Chinese Phonotactic Patterns and the Pronunciation Difficulties Of Mandarin-Speaking EFL Learners

Abstract

To draw EFL teachers' attention to pronunciation difficulties resulting from L1 phonotactic constraints, this study examined the hypothesis that certain syllable structures could cause more mispronunciation than segmental sounds for Mandarin-speaking EFL learners. A 145-word reading passage was developed with a total of 30 target sounds, which included the problematic syllable structures that exhibited Mandarin phonotactic constraints and the most troublesome segmental sounds identified in other studies. 146 college students were tested and the results validated the hypothesis, which demonstrated that the successful pronunciation of individual sounds does not automatically transfer to successful pronunciation at the word level. It is suggested that apart from the teaching of segmental sounds and word stress, teachers need to be informed of the relation between L1 phonotactic constraints and English mispronunciation. Mandarin speaking non-native EFL teachers' cross-linguistic ability may allow them to implement unique pedagogical tactics that address the particular needs of their students to enable them to cope with such aspects of non-segmental pronunciation difficulties.

Key words: phonotactic constraints, pronunciation difficulties, suprasegmental sounds, syllable structures, Mandarin,

Introduction

The test-driven English instruction in Taiwan does not give much attention to learners' speaking ability let alone their pronunciation. Although good pronunciation is not equal to good speaking ability, it contributes to the intelligibility of oral communication since listeners rely on distinguishable vowels and consonants and appropriate intonation contours to understand speakers' talking (Brown, 1989; Munro & Derwing, 1997). The trend of language proficiency testing has been moving toward a more communicative and practical direction and now often includes speaking proficiency testing, which has long been included in the IELTS. Testing speaking proficiency is gradually being integrated into almost all of the standardized language tests today, such as TOFEL and TOEIC, even the most test-driven learners now realize the need for good or at least intelligible pronunciation. Knowing that poor or unintelligible pronunciation might influence their speaking performance, language learners may start to pursue a higher level of intelligibility in order to better express themselves. Accordingly, the teaching of English pronunciation has moved beyond the teaching of segmental sounds; suprasegmental parts of English pronunciation have been included in some of the more recent textbooks (Gilbert, 2005; Miller, 2006; Zerna, 1999). However, while tackling pronunciation difficulties, mispronunciation stemming from L1 phonotactic constraints (sound combinations that may not happen in a language) is still an important missing piece in much pronunciation instruction. This part of suprasegment

instruction in fact may rely on non-native EFL teachers' cross-linguistic ability to make pedagogical changes. In order to draw teacher's attention to this point, this study tested a hypothesis that certain English syllable structures that violated Chinese phonotactic rules could cause more pronunciation difficulties than segmental sounds for Mandarin-speaking EFL learners.

Literature Review

From an interlinguistic point of view, EFL language learners are likely to encounter difficulties when pronouncing sounds that do not exist in their first language. A number of studies (Chang, 2001; Wolfram & Johnson, 1982) have indicated that both inherent and structural pronunciation difficulties mainly result from the differences between the languages. For Mandarin-speaking EFL learners, certain pronunciation difficulties are specified based on error and contrastive analysis approaches. For instance, Tzwe (1987) identified eight inherently difficult English consonants, / ʒ, ŋ, θ, z, s, v, tʃ, f/[1], while Chang (2001) found that /e, æ, ʒ, s, z, v / are more likely to cause pronunciation problems for Taiwanese EFL learners. Huang (2001) concluded that /r, w, l, ŋ, tʃ, dʒ, ʒ / might trouble learners more than the other sounds. It has also been noted that minimal pairs that feature tense and lax vowels such as /i/ and /ɪ/ or /ʊ/ and /ʉ/ cannot be discerned by some learners (Baker, 1982), while vowel length poses another difficulty for Taiwanese EFL learners (for vowel length is not phonemically distinctive in their mother tongue) (Swan & Smith, 1990; Chang, 2001).

