Attention, Perception, and Production of the English Voiceless Interdental Fricative by Chinese Learners of English

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Introduction

For most English learners, a foreign accent has always been a difficulty that they cannot easily overcome. Numerous research studies have examined the reasons for this issue, and have attempted to help learners produce spoken English close to native speakers, if not possible to completely eliminate foreign accents. Among the difficulties learners encounter in acquiring native-like second language (L2) pronunciation, the voiceless interdental fricative (i.e., [θ]) has been considered one of the most difficult sounds to acquire by most English learners. Many studies have identified various substitutions for [θ] in the speaking production of learners with different first language (L1) backgrounds. For example, Rau, Chang, and Tarone (2009) reported that Thai, Russian, and Hungarian learners of English tended to substitute [t] for [θ], while [θ] was usually replaced with [s] by speakers from Asian countries such as Japan, Korea, and China (Lee & Cho, 2002; Rau et al., 2009). In order to explore possible causes of these problematic

performances, one plausible way is to seek the relation between learners' perception and production because it is generally believed that there is a positive correlation between a speaker's perception and production; accordingly, improvement in one part will facilitate the development of the other. However, perception alone by no means determines production. Yang (1997) indicated that speakers' attention, an important factor involved in one's cognitive process of a speaking activity, also influences speaker's perception and production. The following literature review introduces relevant theories and studies that have contributed to this research topic.

Inaccurate [θ] Sound Produced by Chinese Learners of English

Numerous studies have observed some problematic phonetic substitutions in the voiceless interdental fricatives produced by Chinese learners of English, showing that this phoneme is mostly replaced with [f], [s], or [t]. For example, Deterding (2006) analyzed the

pronunciation of 13 young Mandarin Chinese speakers by recording their passage reading and short interviews. He determined that [θ] was mostly replaced by [s], which confirmed the results of Hung's (2005) study. Similar substitution errors were also found by Cheng and He (2008) and Chen and Bi (2008). The value of these two studies lies in their research methods. Cheng and He (2008) developed a four-year longitudinal study into the English pronunciation of 14 English major university students in mainland China to observe how participants' English pronunciation improved. Instead of relying on native English speakers' (NSs) judgment, the correctness of participants' pronunciation was acoustically analyzed via PRAAT, an articulation analysis software in which inaccurate pronunciations were further analyzed through the comparison of phonetic parameters between sounds produced by participants and NSs. Instead of recording participants' speaking output, Chen and Bi (2008) analyzed a spoken English corpus consisting of speech samples by 200 Chinese university students (50 English major students and 150 non-English major students). I predict that their results are quite generalizable due to their use of huge data collected from a fairly controlled group of participants.

However, regardless of the different research methods applied in these studies, they shared one limitation—the researchers attributed the difficulty of acquiring the target [θ] sound to the difference between the L1 (i.e., Chinese) and the L2 (i.e., English). They claimed that the lack of the equivalence of [θ] in Chinese led to Chinese speakers' inaccurate production of that sound (Gao, 2002; Wu, 2008). Drawing narrowly on the findings related to contrastive analysis, researchers might have overlooked other valuable findings and other plausible factors. For example, Rau and Chang (2009) discovered that Chinese speakers performed differently under different circumstances. Specifically, the accuracy rate of the interdental fricative was higher in formal speaking than in casual speaking. Such findings of interlanguage (IL) variation could not be completely explained by contrastive analysis. In order to compensate for its limitation, interlanguage variation, which could be traced back to speaking style (Labov, 1966) and Optimality Theory (OT) (Prince & Smolensky, 1993), has received increasing attention in the field of second language acquisition (SLA).

Interlanguage Variation

Interlanguage variation has been studied from two perspectives: OT and speaking style shifting. OT, proposed by Prince and Smolensky (1993), is constraint-based and output-oriented (Hsu, 2013). Specifically, it states that the phonological output is the speakers' optimal choice out of all the potential candidates with markedness and faithfulness being concerned. Advocates of an OT model proposed that learners with

different L1 backgrounds produced English interdental fricatives differently because their optimal choice of target sounds (i.e., interlanguage) was influenced by their constraint rankings of the L1. Besides, such output is variable because learners would gradually re-rank their linguistic constraints, which would eventually be the same as the constraints on the L2 (Lee, 2006; Lombardi, 2003; Wester, 2007; Yildiz, 2002). The detailed research of the OT model is beyond the scope of this study because the emphasis will be placed on speaking style shifting.

