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An Analysis of Chinese Students' Perception and Production of Paired English Fricatives: From an ELF Perspective*

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English has assumed a new role in international communication in recent decades, that is, as a Lingua Franca (ELF) among speakers with different first languages. This study attempts to investigate and analyze Chinese university students' perception and production of paired English fricatives from the perspective of ELF. By using a listening discrimination task and a reading task, respectively, the study examined how thirty two non-English major freshmen from a key university in Mainland China perceived and produced English fricative consonants. It was found that the participants had extreme difficulty distinguishing between the two sounds in three pairs of consonants in perception, namely, /ð-z/, /v-w/, and /θ-s/. In terms of production, the participants tended to replace the English fricative sounds, especially /ð/, /ʃ/, /v/, /ʒ/, with various substitutes. These results indicate that Chinese students often have more difficulties with certain fricatives than with others. In addition, they seem to have particular problems with voiced fricatives. Therefore, it is suggested that priorities should be given to those that impede mutual intelligibility in international communication, namely, to those that fall into the Lingua Franca Core (LFC).

Key Words: paired English fricatives, ELF, LFC, mutual intelligibility

1 Introduction

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It has been widely acknowledged that English is now used as a lingua franca in intercultural communication, that is, "as the common language for speakers whose mother tongues are different" (Walker, 2010, p. 6). It is also a widely accepted fact that non-native speakers have far outnumbered the so-called native speakers (e.g. Crystal, 2003; Jenkins, 2009; Kirkpatrick, 2007; Walker, 2010). Researchers have suggested that English language teaching and learning should no longer use native speakers as norms, but should emphasize "mutual intelligibility" instead in the use of English as a Lingua Franca (ELF) (Jenkins, 2009; Kirkpatrick, 2007, 2012). Given the current circumstances, Jenkins (2000, 2002, 2009) proposed the notion of "Lingua Franca Core" (LFC) for the teaching of pronunciation, which consists of a set of features important for intercultural communication, especially among speakers of English from the Expanding Circle countries (Kachru, 1985). Among all the features that fall into the LFC, all consonants except the two dental fricatives are included (Jenkins, 2000).

English fricative consonants have long been noted to pose great difficulties for Chinese learners and/or speakers of English (e.g., Deterding, 2006; Hung, 2006; Walker, 2010). In fact, the two dental fricatives have been discussed most widely in the literature, and a common phenomenon with the pronunciation of these two sounds is to replace them with other sounds. This is most obvious in research on different varieties of English, such as using /t/ and /d/ in Singaporean English and Indian English, /f/ and /d/ in Hong Kong English, and /s/ and /z/ in China English, to replace /θ/ and /ð/ (e.g., Kirkpatrick, 2007). Jenkins (2000, 2002) claims that these two sounds do not usually cause misunderstandings and has not included them in the LFC. However, there is not much research on the perception of dental fricatives among English speakers. Neither are there many studies focusing on the acquisition of other fricative sounds. To address the lack, this paper aims to investigate how Chinese university students perceive and pronounce paired English fricatives from the perspective of ELF.

2 Literature Review

2.1 Lingua Franca Core

Researchers have reported that among all the aspects of English, pronunciation is the area causing the most frequent problems in intercultural communication (Deterding, 2013; Jenkins, 2000). It is therefore a crucial element in the teaching of English as a lingua franca.

The Lingua Franca Core (LFC) is "a set of pronunciation features that research has found to be central to intelligibility in ELF" (Walker, 2010, p. xiii). Through a careful examination of oral interactions between speakers

from different first language backgrounds, Jenkins (2000) identified a number of pronunciation features considered to be important to mutual intelligibility in the use of ELF. There are four central areas in the LFC:

- an approximation to all RP/GA consonants, except /θ/ and /ð/.
- the appropriate treatment of consonant clusters, especially initial clusters (e.g., *spring*).
- length differences between vowels (e.g. *beat* vs. *bit*)
- the placement of nuclear stress

The LFC has been discussed extensively in various articles and books (Jenkins, 2000, 2002, 2009; Walker, 2010). Related to the current study, we will mainly focus on a subset of the first area, that is, the features of English fricative consonants. Among the eight fricative consonants that form four pairs, one pair, that is, /θ/ and /ð/ has not been included in the LFC whereas the other three pairs are within the range of the LFC. It is worth exploring how Chinese students use paired fricative sounds and what that can suggest for the LFC.

The previous research on the LFC mainly focuses on the pronunciation aspect. However, how the sounds are perceived also plays a crucial role in international communication. Unlike production, recognition of various accents and the ability to perceive the sounds in different accents are of extreme importance. Moreover, Walker (2010) suggests that an ELF approach based on the LFC to teaching pronunciation highly values the English speakers' own (whether native or non-native) accents, which "constitute part of their respective speakers' identities" (p. 22).

2.2 English and Chinese fricative consonants

English fricative consonants, consisting of nine sounds, namely, /f/, /v/, /θ/, /ð/, /s/, /z/, /ʃ/, /ʒ/, and /h/, form the largest group of English consonants with regard to manner of articulation. As /h/ is not generally a problematic consonant for Chinese students in communication (Wang, 2005), this paper will focus on the first eight, which fall into four pairs in terms of place of articulation, namely, /f/ and /v/, /θ/ and /ð/, /s/ and /z/, /ʃ/ and /ʒ/.

