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## Nuclear Stress Patterns in Reading by Adult Chinese EFL Learners: Explicit Training or Implicit Learning?

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Nuclear stress placement is a complex issue involving grammar, semantics, pragmatics, and information structure. This study examined the nuclear stress placement patterns in reading recordings produced by lower-intermediate and advanced adult EFL learners in China, and assessed the effects of explicit training on controlled production of nuclear stress. It was found that different types of nuclear stress presented asymmetrical difficulties to EFL learners. Production of some types showed more resistance to improvement, while others seemed more susceptible to explicit training, but with only short-term effects. Thus, EFL pronunciation teachers should give priority to those types of nuclear stress that are sensitive to explicit training and spend less time on those types that are either resistant to explicit training or that can be implicitly picked up by learners in the long run.

**Keywords:** nuclear stress in English, EFL pronunciation learning, adult Chinese EFL learners, explicit training

### Introduction

It is widely acknowledged that intonation plays an important role in the intelligibility of discourse (e.g., Clennell, 1997; McNerny & Mendelsohn, 1992; Morley, 1991; Munro & Derwing, 1999; Pickering, 2001; Wennerstrom, 1994). However, intonation has long been neglected among speech features taught and learned in EFL classroom (Clennell, 1997; Chun, 1998; Dalton, 1997; Lengeris, 2012; Levis, 2005; Ramirez Verdugo, 2006; Thompson, 1995; Veselovska, 2015). Similar situations are also noted in Chinese EFL contexts (Chen, Sun & Zhang, 2008; Zhang, 2004). As a consequence, EFL learners in China may not be aware of the significance of intonation in effective communication. This dilemma calls for attention to EFL intonation teaching and learning in China.

One highly salient component of intonation is the nuclear stress, which is vital to speech intelligibility.

Fortunately, it has also proven to be the most teachable aspect of intonation (Chapman, 2007; Dalton & Seidlhofer, 1994; Pennington & Ellis, 2000). Therefore, many suggest that teachers should help EFL learners become aware of nuclear stress (e.g., Celce-Murcia, 1996; Rost, 1990). Drawing on Wells' (2006) theory of English intonation, this research examined adult Chinese EFL learners' nuclear stress placement patterns in their reading and the effectiveness of explicit training on their controlled production of nuclear stress.

## Literature Review

Nuclear stress (or tonic stress, primary stress) is the most prominent stress of an intonation unit. It indicates the focus in discourse (Bolinger, 1989; Cruttenden, 1997), or new or contrastive information (Cruttenden, 1997; Gussenhoven, 1984; Ladefoged, 2009), while old or given information has reduced prominence (Bolinger, 1989; Couper-Kuhlen, 1986). However, the assignment of nuclear stress is complex: it does not always fall on the last content word in the intonation unit (Crystal, 1969), nor does it simply depend on the given-new distinction or the speaker's intentions (Brazil, 1984). It is a complex constituent of intonation constrained by grammatical, semantic, and pragmatic factors (cf. Wells, 2006). Elaborating Crystal's rule for nuclear stress placement in broad focus, Wells (2006) proposes 14 exceptions to the 'final lexical item' rule: final function word, contrast, the weaker stressed part of a compound, old or repeated information, indefinite pronoun, reflexive and reciprocal pronoun, empty word, final vocative, reporting clause, final adverb of place or time, preposition in phrasal verb, final lexical item that is not a noun, event utterance, and wh-adjective object. These exceptions, together with Crystal's rule of the last lexical item, offer a general guideline for nuclear stress placement in British English.

Acknowledging the essential status and role of nuclear stresses in intonation units, it is safe to claim that knowledge of nuclear stress placement should be an essential component in EFL learners' communicative competence. However, the complexity of its placement poses obvious difficulty for learners in both production (Clennell, 1997; Deterding & Hvitfeldt, 1994) and perception (Hahn, 2004), leading to failures in their communication with native speakers. Jenkins (2002) notices that misplaced nuclear stress is also the major cause of communication breakdowns in nonnative to nonnative speech, and thus she proposes to include nuclear stress as the only prosodic feature in her *Lingua Franca Core of English* as an international language. The core features are the major concern in pronunciation classes, so it can be reasonably inferred that nuclear stress should be given priority over all other non-core aspects of connected speech. This view of Jenkins is echoed by Hahn (2004), Pennington and Ellis (2000), and her later work (Jenkins, 2010), who all hold that nuclear stress is more important for intelligibility than other aspects of intonation.