"Speaking style" was first analyzed by Labov (1966), and has been extensively studied both in L1 and L2 acquisition. Later with the increasing interest in IL, speaking style was believed to significantly influence learners' IL (Dickerson & Dickerson, 1977) as well. In general, style shifting is caused by the change of speakers' attention paid to speaking (Labov, 1966, 1970). Based on this principle, Tarone (1982, 1983, 1988) drew a continuum of style shifting with vernacular speaking and careful speaking at each pole respectively, and proposed that the more vernacular speech was, the less accurate it would be. However, Labov and Tarone's theory about "style shifting" was challenged by Dowd, Zuengler, and Berkowitz (1990) and Major (2001) because it was hard to determine the boundary between two adjacent speaking styles. In other words, it was not clear how many different variables two speech samples should have so that they can be identified as two different speaking styles. In addition, even Tarone (1979) admitted that it was challenging to observe "real vernacular speaking" to which speakers paid very limited attention, because of the presence of researchers, the speakers' awareness of research participation, and the application of sound recorders.

To specify the definition of style shifting, some researchers proposed that it is the amount of attention paid to speaking that determines the accuracy of speaking (Ellis, 1994; J. Hulstijn & W. Hulstijn, 1984; Major, 2001). Variationists proposed that the more formal the speaking style is, the more attention would be allocated to pronunciation, and therefore the more accurate the pronunciation would be (Dowd et al., 1990; Major, 2001). Commonly, the formality of four speaking styles was studied. From the most formal to the least formal, they were: word-list reading, paragraph reading, picture describing, and free talking or interviewing (Thompson & Brown, 2012). The English interdental fricative, because of its variation, has always been a popular target sound in the study of the relationship between the formality of speaking and its variation. For example, Schimidt (1977) investigated the English interdental fricatives produced by Egyptian Arabic speakers and discovered that participants were more likely to produce [θ] in more formal speaking. Similarly, Coyne (2008) studied the English interdental fricatives in word list reading and paragraph reading produced

by Cajun people whose L1 was French, and discovered that the participants substituted [t] for [θ] less often in the word list reading task. Therefore, Coyne concluded that higher formality might lead to higher accuracy of speaking production. However, such a correlation between formality and production accuracy in Coyne's study might not be generalizable because of two limitations. First, only four participants were involved in the study. Second, it is questionable if word list reading had a significantly higher level of formality than the paragraph reading task. Rau, Chang, and Tarone (2009) conducted a more generalizable study, in which they investigated 27 Chinese university students' production of the [θ] sound under four circumstances with different levels of formality. Their results also indicated a positive correlation between the formality of the speaking and the accuracy of the target sound.

However, the negative evidence about correlation between accuracy and formality was also found in Thompson and Brown's research (2012). This study observed the speaking production of a Spanish learner of English, and found that the participant pronounced most accurately not in reading minimal pairs but in reading passages. Coyne (2008) also discovered that one of her participants had the highest accuracy in the passage reading task. These unexpected findings indicated that the attention allocated to pronunciation may not necessarily be related to the form

of speaking but other factors may also influence speakers' pronunciation as well.

Attention and Monitoring

Monitoring during speaking is viewed as production-based (Kormos, 1999) because it functions as a "mental eye" through which speakers hold control of their utterance (Berg, 1986). Since the perceptual loop theory (Levelt, 1989,1993) posited that speaking production is parsed into three steps, namely, pre-articulation, articulation, and post-articulation, some researchers have claimed that speaking monitoring should also be studied in these three steps respectively (Kormos, 2000). The pre-articulatory monitoring has been studied by Baars, Motley, and Mackay (1975) and Motley, Camden, and Baars (1982). They believed that speakers would monitor the accuracy of their utterances before the speaking was articulated. This hypothesis led to a further assumption that inaccurate pronunciation was caused either by the lack of attention or by the failure of monitoring. The former involves the allocation of attention consciously or subconsciously controlled by speakers (de Bot, 1992) while the latter relates to self-perception errors.