The major difference between the above four pairs of English fricatives lies in the place of articulation, in other words, where the frication is produced. And the major difference between the two sounds in each pair lies in the voicing feature, namely, whether the vocal folds vibrate or not. Specifically speaking, /v/, /ð/, /z/, and /ʒ/ are labeled as voiced as there is vibration in the vocal folds when they are produced whereas /f/, /θ/, /s/, and /ʃ/ are voiceless as vocal folds do not vibrate in their production.

In contrast, there are altogether six fricative consonants in Mandarin Chinese, which are /f/, /s/, /ʂ/, /ʐ/, /x/, /ç/. These fricatives, the same as English fricatives, are produced with frication at various places in the oral tract. The major difference between Mandarin Chinese fricatives also lies in the place of articulation. Except /ʐ/, which is a voiced sound, all the other five fricatives in Mandarin Chinese are voiceless.

Since both English and Mandarin Chinese have a group of fricative consonants, this section will provide a contrast between the fricatives in these two languages.

Firstly, English and Mandarin Chinese fricatives differ in number. Whereas there are only six fricatives in Mandarin Chinese, there are nine in English. In other words, English has a larger number of fricative sounds than Mandarin Chinese.

Secondly, the two groups of fricatives differ with regard to the feature of voicing. English fricatives consist of four pairs of sounds and the two sounds in each pair differ in voicing: One is voiced and the other is voiceless. However, Mandarin Chinese has only one pair of fricatives which differs in voicing, namely, /ʂ/ and /ʐ/. Actually, except /ʐ/, all the other five fricatives in Mandarin Chinese are voiceless. This indicates that voicing is not as important a feature in Mandarin Chinese as in English. Some studies have reported that Chinese EFL learners have difficulty pronouncing the voiced English fricatives, such as /ð/ (Deterding, 2006; Hung, 2006).

Thirdly, English and Mandarin Chinese fricatives differ in quality. Different vocal organs are involved in the production of the fricative sounds in these two languages. In other words, different places of articulation are involved in producing the two groups of fricatives. Except /f/, which is a labio-dental fricative in both English and Mandarin Chinese, the other fricatives in the two groups do not share many similarities. More specifically, in terms of place and manner of articulation, English fricatives /v/, /ʒ/, /θ/, and /ð/ have no equivalents or semi-equivalents in Mandarin Chinese, and Mandarin fricatives /ʂ/, /ʐ/, /x/, /ç/ have no equivalents or semi-equivalents in English.

Finally, they differ in distribution, that is, the positions that fricatives can occur. None of the Mandarin Chinese fricatives can occur in the final positions in a syllable or a word. The difference in distribution may be a factor leading to the acquisition difficulties.

In summary, English and Mandarin Chinese fricative consonants mainly differ in number, voicing, quality and distribution. These differences may pose various problems for Chinese students in the process of acquiring English sounds, as shall be discussed in the following section.

2.3 Previous studies on the acquisition of English fricatives

Being the largest group of consonants in English with regard to manner of articulation, fricatives have posed various learning difficulties for Chinese students, as reported in previous studies.

Cheng and He (2008) examined the problems that Chinese EFL learners often encounter in the acquisition of English sounds. Based on an analysis of oral segmental errors of advanced English learners, they found that Chinese learners are likely to replace /v/ with [w], and /ð/ with [z], respectively. Cheng & He (2008) hold that the reason for Chinese learners' substitution of [w] and [z] for /v/ and /ð/ is that there are no equivalent sounds to /v/ and /ð/ in Chinese.

Chen and Bi's (2008) study reached a similar conclusion as Cheng & He (2008). Chen & Bi (2008) found that substitution is a major problem for Chinese learners in the development of English pronunciation competence. In addition, their research shows that Chinese learners have difficulty pronouncing /θ/ and /ð/ and distinguishing between /v/ and /w/, and has attributed these difficulties to the principle of least effort (Hung, 2006) as well as to negative transfer of the L1. Chen and Bi (2008) hold that students tend to use the most similar sounds in their first language to avoid the pronouncing difficulty in the new sounds of the second or foreign language.

Besides analysing the problems that Chinese EFL learners may encounter when acquiring English fricatives, researchers have also made effort to seek solutions to these pronouncing problems. To tackle the problem that Chinese learners have in distinguishing /v/ from /w/, Xie (2009) conducted an experiment to examine the effect of frequency on pronunciation correction by means of a microgenetic method. The results of the experiment show that (1) task frequency brings great advantages to pronunciation correction; (2) while input frequency and output frequency both contribute a lot to pronunciation correction, input frequency outweighs much more.

Rau, Chang and Tarone (2009) examined Chinese EFL learners' production of English interdental fricative /θ/ by using a variationist framework. They found that [s] was considered as the most acceptable substitute for /θ/ among Chinese EFL learners. The results demonstrate that the accurate production of /θ/ is mainly related to immediate phonetic environment and speech style. In addition, Rau, Chang and Tarone (2009) also suggest that lexical frequency can facilitate learners' accurate production of /θ/ to some extent, partially consistent with Xie's (2009) finding.

