Assessing L2 Pronunciation Using Measurements of Nuclear Stress Placement and Comprehensibility

Pedro Luis Luchini and Cosme Daniel Paz

Abstract Nuclear stress in English highlights the most important information in a sentence. Its correct use and location are thus fundamental for achieving meaningful communication. English learners who manifest intelligibility and/or comprehensibility problems due to nuclear stress misplacement can improve their pronunciation through explicit focused instruction. This classroom-based study aimed to evaluate the effectiveness of two pronunciation instruction treatments in an EFL context using measurements of nuclear stress placement and comprehensibility. Participants were 50 Spanish-L1 trainees divided evenly into Groups A and B. Both groups were exposed to a traditional, teacher-centered approach to pronunciation teaching (TCT), but Group B added a communicative, awareness-building component (CABC). Participants' free speech samples were assessed before and after instruction via pre- and post-test recordings. A slight tendency for improvement for nuclear stress and higher values for comprehensibility were observed between pre- and post-tests for Group B. A statistically significant simple linear regression was reported only for Group B in the relative response for nuclear stress and comprehensibility, thus demonstrating the benefits of CABC. The assessment protocols proved useful in determining the efficacy of one treatment over the other. The chapter concludes with a discussion of the implications of the findings for pronunciation assessment, research, and teaching.

Keywords L2 pronunciation assessment · Nuclear stress placement · Comprehensibility

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V. G. Sardegna and A. Jarosz (eds.), *Theoretical and Practical Developments in English Speech Assessment, Research, and Training*, Second Language Learning and Teaching,
https://doi.org/10.1007/978-3-030-98218-8_4

1 Introduction

For years, second language (L2) pronunciation instruction has been marginalized in L2 language teaching and research. To date, however, with the advent of economic globalization, technological advances and the subsequent need to establish effective oral communication, pronunciation teaching has been revitalized and has thus reemerged in the applied linguistic research mainstream. As a result, there is a large number of high-ranking pronunciation-specific studies that recognize explicit instruction as crucial for the development of learners' L2 speech intelligibility and comprehensibility (e.g., Derwing et al., 2014; Lee et al., 2015; Saito, 2011; Trofimovich & Isaacs, 2012; Trofimovich et al., 2017). Despite this renewed interest in L2 pronunciation teaching, many in-service and pre-service teachers still report being confused about how to teach and/or assess this construct (Foote et al., 2011; Murphy, 2014; Pennington & Rogerson-Revell, 2019) unless their teacher education programs specifically trained them for pronunciation teaching and assessment (Sardegna, 2020). Also, while some studies have found that segmental aspects are crucial for effective communication, particularly those that carry a high functional load (Munro & Derwing, 2006), others provide robust evidence that prosody, particularly nuclear stress, is essential for understanding (Dauer, 2005; Hahn, 2004; Jenkins, 2000; Luchini, 2017), and should thus be explicitly taught. Therefore, an exploration of the relationship between measurements of nuclear stress placement and comprehensibility and instructional approaches may provide useful information regarding the efficacy of L2 pronunciation instruction.

This chapter reports on an experimental study that conducted such exploration with 50 trainees at a local university in Mar del Plata, Argentina. Participants' first language (L1) was Spanish and their L2 was English. They were split in two groups depending on the pronunciation instruction approach they received. Two specialists assessed their pre- and post-instruction speech samples with respect to nuclear stress placement and ten English native speakers judged the comprehensibility of the same speech samples. The results obtained provide interesting implications for L2 pronunciation assessment, research and teaching, which are discussed at the end of the chapter.

2 L2 Pronunciation Teaching and Assessment

The last 20 years have witnessed a paradigm shift in the goals of L2 pronunciation teaching as numerous renowned research studies in the field have given precedence to intelligibility and comprehensibility over those of nativeness or the eradication of a foreign accent (Derwing & Munro, 2009, 2015; Levis, 2005, 2018). Research findings have shown that pronunciation is a vital component of communicative competence and as such it should be given high priority in the L2 classroom (Morley, 1991). Provided that learners are intelligible and easy to understand, their pronunciation will not obstruct communication. Levis (2005) classified L2 pronunciation teaching into two main categories: teaching that follows the *Nativeness Principle* and teaching that follows the *Intelligibility Principle*. The first category comprises pronunciation instruction whose main goal is to push students to achieve a native-like pronunciation, while the second refers to speech that listeners can comfortably understand despite having some traces of local or regional accent coming from the speaker's L1.

Munro and Derwing (1995) and Derwing and Munro (1997) presented three different dimensions of L2 speech. They refer to *intelligibility* as the extent to which a listener understands L2 speech. They define *comprehensibility* in regard to the measure of how easy or difficult it is for the listener to understand L2 speech; that is, the cognitive effort required by the listener to understand. Lastly, they define *accentedness* as differences between speakers' and listeners' speech production of sounds and sound patterns. Accent is partly independent from intelligibility and comprehensibility (Trofimovich & Isaacs, 2012). Although accent is perceptively evident, it does not necessarily obstruct understanding (Derwing & Munro, 2009, 2015). Frequently, it is difficulties with intelligibility and/or comprehensibility that may cause problems for understanding. This suggests that the main goal for L2 pronunciation teaching should be to focus on those features of pronunciation that may cause problems for understanding, unless the learner's speech is already very clear.

