

THE INFLUENCE OF SONORITY ON THE PRODUCTION OF VERBS ENDING IN -ED BY BRAZILIAN LEARNERS

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Abstract

This study investigated the influence of sonority on the production of vowel epenthesis in verbs ending in *-ed* by Brazilian learners of English. Participants were twenty-six upper-intermediate Brazilian EFL learners who read and audio-recorded ten paragraphs containing 91 verbs ending in *-ed*. The results demonstrated that sonority influenced mispronunciations since the least sonorous obstruents preceding *-ed* induced more vowel epenthesis than the more sonorous sonorants, which in turn induced more epenthesis than vowels in the same position. The results also demonstrated that within the class of obstruents, affricates preceding *-ed* induced more epenthesis than stops, which induced more epenthesis than fricatives, and that, within the class of sonorants, nasals induced more epenthesis than liquids. These results suggest that markedness in terms of sonority affects the production of vowel epenthesis in words ending in *-ed*.

Keywords: verbs ending in *-ed*, markedness, sonority.

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1. Introduction

Overviews of the difficulties Brazilian learners of English present in the pronunciation of the foreign language (e.g. Baptista, 2001, 2002) indicate initial /s/-clusters, single initial and final consonants, and simple past tense *-ed* as problematic sounds. Specifically, studies have found that (a) vowel prothesis is used to deal with initial /s/-clusters (Carlisle & Baptista, 2007; Cornelian Jr., 2003, 2008; Delatorre, 2004; Rauber, 2002, 2006; Rebello, 1997; Rebello & Baptista, 2006; Silveira, 2002b); (b) paragoge is used to deal with single final consonants (Baptista & Silva Filho, 1997, 2006; Delatorre, 2004; Koerich, 2002, 2006; Silveira, 2002a 2004); and (c) vowel epenthesis is used to deal with the *-ed* form of the simple past and past participle of regular verbs (Alves, 2004; Delatorre, 2004, 2005, 2006a, b; Delatorre & Koerich, 2008; Pereira, 1994; Silveira & Alves, *in press*).

Thus, owing to the different and limited number of studies focusing specifically in the object of the present one, that is, the pronunciation of *-ed* (see the description of the studies in section 4), the perspective adopted here was the perspective adopted in studies in the production of initial /s/-clusters that investigated the influence of the preceding phonological environment and the perspective adopted in studies in the production of final consonants that investigated the influence of obstruents and sonorants as phonological environment. Thus, the present study investigates the occurrence of vowel epenthesis as influenced by sonority in terms of (a) obstruents and sonorants; and of (b) different classes of consonants, examining the differential effects of affricates, fricatives, stops, nasals, and liquids preceding the *-ed* morpheme. The theoretical basis for the study was set in terms of Eckman's (1987) Markedness Differential Hypothesis (MDH), Selkirk's (1984) Sonority Sequencing Generalization (SSG), and Hooper's (1976) Consonantal Strength Hierarchy. For the sake of coherence, the English regular verbs in the simple past tense and in the past participle are called verbs ending in *-ed* in this study.

This paper is organized in seven sections. Sections 2, 3 and 4 present the review of literature regarding syllable structure and sonority in the syllable rhyme and/or coda, the results of previous studies in the production of verbs ending in *-ed*, and the hypotheses of the study (section 4). Section 5 presents the method used to collect the data, the data analyses and a brief description of the participants' profile. Thus, Section 6 presents the results and discussion of the results obtained in the present study and section 7 presents the conclusions and final remarks regarding the influence of sonority in the production of verbs ending in *-ed* as well as the possible pedagogical implications and suggestions for further research in this topic.

2. Review of literature

2.1 Syllable structure and sonority

The Metrical Theory describes the syllable as composed of an onset and a rhyme, where the rhyme is divided into a nucleus or peak, the obligatory element of the syllable, and a coda. Regarding the coda, Greenberg (1978) stated that (a) liquids and glides are preferred to occur close to the nucleus of the syllable, whereas the other consonants occur next to the margins; (b) sonorants and voiced consonants and/or sequences of voiced consonants tend to occur close to the nucleus; (c) clusters are homogeneous in terms of voicing; and (d) sonorants can be followed by voiced or voiceless obstruents, once the obstruent is homogeneous in regard to voicing or assimilation. The author also states that (a) /r/ can only be followed and not preceded by /l/; (b) sibilants do not occur together; and, (c) there is a strong tendency for liquids and sibilants not to occur together.

Hooper (1976) and Selkirk (1984), respectively, proposed the Hierarchy of Strength and the Sonority Sequencing Generalization. These are sonority scales (strength scale in Hooper's view) which attribute values of sonority to speech sounds. Although Hooper's scale does not include vowels, it seems obvious that the author agrees with

Selkirk in ranking them as the most sonorous sounds (the least strong, in Hooper's terms), followed by sonorant consonants and then, obstruents, the least sonorous sounds. The ranking also operates in terms of voicing, where voiced obstruents are more sonorous than their voiceless counterparts. In both scales, affricates are ranked as the least sonorous consonants.