In above, many of the previous studies tend to attribute Chinese learners' difficulty in acquiring English fricatives, particularly /θ/, /ð/, and /v/, to the lack of equivalent sounds in Mandarin Chinese and a negative transfer of learners' mother tongue. The previous researchers also suggest that teachers of English should make comparisons between the English and Chinese phonological systems so as to help students distinguish between the sounds of these two languages (e.g., Cheng & He, 2008; Wang, 2005).

The aforementioned studies are all from the traditional second language acquisition perspective by taking RP or GA as pronunciation norms. Although insightful, they have somehow overlooked the latest development in the field of using English as a lingua franca. One exception to this is Deterding (2006). By analysing the English pronunciation of thirteen Chinese speakers from north-east, east, and central China, Deterding (2006) identified some salient features. One of the most salient features identified is substitution of [s] for /θ/, and [z] or [d] for /ð/. Deterding (2006) suggests that some of the salient features, probably including substitution features, "may become established as part of a unique variety of English that is emerging in China" (p.175).

More recently, Deterding (2010) suggests that using native speakers as the pronunciation norms in China is both impractical and neglectful of the current status of English as a lingua franca in a wider communicative context. Deterding (2010) proposes an LFC-based approach to the teaching of English pronunciation in China.

To summarize, the previous research suggests that Chinese EFL learners have various problems in acquiring English fricatives, and a main reason is the lack of real equivalents to English fricatives in Mandarin Chinese. It is generally accepted that without clear and comprehensible pronunciation, we cannot have successful communication with others, especially with people speaking different first languages. Therefore, this study hopes to shed some light on the acquisition of English sounds by examining Chinese students' perception and production of English fricatives from a new perspective, namely, ELF.

3 Research Method

3.1 Research questions

Acquisition of English sounds involves at least two dimensions, namely, perception and production. However, most of the previous research concerning fricatives focused on the pronunciation dimension; little empirical research has been undertaken to investigate how our learners perceive and pronounce English fricative sounds at the same time. Moreover, the previous studies often use native speakers as norms, neglecting the current development of English as a lingua franca. To address the lack, this paper aims to answer the following questions:

1. How do Chinese students perceive paired English fricatives?
2. How do Chinese students produce paired English fricatives?

3. How can Chinese students' perception and production of fricative sounds be explained from the perspective of English as a lingua franca?

3.2 Participants

Thirty two non-English major freshmen from a key university in Mainland China were invited to participate in the study. There are 24 male and 8 female students. They all speak and use Mandarin Chinese as the main language of communication in their daily life in university. At the time of research, they were between the age of 18 and 20. They have all had at least nine years of formal education of the English language in schools before entering university.

3.3 Instruments

As students' acquisition of sounds needs to be measured from two aspects, namely, listening (perception) and speaking (production), two instruments have been designed for this study accordingly, that is, a listening discrimination task and a reading task[1]. The listening discrimination task aims at examining the participants' discrimination of paired fricative sounds in listening comprehension, and the reading task is designed to investigate the participants' actual oral production of English fricatives. In the following is a more detailed description of the two tasks.

(1) Listening discrimination task

The listening discrimination task consists of two sections. The first section aims to gather the participants' personal information, such as their gender, age, main languages used with their parents at home, and so on. The second section is designed to examine the participants' discrimination of seven pairs of English sounds, namely, /f-v/, /θ-ð/, /s-z/, /ʃ-ʒ/, /v-w/, /θ-s/, and /ð-z/. The first four pairs of fricative sounds share the same place and manner of articulation, but differ in the feature of voicing. The last three pairs of sounds are targeted at the participants' ability to distinguish between the two sounds in each pair. Among these three pairs, /v-w/ are produced by different vocal organs in different ways but sound similar to many Chinese students; /θ-s/ and /ð-z/ share the same manner of articulation and voicing feature but have different places of articulation. All these three pairs of sounds have been

[1] An earlier version of the instruments has been used in Xiao (2011). The instruments of the current study were based on the earlier version with some revisions.

reported to bring great difficulties to Chinese learners of English (Chen & Bi, 2008; Cheng & He, 2008).

These seven pairs of sounds are presented in seven groups, with each group consisting of six pairs of words, where each pair differs only in the target fricative sounds. In other words, most of the pairs of words are actually minimal pairs, which differ by only the fricative sounds involved, such as *save* vs. *safe*, and *think* vs. *sink*.

In this task, the participants are required to listen to a recording and choose from each pair of words the word that they have heard on the recording. The listening material is read by a native speaker from America and recorded with an MP3. To make sure that the participants' choices are based on their recognition of the specific sound, these pairs of words are designed to appear in minimal pairs wherever possible[2].

(2) Reading task

The reading task is designed almost the same as the listening discrimination task, consisting of seven groups of words, involving /f-v/, /θ-ð/, /s-z/, /ʃ-ʒ/, /v-w/, /θ-s/, and /ð-z/, respectively. There are three pairs of words in each group and 42 words in total. The same as the listening discrimination task, except for /ʃ-ʒ/ and /θ-ð/, the two words in each pair are designed to differ only in the target phonemes. To avoid the participants' consciousness of the difference between words in each pair, all the words in the reading task are mixed and sequenced randomly.