Many studies examine the comparative efficacy of L2 pronunciation teaching for either segmental (sounds) or suprasegmental features (stress, rhythm and intonation). While various researchers show that sounds are easier to teach and learn (Levis, 2005; Saito, 2014), others claim that suprasegmental-based instruction has an influence on comprehensibility (Derwing et al., 1998; Gordon et al., 2013; Hahn, 2004; Isaacs & Trofimovich, 2012; Kang et al., 2010; McNerney & Mendelsohn, 1992; Munro, 1995; Saito & Saito, 2017). As for the different aspects that make up the suprasegmentals in English, it is known that the protagonist is nuclear stress. This salient prosodic feature plays a decisive role in producing textual cohesion and in sequencing a hierarchical organization of discourse. Nuclear stress points to new and contrastive information and data that are not available for the listener to retrieve from the context or prior knowledge (Bardovi-Harlig, 1986; Halliday, 2013; Pennington & Richards, 1986; Sperber & Wilson, 1986).

Many L2 learners have difficulty learning how to use nuclear stress in English. They often display two major problems: stressing almost all words in an utterance without signaling one major prominent stress, and/or misplacing nuclear stress (Field, 2005; Hahn, 2004). When nuclear stress is misplaced, sentence processing for the listener becomes more difficult, thus compromising comprehensibility (Birch & Clifton, 1995; Kang et al., 2010; Tajima et al., 1997; Terken & Hirschberg, 1994; Winters & O'Brien, 2013). Non-native speakers' intonation, for example, seems to be a crucial factor in native listeners' understanding, as tone choice and location can affect both perceived information structure and pragmatic cues in L2 discourse (Kang et al., 2010).

Numerous research studies show that prosodic features have a strong impact on L2 oral performance assessment (Anderson-Hsieh et al., 1992; Derwing et al., 1998; Isaacs & Trofimovich, 2012; Kang, 2012; Kang & Johnson, 2018; Kang et al., 2010; Saito, 2014). While most of these investigations explore different linguistic and phonological variables and their correlates with intelligibility and comprehensibility, few of them assess the effects of single parameters of English such as nuclear stress placement (Kang & Johnson, 2018) and their relationship with comprehensibility as predictors of L2 oral development. Therefore, classroom-based studies evaluating the properties of such prosodic features and their relationship with comprehensibility warrant further exploration.

In the past, the assessment of L2 pronunciation was marginalized in second language teaching and research, mainly because it was associated with discrete aspects of oral discourse (Lado, 1961). The advent of communicative competence (Hymes, 1972) brought about the years of neglect of pronunciation. It was not until the mid-90s that teachers and researchers began to focus their attention on the value and role of L2 pronunciation assessment for effective language use. At present, the emergence of pronunciation assessment can be partially ascribed to the shift in focus from perceptions of accentedness to the wide-ranging L2 speech dimensions of intelligibility and comprehensibility.

Recent indications among researchers and educational practitioners show that pronunciation assessment has attracted particular interest and gained special importance (Bøhn & Hansen, 2017; Chun, 2006, 2008; Fulcher, 2015; Isaacs, 2008, 2016; Isaacs & Trofimovich, 2016; Kang & Pickering, 2014; Kim, 2015; Thomson, 2018; Trofimovich et al., 2016; Xi, 2010, 2012), signaling that this process is now being considered part of the L2 speaking construct. Until recently, research on pronunciation assessment has relied heavily on listeners' subjective judgments and other L2 speech measurements external to the listener such as speech rate, pause length and location, lexical stress, among others. However, there have been few attempts to explore the impact of measurements of nuclear stress placement and comprehensibility working in tandem for the development of L2 speech.

3 The Study

This classroom-based study sought to assess L2 learners' pronunciation using measurements of nuclear stress placement and comprehensibility to evaluate the efficacy of one particular pronunciation pedagogical treatment over another. The research questions that guided the present study are:

1. To what extent does the addition of a communicative, awareness-rising component to a traditional teacher-centered approach to the teaching of L2 pronunciation contribute to enhance the students' perceived comprehensibility and nuclear stress placement?
2. Is there any degree of association between comprehensibility and nuclear stress placement improvements in each of the treatments applied?

4 Method

4.1 Context and Participants

The experimental context of this classroom-based study was *Discurso Oral II* (DOII), a 16-week pronunciation-specific course of eight weekly hours focusing on suprasegementals. This course is taught in year 2 of the English Teacher Training Program offered at a local state university in Mar del Plata, Argentina. The students enroll in this class after having taken and passed *English Phonetics and Phonology I* and *II*, where they study the nature of English sounds.