As it would be overambitious to teach L2 learners every aspect of English intonation (Dalton & Seidlhofer, 1994; Jenkins, 2000; Nelson, 1998; Roach, 2000), researchers turned to evaluating the teachability of different components of intonation. Findings (Chapman, 2007; Dalton & Seidlhofer, 1994; Pennington & Ellis, 2000) uniformly indicate that among various aspects of discourse intonation, nuclear stress is more teachable and beneficial to learners in improving their oral performance than others. Studies on the importance and teachability of nuclear stress provide a basis and support for its explicit teaching in EFL pronunciation classes. Some scholars, however, express doubts on the necessity of nuclear stress teaching. Jensen (2009), for example, argues that nuclear stress does not deserve its place in the pronunciation curriculum for above-intermediate-level EFL learners, as his experiment showed that Danish EFL listeners' perception of nuclear stress in English does not differ from that of native English speakers. However, this study did not examine whether EFL learners' production of nuclear stress can also approach that of native speakers.

In accord with those advocating the importance and teachability of nuclear stresses, researchers have explored various methods of teaching nuclear stress in EFL pronunciation class. For example, Rannali (2002)

points out that both awareness-raising practice and production-oriented practice are vital for the improvement in the production of nuclear stress. Hahn (2004) further proposes teaching strategies such as using perception exercises and employing longer discourse, as effective means to helping learners practice nuclear stresses. Empirical research, though limited in number, also confirms the usefulness of nuclear stress teaching. Derwing, Munro and Wiebe (1998) find that ESL students who received instruction emphasizing suprasegmentals (primary stress included) “transferred their learning to a spontaneous production” (p.406) and did significantly better in terms of comprehension and fluency. Pennington and Ellis (2000) claim that EFL learners in their study significantly improved their production of primary stress after receiving explicit instruction. Regarding the effectiveness of techniques for nuclear stress teaching, Ramírez Verdugo (2006) reports that the multi-sensory approach brought about significant improvement in Spanish EFL learners’ production of nuclear stress, while Chapman (2007) finds that the task-based learning approach promoted Japanese EFL learners’ production of nuclear stress. In sum, both theoretical and empirical research confirms that the teaching of nuclear stress is generally worthwhile and effective.

In Chinese EFL contexts, there is limited target language exposure, and English teaching and learning in general tend to be test-oriented. Intonation teaching has thus been neglected under this pragmatic atmosphere (Chen et al., 2008; Zhang, 2004). The recent decade, however, has seen a gradual increase in attention to discourse intonation in the EFL classroom (e.g., Bu, 2003; Chen et al., 2008; Jiang & Shi, 2009; Zhang, 2003).

Among the emerging research focusing on nuclear stresses, most aim at a descriptive report of Chinese EFL learners’ misuse and misplacement of nuclear stress, such as using nuclear stress on almost every lexical word (Juffs, 1990), on the final word in a phrase (Deterding, 2010) and on grammatical markers and personal pronouns (Chen, 2008). These problems are typical among Chinese EFL learners of all proficiency levels and thus demand urgent measures. However, researchers seldom go beyond stating the importance of raising learners’ intonation awareness (e.g., Chen, 2006, 2008; Yang & Wang, 2010). The study by Wu, Song and Lan (2010) is one of the few research studies examining the effectiveness of explicit instruction on nuclear stress. In this study, the researchers find that explicit instruction improves Chinese EFL learners’ perception of nuclear stress. However, the effect of explicit instruction on learners’ production of nuclear stress has not been investigated.

To address this gap, the current research investigated the effectiveness of explicit training on Chinese EFL learners’ controlled production of nuclear stress in reading. The following specific questions are postulated: 1) Does explicit training improve EFL learners’ production of nuclear stress? 2) Which types of nuclear stress are sensitive to explicit training? 3) Which types of nuclear stress can be implicitly picked up by learners? 4) Which types of errors are persistent in EFL learners’ controlled production of nuclear stress?