3.4 Data collection and analysis procedures

The study was carried out during a regular English teaching class. First, the participants were asked to fill in their personal information in Section One in the listening discrimination task paper. After that, they were required to listen to the recording in Section Two and tick the words or sounds they had heard. All of their papers were submitted to the researchers after completion. Next, they were invited to a quiet classroom one by one to read each word in the reading task. And their oral production was recorded by the researchers. All the thirty two participants have successfully completed both the listening discrimination task and the reading task.

With regard to the listening discrimination task, one point will be given to the participants when they have chosen the word or sound actually

[2] Because of a lack of sufficient minimal pairs for /θ-ð/ and /ʃ-ʒ/, there are no pairs of words for these two groups differing by only one sound. For these two pairs, the participants would listen to six words from the recording and they are required to choose the fricative sound appearing in each word. More specifically, they should make a choice between /θ/ and /ð/ as well as /ʃ/ and /ʒ/.

read by the speaker. As there are altogether 42 pairs of words, the full mark for the listening discrimination task is 42 points.

As for the reading task, the participants' recordings were submitted to two professional teachers who are experienced in teaching English pronunciation in China. The frequencies and percentages of the participants' RP-like or near-RP production of each fricative consonant were noted and calculated. The calculation is only for description purposes and the authors of this paper do not hold the opinion that Chinese students should pronounce the sounds the same as RP speakers. More importantly, the analysis will be focused on the variant productions of English fricative sounds, such as substitution of [s] for /θ/. The analyses of these variants will be a major concern in this study.

It should be pointed out that although RP is used as a reference in this study to describe the participants' pronunciation of English fricatives, RP is in no sense considered superior to other English accents in this study. The description is based on the participants' actual oral production of target sounds regardless of the other sounds in each word. The inter-rater consistency for the two teachers' judgment of every participant's production of the target sound is higher than 90%, with the disagreement being resolved through negotiation.

4 Results

When all the data were gathered and computerised, descriptive statistics was carried out by using SPSS 21.

4.1 Results of the listening discrimination task

In the listening discrimination task, the participants were asked to choose the word they had heard on the recording from each pair of words. As there is an intended answer in each case, the accuracy rate could be calculated. When the correct answer has been chosen for each pair, one point would be given. So the maximum mean of each group is 6, and the maximum correct answers and points obtained would be 42 in total. In Table 1, the mean and accuracy rate of every group have been summarized.

Table 1. Results of the Listening Discrimination Task

Paired sounds	/f-v/	/θ-ð/	/s-z/	/ʃ-ʒ/	/v-w/	/θ-s/	/ð-z/	Total
Mean	5.31	4.50	4.88	5.25	3.78	4.06	2.69	30.47
Accuracy rate (%)	88.50	75.00	81.33	87.50	63.00	67.67	44.83	72.55

On the whole, the participants' overall performance in the listening discrimination task is not very satisfactory, with an average accuracy rate

being 72.55%. And none of the seven groups has achieved an accuracy rate higher than 90%. Comparatively speaking, the participants performed relatively well in these two groups, /f-v/ and /ʃ-ʒ/, with the accuracy rates being 88.50% and 87.50%, respectively. The accuracy rates of the other five groups are all lower than 85%.

Compared with the first four pairs of fricative sounds that differ only in the voicing feature, all the other three pairs have a much lower accuracy rate, ranging from 44.83% to 67.67%.

Among the seven pairs of sounds under investigation, the accuracy rate of the group /ð-z/ is the lowest (44.83%), followed by the group /v-w/ (63.00%) and /θ-s/ (67.67%).

4.2 Results of the reading task

4.2.1 Production of individual sounds

In the reading task, the participants were asked to read a list of 42 words, corresponding to the seven groups of sounds in the listening discrimination task. Among these 42 words, there are six tokens of /v/, /θ/, /ð/, /s/ and /z/, and three tokens of /f/, /ʃ/, /ʒ/, and /w/, respectively. Table 2 summarizes the frequencies and percentages of the participants' RP-like or near-RP production of each sound under investigation.

Table 2. Results of the Reading Task

Sounds	/f/	/v/	/θ/	/ð/	/s/	/z/	/ʃ/	/ʒ/	/w/	Total
Tokens	3	6	6	6	6	6	3	3	3	42
Mean	3.00	4.09	4.84	4.38	5.97	4.97	2.16	1.50	2.72	33.63
Rate (%)	100	68.17	80.67	72.92	99.50	82.83	71.88	50.00	90.67	80.07

From Table 2, we can see that on average, the participants' pronunciation of the nine sounds involved is RP-like on 80.07% occasions. When the sound /w/ is excluded[3], the rate of closeness to RP is lowered to 79.26%. Among the four pairs of English fricatives, we can draw an order of likeness to RP in terms of pronunciation as follows:

Order of RP-likeness: /f/ > /s/ > /z/ > /θ/ > /ð/ > /ʃ/ > /v/ > /ʒ/

[3] The sound /w/ is excluded because it is not a fricative consonant.