Fifty Spanish-L1 trainees participated in this study. They were divided into two groups: A ($n = 25$) and B ($n = 25$). In Group A, learners were from 20 to 41 years old ($M = 22$), and in Group B, they were from 19 to 30 years old ($M = 22$). Each group consisted of 23 females and 2 males. Their level of English language competence before entering the university was equivalent to a TOEFL iBT Total Score of 70 or above. Their formal L2 instruction ranged from 5 to 9 years at private local language institutes in Mar del Plata, Argentina (M years of instruction: A = 7.12, B = 7.32). None reported having lived in an English-speaking country before taking the course. When data were gathered, these learners were taking other courses in English in the same teacher training program. In both groups, the participants reported not having used English outside the classroom, except for completing homework. Native and non-native English speaker models (their teachers and listening materials) were the type of input they received.

4.2 Teaching Intervention

Both groups were taught during a 16-week period at different times and received suprasegmental instruction using a teacher-centered approach to pronunciation teaching (TCT), which focused on form. The theoretical sessions of instruction lasted 16 weeks and covered aspects relating to English stress, rhythm and intonation. Practical sessions consisted in dictations whereby students were required to recognize and transcribe segmental and prosodic features using phonetic script and pronunciation conventions. Students completed controlled exercises, imitating British English native-speakers using the RP (Received Pronunciation) accent. Student-teacher and student-student interactions were limited. Unlike Group A, Group B included a communicative, awareness-building component (CABC) with a strong focus on the teaching of suprasegmentals. This CABC was taught within the same time-frame as the other group in a weekly 2-h block. To include this component, a lab controlled-practice block was taken out from the instruction. Within the CABC, learners completed a battery of communicative tasks aimed at raising their awareness of specific phonological target forms followed by a period of analysis and reflection (Luchini, 2018). These tasks required students to work collaboratively in class. They were asked to recognize, analyze, reflect and emulate different phonological target forms as well as to self-assess their productions. They were exposed to different native and nonnative English accents.

4.3 L2 Speech Samples

The speech samples were taken from task 2 (T2) of an oral achievement test (Luchini, 2004) administered to participants before and after instruction in the form of pre/post-tests at weeks 1 and 16, respectively. T2 asked learners to compare and contrast two pictures of people doing different activities. This task was chosen because it does not present any interactional phenomena, thus facilitating the data processing as there are no voice overlaps, or changes in tonal adaptation caused by turn taking. Thirty seconds of recording were selected from both the pre- and post-tests which lasted approximately two minutes each. Each speech sample was delimited by the use of two-time markers: after the first 10 s of starting T2, and within the stipulated 30 s. That is, neither the beginning nor the end of the task was included for analysis, thus allowing the study of the central portion of all the recordings, which is the extension of the speech signal with a greater degree of fluency. Working with standardized speech samples in terms of their duration allows for more consistent comparisons among productions.

4.4 Assessment Procedure for Nuclear Stress Placement

Two experienced English pronunciation teacher-researchers (one a balanced Spanish/English bilingual speaker, the other a Spanish-L1 speaker and advanced English-L2 speaker) worked independently, listened to, transcribed, and segmented the spelling transcripts of the students' recordings into tone units. The tone unit is a unit of English phonology, which can be defined as one melodic contour (Halliday & Greaves, 2008). Both filled and empty pauses were removed from the spelling transcripts. The teachers identified and placed nuclear stresses in each tone unit following the rules that govern English nuclear stress, and informed by the context provided by the transcripts. To measure the assessors' degree of agreement, interrater reliability was used. That is, the results of each assessor were compared in order to determine consensus degree. The percentage of homogeneity between results was 89%. Assessors negotiated final agreement for the remaining 11%. The assessors reported that segmenting the orthographic transcripts presented a high degree of complexity, resulting in, for example, one same statement being segmented differently. To standardize this process, both assessors were asked to arrive at a *standard response* against which they would later evaluate the learners' speech samples. Therefore, the assessors compared the learners' recordings to the standard response to determine the correct/incorrect location of nuclear stresses. That is, for each participant's speech sample in both pre/post-test conditions, there was a corresponding standard response (100 speech samples = 100 standard responses). To operationalize this procedure, Trofimovich's personal suggestion was followed (Trofimovich, October, 2009, personal conversation):

> The problem with working with free speech data is normalizing for speech length. Different people produce speech samples that are different in length and therefore they have different opportunities to produce the items that you are measuring. To get a measure for each participant, I would divide each count by the total number of possibilities. These "counts" and "possibilities" depend on what you are measuring. If, for example, in a given speech sample there are five nuclear stresses (as suggested by the specialists), then you have your 5 possibilities. So everything the student has done will be counted out of 5. If, for example, a student got 3 out of 5 of these stresses right, then your correct count for this student is 3. And your final measure will be 3 divided by 5 (3/5), that is, 3 stresses out of 5. So your counts will be a proportion of nuclear stresses produced correctly. If a student got more stresses than there should be, I would not punish him/her for these "extra" stresses.