Greenberg's universals and the sonority/consonantal strength scales were relevant to this study because both Greenberg's universals and Hooper's consonantal strength hierarchy and Selkirk's sonority scale present the possible combinations found in the rhyme and in the coda of the syllables in terms of voicing, place of articulation and sonority/consonantal strength value each consonant may have, which are very important for the production of simple past tense *-ed* since it obligatorily implies the assimilation of the features of the previous sound found in the nucleus of the syllable, such as *play – played*; or in the coda of the syllable, such as *miss – missed*. Moreover, the importance of sonority in the production of simple past tense *-ed* can also be found in Delatorre (2006a, b) and Delatorre and Koerich (2008).

2.2 Studies on the influence of sonority in coda position

According to Tropic (1987) and Eckman and Iverson (1994), obstruents are more marked in final position than sonorants. Eckman and Iverson studied the production of the contrast by Cantonese, Japanese and Korean speakers, predicting that the more marked obstruent coda would induce more vowel paragoge than the less marked sonorant one. Their results confirmed the hypothesis despite L1 interference in the production of final /l/ and /r/.

Studies in the production of codas by Brazilian EFL learners have yielded conflicting results regarding markedness in terms of sonority of the target consonants, either comparing obstruents versus nasals, or comparing affricates, fricatives and stops.

Baptista and Silva Filho (1997, 2006) studied the production of vowel paragoge in obstruents and nasals by a mixed group of six beginning and advanced EFL learners. They found assimilation or

deletion of the nasals, and vowel paragoge in the nasals /m, n, N/ and in the obstruents /p, b, t, d, k, g, f, v, s, z, ʃ, tʃ, dʒ/. Their results confirmed those of Eckman and Iverson and showed evidence of L1 interference since, as in the native language, Brazilians tended to assimilate the nasal feature to the previous vowel deleting the final nasal.

Following the line of research of Baptista and Silva Filho (1997, 2006) and of Koerich (2002), Silveira (2004) investigated the effect of pronunciation instruction on the perception and production of English final consonants by Brazilians. Regarding the influence of sonority in the production test, Silveira (2004) compared the production of vowel paragoge in obstruents /p, b, t, d, k, f, v, dʒ/ and nasals /m, n/ by twenty-two Brazilian beginning EFL learners. Thus, Silveira found that, contrary to her 2002a study, Eckman and Iverson's claim, and Baptista and Silva Filho's results, the less marked and more sonorous final nasals were more frequently modified by paragoge than the less sonorous obstruents in both pre- and posttests of both control and experimental groups, "thus indicating that markedness regarding sonority was not the most important factor" (p. 137) in her study. Moreover, Silveira (2004) also pointed out that her Brazilian participants also used the strategy of deletion of the final nasal and previous vowel assimilation of nasal features to deal with final nasals, as also pointed out by Baptista and Silva Filho (1997, 2006).

Besides the syllable simplification strategies of vowel paragoge and deletion/assimilation of the nasal, Silveira (2002a, 2004) also identified orthographic influence in the pronunciation of words that end with a consonantal grapheme, such as *mad*, and of words that end with the same grapheme followed by a silent "e", such as *made*, since the former were less frequently modified by vowel paragoge than the latter. However, she also found that pronunciation instruction helped her participants to solve this pronunciation problem since the results of the experimental group's posttest suggest that participants from this group were able to neutralize the influence of orthography in the pronunciation of target words that end in a grapheme followed by a silent "e".

Regarding codas formed by the pronunciation of *-ed* endings, following Eckman and Iverson (1994) and Baptista and Silva Filho (1997, 2006), Delatorre (2004, 2005, 2006b) compared epenthesis production in obstruents and sonorants preceding the *-ed* morpheme. Delatorre (2004) found that, following the predicted tendency, for the six advanced speakers of EFL participating in her study, obstruents, as preceding context of *-ed*, induced more epenthesis than sonorants, yielding a statistically significant difference ($p < .05$). Furthermore, Delatorre (2005, 2006b) studied vowel epenthesis in the obstruents /p, b, k, g, f, v, s, z, ʃ, tʃ, dʒ/ and in the sonorants /m, n, l, r/ preceding *-ed*. These studies investigated nine pre-intermediate Brazilian EFL learners and found high rates of epenthesis for all obstruents and low rates for all sonorants with a statistically significant difference ($p < .05$). These studies also analyzed epenthesis in the voiced obstruents /b, g, v, z, dʒ/ and in the sonorants /m, n, l, r/ preceding the *-ed* and found the same tendency, with a statistically significant difference ($p < .05$).

Regarding the influence of sonority within the class of obstruents, Eckman and Iverson (1994) suggested that affricates are more marked than fricatives, which are more marked than stops. Following Eckman and Iverson's (1994) claim, Baptista and Silva Filho (1997, 2006) studied markedness relations within the class of obstruents, comparing vowel epenthesis after final affricates, fricatives and stops by a mixed group of beginning and advanced Brazilian EFL learners and found that the affricates /tʃ, dʒ/ received the highest rate of epenthesis, whereas the fricatives /f, v, s, z, ʃ/ and the stops /p, b, t, d, k, g/ yielded low and similar rates of epenthesis. The authors attributed the low rate of epenthesis for the fricatives to L1 transfer since /s, z, ʃ/ and also /ʒ/ occur in the coda of BP depending on dialect.