The participants' pronunciation of /f/ and /s/ is almost perfectly like RP, at least to the two researchers' ears. Their pronunciation of the remaining six fricative sounds achieves RP-likeness to a much less extent, all below 85%. Comparatively speaking, their production of /ð/, /ʃ/, /v/, and /ʒ/ is the least RP-like, with a rate of likeness ranging from 72.92% to 50.00%.

4.2.2 Substitution for individual sounds

The table above presents the rates of RP likeness in each individual sound under investigation. Next, we will analyze how each sound was actually pronounced by the participants. The previous researchers have suggested that Chinese students tend to use variant sounds to replace target fricative sounds in English. This section aims to explore this issue in more detail. The results are presented according to the order of likeness toward RP.

(1) Substitution for /z/

Table 3 summarizes the participants' substitution for /z/. As there are altogether thirty two participants and there are six words with the target /z/ sound, the total number of possible production of /z/ is 192 tokens. "Mean" refers to the average number of production of every variant sound by each participant. And the "rate" refers to the percentages of each variant sound produced by the participants among all the productions.

Table 3. Substitution for /z/

Sounds	Tokens	Mean	Rate
/z/	192	6.00	100%
[z]	159	4.97	82.83%
[s]	23	0.72	12.00%
[dz]	7	0.22	3.67%
[dʒ]	2	0.06	1.00%
[ð]	1	0.03	0.50%

Table 3 indicates that the rate of substitution of [s] for /z/ by the participants is about 12.00%. In addition, there are seven cases of substitution of [dz] for /z/, two cases of [dʒ] and only one case of [ð] for /z/. On the whole, in 82.83% cases, the participants produced /z/ in a RP like fashion. This result is in line with the listening discrimination task, which shows that the accuracy rate of distinguishing between /s/ and /z/ is 81.33%.

(2) Substitution for /θ/

Table 4 summarizes the participants' substitution for /θ/.

Table 4. Substitution for /θ/

Sounds	Tokens	Mean	Rate
/θ/	192	6.00	100%
[θ]	155	4.84	80.67%
[s]	29	0.91	15.17%
[ð]	8	0.25	4.16%

Table 4 indicates that the rate of substitution of [s] for /θ/ by the participants is as high as 15.17%. There are eight cases of substitution of [ð] for /θ/, which is a quite surprising result and worth a closer examination later. On the whole, on 80.67% occasions, the participants produced /θ/ in a RP like manner. This result is partially in line with the listening discrimination task, which shows that the accuracy rate of distinguishing between /θ/ and /s/ is only 67.67%.

(3) Substitution for /ð/

Table 5 summarizes the participants' substitution for /ð/.

Table 5. Substitution for /ð/

Sounds	Tokens	Mean	Rate
/ð/	192	6.00	100%
[ð]	140	4.38	72.92%
[θ]	20	0.63	10.42%
[s]	14	0.44	7.29%
[z]	9	0.28	4.69%
[dz]	7	0.22	3.65%
[dʒ]	2	0.06	1.03%

As shown in Table 5, on the whole, the participants produced RP-like /ð/ on 72.92% occasions. The rate of substitution of other sounds for /ð/ is as high as 27.08%, and there are as many as five types of substitutes besides the target-like [ð]. Among all the variant sounds, [θ] has the highest percentage (10.42%), followed by [s] (7.29%). These variant sounds fall into two major kinds, voiceless variants, including [θ] and [s], and voiced variants, including [z], [dz] and [dʒ]. The former kind has a total percentage of 17.71%, whereas the latter kind has a percentage of 9.37%. The higher percentage of voiceless

substitutes for /ð/ by the participants is a rather surprising finding and worth a closer examination later in the discussion section. In addition, the substitution of [z] for /ð/ is only 4.69%, which is even a more unexpected finding, different from the previous claims made in the literature.

(4) Substitution for /ʃ/

Table 6 summarizes the participants' substitution for /ʃ/.

Table 6. Substitution for /ʃ/

Sounds	Tokens	Mean	Rate
/ʃ/	96	3.00	100%
[ʃ]	69	2.16	71.88%
[ʒ]	12	0.38	12.50%
[dʒ]	9	0.28	9.37%
[s]	4	0.13	4.17%
[tʃ]	1	0.03	1.04%
[z]	1	0.03	1.04%

Table 6 indicates that the rate of substitution of other sounds for /ʃ/ is as high as 28.12%, and there are as many as five types of substitutes besides the target-like [ʃ]. Among all the variant sounds, [ʒ] has the highest percentage (12.50%), followed by [dʒ] (9.37%). Besides these two types of substitutes, there are four cases of substitution of [s], one case of [tʃ] and another one case of [z] for /ʃ/. Nevertheless, the voiced substitutes of [ʒ] and [dʒ] together (21.87%) account for the majority of substitution cases for the target /ʃ/, which is a rather surprising finding.

On the whole, in 71.88% cases, the participants produced /ʃ/ like RP. This result is consistent with the listening discrimination task, which shows that the accuracy rate of distinguishing between /ʃ/ and /ʒ/ is 87.50%.

(5) Substitution for /v/

Table 7 summarizes the participants' substitution for /v/.

