A PRELIMINARY INVESTIGATION OF TENSE-LAX CONTRAST OF GERMAN VOWELS BY CHINESE LEARNERS

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Abstract: The tense-lax vowel contrast, which is present in German and English but not in Chinese, has been extensively studied in the cross linguistic phonetics for Chinese learners of English [1, 3]. Much research has been dedicated to the perception and production studies of Chinese speakers of English, but few studies focus on L2 learners of German vowels [2]. This study will carry out a preliminary investigation on the tense-lax contrast of German vowels of Chinese learners. The German vowel inventory consists of 14 distinctive monophthongs that include 7 tense-lax pairs, while Chinese vowel inventory does not distinguish tense-lax vowels. The template of Chinese tense-only vowels has been internalized and further becomes filters when native speakers of Chinese begin to acquire a foreign language. Consequently, Chinese learners might often tend to mispronounce lax vowels for tense counterparts or fail to distinguish tense/lax contrasts. This experiment has been carried our on the basis of Azar Trainer [5], an intelligent language tutoring system with multimodal feedback functions. Firstly a perception experiment examined Chinese learners' German vowel discrimination. Pairs of vowels were embedded in carrier words, these speech stimuli were produced by a German native speaker, which is taken as the standard pronunciation in the tutoring system. 12 Chinese learners were asked to identify whether the vowels in the words were long or short vowels. Secondly these 12 Chinese learners were required to read the carrier words in pairs. Results of both perception and production experiments are discussed and improvements for the tutoring system and for further investigations are suggested.

1 Introduction

With the progress of speech technology, language educators become more interested in Computer Assisted Pronunciation Training (CAPT). Complete pronunciation tutoring systems have been developed for foreign language learning, among which EURONOUNCE [5] is an Intelligent Language Tutoring System with multimodal feedback functions, a project funded with support from the European Commission. With the visual-audio feedback, it is especially appealing to Chinese students whose perceptual discriminations are declining and they need visual information to activate their capacity of perception. Experiments have thus been carried out in order to find whether this system could be helpful to the learners.

In the tutoring system, vowel and consonant pronunciations are the focus of the phonetic training. In order to teach the vowel system, pairs of vowels are presented to listeners for them to imitate and evaluations are then presented automatically to the students. The tense-lax pairs are exactly the weakness for Chinese learners; we thus focus our investigation on this topic to elaborate the situation of Chinese students of German learners. Previous investigations were carried out to examine the special difficulties of the Chinese learners of German vowels [2], and the aim of the current research is to make use of the material employed in the system to further investigate whether the learners can perceive the tense-lax contrast correctly, and to provide some feedbacks for the improvements of the tutoring system.

2   Different Vowel Systems

The difference between German and Chinese vowel systems can lead to inaccurate pronunciation of vowels.

German phonetic system consists of seven pairs of vowels, which differ in length but also in vowel quality exhibited by their different articulatory characteristics, we thus use tense-lax contrast instead of long-short in this study to emphasise the latter rather than the former.

However Mandarin has six basic monothongs, /a o i u ü/ in pinyin romanisation. These vowels are equivalent to German long vowels, but some of them can be realized in their short counterparts in certain environments in combination with other vowels or consonants. Therefore Chinese speakers might use different cues in the perception of German vowels.

3   Preparation of Speech Database

3.1   Material for Perception and Production Experiments

Vowel pairs in carrier words are selected from the speech material of the system. Five pairs of seven groups are selected, which are listed in the following table.