Following Baptista and Silva Filho's (1997, 2006) line of research, Koerich (2002, 2006) found a different tendency, although the differences were not statistically significant. The fricatives were most frequently epenthesised, followed by the affricates, and then, by the stops. Differently from Baptista and Silva Filho, this study did not include the fricatives which happen in BP.

Delatorre (2005) studied the production of vowel epenthesis in words in which *-ed* was preceded by an obstruent and found that affricates induced more epenthesis than stops ($p < .05$), which induced more epenthesis than fricatives. The second difference did not reach statistical significance; however, the results are in consonance with Hooper's (1976) strength hierarchy.

Hooper's (1976) and Selkirk's (1984) considerations on consonantal strength and sonority and the suggestion about markedness within the class of obstruents found in Eckman and Iverson (1994) motivated the investigation of markedness within the class of sonorants. In this line of research, Delatorre (2005) investigated epenthesis production in the nasals /m, n/ and liquids /l, r/ preceding the *-ed* and found that nasals induced significantly ($p < .05$) more epenthesis than liquids.

2.3 Studies on English verbs ending in -ed

An overview of studies in the production of verbs ending in *-ed* by Brazilians (Alves, 2004; Delatorre, 2004, 2005, 2006a/b; Delatorre & Koerich, 2008; Pereira, 1994; Silveira & Alves, *in press*) reveals that the insertion of an epenthetic vowel is the simplification strategy most frequently used in dealing with final clusters as in *liked*, pronounced as [laɪkid], [laɪkɪd], or even [laɪkəd]. Interestingly, this epenthetic vowel also appears in the pronunciation of verbs where *-ed* is preceded by a vowel or a diphthong, thus not forming a cluster, as in *played*, which is then pronounced as [pleɪləd]. It is important to mention that in both cases a paragogic vowel may be concomitantly inserted, so that the two words may be pronounced as [laɪkid] and [pleɪlədi]; however, the present study focuses specifically on the epenthetic vowel that occurs in the phonological context that precedes the *-ed* morpheme.

The first study carried out in this respect, Pereira (1994), investigated the production of regular verbs in the simple past tense by twenty beginning and twenty advanced Brazilian EFL learners and found an effect of language proficiency. Following that, Delatorre (2004) investigated six advanced speakers, Delatorre (2005, 2006b) studied

nine intermediate learners, and Delatorre (2006a) and Delatorre and Koerich (2008) studied twenty-six Brazilian upper-intermediate learners. Taken together, the results of these studies showed the same tendency found by Pereira, and demonstrated that regarding the phonological environment preceding *-ed*, consonants induced more epenthesis than vowels, and that voiceless obstruents induced more epenthesis than their voiced counterparts. These results may be explained, firstly, by the fact that the addition of the *-ed* morpheme to a previous consonantal environment creates a more complex, more marked and thus, more difficult coda than its addition to a previous vowel. Secondly, these results may be explained by the fact that markedness in terms of sonority probably has a stronger effect than markedness in terms of voicing in this case.

Adding to that, the results of Delatorre (2005, 2006a) and Delatorre and Koerich (2008) demonstrate the influence of cluster length in the production of *-ed* by comparing single-final consonants, and two and three-member clusters, in which single codas presented less vowel epenthesis production than the two-member clusters which presented less epenthesis production than the three-member clusters ($p < .05$).

Alves (2004) investigated the effect of instruction in the production of *-ed*. His study involved seven pre-intermediate learners of English and found a positive effect of instruction, demonstrated in the results of the posttests. A native language effect was detected since students produced higher rates of epenthesis in verbs in which the consonant preceding *-ed* does not occur in the BP coda, such as /p, f, v, tʃ/ as in *stopped, laughed, lived, and watched* than in verbs ending in consonants which happen in the BP coda, such as /s, l, r/, as in *crossed, called and remembered*. Finally, epenthesis was correctly found in verbs in which *-ed* was preceded by alveolar stops, such as *wanted and needed*, in the pretest. However, few mispronunciations of the alveolars occurred in the posttests when few participants did not produce the epenthetic vowel after the alveolars or deleted the alveolar consonant and the epenthetic vowel, which might suggest that instruction induced participants to be in doubt about the pronunciation of these verbs.

Silveira and Alves (*in press*) extended Alves's study comparing his results with those of a study on the effects of instruction in the perception and production by a group of thirteen pre-intermediate to advanced learners of EFL. Their study indicated that pronunciation instruction was more effective for perception than for production, a result attributed to the saliency of the pronunciation of the vowel when *-ed* follows alveolar stops in contrast with the single-final consonant and the clusters. Specifically, the study showed that (a) [ɪd] was better produced and perceived in both pre- and posttest; and (b) [d] was better perceived than [t] in the pre and posttest and better produced in the pretest.