## **Research Method**

This research was conducted in natural class settings, and it lasted four weeks. To answer the first two questions, explicit training was given to freshmen English majors in an EFL pronunciation class. Before and after the training, reading recordings were collected to find changes and errors in their controlled production of nuclear stress. To answer the last two questions, their recordings were compared with those of junior English majors’ to identify the respective advantages of the two groups. Thus, those types of nuclear stress picked up by the juniors who had received no explicit training in nuclear stress as well as those persistent errors across the groups were identified.

## Participants

The participants of this research involved four classes at a provincial university in central China: two classes of freshman English majors and two classes of junior English majors. Each class included 25-30 students aged 17-22, among whom only 1-3 were male. The freshman participants were intermediate-level EFL learners who have been selected through the National College Entrance Examination and an oral English Examination before their admission to the university. They shared similar English learning experiences and similar course settings. The junior participants were advanced-level EFL learners, and a great majority of them (over 90%) had just passed Test for English Majors Band 4 (a widely recognized national achievement test for English majors in mainland China) before entering their third year at the university.

The researcher taught all these classes English pronunciation in their first semester at university, but the juniors had not received any explicit instruction on nuclear stress in their pronunciation class two years earlier. What they learned at that time was mainly segmentals. Furthermore, the juniors were not likely to have received instruction on nuclear stress in other classes because all the other teachers seldom taught intonation in their classes, let alone nuclear stress.

## Instruments

The instruments were a set of two oral tests (See Appendices 1 and 2) for the freshman English majors and an oral test for the junior English majors. Each test contains 14 sentences adapted from Wells (2006), representing the 14 exceptions to the nuclear stress rule, viz., 1) final function word, 2) contrast, 3) the weaker stressed part of a compound, 4) old or repeated information, 5) indefinite pronoun, 6) reflexive and reciprocal pronoun, 7) empty word, 8) final vocative, 9) reporting clause, 10) final adverb of place or time, 11) preposition in phrasal verb, 12) final lexical item that is not a noun, 13) event utterance, and 14) wh-adjective object.

It is noteworthy that since most of these sentences appear in isolation, they could primarily be used to assess the participants' ability to assign nuclear stress in broad focus. The exceptions are Items 2, 4, 5 and 9, which have their respective contexts and thus could assess the participants' performance of nuclear stress in narrow focus. For all these sentences it is possible to work out a preferred nuclear stress pattern based on Wells' theory, according to whether the sentence is in broad or narrow focus.

The items in the oral test for the junior English majors are identical with those in the first oral test for the freshmen. All three tests are equally appropriate for the participants in terms of structure, length and difficulty.

## Procedure

During the four weeks, the teacher researcher explicitly instructed the freshman participants on the general nuclear stress placement rule and its 14 exceptions in the four weekly 45-minute pronunciation classes. In each class about 15 minutes were devoted exclusively to training in and practice with nuclear stress. The teacher explained the rule and exceptions by using examples in contexts, and the freshman consolidated such knowledge by assigning nuclear stress to sentences and short dialogues, and by practicing reading them aloud in pairs. Oral assignments were set for the freshmen to practice applying the nuclear stress placement rules after class.

Before and after the training, a pretest and a posttest were conducted. The participants were given the printed version of the pretest one week before the training and that of the posttest immediately after the training. For both tests, the freshman participants were given one week for preparing their reading recordings.

They were encouraged to practice well and record their reading when they were satisfied with their pronunciation. The junior participants received no explicit training on nuclear stress, either in the meantime or in their earlier years at the university. They were also given the printed version of the oral test and asked to practice and hand in their reading recordings in one week's time. All recordings were sent to the teacher researcher by email.

## Data Analysis

The valid recordings were from 56 freshmen (doing both pre- and post-tests) and 41 juniors, totaling 153 audio clips. All of them were listened to and analysed by the researcher. Before grading, all recordings were randomised so that the evaluator did not know which preceded or followed the training or which ones were from freshmen or juniors.

To answer the first research question, errors in the freshman participants' test results were counted and statistically analysed. Descriptive statistics (mean and SD) and a paired-samples t-test were computed to examine whether their errors had decreased significantly in their controlled production of nuclear stress in the post-test compared to their pretest performance.

