PL2 PRODUCTION OF ENGLISH WORD-FINAL CONSONANTS: THE ROLE OF ORTHOGRAPHY AND LEARNER PROFILE VARIABLES

PRODUÇÃO DE CONSOANTES FINAIS DO INGLÊS COMO L2: O PAPEL DA ORTOGRAFIA E DE VARIÁVEIS RELACIONADAS AO PERFIL DO APRENDIZ

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ABSTRACT

The present study investigates some factors affecting the acquisition of second language (L2) phonology by learners with considerable exposure to the target language in an L2 context. More specifically, the purpose of the study is two-fold: (a) to investigate the extent to which participants resort to phonological processes resulting from the transfer of L1 sound-spelling correspondence into the L2 when pronouncing English word-final consonants; and (b) to examine the relationship between rate of transfer and learner profile factors, namely proficiency level, length of residence in the L2 country, age of arrival in the L2 country, education, chronological age, use of English with native speakers, attendance in EFL courses, and formal education. The investigation involved 31 Brazilian speakers living in the United States with diverse profiles. Data were collected using a questionnaire to elicit the participants' profiles, a sentence-reading test (pronunciation measure), and an oral picture-description test (L2 proficiency measure). The results indicate that even in an L2 context, the transfer of L1 sound-spelling correspondence to the production of L2 word-final consonants is frequent. The findings also reveal that extensive exposure to rich L2 input leads to the development of proficiency and improves production of L2 word-final consonants.

Keywords: L2 consonant production; grapho-phonological transfer; learner profile.

RESUMO

O presente estudo examina fatores que afetam a produção de consoantes em segunda língua (L2) por aprendizes que foram consideravelmente expostos à língua-alvo em um contexto de L2. Um dos objetivos do presente estudo foi investigar com que frequência os participantes utilizam processos fonológicos que resultam da transferência da correspondência entre ortografia e som da língua materna (L1) para a L2, quando produzem consoantes da língua inglesa em posição de final de palavra. O segundo objetivo consistiu em examinar

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o relacionamento entre índice de transferência grafo-fonológica e fatores ligados ao perfil do aprendiz (e.g., nível de proficiência, tempo de residência em um país da L2, idade de chegada ao país da L2). A pesquisa contou com a participação de 31 brasileiros que residiam nos Estados Unidos, com perfis variados. Os dados foram coletados utilizando um questionário para identificar o perfil dos participantes, um teste de leitura de sentenças (medida de pronúncia) e um teste de descrição oral de imagens (medida de proficiência em L2). Os resultados indicam que, mesmo em um contexto de L2, a transferência da correspondência entre ortografia e som da L1 na produção de consoantes da L2 é frequente. Entretanto, o contato com input de qualidade em L2, combinado com um conhecimento gramatical sólido da L2 na ocasião da chegada ao país da L2, está diretamente relacionado com o desenvolvimento da proficiência e com a melhora na produção das consoantes em final de palavra na língua-alvo.
Palavras-chave: produção consonantal em L2; transferência grafo-fonológica; perfil do aprendiz.

INTRODUCTION AND REVIEW OF LITERATURE

One of the main challenges faced by language learners is making sense of the phonetic/phonological inventory and patterns of the target language. Although influential second language (L2) educators agree that native-like L2 pronunciation is an unreasonable goal, there is a consensus that a certain level of intelligibility is necessary to ensure effective communication among speakers from different L1 backgrounds speaking a shared target language (CELCE-MURCIA, BRITON, GOODWIN & GRINER, 2010). Research in L2 phonology, also known as interphonology, has provided empirical data to help researchers and instructors understand the pronunciation difficulties faced by L2 learners, proposing a myriad of factors that may account for these difficulties, the main ones being markedness (ECKMAN, 1991), sonority (TROPF, 1987), phonological environment (CARLISLE, 1991), and perception (FLEGE, 1995).

One of the many pronunciation difficulties faced by Brazilian learners of English is the production of word-final consonants (e.g., BAPTISTA & SILVA-FILHO, 2006; MAJOR, 1986; SILVEIRA, 2007, ZIMMER, 2004). This paper draws on the findings of these studies and investigates whether the transfer of first language (L1) sound-spelling correspondence may explain the pronunciation patterns displayed by Brazilian learners producing English word-final consonants in a reading-aloud task. This study extends the previous ones by presenting data from participants who had been living in an L2 environment (United States) for

at least one year prior to data collection, which allows us to examine whether the production of word-final consonants by Brazilian learners in an L2 context follows a path similar to that reported for learners who study English in classrooms in Brazil (EFL context). Second, because the present study correlates production data with a number of learner profile variables deemed relevant in L2 acquisition, it is possible to investigate whether these variables can also provide insights into the production of L2 consonants.

