A Study on College Non-English Majors' Acquisition of English Stress Placement

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Abstract

This study is to investigate the acquisition of the English stress system by Chinese adult second language learners whose native language is of a different type from that of English. In the present study, twenty college non-English majors participated in three tasks. Three factors or exactly syllabic structure, lexical class, and stress patterns of known words contributing to the acquisition of English stress system were investigated. First, the participants produced 40 nonwords of different syllabic structures as nouns and verbs in two sentence frames. Second, they were asked to indicate their preference for the first or second syllable stress on the same 40 nonwords. Last, they were asked to write down the real English words they considered to be phonologically similar to the 40 nonwords. The results indicate that syllables with long vowels are likely to attract more stress than syllables with short vowels. Bi-syllabic nouns are likely to receive more first syllable stress than verbs. Analysis of variance on the production and perception data indicated that both syllabic structure and lexical class have an effect on stress placement. In the regression analysis of the three factors, all have significant and unique contribution to the stress placement, with stress pattern of phonological similar real words having the greatest influence. The results showed that phonological theories on English stress placement should consider multiple, competing, probabilistic factors in accounts of main stress placement including syllabic structure, lexical class, and stress patterns of phonologically similar words.

Keywords: stress placement; syllabic structure; lexical class; phonological similar words

1. Introduction

The suprasegmental features or prosodic systems vary from one language to another. Previous studies as in [1] showed that native speakers' acquisition of prosodic features of native language emerges very early in life. As to L2 prosodic acquisition, can a foreign prosodic system be acquired by adults? To what extent can the prosodic system be acquired? The present study is to investigate the acquisition of the English stress patterns in Chinese adult learners of English. Previous studies show that L2 learners can acquire target language stress patterns, but there were some differences as in [2][3][4]. After the publication of The Sound Pattern of English (SPE) by Chomsky and Halle in 1968, a lot of researchers have done experiments to test whether or not the stress rules proposed by SPE exist and determine the English word stress placement. Some experiments reported that the English stress rules were active in word stress placement. Ladefoged, P., & Fromkin, V. 1968 [5] and Trammell, R. L. 1978 [6] showed that the English word stress rules could predict the stress placement on nonwords. Davis and Kelly (1977) [7] found that words used as verbs in sentences were more likely to have final syllable stress. Previous studies about SLA showed that L2 learners could acquire target language stress patterns, but there might be some differences (Archibald [2], Maris [3], Pater [4]). Other studies have found that L2 learners may transfer the stress patterns of their native language into the target language (Eckman, F. 2008 [8], Flege, Frieda & Nozawa 1997 [9]).

Bybee (2001) [10] proposed a theory called usage-based phonology, which states that human's existing stored word knowledge about actual usage and production of real words influences novel words' phonological categories and patterns. By combining the [10]'s usage-based theory and other two factors, Susan, Clark, Tessuo, and Ratree [11] have presented the results of comprehensive experimental studies of speech production and perception designed to further our understanding of the factors influencing main stress placement in native English speakers. The three factors that have been investigated were: syllabic structure, lexical class (noun vs. verb) and stress pattern of phonologically similar words. Distributional descriptions of English stress patterns suggest that the structure of syllables within a word affects stress placement for that word. A standard analysis of English predicts stress based on vowel length and number of coda consonants (see [12]). English is considered to be a quantity sensitive language which means it has feet that are sensitive to syllable weight(i.e., length of vowel and number of coda consonants).Sereno [13] investigated the effect of grammatical category on stress production in categorically ambiguous bi-syllabic words (e.g., answer, design). Nouns have more characteristics of stress on the first syllable, while verbs have more on the second or final syllables. Thus the noun-verb lexical class asymmetry seems to be a strong effect in stress placement.

So far, none of the studies have demonstrated which of the above factors best fits the reality of Chinese adult learners of English. Hence, the current research would address the following three questions:

1. Do the distribution of English main stress and the typological evidence indicate that heavy syllables tend to attract stress?

2. Do bi-syllabic nouns tend to have more stress on the first syllable while bi-syllabic verbs tend to have more stress on the second syllable?