The authors concluded that, despite the positive effect of pronunciation instruction, participants tended to insert an epenthetic vowel to produce the simple past tense *-ed*, which they attributed to L1 phonological and orthographic interference due to differences in the syllable structure of the two languages.

Frese (2006, *in press*) investigated the relationship between perception and production of final *-ed* preceded by oral stops, involving thirty-two Brazilian advanced EFL learners. The results of his investigation showed a positive, strong and statistically significant correlation ($r(32) = .90, p < .01$) between perception and production of the three endings – [ɪd], [t] and [d]. Thus, he also found that the regular verbs in the simple past tense were discriminated (perception test) and pronounced (production test) in a similar pattern, that is, verbs in which *-ed* was perceived and pronounced as [ɪd] were better discriminated and produced than verbs in which *-ed* was perceived and pronounced as [t] which were better perceived and produced than verbs in which *-ed* was perceived and pronounced as [d]. Moreover, Frese found that the scores for the perception of the three different *-ed* pronunciations – [ɪd], [t], [d] – were always higher than the scores for the production of these three *-ed* pronunciations, thus suggesting that the perception of simple past tense *-ed* precedes its production.

In sum, the results of these studies suggest that variables such as (a) preceding environment, for example, preceding consonant or vowel, preceding voiced or voiceless obstruents; (b) cluster length; and (c) L1

interference in terms of L1 phonological and phonetic restrictions and spelling, can influence the production of vowel epenthesis in English verbs ending in *-ed* by Brazilians. Moreover, these studies also demonstrate that the epenthetic vowel is very salient for Brazilians since they produced it very frequently and perceived it more frequently in verbs that require it, those where *-ed* is preceded by alveolar stops. On the other hand, these studies also demonstrate that instruction plays an important role in both perception and production of such words, by helping learners resort less often to vowel epenthesis.

Considering the review of literature presented up to this point and the main objective of this study, that is, to study the possible influence of sonority in the production of verbs ending in *-ed*, the present study have the following hypotheses. Taking into consideration the comparison of the production of vowel epenthesis in verbs ending in *-ed* among the three classes of obstruents, sonorants and vowels, the first hypothesis, based on Hooper's (1976) consonantal strength hierarchy, Selkirk's (1984) SSG, Eckman's (1987) MDH, and on Eckman and Iverson (1994), predicted that obstruents, as preceding context of *-ed*, would induce more epenthesis than sonorants, which would induce more epenthesis than vowels. Thus, the second hypothesis, based on Hooper's (1976) consonantal strength hierarchy, Selkirk's (1984) SSG, Eckman's (1987) MDH, and on Eckman and Iverson (1994), predicted that voiced obstruents, as preceding context of *-ed*, would induce more epenthesis than sonorants.

Moreover, taking into consideration the production of vowel epenthesis in verbs ending in *-ed* within the classes of obstruents and sonorants, the third hypothesis, based on Eckman's (1987) MDH, Eckman and Iverson (1994) and on Baptista and Silva Filho (1997, 2006), predicted that, within the class of obstruents, affricates, as preceding context of *-ed*, would induce more epenthesis than fricatives, which would induce more epenthesis than stops. Thus, the fourth hypothesis, based on Eckman's (1987) MDH, Hooper's (1976) consonant strength hierarchy and on Selkirk's (1984) SSG predicted that, within the class of

sonorants, nasals, as preceding context of *-ed*, would induce more vowel epenthesis than liquids.

The following section presents and describes the participants' profile as well as the material and the procedures used in the data collection and analysis.

3. Method

3.1 Participants

The participants of this study were twenty-six, fifteen females and eleven males, Brazilian EFL learners enrolled at the upper-intermediate level in the English Extracurricular Course at Universidade Federal de Santa Catarina (UFSC) who had taken 270 hours of classroom instruction previously to the data collection session. Their ages varied from 15 to 68 with their mean age being 23 when the data was collected.

3.2 Material

The material for data collection was a sequence of ten short paragraphs (Appendix A). Only monosyllabic verbs were used in this study to avoid interference of stress placement or shifting.

The obstruents /p, b, k, g, f, v, s, z, ʃ, tʃ, dʒ/, the sonorants /m, n, l, r/ and the vowels and the diphthongs /eI/, /oU/ and /aI/ were tested as preceding context of *-ed*. Each context appeared at least three times, one time in each of the monosyllabic verbs that contained this context (see a list of verbs in Appendix B). Each of the twenty-six participants audio-recorded 91 verbs, 80 containing consonantal contexts preceding *-ed* and 11 containing vocalic contexts.

3.3 Procedures for the collection, analysis and transcription of the data

The data were collected in the first semester of 2005, in the foreign language laboratory of UFSC using cassette tape recorders (Sony model ER5030), and head-mounted microphones (Sony model HS95). Participants were divided into two groups and sat in alternate desks to

avoid background noise in the recordings. They received sheets containing the sequence of 10 paragraphs. They were not allowed to take pronunciation notes or to do any previous planning to the readings.