The following section brings information about the syllabic structure of English and Brazilian Portuguese (BP) and about syllable simplification strategies commonly found in the English word-final consonants produced by Brazilians. This will be followed by a review of previous studies on the effects of orthography and learner profile factors on the acquisition of the L2 phonological component.

1. PRODUCTION OF L2 WORD-FINAL CONSONANTS AND L1 SYLLABIC CONSTRAINTS

In English, all consonants except [h][1] can appear in word-final position. Conversely, in BP, only a few consonants are permitted in syllable-final position: [r] and its allophones, the lateral [l], the nasals [m], [n], and [ŋ], and the sibilants [s] and [z] (CÂMARA, 1970; COLLISCHONN, 1996). However, even these sounds are somewhat marginal in the word-final position, being deleted or undergoing phonological weakening processes. For example, [r] tends to be deleted (*comer* 'eat' [ko'me]); [l] is generally vocalized and realized as the glide [w] (*mal* 'bad' [maw]); the nasals lose their consonantal feature with preceding vowel diphthongization and assimilation of the nasal feature (e.g., *bom* 'good' [bõʊ]); leaving only [s] and [z] and their allophones ([ʃ] and [ʒ]) as final consonants phonetically (*às vezes* 'sometimes' [az'vezɪs].

Due to these constraints on syllable structure, BP speakers tend to resort to vowel epenthesis to break up cross-syllabic consonant clusters in the L1, as demonstrated by the example *captar* ('capture'), which is pronounced with the epenthetic vowel [i], yielding [kapi'tax]. This productive L1 process of vowel insertion is also known to be a frequent syllable simplification strategy in BP/English interphonology, being applied to structures such as syllable and word-final

1. Phonetic transcription of English words follow the guidelines proposed by Celce-Murcia; Goodwin; Briton & Griner (2010), while the transcription of Portuguese words follow Cristófaro-Silva (2002).

singleton consonants that are not permitted in BP (e.g., 'notebook' ['noʊti'buki]. Other processes have often been identified in the production of word-final consonants, among which are deletion (e.g., 'dog' [dɔ]), palatalization (e.g., 'pod' [pɔdʒ]), devoicing (e.g., 'does' [dʌs]), vocalization of nasals (e.g., 'ham' [hɛ̃y]), and delateralization of [l] (e.g., 'ball' [bɔw]) (ZIMMER, SILVEIRA & ALVES, 2009).

As previous studies have shown (SILVEIRA, 2007; ZIMMER, 2004), the production of English word-final consonants is also influenced by orthography. Interphonology studies have frequently relied on reading-aloud tasks to collect data, but little has been said about the extent to which speech samples elicited by means of reading tasks are affected by orthographic input. Zimmer (2004) maintains that learners activate their knowledge of the L1 alphabetic and phonetic-phonological systems to some extent when performing reading-aloud tasks in the L2. This activation may account for some non-target productions of L2 sounds, such as when Brazilian learners of English pronounce the digraph ge as [ʒ] in words like 'page' [peydʒ], realized as [peyʒ].

The inventories of graphemes of English and BP and their respective sound correspondences are displayed in Table 1, which includes the English single and double consonant graphemes (e.g., 'sun', 'ball') tested in the present study, as well as sample words, and sound correspondences for these graphemes in English and BP. The last rows display single consonants followed by a silent *–e* grapheme (e.g., 'name', 'whale'). Data were collected with English words ending in six graphemes: *m/me, n/ne, ll/le*, which in English correspond to the sounds [m], [n], and [l], respectively. Note that the English consonant graphemes examined here are highly frequent in monosyllabic words, and for this reason *l* and *lle* were not included. As can be seen in Table 1, if BP learners produce the tested sounds relying on L1 sound-spelling correspondence, the nasal consonants should be vocalized (e.g., 'ham' [hɛ̃y] 'sun' [sʌ̃]) and the [l] should lose its lateral feature, being produced as [w]. Furthermore, the consonants tested in the silent *–e* condition should be produced with a paragogic vowel (e.g. 'name' ['neymi].