This procedure consists in dividing the total number of coincidences in the students' productions of nuclear stresses by those agreed in the assessors' standard responses. For example, if for the same speech sample, a learner marked three nuclear stresses while the assessors agreed on five, the average for that participant was 3 out of 5 (3/5), equivalent to: 0.6. Whenever learners' production evidenced a greater number of nuclear stresses than those identified by the assessors, those were not considered as part of the total average. Only nuclear stresses that matched the standard response number counted as correct answers. This procedure is illustrated in Table 1, using Student 9's speech sample in pre-test condition (Group A) as an example. Slanted bars (/) indicate tone unit boundaries. Syllables bearing the nuclear stress are shown in **bold font**.

Whereas the assessors identified six nuclear stresses in the standard response, the analysis of Student 9's speech sample shows 8 nuclear stresses, 3 of which matched the ones they had identified in the standard response. Following Trofimovich's suggestion, then, the value of (1) represents total coincidence of nuclear stress placement in both samples. In this case, it indicates a coefficient of 0.5.

Table 1 Pre-test condition: sample of standard response and assessors' perceptual analysis

Standard response *Pre-test*	Perceptual analysis *Pre-test*
/there's just one young **man**/ I think he might be playing some kind of **ins**trument/ or he has drunk many **so**das apparently/ In the **first** picture/ they have like a **lunch** meeting or something/ probably there are **more** people/	/there's just one young **man**/ I think he might be playing some kind of **ins**trument/ or he has drunk many **so**das apparently/ In the first **pic**ture/ they have like a lunch **meet**ing/ or **some**thing/ **prob**ably/ there are more **peo**ple/

Table 2 Post-test condition: sample of standard response and assessors' perceptual analysis

Standard response *Post-test*	Perceptual analysis *Post-test*
The first **two** teenagers/ probably are at a **table/** having a lot of **food/** I cannot say **what** it is/ or what **kind** of food it is/ but it doesn't look very **health**y/ They are like at the **din**ner party/ or something of the **sort/** And in the **sec**ond photograph/ they seems to be at the **street/**	The first two teen**age**rs probably/ are at a **table/** having a lot of **food/** I cannot **say**/ what it is or what kind of **food** it is/ but it doesn't look very **health**y/ They are like at the **dinn**er party/ or something of the **sort/** And in the second **pho**tograph/ they seems to be at the **street/**

The same assessment procedures were used to analyze Student 9's production in the post-test condition (Group A). Table 2 shows both the standard response and the assessors' perceptual analysis.

From their experience as pronunciation teachers and guided by phrase stress rules, the assessors identified ten nuclear stresses which they highlighted in their standard response. Interestingly, in their perceptual analysis of Student 9's production, they also recognized ten nuclear stresses, of which six matched those they had identified in the standard response. The results in the post-test condition reveal a coefficient of 0.6, indicating an improvement in the location of nuclear stresses.

Two acoustic profiles of the same phrase "*and in the second photograph*" taken from this same speech sample are shown below. The computer program *Speech Analyzer*® for acoustic analysis of speech sounds was used (see https://software.sil.org/speech-analyzer/). Figure 1 shows Student 9's production taken from the post-test condition. Figure 2 shows the production of the same phrase coming from the balanced Spanish/English bilingual assessor. The student misplaces the nuclear stress on the word "*photograph*," while the assessor, in her role as bilingual speaker and specialist correctly locates the stress on the word "*second*," consistent with the rules that govern contrastive stress placement in English.

Figure 1 shows three acoustic records in four windows that allow visualization of the variations in the speech wave and intensity (on the left), and frequency (F0) and harmonics (on the right). All reflect the physical properties with which Student 9 emitted the phrase "*and in the second photograph*." In the windows located on the right-hand side, for example, two important peaks of F0 are located: the first of approximately 200 *Hz* corresponding to "*second*," and the most significant is 258 *Hz* in '*photograph*,' which acquires all the requirements of a nuclear stress, peak intensity of around 60 dB (decibels) being added to these F0 values.

Figure 2 illustrates the extent of individual variations in the production of prosodic contours. In principle, and always within the comparison of the same phrase emitted by two female speakers, it is observed that nuclear stress assignation is different. In this case, the assessor decides to highlight the first syllable of the word "*second*," because she has taken into account the variants of the discursive context, always bearing in mind the order of the implementation of T2. The need to use contrastive