To answer the second research question, the freshmen's recordings were analysed phonologically with the nuclear stress in each utterance indicated. Errors in their production of nuclear stress in pre- and posttests were summarized respectively and compared to pinpoint the specific gains (as revealed by errors eliminated or less frequent in the posttest) as well as persistent errors.

To answer the third and fourth questions, the juniors' recordings were analysed in the same way as described above, and their production errors in nuclear stress were summarised and compared with those made by the freshmen in the posttest. Thus, those types of nuclear stress that can be acquired through implicit learning and those requiring explicit training were identified, and common errors were summarised.

## Findings and Discussion

### Effectiveness of Explicit Training on Nuclear Stress

A paired-samples t-test was run to evaluate the effectiveness of explicit training on the freshman participants' controlled production of nuclear stress. The t-test indicates that the percentages of misperforming participants decreased moderately in the posttest ( $M = 7.18$ ,  $SD = 2.771$ ) compared to the pretest ( $M = 8.68$ ,  $SD = 2.241$ ),  $t(55) = 4.248$ ,  $p < .05$ ,  $d = 0.568$ . This suggests that the explicit training moderately improved the participants' controlled production of the target types of nuclear stress.

In order to determine which types of nuclear stress are sensitive to explicit training or are resistant to it, the number of freshmen participants who assigned nuclear stress wrongly for each item of the pretest and posttest was calculated.

TABLE 1  
*Percentages of Misperforming Freshmen by Item in Pre- and Posttests*

Pretest		Posttest			
Item	%	Item	%		
1	I've just received a <u>letter</u> from her.	67.9%	1	I've just <u>talked</u> with her about it.	46.4%
2	You've told me what <u>Emma</u> wants, but what do <u>you</u> want?	66.1%	2	<u>She</u> said it was wrong, but <u>he</u> said it was right.	39.3%

3	I'm going to buy a new <u>mobile</u> phone.	50.0%	3	I want to change my <u>library</u> book.	44.6%
4	—Shall we walk to the <u>restaurant</u> ? — <u>Yes</u> , in fact I'd <u>prefer</u> to go on foot.	96.4%	4	—Can I introduce you to the <u>manager</u> ? — <u>Actually</u> , I've already <u>met</u> Mr. Jenkins.	87.5%
5	Mary wants some <u>chocolate</u> , and <u>Peter</u> wants some, <u>too</u> .	0%	5	The train was <u>crowded</u> , so I decided to catch a <u>later</u> one.	8.9%
6	You're looking rather <u>pleased</u> with yourself.	89.3%	6	We've got to <u>help</u> each other.	58.9%
7	Let's go back to <u>my</u> place.	71.4%	7	Sally is such a <u>nice</u> person.	26.8%
8	We'll see you on <u>Tuesday</u> , then.	30.4%	8	You've got to slow <u>down</u> a bit.	67.9%
9	—“How are you <u>doing</u> ?” He asked. —“I'm <u>fine</u> ,” she replied.	85.7%	9	—“What's your <u>name</u> ?” He asked. —“I'm <u>Susan</u> ,” she replied.	57.1%
10	There's a <u>mosquito</u> on your finger.	96.4%	10	I had an unexpected <u>letter</u> yesterday.	64.3%
11	What are you <u>looking</u> at?	37.5%	11	Who are you <u>talking</u> to?	39.3%
12	Look at the <u>tie</u> he's wearing!	76.8%	12	Where's that <u>sweater</u> I gave you?	57.1%
13	There's a <u>train</u> coming.	62.5%	13	There's a <u>bird</u> flying.	73.2%
14	Which <u>route</u> did you take?	60.7%	14	Which <u>hotel</u> are you staying in?	50.0%

According to Table 1, the percentages of misperforming participants for Items 1, 2, 3, 4, 6, 7, 9, 10, 12, and 14 all decreased after teaching the nuclear stress rules. This means that fewer participants made mistakes in the posttest when assigning nuclear stress to sentences containing a final function word (Item 1), a contrast (Item 2), a final compound (Item 3), repeated information (Item 4), a final reflexive/reciprocal pronoun (Item 6), a final empty word (Item 7), a final reporting clause (Item 9), a final adverbial of time or place (Item 10), a final noun modifier (Item 12), and a wh-adjective object (Item 14). Among these items, the participants' performance on Item 7 improved the most, with a decrease of 44.6% in the percentage of participants who made mistakes, followed by Item 10, with a decrease of 32.1%, and Items 6, 9, 2, with respective decreases of 30.4%, 28.6% and 26.8%. This suggests that the exception categories of empty words (Item 7), final adverbials of time or place (Item 10), final reflexive/reciprocal pronouns (Item 6), final reporting clauses (Item 9), and contrasts (Item 2) are the most sensitive to explicit training, i.e., they are the easiest for the EFL learners to master after receiving explicit training. In contrast, explicit training seemed to have no positive effect on Items 5, 8, 11, and 13.

