THE PRODUCTION OF ENGLISH WORD-FINAL / i / BY BRAZILIAN LEARNERS - A MATTER OF TIME

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ABSTRACT**:** The process of learning an L2 is strongly influenced by L1 patterns, mainly in early stages of acquisition. Zimmer & Alves (2007) state that learners gradually increase automatic access to L2 phonetic and phonological structure and reduce access to L1 patterns, although a certain degree of transfer will always exist in the acquisition process. The present study aims at verifying the influence of a prosodic pattern and its acoustic correlates from Brazilian Portuguese (BP) on the production of English words: if durational characteristics of BP unstressed word-final vowel affects the production of English word-final vowel /i/. Data from nine participants – six Brazilian learners and three native speakers of English – were collected through the reading of a carrier-sentence which contained the CVCV target words ending in /i/. Acoustic data show that English word-final /i/ produced by Brazilians have considerable shorter duration in relation to native speakers' vowels, revealing that learners at the intermediate level have not acquired the proper durational pattern of such unstressed final vowel in English.
KEYWORDS: duration; L2 acquisition; acoustic phonetics

RESUMO: *O processo de aprendizagem de uma L2 é fortemente influenciado por padrões da L1, principalmente em estágios iniciais da aquisição. Zimmer & Alves (2007) afirmam que os aprendizes gradualmente aumentam o acesso automático às estruturas fonética e fonológica, embora algum grau de transferência permaneça no processo da aquisição. O presente estudo tem por objetivo verificar a influência de uma característica prosódica e seus correlatos acústicos do PB na produção de palavras em inglês, a saber, se as características da vogal átona final do PB em termos de duração são transpostas para vogais finais da língua inglesa. Dados de nove informantes – seis aprendizes brasileiros e três falantes nativos de inglês – foram coletados através da leitura de uma frase veículo que continha as palavras-alvo, que configuravam um padrão CVCV, em que a última vogal era /i/. Os dados acústicos mostram que os brasileiros produzem vogais com menor duração que as produzidas por falantes nativos de língua inglesa.*
PALAVRAS-CHAVE: *duração; aquisição de L2; fonética acústica*

Introduction

Learning a foreign language (L2) is a complex and dynamic process that requires the individual not only the domain of phonological, morphological, syntactic, semantic and discourse aspects, but also the ability to interrelate each of these elements. Regarding phonetic and phonological aspects, the learner must produce L2 sounds and use syllabic, stress and rhythmic patterns that are often dissimilar to the ones used in their native language (L1), besides understanding the relationship among these elements. Thus, it is common for individuals to use the phonetic-phonological patterns of their L1 in the

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production of utterances in L2, sometimes compromising the intelligibility of their speech. Zimmer & Alves (2007) explain that foreign language learning is initially highly influenced by the structures of L1, and the learner increases, little by little, automatic access to L2 lexicon and structure of phonetic-phonological knowledge without using L1 aspects as much, although some degree of transfer between the two languages is always present.

A great deal of research has been held in Brazil in order to verify the acquisition of phonological aspects of English as an L2 by Brazilian learners (BLs). Some of these studies concern the presence or absence of an epenthetic vowel after stop consonants in coda position in English words produced by BLs (Major, 1986, Major 1987; Fernandes, 1996; Baptista Filho & Silva, 1997; Koerich, 2002; Silveira, 2004; Alves, 2004; Ferreira, 2007). These studies showed that BLs, at a greater or lesser rate, produce an epenthetic vowel after stops in coda position in English words mainly because of differences in the syllabic structures found between this L2 and Brazilian Portuguese (BP). However, the "errors" of production in these studies were not only assigned to the transfer of the BP syllabic pattern into English; factors such as level of proficiency in L2, markedness relationships and phonological environment also proved to influence the production of the epenthetic vowel. There is also the fact that these studies were based on auditory analysis, which may bias results if something expected is “heard”, but not actually performed by participants.

Ferreira (2007) found that BLs at an intermediate level of proficiency produce an epenthetic vowel after English word-final stops only in 7% of cases. This research aimed at verifying whether learners produce the difference between words ending in stops such as *luck* and disyllabic words ending in -y, such as *lucky*. Data were analyzed acoustically and results showed that although learners produce some type of friction after releasing the articulators in word-final oral stops, the epenthetic vowel was performed in just a few cases. Such low rate was attributed mainly to learners’ level of proficiency. Therefore, it was concluded that BLs, as they progress in the study of English as L2, gradually stop inserting the epenthetic vowel, satisfactorily producing the difference between words such as *luck* and *lucky* in most cases. Conversely, another fact was evidenced in the production of BLs regarding the two-syllable words: final vowels were significantly reduced in duration compared to the vowels produced by the native speaker of English, whose production was collected for the research. The data collected was not enough to assert that Brazilians produce vowels with reduced duration mainly because of the lack of data from native speakers of English. However, there seemed to be a tendency of the learner to produce word-final English vowels similarly to BP unstressed final vowels. This happens because learners produce English word-final vowels (in our case, /i/) using BP stress patterns, in which the stressed vowels have longer duration whilst in unstressed vowels, the duration is severely reduced.