3. Do the stress patterns of real words play a role in the stress assignment on new words?

2. Method

2.1. Subject

Twenty (11 females & 9 males) Chinese college non-English major students were chosen as participants in this study. Most

of them began learning English as a foreign language in the fourth grade of their elementary schools, generally at the age of 9. All of them have passed CET4 and TOEFL. Every participant is normal in vision and audition. None of them have reading or listening problems. Before taking the experiments, the participants were asked to score their English competence in reading, writing, speaking and listening on a 9-point scale. The mean of their self-reported score was 7.14, 6.42, 5.71, and 6.71.

2.2. Materials

40 English bi-syllabic nonwords with 4 different syllabic structure types were used as the stimuli. Each syllabic structure type contained 10 nonwords. Those words were read by a native English speaker as isolated stressed syllables and got recorded. The native English speaker also recorded the sentences "I'd like a __" and "I'd like to__" as the noun and verb frame. The final words "a" and "to" were pronounced in a schwa form: [ə] and [tə]. The materials were recorded on a digital voice recorder via a high quality microphone, and were digitalized to 16 bit, 50% peak intensity by Cool Edit Pro 2.1.

2.3. Method

In the production task, the 40 bi-syllabic nonwords were presented as isolated stressed syllables. The participants were asked to combine the isolated, stressed syllables into a single word and kept the two syllables they heard by the order and then said it in the noun and verb frames, thus constituting 80 (40×2) tokens. Then in the stress preference perception task, the same words were produced with stress on the initial and final syllable in each of the carrier frames "I'd like a __" and "I'd like to __", and the participants responded as to whether they preferred the sentence with the first or last syllable stress on the nonword. In the word similarity task, the participants were asked to write down the real English words they considered to be phonologically similar to the 40 nonwords.

3. Results

3.1. Production Task

Four different kinds of syllabic structures were used: Type 1 (CVV CVCC), Type 2 (CV CVCC), Type 3 (CV CVC), and Type 4 (CV CVVC). They differed in the length of vowels and final consonant clusters. The 40 nonwords were produced in two sentence frames, one in the noun sentence frame, the other in the verb sentence frame. Since those nonwords were bi-syllablic words, it was expected that nonwords produced in the noun sentence frame would be more likely to have first syllable stress than nonwords produced in the verb sentence frame. If statistical generalizations about the distribution of main stress placement among lexical items have an effect on the placement of stress in novel words, then the lexical class should have a significant effect and nouns should receive more first syllable stress than verbs independent of the syllabic structures. For Figure 1, it presents the percentage of the first syllable stress for the 40 nonwords in four different syllabic structures in two sentence frames.

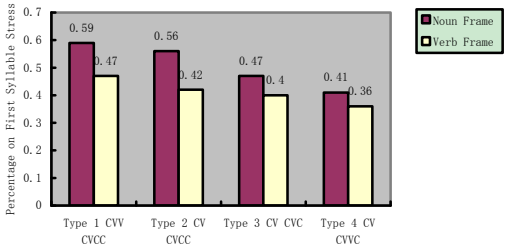

Figure 1： *Results of Production Task*

Obviously, the stress in the first syllables in noun frame was predominantly more than the stress in the first syllables in verb frame, no matter what the syllabic structure was. The first syllable stress in Type 1 (CVV CVCC) was slightly more than that in Type 2 (CV CVCC). It is the same case for Type 3 (CV CVC) and 4 (CV CVVC). Type 2(CV CVCC) received more first syllable stress than Type 3(CV CVC), which meant that even though Type 2 (CV CVCC) had the consonant cluster in the final syllable, the vowel in the first syllable still had stronger influence on stress placement.

F test was applied to test the effect of syllabic structure and lexical class. The results of the F test demonstrated that both the effect of syllabic structure and lexical class were significant, $F(3, 18) = 111.73$, $p<0.001$, and $F(1, 18) = 30.55$, $p<0.001$. The interaction between syllabic structures and lexical class was significant, $F(3, 18) = 40.18$, $p<0.001$. In the noun sentence frame, the effect of syllabic structure was significant according to the result of F test, $F(3, 18) = 5.82$, $p<0.001$. In the verb sentence frame, the effect of syllabic structure was also significant according to the result of F test, $F(3, 18) = 12.24$, $p<0.001$. The effect of the two lexical classes, noun and verb was investigated for the four different syllabic structures by F test. The results were $F(1, 18) = 20.87$, $F(1, 18) = 30.76$, $F(1, 18) = 57.24$, $F(1, 18) = 43.29$, respectively, indicating that all the effects were significant. However, nouns received more first syllable stress than verbs did.

