Error Analysis of English Pronunciation Acquisition by Chinese Non-English Majors

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Abstract: Chinese non-English majors are a large group of English learners. In the process of English pronunciation acquisition, issues such as incomplete phonological knowledge, transfer of mother tongue, and overgeneralization, lead to confusion of phonemes and stress, misunderstanding of syllable structure, and errors of assimilation, drop, and epenthesis. The accuracy of English pronunciation can only be improved by knowing both English and Chinese phonological systems, strengthening the teaching of English phonological knowledge, and adopting various phonological training activities.

Keywords: English pronunciation acquisition; Non-English majors; Error analysis; Investigation; Second language acquisition

1. Introduction

Language is a symbolic system that combines sound and meaning, and pronunciation is the material shell of language, which is the material means for a language to realize its social function [1]. English pronunciation acquisition is an important part of learning English, which determines whether the learners can speak English well, and relates to whether the combination of sound and meaning can successfully express their thoughts. Therefore, topics on how to promote the efficiency of second language pronunciation acquisition and explore the factors affecting pronunciation acquisition, as well as how to improve the teaching level of English pronunciation and learners' English proficiency have been attracting the interest of researchers.

From the current research situation, many scholars at home and abroad have discussed second language pronunciation acquisition from the aspects of cultural identity, learning style, mother tongue influence, and teaching method. Gatbonton *et al.* [2] investigated the relationship between racial group affiliation and second language pronunciation accuracy. They found that second language learners, on the one hand, try to reach the pronunciation level of the target language, and on the other hand, they keep the native language due to the pressure of the racial group. It suggests that learners' accents are related to their ethnic group affiliation. The prosody of the native language has a strong influence on the acquisition of English stress patterns [3]. Adults' English pronunciation is more influenced by their mother tongue than that of children and adolescents

[4]. Gorsuch [5] found that subjects' suprasegmental listening improved, while suprasegmental articulation did not improve based on output pronunciation training. Native Cantonese ESL (English as a Second Language) learners who have difficulty in pronouncing word-initial consonant clusters generally do not add sounds but use omission and substitution [6]. Zhao and Jin [7] found that the use of multimedia technology in a spoken language class of English major can significantly improve students' pronunciation proficiency.

These studies have discussed in-depth pronunciation acquisition of L2 from different perspectives, but none of them has addressed a large population of English learners in China, namely, Chinese non-English major college students, with more than 35 million students enrolled in schools. With the continuous development of China's communication with the world, all kinds of talents who are able to communicate in English have become a need for the development of all walks of life in China. Therefore, exploring the English acquisition status of this huge group of individuals, especially the ways and devices of pronunciation acquisition, is of great practical significance and theoretical construction value for China's socioeconomic development and the disciplinary research of language cognition. This study focuses on this perspective and examines the status of English pronunciation acquisition of non-English major college students through classroom observation, pronunciation tests, and case studies, aiming to answer the following two questions:

(1) What are the modes and mechanisms of English phonological acquisition of non-English major college students?
(2) What are the causes of errors in English speech acquisition among non-English major college students?

2. Research methods

2.1. Research subjects

The participating subjects in this study were 36 students in their first year of university majoring in mechanics at a university in Shaanxi Province. They were subjected to classroom observation, phonological tests, and case studies of English phonological acquisition. Among them, 29 were male and 7 were female; they came from 15 provinces, including Zhejiang, Sichuan, Jiangxi, Henan, Gansu, and Shaanxi; their ages ranged from 19 to 21 years old, and Chinese was their native language. All subjects had been learning English for more than eight years, and their reading and writing competencies were higher than their listening and speaking skills. There were also three students who participated in the case study (**Table 1**), and their English phonological acquisition was as follows:

(1) They relied on the pattern of audio-visual and then imitation to learn phonetics.
(2) They had a certain degree of expressive ability in English and were able to communicate with people in daily life, but the accuracy of their pronunciations was weak.
(3) They did not pay enough attention to the learning of English phonetics, and they did not take the initiative to receive phonological training.

Table 1. Subjects' background information for the case study

Name	English proficiency	Gender	Age	Major	Grade
Subject 1	Medium level	Male	18	Mechanics	Freshman
Subject 2	Medium level	Male	19	Mechanics	Freshman
Subject 3	Medium level	Male	18	Mechanics	Freshman

2.2. Research instruments

This study used classroom observation, phonological tests, and case studies to investigate the English phonological acquisition status of Chinese non-English major college students. Classroom observation was conducted mainly in the subject's college English classroom once a week for two months.