Acoustic correlates of stress BP and English

In order to establish the relationship between the phonetic and prosodic levels in the acquisition of English as an L2 by BLs, it is relevant to describe the stress patterns and their acoustic correlates in both L1 and L2. According to Massini-Cagliari (1992, p.9), "more recent phonological models (nonlinear) have defined stress as a relation of

prominence among syllables: the most prominent are the stressed and the least prominent, the unstressed." The same author points out that this prominence takes place at the phonetic level - in both acoustic and articulatory terms – but in different ways in each language. Nevertheless it is important to refer to the relative nature of stress, pointed out by Clark & Yallop (1995), who claim that the syllable is not stressed or unstressed in absolute terms, but in relation to other adjacent syllables or other nearby reference. Such prominence is characterized as phonic salience at the phonetic level, being treated in lexical terms or related to the rhythm of the language. Lexical stress has phonological status in BP and English. This means that identical words in their segmental composition may have morphological and / or semantic differences as in '*sábia* (‘wise’) / *sa'bia* (knew) / *sabi'á* (thrush) in Portuguese, and per'mit / 'permit in English.

For BP, Massini (1991) claims that duration is the main physical correlate of stress, so that stressed syllables have longer duration, and unstressed, shorter duration. In the same study, the author also investigated the relationship between stress and intensity, and found out that the latter figures as another important physical correlate of stress in BP. In relating these two acoustic correlates, she concluded that in "...29% of cases, stress is characterized only by the duration, and in 10%, only by the intensity, whereas in 61% of the cases, the emphasis is phonetically characterized by the two parameters "(MASSINI-CAGLIARI, 1992, p. 23). Therefore, the interaction between these two parameters was found to be very important for the characterization of lexical stress in BP. In addition to duration and intensity, vowel quality is also modified because of stress, leading to vowel reduction. Moreover, the variation of fundamental frequency (F0) was also analyzed, but shown to be irrelevant to the phonetic characterization of lexical stress.

In fact, there is not only a physical correlate that characterizes stress in a language, but the co-occurrence of parameters more often associated with the lexical stress than others. Furthermore, the importance of these parameters varies from language to language, as well as its relative independence (LEHISTE, 1970). In English, research sought to determine more precisely the hierarchy of acoustic correlates of stress and their interrelationship. Fry (1955, 1958), in his studies using synthetic speech, concluded that F0, intensity and duration affect the identification of stress, and changes in duration but not in intensity were enough for stress to be clearly identified. For this author, the hierarchy of these acoustic correlates would be F0, duration and intensity. Lieberman (1960) assigned F0 utmost importance for the identification of stress, followed by intensity and, finally, duration. Other studies (Fear, Cutler, & Butterfield, 1995; Sluijter, van Heuven, & Pacilly, 1997) consider acoustic correlates of stress in English redundant, and believe that the segment always provides stress information. To conclude, although there is not complete agreement among the authors, F0 seems to be the most reliable acoustic correlate for stress identification, followed by duration and intensity.

Word-final vowel duration in Ferreira (2007)

Data from 13 participants were collected - 12 Brazilian[2] and one American – who were recorded reading a carrier-sentence (Say X, please) containing the following target

[2] BLs had from 250 to 300 hours of formal instruction in English and could be placed in level B1 or B2 from the Common European Framework of Reference for Languages.

words: pop / poppy, bob / bobby, pet / petty, dad / daddy, luck / lucky, bug / buggy. The CVCV words were analyzed and only 16.7% of the cases produced by the BLs presented palatalization, africation or aspiration of the last consonant, or the devoicing of the last vowel. In few cases, learners did not produce the last vowel. The duration of the word-final vowel was significantly shorter than that of the English NS:

Participants		**Native Speaker**	**Brazilian learners** (12 participants)
Word			
Poppy	Mean	23.9	12.1
	std. dev.	4.4	4.2
Bobby	Mean	24.8	15.1
	std. dev.	2.9	3.3
Petty	Mean	25.4	9.5
	std. dev.	4.4	5.7
Daddy	Mean	24.4	16.5
	std. dev.	1	4.4
Lucky	Mean	19.3	8
	std. dev.	3.6	4.4
Buggy	Mean	32.2	16.1
	std. dev	2.1	4.4

Table 1: mean of relative duration of the final vowel in % and standard deviation

These results show that word-final vowels produced by BLs are greatly reduced in duration in relation to the data produced by the native speaker. In 40% of cases, BLs produced vowels with less than half the duration of the native speaker's, revealing a possible influence of the stress pattern of BP disyllabic words in the production of the final vowels the same type of words in English.