Kormos (2000) reviewed the previous studies (e.g., Tarone, 1983; Tarone & Parrish, 1988), and summarized that the accuracy of speaker's production was influenced by the amount of attention the speaker paid to it. In order to identify the amount of attention allocated to different aspects of speaking such as the

lexicon, semantics, and/or phonetics, she recruited 40 Hungarian learners of English to accomplish an information-gap role play and a retrospective interview afterwards. She regarded the instances of self-repair as the existence of attention. Her analysis showed that attention was paid first to the lexicon and then to grammar. She believed that such a priority hierarchy would be applied to all learners, irrespective of proficiency level. Although Kormos' study did not take into account speakers' attention to pronunciation, Wheeldon and Levelt (1995) explored this issue five years prior to Kormos.

Wheeldon and Levelt (1995) focused on how speakers monitored phonological encoding. They asked Dutch participants to silently translate the L2 English stimulated words they heard into their L1 Dutch, and during the translation, to press the button whenever they noticed that they encountered the target Dutch phoneme which they were required to monitor. A comparison between the participants' response time when the target Dutch phoneme was in the word initial position with the response time when it was in other word positions showed that the participants monitored word initial phonemes significantly faster than other phonemes. Their findings illustrated that monitoring was influenced by word position of the target segment. This argument was supported by Rau et al. (2009)'s study in which Chinese learners of English monitored their words' initial interdental fricative most effectively.

Distraction

Two predominant methods of studying participants' internal attention are thinking aloud and stimulated recall. However, alternative research methods have been called for since it is impossible for participants to think aloud while speaking and the details from the stimulated recall might potentially be incomplete or incorrect due to limited short-term memory. Although we cannot precisely predict how much participants would pay attention to L2 data, it seems reasonable to assume that participants would pay less attention to L2 data if they are distracted by other tasks. Based on previous research, Zeamer and Fox Tree (2013) posited that auditory distraction would cost people extra cognitive effort and shift their attention from the focal task. Al-Hejin (2005) further noted the concepts of attention in SLA that the more demanding a task is, the more attention people need to pay to it. These studies implied that if distracted by another task, participants would pay less attention to the primary task. Because of the salient influence that distraction has on attention, it will be included in the study as an independent variable that may differentiate participants' performance.

Production and Perception

Sometimes speakers may not be able to identify production errors, even though they are carefully monitoring their pronunciation. In other words, it is not the

lack of attention but the failure of self-perception that leads to inaccurate production. In fact, many researchers have studied the relation between perception and production. One popular belief is that perception influences production. For example, Brannen (2011) analyzed the perception and production of English interdental fricatives by participants from Japan, Russia, France, and Québec Canada (French speaker). He observed a relationship between participants' perception and production of target sounds and posited that the improvement of perception could facilitate the development of production. Similarly, Fu (2011) discovered a positive relation between Taiwanese ESL learners' production and perception of interdental fricatives.

However, opposite results were also found by other researchers. For example, Lee (2011) found no relation between a group of advanced Korean EFL learners' perception and production of interdental fricatives. Also, both Syed (2013) and Owolabi (2012) found that learners only had difficulty in producing English interdental fricatives, but not in perceiving them.

Another issue in studying the relation between perception and production is that little attention has been paid to learners' self-perception. In early research, usually it was assumed that learners' ability to perceive their own production was the same as that to perceive the production of native speakers.