Table 1. English graphemes tested in the study

Graphemes in word-final position				
Graphemes	English Examples	English sounds	BP Examples	BP sounds
m	ham	[μ]	som, bem	[o)))Y, ε)I)] ετχ.
n	sun	[ν]	hífen	[ε)I)]
ll	ball	[ℜ]	bell[a]	[ω]
Graphemes followed by silent –e				
me	name	[μ]	tome	[με, μI]
ne	wine	[ν]	cone	[νε, νI]
le	whale	[ℜ]	mole	[λε, λI]

[a]This is a last name of foreign origin in BP.

Researchers have proposed that the production of L2 speech sounds is highly influenced by the way learners perceive these sounds (e.g., FLEGE, 1995; BEST, 1995). Thus, as the L1 becomes more stable throughout childhood and early adolescence, L2 learners are more likely to assimilate L2 sounds into L1 categories, thus preventing them from creating new categories for the L2 (FLEGE, 1995). Detey and Nespoulous (2008) argue that orthography also affects the way L2 sounds are perceived.

Young-Scholten and Archibald (2000) argue that most language learners are literate adults, whose contact with the L2 relies greatly on written material. These learners' first contact with L2 words generally involves written input, and constant access to the orthographic representations of words may lead learners to rely heavily on L1 sound-spelling correspondences when pronouncing L2 words. Erdener and Burnham (2005) contend that speech perception relies greatly on visual input and that, for literate learners, orthography is one important source of this type of input.

Silveira (2007) investigated how often EFL Brazilian learners resorted to a paragogic vowel to produce English word-final consonants. A comparison was also made between words ending in a consonant grapheme 'mad' and words spelled with a final silent *–e* grapheme 'made' in order to assess whether spelling influenced the production of word-final consonants. The findings regarding the effects of orthography indicate that this variable influences the production of word-final consonants and that words spelled with the silent *–e* triggered higher rates of vowel paragoge.

The empirical studies reviewed above suggest that orthography influences the production of L2 sounds and that this influence is related to learners transferring their knowledge of L1 sound-spelling correspondences, which sometimes leads to non-target productions. Koda (2007) points out that traditional definitions of transfer (e.g., GASS & SELINKER, 1983) have implied that transfer phenomena

tend to hinder L2 acquisition and are likely to disappear once L2 proficiency is attained. However, Koda proposes a different view of transfer as "the ability to learn new skills by drawing on previously acquired resources" or "automatic activation of well-established L1 competencies (mapping patterns) triggered by L2 input" (p. 17). Therefore, transfer cannot be easily controlled: both L1 and L2 are activated automatically, which means that L1 information cannot be "suppressed by learners when processing L2 lexical information." (p. 18). Moreover, transfer happens when a particular item is fully automatized in the L1 and, unfortunately, negative transfer (i.e., transfer that hinders L2 acquisition) is unlikely to cease completely, even after learners have achieved high proficiency levels in the L2.

A question posed by the present study is what factors can explain why certain L1 phonological processes are transferred into the L2 and whether they are still frequent in the interphonology of learners living in an L2 context. The following section examines studies that have attempted to clarify the role of learner profile variables in the acquisition of L2 phonology.

1.1. Learning context and learner profile factors

The present study examines the role of factors related to learning context, L2 proficiency, age, education, attendance in EFL and ESL courses, and L2 input quality. Learners immersed in a naturalistic setting may or may not have access to formal instruction in English and sometimes, due to their socio-economic status or for personal reasons, are not really immersed in the culture of the L2 and have few opportunities to really learn the language (ESPENSHADE & FU, 1997; SHIH, 2008).

DeKeyser (2007) points out that study abroad periods may fail to boost L2 acquisition if learners lack a sufficient level of proficiency in the L2 upon arrival in the target country. This is because study abroad experiences very often fail to provide learners with the kind of practice considered in cognitive psychology, especially Skill Acquisition Theory (ANDERSON, 1982), to be optimal. The author concludes that the role of study abroad experiences is to help learners move to the last stage of skill acquisition – automatization, and this can only be achieved if they have already reached an intermediate level of proficiency in the target language. DeKeyser's observations highlight the importance of attending language courses prior to spending time in an L2 context as a means to facilitating L2 acquisition.

In their study with Chinese speakers living in the US, Flege and Liu (2001) found that the participants enrolled in undergraduate or graduate programs became

more proficient in English as their length of residence increased, but the same was not true for the nonstudents, who were just involved in research or working at the university where the data were collected. The fact that only students' performances seem to improve as length of residence increases is attributed to the quality of input received, since these learners were more likely to be inserted in a rich input situation for L2 learning, being constantly exposed to the L2 in the classroom and using English with native speakers.