Objectives

This research aims at verifying whether the duration of final vowels in English CVCV words produced by Brazilians is actually shorter than that of English native speakers'. Considering that in BP, duration is the most important acoustic correlate of stress and that, in English, the most significant correlate is F0 variation, it seems reasonable to speculate that the way the Brazilians produce unstressed word-final vowels in PB influences the production of the final vowels of English disyllabic words. Therefore, it is intended to investigate whether this BP feature affects Brazilian learners' production of English final /i/.

Method

Some of the data analyzed in this study is part of the corpus collected by Ferreira (2007)[3]. Data from six Brazilian participants of that research – three male and three female – as well as from the native speaker, were selected. In addition to these data, we recorded two other native speakers – a male and another female - producing the same target words used by Ferreira. Therefore, data from six BLs of English at intermediate level and three NSs from the USA were analyzed acoustically through the software Praat®[4] for the duration of the final vowels of CVCV words *(*poppy, bobby, petty, daddy, lucky, buggy*)*. Duration was measured concerning the final vowel and the sentence, and relative duration was calculated dividing the vowel duration by the sentence duration. The parameters used in the interpretation of acoustic events were based on Read & Kent (1992).

Results and discussion

Data analysis pointed to the confirmation of our hypothesis, revealing durational characteristics of the vowels produced by the BLs to be quite distinct from the native speakers' data. The duration of the final vowels produced by NSs is significantly higher than that of Brazilian learners. The bar graphs represent the difference:

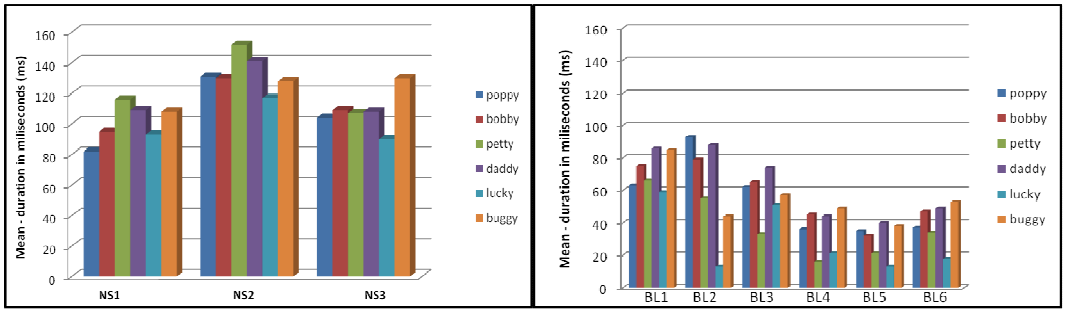

Figure 1: Mean duration in milliseconds of final vowels produced by the three native speakers (NS) and six Brazilian learners (BL).

In general, vowels produced by the BLs are much shorter than those produced by the NSs. In cases like the word lucky produced by BL2, the extremely low mean is justified by the non-production of the vowel in some of the target words.

With respect to the relative duration, the data reinforce the discrepancy between the duration of vowels by BLs and NSs. The relative duration of the vowel in relation to the sentence is a more reliable parameter to compare the data, given that a segment is not shorter or longer in absolute terms, but its duration depends on other factors, such as speech rate. If the BLs produce shorter vowels because of a higher speech rate, the relative duration would be greater, which does not happen as can be seen in the following charts:

[3] Participants of Ferreira (2007) – 12 Brazilian learners of English as L2 at intermediate level of proficiency and na American native speaker – were recorded reading a carrier-sentence (*Say X, please*) containing the following target-words: pop/poppy, bob/bobby, pet/petty, dad/daddy, luck/lucky, bug/buggy. Each participant recorded the sequence of sentences three times, producing a total of 468 tokens.