Vowel Pairs	Words		
[a:] – [a]	der Wal – der Wall	der Staat – die Stadt	lahm – das Lamm
	die Bahn – der Bann	der Schal – der Schall	
[i:] – [I]	ihm – im	schlief – schliff	liest – die List
	bieten – bitten	die Miete – die Mitte	
[u:] – [U]	die Pute – die Putte	die Krume – krumme	gesucht – die Sucht
	das Fuder – das Futter	die Grube – die Gruppe	
[y:] – [Y]	fühlen – füllen	die Hüte – die Hütte	die Lüge – die Lücke
	die Düne – der Dünne	der Kühnste – die Künste	
[e:] – [E]	wegen – wecken	zehren – zerren	reden – retten
	Speeren- sperren	stehlen–stellen	
[o:] – [O]	zogen – zocken	roden – verrotten	der Ofen - offen
	sogen – die Socken	der Schoß – schoss	
[2:] – [9]	böten – können	lösen – die Röcke	rötlich – das Zöpfchen
	die Löhne – den Stöcken	beschwören – das Söckchen	

Table 1 – Carrier words and the German paired vowels represented in SAMPA

We have two main criteria in finding carrier words: 1) first, they should be meaningful words instead of nonsense words; 2) second, they are ideally minimal pairs, such as "fühlen – füllen", so that the only difference between them is the tense-lax vowel.

3.2   Subjects

12 Chinese students studying German at Tongji University were asked to take part in the perception and production experiments. Among these subjects 4 students had studied German for two, three and five years respectively. They were between 20 – 24 years old, three of them

are male, and seven are female students. They come from different parts of China and have no disorder in perception or production.

4 Perception Experiment

4.1 Procedure

Before the perception experiment several questions were put forth, such as:

1) What is the difference between German long and short vowels?

2) How to judge the differences between long and short vowels in listening?

We have altogether seven groups of words, the first six of which were put in tense-lax pairs with random order that means sometimes with tense-lax or lax-tense order. The last group [2:] – [9] was put in [2:] – [e:] and [9] – [E] contrasts with the following words in Table 2:

Vowel Pair	Words		
[2:] – [e:]	böten – beten	lösen – lesen	rötlich – redlich
	beschwören – sich beschweren		die Löhne – die Lehne
[9] – [E]	können – kennen	die Röcke – der Recke	den Stöcken – der Stecken
	das Zöpfchen – das Zäpfchen		das Söckchen – das Säckchen

**Table 2** – Words for perception test of vowel pair [2:] – [9]

These words were played in pairs only once to the students, they were asked to indicate whether the vowel they have heard was long or short vowel on a prepared test sheet.

4.2 Results of Perception Experiment

The answers to the questions are usually (over 90%) :

1) The differences between German long and short vowels are only duration;

2) If the duration is longer, it is long vowel; and vice verse, is a short vowel.

The average accuracy of four students in each of the three different levels were calculated, the results are presented in Figure 1.
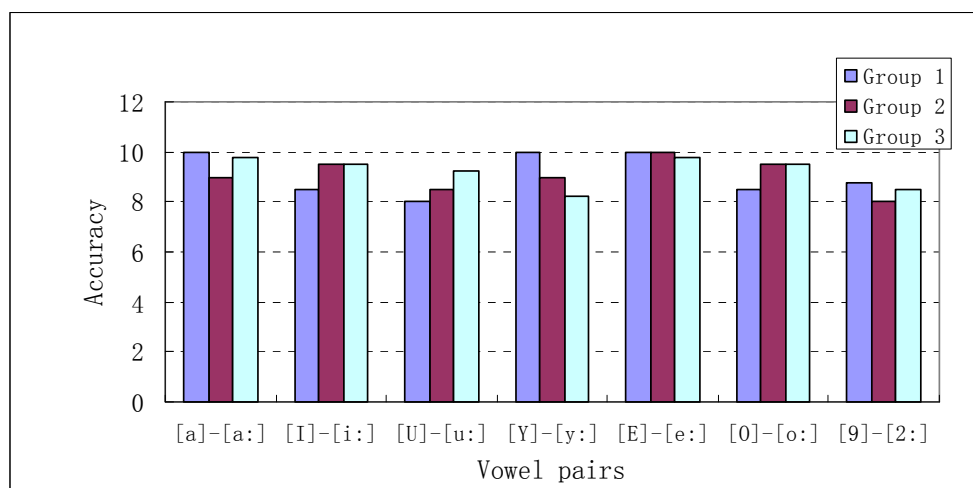
Figure 1 – Results of vowel (represented in SAMPA) perception experiment

The results are presented in average amount of three different groups. Group 1 – 3 are students who have learned German for 2, 3 and 5 years respectively. The average accuracy of each group is presented in Figure 1. There are ten words in each tense-lax vowel pair, if the accuracy reaches 10; it means that all four students are correct in identifying each vowel in the carrier words.