The English monosyllables ending in *-ed* were auditorially analyzed by three raters – the author of this article and two advanced Brazilian EFL speakers with experience in EFL teaching and research. The raters analyzed the recordings with the help of two typed materials – the ten paragraphs and a list of the monosyllabic words in the sequence they were recorded. The raters' analyses should indicate: (a) whether or not there was an epenthetic vowel before *-ed*; (b) whether the verb was pronounced in the present tense; (c) whether the phonological context preceding *-ed* was mispronounced; and finally, (d) whether the target word was replaced by another word. The criterion used to establish whether or not an epenthetic vowel was produced was agreement between two of the raters. If there was disagreement among the three raters, one of them would analyze the token again and be asked to choose between one of the options previously identified.

Among the 2,366 tokens, the first and the second rater had an agreement of 82.42% of the tokens (or 1,950 tokens) after the comparison of their judgments. Thus, the 17.58% of the tokens that remained (or 416 tokens) were analyzed by a third rater whose analyses were compared to the analyses of the previous raters in order to reach the criterion of equal judgment by two different raters. After the third analysis, the pronunciation of 30.31% of the tokens (or 126 tokens) remained unsolved. Thus, to avoid discarding these tokens, the first rater listened to the 126 tokens again and chose one of the pronunciations among the three previously pointed out by the raters. Thus, the 2,366 tokens of *-ed* included in the study were transcribed according to the IPA and grouped according to the type of coda; however only 1,780 of them (or 75.23%) were used to carry out the study due to mispronunciations, such as, saying the verb in the present tense or replacing it by another word.

Regarding the statistical analysis, Chi-square tests with $p .05$ being considered significant and with 1 degree of freedom were applied to

the data. The statistical analysis considered: (a) obstruents versus sonorants and sonorants versus vowels, to test hypothesis one; (b) voiced obstruents versus sonorants and sonorants versus vowels, to test hypothesis two; (c) affricates versus fricatives, versus stops to test hypothesis three; and (d) nasals versus liquids to test hypothesis four.

4. Results and discussion

This study investigated vowel epenthesis production in verbs ending in *-ed* in a paragraph reading task by BP speakers learning English as an FL. Overall results demonstrate that 78.14% of the 1,780 tokens, or 1,391 verbs ending in *-ed*, were epenthesized. These results were analyzed according to the influence of markedness and sonority of the preceding context of *-ed*.

4.1 The influence of sonority of the preceding context – Hypotheses 1 and 2

The first hypothesis predicted that obstruents would induce more epenthesis production than sonorants, which would induce more epenthesis than vowels as preceding contexts of *-ed*. Table 1 displays the results.

Table 1

Rates of epenthesis after obstruents, sonorants and vowels preceding *-ed*

	OBSTRUENTS (stops, fricatives, affricates)	SONORANTS (nasals, liquids*)	VOWELS
N° Prod	1,200	340	240
N° Epen	1042	229	120
% Epen	86.83%	67.35%	50.00%

* Several tokens containing /l/ were excluded from the analysis due to the vocalization of /l/ preceding the *-ed* morpheme (e.g., *called* [kɔwd] and *killed* [kɪwd]). When this was the case, no vowel epenthesis was produced.

As Table 1 demonstrates, the obstruents /p, b, k, g, f, v, s, z, ʃ, tʃ, dʒ/ as preceding contexts of *-ed*, induced significantly more vowel epenthesis than the sonorants /m, n, l, r/ ($\chi^2(1, N = 1,540) = 69.73, p < .0001$), which induced significantly more vowel epenthesis than the vowels and diphthongs /eI, oU, aI/ ($\chi^2(1, N = 580) = 16.86, p < .0001$). Moreover, these results followed the tendencies found in Delatorre's (2004, 2005, 2006b) studies in which the least sonorous obstruents induced higher rates of vowel epenthesis than the sonorants, which induced more vowel epenthesis than the more sonorous vowels as preceding contexts of *-ed*. Thus, the results of the present study altogether with the results of the previous studies on *-ed* suggest that markedness in terms of sonority is a relevant factor in the production of vowel epenthesis in verbs ending in *-ed*. Moreover, the results of the present study go in the direction of those found by Eckman and Iverson (1994) and by Baptista and Silva Filho (1997, 2006) for the production of vowel paragoge in obstruents versus sonorants by Chinese, Cantonese and Korean learners of EFL and by Brazilian EFL learners, respectively, thus, suggesting that sonority/consonantal strength is a relevant factor for the production of English codas by speakers of other L1s.

Furthermore, this study also investigated the production of vowel epenthesis in voiced obstruents versus sonorants preceding *-ed*. Thus, the second hypothesis predicted that voiced obstruents would induce more epenthesis production than sonorants as preceding contexts of *-ed*. Table 2 displays the results.

