PALATALIZATION IN BRAZILIAN PORTUGUESE/ENGLISH INTERPHONOLOGY

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ABSTRACT: This research focuses on palatalization of final alveolar stops by Brazilian learners of English. Thirty learners from the pre-intermediate level of an English course read a sentence list in English, containing word-final alveolar stops, and a sentence list in BP, containing word-final *te* and *de*. Considering L1 transfer, it was expected that the production of English final alveolar stops would be problematic. This production was examined according to two hypotheses. The first hypothesis was that absence of palatalization in BP would indicate absence of palatalization in BP/English interphonology and the second hypothesis was that the phonological environments which trigger palatalization in BP/English interphonology would not coincide with those environments which trigger palatalization in BP. Both hypotheses were supported.
KEYWORDS: Alveolar stops; coda; interphonology; palatalization; phonological environment.

INTRODUCTION

In the last decades, studies on interlanguage (IL) phonology have gradually gained considerable space and respect in the field of Applied Linguistics (Major 1998; Baptista 2000). In Brazil, a growing but still limited body of research has been conducted on IL phonology of Brazilian learners of English concerning the process of vowel epenthesis (e.g. Tarone 1980/1987; Baptista & Silva Filho 1997; Fernandes 1997; Rebello 1997; Koerich 2002; Rauber 2002; and Silveira 2004). For instance, Tarone

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(1980/1987) investigated the influence of the first language (L1) on the choice of syllable simplification strategies by comparing Brazilian Portuguese (BP) to Cantonese and Korean learners of English, Baptista and Silva Filho (1997) investigated the process of vowel epenthesis in the production of syllable-final consonants, Koerich (2002) investigated vowel epenthesis in the perception and production of word-final consonants. Other researchers have investigated change of features of final consonants in Brazilian Portuguese/English interphonology. For instance, Moore (2004) investigated the perception and production of the dark /l/ and Kluge (2004) investigated the perception and production of final nasals. These studies have suggested that L1 heavily influences the pronunciation of second language (L2) consonants.

Final consonants production has been studied with special interest because English syllable structures are more complex than BP ones, allowing words to end in obstruents. In order to simplify the English syllabic structure, BP learners may add an epenthetic vowel to a final obstruent turning CVC syllables into a CV.CV sequence and in the case of alveolar stops they may also produce palatalization or even palatalization with vowel epenthesis. For instance, vowel epenthesis and palatalization may be found in the production of loanwords such as *Internet*, which is pronounced by Brazilians as [intɛrnɛte], [intɛrnɛtɪ] or [intɛrnɛtʃɪ] according to dialect.

Thus, it seems that L1 transfer may operate in the production of final alveolar stops in English by BP learners. In BP, /t/ and /d/ vary according to the following phonological environment, characterizing different dialects, and sometimes, speakers' idiolects. That is, /t/ and /d/ undergo palatalization as a non-distinctive geographical dialect marker. Hooper (1976: 54), for instance, states that BP "has a palatalization process affecting /t, d/ before front high vowels". So, BP speakers may say [gatʃiɲo] for *gatinho* - 'kitten', but [gato] for *gato* - 'cat'.

Final alveolar stops are prohibited in word-final position in BP, but are frequently found in final position in English where they might undergo various allophonic processes. As previously mentioned, the contrasts between BP and English syllable structures and the operation of allophonic processes may lead learners of English to misunderstand as well as mispronounce final /t/ and /d/. Despite general awareness, on the part of English teachers, of the difficulties final alveolar stops pose to the students, the literature on the production of these specific sounds is scarce. The

present study contributes with data and insights for pronunciation instruction, in order to help learners overcome these difficulties. By mapping the least and most problematic variables affecting the production of final /t/ and /d/, as, for example, following environments, lessons can be planned and the target sounds practiced in a productive way.

In order to contribute to the investigation of errors in the production of alveolar stops in final position, in the present study, BP learners of English were recorded reading monosyllabic words containing final alveolar stops in several phonological environments in English and a sentence reading test in BP. The data obtained was analyzed concerning palatalization and palatalization with vowel epenthesis. The present study aimed at examining the relationship between BP idiolect and palatalization in Brazilian Portuguese/English interphonology.