The phonological tests covered the entire English phonological system, including phonetics, phonemic, syllables, words, phrases, sentences, and parts of speech (**Table 2**). The test focused on the phonemic, stress, and flow variation of the English language. Prior to the formal test, subjects were given 10 minutes to familiarize themselves with the phonological material, and the formal test was limited to 20 minutes to complete all the phonological readings. Below is a portion of the corpus for the test:

(1) phonemic: [ə:], [ə], [ɑ:], [ʌ], [e], [æ], [ɛə], [uə], [iə], [au], [əu]
(2) word: look, lack, flower, month, opportunity, refuse, hour, crown, louder
(3) phrase: as in see, as in here, another land, farmer Barnes, harbors and farms, a soft song, looked at it, a new suit, huge spoons, one month, a sudden jump, a firm girl, an hour and a half
(4) stress: 'avenue, 'practical, 'opportunity, re'fuse, uni'versity, 'pupil, 'duty...
(5) liaison: handsome is... / for half an hour... / in the first and... / looked at it as long as... / he is best of all...

Table 2. Content of the English phonetics test

	English phonemic		Phrase	Sentence	Text
	Vowel	Consonant			
Number(s)	20	28	16	10	328

The case study was a one-month follow-up of three subjects with the aim of exploring their previous patterns of speech acquisition and speech acquisition devices under the researcher's standard English speech intervention. During this period, a phonological test and a post-test retrospective interview were administered to the subjects. When the subjects' English speech errors were found, the researcher explained the place and the manner of speech, and performed the correct demonstration, so as to understand the problems of non-English majors in English speech acquisition through this process of error correction.

2.3. Data collection

Information on the frequency of interaction, length of utterances, phonemic articulation, lexical stress, sentence intonation [8], and semantic expressiveness of non-English majors college students in the English classroom was collected through classroom observation, and detailed classroom records and live video were carried out.

In order to ensure the reliability of the phonological tests and to obtain reliable data for the study, the tests were administered by the English lecturers of these subjects. The testing location was set up in a quiet multimedia classroom so that a computer could be used to accurately recognize and record each voice of the subjects. Subsequently, the collected audible English speech data were compared and categorized with the British Standard Pronunciation (Received Pronunciation or RP). Ten subjects were also randomly interviewed in depth about their specific performance in the English test in order to understand the status of their English speech acquisition.

The data for the case study came from the researcher's speech interactions with the three subjects, in order to record and detect the ways and mechanisms of their speech acquisition.

2.4. Data analysis

Suenobu *et al.* [9] categorized speech errors into six types, including vowel addition, vowel substitution, consonant substitution, consonant drop, stress error, and pause error. Based on this, the framework for analyzing the data in this study was set to the following five categories:

(1) Additive phonological error: It refers to the addition of a phonological sound that was not there, e.g. reading please (/pli:z/) as /pə'li:z/ and adding a vowel /ə/ that was not there.

(2) Substitution-type phonological errors: It refers to the mispronunciation of one speech sound as another, e.g. mispronouncing think /θink/ as /sink/.

(3) Dislocation phonological errors: It refers to the omission of a phonological sound that should be there, e.g. mispronouncing parade (/pə'reid/) as /pə' rei/, leaving out the stop consonant /d/.

(4) Stress error: It refers to the failure to rephrase some words or syllables in speech so that they do not sound louder than the surrounding words or syllables. For example, hospital is mispronounced as /hɔs'pitəl/, when in fact the stress is on the third last syllable, which should be /'hɔspitəl/.

(5) Phonological rheological error: It refers to the wrong handling of assimilation, liaison, voicing, and devoicing in normal speech communication, e.g. the phrase "next door" is not liaison to /nekstˈdɔ:/, and the phoneme /t/ is not loss of plosion; the phoneme /k/ in the word "discover" (/di'skʌvə/) is to be voiced as /g/, which is to be pronounced as /di'sgʌvə/.

Data analysis is divided into the following steps: Firstly, the researcher carefully verified and recorded each case of phonological errors based on the subjects' English phonological performance presented in classroom observations, phonological tests, and case studies in comparison with the British Standard Phonology; secondly, the errors were categorized according to the English phonological error analysis framework established above; subsequently, the frequency of each type of error was counted and the phonological contexts in which each type of error appeared and the status of their acquisition were explored.

3. Discussion

Through an empirical study of classroom observation, phonological testing, and case studies, we discussed and analyzed the status and errors of non-English major university students in English phonological acquisition in terms of English phonemic acquisition, stress acquisition, and sandhi in English.

3.1. English phonemic acquisition

A phoneme is the smallest unit of speech that can distinguish the meaning of two words in a language. A phoneme can be recognized using the minimal pair test, where a word is taken and one of its phonemes is replaced to see if it produces a different meaning [10]. For example, if /b/ is replaced with /p/ in the word "ban" (forbidden), then the word "ban" becomes the word "pan" (pan), and the meaning of the word changes, thus /p/ and /b/ are distinctive phonemes. Similarly, in the words "ban" and "bin," only the vowels /i/ and /æ/ are different, so /i/ and /æ/ are also different phonemes. The number of phonemes varies from language to language. For example, English has 48 phonemes, with 20 vowels and 28 consonants. French has 36 phonemes. Mandarin Chinese has a total of 60 consonants and rhymes.