Table 2

Rates of epenthesis after voiced obstruents and sonorants preceding *-ed*

	VOICELESS OBSTRUENTS (stops, fricatives & affricate)	VOICED OBSTRUENTS (stops, fricatives & affricate)	SONORANTS (nasals & liquids)
N° Prod	781	348	340
N° Epen	690	286	229
% Epen	88.34%	82.18%	67.35%

As Table 2 demonstrates, voiced obstruents induced a significantly higher rate of epenthesis than sonorants, as shown by the Chi-square test ($\chi^2(1, N = 688) = 20.09, p < .0001$). These results corroborate those of Delatorre (2004, 2005, 2006b), as well as the results for the overall comparison between obstruents versus sonorants just mentioned, since voiced obstruents are also considered less sonorous than sonorants according to the sonority scale and/or consonantal strength hierarchy. Moreover, the results of the present study seem to reinforce the argument that markedness in terms of sonority plays a more important role in epenthesis production in verbs ending in *-ed* than markedness in terms of voicing of the preceding context, as discussed in Delatorre (2006a) and in Delatorre and Koerich (2008), which attributed higher rates of epenthesis in voiceless obstruents preceding *-ed* to markedness in terms of sonority since voiceless obstruents received the highest consonantal strength or less sonorous values, thus inducing more vowel epenthesis production as contexts preceding *-ed* than their voiced counterparts.

The influence of obstruents and sonorants as preceding contexts of *-ed* taken together with the sonority/consonantal strength values each consonant receives yielded another discussion regarding sonority within the coda produced in verbs ending in *-ed*. Since sonorants are more similar to vowels than to obstruents that represent the pronunciation of verbs ending in *-ed*, sonorants less frequently require an epenthetic vowel to solve the problem of similarity/difference in the sonority/consonantal strength values whereas obstruents seem to induce higher rates of vowel epenthesis production as preceding context of *-ed* because they are more similar in sonority/consonantal strength values to the past tense marker represented by another voiced or voiceless obstruent than the sonorants. Thus, obstruents would more frequently require an epenthetic vowel to solve this problem of similarity in sonority/consonantal strength values, which might also explain higher rates of epenthesis in obstruents preceding *-ed* than in sonorants in the same position.

This discussion on the influence of preceding and following sonority/consonantal strength values was also observed in Baptista

and Silva Filho (1997, 2006) who found that final consonants whose values were dissimilar from those of the following consonant were less frequently epenthesized by vowel paragoge than consonants whose values were more similar than those of the following consonant. Baptista and Silva Filho examined this difference in sonority according to Murray and Veneman's (1983) Syllable Contact Law (SCL) by establishing syllable contact numbers (SCN) across syllables, that is, between the final consonant of the coda and the consonant of the following onset. However, the present study does not analyze the SCN within the coda of verbs ending in *-ed*, thus leaving this analysis as a suggestion for further research.

Another characteristic that seems to go in favor of the sonorants, as preceding context of *-ed*, is the homorganic characteristic of the coda described in Greenberg's (1978) universals. That is, the alveolar nasal and liquids (lateral and retroflex) are homorganic to the past tense marker [d] in terms of voicing and of place of articulation with the exception being the bilabial nasal that is homorganic only in terms of voicing. Obstruents, on the other hand, are homorganic mainly in terms of voicing of the preceding context and the past tense marker, either voiced or voiceless alveolar stops, with the exception in the present study being the alveolar fricatives which are homorganic in terms of voicing and place of articulation. Consequently, this difference in terms of number of codas that are homorganic in both features – voicing and place of articulation – might help explain why sonorant codas, which have three different homorganic codas with both features, tend to induce less vowel epenthesis in verbs ending in *-ed* than obstruent codas that have only one pair of consonants that have the same voicing and place of articulation in the coda of verbs ending in *-ed*.

The above discussion together with the data regarding the influence of obstruents and sonorants preceding the *-ed* morpheme and those of Baptista and Silva Filho (1997, 2006) regarding the influence of final obstruents and nasals, suggests that markedness in terms of sonority is a relevant factor affecting the production of English codas

by Brazilians learning EFL. Moreover, the results of Silveira's (2004) study, which were contrary to those of Baptista and Silva Filho, suggest that level of proficiency, orthography of the target word-final consonant and L1 transfer of the deletion/assimilation of the final nasals might have resulted in the low influence of markedness in terms of sonority in the production of final obstruents and sonorants by Brazilian beginning EFL learners. As occurred in the production of word-final consonants in Silveira's (2002a, 2004) studies, orthography also tends to play an important role in the production of verbs ending in *-ed* since it seems to have induced vowel epenthesis production after all consonantal and vocalic contexts preceding *-ed*, as claimed by Alves, (2004), Delatorre (2005, 2006a) and Silveira and Alves (*in press*).

4.2 The influence of markedness within the class of obstruents – Hypothesis 3

The third hypothesis predicted that affricates would induce more epenthesis than fricatives, which would induce more epenthesis than stops, as preceding contexts of *-ed*. The results are displayed in Table 3.