Flege and Liu (2001) criticize the view that age of exposure to the L2 determines the proficiency level to be reached by a language learner (JOHNSON & NEWPORT, 1989; PATROWSKY, 1990). They point out that many studies investigating people who started learning an L2 after puberty disregard the effects of the quality of input received by late learners (in the community, at home, or at work) and the amount of time they have been exposed to the L2 both in a naturalistic context and in terms of access to formal instruction in the L2. Flege and Liu suggest that the fact that children seem to be more successful than post-puberty learners in acquiring an L2 may be due to the quality and amount of L2 input they receive, and not because of neurological limitations.

There are few studies investigating how Brazilians living in an English-speaking country acquire the L2 phonological features (e.g., BAPTISTA, 1992), but they do not deal specifically with word-final consonants. The present study aims at contributing to this research area by examining how orthography, proficiency level and other nonlinguistic variables influence the production of English word-final consonants by Brazilians living in an L2 context. The study analyzes the production of three English word-final consonants ([m, n, l]), examining the occurrence of phonological processes resulting from transfer of L1 sound-spelling correspondence into the L2. Moreover, the study investigates whether transfer is related to learner profile factors such as proficiency level, length of residence in the L2 country, age of arrival in the L2 country, education, chronological age, use of English with native speakers (NSs), and attendance in EFL and ESL courses.

2. METHOD

The study investigated 31 Brazilians living in New York, New Jersey, and Connecticut. Speaking data were also collected from two American speakers who participated as controls. Four English teachers, two Brazilians and two Americans, contributed to the study as raters for the proficiency test given to the participants.

All participants and raters voluntarily participated in the study and no financial compensation was offered. The group of Brazilian informants included 24 (77.4%) females and 7 (22.6%) males, and their ages ranged from 19 to 60 (m = 37.3, SD = 9.0). The participants were originally from different parts of Brazil, but mostly from the southeast region (São Paulo, Minas Gerais, Rio de Janeiro, and Espírito Santo, in that order).

Table 2 shows that, on average, the 31 participants had finished secondary studies prior to moving to the United States (m = 12.8 years of schooling, SD = 2.8). One participant had not finished elementary school, one had only attended primary school, six had not concluded secondary school, five participants had concluded secondary school, and eighteen had completed at least part of their post-secondary studies in Brazil. To ensure that all participants were literate in their L1, they were asked to read a short text in Portuguese, prior to beginning the data collection. Most participants reported having had formal English instruction in Brazil (m = 29.5 months, SD = 35.8), but 25.8% had moved to the United States without having attended any EFL course, while 9.6% had studied English in Brazil for eight years or more. As for attendance in ESL courses, the number of months was much lower (m = 10.5 months, SD = 10.7), and 32.2% of the participants reported not having attended this type of course. All participants arrived in the United States (US) when they were 18 or more years old, with the average age being around 30 (SD = 8.1). The participants had been living in the US for 7.5 years on average, but two participants had arrived in the US one year prior to data collection and another had been living in the US for 22 years. Very few participants reported having attended school after arriving in the US, and those who did, had studied a maximum of four years (m = .37). Using a scale ranging from 0 (never) to 5 (five hours a day or more), the participants reported spending an average of three hours a day speaking with native speakers of English, but two of them reported not using English with native speakers at all.

Table 2. Participant profiles: mean, standard deviation[2] and range (n = 31)

	Mean (m)	Standard Deviation (SD)	Range
Chronological age (years)	37.3	9.4	19-60
Schooling in Brazil (years)	12.8	2.8	2-17
English as a foreign language (months)	29.5	35.8	0-144
English as a second language (months)	10.5	10.7	0-40
Age of arrival in the United States (years)	29.2	(8.1)	18-51
Length of Residence – United States (years)	7.6	5.2	1-22
Schooling in the United States (years)	.37	.87	0-4
English use with nonnative speakers (scale: 0-5 hours/day)	3	1.5	0-5

The study relied on a production test (sentence-reading task), a questionnaire, and an L2 proficiency test (oral picture-description task) to gather relevant data. The pronunciation test was a sentence reading task with 75 statements, each containing one carrier word, that is, a monosyllabic word whose syllabic structure was CVC (consonant/vowel/consonant) containing a target consonant sound. The participants received different randomized versions of the reading test to minimize any order effects. Thirty sentences contained the test items (see Appendix). The sentences contained a maximum of six words, to keep pausing to a minimum, and the vocabulary level of the sentences was kept as basic as possible, to prevent the participants from stumbling over difficult words. A total of 930 tokens were tested (3 sounds tested 10 times, produced by 31 participants).