[4] Available for free download at http://www.fon.hum.uva.nl/praat/

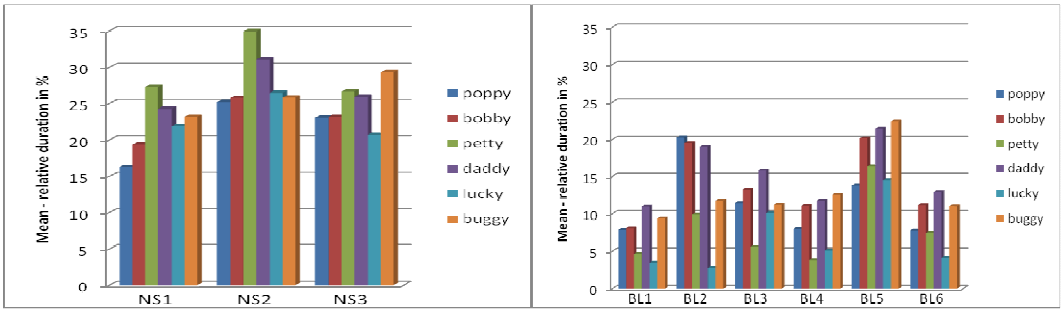

Figure 2: mean relative duration of the final vowel produced by the NSs and the BLs (in %).

It is quite clear that BLs do not produce word-final vowels as the NSs do, following the trend indicated in the study by Ferreira (2007). Another feature brought to light by the relative duration means is that is NSs seem to adjust vowel duration according to the place of articulation of the preceding consonant: vowels followed by alveolar stops are longer than the ones followed by velar stops, which in turn are longer than those followed by the bilabials. This relationship is not regularly present on the data from the BLs.

The data produced by BLs and NSs reveal that learners have not yet acquired this vowel durational pattern in word-final position. Most BLs produce, as shown in the following table, much shorter vowels than the NSs:

Participant / **Word**		**BL1**	**BL2**	**BL3**	**BL4**	**BL5**	**BL6**	**NS1**	**NS2**	**NS3**
Poppy	Mean	7.9	20.3	11.4	8	13.8	7.8	16.2	25.2	23
	std. dev.	4.2	2.8	0.4	0.7	0.8	1.7	0.4	2.4	3.5
Bobby	Mean	8.1	19.5	13.2	11.1	20.2	11.2	19.3	25.8	23.1
	std. dev.	0.3	3.4	2.4	1.9	0.8	3.6	2.6	6	2.4
Petty	Mean	4.6	9.9	5.6	3.8	16.4	7.4	27.3	34.9	26.6
	std. dev.	0.9	8.7	1.8	3.5	3.3	2.9	A	3.3	2.9
Daddy	Mean	11	19	15.8	11.8	21.4	12.9	24.2	31	26
	std. dev.	0.8	1.5	2.1	2.4	4.4	1.1	0.6	4.5	2.1
Lucky	Mean	3.4	2.8	10.1	5.1	14.5	4.1	21.9	26.4	20.7
	std. dev.	3.2	4.8	4.4	4.4	2.6	3.2	4.9	0.8	3.5
Buggy	Mean	9.4	11.8	11.2	12.5	22.4	11	23.1	25.8	29.3
	std. dev.	1.7	2.1	1.8	1.9	1.9	1.9	2.2	5.5	3

Table 2: Mean relative duration of the vowel and standard deviation in % for each of the words produced by the BLs and NSs.

BL5 was the participant who produced vowels with the closest duration to those of the NSs' and also presented the smallest variance in his production. In bobby, daddy and buggy, the mean duration was very similar to the means produced by NSs. On the other hand, in poppy, petty and lucky, BLs means were considerably lower than those of the NSs'. Vowels produced by FB5 were longer when preceded by voiced stops, which seems to have been a trend for other BLs as well. Data from NSs do not indicate such trend, as the means of the vowels followed by voiced stops are not regularly longer than ones followed by voiceless stops. This characteristic found in the BLs' data seems to be related to the production of longer fricative noise after the release of the

articulators in voiceless stops. It is natural and physiologically explained that, with the release of the articulators, fricative noise is produced - this also happens in the NSs' data. However, the referred noise detected in BLs' data was much longer, somehow influencing the production of the final vowel, as in these cases, vowel duration was significantly reduced. To illustrate this feature, we have the following figure:

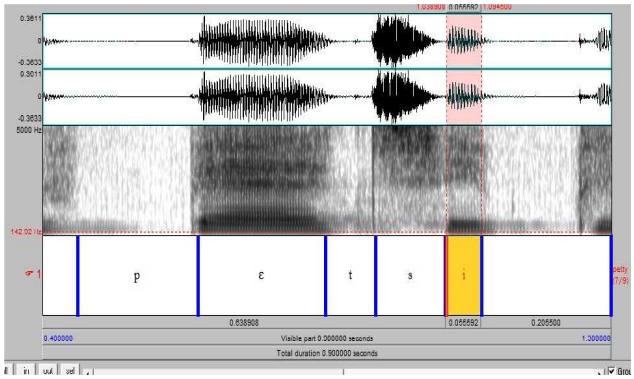

Figure 3: spectrum and spectrogram of petty produced by a BL.