3.2. Perception Task

The participants were asked to listen to the pre-recorded phrases in pairs four times with two stress types in two frames. They should indicate which one sounded more like a real English sentence. Figure 2 presents the percentage of the first syllable stress for the 40 nonwords in four different syllabic structures in two sentence frames.

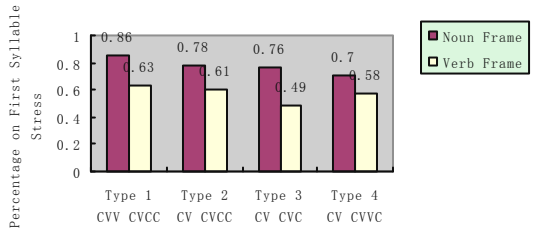

Figure 2: *Results of Perception Task*

First, in the four different syllabic structures, the stress in the first syllables in noun frame was more than the stress in the first syllables in verb frame, no matter what the syllabic structure was. The number of first syllable stress in Type 1 (CVV CVCC) was more than that in Type 2 (CV CVCC). The first syllable stress in Type 3 (CV CVC) was slightly more than that in Type 4 (CV CVVC). Unlike the results in production task, by comparing the percentage of first syllable stress in Type 2 (CV CVCC) and Type 3 (CV CVC), it was found that Type 2 (CV CVCC) only had a very small higher percentage. However, it still meant that even though Type 2 (CV CVCC) had the consonant cluster in the final syllable, the vowel in the first syllable still had stronger influence on stress placement. Second, nonwords in noun sentence frame were more preferred to have first syllable stress than nonwords in verb sentence frame. They scored 0.86, 0.78, 0.76, and 0.83 in four different syllabic structures. But in the verb sentence frame, they scored only 0.63, 0.61, 0.49, and 0.58.

The results of the F test demonstrated that both the effects of syllabic structures and lexical classes were significant, $F(3, 18) = 53.47$, $p<0.001$, and $F(1, 18) = 44.72$, $p<0.001$.The interaction between syllabic structure and lexical class was significant, $F(3, 18) = 62.36$, $p<0.001$. In the noun sentence frame, the effect of syllabic structure was significant according to the result of F test, $F(3, 18) = 5.63$, $p<0.001$. In the verb sentence frame, the effect of syllabic structure was also significant according to the result of F test, $F(3, 18) = 7.19$, $p<0.001$. The effect of the two lexical classes, noun and verb was investigated for the four different syllabic structures by F test. The results were $F(1, 18) = 9.25$, $F(1, 18) = 28.36$, $F(1, 18) = 38.45$, $F(1, 18) = 37.33$, respectively, indicating that all the effects were significant. However, nouns received more first syllable stress than verbs did.

The predictions made before for syllabic structures were consistent with the results. Syllables with long vowels had more stress than syllables with short vowels in words of comparable syllable structures (Type 1 had more first syllable stress than Type 2; Type 3 had more first syllable stress than Type 4). Additionally, heavy syllables with a long vowel and consonant tend to attract more stress than the syllables with a consonant cluster (Type 2 had more first syllable stress than Type 4). Syllables with short vowels and consonant clusters didn't attract more stress than syllables with short vowels and single consonants, because the result showed Type 3 < Type 2.

3.3. Word Similarity Task

410 out of 800 (40 nonwords x 20 participants) were produced. Most of them were bi-syllabic words (326 out of 410, namely 79.51% in this case); some were monosyllabic words; and there were also few tri-syllabic words, or exactly 34 out of 410 which is 8.29% in this case). For words with three syllables, the author coded the first syllable stress for stress on the first syllable and final syllable stress for stress on the second or third syllable. For every nonword that the participants heard, they were asked to write only one word they could think of. On average, the mean number produced by per participant was 20.5 out of 40 nonwords. The highest production was 40 and the lowest production was 3. The words produced were all kinds of words, which meant that the participants considered all different kinds of words to be phonologically similar words to the stimuli.