In this study, through the English short-text reading test, it was found that non-English majors college students have a certain number of phonemic addition, phonemic substitution, and phonemic dislocation errors in English phonemic acquisition (**Table 3**). Particularly, there were numerous vowel substitution errors, accounting for 37%, and relatively fewer consonant dislocation errors, accounting for 15%. The main reasons for these errors are English phonemic confusion, poor understanding of the concept of allophone, and the

negative transfer of Chinese phonology.

Table 3. English phonemic acquisition errors

Type(s)	Vowel addition	Vowel substitution	Consonant substitution	Consonant dislocation	Total
Number(s)	145	181	92	76	494
Proportion	29%	37%	19%	15%	100%

3.1.1. English phonemic confusion

English speech can be divided into vowels and consonants according to whether the airflow through the mouth or nasal cavity is obstructed [11]. Vowels are classified into unitary and sliding vowels according to their sound quality, and sliding vowels include diphthongs and triphthongs. English consonants are further classified based on their mode of articulation into stops, fricatives, stop-fricatives, nasals, passes, lingual margins, and flashes; and according to their place of articulation into bilabial, labiodental, dental, alveolar, postalveolar, curly-alveolar, hard palatal, soft palatal, and voiced consonants.

In the case study, it was found that non-English major college students had phonemic confusion in the acquisition of these English phonemes. In the short-text reading test, many phonological substitution errors occurred. For example, many subjects confused the nasal /n/ with the velar /l/, often replacing the phonemic /l/ with the phonemic /n/; they would mispronounce the word "nick" /nik/ as /lik/, and the word "nice" /nais/ as /lais/; there were also many students who could not tell the difference between the alveolar /s/ and the dental /θ/, and they always pronounced than /θæŋks/ as /sæŋks/, and mispronounced things /θiŋ/ as /siŋ/. Some students also added extra speech sounds after a phoneme, for example, when reading aloud the sentence: "So I'm walking down the street, people are saying no picture, no picture." When reading the word "picture" at the end of a sentence, it would be mispronounced as /'pi:iktʃə/, and a long vowel /i:/ would be added after the phoneme /p/.

In terms of English vowels, many subjects were also unable to pronounce them in a standard way. In reading aloud, English words such as the following, "flower, hear, here, month, mow, island, iron, crown, louder, houses, and howl" showed errors in vowel pronunciation. It was learned through interviews that they had not yet acquired the pronunciation of English diphthongs correctly, such as [ɔi], [ai], [ɛə], [uə], [iə], [au], [əu], and problems such as "put the boot on the wrong leg" and "mispronunciation" were often observed. Therefore, phonemic confusion in phonological acquisition is an important cause of English mispronunciation.

3.1.2. Poor understanding of allophone

Allophone refers to the fact that the same phoneme is pronounced differently in different phonological contexts. For example, the English phoneme /p/ is pronounced differently in the words "put" and "span," where /p/ in the word "put" is aspirated and is transcribed phonetically as [pʰut] in the narrow transcription; in the word "span," /p/ is non-aspirated and its phonetic transcription is [spæn]. The phonological rule is that the phoneme /p/ is non-aspirated after the phoneme /s/ and is aspirated in all other positions. Both the aspirated [pʰ] and non-aspirated [p] are allophones of the same phoneme /p/. In the case study of this research, it was found that non-English majors college students were confused in terms of allophones about how to pronounce a phoneme correctly in a specific phonological context. For example, in the phonological test, many subjects did not know the allophone of the phoneme /l/, as in the following sentence: "While telling the story, he worked in a few jokes to make his listeners laugh." Most of the subjects mispronounced the word "telling" in the sentence, equating the phonemic /l/ in "telling" with the /l/ in the word "tell." That is to say, when producing the velar sound /l/, the tongue curls towards the soft palate at the back of the mouth, which is similar to the character of

the curled tongue and resembles the way of pronouncing the character "□" (*shu*, book) in Mandarin Chinese, which is called velarization in phonetics. Phonetically, the phonetic change of the phoneme /l/ is labeled as [ɫ], which is phonetically called "dark l."