The above studies center their discussions in particular on the problems of segmental sounds; however, difficulties resulting from structural differences at the syllable level are rarely addressed. Moreover, based on the researchers' teaching experiences, we find that although individual sounds do cause pronunciation difficulties, certain syllable structures

[1] The phonetic symbols presented in this paper are Kenyon & Knott (K.K.) phonetic symbols.

seem to be more difficult to tackle than segmental sounds. For instance, we have found that some of our students seem to have no problem pronouncing /p/ and /l/ when they are separated; yet, when they articulate the word *please* with /p/ and /l/ adjoined as a consonant cluster, it is often mispronounced as *prease*. Another slightly different example can be found in the word *fun*, which is often pronounced as /faŋ/. Given that /ʌ/ and /n/ can be correctly pronounced independently, to interpret the mispronunciation merely from the segments of English phonology is not sufficient to explain these kinds of pronunciation problems. As this sort of mispronunciation may result from structural differences of phonological sequencing, the influences of Chinese phonotactic constraints seem to be an appropriate approach to look into learners' English pronunciation difficulties since it goes beyond the realm of segmental sounds.

Unfortunately, studies that comparatively investigate levels of pronunciation difficulties in both segmental and phonotactic aspects are rare. Learners' mispronunciation is still interpreted mostly by measuring segmental mistakes. Nakashima (2002), for instance, reanalyzed Japanese English learners' segmental mistakes [pointed out by Jenkins (2000)] and argued that it was the syllable structures rather than the segmental sounds that caused the pronunciation difficulties evidenced.

Phonotactic Differences and Pronunciation Problems

Before Nakashima's argument, Wolfram and Johnson (1982) had already indicated in their book that phonotactic differences between languages may cause learning problems for L2 learners. Differences such as distribution patterns of segments, CV (C=consonant, V=vowel) sequences regarding syllable types and segment clusters, and particular phonetic sequences are reflected in learners' modified production, which reveals the interference of L1 phonotactic constraints on L2 output (p.192). Several contrastive studies (Huang, 2001;

Hansen, 2001; Tarone, 1987; Trammell, 1993) also drew our attention to L2 learners' deviant pronunciations resulting from L2 sound sequences that violate the rules of L1 phonotactic constraints. For instance, we know that the syllable structures of Chinese are V, VC, CV, and CVC, while in English the syllable structures are far more complicated with various extended consonant clusters that consist of up to three consonants before and after a vowel as in the word *splurged* (CCCVCCC) or four consonants after the sounded vowel as with the words *glimpsed* (CCVCCCC) or *scrambles* (CCCVCCCC). Since Chinese phonotactic constraints do not permit consonant clusters, learners are more likely to encounter difficulties in pronouncing them. In some other cases, though the researchers did not specify the influence of phonotactic differences, the deletion or devoicing of consonant clusters or obstruents and inflected -ed at word finals can also be explained by phonotactic differences since these sound sequences are not permissible or do not exist in Chinese (Broselow, Chen, & Wang, 1998; Flege 1989; Flege & Wang 1989).

Although this observation derived from the contrastive analysis of permissible phonological sequences in languages gives us another perspective to analyze and explain some mispronunciations, it is seldom the focus of pronunciation instruction. That is, unlike those limited segmental sounds that are systematically listed and incorporated into the practice of minimal pairs in many textbooks, problematic phonotactic patterns or syllable structures are still trying to find their way into pronunciation instructions to raise teachers' and learners' awareness of these aspects of speaking difficulties.

Nevertheless, in the research of accented speech and its influence on intelligibility, a consensus has been reached that suprasegmental errors affect the overall comprehensibility of L2 speech more than segmental ones (Anderson-Hsieh, Johnson, and Koehler, 1992; Gilbert, 1995; Morley, 1994, Burgess and Spencer, 2000). In Derwing, Munro, and Wiebe's study

(1998), experimental evidence was provided to prove that instruction on suprasegmental features of English phonology such as word stress, sentence stress, speaking rate, intonation, and rhythm significantly improved the comprehensibility and fluency of the subjects' speaking. Thereby, the inclusion of suprasegmental features such as word stress and sentence focus in instructional materials is bourgeoning (Gilbert, 2005). Apart from the teaching of English prosody, in Miller's book (2006), practices for final sounds, consonant clusters, and /r/ and /l/ are included, which to some extent reflect the research literature by using a newer approach to tackle the common phenomenon of word final consonant deletion and the notorious /r/ to /l/ confusion. As the instruction of English pronunciation has been crossing the boundary from the segmental area, there is no reason that L1 phonotactic constraints should be ignored since the learning of L2 syllable structure fundamentally affects the learning of the prosody and rhythm of a language.