Item 5 aims at assessing the participants' ability to assign nuclear stress to sentences containing an indefinite pronoun. In Pretest Item 5, the indefinite pronoun is followed by another tone unit, that is, 'too', which takes another nuclear stress. However, the recordings reveal that most of the participants took 'and Peter wants some, too' as one tone unit, thus 'too' became the final word in the single tone unit. As a consequence, the participants found it easy to de-accent 'some' preceding the following accented word. The indefinite pronoun in Posttest Item 5, however, is in utterance final position. Therefore, due to the habit of accenting the last word in an utterance, a small number of the participants still accented the indefinite pronoun even after receiving explicit training. This suggests that the intermediate-level EFL learners tend to de-accent the indefinite pronoun when it is followed by a monosyllable tone-unit, and assign primary stress to the indefinite pronoun when it is in final position.

Items 8, 11 and 13 respectively examine the participants' assignment of nuclear stress in final vocative sentences, final phrasal verb sentences, and event sentences. In the pretest of Item 5, the final vocative is a monosyllable, while in the posttest, it contains two words. Thus, the vocative in the posttest may have attracted more attention from the participants and therefore increased the possibility of receiving nuclear stress. For Items 11 and 13, many participants made more errors after receiving explicit training. The participants' poor performance on Items 11 and 13 may be attributed to Chinese EFL learners' habit of accenting the ending word in an utterance (Deterding, 2010), irrespective of its grammatical category.

Based on the above discussion, it can be concluded that the four-week explicit training moderately

improved the freshmen's controlled production of nuclear stress. For nuclear stress placement in some types of sentences, their errors decreased greatly, while other types still posed difficulty even after receiving the training. In addition, a recurring error pattern is accentuation of utterance-final words.

### Comparison of Freshmen's and Juniors' Performance

An independent-samples t-test compared the freshman participants' production of nuclear stress in the posttest and the juniors' production of nuclear stress by item. The t-test indicates that the percentages of misperforming juniors for all items ( $M = 53.04$ ,  $SD = 22.57$ ) did not differ significantly from those of misperforming freshmen in their posttest ( $M = 54.59$ ,  $SD = 20.41$ ),  $t(26) = .191$ ,  $p > .05$ ,  $d = .19$ . This means that there was no significant difference between the freshmen's performance in the posttest and the juniors' performance. This result suggests that explicit training had facilitated and accelerated the freshmen's acquisition of nuclear stress because after four weeks of training their mastery of nuclear stress was similar to that of the juniors.

Percentages of the misperforming freshmen in the posttest and those of the juniors were compared by item to determine the types of nuclear stress which can be naturally acquired without explicit training, as well as those that are difficult to learn either with or without the intervention of explicit training.

