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Vozeamento e dessonorização das fricativas alveolares do inglês: uma investigação de produções de falantes brasileiros

Voicing and devoicing English alveolar fricatives: an investigation of Brazilian learners' production

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RESUMO

Este estudo examinou a ocorrência de alteração de vozeamento em fricativas alveolares do inglês produzidas por falantes do Português Brasileiro (PB) em diferentes contextos fonológicos. Os participantes foram 23 falantes nativos do PB e 4 falantes nativos do inglês americano, e todos eles gravaram 54 frases em inglês contendo os sons-alvo. Os resultados mostraram que o contexto fonológico que desencadeou maiores taxas de dessonorização com /z/ foi uma pausa e uma consoante surda, e o contexto fonológico que desencadeou maiores taxas de dessonorização com /s/ foram uma consoante sonora e uma vogal. Além disso, a presença do grafema <e> na posição final da palavra influenciou a alteração de vozeamento.

PALAVRAS-CHAVE:
Segunda língua. Pronúncia. Alteração de vozeamento. Codas. Fricativas Alveolares.

ABSTRACT

This study examined the occurrence of voicing change in English alveolar fricatives produced by Brazilian-Portuguese (BP) speakers in different phonological contexts. The participants were 23 native speakers of BP and 4 native speakers of American English, and all of them recorded 54 English sentences containing the target sounds. The results showed that the phonological context that triggered higher rates for devoicing with /z/ were a pause and a voiceless consonant, and the phonological context that triggered higher rates of voicing with /s/ were a voiced consonant and a vowel. In addition, the presence of the <e> grapheme in word-final position influenced the production of voicing change.

KEYWORDS:
Second language. Pronunciation. Voicing change. Codas. Alveolar fricatives.

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1. Introduction

Each language has its own set of sounds, and when comparing two different languages, some of the sounds may be similar or identical. However, although two languages may have the same sounds, this does not mean that the sounds have the same status (phoneme or allophone) or the same distribution within syllables or across word boundary Yavas (2011). The sound [tʃ], for example, is a phoneme in English, but an allophone in Brazilian Portuguese (BP). In English, the use of this sound changes the meaning of a word, as demonstrated by the minimal pair each [itʃ] and eat [it]; in Brazilian Portuguese (BP), on the other hand, this sound simply represents a variant of /t/ (tia [tʃiɐ], [tiɐ] , 'aunt').

Non-target pronunciations that interfere with communication are a concern for the area of teaching and learning a foreign language. Research on the acquisition of English pronunciation by Brazilians has identified many difficulties that the learner faces when learning a foreign language, such as voicing change (SILVEIRA; SOUZA, 2011; ZIMMER, 2004), consonant clusters (BETTONI-TECHIO, 2008; CORNELIAN JR., 2003, RAUBER, 2002), the approximant /ɫ/ (MOORE, 2008; BARATIERI, 2006), and interdental fricatives (REIS, 2006). Voicing change is one phenomenon that affects accuracy in English pronunciation when speakers of other languages, such as BP and German are learning English as a foreign language (PIROTH; JANKER, 2004; SILVEIRA; SOUZA, 2011; SIMON, 2010; SMITH, ET AL., 2009; ZIMMER, 2004).

The notion of voicing change, central to this study, refers to the cases in which a learner produces a consonant sound with the voicing feature different from the target. For example, when a voiced consonant such as /z/ is produced as the voiceless [s], or the voiceless /s/ is produced as the voiced [z]. Although there are some studies on this matter involving other languages (PIROTH; JANKER, 2004; SIMON, 2010; SMITH, 1997; SMITH, ET AL., 2009), voicing change has hardly been investigated in BP/English interphonology studies. For this reason, the main purpose of this work is to investigate and analyze the occurrence of voicing change as a phonological process in BP EFL (English as a Foreign Language) learners' production of English, thus providing results which can be used to address this pronunciation difficulty in FL teaching.

In this sense, this study examined whether the phonological context following the target consonants influences the rates of voicing change. To examine the effects of this independent variable – following phonological context – two research questions (RQ) guided the study:

RQ1: In what phonological contexts do Brazilian learners produce voicing change with the English sounds /s/ and /z/ in word-final-position?

RQ2: How does spelling affect voicing change with /s/ and /z/ in word-final position?

Based on previous studies with BP speakers as well as with speakers of other languages (FULLANA; MORA, 2009; SILVEIRA, 2012; SMITH, 1997; YAVAS, 1997; ZIMMER, ET AL., 2009; ZIMMER, 2004), two hypotheses (H) were proposed for this study:

H1: Voicing change would occur in the following conditions: participants would voice the /s/ followed by a voiced consonant or a vowel, and devoice the /z/ followed by a voiceless consonant or a pause, thus transferring the phonotactic rules of BP into English (CRISTÓFARO-SILVA, 2010).

H2: Voicing would be more frequent with words spelled with the silent –e (e.g., house; case) than without this grapheme (e.g. this; bus). More specifically it was expected that the sound /s/ would be voiced when the word is spelled with the silent –e (see details in Section 2.5). Moreover, devoicing would be less frequent with words spelled with the silent –e grapheme (e.g., these; lose) than without this grapheme (e.g. does; moves); that is, it was expected that the sound /z/ would be less frequently devoiced when the word was spelled with the silent –e grapheme (SILVEIRA, 2009, 2012). If this hypothesis is confirmed, it would indicate that the learners are transferring the sound-to-spelling rules of their L1 into the FL as well, given that <s> is voiced in BP when it is surrounded by vowel graphemes (e.g., casa).