4.3 Discussion of the Perception Experiment

From the answers to the questions and results in Figure 1, following conclusions can be drawn:

1) A non-linguistic student usually takes it for granted that long vowels differentiate from short vowels only in duration. They are not aware that there are some quality differences because of different acoustic characteristics. A phonetic course aided with the tutoring system is much helpful to these students.

2) They hear the duration of the vowels rather than the acoustic properties such as formants of the vowels. Because the recordings are taken from the material of the tutoring system, two words are read in sequence with the first one containing a long vowel in rising tone, and the second one containing a short vowel in falling tone, which coincides with the relationship of tones and duration in Chinese. While rising tones are perceived longer as falling tones [4], which helps the listeners to achieve very high accuracy in the perception of vowel contrast regardless of the formant differences. The last pair [2:] – [9] proves a little bit difficult to them, because tone difference is absent, which also leads to a relative worse accuracy than the other pairs. A better variant for the listeners to hear the tense-lax vowel is to take these words from the same carrier sentence, and play to them individually rather than in pairs. The cue of tone will be eliminated; the cue of duration can thus be weakened.

3) There are no significant differences among different levels of these subjects. Because these are simple words, or minimal pairs, knowing more words does not seem to help in identifying the tense-lax vowels. Moreover, the perceptual discrimination between tense-lax vowels has not been improved much by spending 1 or 2 years more on learning German without any phonetics course.

4) The quality of [a] and [a:] does not differ very much as the other pairs, but the Chinese students can still tell the differences better that some other pairs, such as [u:] – [U].

These are only preliminary results which have been suggested for further research investigations.

5 Production Experiment

5.1 Procedure

Recordings were made in a quiet room at a sampling rate of 16 kHz with 16-bit resolution. The reading list is presented to them in pairs described in Table 1.

5.2 Results of Production Experiment

The recording of 70 words of each speaker results in 840 words. They were first annotated and then the acoustic parameters such as duration and formant were calculated. The duration values are presented in Figure 2, group classification remains the same as in the perception experiment.
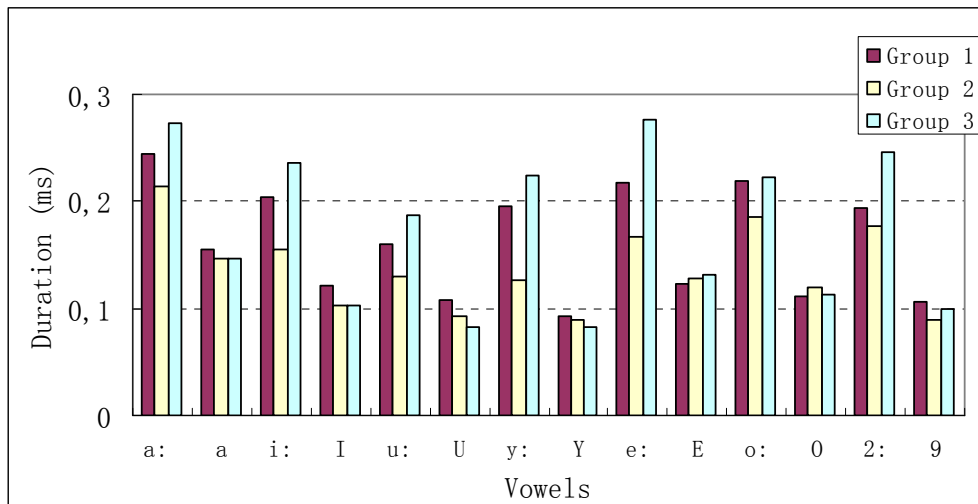
Figure 2 – Duration of German vowels (represented in SAMPA) produced by Chinese learners

It is obvious that the duration of long vowels are longer than their short counterparts in each group and of every speaker, which corresponds with the pronunciation of German native speakers. The ratio of long vowel to short vowel is from 1.63 to 2.07, which is still larger than that of native German speakers.