In the hope of contributing to the experimental study of L1 phonotactic constraints and English pronunciation difficulties, this study will test the proposed hypothesis to see whether certain phonotactic patterns may cause more difficulties than segmental sounds in the learning of English pronunciation for Taiwanese EFL learners. A quantitative measure and a descriptive analysis will be taken to investigate learners' mispronunciation; the distribution of mistakes made in segmental sounds and those resulting from phonotactic constraints will be ranked. However, the main purpose is to draw attention to the teaching of English phonology at the syllable level rather than to differentiate the levels of pronunciation difficulties between segmental sounds and phonotactic patterns.

Problematic Syllable Structures for Mandarin Speakers

Since not many specific consonant clusters or problematic syllable structures are not

well recognized in the study of Taiwanese EFL students' mispronunciation, it is not surprising that some mispronunciations stemming from phonotactic differences could be mistreated as problems with segmental sounds. For instance, a number of studies indicate that Mandarin-speaking learners have a problem pronouncing the vowel /e/, which is quite perplexing for the teacher because this particular sound does exist in Mandarin. Taiwanese EFL students can articulate /e/ correctly in the words such as *play* and *bay*; strangely, it is quite common that they pronounce *lake* as /lɛk/ or *tape* as /tɛp/. Though these words comply with Chinese syllable structure of CVC, it seems to violate another phonotactic rule in Chinese, which we surmise is the combination of /e/ and a final consonant. In Chinese, /e/ is always positioned in the syllable final of CV or CVV structure; any final consonant attached to it seems to lead to distortion of the vowel quality and thus the diphthong /e/ is shortened to /ɛ/ and words such as *lame* is pronounced /lɛm/; *safe* is /sɛf/; *sale* is /sɛl/, *sane* is /sɛn/, and so forth.

Similarly, we also find that a large portion of mispronunciation in our students' speaking involves nasal /n/ and liquid /l/ and their adjacency with certain vowels and consonants. The /n/ trouble, as we call it, is three fold. First, when considering the syllable structure of the vowel sounds /au/ or /ʌ/ with /n/ as in /aun/ in *found* and *town*, or /ʌn/ in *sun* and *fun*, the vowels /au/ and /ʌ/ are usually changed into /a/ and the alveolar /n/ is replaced with /ŋ/. Thus, *town* is pronounced /taŋ/, and *sun* is pronounced /saŋ/. No similar situation is found in the adjacency of /i/ or /u/ in the words *mean* or *soon*. In Chinese, there are /au/ and /ʌ/ sounds; yet, they are always word finals. Hence, /n/ adjoined next to /au/ and /ʌ/ sounds may cause pronunciation problems. Second, the syllable structure of /e/ and /n/ poses as another problem. When pronouncing /en/ such as *paint*, *train*, or *complain*, /e/ is often changed to /ɛ/ and the words are mispronounced as /pɛnt/, /trɛn/, and /kʌmplɛn/. The abovementioned L1 constraint of /e/ + consonant is also a possible explanation of this phenomenon. However, students who

can successfully pronounce /e/ + consonant may still have problems due to this syllable structure. Third, students are found to insert a /n/ when encountering the combination of /i/or /ɪ/ with a stop or affricative, which is not permissible in Chinese. Thus, *city* becomes *cinty*, *leak* is pronounced *leank, itchy* turns to *intchy* and *stick, stink*, and so on.

For liquid /l/, it is found that /l/ causes different pronunciation difficulties based on positional differences or the context in which the sound occurs (Huang, 2001; Hide & Van de Poel, 2002). As Young-Scholten and Archibald (2000) indicate, an obstruent + /l/ is not allowed in Chinese and thus will cause pronunciation difficulty in words such as *please* (/pl/) or green (/gr/). We find that light /l/ at the onset of a word or a syllable such as *light* or *allow* is not usually as troublesome as dark /l/ when positioned post-vocalically or at word-end such as in *cult* or *little,* which does not exist in Chinese. For example, the positional differences of dark /l/ may result in different strategies to deal with the difficulties. Deletion of dark /l/ is found as a common strategy used when pronouncing dark /l/ as positioned in word internals such as *world, sold, silver*, and the like, while the substitution of dark /l/ with /ɔ/ is found in words such as *girl* and *tell*, where /l/ is at the word-final. In addition, a very interesting phenomenon is found with the word *learn*. Although /l/ is the onset and is supposed to be less difficult, a good number of students pronounce the word *learn* as /nɜn/. It seems that they assimilate the /l/ sound with the /n/ sound and it is possible that the articulation positions are similar in Mandarin.

