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Research on the Impact of Word Stress on the Vowel System of English

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Abstract: Word stress is a fundamental aspect of English pronunciation that significantly influences comprehension in spoken communication. Despite its importance, many Chinese English learners find it hard to master the nuanced patterns of stress that distinguish stressed from unstressed syllables, particularly regarding vowel production, a topic studied by few researchers. Therefore, this study aims to explore the impact of word stress on the vowel system of English through an experimental analysis. Twenty disyllabic words with one stressed and one unstressed syllable were analyzed. Using auditory analysis software, the production of stressed and unstressed vowels by both native and non-native speakers was recorded, analyzed and then compared. Results indicate that native speakers produce stressed vowels with greater intensity and duration than unstressed vowels, while non-native speakers show less distinct differences.

Keywords: unstressed vowels, stressed vowels, duration, intensity.

1. Introduction

Word stress is a crucial yet often overlooked aspect of English pronunciation. Research has shown that word stress plays a pivotal role in spoken communication, affecting both speech clarity and vowel comprehensibility [1, 2]. Despite its importance, many Chinese English learners struggle to grasp the subtleties of stress, particularly in vowel production, a topic that has not been extensively explored in the literature [3]. In addition, compared with the research on English syntax and morphology learning, the research on English word stress is relatively lacking, especially the research on stress in the process of second language acquisition [4, 5]. This study is motivated by the need to fill this research gap and to understand how word stress impacts the vowel system of English and aims to contribute to the understanding of these relationships by examining the acoustic properties such as intensity and duration of stressed and unstressed vowels in native and non-native speakers. This paper focuses on the following two questions: Whether stressed vowels are produced with greater intensity than unstressed vowels, whether stressed vowels are produced with longer duration than unstressed vowels.

The data were collected as follows: participants were recorded while producing a predefined set of words with both stressed and unstressed syllables. The sample included 15 native English speakers and 1 non-native speaker. The recordings were then analyzed using Praat to compare the vowel production in stressed and unstressed syllables within and between groups. Findings of this study demonstrate how word stress influences the English vowel system, offering insights for improving pronunciation for both native and non-native speakers.

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2. Analysis of the Stressed and Unstressed Vowels

This chapter will analyze the stressed and unstressed vowels in three aspects, namely its intensity, duration and position.

2.1. Intensity of Stressed and Unstressed Vowels

Before the analyses of intensity between stressed and unstressed vowels, this study selects 20 words each with two syllables and has only one stressed vowel and unstressed vowel in order to conduct the analyses more conveniently and compare the data more easily. Then, praat was used to access the intensity of stressed and unstressed vowel of each word. Due to variations in participants' volume, the intensity difference between stressed and unstressed vowels was used to present the impact of word stress on the vowel system of English, which is more equatable. The chart below shows the Average Difference in Intensity between Stressed and Unstressed Vowels(dB).

Table 1: Average Difference in Intensity between Stressed and Unstressed Vowels(dB)

Word	Non-native Speakers	Native Speaker
about	0.97	3.89
again	2.12	6.18
canvas	4.98	3.37
better	6.40	4.57
climate	6.8	7.04
coffee	6.75	6.81
country	9.17	7.21
daughter	8.65	3.93
dollar	8.86	4.27
happy	7.28	4.14
journey	9	10.36
kitchen	5.62	4.17
lady	7.80	5.75
lesson	5	7.51
money	7.71	6.09
before	3.07	4.02
alarm	1.15	1.09
aside	2.39	4.98
berry	9.42	8.53
carpet	7.24	2.18

Table 1 indicates the average difference in intensity between stressed and unstressed vowels of both 15 non-native speakers and 1 native speaker are positive numbers, meaning that stressed vowels are produced with greater intensity than unstressed vowels.

2.2. Duration between Stressed and Unstressed Vowels

The same 20 words were used to analyze duration, with Pratt measuring the duration of each vowel. To account for variability in reading speed, the difference in the proportion of stressed vowel duration relative to total word duration was calculated.

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Table 2: Average Difference in the proportion of Duration between Stressed and Unstressed Vowels(%)

Word	Non-native Speakers	Native Speaker
about	28.4	29.4
again	24.8	9
canvas	4.54	6.3
better	6.2	16.2
climate	9.8	17.3
coffee	2.7	6.5
country	-0.1	8.2
daughter	14.2	19.2
dollar	18.3	25.2
happy	2.0	14.5
journey	16.6	11.1
kitchen	5.0	5.1
lady	16.7	19
lesson	6.9	4.2
money	11.2	6.8
before	18.6	16.9
alarm	21.6	40.1
aside	33.0	32.6
berry	17.3	12.3
carpet	11.0	14.3

Table 2 presents the average difference in duration between stressed and unstressed vowels of both 15 non-native speakers and 1 native speaker are positive numbers, meaning that stressed vowels are produced with longer duration than unstressed vowels.

2.3. Position of Stressed and Unstressed Vowels

This section examines how the position of stressed and unstressed vowels affects their intensity and duration differences.

2.3.1. Position and Intensity Differences

1)When the unstressed vowels are followed by stressed vowels, non-native speakers tend to produce a smaller difference in intensity between stressed and unstressed vowels, while native speaker shows a more significant difference. For example, ‘about’ is a word which unstressed vowel is followed by a stressed vowel. Its average difference in intensity of non-native speakers between stressed and unstressed vowel is 0.91, significantly lower compared to 3.89 for native speakers The result is partly because Chinese is a language which intensity is allocated evenly. Therefore, non-native speakers do not pay much attention to the different intensity between stressed and unstressed vowels. As a result, non-native speakers have to allocate the intensity appropriately, mainly focus on the stressed vowels.