2. Review of Literature

Yavas (2011) points out that the realization of the consonant voicing feature depends on the position of the consonant in a word. He states that in English, voiced consonants are partially voiced when in initial and final position and he adds that voiced consonants are only fully voiced in intervocalic position. He also points out that voiceless and voiced consonants differ in relation to length of the preceding vowel or sonorant consonants. Therefore, the vowel/sonorant that comes before a voiced alveolar fricative /z/ is longer, while vowels before voiceless consonants are shorter because these consonants are fortis, and this involves "an earlier onset of the articulatory closure" (LISKER, 1973, p. 228). Before voiced consonants, on the other hand, vowels are lengthened to "allow time for laryngeal readjustment needed if voicing is to be maintained during

oral closure" (LISKER, 1973, p. 230).

Like English, the BP consonantal system includes the alveolar fricatives, /s/ being voiceless and /z/ voiced. However, these segments can be modified by its phonological context in different ways. Assimilation, for example, is a type of modification that a segment can undergo because of the phonological context surrounding it. In BP, a similar voice assimilation pattern is found across morpheme and word boundaries for the alveolar fricatives, which assimilate the voice quality of the following consonant (regressive assimilation):

'pés' [pɛs], 'pés molhados' [pɛz moˈʎadʊs], 'pés compridos' [pɛs kõˈpɾidʊs]
'paz' [pas], 'paz para' [pas ˈpaɾɐ], 'paz logo' [paz ˈlɔgʊ]

It is worth mentioning that BP has alveolar fricatives allophones, namely [z ʒ] and [s ʃ], which are conditioned by the linguistic and non-linguistic environments, according to the BP regional dialect (CRISTÓFARO-SILVA, 2010).

In this sense, the present study investigated the voicing assimilation patterns of the English alveolar fricatives in the production of Brazilian learners of English from different regions of Brazil. According to Fronkin, Rodman, Hyams (2011), English also presents assimilation of voice across morpheme and word boundaries. An example of morpheme boundary assimilation is when a noun plural marker is added to a word. In these cases, the morpheme -s will assimilate the voicing quality of the previous consonant (progressive assimilation): 'pets' [pʰɛts] and 'pads'[pʰædz]. As for across word boundary assimilation, it is always regressive (i.e., the consonant coda assimilates the voicing quality of the following consonant), but it only occurs when a voiced consonant is followed by a voiceless one. For example, compare the pronunciation of the –s morpheme, /s/ and /z/ below:

'goes' [gowz], 'goes by' [gowz baj], 'goes to' [gows tu]
'pets' [pɛts], 'pets may'' [pɛts mej], 'pets can' [pɛts kæn]
'house' [haws], 'house mix' [haws mɪks], 'house fix' [haws fɪks]
'nose' [nowz], 'nose mark' [nowz maɹk], 'nose tip' [nows tɪp]

Although many studies have shown that the L1 influences the production of FL sounds (FULLANA; MORA, 2009; SIMON, 2010; SMITH, et. al., 2009; ZIMMER; ALVES, 2008), L1 transfer

does not account for all types of non-target pronunciation. Moreover, interphonology research has frequently resorted to the notion of markedness to explain the development of FL phonology. One example is the Structural Conformity Hypothesis (SCH), which states that "interlanguages and primary languages are similar in at least one important respect: they both obey the same set of universal generalizations" (ECKMAN, 2009, p. 13).

For Eckman (2009), focusing on the areas of difference between the L1 and the FL, the marked structures would be more difficult than the corresponding unmarked structures. In BP, for example, there are not any stops in final position. The sequence VC (vowel-consonant), then, is more marked than CV (consonant-vowel), since the former, containing stop consonants, is not part of the BP word structure. Therefore, one of the phenomena that may occur in this case, when a native speaker of BP is learning English, is vowel paragoge, which is the insertion of an extra vowel, and in this case, the vowel will be inserted after the final stop (i.e., VC becomes VCV, (KOERICH, 2002)).

Eckman's (1991, 2009) Structural Conformity Hypothesis (SCH), affirms that the universal generalizations that are appropriate to first languages (L1s) are also appropriate to interlanguages. In addition, this hypothesis sustains that interlanguages and L1s are similar because they follow the same group of universal generalizations . Furthermore, the SCH argues that interlanguages will follow L1 universals, and in this case, if the universal principle affirms that a voice contrast in the end of a word implies a voice contrast in the middle and beginning of a word in the L1, for example, then this must be true for interlanguages as well (ECKMAN, 1991).

A universal generalization about the sounds being analyzed here is that [z] is more marked than [s], because voiced sounds are less frequent in the world's languages. If the SCH prediction is correct, the English words ending in [z] will yield more non-target pronunciations than the words ending in [s] in the BP speakers' interphonology. Consequently, the English /z/ is more likely to cause miscommunication than /s/, since the former is always voiced or partially voiced.

Previous research (SILVEIRA, 2012; 2009; 2007; 2004; ZIMMER, 2004) has shown orthography as a variable influencing the pronunciation of English sounds by BP learners, especially because of reliance on L1 spelling-sound correspondence. Zimmer's (2004) study investigated the L1–FL transfer of grapho–phonic–phonological knowledge, showing that it is not only phonological knowledge that is transferred to FL speech, but also the principles of the L1 alphabetic systems. Thus, when Brazilian learners are speaking or reading in the FL, they have a tendency to rely on the sound-spelling correspondence of their L1, due to their rooted L1

alphabetic knowledge.

Finally, concerning the occurrence of voicing change, SILVEIRA (2012) explains that the occurrence of voicing change in English is influenced by orthography, since it hinders the target-like production of word-final /s/ and /z/. According to the author, voicing change occurred less frequently with /z/ when followed by the silent –e grapheme (e.g.: 'nose'). On the other hand, the silent –e grapheme caused more voicing change for /s/ (e.g., 'mouse').