From the above-observed phenomena, in light of phonotactic constraints, one can narrow down the phonotactic patterns to a few specific syllable structure pronunciation problems that Taiwanese EFL learners are more likely to encounter. These syllable structures are:

1. /e/ + consonant: /e/ is shortened to /ɛ/;

2. /au/ or /ʌ/ + /n/ as in -own and -un/-on, which are pronounced /aŋ/.
   /e/+/n/ in -aine/-ane is prounced /ɛn/, and;
3. Dark /l/, particularly the postvocalic /l/ such as /ɝl/, /ɔl/, /ʌl/, and /el/, the /l/ is deleted or changed to /ɔ/.

We hypothesize that these syllable structures are more difficult to pronounce than most of the segmental sounds usually addressed in the study of Taiwanese EFL students' mispronunciation (see Table 1). If our hypothesis is confirmed, the influence of Chinese phonotactic constraints may need to be included as an indispensable perspective to examine learners' errors in English pronunciation. Some learners' errors previously found in the segmental area may need to be reanalyzed under the L1 phonotactic constraints paradigm rather than be treated as inherent difficulties or an inability of articulation. By doing so, the teaching of English pronunciation would be more comprehensive once teachers are informed of these particular syllable structures and include them in their teaching practice to raise students' awareness of these sorts of difficulties.

Method

Instrument

To test the hypothesis that /e/, /n/, and /l/ related syllable structures are more likely to cause pronunciation difficulties compared to segmental sounds, a reading passage was developed (Appendix 1) which includes the troublesome syllable structures previously mentioned and the segment sounds addressed in other studies. The test was inspired by Prator and Robinett's (1985) diagnostic passage; their passage was designed for segmental sounds and the lexical and syntactic complexity was quite difficult for some students as they often stumbled on polysyllabic words when trying to locate the stresses, and sometimes they paused inappropriately, due to their lack of comprehension when reading longer sentences.

Thus, their test might have to some extent drawn on the students' linguistic knowledge, rather than accurately reflect the students' pronunciation ability. To avoid the influence of linguistic ability on the test results, the passage used for this study was written like a short story and used high frequency words to embed the target sounds.

The testing points and the target words on segmental sounds are presented in Table 1, while /e/, /n/ and /l/ related phonotactic patterns are categorized according their positional differences in syllable structures as seen in Table 2. For instance, liquid /l/ was divided into four different target sounds due to learners' various modified outputs possibly related to the positional differences of /l/. For dark /l/, deletion is observed when it is in word initial positions while substitution is more common when it is in word final positions. The 145-word passage includes: 11 vowels, 10 consonants, 2 /e/ related sounds, 4 /l/ related sounds, and 3 /n/ related sounds. A total of 30 target sounds and syllable structures were tested.

Although each segmental sound and syllable structure does not have an equal number of words, the counting of mispronunciation is based on the sounds present instead of the words. Thus, a student might mispronounce more than one word of a particular sound; the mistakes are still counted as one.

Table 1: Target Segmental Sounds and Words in the Reading Passage

/ɪ/	/i/	/ɔ/	/o/	/ɛ/
l*i*ve, f*i*sh, l*i*ttle, r*i*ver, b*i*g	sl*ee*p	cl*aw* f*a*ll	foll*ow*	r*e*d pl*ea*sure

/æ/	/ʊ/	/u/	/ɜ/	/ɔɪ/	/ʌ/

c*a*t, n*a*tural, c*a*tch, r*a*n	l*oo*k w*oo*d	f*oo*d	w*or*ld w*ere* lea*r*ned	t*oy*	j*u*st

/ʒ/	/v/	/f/	/s/	/z/
plea*s*ure	Li*v*e gi*v*ing	*f*ood *f*ault *f*ollow fang	*s*mall *s*nore *m*ice said	wa*s*

/θ/	/ð /	/tʃ/	/ŋ/	/w/
*th*ank	mo*th*er fa*th*er	cat*ch*	fa*ng* lo*ng*	*w*ood

Table 2: /e/, /n/ and /l/ Related Syllable Structures in the Reading Passage

/e/ related	/e/ at word finals		/e/ + consonant	
	Pl*ay* d*ay*		l*a*ke w*a*ke c*a*me	
/l/ related	Light /l/	Dark /l/ (post-vocalic)	Dark /l/ (word finals)	Obstruent + /l/