Table 3

Rates of epenthesis after obstruents preceding *-ed*

	STOPS (bilabial & velar)	FRICATIVES (labiodental, alveolar & alveopalatal)	AFFRICATES (alveopalatal)
N° Prod	562	527	111
N° Epen	504	435	103
% Epen	89.67%	82.54%	92.79%

As Table 3 demonstrates, the predictions were partially confirmed – the affricates induced more epenthesis than the stops and fricatives. However, the fricatives, predicted to be more prone to epenthesis than stops yielded the least epenthesis of the three classes. Following

these results, the Chi-square test comparing epenthesis on affricates and stops yielded a non-statistically significant difference ($\chi^2(1, N = 673) = 1.01, p > .05$), corroborating the results of Delatorre (2005), which, contrary to the present study, yielded a statistically significant result ($p < .05$).

The comparison of epenthesis production after fricatives and stops shows that the latter induced significantly more mispronunciations than the former ($\chi^2(1, N = 1089) = 11.66, p < .001$), contradicting the predictions based on Eckman and Iverson's (1994) and on Baptista and Silva Filho's (1997, 2006) studies, and following the tendency attested in the results of Delatorre (2005).

These results also go in the direction of Greenberg's (1978) universals since clusters formed by a fricative plus a stop induced less epenthesis than clusters formed by stops. Concerning affricates, Greenberg considered that they are formed by a stop plus a fricative, which possibly indicates that the production of epenthesis is more frequent after affricates than after stops preceding *-ed* because, as stated by Greenberg (1978) and Hooper (1976), affricates result from the articulation of a stop and a fricative in one speech segment. In the same line of thought, Hooper (1976) states that, due to their complexity, affricates are attributed value seven (the highest value) in her hierarchy of strength, which characterizes them as being more problematic than stops.

Thus, the results of the present study suggest that Brazilian EFL learners' production of epenthesis within the class of obstruents is influenced by sonority since epenthesis decreases when sonority increases.

Finally, the influence of classes of obstruents on vowel epenthesis and vowel paragoge on obstruents preceding *-ed* and on single codas produced by Brazilian EFL learners seems to be uncertain at the moment due to the differences in the results obtained by Baptista and Silva Filho (1997, 2006), Koerich (2002, 2006), Delatorre (2005), and in the present study.

4.3 The influence of markedness within the class of sonorants – Hypothesis 4

The fourth hypothesis predicted that nasals would induce more epenthesis than liquids preceding *-ed*. Table 4 displays the results.

Table 4

Rates of epenthesis after sonorants preceding *-ed*

	NASALS (bilabial & alveolar)	LIQUIDS (lateral & retroflex)
N° Prod	165	175
N° Epen	123	106
% Epen	74.54%	60.57%

As Table 4 demonstrates the nasals /m, n/ induced significantly more epenthesis than liquids, as attested by the Chi-square test ($\chi^2(1, N = 340) = 7.54, p < .01$) following the tendency found in Delatorre (2005). In other words, the more marked and less sonorous nasals induced more vowel epenthesis than the less marked and more sonorous liquids preceding *-ed*, as expected. The results of the present study and those of Delatorre (2005) suggest that markedness in terms of the influence of sonority within the class of sonorants is a relevant factor for the production of vowel epenthesis in words ending in *-ed*, as they seem to be for the production of epenthesis within the class of obstruents discussed above.

5. Conclusion

The results of the present study demonstrate that sonority has an influence in the production of verbs ending in *-ed* since markedness in terms of sonority seems to explain the differences in epenthesis in obstruents versus sonorants, and in voiced obstruents versus sonorants as well as the production of vowel epenthesis within the classes of

obstruents and sonorants with the less sonorous sounds being more troublesome for Brazilian EFL learners than their more sonorous counterparts.

Regarding the pedagogical implications, these results and those of Delatorre (2004, 2005) suggest that the teaching of verbs ending in *-ed* to Brazilian EFL learners should follow the increase order of difficulty of the preceding context, that is, begin by the introduction of verbs in which *-ed* is preceded by vowels/diphthongs, followed by liquids, nasals, fricatives, stops, and, finally, affricates.

Further research on the influence of the preceding context of verbs ending in *-ed* could investigate the influence of preceding obstruents, sonorants and/or vowels/diphthongs in the perception and production of verbs ending in *-ed* by Brazilian learners of English from different levels of proficiency and by speakers of different L1s with different levels of proficiency as well. Moreover, the effect of explicit instruction, production and perceptual training in perception and/or production of regular verbs ending in *-ed* by speakers from different levels of proficiency and different L1s should also be investigated.

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APPENDIX A

1 - The puppy

The child cried a lot when her mother told her her puppy had died. The little dog was killed by a car that passed by on the street. The girl prayed it could be alive but her father called a veterinarian and it was too late. She touched it for the last time and kissed him goodbye. Then, she slept in her father's arms.

2- A terrible day

George woke up late that day. He washed his face and brushed his teeth very quickly. He didn't have breakfast, but even so, he missed the bus. He wished so much he had a car! However, he had never saved enough money to buy one. He tried to take a cab, but he remembered there was a strike. So, lucky George walked fast to work. He worked hard that day and at the end of the day, his boss said that the company was going to be closed soon.