The target consonants included in the production test were [m, n, l]. The target sounds were tested 10 times each under two different conditions: (a) testing the sound in a word ending in a consonant grapheme (e.g., the sound [n] tested with the word 'sun'); (b) testing the same consonant followed by a silent *–e* grapheme (e.g., 'bone'). All sounds were tested in three phonological contexts: twice followed by a vowel, twice by a consonant, and once followed by a pause). The sentences were designed so as to avoid the target consonants being followed by [i], which would make it difficult to identify tokens produced with a paragogic vowel (e.g., 'name' [naɪˈmi]), or by consonant clusters known to pose articulatory difficulties to BP learners of English (e.g., [st] as in 'stop'). Although there was an attempt to control for the phonological environment variable with the inclusion of the three phonological contexts, no specific analysis per phonological environment will be provided.

2. The descriptive statistics that appear in Table 2 will be explained at the end of this section.

Information about learner profile variables was gathered using a questionnaire written in English and completed by the 31 participants. This instrument provided the information summarized in Table 2. Because the participants differed a lot in terms of proficiency level and their experiences as language learners, it was deemed appropriate to use a measure of L2 proficiency that would be suitable for all learners. Thus, the participants' English proficiency levels were measured by using an oral picture-description task and by having their performance evaluated by four independent raters. The participants orally described a set of 26 slides containing a number of colorful images of people performing actions, as well as animals and objects in general, prepared as a Power Point presentation.

The data collection began with a brief training session for the participants so that they could get used to the tasks, the recording devices (GoldWave 5.23 software and Olympus Digital Voice Recorder WS-311M), and the computer used to display the slides. The participants were asked to press the page-down key to see each of the 26 slides for the picture-description test and each of the 75 sentences in the sentence-reading task. Each participant was tested and recorded on an individual basis in a quiet room at a convenient location for them, and the sessions lasted from 30 minutes to almost two hours. The tasks were completed in this order: questionnaire, picture-description test, and sentence-reading test. The two native speakers of English completed the picture-description test only and were also recorded individually. The researcher provided the instructions to the participants in Portuguese.

An audio CD was prepared including an approximately two-minute sample from each participant. The CD was edited using the software GoldWave version 5.23 (2008) and all long pauses were removed from the samples. The final version included nearly two hours of recording time. The first track included a two-minute sample that the raters used during the training session, and the four remaining tracks contained the data for the 31 Brazilians participating in the study, as well as the recordings of the two native speakers of English. Each rater received a different version of the CD, in which the recordings were presented in a randomized order. The raters completed the rating task individually at home. First, they were asked to read the instructions and perform a brief training session. They were warned that there was no correct answer for the picture-description test, and that the participants' varied a lot in the amount of details they provided while describing the images. Thus, their rating should really focus on their subjective notion of language proficiency, as they would do if they were placing one of their students in an English course. The raters reported spending about 1.5 to 2 hours to perform

the rating task, carried out in two or more sessions. The raters were not aware that the CD contained data from native speakers of English, as the researcher just informed them that she had recorded people of varied English proficiency levels. This procedure was expected to help the researcher evaluate the raters' criteria for assigning rates to the participants, which is discussed elsewhere (SILVEIRA, in preparation).

The raters listened to speech samples of each participant and used a rating scale to evaluate the participants' English proficiency levels. The scale instructed the raters to evaluate the overall proficiency level of participants, in a scale ranging from 1 (very low proficiency) to 12 (native-like proficiency). All raters were experienced English teachers in their mid 30s. Two of them were native speakers of Portuguese and had been teaching English in Brazil for over 10 years. Both were PhD students in Applied Linguistics in an English graduate program in Brazil. The other two raters, one female and one male, were native speakers of English working in English language courses in New York City. They were also experienced English teachers, holding a Master's in TESOL and English literature, respectively.