	*l*earned	wor*l*d	sma*ll*	p*l*ay
	*l*ord	fau*l*t	litt*l*e	c*l*aw
	*l*ong		natura*l*	s*l*eeping
	*l*oudly		ca*ll*	p*l*easure
	*l*uckily		ow*l*	
	*l*ittle			

/n/ related	/aun/	/ʌn/	/en/
	t*own*	f*un*	p*ain*ted
	s*oun*d	s*un*	
	f*oun*d	r*un*	

Subjects

A pilot study was conducted involving 25 English major freshmen in the 2004 academic year to evaluate the test items and testing procedures. The current study was conducted in the summer of 2005. The subjects were 34 graduate and 112 undergraduate non-English major students who voluntarily attended a summer English course offered by the Department of Applied Foreign Languages at The National Yunlin University of Science and Technology. Considering that their English proficiency levels might not correspond to their academic levels, these students were placed in different levels based on Yang's (2004) reading diagnostic test, which was developed particularly for college students in Taiwan based on their previous learning content and thus was suitable for the subjects of this study. The subjects were put into five different classes according to their levels. Level 1 represents the pre-beginning level and Level 5 is the advanced level. The distribution of the students according to level is presented in Table 3.

Table 3: The Distribution of the Subjects by Five Levels

	Level 1	Level 2	Level 3	Level 4	Level 5	Total
Graduate Students	8	2	2	5	17	34
Undergraduate	25	35	15	21	16	112
Total	33	37	17	26	33	146

Four teaching assistants who were recruited to teach the speaking and pronunciation classes were trained to help with the testing and marking. These assistants were considered highly successful language learners whose English pronunciation and ability to identify mispronunciations were tested and evaluated by the author and the second author (a native speaker of Northern American English) to ensure the accuracy needed to detect mispronunciations in the subjects' oral reading.

Procedures

To rule out the influence of unfamiliar lexical items and performance anxiety, the students were given sufficient time to look up unknown words and practice their pronunciation before taking the test. When the practice was finished and the students indicated their readiness to read the passage out loud, the test proceeded individually and the reading was recorded for later evaluation. Each recording lasted a little longer than one minute.

The teaching assistants and researchers listened to the tapes and marked the mispronounced words. Each tape was played at least twice to ensure that all mispronounced words were detected. When encountering uncertainty in deciding whether a sound was mispronounced or not, agreement was sought by at least two assistants and one of the authors.

After marking the pronunciation errors, each target sound was counted for its frequency of mispronunciation and statistical analysis was applied to see the frequency distribution of all the target sounds. The target sounds were then ranked from the most mispronounced sounds to the least.

Findings and Discussion

The results are presented in Table 4. A total of 25 sounds are ranked from the most mispronounced to the least, which does not include the sounds that had a mispronunciation rate lower than 13%, which are /o, ʊ, ʌ, v, f, s, z, tʃ/ and /e/ at word finals. Four non-target sounds, /ɔr/, inflected -ed, /ar/ and /ɪəst/ (as in in the word *happiest*), are also included due to their high frequency of mispronunciation. Of the 25 ranked sounds, six target syllable structures (from 9 in total) fall into the top 15 most mispronounced sounds; five segmental sounds (from 21 in total) are among the top 15, which are /ʒ/, /ɔ/, /ŋ/, /θ/, and /ɝ/. The final 2 sounds in the top 15 are /ɔr/ and inflected -ed, which could also be described as phonotactic patterns. The results of this study confirm what had been hypothesized, that the subjects encountered more pronunciation problems with certain syllable structures related to Chinese phonotactic constraints than with segmental sounds.

The most mispronounced sound was the fricative /ʒ/ in the word *pleasure*. Almost 90% of the students could not articulate this consonant correctly. As indicated by Tzwei (1987) and Huang (2001), this consonant is inherently difficult and the reason for it being difficult for Chinese and Taiwanese speakers is that it is not found in Chinese. The second most mispronounced sound was dark /l/ positioned after a vowel. In this study, it was the words *world* and *fault*; with 87% of the subjects deleting the /l/ sound. Compared to light /l/ at word initials, this phonotactic pattern was tenaciously difficult.