In the word "telling," however, the phoneme /l/ is not pronounced as "dark l," but as a "clear l" (labeled [l], which refers to the sound made when the airflow forms an incomplete closure with the palate on one or both sides of the tongue). There are two reasons for this. On the one hand, the English phoneme /l/ has a phonological rule that it is pronounced with a fuzzy tongue-side sound [ɫ] (dark l) when it follows a vowel phoneme, as in the words "deal" and "milk," and with a clear tongue-side sound [l] (clear l) when it precedes a vowel phoneme, as in the words "look" and "lead." In the word "telling" /ˈteliŋ/, the phoneme /l/ appears both in front of the vowel /i/ and behind the vowel /e/. Thus, it cannot be judged quickly whether the phoneme /l/ is pronounced "dark l" or "clear l" at this point. On the other hand, according to the phonological maximal onset principle (MOP), which states that a consonant should be placed at the beginning of a syllable rather than at the end of a syllable, the phoneme /l/ in the word "telling" /ˈteliŋ/ should belong to the beginning of the second syllable /liŋ/, and the phoneme /l/ appears before the vowel /i/, so the phoneme /l/ in the word "telling" should be pronounced "clear l" [l] rather than [ɫ]. As many subjects were not aware of the allophone of /l/, phonemic mispronunciations occurred.

3.1.3. Negative transfer of Chinese phonology
Language transfer is the effect of one language on another language, including positive and negative transfer. Phonology, as one of the forms of language expression, is often associated with both positive and negative phonological transfer in the process of second language acquisition [12]. Negative transfer, also known as "interference," is caused by the influence of the rules of the mother tongue in the process of the second language acquisition, resulting in errors in the second language expression. For example, when a French person who learns English says "Je suis ici depuis dimanche," he will make a tense error when he expresses it in English, such as "I am here since Sunday"; or in English pronunciation, this French learner unconsciously pronounces the English phoneme /r/ as the French velar /r/.

In this study, it was found that for non-English major college students whose native language is Chinese, there are many phenomena of negative phonological transfer in English phonological tests. It is specifically manifested in the following aspects.

Firstly, English stops such as /p/, /b/, /t/, /d/, /k/, and /g/ are pure consonants, and some students misread them as the "yunmu" (initial consonant of a Chinese syllabus) "p, b, t, d, k, g" in the phonics test. However, the Chinese syllabus is not a combination of consonants and vowels. When "shengmu" and "yunmu" are combined to form a syllable, the vowels added after the consonants must be removed. In fact, "Pinyin" in Mandarin is purely consonant. Because of the "yunmu", some students then misread the word "cup" /kʌp/ as /kʌpuː/, the word "black" /blæk/ as /bəlækə/, the word "but" /bʌt/ as /bəʌtə/, and the word "bird" /bəːd/ as /bəːdə/.

Secondly, it was learned from the interviews after the phonological test that some subjects found it difficult to pronounce the fricative /ʃ/ and the velar /tʃ/ and /dʒ/ in the English phonemes. When they pronounced the fricative /ʃ/ and the velar /tʃ/ and /dʒ/, they simply substituted the pronunciation of "x, q, and j" in Mandarin (Pinyin) for the pronunciation of the English phonemes /ʃ/, /tʃ/, and /dʒ/. For example, when they pronounced the word "cheese," they mispronounced the phoneme /tʃ/ as the Mandarin's "yunmu" "q"; when they pronounced the word "orange," they mispronounced the phoneme /dʒ/ as the Mandarin's "yunmu" "j." This negative transfer of Chinese phonology seriously affects the correct pronunciation of English.

In addition, there is no contrast between long and short sounds in Chinese phonology, while there is

a difference between long and short vowels in English, thus many subjects are influenced by the Chinese language and pronounce the long sounds in English as short sounds, such as mispronouncing the word "beat" /biːt/ as "bit" /bit/, the word "peach" /piːtʃ/ as another word "pitch" /pitʃ/, the word "heart" /hɑːt/ as another word "hut" /hɑːt/. Therefore, the negative transfer of Chinese phonology has led to many substitution or additive phonological errors in the English phonemic acquisition of non-English major college students.

3.2. Stress acquisition

Stress is the pronunciation of a word or syllable with more force than the surrounding words or syllables, and refers to the intensity of the speech force that generates the syllable. It is manifested in the fact that when pronouncing a stressed word or syllable, the lungs need to deliver more air, and it is also louder to hear, higher in pitch, and longer in duration. The difference between syllables often lies in the stress and non-stress, with the more stressed syllables being the primary stress and the relatively weaker stressed syllables being the secondary stress, such as in the word "epiphe'nomenal," where the primary stress is on "-no-," the secondary stress is on "epi-," and the rest of the syllables are non-stressed syllables. Moreover, the stress of each English word is determined and the position of the stress is regular. For monosyllabic and disyllabic words in English, the first syllable is usually stressed; for multisyllabic words, the third last syllable is usually stressed. In the classroom observation of this study, many students faced the situation of stress mispronunciation. For example, "'opportunity, 'refuse, hos'pital, prac'tical, mo'del, con'cert" and so on. Therefore, we examine the errors of non-English major college students in English stress acquisition from three aspects: word class stress, stress-word meaning relationship, and syllable structure.