To investigate the relationship between known real English phonologically similar word stress patterns and nonword stress patterns, linear regression is applied to the data obtained from production task and perception task.(Table 1)

Table 1. *T-test of the Relationship between Phonological Similar Word Stress Patterns and Nonwords*

Task	Non-word	T Stat	Freedom	P-value	Confidence Level	Standard Error
Production	Noun	33.8883	18	0.000963	95%	0.095782
Production	Verb	27.3753	18	0.000528	95%	0.126118
Perception	Noun	72.5695	18	0.000356	95%	0.097332
Perception	Verb	46.7812	18	0.000323	95%	0.246831

English phonologically similar word stress patterns coded as having first syllable stress and the nonwords as nouns coded as having first syllable stress, the results indicate that there is a significant relationship between them ($p< 0.001$). The more first syllable stress words provided by the participants, the more first syllable stress they produced and perceived in the first and second task.

3.4. Analysis of the three factors

This paper investigated three factors affecting the English stress placement: syllabic structure, lexical class, and phonological similarity words. The analysis of each task above indicates that each factor affects the English stress placement. When the three factors come together, the contribution of each factor is also investigated. F test was used to investigate whether it is appropriate to add one or more than one variables in the multivariate regression model. This test is based on the analysis of the decrease of Sum of Squares due to Error (SSE) in the multivariate regression model when one or more than one variable are added. The following figure represents the analysis.

Table 2. *Regression Analysis of the Three Factors*

Variables	*SSE*	*Diff in SSE*	*F*	*P-value*
Original model	20.023	-	34.17	<0.001
Syllabic Structure	18.234	1.789	20.45	<0.001
Lexical Class	15.393	2.841	35.34	<0.001
Phonological Similarity	11.259	4.154	20.93	<0.001

When a variable is added, the SSE decreases significantly, and the F test proves that the contribution is significant. Phonological similar words have the greatest effect, $F=20.93$, $p<0.001$, and the next significant factor is lexical class, $F=35.34$, $p<0.001$, and syllabic structure has the least effect, $F=20.45$, $p<0.001$.

4. Conclusions

The aim of this paper is to investigate the factors that affect the English stress placement by English learners of Mandarin speakers who are English -majors. The three factors that had been investigated were syllabic structure, lexical class, and

phonological similar words. Through the experiment study, now we can answer the three questions.

Q1: Do the distribution of English main stress and the typological evidence indicate that heavy syllables tend to attract stress? Yes. In the production and perception task, heavy syllables with long vowels tend to be stressed more than syllables with short vowels, and heavy syllables with one short vowel and one consonant tend to attract more stress than syllables with two consonants, namely consonant clusters.

Q2: Do bi-syllabic nouns tend to have more stress on the first syllable while bi-syllabic verbs tend to have more stress on the second syllable? Yes. The results indicate that no matter what syllabic structure the nonword has, nonwords produced as nouns composed of two syllables were more frequently stressed on the first syllable than verbs.

Q3: Do the stress patterns of real words play a role in the stress assignment on new words? Yes. According to the analysis above, the stress pattern of phonologically similar words have the highest prediction than that of syllabic structures and the distribution of stress in lexical classes. Applying usage-based phonology in this paper, it can be inferred that the distributional stress pattern in real English words can be perceived and learned by human, and therefore be applied in novel words and affects the shaping of the form and the content of the sound. Thus, human's existing knowledge of stress pattern in different vowel and lexical classes, and phonological similar words could be included in human's generalization of statistical distribution.

In summary, several factors were found to uniquely affect main stress placement on bi-syllabic nonwords: lexical class (nouns attracted first syllable stress and verbs final), syllable structure (long vowels were especially found to attract stress) and the extension of the stress pattern of a phonologically similar word. Models of stress placement allowing multiple and potentially competing factors to play a role in stress assignment would be supported by the empirical results presented here.

5. Acknowledgements

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7. Appendix 40 nonwords used in the study

Type 1 CVV CVCC	**Type 2 CV CVCC**	**Type 3 CV CVC**	**Type 4 CV CVVC**
pie gist	pi gist	ba gap	wi good
bar minz	bi minz	gu gif	ga teit
bay bikt	bi bikt	bi wit	bou weip
toe fins	tu finz	ni sin	ni weel
gee wips	gouwips	ge lem	ge loin
dear gekt	de gekt	ki wet	ki wein
soo tist	sa tist	bou lis	loo lears
boy wups	be wups	koo lik	koo pine
nee gept	mi gept	tou fig	tou feik
toe pikt	ne gipt	doo giz	du tearf