Table 3 shows the proficiency ratings assigned to the Brazilian learners. The mean combining all raters shows that, on a scale from 1 to 12, the participants' overall proficiency level was 6.9, and the range indicates that no participant received the maximum score (12) from all raters, since the highest average rate is 10.8. However, the two Brazilian raters and one American rater assigned the maximum rates to two participants (S20 and S26). These results indicate that the overall proficiency level of the participants is intermediate. The American raters assigned significantly lower rates ($m = 6.6$, $SD = 1.8$) than the Brazilian raters ($m = 7.9$, $SD = 2.5$), as demonstrated by a paired-sample t test[3] ($t = 6.55$, $p < .01$).

Table 3. Overall proficiency rates for the Brazilian participants (maximum score = 12)

	Brazilian raters	American raters	All raters combined
Mean	7.9	6.6	6.9
Standard Deviation	2.5	1.8	2.0
Range	4-12	3-10	4-10.8

The data used to analyze the participants' pronunciation came from the sentence-reading task. The researcher listened to the recordings and transcribed

3. A paired-sample t-test is used to compare the means of two sets of scores assigned to the same sample (e.g., in a pretest/posttest design, or, as in the case of this study, evaluations performed by different raters).

the 30 singleton word-final consonants produced by each participant. Another listener with experience in phonetic transcription, a PhD student from an Applied Linguistics program, carried out the same procedure separately. The two listeners worked together to decide on the few cases that generated different transcriptions and listened to the tokens until they reached an agreement.

The information collected via questionnaire helped build the participant profiles and identify the relevant variables reported in Section 2.2. Both the questionnaire data and the proficiency rating were analyzed and correlated with the pronunciation data (sentence-reading task) in order to provide answers to the research questions guiding the study. The data were submitted to statistical analysis using the SPSS software. In addition to descriptive statistics (percentages, means (central tendency), standard deviation (dispersion), and range (minimum and maximum score), non-parametric Spearman correlations were run to verify the relationship between all the variables included in the study.

In order to analyze the phonological process data[4], the framework proposed by Zimmer (2004) was adapted. Table 4 displays the four processes used to classify the non-target productions of word-final consonants and the consonant sounds included in this study.

Table 4. Summary of phonological processes and relevant consonant sounds

Processes	Examples	Sounds
Syllable simplification – Vowel Paragoge	name [nεΨμι]	[μ, ν, λ]
Syllable simplification – Deletion	whale [ωεΨ]	[μ, ν, λ]
Delateralization and rounding of /l/	doll [δ ω]	[λ]
Vocalization of nasals	ham [ηε)ψ)]	[μ, ν]

3. RESULTS AND DISCUSSION

This section begins with the reporting and discussion of the results for the first research question, focusing on how frequently the participants resorted to the phonological processes described in Section 2.3 and how transfer of the L1 sound-spelling correspondence might have affected the production of the English word-final consonants. Next, the second research question is answered by correlating

4. The few cases of Consonant Change, one of the processes identified by Zimmer (2004) were due to misreading and were excluded from the analysis, as they were not a direct result of L1 sound-spelling transfer (e.g., 'sing' being read as 'say').

the participants' performances in the sentence-reading test with their English proficiency rates and a myriad of learner profile variables.

3.1. RQ1: Frequency of phonological processes and L1 sound-spelling correspondence

Vowel Paragoge and Deletion are the phonological processes that apply to all consonants being tested. Table 5 shows that Vowel Paragoge occurred in 5% of the tokens, and this was particularly frequent after the nasal consonants in words ending in the silent –e grapheme (e.g., 'bone' [∪βοωνι] and 'name' ['νεψμι]). The sound [l] was never produced followed by a paragogic vowel in words without the silent *–e* grapheme, such as 'bill'. All target sounds in words with the silent *–e* grapheme yielded higher paragoge rates than in words without. Indeed, the results show that the participants produced the paragogic vowel in 9.2% of the words ending in the silent *–e* and in only 0.6% of the words ending in the consonant grapheme, thus suggesting that Vowel Paragoge is more pervasive with words ending in the silent *–e* condition. Moreover, the nasal consonants triggered over 55% of the total number of paragogic vowels. The Deletion process was rarely used and only with [l] (0.3%). The few cases of [l] deletion seemed to be due to misreading of the word 'whale', which may have been unfamiliar to a few participants who made long pauses and had difficulty reading this word.