3. Method

The purpose of this study was to investigate the extent to which voicing change occurs in the production of alveolar fricatives by Brazilian learners of English. Therefore, this study examined whether the phonological context following the target consonants and orthography influenced the rates of voicing change. In this section we present the participants, the research instruments, and the procedures for data collection and data analysis.

2.1 Participants

There were 27 participants in this study. 12 of them were native speakers of Brazilian Portuguese (NBP) undergraduate students of the third and fifth semesters of the *Letras e Literaturas de Língua Inglesa* Program of the *Universidade Federal de Santa Catarina* (UFSC), 11 were NBP graduate students in the first semester of the *Programa de Pós-Graduação em Inglês* (PPGI) at UFSC, and four of the participants were native speakers of American English (NE). The NBP participants came from different parts of Brazil: (a) Santa Catarina (16), (b) Paraná (2), (c) São Paulo (2), (d) Rio Grande do Sul (1), (e) Mato Grosso do Sul (1), and (f) Brasília (1), but all of them were living in Florianópolis at the time of the data collection. Their age ranged from 17 to 46 years at the time of data collection (m = 27.58), and 17 were females and six males. No proficiency test was administered to the group, but we assumed their proficiency levels range from pre-intermediate to advanced, considering that the participants were undergraduate and graduate students of *Letras*, as mentioned before. As proficiency was not an independent variable in this study, no proficiency measure was used.

In relation to the NE participants, there were three males and one female, and they came from different places in the United States: (a) Michigan (2), (b) Illinois (1), and (c) California (1).

Two of these participants were living in Florianópolis at the time of data collection. One of them had been living in Brazil for 1 year and a half, and the other for 9 months. Their ages ranged from 27 to 49 (m = 39).

All participants were invited to contribute to the study on a volunteer basis. The participants were divided into two different groups: (a) one control group, formed by NE speakers, and (b) one experimental group formed by NBP speakers.

2.2 Instruments and data collection

Data for this study were collected through a website (www.l2pronunciation.com) designed for the study in order to facilitate the storage of the data. The process of collecting data was divided into two different stages after the participant logged in: (1) administration of a questionnaire, and (2) recording of a sentence-reading test. The objective of the questionnaire was to elicit participants' biographical information regarding city of origin, age, education, length of contact with the target language, attendance in EFL courses, and so on. The sentence reading task was divided into two phases: (1) the English sentence reading task and (2) the Portuguese sentence reading task. The NE group recorded the English sentences only; the NBP groups recorded both English and BP sentences.

The sentence-reading test consisted of a list of 54 sentences written in English and 16 sentences written in Portuguese. The sentences in English contained monosyllabic words ending in <s> and <se> in different combinations of following phonological context: (a) the voiceless consonant /p/ (e.g., 'This paper is mine'); (b) the voiced consonant /b/ (e.g., 'The house backyard is huge'); (c) the /aj/ diphthong (e.g., 'Does irony count?'); and a pause (e.g., 'If you play, you might lose.'). The sentences were designed with focus on the expected pronunciation of the <s> and <se> graphemes at the end of the words (i.e., [s], as in this and house, or [z] as in does and lose), and on the spelling of the monosyllabic words (i.e., final <s> , as in this, miss, bus, goes, does and moves, or final or <se>, as in mouse, house, case, these, those and lose). The words following the target sounds were also chosen carefully, with control of the phonological environment, as described above.

The dependent variable was the frequency of voicing change, and the independent variables were, thus, spelling, with two levels (words with silent –e versus words with no silent – e), and phonological context, with four levels (voiceless consonant, voiced consonant, vowel,

pause). Moreover, the first and last three sentences of the list of English sentences were distractor trials.

The sentences in BP were also controlled orthographically and phonologically, containing words ending in the <s> and <z> graphemes also in different combinations of following phonological contexts: (1) followed by the voiceless consonant /p/ (e.g., 'Deve-se usar menos papel'); (2) followed by the voiced consonant /b/ (e.g., 'Talvez beleza não seja importante'); (3) followed by the vowel /a/ (e.g., 'Ele faz aniversário amanhã'); and (4) followed by a pause (e.g., 'Você podia falar menos').

The BP data were used as a baseline in order to verify if the participants' voicing assimilation patterns followed the patterns predicted in the literature, that is, if they produced the graphemes <s> and <z> as [z] when followed by a vowel or a voiced consonant, and as [s] when followed by a pause or a voiceless consonant.

The lists of sentences were recorded individually by the BP and the NE participants using the Nanogong software at 24.000 kHz, which resulted in good sound quality. The participants had access to this software through the website previously mentioned. Since the NE group was the control group and recorded the English sentences only, which would make it possible to analyze the extent to which their productions match the pronunciation predicted in the literature for the target sounds in the four phonological contexts (followed by a vowel, a voiced consonant, a voiceless consonant, and a pause) for native speakers' pronunciation. Moreover, their productions were compared with the BP groups' productions.

2.3. Data analysis

Once the production data were collected, the target sounds were transcribed phonetically by the first researcher, and the results were displayed by participants and by phonological contexts. In addition to the phonetic transcription, the data were submitted to acoustic analysis, with the use of PRAAT, with the objective of facilitating and giving reliability to the auditory judgment data. Whenever there was a doubt in relation to whether the target sound produced by the participants was voiceless or voiced, PRAAT helped with the visualization of the spectrograms. Figure 1 below illustrates the voiceless alveolar fricative, /s/ and the voiced alveolar fricative, /z/. Note that the difference between a voiceless and a voiced alveolar fricative sound can be perceived through the pulses (vertical lines over the top part) as well as through the dark mark

(voicing bar) located at the bottom of the spectrum of the voiced consonant.