2. ALVEOLAR STOPS AND PALATALIZATION

Palatalization is the commonest allophonic process involving alveolar stops in BP where alveolar stops are in complimentary distribution with affricates [t ʃ , dʒ]; that is, affricates are not phonemes in BP but allophonic variations of alveolar stops. Alveolar stops tend to be palatalized when followed by a high front vowel (Hooper 1976; Silveira 1986; Monaretto, Quednau, & Hora 1999; Albano 1999, 2001; Cristófaro Silva 2002).

Monaretto et al. review the interpretations of Lopez (1979), who analyzes palatalization in the dialect of people from Rio de Janeiro according to linear phonology and of Hora (1993), analyzing it in the dialect of people from Bahia according to autosegmental phonology. Regardless of the interpretation, palatalization is characterized as a process of assimilation in which, under the influence of one of the distinctive features of the front vowels [i] and [ɪ] or the glide [j], the alveolar stops are palatalized in different parts of the country. Câmara Júnior (1977) states that /e/ is replaced by an allophonic variant [i] in unstressed syllables. Therefore, even words spelled with final alveolar stops followed by 'e' are subject to palatalization.

According to Albano (1999, 2001), palatalization has both dialectological and sociolinguistic interest since its occurrence differs among regions as well as age range. The author exemplifies her claim saying that people from Rio de Janeiro of all ages produce the allophonic affricate variants; whereas people from São Paulo over 50 years of age do not palatalize. In southern Brazil, where the present study was carried out, there are at least eleven variations of the production of 'te' after a stressed syllable as in the word *sete* 'seven' [sete].

In English, word-final alveolar stops are palatalized when they appear before /j/ as in *would you* [wʊdʒyu:], and in its reduced alternative [wʊdʒu:].

3. ALVEOLAR STOPS AND PALATALIZATION IN BRAZILIAN PORTUGUESE/ENGLISH INTERPHONOLOGY

As acknowledged by Bond (2001) and shown in the data of Xavier (1989), BP learners of English tend to palatalize final alveolar stops even when this process is not allowed by the phonotactics of English. This can be explained based on Lado (1957, as cited in Eckman & Iverson 1993) when he argues that the splitting of two native language allophones into separate phonemes would represent maximum difficulty in L2 pronunciation.

Since in some dialects BP speakers palatalize alveolar stops when these are followed by a high front vowel, it is expected that language transfer operates, triggering palatalization of the alveolar stops in their Brazilian Portuguese/English interlanguage, and since vowel epenthesis (/i/) is a salient feature of these learners pronunciation, it is expected that palatalization in Brazilian Portuguese/English interphonology may be accompanied by the addition of the vowel as well.

4. METHOD

The present study aimed at investigating the following hypotheses: (a) absence of palatalization in BP may indicate absence of palatalization in BP/English

interphonology; and (b) the phonological environments which trigger palataliation in BP/English interphonology do not coincide with the phonological environments which trigger palatalization in BP.

The participants were thirty pre-intermediate students of English (with approximately 150 hours of previous instruction), fifteen male and fifteen female with ages ranging from 15 to 47 years. They were enrolled in the Extracurricular Course at the Federal University of Santa Catarina (UFSC).

The materials designed for data collection were a profile questionnaire assessing biographical information and two production tests – a sentence reading test in English and a sentence reading test in BP. Participants' production of final alveolar stops in English was assessed by a sentence reading test which consisted of a list of 240 topically unconnected short sentences containing monosyllabic words ending in /t/ or /d/ in different following phonological environments. The following environments tested consisted of the vowels /i, ɛ, ɔ/, the consonants /p, b, t, d, k, g, f, v, s, z, tʃ, dʒ, h, l, m, n/, and silence. The limitation in terms of vowels was due to the fact that the quality of the vowels was not being tested. It was essential to include the high front vowel /i/ since, in BP, palatalization is triggered by its presence in the following environment of an alveolar stop. The other two vowels, /ɛ/ and /ɔ/ were included in order to provide both a front and a back vowel as following environment. Sentences were randomized for presentation so that each participant read them in a different order, thus ensuring the absence of ordering effects.