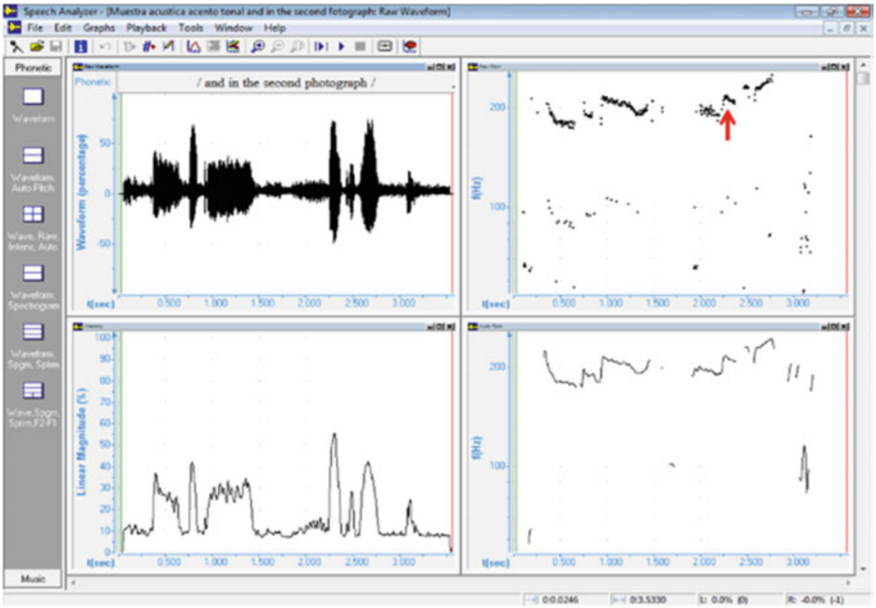

Fig. 1 Acoustic profile of the phrase "*and in the second* ***photo****graph*" issued by the student (the arrow indicates nuclear stress location)

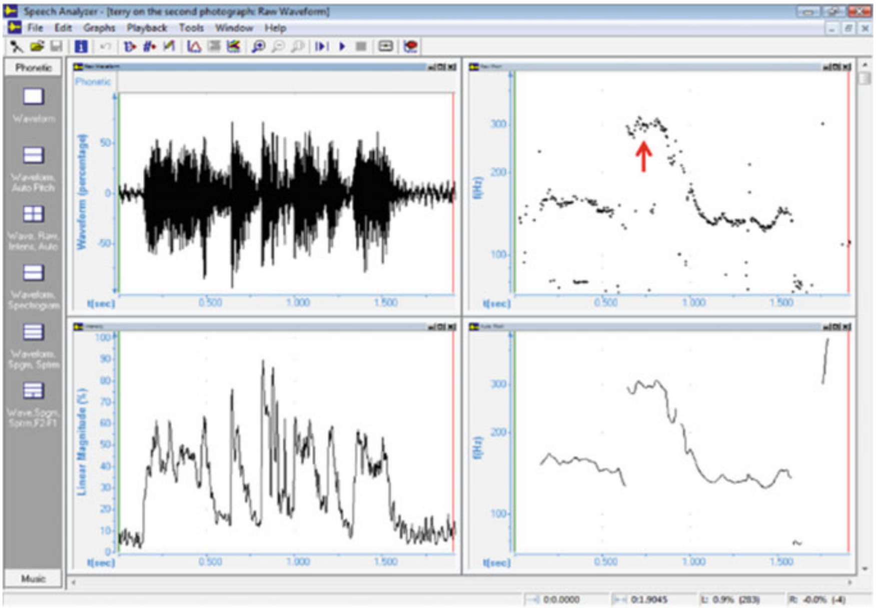

Fig. 2 Acoustic profile of the phrase "*and in the* ***sec****ond photograph*" issued by the assessor (the arrow indicates nuclear stress location)

stress in this case leads her to produce a 310 Hz frequency peak that accompanies an energy rise of around 89 dB. To her sharp register, we must add what is displayed in the first window on the left: the fluency of her continuous speech flow, which does not present any sign of hesitation, thus there is no explicit pause. This is clearly shown by the compression of the waveform, where we can see a noteworthy difference between the two speakers' realizations of the same phrase. In Fig. 1, this same window presents hesitation or doubt, equivalent to a pause between the stresses mentioned (see distance in the temporal axis of the windows located to the right of Fig. 1, between the words "*second*" and "*photograph*").

Observation of these acoustic profiles allows us to distinguish the scope of individual differences and degrees of training in the use of English pronunciation between the two speakers. The acoustic aspect that is associated with a better command of English is manifested by the balanced bilingual speaker. This type of acoustic analysis highlights the importance of the use and localization of the nuclear stress. We can see that the operationalization of this assessment procedure provides interesting information that allows to evaluate the efficacy of speakers' use and placement of nuclear stress in free speech production in English and to measure their linguistic development and oral proficiency over time.

4.5 Assessment Procedure for Comprehensibility

Ten experienced English native speaker raters, operating independently, listened to the 100 speech samples and rated them using a Likert-like scale ranging from 1–9 to determine the speakers' degree of perceived comprehensibility. In this context, comprehensibility means the perceived ease or difficulty of understanding L2 speech, that is, the cognitive effort made by the listener to understand accented speech (Munro & Derwing, 1995). The listeners made a scalar judgment of comprehensibility where 9 indicated total ease of understanding and 1 showed poor comprehensibility or high degree of effort on the part of the listener to understand non-native speech. The raters heard each stimulus once. To reduce the effects of fatigue, they were given short breaks in between the recordings. None of the raters reported having had hearing impediments.