Therefore, it might be worth exploring if there is any difference between these two types of perception. Taken together, the research questions of this study are:

1. What is the effect of speaking style on the production accuracy of [θ]?
2. What is the effect of word position on the production accuracy of [θ] in word list reading?
3. What is the effect of speaking style and word position on production accuracy of [θ]? Do they interact?
4. What is the effect of auditory distraction on accuracy of [θ] in word list production?
5. What is the effect of auditory distraction and word position on production accuracy of [θ]?
6. What factors attract learners' attention to the production and perception of [θ]?
7. Is there a relationship between L2 learners' speaking perception and production?
8. What is the effect of distraction on participants' monitoring strategies?

Method

Participants

Twenty-five female Chinese graduate students and nine male Chinese graduate students participated in this study. All of them were enrolled at a large university in the United States, and their first language was Mandarin. When they participated in this study, their length of residence (LOR) in the United States ranged from six months to three years,

with a mean of 13.24 months (SD = 9.43 months). About two-thirds of the participants were engineering students who had comparatively limited opportunities to speak English with NSs.

Five NSs participated as raters. Four of them were ESL instructors at the university. Each had at least two years of ESL teaching experience. The fifth rater was a program coordinator who frequently communicated with international graduate students.

Materials and Procedures

Before asking the participants to complete the experiment tasks, the researcher asked a rater to read 15 groups of the minimal pairs with a total of 41 words for the perception test. The minimal pairs were adopted from Rau et al. (2009) and the [θ] sound was included in each pair. The voice was recorded on a SONY recording pen and was later edited by the software Gold Wave so that the volume was amplified while the noise was eliminated.

The experiment tasks had three phases: the production test, the perception test, and the interview. Each phase was further divided into several steps. First, the participants were asked to tell the story *The Three Little Pigs,* which was adopted from Rau et al. (2009)'s study, based on eight picture prompts. They were given one minute to plan the story, and were expected to include as much information as possible from the pictures in their stories.

Second, the participants were asked to listen to the recordings of their story telling and to recall whether they paid attention to [θ] while producing it. If they paid attention to the target [θ], they were also required to explain their strategies for monitoring the production accuracy of this sound. The stimulated recall was recorded using the recording pen.

Third, half of the participants were provided with a word list containing 37 words divided into fifteen groups of minimal pairs, all of which included the [θ] sound. This word list was adopted from Rau et al. (2009). A piece of Chinese news was also selected from a China Central Television (CCTV) News Report and edited using the Gold Wave to reduce the background noise. I chose The CCTV News Report because the reporter's voice was clear and speaking rate was moderate. In addition, the language spoken by the reporter was standard Mandarin. The participants were asked to listen to this news report played in the headphones while reading aloud all the minimal pairs on the word list at a normal speed. They were asked to remember as many details of the news report as they could because immediately after they listened to the news, they were expected to repeat it to the digital recording pen.

Fourth, that group of the participants was told to read another 15 groups of minimal pairs, which included 44 words in total. Like the first word list, [θ] was also involved in each minimal pair. This time, no additional task was required.

The other half of the participants were required to go through the fourth step first and then the third step.

Fifth, the participants were asked to complete a 12-item questionnaire. Half of the items addressed their overall attitude towards accented English spoken by Chinese learners of English, especially concerning [θ], and the other half concerned their attention paid to [θ] during story telling and word list reading. Sixth, the participants were required to listen to 15 groups of minimal pairs read by the fifth rater and to write down whatever words they heard. They were allowed to use IPA symbols, which was shown to them for reference, if they did not know how to spell the words. After that, they were asked to listen to another 30 groups of minimal pairs read by themselves during step three and step four. They were also required to write down the words they heard. In order to reduce the influence of participants' memory for these minimal pairs, they were not told that they were listening to their own recordings.

Last, a one-to-one interview was conducted between the participant and the researcher in Chinese because it was the first language of the interviewer and the interviewee.

All the participants' speaking data were recorded using the recording pen and were stored on a private password-protected laptop for analysis. The procedures of the study are summarized into Table 1.