Figure 1. Spectrogram of the sounds /s/ and /z/.
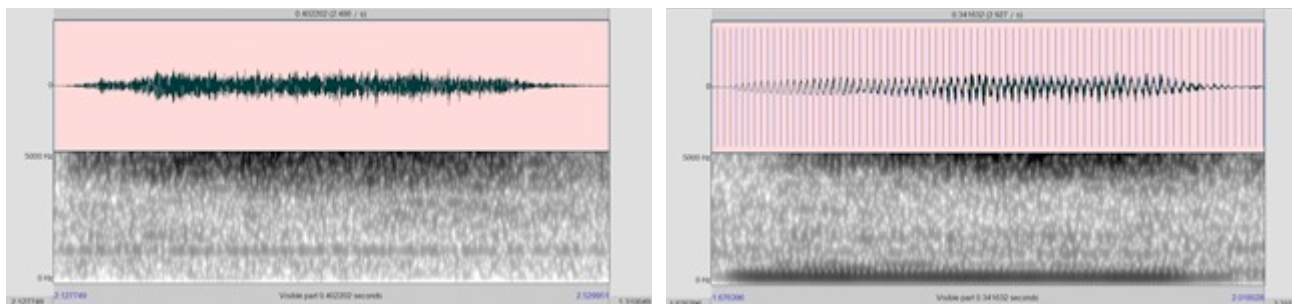
After that, the data were statistically analyzed in terms of number of tokens presenting voicing change occurrence, comparing data within groups, using the Statistical Package for Social Sciences (SPSS) software 16.0 for Windows. The comparison within groups made it possible to observe whether voicing change occurrence stemmed from L1 transfer, that is, if the target sounds were produced the same way in different phonological contexts in English as well as in Portuguese. The Shapiro-Wilk tests indicated that the variables were not normally distributed. For this reason, non-parametric tests were used to analyze most of the dataset, with alpha set at .05.

4. Results and Discussion

The research questions posed in this study aimed at investigating the influence of (a) following phonological context (a pause, a vowel, a voiced and a voiceless consonant), and (b) spelling (the silent –e grapheme) on the production of voicing change by Brazilian learners of English. In the following sections we attempt to answer each research question and discuss their accompanying hypotheses by presenting the results obtained with the English sentences produced by the BP participants. Before reporting the results obtained for the experimental group, it is important to present the baseline L1 data provided by both the native speakers of English and the native speakers of Brazilian Portuguese.

Regarding the analysis of the data provided by NE speakers, the results show that the total amount of devoicing occurrence with /z/ was 10.41%. The phonological contexts in which the devoicing with /z/ occurred were a voiceless consonant and a pause. In fact, the target sound, when followed by a pause, was partially devoiced by almost all NE participants. These results were expected, considering that, according to Smith (1997), the voiced alveolar fricative is difficult to

produce; thus, it is expected that even native speakers of English would simplify their production by partially devoicing it. Furthermore, the author states that the probable explanation for the devoicing of /z/ is that simultaneous voicing and frication are difficult to produce.

As for the BP data provided by the Brazilians, the results showed that the rate of devoicing with <z> was only 3.12% of the total, while [z] was always produced as a voiceless consonant when followed by a pause or a voiceless consonant. That is to say that the majority (96.88%) of the recorded sentences followed the patterns predicted in the literature, assimilating the voicing of the following segment. However, few occurrences of devoicing were found. They happened with words spelled with <z> and followed by a voiced consonant or a vowel. This non-expected production may have been influenced by the task-type used to collect data: reading sentences. It is believed that this type of task might affect participants' production, since they tend to speak more carefully and more slowly when reading, thus, inserting pauses between the target words and the following ones. As previously discussed, pauses lead to devoicing of word-final [z].

3.1 The role of phonological context

For research question one, the focus was on analyzing the phonological context that followed the English alveolar fricatives in word-final position. The hypothesis predicted that participants would voice the /s/ followed by a voiced consonant or a vowel and devoice the /z/ followed by a voiceless consonant or a pause. Table 1 displays the total frequency and percentage of voicing change occurrence according to the different phonological contexts used in this study ([p b aj], __ (pause)).

Table 1: Percentage of voicing change occurrence according to phonological context

voicing				devoicing			
s__	s[aɪ]	s[b]	s[p]	z__	z[aɪ]	z[b]	z[p]
5.80%	52.90%	59.42%	28.98%	93.48%	31.16%	16.66%	68.84%

The results displayed in Table 1 support hypothesis 1, given that the phonological contexts that yielded the highest rates of voicing with /s/ in word-final position are a voiced consonant (59.42%) and a vowel (52.90%). In addition, the phonological contexts that yielded the highest rates of devoicing with /z/ in word-final position are a pause (93.48%) and a voiceless consonant (68.84%). These results can be explained by the Structural Conformity Hypothesis (SCH) (ECKMAN,

2009) as well as by cross-linguistic influence (ODLIN, 1990), also known as language transfer. In the case of this study, participants tended to transfer the BP assimilation rule (CRISTÓFARO-SILVA, 2010), assimilating the voicing feature of the following segment. As a consequence, they ended up voicing the /s/ when followed by a voiced consonant and a vowel, and devoicing the /z/ when followed by a pause and a voiceless consonant.