TABLE 2

*Percentages of Misperforming Freshmen in Posttest and Juniors by Item*

Freshmen (posttest)		Juniors	
Item	%	Item	%
1 I've just <u>talked</u> with her about it.	46.4%	1 I've just received a <u>letter</u> from her.	51.2%
2 <u>She</u> said it was wrong, but <u>he</u> said it was right.	39.3%	2 You've told me what <u>Emma</u> wants, but what do <u>you</u> want?	31.7%
3 I want to change my <u>library</u> book.	44.6%	3 I'm going to buy a new <u>mobile</u> phone.	58.5%
4 —Can I introduce you to the <u>manager</u> ? — <u>Actually</u> , I've already <u>met</u> Mr. Jenkins.	87.5%	4 —Shall we walk to the <u>restaurant</u> ? — <u>Yes</u> , in fact I'd <u>prefer</u> to go on foot.	82.9%
5 The train was <u>crowded</u> , so I decided to catch a <u>later</u> one.	8.9%	5 Mary wants some <u>chocolate</u> , and <u>Peter</u> wants some, <u>too</u> .	0%
6 We've got to <u>help</u> each other.	58.9%	6 You're looking rather <u>pleased</u> with yourself.	75.6%
7 Sally is such a <u>nice</u> person.	26.8%	7 Let's go back to <u>my</u> place.	68.3%
8 You've got to slow <u>down</u> a bit.	67.9%	8 We'll see you on <u>Tuesday</u> , then.	14.6%
9 —“What's your <u>name</u> ?” He asked. —“I'm <u>Susan</u> ,” she replied.	57.1%	9 —“How are you <u>doing</u> ?” He asked. —“I'm <u>fine</u> ,” she replied.	50.0%
10 I had an unexpected <u>letter</u> yesterday.	64.3%	10 There's a <u>mosquito</u> on your finger.	80.5%
11 Who are you <u>talking</u> to?	39.3%	11 What are you <u>looking</u> at?	22.0%
12 Where's that <u>sweater</u> I gave you?	57.1%	12 Look at the <u>tie</u> he's wearing!	56.1%
13 There's a <u>bird</u> flying.	73.2%	13 There's a <u>train</u> coming.	43.9%
14 Which <u>hotel</u> are you staying in?	50.0%	14 Which <u>route</u> did you take?	75.6%

According to Table 2, compared with the freshmen's posttest results, the juniors performed worse on Items 1, 3, 6, 7, 10, and 14, but slightly better on Items 2, 4, 9, and 12, and significantly better on Items 5, 8, 11, and 13. Based on this comparison, the teachability of nuclear stress assignment to the 14 items discussed above is summarised in Table 3:

TABLE 3  
*Teachability of Nuclear Stress in Different Types of Sentences*

High (to teach)	Medium (neutral)	Low (not to teach)
Item 1 final function word	Item 2 contrast	Item 5 final indefinite pronoun
Item 3 final compound	Item 4 repeated information	Item 8 final vocative
Item 6 final reflexive/reciprocal pronoun	Item 9 reporting clause	Item 11 preposition in final phrasal verb
Item 7 final empty word	Item 12 final noun modifier	Item 13 event utterance
Item 10 final adverb of place or time		
Item 14 wh-adjective object		

Since the freshmen received short-term explicit training in nuclear stress placement while the juniors did not receive such training, it can be inferred that for Items 1, 3, 6, 7, 10, and 14, it is strongly advisable to offer EFL learners explicit training; for Items 2, 4, 9, and 12, some explicit training may be helpful; while for Items 5, 8, 11, and 13, no explicit training is needed. That is, in teaching nuclear stress, EFL teachers need to provide sufficient training in assigning nuclear stress to some types of sentences, namely, those with a final function word (Item 1), a final compound (Item 3), a final reflexive or reciprocal pronoun (Item 6), a final empty word (Item 7), a final adverb of place or time (Item 10), and a wh-adjective object (Item 14). Among these exceptions, Items 7 and 10 deserve the most attention because the freshmen improved the most on these items after receiving explicit training, while the juniors, who received no training, performed worst with these.

It is also noteworthy that the freshmen did not improve on Items 5, 8, 11, and 13 after receiving explicit training, but the juniors performed rather well on these four items. This suggests that these items are rather resistant to explicit training, which has a negative effect on EFL learners' acquisition of these types of nuclear stress, namely, those in sentences containing a final indefinite pronoun (Item 5), a final vocative (Item 8), a preposition in final phrasal verb (Item 11), and event utterance (Item 13). Therefore, these items should be excluded from nuclear stress teaching in EFL pronunciation classes, leaving them for EFL learners to acquire in their natural learning process.

## Comparison of General Error Patterns

All the errors made in each test were counted and categorised to determine the recurring error patterns of each group.