Table 1. *The Procedures of the Study*

Steps	Methods of Collecting Data	Materials
Step One: Story telling	Recording	Story pictures
Step Two: Stimulated recall	Recording	Recordings of Story telling
Step Three: -Second word list reading (with auditory distraction) - News retelling	Recording	Second word list, headphones
Step Four: First word list reading (without auditory distraction)	Recording	First word list
Step Five: Questionnaire	Writing down answers	Questionnaire
Step Six: other-perception, self-perception	Writing down the words perceived	Recordings of the word list reading
Step Seven: Interview	Recording	Interview questions

Analysis

In order to answer the research questions, both quantitative and qualitative data were analyzed. The first step in the quantitative data analysis was the evaluation of the participants' production and perception. Four ELC teaching assistants, English NSs, were assigned to evaluate the participants' speaking output. Each rater was responsible for evaluating 17 participants' use of [θ] in their story telling and word list reading. The rating arrangement was carefully designed so that each participant could be rated by two raters. Table 2 illustrates how each rater The raters were required to accomplish two tasks: first, to identify the [θ] sounds that were mispronounced as other sounds by the participants; second, to spot the sounds that were mispronounced as [θ] by the participants. The raters recorded the rating results on the rating sheets. After comparing the rating results of these four raters, the fifth rater was called in to judge any discrepancies between each pair of raters. The final results were based on a consensus reached by at least two raters. The researcher investigated the results of the participants' perception tests through two steps: first, the researcher compared the words produced by the NS and the corresponding words written down by the participants; second, the researcher compared the words the participants were supposed to produce, the words the raters determined that they had actually produced, and the corresponding words the participants wrote down during the perception tests. Each discrepancy was counted as one perception error and the percentages of inaccuracy were calculated through dividing the number of erroneous words by the total number of the words.

Table 2. *The Rating Arrangement*

Raters	Participants	
Rater 1	1~10	18~24
Rater 2	1~10	11~17
Rater 3	11~17	25~34
Rater 4	18~24	25~34

Based on the ratings provided by the raters, the researcher further categorized the erroneous words, which were either produced or perceived incorrectly, into three groups according to where the [θ] was positioned in the word: initial, medial, or final. For each group, the percentage of erroneous words was also calculated. In addition, the researcher transcribed the data from interviews and was assigned to the participants stimulated recalls for a qualitative analysis.

Anticipated Results

The pilot study showed that participants performed the best in the word list reading without the distraction of the news while the worst in the story telling. Also they paid more attention to the production of [θ] in word list reading than they did in story telling. This pilot study yields following anticipated results. First, participants will have a higher accuracy of voiceless interdental fricative in word-list reading than in story telling because they would be

able to pay more attention to pronunciation while reading the word list. Second, in terms of the position of erroneous [θ] sounds, it is expected that participants will make the fewest errors in producing the [θ] in the word-initial position. Third, although not tested in the pilot study, it is still very likely that participants who are not required to listen to the news report will perform better than those asked to listen to the news report while reading the word list. Fourth, the amount of attention paid to the production of target sounds may have a negative correlation with the percentage of errors. Fifth, a positive correlation might be found between participants' production and perception.

The limitations of this study will be weak generalizability because of the small sample of participants. Also it would be better if each participant was required to do a stimulated recall.

Nevertheless, this study will have pedagogical implications for SLA. First, instructing learners to strategically allocate more attention to the phones that are most likely to be pronounced incorrectly might help learners to improve their overall pronunciation. Second, instructors are recommended to identify the reason that leads to learners' incorrect pronunciation before designing the methods of instruction. The possible difficulties indicated from this study are: a) knowing what the correct pronunciation should be; b) failing to self-monitor the speech production; and c) not knowing how to produce the target sound[i].

This study lays the foundation for future research about the relation between speakers' working memory and their accurate pronunciation. Because the accuracy of pronunciation is significantly determined by the amount of monitoring (i.e., attention) allocated to it as expected to be shown in this study and because monitoring is influenced by available total attentional resources, which is closely related to speaker's working memory capacity (Broadbent, 1958; Gathercole & Baddeley, 1994; Robinson, 1995), it is hypothesized that learners' working memory capacity plays the role in their L2 speech pronunciation, as evidenced by Reis, Kluge, and Bettoni-techio, (2007) and O'Brien, Segalowitz, Freed, and Collentine, (2007).

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