4.6 Data Analysis

The statistical analysis was performed using *InfoStat* software v2020e (Di Rienzo et al., 2014). Mean values, standard deviation and least significant differences were calculated using the *LeastSquares Fit model*. Mean comparisons were made with independent samples t-tests in each group for both independent variables (nuclear stress and comprehensibility) with $\alpha = 0.05$. A simple linear regression analysis was performed between the relative responses (RR) of nuclear stress and comprehensibility: RR = (post-test − pre-test / pre-test) × (100) to determine whether the variations in one of the variables explain the variations in the other. Outliers were removed prior to analysis.

5 Results

In either treatment, no significant differences were observed between pre- and post-test conditions for both nuclear stress and comprehensibility (see Tables 3 and 4).

However, a slight tendency for improvement for nuclear stress and higher values for comprehensibility are observed between pre- and post-tests in the CABC treatment, which indicates that Group B improved the nuclear stress coincidence coefficient (i.e., closer to 0.8) and the degree of comprehensibility (i.e., higher than 6) (see Figs. 3 and 4).

The simple linear regression analysis between RRNS (relative response nuclear stress) and RRC (relative response comprehensibility) for Group A (TCT) was not statistically significant with a *p-value* of 0.6073 and an *adjusted R-squared* of −0.03421. On the other hand, the simple linear regression analysis of Group B (CABC) was statistically significant with $\alpha = 0.1$ (probability error of 10%) with a *p-value* of 0.0542 and an *adjusted R-squared* of 0.1383.

Figure 5 shows the dispersion of the data between the relative responses of the analyzed variables (RRNS and RRC), and the simple positive linear regression line is shown only for Group B. The improvements obtained by this group, exposed to the CABC treatment, explain 14% of the variation in RRC, while Group A, under the TCT treatment, does not register a relationship between the variables. This indicates the lack of relationship between the variation in nuclear stress placement throughout the instructional period and the variations in comprehensibility.

6 Discussion

Both experimental groups underwent a teacher-centered treatment (TCT), but only Group B included a communicative-awareness-building component (CABC). Intra-group analyses revealed that Group B obtained better results in the two variables analyzed (nuclear stress and comprehensibility), thereby demonstrating that formal instruction that includes a communicative component tends to show better improvements on students' productions. In this communicative block, Group B learners completed a battery of progressive tasks aimed at raising their awareness of specific phonological target forms followed by a period of analysis and reflection. These tasks were sequenced in order to lay emphasis on a meaning-form-meaning progression that sought to recognize phonological gaps in the students' interlanguage while in the process of constructing meaning. Phonological gaps were

Table 3 Intragroup mean comparison for nuclear stress (independent samples *t*-tests)

Treatment	G1	G2	*M* (1)	*M* (2)	*M*(1) − *M*(2)	LI (95)	LS (95)	pHomVar	*t*	*p*	Test
CABC (n = 21)	(post-test)	(pre-test)	0.80	0.72	0.08	−0.03	0.18	0.3190	1.46	0.1518	Bilateral
TCT (n = 23)	(post-test)	(pre-test)	0.78	0.78	−4.8E-03	−0.010	0.09	0.8308	−0.11	0.9156	Bilateral

Table 4 Intragroup mean comparison for comprehensibility (independent samples *t*-tests)

Treatment	G1	G2	*M* (1)	*M* (2)	*M* (1) − *M*(2)	LI (95)	LS (95)	pHomVar	*t*	*p*	Test
CABC (n = 21)	(post-test)	(pre-test)	6.19	6.11	0.08	−0.31	0.46	0.9560	0.40	0.6892	Bilateral
TCT (n = 23)	(post-test)	(pre-test)	6.07	5.96	0.10	−0.53	0.74	0.8393	0.33	0.7425	Bilateral