Even though the light /l/ at word initials was not as a troublesome as dark /l/ at word internals or word final positions, there were still more than 50% of the subjects who made mistakes with the onset /l/, which was exclusively found in the word *learned*. The mispronunciation resulted in the replacement of the onset /l/ with /n/. Interestingly, this finding seems to contradict the study of Hide and Van de Poel (2002), who found that Chinese learners of English tend to substitute initial /n/ with /l/. The relationship between /n/ and /l/ in mispronunciation may need detailed scrutiny before any conclusion on this aspect of error can be equivocally drawn.

The sound /ɔ/, which has not been discussed much in the literature on pronunciation study, surfaced in this study as the third most mispronounced sound. 81.5% of the subjects mispronounced the word *claws* as /kloz/ or /klauz/. Although this sound exists in Chinese, it is always preceded by the consonant /w/ as in the Chinese words /hwɔ / (fire), or /dwɔ / (hide). Nevertheless, the combination of /l/ and /o/ found in the Chinese words */Lou/* (stairs) may have seemed similar to *claw* for the subjects and this might explain why they morphed *claw* into /klo/.

Table 4: Ranking of Target Sounds Based on Frequency of Mispronunciation (target sounds are bolded)

Rank	Sound	Number of Mispronunciations in Different Levels						Percentage of Mispronunciation
		Level 1 (33)	L. 2 (37)	L. 3 (17)	L. 4 (26)	L. 5 (33)	Total (146)	
1	/ʒ/	31	37	17	23	23	131	89.7
2	**Dark /l/ (post-vocalic)**	23	34	16	25	29	127	87.0

3	/ɔ/	29	29	17	22	22	119	81.5
4	**/aun/**	21	30	16	20	30	117	80.1
5	/ɔr/	29	31	11	20	24	115	78.8
6	-ed	30	29	11	16	27	113	77.4
7	**/en/**	23	32	16	14	23	108	74.0
8	**/e/+ consonant**	30	31	16	12	18	107	73.3
9	/ŋ/	16	30	15	18	24	103	70.5
10	/θ/	33	34	13	12	11	103	70.5
11	/ɜ/	22	26	9	25	18	100	68.5
12	**Dark /l/ at word finals**	28	23	12	14	16	93	63.7
13	**/ʌn/**	16	34	15	8	17	90	61.6
14	**Onset /l/ in *learn***	22	16	9	10	19	76	52.1
15	/u/	20	22	12	7	9	70	47.9
16	/ar/	11	17	6	18	17	69	47.3
17	/ɪəst/	11	18	0	22	17	68	46.6
18	/w/	19	20	12	7	9	67	45.9
19	/ð/	25	24	6	6	6	67	45.9
20	/æ/	15	30	16	2	3	66	45.2
21	/ɪ/	15	21	15	5	4	60	41.1
22	/ɛ/	13	18	2	7	11	51	34.9
23	**Obstruent +/l/**	21	9	0	2	3	35	24.0

24	/ɔɪ/	7	10	2	0	3	22	15.1
25	/i/	8	7	0	2	2	19	13.0

The fourth most mispronounced sound combination was /aun/; more than 80% of the subjects could not correctly pronounce the sound when reading *town*, *sound*, and *found*. It is assumed that these words violate the phonotactic rule in Chinese that does not allow nasal /n/ to be attached to /au/. Thus, even though the subjects could pronounce /tau/, similar to the way they would pronounce *peaches* in Chinese, it was difficult for them to pronounce /taun/. Most of them changed it to /taŋ/, which is a sound similar to another Chinese word, *sugar*. However, this does not mean that /n/ is always changed into /ŋ/. In fact, 70% of the subjects had problems with the nasal sound /ŋ/; the word *fang* was often mispronounced as /fɛn/. Interestingly, the same mistake was not found in the word *long*. Next, we surmised that the /æ/ and /ŋ/ combination was another case of a phonotactic pattern difference since /æ/ is absent in Chinese and /ŋ/ in Chinese can only be adjoined with two vowels, /i/ and /u/. Thus, to pronounce /æ/ and /ŋ/ together could result in pronunciation difficulty.

Unexpectedly, the words *lord* and *snored* were mispronounced by 79% of the subjects and / ɔ r/ ranked as the fifth most mispronounced sound. Though these words were not meant to be target words, they were mispronounced so often that their significance to this study should not be ignored. The unexpected /ɔr/ sound may reflect the difficulty of R-controlled vowels to Taiwanese EFL students since /r/ is an absent phoneme in Taiwanese (though not in Mandarin Chinese). The deletion of /r/ and the change of /ɔ/ to /o/ when pronouncing *lord* or *snored* seemed a predictable outcome when facing the double jeopardy of /ɔ/ and /r/ in these words. Similarly, the /r/ in /ar/ as in the word *sharp* was also deleted by almost half of the students (47.3%).

