1-2 conform to this principle.

Chinese EFL Learners Tend to Mix up Vowel Qualities of [i] and [ɪ]

From Figure 2 to Figure 7, for words containing vowel [i], the average range of F1 is 250-350 Hz, the average range of F2 is 1900-2500 Hz. Compared with formant values of American speakers, F1 of Chinese speakers is 50 Hz higher in average while F2 remains relatively the same. It shows that Chinese speakers have lower tongue positions when pronouncing [i]. For vowel [ɪ] in all the charts, the average ranges are F1: 320-450 Hz, and F2: 1700-2400 Hz. Again, a comparison of these data along with those of native speakers shows that though F1 did not change much, F2 values are higher by about 300 Hz. It can be seen that Chinese speakers post their tongue more forward than it should be when pronouncing [ɪ]. These two findings about tongue positions show that differences of [i] and [ɪ] become less obvious in Chinese speakers' articulations.

Generally speaking, only two of the speakers have completely separated [i] from [ɪ]. Plots of other three speakers have overlapped in various degrees, which means that they did not realize the true differences of vowel qualities between [i] and [ɪ]. What is more, when investigating five speakers separately, it is not hard to find out that formant values vary greatly in different speakers' articulations and their relative positions are not remained in the same proportion.

Conclusions

This paper investigated the differences of vowel pronunciation between China English and American English.

Two native speakers and five Chinese speakers have read 20 short sentences containing two vowels [i] and [ɪ]. Their voices were recorded by computers and analyzed by Praat—software for phonetic analysis. Praat can generate spectrograms of sounds and provide formant values. This thesis only concerns the first and second formants. F1 is related to vowel height, which means the height of tongue position and openness of mouth. F2 is related to backness—whether the tongue is in the front or back of mouth. This paper has put formant values in a more direct way to show articulation features—vowel charts, as have shown from Figure 1 to Figure 7.

Using formant data and vowel charts, this paper investigated into distinctions of [i] and [ɪ] of native speakers' articulations. Also, it compared the differences of Chinese speakers and native speakers. Native speakers distinguish [i] and [ɪ] both in vowel height and backness, which means these two vowels have different qualities. Formant values of Chinese speakers, however, rest in different ranges. Chinese speakers tend to pronounce [i] lower and [ɪ] more forward. These mistakes directly lead to the fact that Chinese speakers believe these two vowels are of similar pronunciations. As it turns out, plots overlap in Chinese speakers' formant charts. Vowel lengths are also included in investigation. The result is that Chinese speakers tend to pronounce [ɪ] half the time of [i], since they emphasize this aspect as the most important difference between [i] and [ɪ].

This paper also sheds light on phonetic researches. Some pronunciations are taken for granted for Chinese English speakers, but are all the pronunciations authentic enough to be widely accepted? More surveys and researches on China English, added with the comparison of it with American English, would offer help in future English learning and teaching in China.

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