Palatalization in BP was assessed through a sentence reading test which consisted of 16 short unconnected sentences in BP. The target words in these sentences were words containing the graphically represented syllables 'te' and 'de' at the end of words (e.g. *interessante* [ĩteɾesãtɪ] – 'interesting' and *de* [dɪ] – 'of').

Participants volunteered for the study and were not aware of its specific objective, only that the study concerned Brazilian Portuguese/English interphonology. The data gathering session was held in the foreign language laboratory at UFSC during regular class hours. First, participants answered the profile questionnaire and were then instructed for the first reading test – the English test. The reading of the 240 sentences took approximately 20 minutes. Following the reading test in English, participants were instructed for the second reading test – the BP test. The BP test was applied after

the English test to avoid calling participants' attention to the objective of the English test. Participants took less than five minutes to complete this test.

The equipment used for the recording conssited of two consoles (Sony model LLC4500MKII), twenty cassette tape recorders (Sony model ER5030), and head-mounted microphones (Sony model HS95). Participants were assigned places in the language laboratory being as far from each other as possible to prevent interference in the recordings and assure sound quality.

The written and oral instructions for the questionnaire and for the two tests were given in Portuguese. The students were classified according to palatalization in BP in order to establish a relationship between idiolect and palatalization in Brazilian Portuguese/English interphonology.

5. SPEECH PRODUCTION DATA TREATMENT AND JUDGMENT PROCEDURES

Participants' recordings were digitized at 22.05 kHz using a regular cassette recorder connected to a computer with the aid of Cool Edit software. The recordings were converted into mono to facilitate the subsequent acoustic analysis.

The acoustic analysis, carried out using Praat software, aimed at facilitating and giving reliability to the data judgment. The researcher judged all the tokens relevant to the study by carefully listening to the recordings and analyzing sound waves and spectrograms as many times as necessary to classify each sound produced where the target was a final alveolar stop. Thus, auditory and visual cues were employed to obtain the most accurate transcription of the data possible.

The judgement procedures started with the classification of the production into four categories: (1) targetlike productions of /t/ or /d/; (2) palatalization of /t/ or /d/ ([tʃ, dʒ]); (3) palatalization of /t/ or /d/ with vowel epenthesis ([tʃi, dʒi]); and (4) other errors.

Along with tokens where the time span between target sound and following environment was greater than .35 s (Zsiga, 2000), all tokens where the following environments were clearly mispronounced, in a way that would interfere with the analysis, were discarded. Thus, of the 7,200 tokens tested (240 for each of the 30 subjects), 5,618 were left for statistical analysis. That is, of the 3,600 tokens produced

when the target was /t/, 1,699 were discarded, and of the 3,600 produced when the target was /d/, 1,683 were discarded.

The statistical analysis of the data was carried out using the SPSS software. The Pearson Product Moment Coefficient of Correlation (*r*), a parametric test, was the analytic procedure carried out in order to assess whether and to what extent the relationships between processes were statistically significant. The Spearman's Rank Order Correlation (*rho*), a non-parametric test, was run when the presence of outliers was assumed to compromise Pearson's results. Paired sample *t*-tests were run with the intent of verifying if two variables triggered different mispronunciations and if there was a hierarchy of errors concerning their frequency.

6. RESULTS AND DISCUSSION

Table 1 shows the rates of targetlike production, palatalization, palatalization with vowel epenthesis, and other errors:

Type of Production	Nº Productions	Rate	SD
Targetlike	3,255	57.9%	.23
Palatalization	604	10.7%	.15
Palatalization with vowel epenthesis	107	1.9%	.04
Others	1,652	29.5%	-
Total	5,618	100%	–

Table 1: Production of Brazilian Portuguese/English final alveolar stops

Palatalization is a common process in the production of alveolar stops and alveolar fricatives in Brazil. Therefore, it was expected that it would be frequent in the present study. As shown in Table 1, in fact, it appeared as a frequent misproduction of English final alveolar stops, by itself and accompanied by vowel epenthesis. An interesting piece of data seems to deserve closer attention – the fact that palatalization alone was significantly more frequent (p<.001) than palatalization with vowel epenthesis $t(29) = 4.19$. The low frequency of the combination may be also due to voicing of the target since palatalization is more frequent when the target is the voiceless alveolar stop and vowel epenthesis is more frequent when the target is the

voiced alveolar stop (Bettoni-Techio, 2005). The low frequency of palatalization with vowel epenthesis also seems to indicate that if palatalization of /t/ and /d/ is triggered by vowel epenthesis, the epenthetic vowel tends to be omitted in the production process.