Inflected words with -ed endings ranked as the sixth most mispronounced sound. Although it was not included as a target sound, it might be caused by phonotactic constraints with voiceless consonant clusters at word finals. However, it could also be from the influence of grammar problems. The change of verb tenses for inflected words in English is absent in Chinese; despite conscious learning and practice, Taiwanese EFL learners tend to use uninflected forms of verbs. In this study, only 22% of the subjects could correctly pronounce the inflected –ed form. Of these, the most mispronounced word was *thanked*. The majority of the subjects deleted the -ed part; for those who remembered to maintain the inflected form but mispronounced it, an insertion of /ə/ after the voiceless /k/ to form an extra syllable as /θænkət/ was commonly found. Other variations such as /θænkɪd/, /θænkəd/ might also indicate an unfamiliarity with the inflected rule. In any case, the vowel epenthesis suggested an avoidance of the consonant cluster, which is not allowed in Chinese.

Another unexpected common mistake found was with the word *happiest*, which was predominantly mispronounced as *happinist*, with a few cases of *happist*. Again, the insertion of /n/ was found. However, it seems that the phonotactic pattern */i/ or /ɪ/ + stop or affricative* we have suspected from the students' mispronunciation is not sufficient to explain the /n/ insertion between *i* and *est*, which may indicate another Chinese phonotactic constraint that rejects the adjoining of the two vowels /ɪ/ and /ə/ and thus is syllabicated by the inserted /n/ to form an extra syllable. For the same reason, as with the subjects who mispronounced *happiest* as *happist*, the deleting of /ə/ might be a strategy of syllable simplification that makes the articulation easier.

We calculated the mean percentage of all the mispronounced sounds ranked in Table 4 for each level and found that that the higher level students made fewer mistakes in this test, as shown in Table 5. This could indicate that proficiency level might play a role in overall

pronunciation performance. However, the factors that influence performance differences across different levels may need further investigation.

Table 5: Mean Percentage of Mispronunciations for Each Level

Total	N	Level 1	Level 2	Level 3	Level 4	Level 5
	Mean %	62.8	66.2	62.1	48.8	46.7
	N of sounds	25	25	25	25	25
	Std. Deviation	22.8	22.8	34.6	30.4	26.6

Conclusion and Suggestions

This study presents another aspect of learners' mispronunciations influenced by Chinese phonotactic constraints found in certain English syllable structures. The three syllable structures (/e/+ consonant, /aun/, /ʌn/, /en/ and dark /l/) are proven to be more troublesome for Taiwanese learners than most of the individual sounds addressed in other studies. The fact that successful pronunciation of segmental sounds did not automatically transfer to the same success at the syllable level is demonstrated in this study; the learning of pronunciation at the lexical level may somehow be more complicated than the learning of individual sounds.

The results of this study indicate a need to revise the learning and instruction of English pronunciation in Taiwan (and maybe in any EFL context). Apart from the learning of segmental sounds, language learners may need to practice certain phonotactic patterns that differ from L1 sound sequences in order to correctly articulate troublesome words similar to those presented in this study. In their study of remedial pronunciation instruction for Chinese learners, Hide and Van de Poel (2002) also suggest that pronunciation teaching should take

care of structural and lexical problems. As new approaches to pronunciation teaching have integrated suprasegmenal features of English phonology, problematic syllable structures stemming from the influence of L1 phonotactic constraints should be also included.

However, the textbooks used for the teaching of English pronunciation in Taiwan, at least at the college level, are mostly generic imported books that are made for ESL students around the world; the phonotactic issues specific to Taiwanese EFL students thus remain unattended. The reason syllable structure pronunciation practice cannot be found in current textbooks could be because phonotactic constraints between different languages are varied. Thus, the study of English mispronunciation within the domain of phonotactic patterns in one language may not be able to transfer to another one, so the possibility of including all the various phonotactic patterns in one instruction book is slim.