Table 7. Substitution for /v/

Sounds	Tokens	Mean	Rate
/v/	192	6	100%
[v]	131	4.09	68.17%

[w]	60	1.88	31.33%
[f]	1	0.03	0.50%

As shown in Table 7, the rate of substitution of [w] for /v/ by the participants is as high as 31.33%. There is only one case of substitution of [f] for /v/, which is too few to draw any conclusion.

On the whole, the participants produced RP-like /v/ in 68.17% cases. This result is consistent with the finding of the listening discrimination task to a large extent, which shows that the accuracy rate of distinguishing between /v/ and /w/ is only 63.00%.

(6) Substitution for /ʒ/

Table 8 summarizes the participants' substitution for /ʒ/.

Table 8. Substitution for /ʒ/

Sounds	Tokens	Mean	Rate
/ʒ/	96	3.00	100%
[ʒ]	48	1.50	50.00%
[dʒ]	23	0.72	23.96%
[ʃ]	20	0.63	20.83%
[s]	3	0.09	3.13%
[z]	2	0.06	2.08%

Table 8 demonstrates that the rate of substitution of other sounds for /ʒ/ by the participants is as high as 50.00%, and there are as many as four types of substitutes besides the target-like [ʒ]. Among all the substitutes, [dʒ] has the highest percentage (23.96%), followed by [ʃ] (20.83%). Besides these two types of substitutes, there are three cases of substitution of [s], and two cases of [z]. The high percentage of retroflex substitutes of [dʒ] and /ʃ/ together (44.79%) accounts for the majority (over 89.6%) of all substitute sounds for the target /ʒ/, which is a very interesting finding.

On the whole, in 50.00% cases, the participants produced /ʒ/ like RP. This result is in vast difference from the listening discrimination task result, which shows that the accuracy rate of distinguishing between /ʃ/ and /ʒ/ is about 87.50%.

5 Discussion

5.1 Perception of paired fricatives

As has been reported in the previous section, the participants' overall performance in the listening discrimination task is not very satisfactory, with an average accuracy rate of merely 72.55%, and none of the seven groups has achieved an accuracy rate higher than 90%. Moreover, except /f-v/ and /ʃ-ʒ/, the accuracy rates of the other five groups are all lower than 85%. These results indicate that Chinese students seem to have considerable difficulties in discriminating between pairs of fricative sounds in English. As there have been no similar studies undertaken before, the researchers are hesitating to draw a definite conclusion at this stage.

Compared with the four pairs of fricative sounds that differ only in the voicing feature, the other three pairs of sounds have much lower accuracy rates. More specifically, the accuracy rate of the group /ð-z/ is the lowest (44.83%), followed by the group /v-w/ (63.00%) and /θ-s/ (67.67%). The previous studies have documented that Chinese EFL learners tend to replace /θ/ and /ð/ with [s] and [z], respectively; they also often substitute [w] for /v/ (e.g., Cheng & He, 2008; Deterding, 2006). The results of the current study seem to coincide with the previous research in that Chinese learners of English have considerable difficulties in these three pairs of sounds, namely, /ð-z/, /v-w/ and /θ-s/. However, the current study confirms that the difficulties lie in the perception dimension to a large extent. Moreover, the voicing feature does not seem to cause the greatest problem for our students in terms of perception. Next, we shall turn to the production aspect for a more in-depth analysis of the acquisition of English fricatives by Chinese students.

5.2 Production of paired fricatives

In terms of production of paired English fricatives, it has been found that the participants' pronunciation of the nine sounds involved is RP-like on 80.07% occasions. When the sound /w/ is excluded, the rate of closeness to RP is lowered to 79.26%. Based on the results, an order of likeness to RP with respect to pronunciation has been drawn, which is repeated as follows for the convenience of discussion.

Order of RP-likeness: /f/ > /s/ > /z/ > /θ/ > /ð/ > /ʃ/ > /v/ > /ʒ/

The participants' pronunciation of /f/ and /s/ is the closest to RP. This result is not surprising, given that there are similar, although not exactly the same sounds to /f/ and /s/ in Mandarin Chinese. This result can be regarded as an example of positive transfer of phonological features from speakers' L1 to L2.

The participants' pronunciation of the remaining six fricative sounds achieves RP-likeness to a much less extent, all below 85%. Comparatively speaking, their production of /ð/, /ʃ/, /v/, and /ʒ/ is the least RP-like, with a rate of likeness ranging from 72.92% to 50.00%. Previous studies have suggested that Chinese students have many difficulties pronouncing voiced fricative consonants (Deterding, 2006; Hung, 2006). The result from the current study is in line with the previous findings, with an exception of the sound /ʃ/. However, as there are no equivalent sounds to /ð/, /ʃ/, /v/, and /ʒ/ in Mandarin Chinese, this result also seems to show support for the negative transfer hypothesis. However, this is not the whole picture, as shall be discussed next.

The analyses of substitution for the afore-mentioned fricative sounds often produce complicated pictures. A common characteristic among the pronunciation of target English fricatives is that there are many variant productions of each fricative consonant in addition to the target-like sound.