Furthermore, Table 2 shows the descriptive statistics (means, standard deviation (SD), minimum and maximum number of occurrence) for voicing change according to the following phonological context. As shown in Table 2, the mean voicing occurrence with /s/ in word-final position per participant for both cases are, respectively, *3.17* (min. = 0; max. = 5) when followed by a vowel and *3.56* (min. = 1; max. = 5) when followed by a voiced consonant. The other phonological contexts following the target sound (i.e., a voiceless consonant and a pause) also obtained the voicing of /s/, at a lower rate though. The mean voicing occurrence with the target sound in word-final position was *0.34* (min. = 0; max. = 2) for the pause context, and *1.73* (min. = 0; max. = 3) for the voiceless consonant context. Therefore, some other variables may have influenced the occurrence of voicing of /s/ in these contexts, such as the silent –e grapheme.

Table 2. Descriptive statistics for voicing change occurrence with /s/ and /z/ in word-final position in different phonological contexts

	Tokens	Means	SDs	Min.	Max.
/s/pause	6	.34	.64	0	2
/s/vowel	6	3.17	1.52	0	5
/s/voiced C	6	3.56	1.23	1	5
/s/voiceless C	6	1.73	1.17	0	3
/z/pause	6	5.60	.58	4	6
/z/vowel	6	1.86	1.45	0	5
/z/ voiced C	6	1.00	1.12	0	3
/z/voiceless C	6	4.13	1.09	2	6

The results concerning the devoicing of the target sound /z/ are in accordance with what was predicted in Hypothesis 1. It was expected that two phonological contexts following the target sound would cause the participants to devoice /z/ in word-final position: a pause, whose mean devoicing occurrence was *5.60* (min. = 4; max. = 6); and a voiceless consonant, whose mean devoicing occurrence was *4.13* (min. = 2; max. = 6). As expected, the devoicing of /z/ followed by a pause had a very high mean, thus confirming a natural tendency in the FL, given that native speakers of American English also devoice /z/ in word-final position when followed by a pause

(SMITH, 1997), or, at least, partially devoice /z/ in word-final position (YAVAS, 2011). Although partially devoiced /z/ was not verified acoustically in this study, these results offer support for the SCH predictions and highlight the role of L1 transfer.

Moreover, the mean results regarding the other two phonological contexts following /z/ in word-final position are: a vowel, whose mean devoicing occurrence was *1.86* (min. = 0; max. = 5); and a voiced consonant, whose mean was *1.00* (min. = 0; max. = 3). The devoicing of the target sound followed by these two phonological contexts, although minimal, was not predicted in the hypothesis proposed. Nevertheless, it is believed that other aspects influenced the devoicing of /z/ in word-final position when followed by a vowel and a voiced consonant, such as the conditions in which data were obtained and the type of task applied to collect data, which may have led the participants to pause after reading the target word, thus changing the phonological context. Nevertheless, these unexpected pauses were not verified acoustically.

In order to confirm whether the comparison of means in the different phonological contexts was significant, a Friedman test was used. The test compared the means of non-target productions of /s/ and /z/ in each phonological context, and the results indicated a significant difference (X^2 = 115.36, *p* = .001), thus corroborating Hypothesis 1. With the intention of identifying which means were significant, it was necessary to run Wilcoxon tests comparing each pair of means for each sound. Due to the multiple mean comparisons, Bonferroni adjustment (LARSON-HALL, 2010) was performed and the *p* value was only considered significant if it was equal to or lower than *.004*. The results of the Wilcoxon tests indicate that most phonological context means presented significant differences (*p.* < .004 in most cases), except for the vowel <ai> (e.g., The *bus I* need is late; *Does irony* count?) versus the voiced consonant <b> (e.g., *This bottle* is half empty; Paul *goes babysitting.*) for both /s/ and /z/ in word-final position (*p.* = .164 and *p.* = .008, respectively). This lack of significance in both cases was probably due to the BP rule, which is the same for both cases (/z/-vowel = 3.17 versus /z/-voiced consonant = 3.56; /z/-vowel = 1.86 versus /z/-voiced consonant = 1.00).

Previous studies that investigated the influence of phonological context (CARLISLE, 1991; EDGE, 1991; SILVEIRA, 2012; SIMON, 2010) presented evidence that this variable plays an important role in the production of FL sounds, especially because the phonological processes that occur in different phonological contexts are likely to be automatically transferred from the L1 to the FL (as language learners are not aware of this transfer). Thus, the results of the present study concerning the role of the phonological context in the occurrence of voicing change corroborate

the results from the aforementioned studies.

3.2. Interaction between phonological context and orthography

Table 3 allows us to triangulate the results for the roles of orthography and phonological context and possibly clarify the unexpected occurrences of voicing change for certain phonological contexts.

Table 3: Percentage of voicing with word-final /s/ displayed by word and phonological context

Context / Words	this	miss	bus	mouse	house	case
Pause	0%	0%	0%	13.04%	17.39%	4.35%
Voiceless Cons.	0%	0%	0%	65.22%	39.13%	69.56%
Voiced Cons.	69.56%	4.35%	39.13%	73.91%	78.26%	91.30%
Vowel	60.87%	4.35%	30.43%	69.56%	73.91%	78.26%

It is possible to see in Table 3 that the words '*this'*, '*miss'*, and '*bus'*, when followed by a pause or a voiceless consonant, did not lead to the occurrence of voicing change. On the other hand, when they were followed by a vowel or a voiced consonant, the percentage of voicing production with /s/ in word-final position was high, except for the word '*miss'*, whose spelling <ss> may have prevented voicing change (4.35%), considering that in BP the <ss> is always pronounced as [s] (CRISTÓFARO-SILVA, 2010). The word '*this*' obtained the highest rates for voicing (vowel context = 60.87%; voiced consonant context = 69.56%), followed by the word 'bus', whose rates were almost half of the word '*this*' (vowel context = 30.43%; voiced consonants context = 39.13%). A possible explanation for the higher percentage of voicing with '*this*' may be the fact that the pronunciation of this word is often confused with the pronunciation of '*these*', which ends in /z/.