It is therefore important for EFL teachers, particularly those with cross-linguistic ability, to supplement their teaching with extra attention paid toward the influence of L1 phonotactic constraints. The design of new syllabi that integrates the teaching of problematic syllable structures due to language differences may sound overwhelming, but in fact, the influence of phonotactic constraints can be systematically introduced – starting with high frequency words, since the clusters or syllable structures that are more likely to cause pronunciation problems should be limited in number and can be specified based on the phonotactic rules of the L1. A couple of suggestions are made below that apply the findings from this study to classroom practice.

A fundamental step to tackle problematic syllable structures is to raise teachers' and students' awareness of pronunciation difficulties that go beyond segmental problems. For people who have only received pronunciation instruction on segmental sounds and/or those who are not conscious of their suprasegmental pronunciation problems, diagnostic tests may be an explicit intervention tool that can direct their attention to such problems that have not

yet been noticed. In this study, many students were surprised to discover that they had made mistakes with words that they had been mispronouncing for years. The diagnostic test developed in this study can be used to serve such an awareness-raising purpose. Similar diagnostic tests on other aspects of suprasegmental features could also be developed to focus on the same concerns.

After raising learners' awareness of pronunciation problems, approaches to teaching English pronunciation may need to shift as well. The traditional ways of teaching English phonology through phonetic symbols may not be sufficient to tackle syllable structure problems as discussed in this paper. ESL/EFL instructors may consider utilizing the instruction of English phonics to supplement classroom pedagogy. Although the teaching of phonics was not originally designed for the teaching of English pronunciation, it does teach the association between letter patterns and sounds, which includes some syllable structures that do not follow Chinese phonotactic rules. For instance, two consonant blends such as bl-, fl-, and gl-, the pattern of obstruent + /l/ that troubles some Chinese students, and consonant clusters such as scr-, spr-, or scr- at word initial, or -lb, -lk, and -mp at word finals could be integrated into the pronunciation teaching to familiarize students with these spelling patterns and strengthen their psychomotor skills when pronouncing them.

Nevertheless, English phonics does not highlight phonotactic patterns such as those found in this study, although how Phonics organizes English spelling patterns is an easy way for teachers to locate syllable structures that are not permissible in Chinese. From their teaching experiences and an understanding of their students' learning, teachers should be encouraged to develop their inventory of troublesome syllable structures and integrate them into their Phonics pronunciation instruction. In our pronunciation class, for example, students were required to expand the word family of the particular syllable structures they had

problems with and practiced them until they could master the structures. If a student had trouble pronouncing *world,* then he or she had to look for other words with a similar syllable structure, such as *swirled* or *twirled,* and make a silly sentence such as *My world swirled and twirled after a sleepless night* for practice.

The last suggestion, which could be a long-term concern for English teaching in Taiwan, is to promote the qualification of the teachers who are trained to teach English phonology. A study done by the first author in 2005 revealed that only 38% of the teachers had ever been trained to teach English pronunciation or Phonics; yet, 72% of them had taught the subject, based on 122 questionnaires collected from in-service training workshops held in two counties in southern Taiwan for elementary and middle school English teachers. Most of the teachers were able to identify segmental problems they had encountered in English pronunciation; however, they had relatively little awareness of suprasegmental problems, such as syllable structures and prosody. Since teachers are one main source for students to emulate English pronunciation, the teacher should be well trained and informed about integrative teaching approaches that target both segmental and suprasegmental pronunciation problems.

Besides being trained in the training of English pronunciation and phonics, teachers should be informed about L1 constraints on L2 pronunciation, so that they can be more attentive to this aspect of pronunciation difficulty and supplement their teaching with syllable structures similar to those discussed in this study. Researchers and teachers of English pronunciation from different L1 backgrounds need to explore more in this area, and hopefully develop handbooks (or the like) that address the particular needs of their students when coping with non-segmental pronunciation difficulties.

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Appendix 1

A Reading Passage for Pronunciation Assessment

In a small town by a lake, there lived three little mice. They were the happiest mice in the world. They learned to fish in the river and play with natural toys and had fun every day. They painted their house red like the sun, and thanked the Lord for giving them food. One day, a big cat with long fangs and sharp claws came into the woods to look for three little mice, who were sleeping by the lake. They snored so loudly that the cat just followed the sound and soon found them. When the cat was about to catch the mice, an owl called out, “Wake up! Run for your lives!” The mice woke up and ran. Luckily, they got away. “It’s my fault!” cried Mother Mouse, “we shouldn’t have fallen asleep.” Father Mouse thanked the owl, who just said, “My pleasure.”