BP learners of English tend to palatalize final alveolar stops when this process is not allowed by the phonotactics of the language. This tendency is assumed to result from language transfer, since palatalization is a salient feature in many BP dialects. In order to verify this assumption, participants were asked to read a list of sentences in BP containing tokens where palatalization was common in many BP dialects. Figure 1 below shows the relationship between palatalization in BP and palatalization in Brazilian Portuguese/English interphonology:
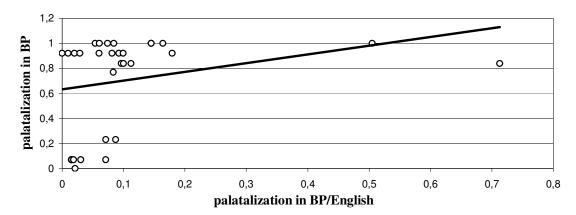

Figure 1: Relationship between palatalization in Brazilian Portuguese and palatalization in Brazilian Portuguese English interphonology

The Pearson Correlation test did not yield a significant correlation (r (30) = .271, p >.05). The Spearman's Rank Order Correlation, on the other hand, yielded *rho* (30) = .368 significant at .05 level. The correlation coefficients for palatalization with vowel epenthesis and palatalization in BP were r (30) = .255, and *rho* (30) = .241, both non-significant at .05 level. The lack of correlation with Pearson's test and the small correlation with the Spearman's test indicate that the presence of palatalization in BP does not necessarily lead to palatalization in English. These results seem to indicate that L1 idiolect alone cannot account for palatalization in English.

The first hypothesis was that absence of palatalization in BP would indicate absence of palatalization in BP/English interphonology. In order to investigate the

hypothesis Pearson Correlation tests were run only for the participants who palatalized in BP less than 25% of the time. Figure 1 shows that the participants who did not palatalize in BP did not palatalize or palatalized very little in English, which might be seen as an indication that the absence of palatalization in BP may be a predictor of its absence in Brazilian Portuguese/English interphonology. This tendency was confirmed by the statistical test which yielded the following results: palatalization in BP and palatalization in Brazilian Portuguese/English, $r(8) = .776$, $p = .023$; and palatalization in BP and palatalization with vowel epenthesis in Brazilian Portuguese/English, $r(8) = .707$, $p = .050$. The hypothesis was supported.

The second hypothesis was that the phonological environments which trigger palatalization in BP/English interphonology do not coincide with the phonological environments which trigger palatalization in BP. As previously mentioned palatalization in BP is triggered by a front high vowel in the following environment and in interphonology this seems to be random since a classic example of palatalization in BP/English is the pronunciation of the word *two* as [tʃju]. Three vowels were selected to stand for the whole group. Table 2 shows the production rates for the vowels in the following environment:

Following Environment	N	N° Prod	Palatalization Rate %	SD
i	206	16	7.8	.23
ɛ	268	19	7.1	.11
ɔ	287	40	13.9	.19
Total	799	75	9.4	-

Table 2: Rates of mispronunciations by vowels in the following environment

Even though it is claimed that front vowels tend by nature to generate palatalization (Wise, 1957), which is true for BP, the hierarchy of difficulty yielded from *t*-tests in the present study was that silence caused more palatalization than consonants, which caused more palatalization than vowels. The statistical tests run for the vowels showed that /i/ was not a palatalization motivator. The lax vowel seemed to be less problematic as a following environment: For the pair /ɛ/-/ɔ/, *t* (29) = -3.14, *p* < .01.

In spite of the lack of significance in the difference between front vowels and between the pair /i/-/ɔ/, the back vowel yielded more palatalization than both front vowels. Even though there may be a certain relationship between palatalization in BP and palatalization in BP/English interphonology, the process of palatalization in interphonology deserves more detailed research since the environments where this process occurs in the L1 do not coincide with those observed in the BP/English interphonology supporting the second hypothesis.