3 - Olympic Games

In Athens 2004, Brazil had the best performance in the Olympic Games ever. The male volleyball team played against the Italian team and won the gold medal for the second time. Many Brazilian families watched the game that Sunday morning. At the end, all Brazilians were very proud of their team. A number of Brazilian athletes helped Brazil to be ranked in 18th place. Maybe the country could have reached 16th place if the Brazilian marathonist had not been stopped by a mad guy. Then, Vanderlei Cordeiro de Lima was the third. When he entered the stadium, the crowd cheered him with enthusiasm. The crazy guy was arrested but not judged guilty.

4 - September 11th

That was the day nine terrorists attacked the United States. The first and the second attacks happened in New York and the third one in Washington. Four planes were used in the attacks. The terrorists were mixed with the other passengers. They said they were linked to Osama Bin Laden. Many policemen and firemen risked their lives to save people. Everywhere people stopped and prayed for the victims. People who lived in New York were scared and afraid of new attacks. Many Brazilians changed their minds and moved back to Brazil after September 11th. After that the United States bombed Afghanistan and Iraq. They claimed it was an act to find and punish Bin Laden who, according to the American government, caused the war.. The government didn't accept arguments against the war although many people asked for a stop all over the world.

5 - Primitive people

This story is about an ancient culture in which people liked practicing different sports. Every year they planned what they were going to do and trained for the competitions. During the summer they climbed hills, jogged, rowed, golfed and surfed. In the winter, when it snowed, the women worked on handicraft while the men hunted and played ball games. When they won the game, they raised a flag with their left hand. As a

tradition, the winner of the season got married on that day. After the ceremony, the tribe gathered together, talked, danced and laughed a lot.

6 - The robber

Yesterday, the police arrested a robber who used to spend some time watching an area before he mapped it. Ten days before, he camped near the house he intended to rob and studied the family's routine. Then, he waited till the moment the owners went out and jumped over the wall and broke into the house. He robbed all he could and shared with a friend. The police solved the case immediately because the guy was filmed by the safety system and then they found the campsite.

7 - Technology

Human society has searched for new technologies throughout time. In the beginning, men made fire from wood. Some time later, they started to use stored food, which would be served throughout the years. With the development of electricity, human society has been dogged by the necessity of creating new things all the time. Interesting creations have been the lift and the stereo where the sound of the era could be heard. Nowadays, plugged to a computer, text can be filed and mailed everywhere instantly.

8 - Good Friends

Last Friday John went downtown and parked his car near the shopping center. Suddenly, he saw a man who looked like his friend Paul. John didn't expect to meet Paul there, but he crossed the street and called the guy. When the guy turned his head, John saw that, in fact, it was not Paul but a very old friend that had just arrived from a long trip around the world.

9 - Bus-driver

Mr. Smith learned to drive when he was 12. At a young age he became a bus-driver. One day the bus broke down. He slowed down, stopped the bus and the passengers left it. Mr. Smith phoned a mechanic. After half an hour, the mechanic came. He checked the transmission and fixed it. When Mr. Smith realized that the time spent to fix the bus ranged from 3 to 5 minutes, he made an important decision: He decided he was going to take a course and learn how to fix engines. Nowadays, Mr. Smith owns a chain of fancy garages.

10 - Children

Peter and Helen are brother and sister. They generally play together but yesterday Peter got sick. He coughed the whole night and when he woke up in the morning he couldn't go to school. He stayed in bed until his sister got back home from school. She thought he was asleep, so she passed near him and grabbed his sandwich. Peter screamed and their parents were miffed. They grasped both children's hands and took them to the dinner table. Peter's parents hoped he would be fine next morning and he was. However, the following day at school, Peter's teacher said he had skipped most of the activities during the last days he was sick. In fact, Peter got what he wanted: he loafed a lot at home while he was sick.

APPENDIX B

List of words ending in *-ed* grouped according to coda constituency

Two-member clusters	Three-member clusters	Vowel/diphthong + /d/
/pt/ stopped, mapped, hoped, skipped	/spt/ grasped	/eId/ played, prayed, stayed
/bd/ robbed, grabbed	/skt/ asked, risked	/oUd/ rowed, snowed, slowed
/kt/ walked, talked, liked, looked like, checked	/mpt/ jumped, camped	/aId/ cried, tried, died
/gd/ jogged, dogged, plugged	/Nkt/ linked, ranked	
/ft/ laughed, coughed, miffed, loafed	/lpt/ helped	
/vd/ saved, lived, moved	/rkt/ worked, parked	
/st/ missed, passed, kissed, crossed	/lft/ golfed	
/zd/ closed, used, caused, raised	/rft/ surfed	
/St/ washed, brushed, wished	/lvd/ solved	
/tSt/ touched, watched, reached	/rvd/ served	
/dZd/ judged	/kst/ mixed, fixed	
/md/ climbed, bombed, claimed, screamed	/nst/ danced	
/nd/ trained, planned, phoned	/rtSt/ searched	
/ld/ killed, called, filed, mailed	/ndZd/ changed, ranged	
/rd/ cheered, scared, shared, stored	/lmd/ filmed	
	/rnd/ turned, learned	