3.2.1. Ambiguity of word class stress

According to the grammatical features, semantic features, and quantitative variability of vocabulary in language, we divide English word classes into grammatical words and lexical words. Grammatical words mainly refer to the class of words that participate in the structure of phrases, clauses, composite sentences, and even parts of speech, including conjunctions, prepositions, articles, and pronouns. Vocabulary words are mainly used to refer to the substance, action, and nature of this class of words, including nouns, verbs, adjectives, and adverbs and so on. In everyday verbal communication, not all words are pronounced equally loudly; some words are spoken softly and quickly and more ambiguously, while others are spoken heavily and slowly and more clearly.

According to the law of English word stress, the words that need to be stressed in discourse communication are usually lexical words, such as nouns, verbs, adjectives, adverbs, number words, etc. and those that do not need to be stressed are mostly grammatical words, such as articles, conjunctions, prepositions, and exclamations.

In this study, when the subjects were given a phonological test on word class stress, many students could not distinguish on which word need to be stressed. Some examples are shown in the following sentence's stress.

(1) The streets are wide and clean. I like to walk around.

In this sentence, <u>streets</u> is a noun, <u>wide</u> and <u>clean</u> are adjectives, <u>like</u> and <u>walk</u> are verbs, and <u>around</u> is an adverb; they need to be stressed; <u>the</u> is a coronary, <u>are</u> is a weak verb, <u>and</u> is a conjunction, <u>I</u> is a pronoun, and <u>to</u> is an auxiliary; they are not stressed.

(2) I am so glad to see you again. We haven't seen each other in ten years.

In this sentence, "so, glad, see, again, haven't, seen, each other, ten years" should be repetitively stressed, while "I, am, to, you, We, in" are not.

The subjects were asked to read the above two sentences three times, and it was found that the parts of

speech and syllables were stressed differently each time; some students would stress any word in the sentence casually, sounding high and low, and not caring at all about the expression of the meaning of the sentence or the focus of the discourse. Some students stressed all the words in a sentence, like a robot talking in a cartoon.

Therefore, from the beginning of recognizing an English word, we should know their parts of speech, semantic meaning, and the place of syllable stress, so that these word stress mistakes will not be made in future foreign language communication.

3.2.2. Stress-word meaning relationship

Stress is mainly related to sound force as well as pitch and length, and belongs to the suprasegmental phoneme. Due to the influence of the stress pattern, the difference in the place of the word stress will cause changes in the meaning of the word, which has an obvious discriminant function. In the case study, when students read aloud the words "import" and "record" in the following two sentences, their stresses were placed on the first syllable, resulting in semantic errors.

(1) The country im'ports most of its raw materials.

Cheap foreign 'imports should be restricted.

(2) Historians re'cord how Rome fell.

The airline has a bad safety 'record.

In English vocabulary, there are some disyllabic verbs that change from verb to noun or adjective, the stress distribution pattern of the verb changes from /-'-/ to stress distribution pattern of the noun or adjective /'—/, and its lexical meaning also changes. For example, the word "con'vict" /kən'vikt/ with the stress on the second syllable is a verb, means "convict somebody of a crime"; if the stress is on the first syllable, it is a noun, meaning "criminal." Similarly, the word "in'sult" with the stress on the second syllable is a verb, means "to abuse." If the stress is on the first syllable, it is a noun, meaning "scornfulness."

Similar instances like: pro'duce (v. to make), 'produce (n. product, farm produce, industrial produce); re'bel (v. revolt), rebel (n. refers to someone who revolts); con'duct (v. insult), 'conduct (n. morality). So, the words "import" and "record" in the reading test above are verbs in their first sentences, and the stress should be on the second syllable. In Mandarin Chinese, there is also a phenomenon of changes in the meaning caused by changes in sounds stress, such as " 大爷 " (*daye*), " 大麻子 " (*damazi*), " 火烧 " (*huoshao*).

In addition, the change of the place of sentence stress will also cause the change of the sentence's meaning. Sentence stress means that the stress falls on the semantically important words in the sentence. For instance, the conversational implicature depends on the speaker's pointing, that is to say, it depends on which cluster or level the speaker chooses to place. For example, in the sentence "I know you can play badminton," stress on different words or levels brings different meanings.

(1) **I** know you can play badminton. (The others do not know that you play badminton.)

(2) I **know** you can play badminton. (You have to stop hiding things from me.)

(3) I know **you** can play badminton. (I do not know if others can play badminton.)

(4) I know you **can** play badminton. (Why do you say you cannot play badminton?)

(5) I know you can **play badminton**. (I do not know if you play other sports.)

Therefore, ignoring English lexical stress and sentence stress placement can produce difficulties in semantic output.