Conversely, all the words with the silent –e grapheme, '*mouse*', '*house*', and '*case*', displayed voicing change in word-final position. The word '*mouse*' obtained a low rate of voicing occurrence when followed by a pause (13.04%). On the other hand, when this word was followed by the other phonological contexts, the percentage of non-target production was similarly high (voiceless = 65.22%, voiced = 73.26% and vowel = 69.56%). Likewise, the word '*house*' presented high rates when followed by a voiced consonant and a vowel (78.26% and 73.91%, respectively),

and lower rates when followed by a pause (17.39%). However, when the word '*house'* was followed by a voiceless consonant, the percentage was nearly 40%, not close to the results presented for the pause phonological context, nor close to the results presented for the vowel and voiced consonant contexts. The word '*case'*, in turn, obtained the highest and the lowest rates of voicing change: when followed by a voiced consonant (91.30%), and when followed by a pause (4.35%). The other phonological contexts (i.e., a vowel and a voiceless consonant) obtained rates similar to the other words (78.26% and 69.56%, respectively).

Results displayed in Table 3 clearly show that orthography plays a major role in the voicing change of alveolar fricatives in words containing the silent <e>, leading participants to voice /s/ in phonological contexts where this was not expected to happen if they were merely transferring the BP phonotactic rules. Moreover, orthography can have a positive effect as well, as shown by the results with the word '*miss*', which yielded the lowest percentages of voicing change in all phonological contexts due to the <ss> spelling.

Now we turn to the results for /z/ devoicing, observing the interaction between phonological context and orthography. Table 4 shows the percentage of devoicing with / z / in word-final position for each target word.

Table 4: percentage of devoicing with word-final /z/ displayed by word and phonological context

Context / Words	goes	does	moves	these	those	Lose
Pause	100%	95.65%	100%	95.65%	95.65%	69.56%
Voiceless Cons.	100%	100%	78.26%	78.26%	39.13%	17.39%
Voiced Cons.	43.48%	13.04%	8.69%	17.39%	17.39%	0%
Vowel	52.17%	65.22%	21.74%	17.39%	13.04%	13.04%

It can be seen from the results displayed in Table 4 that two phonological contexts, a pause and a voiceless consonant, induced almost 100% of devoicing for nearly all the words ending in <s> (i.e., '*goes'*, '*does'*, and '*moves'*), except for the word '*moves'*, whose percentage of devoicing occurrence was 78.26%. However, the same words (i.e., '*goes'*, '*does'*, and '*moves'*) obtained different results when followed by a voiced consonant or a vowel. Of these words, the word that presented the highest rates for devoicing when followed by a voiced consonant was '*goes*' (43.48%), and when followed by a vowel was '*does*' (65.22%), which lead us to think that some

other factors, such as the type of task used to collect data (i.e., reading sentences), may have induced these high rates of devoicing, as the participants might have paused after reading these target words. The word '*goes*' also presented a high rate of devoicing when followed by a vowel (52.17%). On the other hand, the word 'moves' presented the lowest rates of devoicing (vowel = 21.74%; voiced consonant = 8.69%), followed by the word '*does*', whose rate of devoicing occurrence when followed by a voiced consonant was also low (13.04%).

Table 4 also displays the results for the words with the silent –e grapheme, '*these*', '*those*', and '*lose*'. The phonological context that yielded the highest rates for devoicing with /z/ in word-final position was a pause, whose percentage of devoicing occurrence with the words '*these*' and '*those*' was almost 100% (95.65%). The result presented for the word 'lose' was lower than the previous ones (69.56%). In addition, the voiceless consonant context also presented a high rate of devoicing for the word '*these*' (78.26%), which was the highest rate among the words containing the silent –e. On the other hand, the same phonological context that generated high devoicing rates for the word '*these*', also produced lower rates for the words '*those*' (39.13%) and '*lose*' (17.39%). Perhaps it was not only the phonological context that influenced the non-target production, but also the target word itself, considering that many participants confuse the pronunciation of '*these*' and '*this*', as mentioned before. Furthermore, the word that yielded the lowest rate for devoicing when followed by a voiced consonant was '*lose*' (0%). The other words basically presented the same devoicing rates: (1) 17.39% was the percentage of devoicing occurrence for the word '*these*' when followed by a vowel and a voiced consonant, and for the word '*those'* when followed by a voiced consonant; (2) 13.04% was the percentage of devoicing occurrence for the word '*those*' as well as for the word '*lose*' when followed by a vowel. In conclusion, the phonological contexts that produced the lowest and the highest devoicing rates were a voiced consonant and a pause, respectively, and the words that generated the lowest and the highest rates of devoicing were '*lose*' and 'these', respectively. This leads us to state again that it is not only the phonological context that influences the non-target production, but also the target word itself.

The interaction between orthography and phonological context is not clear for the /z/ devoicing results. The results displayed in Table 3 show a trend that is similar for both words with and without the silent <e>, with the pause and voiceless consonant contexts yielding the highest rates of devoicing, as expected. Nevertheless, it is also possible to observe a facilitative effect of orthography, since the silent <e> words obtained lower rates of devoicing in nearly all contexts.

Nevertheless, we cannot overlook the predictions of the SCH, since the results with /z/ indicate that this sound yields high percentages of voicing change in all phonological contexts, with all words tested, regardless of their spelling.

5. Conclusion

This study investigated the occurrence of voicing change with /s/ and /z/ in word-final position by BP learners of English. It was believed that two variables would influence the production of voicing change, namely: (1) phonological contexts following the target sounds (i.e., a pause, a vowel, a voiced consonant and a voiceless consonant); and (2) orthography (i.e., silent –e condition).