On the other hand, there are few formant differences between long and short vowels; all short vowels have similar formant structures to that of long vowels.
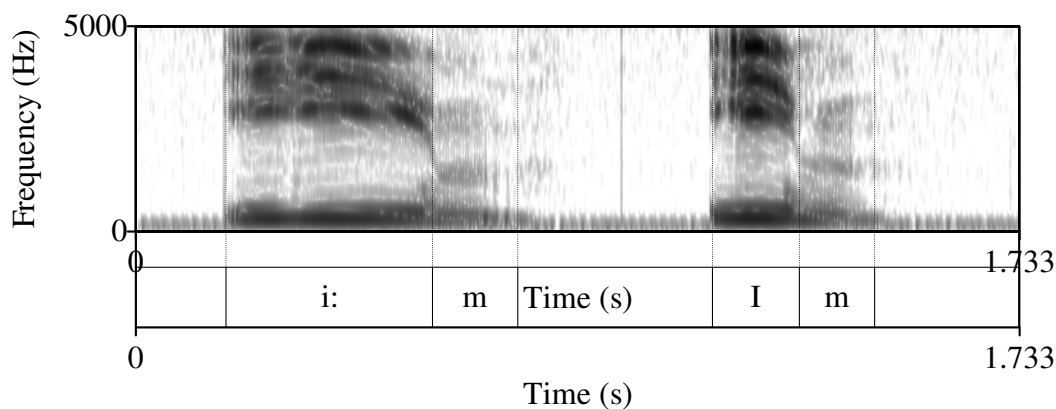

Figure 3 – Spectrogram of "ihm [i:m]" and "im [Im]" produced by one Chinese speaker

Figure 3 illustrates one representative example of *im* [i:m] and *ihm* [Im] produced by one Chinese speaker. The speaker produced a same formant structure of short vowel [I] as that of long vowel [i:]. Because in Chinese phonology system there is no short vowel [I], it is perceived as having the same formant structure and articulated with the same tongue position as long vowel [i:], but in shorter duration.

All the produced words were then evaluated by two German native speakers, they were asked to give a general impression to the vowels produced and to decide the whether they could hear the difference of tense – lax vowels in all the word pairs produced by the Chinese speakers. There are two interesting findings

1) Long vowels get better scores than their short counterparts, which has been reported in previous studies [2];

2) German native speakers can still hear the difference between the vowels even if acoustic properties are similar, but the duration is different, especially when the longer vowels in rising tone and the short vowel in falling tone.

5.3 Discussion of the Production Experiment

The production result also reflects the fact that the vowels on rising tones are perceived longer than those on falling tones in the world's languages [8]. If this is the case, then the imitation of the two paired words with the long vowel in rising tone and the short vowel in falling tone in the tutoring system is not optimal for learners. The Chinese students try to imitate the intonation and duration of these two words again and again, but they have never paid attention to the acoustic properties of the vowels. And they believe that the vowel in rising tone is longer and the vowel in falling tone is shorter, which is also true to certain degree. The interference of tone in the perception of long-short vowels has also been reported in other studies [6, 7]. The tutoring system should have avoided the prosodic differences between the long and short vowels, and will highlight the acoustic properties of these vowels, so that the learners can get the essential difference of the tense-lax vowels.

6 Conclusions

This paper illustrates that the terminology of long and short vowels misleads the Chinese students into imagining that vowel length is the distinguishing factor.

Moreover the tones interference with the perception of vowel length, it is natural for Chinese students to imitate the tones rather than the acoustic properties in the pronunciation tutoring system, which should be improved especially for Chinese students.

7 Acknowledgements:

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