In order to better understand the effects of following environment on palatalization production in BP/English interphonology, the rates of palatalization were also calculated for consonants and silence as following environments. Table 3 presents the results:

Following Environment	N		Palatalization	
		N° Prod	Rate %	SD
p	293	44	15.0	.23
b	293	23	7.8	.19
t	272	24	8.8	.18
d	303	23	7.6	.14
k	258	42	16.0	.24
g	283	39	13.8	.18
f	283	57	20.0	.24
v	273	42	15.4	.16
s	294	7	2.4	.08
z	293	9	3.0	.09
tʃ	266	19	7.1	.12
dʒ	287	30	10.4	.14
h	260	32	12.3	.14
m	251	29	11.6	.16
n	297	37	12.4	.21
l	284	21	7.4	.13
Silence	329	51	15.5	.24
Total	4,818	529	10.9	-

Table 3: Rates of mispronunciations by consonants and silence in the following environment

Voicing does not seem to play an important role concerning the following environment for palatalization, although there seems to be a tendency for voiceless sounds being more problematic. However, the bilabial stops were the only pair to present statistical significance (p<.01). The voiceless bilabial stop significantly triggered more palatalization than its voiced counterpart, $t(29) = 3.34$.

Place of articulation seems to have affected targetlike production. Among the stops, the alveolars, probably because of gemination, are the least problematic environments when the targets are the alveolar stops. For palatalization, velars were significantly (p<.01) more problematic than alveolars, $t(29)$ = -3.14, which was the only significant difference among the oral stops. Palatalization seems to depend on the markedness of the following environment regarding place of articulation. Fricatives present extremes; whereas labiodentals are amongst the most problematic following environments concerning palatalization, the alveolar fricatives are amongst the least problematic ones, which yields a highly significant (p<.01) difference, $t(29)$ = 4.92. The glottal fricative is also significantly (p<.01) more problematic than the alveolar fricatives, $t(29)$ = 4.69, and its difference from the labiodentals is not significant. The results indicate that between the nasals there are not significant differences. The alveolar liquid, which was the only other sonorant consonant tested, yielded significantly (p<.05) less difficulty in relation to the alveolar nasal, $t(29)$ = -2.132.

The results of the statistical tests indicate the influence of the following environment on the production of final alveolar stops. In order to illustrate the effects of following environments, two words which were tested with both least problematic and most problematic following environments were organized in Table 4 and frequencies of palatalization were calculated for each instance:

Environment	Target	N	Palatalized	Rate	Token
/f/	t	25	10	40%	boat fever
/s/	t	24	1	4%	boat sank
/f/	d	23	7	30%	road forks
/s/	d	24	1	4%	road sign

Table 4: Rates of palatalization by combination of words and following environments according to difficulty

Besides confirming that following environments affect palatalization, the table also shows that palatalization is not word specific. Thus, familiarity and frequency of use had less influence on word production than phonological environment. For example, the words 'boat' and 'road', which were combined with both most and least problematic following environments had the following frequencies of palatalization: 'boat' – was palatalized 40% of the time when followed by [f] and only 4% of the time when

followed by [s], and 'road' – was palatalized 30% of the time when followed by[ʃ] and only 4% of the time when followed by [s]. This line of results seems to indicate that familiarity with the word did not lead participants to mispronounce them since the frequencies varied according to the difficulty of the following environment.

7. CONCLUSION

7.1 FINAL REMARKS

The main objectives of the present study were to investigate whether lack of palatalization in BP would indicate lack of palatalization in BP/English interphonology and whether the environments which trigger palatalization in BP/English interphonology coincide with the environments which trigger palatalization in natural languages. The main findings are summarized below:

Finding 1: BP learners who usually do not palatalize word-final 'te' and 'de' in BP, do not tend to palatalize final alveolar stops in English.

Finding 2: The rate of production of palatalization with vowel epenthesis was around 2%. This low frequency seems to indicate that if palatalization of /t/ and /d/ is triggered by vowel epenthesis, the epenthetic vowel tends to be omitted in the production process.

Finding 3: Velar stops in the following environment of alveolar stops tend to be more problematic than bilabial stops and bilabials more problematic than alveolar stops concerning palatalization showing that markedness of following environment regarding place of articulation might have influenced learners' production.