Concerning the influence of phonological context on the production of voicing change, results from the data analysis corroborated the hypothesis proposed: the phonological contexts that yielded higher rates of voicing of /s/ in word-final position were a voiced consonant and a vowel, and those that yielded higher rates of devoicing with /z/ in word-final position were a pause and a voiceless consonant. The results demonstrated that BP learners transfer the BP assimilation rule of the voicing feature of the following segment when producing English FL alveolar fricatives in word-final position, thus corroborate the results of previous studies.

Regarding orthography, results partially support the hypothesis proposed presenting evidence that the silent –e grapheme played a role in the production of voicing of /s/ in word-final position and of devoicing of /z/ this position, though the latter was to a lesser degree. This influence might be caused by L1 sound-spelling rule transfer, inducing the BP learners to assimilate the voicing feature of the silent –e grapheme and producing non-target sounds in the case of /s/ words, and causing them to produce the target words more accurately in the case of /z/ words.

Moreover, the higher frequency of voicing change occurrence with /z/ may be explained by the SCH (ECKMAN, 1991, 2009), which can predict the level of difficulty of acquiring FL structures based on markedness principles of the world's languages. Thus, since [z] is more marked than [s] in final position, the English words ending in /z/ yielded more non-target pronunciations by the learners in this study than the words ending in /s/.

The goals of the present study were achieved, considering that now there is a better understanding of voicing change of alveolar fricatives in word-final position in BP/English interphonology. This knowledge may help us to understand the acquisition of the English

phonological system and may also be very useful, for teachers to be aware of the possible non-target pronunciations their students are likely to produce, so that they can provide help to minimize the transfer of L1 processes that lead to non-target production. The occurrence of voicing change with /s/ and /z/ in word-final position is consolidated L1 process that is often transferred to the FL, sometimes resulting in non-target productions, which learners may not be aware of. Pronunciation materials should be designed for specific audiences, focusing on the probable problems that particular FL learners are likely to have when acquiring the FL sound system, and in this case, the production of alveolar fricatives in word-final position. Being aware of this issue can also make students more concerned about their pronunciation, leading them to possibly invest more time trying to pronounce word-final alveolar fricatives in a more target-like fashion.

Although this study has its hypotheses based on previous research and overall succeeded in answering the proposed research questions, there are some limitations that are worth mentioning. The task used to collect data (i.e., reading non-topic-related sentences) might have biased the participants' production, thus, influencing the results. Since this type of task allows the participants to control better their pronunciation, the production might also sound mechanical, containing more pauses than natural speech (SILVEIRA, 2007). Conversely, when we use non-controlled speech, it is possible to have natural speech, but it is difficult to obtain the production of the target sounds in specific phonological contexts.

In conclusion, the role of phonological context and orthography should be taken into careful consideration in BP/English interphonology studies, considering that the results presented in this study draw attention to their role in the production of FL sounds. In fact, we saw in this study that these variables are naturally transferred from the L1 to the FL speech. These findings emphasize the necessity of providing learners of English with pronunciation instruction focusing on their needs, and including sound-spelling correspondence comparisons between the two languages, so that learners could become aware of the different sound-spelling correspondences. Thus, the results presented here can be useful to improve the design of specific pronunciation materials for Brazilian learners, focusing on the usual pronunciation difficulties that Brazilian learners face when acquiring an FL, and also taking into consideration the issues of orthography and phonological context influence.

Referências

BARATIERI, J. P. *Production of /l/ in the English coda by Brazilian EFL learners: An acoustic-articulatory analysis.* 2006. Dissertação (Mestrado em Letras-Inglês) – Programa de Pós-Graduação em Inglês, Universidade Federal de Santa Catarina, Florianópolis.

BETTONI-TECHIO, M. *Perceptual training and word initial /s/- clusters in Brazilian Portuguese/English interphonology.* 2008. Tese (Doutorado em Letras-Inglês) – Programa de Pós-Graduação em Inglês, Universidade Federal de Santa Catarina, Florianópolis.

CARLISLE, R. S. The influence of the environment on vowel epenthesis in Spanish/English interphonology. *Applied Linguistics*, v. 12, n. 1, p. 76-95, 1991.

CELCE-MURCIA, M.; BRINTON, D.; GOODWIN, J. M. *Teaching pronunciation*. New York: Cambridge University Press, 2010.

CORNELIAN JR., D. *Brazilian learners' production of initial /s/ cluster: Phonological structure and environment.* 2003. Dissertação (Mestrado em Letras-Inglês) – Programa de Pós-Graduação em Inglês, Universidade Federal de Santa Catarina, Florianópolis.

CRISTÓFARO-SILVA, T. *Fonética e fonologia do português: roteiro de estudos e guia de exercícios*. São Paulo: Editora Contexto, 2010.

ECKMAN, F. R. The structural conformity hypothesis and the acquisition of consonant clusters in the interlanguages of ESL learners. *Studies in Second Language Acquisition*, v. 13, n. 1, p. 23-41, 1991.

_____. Typological markedness and second language phonology. In: HANSEN, J. G. E.; ZAMPINI, M. L. (Eds.). *Phonology and second language*. Philadelphia: John Benjamins, 2009. p. 95–115.

FROMKIN, V.; RODMAN, R.; HYAMS, N. *An Introduction to Language*. Boston:USA: Wadsworth, 2011.

FULLANA, N.; MORA, J. C. Production and perception of voicing contrast in English word-final obstruents: Assessing the effects of experience and starting age. In: WATKINS, M. A.; RAUBER, A. S.; BAPTISTA, B. O. (Eds.). *Recent research in second language phonetics/phonology: perception and production*. Cambridge: Cambridge Scholars Publishing, 2009. p. 97-117.