●Substitution for /z/

It was found that the participants' production of /z/ has reached a relatively high rate of likeness to RP (82.83%). Among all the four other variant sounds for /z/, the rate of substitution of [s] for /z/ is as high as 12.00%, whereas the other three substitutes, namely, [dz], [dʒ], and [ð], occurred much less frequently. These results, together with the result from the listening discrimination task in terms of /s-z/ distinction, suggest that [s] is the most frequent substitute for /z/ in both perception and production. This result may show a trace of devoicing in Chinese students' acquisition of /z/, from the voiced alveolar fricative to its voiceless counterpart. It may also be an instantiation of mother tongue influence, as there is only one voiced fricative sound in Mandarin Chinese.

●Substitution for /θ/

The result indicates that the rate of substitution of [s] for /θ/ by the participants is approximately 15.17%. This result is partially in line with the listening discrimination task, which shows that the accuracy rate of distinguishing between /θ/ and /s/ is only 67.67%. The results are also partially consistent with the previous research findings (Deterding, 2006; Rau, Chang & Tarone, 2009). As reported in the literature, Chinese students tend to replace /θ/ with [s], which has been supported by the current study. However, this study found that in comparison with substitution, Chinese students have more difficulty distinguishing /θ/ from /s/ in listening. These results suggest that Chinese students may have more difficulties recognizing than producing the voiceless dental fricative.

Another interesting and unexpected finding with respect to the pronunciation of /θ/ is that there are eight cases of substitution of [ð] for /θ/. The researchers have not found a good explanation to this finding and hope to carry out a more in-depth investigation of this phenomenon in the future.

●Substitution for /ð/

It was found that the rate of substitution of other sounds for /ð/ by the participants is as high as 27.08%, and there are as many as five types of substitutes besides the target-like [ð]. These variant sounds can be divided into two major kinds, voiceless variants, including [θ] and [s], and voiced variants, including [z], [dz] and [dʒ]. The former kind has a total percentage of 17.71%, whereas the latter has a percentage of 9.37%. Although the higher percentage of voiceless substitutes, especially of [θ] for /ð/, is a rather surprising finding, this result confirms the phenomenon of devoicing in the pronunciation of voiced fricatives, consistent with our analysis of the production of /z/ by the participants.

In addition to the devoicing phenomenon, it was found that the substitute of [z] for /ð/ is only 4.69%, which is a more unexpected finding, different from the previous claims commonly made in the literature. The previous studies have often reported that Chinese ELF learners tend to replace /ð/ with /z/ (e.g., Cheng & He, 2008). However, in the current research, the substitute of [z] for /ð/ occurred only 9 times, at a much lower frequency than [θ] and [s].

The results concerning the production of /ð/ are only partially in line with those from the listening discrimination task, which found that the accuracy rate of distinguishing between /θ/ and /ð/ is 75.00%, but the accuracy rate of distinguishing between /ð/ and /z/ is only 44.83%. These results suggest that Chinese students do have difficulties acquiring the voiced dental fricative /ð/. They have more problems distinguishing /ð/ from /z/ than from /θ/. However, in pronunciation, they seem to use the devoicing strategy (from /ð/ to /θ/) more frequently than the substitution strategy (replacing /ð/ with /z/). But as this finding has not been reported before, more empirical research is needed to draw a more definite conclusion.

●Substitution for /ʃ/

As was reported, besides the RP-like [ʃ], the participants used as many as five types of substitutes for the voiceless palato-alveolar fricative, and the rate of substitution is as high as 28.12%. Among all the variant sounds, [ʒ] has the highest percentage (12.50%), followed by [dʒ] (9.37%). These two voiced substitutes, [ʒ] and [dʒ] together (21.87%) account for the majority of substituting sounds for the target /ʃ/. This result is rather surprising for the

researchers, and further research is needed to derive any hypothesis for the substitution of voiced sounds for a voiceless fricative.

●Substitution for /v/

This study found that on the whole, the participants produced RP-like /v/ in 68.17% cases, and the rate of substitution of [w] for /v/ is as high as 31.33%. These results are consistent with the finding of the listening discrimination task to a large extent, which shows that the accuracy rate of distinguishing between /v/ and /w/ is 63.00%. The results of the present study show support for previous research (e.g., Chen & Bi, 2008; Xie, 2009) and we can draw a tentative conclusion that Chinese students have great difficulties producing /v/ as well as perceiving the difference between /v/ and /w/.

●Substitution for /ʒ/

Among all the fricative sounds under investigation, /ʒ/ seems to have the greatest problem for our participants in pronunciation, with a rate of substitution as high as 50.00%. Moreover, there are as many as four types of substitutes besides the target-like [ʒ], among which [dʒ] has the highest percentage (23.96%), followed by [ʃ] (20.83%). The high percentage of retroflex substitutes [dʒ] and [ʃ] together accounts for the majority of all substituting sounds for the target /ʒ/. The substitution of [ʃ] for /ʒ/ is not difficult to understand, as it is another instantiation of devoicing phenomenon. However, the substitution of [dʒ] for /ʒ/ is rather unexpected and has never been reported in the previous studies. Using an affricate to replace a fricative sound seems to be against the simplification tendency in the process of acquiring a second or foreign language. Affricates are obviously more complex than fricatives by involving two segmental components. However, the result of the present study may be explained by referring to the fact that there are altogether six affricate sounds in Mandarin Chinese, more than in English, which has only two affricates.