Table 5. Frequency of phonological processes per consonant (percentages in parentheses [a])

Sound - Spelling	Vowel Paragoge	Deletion	Delateralization	Vocalization of Nasals	Total
[l] - ll	0 (0.0)	0 (0.0)	107 (69.0)		107
[l] – le	10 (6.4)	3 (1.9)	80 (51.6)		93
[n] – n	1 (0.6)	0 (0.0)		63 (40.6)	64
[n] – ne	17 (11.0)	0 (0.0)		3 (2.0)	20
[m] – m	3 (1.9)	0 (0.0)		19 (12.5)	22
[m] – me	16 (10.3)	0 (0.0)		1 (0.6)	17
Total produced	47 (5.0)	3 (0.3)	187 (60.3)	86 (13.9)	323
Tokens[b]	930	930	310	620	

[a] Percentages were calculated by dividing the number of times the process was used with a specific consonant by 155 (total number of tokens for each consonant).
[b] Tokens = number of consonants with which the process could be used, multiplied by the number of times the consonant was tested (5) and by the number of participants (31).

Table 5 shows that Delateralization was the most recurrent phonological process, even though it applied to the [l] only. The participants resorted to this

process to produce 60.3% of the words ending in [l], and the percentages were higher for words ending in a consonant grapheme (e.g., 'ball') than for words ending in the silent *–e* grapheme (e.g., 'whale'), 68% and 51.6%, respectively. This is probably connected to the fact that the words ending with the silent *–e* triggered other phonological processes: Vowel Paragoge (6.4%) and Deletion (0.3%), which means that 59.9% of the silent *–e* words were produced by resorting to an L1 phonological process. Still, the total rate of phonological processes (Delateralization only) for the words ending in l is 9.7% higher than for the words ending in *le*. These results suggest that the silent *–e* condition reduces the rates of L1 phonological process use.

Vocalization of the nasals [m] and [n] occurred 13.9% of the time. This process was more frequent with [n] (42.6%) than with [m] (13.1%). Note that when the nasal consonants were spelled with the silent *–e* grapheme, the Vocalization rates were much lower (2% and 0.6%, respectively), thus indicating that the silent *–e* condition prevented many participants from vocalizing the final nasal. In these cases many participants realized [m] and [n] in a target-like fashion, but, as discussed before, some of them resorted to Vowel Paragoge. Thus, once more, the silent *–e* condition actually helped the participants to produce the consonants in a more target-like fashion. Indeed, 55.6% of the nasals ending in a consonant grapheme were produced by resorting to L1 sound-spelling correspondence transfer (Vocalization or Paragoge), against 23.9 % of the nasals ending in the silent *–e* condition.

The rates of Vowel Paragoge reported in the present study are in agreement with Zimmer's (2004) and Major's (1996) crossectional studies, which demonstrates that this phonological process tends to disappear as proficiency increases. Although Vowel Paragoge has been identified as a typical feature of BP-English interphonology, due to the L1 syllabic constraints, recent studies (OLIVEIRA, 2009) have shown that in some BP dialects, especially from Minas Gerais (the state of nearly 23% of the participants), there is a tendency for speakers to delete the unstressed vowels in word-final position (e.g., *dedo* 'finger' [ded]), thus creating new (C)VC syllabic patterns in BP. This fact may also account for the lower rates of Vowel Paragoge reported here.

The results of the present study also show how L1 sound-spelling transfer triggers other phonological processes that are likely to delay the target-like production of English word-final consonants: Delateralization and Vocalization of Nasals. Focusing on the Delateralization process, the present research corroborates the findings of the former studies (BARATIERI, 2006; ZIMMER, 2004), thus

showing that this process remains fairly frequent even with learners who have spent at least one year in an English-speaking country and who have different English proficiency levels.

Another pervasive phonological process is Vocalization of Nasals. Kluge and Baptista (2008) argue that [m] triggers higher Vocalization rates because the word-final *m* grapheme is highly frequent in BP words (e.g., *com* 'with'), while n only occurs in few words (e.g., *hífen* 'hyphen'). Thus, Brazilians tend to associate the *m* grapheme more often with the L1 phonological process and vocalize the word-final nasals in words spelled with *m*. The findings of the present study challenge this explanation, indicating that the silent –*e* condition inhibits the occurrence of Vocalization, and that the words that are not spelled with silent –*e* are vocalized more often when they are spelled with *n*. Clearly, this issue deserves further investigation, but the present study has confirmed the persistence of Vocalization of Nasals in the interphonology of learners from different proficiency levels and living in an L2 context.