TABLE 4  
*Comparison of Major Errors in General*

General Errors	Total <i>n</i>	NS on Last Word <i>n</i> (%)	Multiple NS <i>n</i> (%)	NS on Pron. <i>n</i> (%)	Error of Contrast <i>n</i> (%)	NS on Prep. <i>n</i> (%)
Freshmen Pretest	775	494 (63.7%)	140 (18.1%)	99 (12.8%)	37 (4.8%)	22 (2.8%)
Freshmen Posttest	422	318 (75.4%)	98 (23.2%)	75 (17.8%)	22 (5.2%)	38 (9.0%)
Juniors	301	293 (97.3%)	100 (33.2%)	54 (17.9)	13 (4.3%)	11 (3.7%)

As can be seen from Table 4, in all three tests, the participants shared similar error patterns, i.e., improper nuclear stress on utterance-final words (regardless of its grammar category and utterance meaning) exhibited the highest percentages, far outnumbering all the other error types. This finding echoes Deterding (2010), who also found that a common problem in Chinese EFL learners' intonation is that they tend to assign nuclear stress on the utterance-final word.

The second largest group of errors was double or multiple nuclear stresses in an utterance, followed by improper nuclear stress on pronouns, errors in contrast, and improper nuclear stress on prepositions. This finding is consistent with Juffs (1990), who claims that Chinese EFL learners tend to assign nuclear stress to almost every content word in an utterance, and Chen (2008), who also finds that Chinese EFL learners are inclined to place nuclear stress on grammatical markers and personal pronouns.

It is worth mentioning that in the posttest the freshmen made more nuclear stress errors on prepositions. This is because in the posttest the freshmen tended to accent the two-syllable preposition ‘about’, with 15 cases of this error, while in the other two tests there are only monosyllabic prepositions and therefore the participants performed better.

Table 4 also reveals that the number of errors in assigning nuclear stress to the last word decreased greatly after the freshmen received explicit training, and the juniors, without any instruction, made even fewer such errors than the freshmen in their posttest. However, the percentage of this type of error increases across the three tests, with the juniors’ final-word errors accounting for 97.3% of their total errors. This shows that although EFL learners can reduce this type of error in their learning process, it is more persistent compared with other minor error types.

A closer look at the errors shows some further features of the participants’ error patterns. Tables 5 and 6 show the subcategories of improper nuclear stress on utterance-final words and on function words.

TABLE 5

*Types of Improper Nuclear Stress on Last Word*

Test	Improper Nuclear Stress on Last Word		
	Freshmen Pretest	Freshmen Posttest	Juniors
Total <i>n</i>	494	318	293
On Content Word <i>n</i> (%)	369 (74.7%)	210 (66.0%)	228 (77.8%)
On Function Word <i>n</i> (%)	125 (25.3%)	108 (34.0%)	65 (22.2%)

Table 6

*Types of Improper Nuclear Stress on Function Words*

Test	Improper Nuclear Stress on Pronoun			Improper Nuclear Stress on Preposition		
	Freshmen Pretest	Freshmen Posttest	Juniors	Freshmen Pretest	Freshmen Posttest	Juniors
Total <i>n</i>	99	75	54	22	38	11
Final <i>n</i> (%)	87 (87.9%)	48 (64.0%)	50 (92.6%)	22 (100%)	22 (57.9%)	9 (81.8%)
Non-final <i>n</i> (%)	12 (12.1%)	27 (36.0%)	4 (7.4%)	0 (0%)	16 (42.1%)	2 (18.2%)

As seen in Table 5, among the improper nuclear stress on the last word in an utterance, a great majority (over 65%) fall on content words rather than on function words in all three tests. According to Table 6, over half of the nuclear stress errors with pronouns and prepositions are found in final position. That is, the participants tended to assign nuclear stress to the utterance-words, whether it was a content word, a pronoun, or a preposition. However, function words or grammatical markers were less likely to receive nuclear stress in non-final positions.

Based on the above discussion, we can conclude that both groups shared similar error patterns in controlled nuclear stress production, whether they had received explicit training or not. As this training lasted only four weeks, it is difficult to say whether explicit training may impact general error patterns in nuclear stress production. This remains a topic yet to be explored.

## **Pedagogical Implications**

From the findings of this research, some pedagogical implications can be drawn.

The results of the freshmen's posttest reveal that explicit training plays a positive role in EFL learners' acquisition of nuclear stress. It is not just that explicit training improves their perception of nuclear stress as previous research has found (e.g., Wu et al., 2010), but that it promotes their production of nuclear stress as well. In addition, the comparison between freshmen's production of nuclear stress in the posttest and that of the juniors indicates that there is no significant difference in the performance of the two groups. Thus, explicit training can accelerate EFL learners' acquisition of nuclear stress. It is therefore quite advisable to include explicit training in nuclear stress in EFL pronunciation classrooms, and if possible, to incorporate it into other communication-oriented classes.