In comparison with production, the participants performed much better at distinguishing between /ʃ/ and /ʒ/, with an accuracy rate of 87.50%. The discrepancy between perception and production is not uncommon in the present study, which suggests that Chinese students may experience different difficulties in perceiving and producing fricative sounds.

5.3 Acquisition of paired fricatives from the ELF perspective

The discussion of the perception and production of English fricatives demonstrates that the participants have a varied performance in distinguishing between different pairs of fricatives and using various substitutes for English fricative sounds in pronunciation. Moreover, there is a

general tendency that Chinese students have more difficulties in pronouncing voiced fricatives and tend to substitute their voiceless counterparts for them. These results suggest that when teaching and learning English fricative sounds, more emphases should be placed on some fricatives than on others. The question is which fricatives should be emphasized more or given priorities?

A common understanding is that more emphases should be given to those that cause most acquisition difficulties. In the context of China, /θ/ and /ð/ are certainly on the top list. However, a more up-to-date view toward this is that priorities should be given to the sounds that fall into the Lingua Franca Core (LFC) (e.g., Jenkins, 2000, 2009; Walker, 2010). As discussed earlier, the LFC consists of a set of pronunciation features, important for mutual intelligibility in ELF. According to the LFC, /θ/ and /ð/ are not included, because these two consonants are "inherently difficult to pronounce, notoriously resistant to classroom teaching, and unnecessary for ELF intelligibility" (Walker, 2010, p. 30).

We should also bear in mind that discarding /θ/ and /ð/ in teaching is not helpful, either. Whereas we can accept the various substitutes for dental fricatives, we must not forget that Chinese students also have considerable difficulties in distinguishing between the two sounds in these two pairs /ð-z/ and /θ-s/. As Walker (2010, p. 88) has noted, "For optimum efficiency in ELF communication, it is not enough that speakers adjust their pronunciation. Listeners need to be more flexible in interpreting what they hear. By doing so, they will be able to deal more comfortably with the variations in accent that are characteristic of ELF". In other words, students need to have the ability to perceive and distinguish between dental fricatives from other sounds that are perceived to be similar.

To achieve this goal, Jenkins calls for an "extensive focus on the LFC sounds, including drilling and tailor-made minimal pair work." (2000, p. 189). Walker (2010, p.76) interprets "tailor-made" as "the need to generate minimal pair exercises that focus on contrasts that are difficult for learners from specific first-language backgrounds". For example, minimal pair exercises on /ð-z/, /θ-s/, and /v-w/ can be designed for Chinese students as well as students from other countries who may encounter the same problems.

6 Conclusion

By adopting a listening discrimination task and a reading task, this study investigated thirty two non-English major university students' perception and production of paired English fricatives. The following is a summary of the major findings. (1) The participants' performance in perception and production is not as satisfactory as expected. (2) Compared with the four pairs of fricative sounds that differ only in the voicing feature, the other three

pairs of sounds under investigation all have a much lower accuracy rate with respect to perception, with the group /ð-z/ being the lowest (44.83%), followed by the group /v-w/ (63.00%) and /θ-s/ (67.67%). (3) In terms of production, Chinese students tend to replace target fricatives with various kinds of sounds. Substitution occurs frequently for these fricative consonants, /θ/, /ð/, /ʃ/, /v/, and /ʒ/, arranged from the least frequent to the most frequent. (4) Chinese students tend to devoice the voiced fricative sounds in pronunciation. In other words, they often substitute the voiceless counterparts for the voiced fricatives, in particular, for /z/, /ð/, and /ʒ/.

It has been suggested that Chinese students' perception and production of fricative consonants may be influenced by various factors, such as L1 transfer, positive or negative, and the principle of least effort. Considering the difficulties that Chinese students experience in acquiring English fricative consonants, we should place more emphasis on the sounds that fall into the LFC.

The current study has several limitations as follows. First, it has adopted an experimental approach to collecting data. In the future, natural perception and production data will be preferred. Second, the sample size is not very large. More participants can be involved to examine their acquisition of paired English fricatives. Thus, the unexpected findings obtained in this study, such as substitution of [ð] for /θ/, [ʒ] and [dʒ] for /ʃ/, may be explained with more sufficient data. Third, this study has not provided adequate explanations for some interesting findings obtained, such as the higher difficulty rates in perception than production of some fricatives[4]. Further research is needed to confirm such findings before any conclusions can be drawn. Finally, the analysis has not taken into consideration other varieties of English, as the context involved is not a real situation of using English as a lingua franca. In the future, more English accents should be considered in the investigation of Chinese student's English phonology.

The results of the study have important implications for the teaching and learning of English pronunciation. The study reveals Chinese university students' strengths and weaknesses in the acquisition of paired English fricatives. On the whole, Chinese students seem to have encountered many difficulties in the perception and production of English fricative consonants. Moreover, they often have varied performance when different fricatives are concerned, particularly with voiced fricatives. Therefore, it is suggested that priorities should be given to those sounds that may impede mutual intelligibility in international communication, especially in contexts where English is used as a lingua franca.

[4] We are thankful for the anonymous reviewers for pointing out this limitation and hope to solve the problem in our future studies.

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