3.2.3. Ambiguous concept of syllable structure

Syllable is an important element in the characteristics of a suprasegmental segment, which is a phonological

unit that describes muscular tension in the articulatory organs and the increase or decrease of the loudness of speech. A syllable consists of an onset and a rhyme. Rhyme consists of nuclear and coda. The nuclear of a syllable is usually a vowel, and an onset and a coda are consonants, as shown in the syllable structure in **Figure 1**.
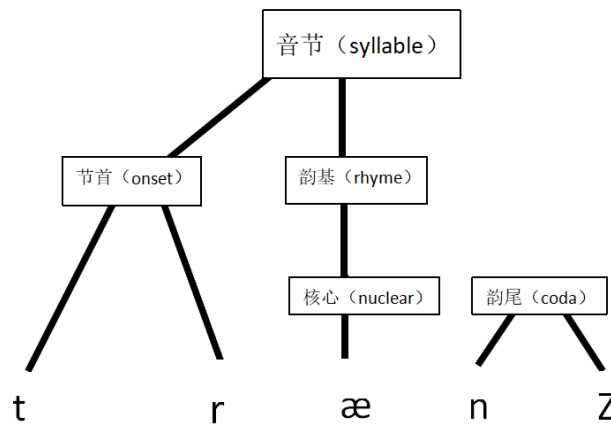

Figure 1. Schematic diagram of the syllable structure

All syllables must have a nuclear, but not all syllables have an onset and coda. Syllables without a coda are open syllable and syllables with a coda are closed syllable. In any language, only one part of speech is allowed in the syllable composition, and no other part of speech is allowed [13]. Therefore, the common syllable structures in English are "CCVC" (where C is short for the consonant; V is short for the vowel), such as black, class; "VCC" such as each, arm; "CVC" such as bag, but; "V" such as eye, a; "CV" such as go, tie; and "VC" such as am, at [14]. In English, a word might be a monosyllabic word like "cat, book," etc., or a polysyllabic word like "linguistically, circumstances," etc. Stress in English words generally falls on stressed syllables, so not every syllable is stressed. If the word is stressed, only the vowels in the syllable are stressed.

In the case study, the subjects were instructed to read the following sentence: "I understand the concept of the theory but I'm not sure about its details." It was found that the subjects could not pronounce the word "concept" /'kɔnsept/ correctly in the sentence. Then, when the subjects analyzed the syllable structure of the word "concept," there were incorrectly two-syllables divisions as /kɔns/-/ept/ and /kɔnse/-/pt/, even three-syllable division as /kɔ/-/nse/-/pt/. Since the subjects were not able to parse the syllable structure correctly, they uttered multiple word stresses for the word "concept" such as /kɔn'sept/, /kɔnse'pt/, /'kɔnsep't/, /kɔn'sep't/. Plus, errors of stressing consonants also occur.

After the interviews, it was learned that the subjects could not make the correct division of the word "concept," lied in two syllables /kɔn/ and /sept/, and they were not sure on which syllable to stress. It reflects the insufficiency and lack of knowledge of the syllable structure of English for non-English majors college students, and it also led to a lot of stressing errors in their daily communication.

3.3. Sandhi in English

Sandhi is a certain change in the pronunciation of one of the speech sounds after the pronunciation of a language unit has entered speech due to the influence of various factors of the preceding and following speech [15]. Common sandhi includes assimilation, dissimilation, weakening, losing, and so on. In this study, the subjects made many errors in phonological assimilation, phonological losing and addition. For instance, the phrase "pick it up" was not liaison to /pikitʌp/, and the first /t/ in the adjective phrase "qui(t)e different" did not lose the plosion, and /sk/ in the word "skate" /skeit/ was not voiced. Therefore, we explore the errors made by non-

English major university students in sandhi in terms of phonological assimilation, phonological losing, and phonological addition.

3.3.1. Lack of assimilation

Assimilation is a phonetic change in which a speech is affected by a neighboring speech and becomes similar to the neighboring speech. The phenomenon of assimilation is relatively common in spoken language, mainly in rapid and relatively casual discourse. According to the direction of assimilation, assimilation can be divided into progressive assimilation and repressive assimilation. If A represents the preceding sound and B represents the post sound, then the sound change that occurs in B due to the influence of A is called progressive assimilation; if the sound change that occurs in A due to the influence of B is called regressive assimilation.

In the phonological test, the alveolar nasal /n/ in the word "man" is not repressive assimilation when the subject reads the sentence "The man [ŋ] keeps the key to the lock." It is known that the students did not know much about the assimilation of the consonant /n/ that occurs before the soft palatal sound /k/ or /g/, to the soft palatal sound /ŋ/ (such sandhi in the phonology called "velarization"). In lexical reading, some subjects misread the word "open" /ˈəʊ pm/ as /ˈəʊ pn/, and the word "happen" /ˈhæpm/ as /ˈhæpn/. Such errors result from that they did not know the phonological rule: the nasal /n/ is assimilated to the bilabial nasal /m/ when it occurs after bilabial consonants /p/ and /b/ in the process of sandhi.

Particularly in the devoicing process in English, students knew little about this assimilation. They commonly mispronounce the phrase "five times" as /faivtaimz/, and mispronounce the verb phrase "disturb to" as /diˈstəːbtə/. **Table 4** shows the devoicing process.