Figure 3 shows the noise after the burst, in this case an alveolar fricative of approximately 114 milliseconds. The vowel, however, lasts only 50 milliseconds. The production of this fricative noise happens in some dialects of English, but even with the production of noise, NSs do not probably shorten the following vowel. In other data from BLs, there was the production of such noise, sometimes even containing the vowel / i /formants, as for example in the following figure:

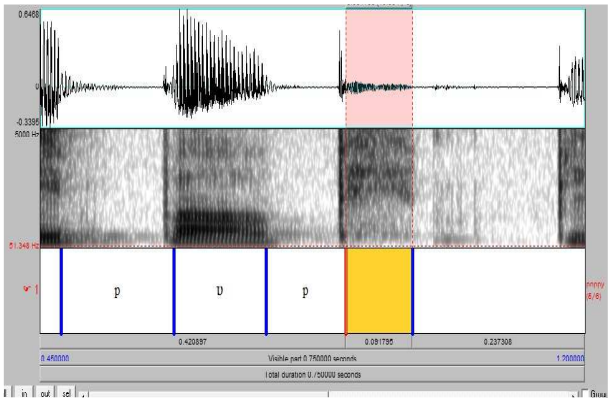

Figure 4: spectrum and spectrogram of poppy produced by a BL.

As we see in this figure, the participant produces an acoustic event much like the front-high vowel /i/, but without vibrating the vocal folds. Such acoustic event lasts more than 90 milliseconds - a reasonable time if compared with the vowels produced by NSs.

Thus, based on acoustic analysis of the data from BLs selected for this study, it can be stated that the duration of the final vowel in English words does not correspond to the NSs's values. Although we have not analyzed data from BP in relation to the duration of unstressed word-final vowels, Massini-Cagliari (1992) ensures that unstressed vowels, particularly post-stress, have shorter duration and intensity than stressed ones. Moreover, duration does not figure as the main acoustic correlate of stress in English, with F0 and

intensity playing this role, as pointed out by Lieberman (1960). We can see that characteristic in the following data:

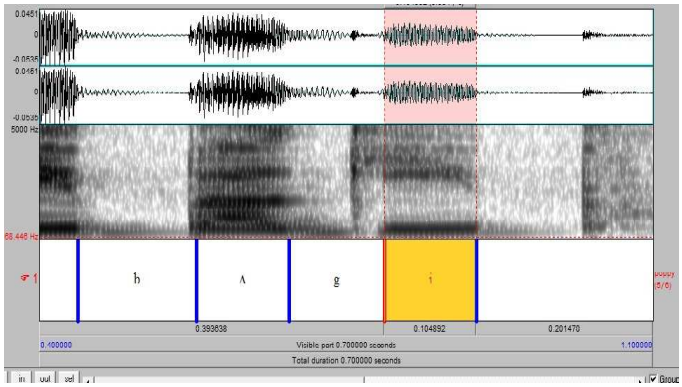

Figure 5: spectrum and spectrogram of buggy produced by a NS.

In this figure, we can see that the final vowel has the same duration as the stressed vowel of the word, 105.6 and 104.8 ms, respectively. This feature happens in other tokens, illustrating the durational difference between the BP and English. This difference is certainly influencing the production of BLs of English, especially in the early stages of proficiency.

Concluding remarks

From the presented results, we conclude that the BLs produce the word-final vowel /i/ of disyllabic English words with shorter duration when compared to data from NSs. This fact can be explained by the difference between the BP and English with respect to the phonetic realization of lexical stress. It seems that BLs, at least the ones at intermediate level of instruction in English, do not make durational adjustments required for the production of the final vowel of this L2. This characteristic corroborates the strong influence of L1 patterns in L2 acquisition. Nevertheless, some issues still remain: what are the durational characteristics of unstressed final vowels of the PB? As the Brazilians produce the final vowel in words without the morpheme-y, like *honey* or *happy?* BLs get to produce vowels with longer duration as they reach higher levels of proficiency?

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