Our research results also show that explicit training is not effective with all types of nuclear stress and some types of errors seem to be quite persistent. This suggests that in EFL pronunciation classes, different types of nuclear stress should be treated differently. Those that are sensitive to explicit training, i.e., easy to learn, should be given priority, and the training should not stop at raising EFL learners' perception only, but should aim at improving their production as well. As for those that are resistant to explicit training, the major focus of the training should be to raise EFL learners' perception. In addition, as the juniors in our research acquired those types of nuclear stress which were resistant to explicit training rather satisfactorily, it would be sensible for EFL pronunciation teachers to exclude these types of nuclear stress from their teaching and leave them for natural uptake.

In addition, as the distribution of major error types (i.e., final words, multiple nuclear stresses, pronouns, prepositions, and contrasts) is consistent across the recordings of the three tests, it would be especially helpful if teachers devote more time and attention to these error types. For example, the teacher can raise EFL learners' awareness of such prominent errors in their pronunciation by playing and analysing their recordings in class. Furthermore, the teacher can also provide more opportunities for learners to practice the corresponding types of nuclear stress. These awareness-raising and production-promoting activities should be repeated over a long time to achieve any results. Our research findings also show that although persistent in all the participants' production of nuclear stress, almost all five major types of errors decreased after the freshmen had received explicit training, and their performance in the posttest was quite close to that of the juniors. This further lends empirical support to explicit training, which may accelerate EFL learners' acquisition of nuclear stress.

## **Conclusion**

This research investigated the effectiveness of explicit training on adult Chinese EFL learners' acquisition of nuclear stress and the errors in their controlled production of nuclear stress. It is found that short-term explicit training moderately improved the participants' production of nuclear stress and that although the different groups of participants shared the same error patterns, teaching nuclear stress patterns reduced all five major types of errors in their controlled production of nuclear stress. Thus, the findings provide empirical support for explicit training in nuclear stress in EFL pronunciation classrooms. However, explicit training is not equally effective with all types of nuclear stress. It seems that some types of nuclear stress are sensitive to training, while others are rather resistant to it.

This research is not without limitations. The training lasted only four weeks, as a result of which, its effectiveness might have been undermined. Furthermore, the number of participants is not large enough to represent the Chinese EFL learners in general, and there is no delayed posttest to check the durability of the

effects of explicit training. Future research studies may recruit more EFL learners with more diversified backgrounds, and conduct longer training with a delayed posttest to generate more representative results and to more accurately measure the effectiveness of explicit training on nuclear stress.

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## **Appendix A**

### **Pretest for Freshmen & Test for Juniors**

Read the following sentences as naturally as possible:

- (1) I've just received a letter from her.
- (2) You've told me what Emma wants, but what do you want?
- (3) I'm going to buy a new mobile phone.
- (4) — Shall we walk to the restaurant?  
— Yes, in fact I'd prefer to go on foot.
- (5) Mary wants some chocolate, and Peter wants some, | too.
- (6) You're looking rather pleased with yourself.
- (7) Let's go back to my place.
- (8) We'll see you on Tuesday, then.
- (9) — "How are you doing?" He asked.  
— "I'm fine," she replied.
- (10) There's a mosquito on your finger.
- (11) What are you looking at?
- (12) Look at the tie he's wearing!
- (13) There's a train coming.
- (14) Which route did you take?

## **Appendix B**

### **Posttest for Freshmen**

Read the following sentences as naturally as possible:

- (1) I've just talked with her about it.
- (2) She said it was wrong, but he said it was right.
- (3) I want to change my library book.
- (4) — Can I introduce you to the manager?  
— Actually, I've already met Mr. Jenkins.
- (5) The train was crowded, so I decided to catch a later one.
- (6) We've got to help each other.
- (7) Sally is such a nice person.
- (8) You've got to slow down a bit.
- (9) —“What's your name?” He asked.  
— “I'm Susan,” she replied.
- (10) I had an unexpected letter yesterday.
- (11) Who are you talking to?
- (12) Where's that sweater I gave you?
- (13) There's a bird flying.
- (14) Which hotel are you staying in?