Finding 4: Palatalization seems not to be word specific but probably environment specific. However, the environments which trigger palatalization in interphonology do not coincide with the environments which trigger palatalization in natural languages.

7.2 LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

There was an imbalanced number of participants regarding idiolect. Out of 30, only eight belonged to the group that does not palatalize in BP. In order to overcome

this limitation part of the data could have been gathered in regions where people do not palatalize as the mid-west and north of Santa Catarina.

Another important limitation concerns the small number of participants. As no studies had been carried out concerning final alveolar stops and palatalization in Brazilian Portuguese/English interphonology, the present study played an exploratory role. Thus, there was a large number of following environments wich made the transcription sections long. As a suggestion for further research, the variety of following environments could be reduced and the number of participants increased.

The fourth important limitation was that a reading test was chosen in order to better cover the environments of interest; however, free speech could have triggered different errors with different frequencies. Further research could replicate the different tasks applied by Koerich (2002) in order to gather her data, but with participants with higher proficiency level and concentrating the analysis on the final alveolar stops.

7.3 PEDAGOGICAL IMPLICATIONS

This study has shown that idiolect as well as L1 may influence the acquisition of a second language phonological system. Therefore, especially when addressing pronunciation instruction, materials should be designed for specific audiences and teachers should be aware of the possible errors their students are likely to produce in order to help learners to prevent and correct them.

Palatalization is a frequent error in BP learners of English production and it is scarcely addressed in the literature. In most pronunciation and course books, palatalization of final alveolar stops is only approached regarding its native-like production in environments before /j/. Since little straightforward practice, if any, is provided aiming at its avoidance, teachers should address palatalization avoidance along with the exercises that promote palatalization from the beginning of the learning process. The present study has shown that the type of error depends not only on learner' idiolect but also on phonological environment; for instance, /s/ is not problematic as a following environment. Thus, when teaching negatives, teachers could explore these least problematic environment (e.g. I'm not sorry) in order to provide good input and practice opportunity. More problematic environments may be included progressively after learners had mastered the easier structures.

The main findings of this research show that markedness relations interact with transfer and phonological environment in order to build interphonologies. Besides being language specific, interphonologies vary greatly among speakers of a same language. Individual differences are present in the learning rate and in the ultimate achievement as well. Some individual differences can be related to motivation and the use of learning strategies while others are related to aptitude. Individual differences interact among themselves and between the outcome of the interaction among the linguistic variables. Even embedded in such a complex reality, the present study has shown that patterns do exist. Understanding these patterns and applying them to the teaching and learning of an L2 may reduce individual differences promoting intelligibility.

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RESUMO: Esta pesquisa focaliza a produção de plosivas alveolares em final de sílaba por estudantes brasileiros de inglês. Trinta estudantes do nível pré-intermediário de um curso de inglês leram uma lista de sentenças em inglês contendo palavras terminadas por /t/ ou /d/ e uma lista de sentenças em PB contendo palavras com sílabas finais te e de. A produção foi examinada objetivando responder a duas hipóteses. A primeira hipótese era que ausência de palatalização em PB indicaria ausência de palatalização na interfonologia e a segunda era que o contexto fonológico que promove palatalização na interfonologia não coincide com o contexto fonológico que promove palatalização na língua materna. As duas hipóteses foram confirmadas.
PALAVRAS-CHAVE: Plosivas alveolares; coda; interfonologia; palatalização; contexto fonológico.

ABSTRACT: This research focuses on palatalization of final alveolar stops by Brazilian learners of English. Thirty learners from the pre-intermediate level of an English course read a sentence list in English, containing word-final alveolar stops, and a sentence list in BP, containing word-final *te* and *de*. Considering L1 transfer, it was expected that the production of English final alveolar stops would be problematic. This production was examined according to two hypotheses. The first hypothesis was that absence of palatalization in BP would indicate absence of palatalization in BP/English interphonology and the second hypothesis was that the phonological environments which trigger palatalization in BP/English interphonology would not coincide with those environments which trigger palatalization in BP. Both hypotheses were supported.
KEYWORDS: Alveolar stops; coda; interphonology; palatalization; phonological environment.