Table 4. English phonological assimilation: The process of devoicing

five times	[fai**v**taimz]→ [fai**f**taimz]
disturb to	[diˈstəː**b**tə]→[diˈstəː**p**tə]
has to	[hæ**z**tə]→[hæ**s**tə]

Voiceless sound is the sound produced by not vibrating the vocal cords when pronouncing a word, and devoicing is actually the process that a voiced sound becomes a voiceless sound. Taking "five times" as an example, devoicing follows the rule that when a voiced consonant /v/ encounters a voiceless consonant /t/, the voiced consonant /v/ will become its corresponding a voiceless consonant /f/ (pairs of voiced and voiceless consonants in English include f, v; s, z; θ, ð; ʃ, ʒ; tʃ, dʒ), and such an assimilation of sandhi is called devoicing. Hence, the phrase "five times" /faivtaimz/ is pronounced as [faiftaimz]. This rule can be abbreviated as:

Voiced sound→Voiceless sound /__ voiceless sound

(the slash "/" indicates the circumstance in which the sandhi was produced and the horizontal line "_" indicates the location of the target segment)

This rule is expressed as follows: when a voiced sound precedes a voiceless sound, the voiced sound is transformed into the corresponding voiceless sound. Therefore, the voiced consonants /b/ and /z/ in "disturb to" and "has to" become the corresponding voiceless consonant /p/ and /s/ for they are both followed by the voiceless consonant /t/. The students did not know much about the devoicing rules, which leads to stiff pronunciation and poor language use. Therefore, without mastering the sandhi rules in English, they will pronounce unclear and awkward sounds.

3.3.2. Phonological losing

Phonological losing is the omission of one or several sounds for convenience in a coherent discourse, hence, also called omission. Such an omission sometimes occurs within a word or at word-to-word connections. Phonological losing occurs mainly in rapid and random words flow. Phonological losing can be divided into two categories: historical phonological losing and contextual phonological losing [16]. Historical phonological losing is the omission of some phonological sounds that have been inherited from history, such as the silent letters of some words, for example:

    (1)   Losing phoneme /b/: bomb, climb, lamb

    (2)   Losing phoneme /s/: island, isle

    (3)   Losing phoneme /t/: castle, listen

    (4)   Losing phoneme /k/: knight, knife

Contextual phonological losing refers to a phenomenon of omitting a consonant in conversation, such as "ge(t) through, sto(p) talking, a bi(g) zoo, re(d) flags."

In the case study, it was found that the subjects pronounced the sounds that should have been a historical phonological losing, such as misreading the word "island" /ˈailənd/ as /ˈaizlənd/ and added the phoneme /z/ that should be omitted. Same mistake appears in the word "castle" /ˈka:sl/ and the word "knight" /nait/, the subjects misread as /ˈka:stl/ and /knait/. In the pronunciation test, there are many students who mispronounced the adverbal phrase "after all" /a:ftərɔ:l/ as /a:ftə ɔ:l/, and the verbal phrase "stir up" /stə:rʌp/ as /stə: ʌp/. They had no awareness that the phoneme /r/ is not pronounced at the end of the word, but when it is followed by a word that starts with a vowel, it must be pronounced. That is why we pronounced the word "here" as /hɪəra:/, not /hɪə a:/. In addition, when reading the sentences, the subjects also mispronounced the abbreviated forms of the words, such as reading "I'm" as " I am" , "he's" as " he is", "can't" as "cannot", and adding the phoneme /æ/, /i/ and /ɔ/ that should be lost. Therefore, phonological losing is a phonetic phenomenon that often occurs in the sandhi of words flow. Non-English major college students who do not understand the law of phonological losing will make these mistakes.

3.3.3. Overgeneralization

Overgeneralization is a common phenomenon in second language acquisition. It means that learners extend the use of the rules of a language item to an area that it should not be [16], including adding "-er" to all comparative adjectives. For example, the wrong addition of "-er" to the end of the word "beautiful" indicates the comparative "beautifuler," but the comparative form of a polysyllabic adjective is preceded by "more."

In this case study, many subjects made the mistake of overgeneralization by pronouncing [z] to all plurals ending in "-s" when reading the following sentence: "There are many books, magazines, papers, journals, pictures, desks and couches in the library." In fact, the correct pronunciation of plural nouns in a sentence is as follows:

    (1) books   /bukz/

    (2) magazines   /mægə'zi:nz/

    (3) papers   /peipəz/

    (4) journals   /dʒə:nəlz/

    (5) pictures   /piktʃəz/

    (6) desks   /desks/

    (7) couches   /kaʊtʃiəz/

According to the interview, students did not know that when the end of a noun is a voiceless consonant, adding the suffix "-s" after the voiceless consonant means the plural, which is pronounced as [z], such as:

(1) tables   /teibl**z**/

(2) stools   /stu:l**z**/

(3) rugs   /rʌg**z**/

(4) pillows   /piləu**z**/

In particular, when ending with a sibilant [17], followed by a suffix "-s" to signify a plural noun, it is pronounced [əz]. Almost all students were not familiar with these. This is called "phonological addition" in phonetics. Phonological addition refers to the addition of the new sound in the original sequence of the sounds for the sake of natural, smooth, and labor-saving pronunciation. For example, in Chinese, adding a consonant [w] to the front of the modal word " 啊 [a]" and then becomes [wa], such as " 这座楼好高啊 !" (*zhezuolouhaogaowa*!). English nouns that end in a sibilant fricative /s, ʃ, tʃ, z, dʒ /, followed by "-s" to indicate the plural, need to add a vowel [ə] in front of [z], pronounced as [əz]. In phonology, it called is the "obligatory contour principle." It means that a vowel is added when two consonants occur together, or a consonant is added when two vowels occur together. Taking the article before a noun for example, if the noun begins with a vowel, then a nasal [n] is added before the indefinite article "a," which becomes [ən], as in "an apple."

The phonological addition rules of the noun plural about [z] (∅ refers to vacancy):

∅→[ə] / [sibilants] __ [z]

Therefore, according to the phonetic test and post-test interview, non-English major college students did not know the phenomenon of phonological addition in the sandhi, so they will pronounce all noun plurals with ending in "-s" in [z], and then make the mistake of overgeneralization.

4. Conclusion

The main results of the study are summarized as follows:

(1) Non-English major college students' English phonological acquisition suffers from phonemic confusion, ambiguity of phonemic variants, lack of knowledge of stress, poor understanding of syllabic structure, as well as lack of assimilation, phonological losing, and the correct handling of augmentation in speech stream sound change.

(2) Factors that cause errors in English phonological acquisition among non-English major college students include native language transfer, insufficient knowledge of the English phonological system, and overgeneralization.

This topic has a lot of implications for the study of second language phonological acquisition and foreign language teaching.

Firstly, English and Chinese languages have unique phonological systems, which should not lead to phonological confusion or negative transfer of phonological knowledge. Language is a symbolic system [18], and the sound coding and referencing of the two languages are completely different. English has vowels and consonants totaling 48 phonemes, and the combination of these phonemes and the type of syllable structure are relatively complex, while the phonological system of Chinese consists of consonants, rhymes, and tones, which is a typical tonal language. Therefore, in the process of English phonological acquisition, non-English major college students should be familiar with the phonological system of their mother tongue, and should avoid transferring the pronunciation of Hanyu Pinyin to the pronunciation of English phonology, which will result in the pronunciation mismatch between the two languages.

Secondly, we should strengthen and clarify the teaching of English phonological knowledge. It is challenging for learners whose mother tongue is Chinese to understand and master the phonetic and phonological rules of English. For example, the English dental /θ/ and /ð/ as well as the glottal [ʔ] are more

difficult to pronounce because there are no such phonemes in Chinese. Moreover, in English allophone, the aspirated consonant [p^h] and non-aspirated consonant [p] belong to the same phoneme /p/, whereas in the Chinese phonological system, they are two distinctive phonemes, such as " 斌 " (*bin*) and "□" (*pin*). Furthermore, the syllable composition of English is affected by the sonority scale of each phoneme [19]. Therefore, in the study of English phonetics, teachers need to clarify these phonological rules and the assimilation, dissimilation, and addition of sounds in the flow of speech, so that students can understand deeply.

Thirdly, learners should practice and imitate more and use a variety of speech training activities to improve their English speech. English pronunciation, stress, sound change, and rhythm have their own rules. In the acquisition of phonetics, phonetics and vocabulary teaching can be combined, phonetics training can be integrated into grammar learning, pronunciations practice can be strengthened in the development of language skills of listening, speaking, reading, and writing, and the ideograms of stress and intonation can be enhanced in the context and communication of discourse. When conditions are available, visualization technology can be adopted to assist English phonological teaching, improve the accuracy of phonological teaching, and prevent students from forming pronunciation misconceptions due to mother tongue transfer or overgeneralization.

The limitation of this study is that the sample size is small, and only first-year university students were chosen as the research subjects, which cannot represent the whole non-English majors college students in English phonological acquisition, and the results of the study can be used as a hypothesis or reference for future large-sample studies. In addition, the topic can be further researched in the following aspects:

(1) Exploring teaching models to enhance English phonological acquisition of students of different ages.
(2) Studying the similarities and differences in English phonological acquisition of non-English major college students in different countries or regions.
(3) The phonological tests in the empirical study can be implemented by using real daily conversations so as to reduce the subjects' deliberate attempts to pronounce certain English phonological sounds correctly in the tests.

Disclosure statement

The authors declare no conflict of interest.

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