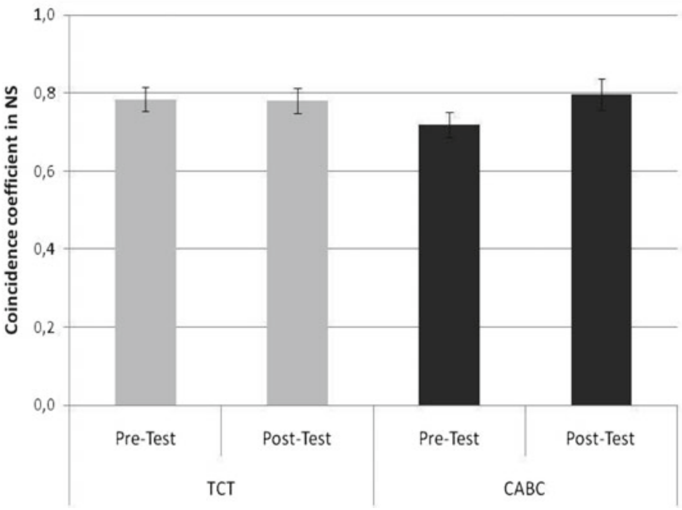

Fig. 3 Coincidence coefficient in nuclear stress

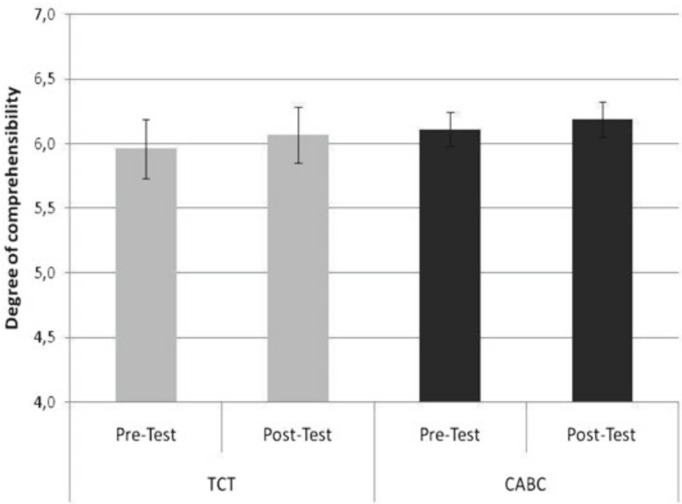

Fig. 4 Degree of comprehensibility

filled in language-pronunciation focused sessions by making comparisons between input and output which brought about discussions, always focusing on phonological target forms (Samuda, 2001; Swain & Lapkin, 2001). The aim of these tasks was to help students raise their awareness of key phonological features and the

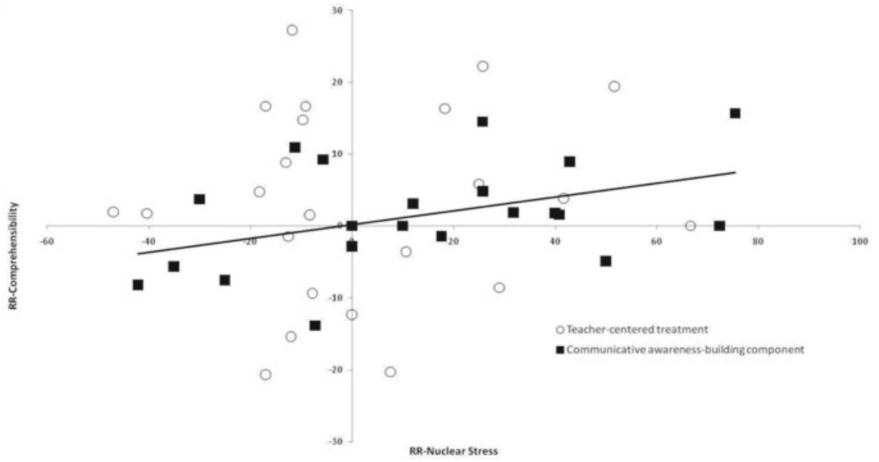

Fig. 5 Simple linear regression analysis between RRNS and RRC for TCT (Group A) and CABC (Group B) treatments

contribution of these aspects for establishing both receptive and productive intelligibility/comprehensibility. The inclusion of CABC promoted some degree of improvement in the target form, and thus provides the groundwork for more accurate nuclear stress placement.

The simple linear regression analysis between RRNS and RRC in Group A was not statistically significant, showing no relationship between the variables. The pedagogical treatment applied to Group A (TCT) was more aligned with the *Nativeness* paradigm. This finding echoes findings from other studies framed within the *Nativeness* paradigm (see Thomson & Derwing, 2014), which showed an unclear relationship between pronunciation improvement with discrete features and more intelligible and comprehensible speech. In contrast, a statistically significant linear regression between RRNS and RRC was found for Group B, which included the CABC treatment (more aligned with the *Intelligibility* principle). Group B's 14% improvement in comprehensibility was due to students' progress in nuclear stress placement. Thus, the results of the current study are more in line with previous findings showing that the *Intelligibility*-oriented paradigm is highly related to better achievements in intelligibility and comprehensibility (Isaacs & Trofimovich, 2012; Jułkowska & Cebrian, 2015; Kang, 2010; Saito et al., 2015, 2016; Thomson, 2018; Trofimovich & Isaacs, 2012). Isaacs and Trofimovich (2012) amalgamated intelligibility and comprehensibility suggesting that issues concerning comprehensibility are consistent with the instructional goals of helping learners attain intelligible pronunciation. It appears then that an awareness-rising, communicative-based approach for the teaching of suprasegmentals improves nuclear stress placement which, in turn, brings about advances in comprehensibility. Therefore, it seems to be advisable for pronunciation teachers to incorporate form-focused classroom tasks that strictly aim to develop the correct use and localization of nuclear stress enabling students to achieve better comprehensibility. The CABC instructional block was limited to two weekly hours. The question for further investigation remains: Had the students received more instructional hours within the CABC framework, would their degree of comprehensibility have been better?