2)When the stressed vowels are followed by unstressed vowels, non-native speakers often show a bigger difference in intensity between stressed and unstressed vowels than native speakers. For example, ‘daughter’ is a word which stressed vowel is followed by an unstressed vowel. Its average difference in intensity of non-native speakers between stressed and unstressed vowel is as high as 8.65 compared to 3.93 for native speakers. The result is also due to Chinese pronunciation. In Chinese,

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speakers are more likely to have a higher intensity at the beginning. Therefore, non-native speakers might mainly focus on the first syllable, which is the stressed vowels. However, too much difference in intensity between stressed and unstressed vowels in English production is not natural and native like. Thus, while speaking English, speaker has to strike a balance between their Chinese way of pronunciation and English stress on words.

2.3.2. Impact of Position of Stressed and Unstressed Vowels on Duration between Them

Additionally, there are also some differences in duration between stressed and unstressed vowels when their positions are different.

1) When unstressed vowels are followed by stressed vowels, speakers from both non-native speakers and native speakers tend to have a bigger difference in the proportion of duration between stressed and unstressed vowels. For example, the word ‘about’, ‘again’ and ‘aside’ have the highest difference in the proportion of duration between stressed and unstressed vowels in the category of non-native speakers, which are all words whose unstressed vowels are followed by stressed vowels. Likewise, the word ‘about’, ‘alarm’ and ‘aside’ have the highest difference in the proportion of duration between stressed and unstressed vowels in the category of native speaker, which are also words whose unstressed vowels are followed by stressed vowels.

2) When stressed vowels are followed by unstressed vowels, speakers from both non-native speakers and native speakers tend to have a smaller difference in the proportion of duration between stressed and unstressed vowels. For example, the word ‘coffee’, ‘country’ and ‘happy have the lowest difference in the proportion of duration between stressed and unstressed vowels in the category of non-native speakers, which are all words whose stressed vowels are followed by unstressed vowels. Similarly, the word ‘kitchen’, ‘lesson’ and ‘canvas’ have the lowest difference in the proportion of duration between stressed and unstressed vowels in the category of native speaker, which are words whose stressed vowels are followed by unstressed vowels as well. However, compared with native speaker, non-native speakers tend to have a lower difference in duration between stressed and unstressed vowels. This is a common problem of many Chinese English learners, they tend to extend their sound, which is not the feature of English. Therefore, learners should learn to end quickly if the stressed vowel is followed by an unstressed vowel.

3. Factors Influencing the Realization of Stress in Non-Native Speakers

3.1. First-Language Influence

First-language (L1) influence is another critical factor that can affect the stress patterns of non-native speakers. Speakers tend to transfer L1 phonetic and phonological rules of to their second language (L2), leading to deviations from the native-like stress patterns. The influence of the native language on non-native speakers' English stress patterns is a complex phenomenon. Gilbert’s study on the role of the native language in the development of English stress patterns among Dutch learners suggests that the syllable structure characteristics of the native language may affect learners' perception and production of English stress, which can also be found in differences observed in this study about non-native speakers' production of English stress [6]. Chinese speakers are more likely to perform a higher intensity at the beginning of each word. Therefore, non-native speakers might mainly focus on the first syllable, which is the stressed vowels, and this obvious difference in intensity between stressed and unstressed vowels in English production may be strange to native speakers.

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3.2. Frequency of Word Use

High-frequency words show similar stress patterns across both speaker groups. For instance, ‘lesson’ and ‘about’ are high-frequency words, and both the difference in intensity between stressed and unstressed vowels and the difference in duration between stressed and unstressed vowels of native and non-native speakers are quite similar. ‘Lesson’ has a difference in intensity between stressed and unstressed vowels of 5 in non-native speakers category and 7.51 in native speakers category. Similarly, the word ‘about’ has a difference in duration between stressed and unstressed vowels of 6.9 in non -native speakers category and 4.2 in native speakers category.

3.3. Phonetic Simplicity of Word

The phonetic simplicity of words can also play a role in stress production. Words with simpler syllable structures are easier to process and produce, which may lead to more accurate stress placement. Words like ‘before’ and ‘lady’ revealed that non-native speakers were able to approximate the native stress pattern more closely, possibly due to the simplicity of these words' phonetic structures. For example, the word ‘before’ has a difference in intensity between stressed and unstressed vowels of 3.07 in non-native speakers category and 4.02 in native speakers category. Similarly, the word ‘before’ has a difference in duration between stressed and unstressed vowels of 18.6 in non -native speakers category and 16.9 in native speakers category.

4. Conclusion

This study provides a deeper insight into production of stressed vowels and unstressed vowels among non-native speakers and notice speakers. The analysis, centered on intensity and duration, reveals that stressed vowels are consistently produced with greater intensity and longer duration by both groups, indicating the fundamental role of stress in English vowel articulation. However, Non-native speakers, particularly those influenced by their L1, often failed to produce more natural stress distinctions native speakers make, especially in intensity allocation and duration control.

The study's limitations include a small sample size(15 non-native speakers and one native speaker), which restricts generalizability. Future research should aim to broaden the participant pool and explore according language pedagogy to capture a more comprehensive understanding and effective teaching of stress patterns in English.

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