KOERICH, R. D. *Assessing nonnatives' discrimination of English #CVC# and #CVCV# sequences*. 1999. (Unpublished manuscript) - Universidade Federal de Santa Catarina, Florianópolis.

_____. *Perception and production of word-final vowel epenthesis by Brazilian EFL students*. 2002. Tese (Doutorado em Letras-Inglês) – Programa de Pós-Graduação em Inglês, Universidade Federal de Santa Catarina, Florianópolis.

LARSON-HALL, J. *A guide to doing statistics in second language research using SPSS*. New York: Routlege, 2010.

LISKER, L. *On "explaining" vowel duration variation*. In: WINTER MEETING OF THE LINGUISTIC SOCIETY OF AMERICA, 1973, San Diego. *Anais…* San Diego: [s.n.], 1973. p. 28-30.

MATEUS, M. H.; D'ANDRADE, E. *The phonology of Portuguese*. Oxford: Oxford University Press, 2000.

MOORE, D. H. *The perception of English word-final /l/ by Brazilian learners.* 2008. Dissertação (Mestrado em Letras-Inglês) – Programa de Pós-Graduação em Inglês, Universidade Federal de

Santa Catarina, Florianópolis.

ODLIN, T. *Language transfer: cross-linguistic influence in language learning*. New York: Cambridge University Press, 1990.

PIROTH, H. G.; JANKER, P. M. Speaker-dependent differences in voicing and devoicing of German obstruents. *Journal of Phonetics*, v. 32, n. 1, p. 81-109, 2004.

RAUBER, A. *The production of English initial /s/ clusters by Portuguese and Spanish EFL speakers.* 2002. Dissertação (Mestrado em Letras-Inglês) – Programa de Pós-Graduação em Inglês, Universidade Federal de Santa Catarina, Florianópolis.

REIS, M. S. *The perception and production of English interdental fricatives by Brazilian EFL learners.* 2006. Dissertação (Mestrado em Letras-Inglês) – Programa de Pós-Graduação em Inglês, Universidade Federal de Santa Catarina, Florianópolis.

SILVEIRA, R. *The influence of pronunciation instruction on the perception and production of English word-final consonants*. 2004. Tese (Doutorado em Letras-Inglês) – Programa de Pós-Graduação em Inglês, Universidade Federal de Santa Catarina, Florianópolis.

_____. The role of task-type and orthography in the production of word-final consonants. *Revista de Estudos da Linguagem*, v. 15, n. 1, p. 143-176, 2007.

_____. Investigating the role of orthography in the acquisition of L2 pronunciation: A case study. In: WATKINS, M. A.; RAUBER, A. S.; BAPTISTA, B. O. (Eds.). *Recent research in second language phonetics/phonology: perception and production.* Newcastle upon Tyne: Cambridge Scholars Publishing, 2009. p. 270-290.

_____. Avaliando a proficiência oral em língua inglesa: o papel do perfil dos avaliadores e dos informantes. In: MOTA, M. B.; BERGSLEITHNER, J. M.; WEISSHEIMER, J. (Orgs.). *A formação de professores de línguas: novos olhares.* Campinas: Pontes Editores, 2011. p. 73-95.

_____. Pronunciation Instruction and Syllabic-Pattern Discrimination. *DELTA* (*Documentação de Estudos em Linguística Teórica e Aplicada*), v. 27, n. 1, p. 5-22, 2011.

_____. L2 Production of English word-final consonants: the role of orthography and learner profile variables. *Trabalhos em Linguística Aplicada*, v. 51, n. 1, p. 15-28, 2012.

_____.; SOUZA, T. A percepção e a produção das fricativas alveolares da língua portuguesa por hispano-falantes. Revista de Estudos da Linguagem. V. 19, p. 167-184, 2011.

SIMON, E. Phonological transfer of voicing and devoicing rules: evidence from L1 Dutch and L2 English conversational speech. *Language Sciences*, v. 32, n. 1, p. 63-86, 2010.

SMITH, B. L.; HAYES-HARB, R.; BRUSS, M.; HARKER, A. Production and perception of voicing and devoicing in similar German and English word pairs by native speakers of German. *Journal of Phonetics*, v. 37, n. 1, p. 257-275, 2009.

SMITH, C. L. The devoicing of **/z/** in American English: effects of local and prosodic context. *Journal of Phonetics*, v. 25, n. 1, p. 471-500, 1997.

YAVAS, M. Final stop devoicing in interlanguage. In: YAVAS, M. (Ed.). *First and second language phonology*. San Diego: Singular Publishing Group, Inc., 1994. p. 267-282.

_____. The effects of height and place of articulation in interlanguage final stop devoicing. *International Review of Applied Linguistic*, v. 35, n. 2, p. 115-125, 1997.

_____. *Applied English Phonology*. Oxford: Wiley-Blackwell, 2011.

ZIMMER, M. *Transferência do conhecimento fonético-fonológico do português brasileiro (L1) para o inglês (L2) na recodificação leitora: uma abordagem conexionista*. 2004. Tese (Doutorado em Letras) – Programa de Pós-Graduação em Letras, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre.

_____.; ALVES, U. K. On the status of terminal devoicing as an interlanguage process among Brazilian learners of English. *Ilha do Desterro*, n. 55, p. 41-62, 2008.

_____. SILVEIRA, R.; ALVES, U. K. *Pronunciation instruction for Brazilians: bringing theory and practice together*. Newcastle upon Tyne: Cambridge Scholar Publishing, 2009.