The data from this study reinforce and complement the pedagogical claim that emphasizes the importance of teaching nuclear stress placement to achieve higher levels of comprehensibility (Hahn, 2004; Kang, 2010; Morley, 1991). In her Lingua Franca Core, Jenkins (2000, 2002) includes nuclear stress as an essential feature because it contributes to mutual intelligibility in interactions among non-native speakers from different linguistic backgrounds. Along these lines, McNerney and Mendelsohn (1992) affirm that suprasegmentals must be taught before any other phonological aspect because they have a direct impact on the students' comprehensibility. They argue that giving priority to suprasegmentals not only improves students' comprehensibility but also contributes to raising their self-esteem as greater changes can be effected in their speech. Similar pedagogical arguments have been put forward by some other researchers (Brazil et al., 1980; Brown, 1995; Celce-Murcia et al., 2010; Clennell, 1996; Derwing et al., 1998; Kang, 2010; Kang & Johnson, 2018; Morley, 1991; Pennington & Ellis, 2000; Pennington & Richards, 1986). These findings lead to important pedagogical implications for language teachers, program designers and developers. Pronunciation classes can focus—though not exclusively—on suprasegmental differences directly related to nuclear stress placement and listeners' comprehensibility.

Finally, the design and systematization of an assessment protocol for measuring L2 pronunciation features permeates this chapter. The speech measures were analyzed using both auditory and instrumental techniques. Ten raters measured comprehensibility using a numerical scale of listener perception. For nuclear stress measurements, two specialized teacher-researchers provided a standard response for each speech sample that was later compared against the students' productions. Nuclear stress measurements were then compared with those of comprehensibility using simple linear regression analysis. This comparison determined the efficacy of one treatment over the other. The main findings of this study draw light on the usefulness of the implemented pronunciation assessment protocol for evaluating the effectiveness of L2 pronunciation instruction. This protocol may be valuable for other teachers and researchers interested in measuring students' L2 pronunciation gains and compare results in other teaching contexts using the same or other pedagogical treatments.

6.1 Limitations

Although the findings of this study yielded interesting results regarding the impact of one L2 pronunciation pedagogical treatment over another, there are a number of limitations that are worth discussing. As opposed to lab experiments, classroom-based studies, such as this one, inevitably allow for other influencing linguistic factors that need to be taken into account. The students in both groups were simultaneously taking other English classes along with DOII. This classroom input could have enhanced their L2 pronunciation development as well. Both groups showed a slight tendency towards improvement in their oral productions after instruction. Yet, Group B scored higher results than Group A. This intragroup difference is attributed to the inclusion of the CABC in the pedagogical treatment applied to Group B. As already mentioned, it is worth posing the question whether a larger CABC workload would have produced further advancement in comprehensibility. Moreover, a comparative study that evaluates the impact of two entirely different treatments, one of them being exclusively based on the CABC pedagogical principles, would be needed.

The current study involved the measurement of one single prosodic feature: nuclear stress placement. Research on measurements of other elements of oral proficiency such as lexical stress, rhythm and pause duration, location and frequency, for example, would have yielded more information to corroborate or contradict the findings obtained. Additionally, learning about the students' beliefs and perceptions regarding the development of their L2 productions before and after instruction would have allowed to cross-check different types of data, confirm findings, and perhaps help to interpret the results obtained. Unfortunately, due to time constraints, neither option was possible. Finally, all the participants were L1-Spanish speakers studying to become English teachers. Results from populations of other cultural and linguistic backgrounds, and learning goals could provide other types of information.

7 Implications

This study may be a valuable contribution to future teachers and researchers. Correct nuclear stress placement contributes to increased comprehensibility and as such should be given high priority in the L2 pronunciation class. These findings may also lead to important pedagogical implications, providing additional evidence to support the importance of suprasegementals on listeners' perception and clarify their relationship with comprehensibility on L2 learners' speech. Teachers, trainers, program designers and developers should focus their attention on devoting more class time to teach this prosodic feature.

Furthermore, a pedagogical proposal for the teaching of suprasegmentals, as the one deployed in the CABC group, whereby tasks function as a pivot to develop phonological awareness, promotes self-efficacy and pushes learners to use metacognitive skills. Both these factors increase the chances of further development of comprehensible read-aloud L2 oral production (Sardegna, 2012, 2021). The current study contributes to this line of research by showing how improvements in nuclear stress placement via awareness-raising relate to improvements in speech comprehensibility in a picture description task. Further research in this area is needed to confirm and extend the findings to other speech features.

8 Conclusion

Pronunciation instruction is not a marginalized area of second language teaching and research anymore. This field is growing swiftly. Explicit pronunciation instruction can have a significant effect on students' oral production because it focuses on learners' attention to phonetic information and increases phonological awareness, which promotes learning in a way that exposure alone does not. Previous research on L2 pronunciation has concentrated on identifying L2 learners' stress patterns. Only a few studies have measured the effect of nuclear stress placement along with comprehensibility ratings, and have used this assessment procedure as an instrument to evaluate the effectiveness of L2 pronunciation instruction. The innovative assessment procedure used in this classroom-based study proved useful to determine such efficacy. As mentioned earlier, further studies are needed to corroborate or contradict these findings, as well as to increase our understanding of suprasegmentals as predictors of L2 pronunciation development, and to help define instructional priorities.

Acknowledgements Thanks to Mariela Xynos and Ubiratã Kickhöfel Alves for their comments and suggestions on earlier drafts.

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