To conclude this section, the comparison between monosyllabic words ending in a consonantal grapheme and those ending in the silent –*e* grapheme showed that the silent –*e* condition leads the participants to resort less often to certain phonological processes, and to occasionally produce the word-final consonants in a more target-like fashion, and this is especially true for the nasal consonants. On the other hand, the silent –*e* triggered higher percentages of Vowel Paragoge than the words ending in a consonant grapheme, which indicates that, when faced with words containing this vowel grapheme, Brazilians are more likely to resort to the insertion of the paragogic vowel, which results in the production of a CV syllable, the canonical syllabic pattern (e.g., 'name' ['ney.mi]) in Brazilian Portuguese (KOERICH, 2006; SILVEIRA, 2007).

3.2. RQ2: Production of phonological processes and learner profile variables

Some researchers have pointed out the importance of paying attention to the role played by learner profile variables when attempting to understand how L2 sounds are acquired (e.g., FLEGE & LIU, 2001). The second research question investigated in this study seeks possible interactions between the rates of phonological processes used by the participants and their profiles in regard to (a) English proficiency; (b) chronological age; (d) education in Brazil and the United States (US); (e) attendance in English courses in Brazil (f) and in the United States;

(g) use of English with native speakers of English; (g) length of residence in the US; and (h) age of arrival in the US. The descriptive statistics for all these variables have been reported in the Method section (Table 2).

In order to answer the second research question, the participants' profile variables and their frequency of use of the phonological processes (see Section 3.1) were correlated. Due to the nature of some of the nonlinguistic variables, non-parametric correlations (Spearman) were run. The results in Table 6 indicate that the strongest correlations were obtained with L2 proficiency rates ($r = -.722$, $p < .01$), followed by use of English with native speakers ($r = -.482$, $p < .01$), and EFL courses ($r = -.433$, $p = .01$).

It is important to highlight that only the proficiency variable displays a strong correlation with phonological process use, while the other variables yielded moderate-to-weak correlations. All correlations (except for the chronological age, age of arrival variables, and attendance in ESL courses) are negative, thus indicating that the participants with lowest rates of phonological process use are (a) the most proficient, (b) those who had studied EFL for a longer time before arriving in the US, and (c) those who used English with native speakers more often. The participants' education in the US yielded a low, negative correlation and nearly approached significance ($r = -.337$, $p = .06$) , thus indicating that the participants who attended college or graduate school in the L2 country tended to resort less often to phonological processes as well. Another variable that approached significance was attendance to ESL courses ($r = .330$, $p = .06$), but it yielded low, positive correlations, suggesting a tendency for the students who studied ESL for a longer time to display higher rates of phonological process use. However, education in Brazil yielded only low, non-significant, negative correlations, and the same was true for length of residence in the US. Chronological age and age of arrival were positively correlated and failed to reach significance, thus indicating these two age variables were not good predictors of rate of phonological processes stemming from transfer of L1 sound-spelling correspondence into the L2.

Table 6. Spearman correlations (two-tailed) for phonological process use and learner profile variables

	Proficiency	Age	BR Educ.	EFL	ESL	NSs	US Educ.	Residence	Age of arrival
Correlation (r)	-.722	.292	-.245	-.433	.330	-.482	-.337	-.150	.288
Probability value (p)	.00	.10	.18	.01	.06	.00	.06	.42	.11

BR educ. = education in Brazil; EFL = English as a foreign language; ESL = English as a second language; US education = education in the United States.

As discussed in the literature on L2 phonological acquisition, frequent use of English with native speakers and attendance at school in the L2 country provide rich L2 input (FLEGE & LIU, 2001), and also an opportunity to use the target language and to work on possible pronunciation difficulties that hinder communication. The results reported here show that another relevant factor for the decrease in the rates of phonological processes is the amount of formal target language instruction the participants received prior to moving to the L2 country, which corroborates DeKeyser's (1997) claim that learners who arrive in the L2 country with a solid background about the L2 grammar are more likely to make good use of the richness of L2 input. Further support for this assumption is provided by the fact that the rates of phonological process use of the participants who attended ESL courses were higher than for the participants who did not, possibly because among the participants who reported having attended ESL courses were 87.5% of those who had not attended formal English classes in Brazil. This probably means that the lack of a solid background in English when these participants arrived in the US may have led them to resort to L1 sound-spelling transfer more often when producing the L2 words, and this also made the phonological processes investigated here more resilient to change.

The results also showed that long periods of residence in the L2 country and high levels of formal education in the L1 country are weakly related to a possible improvement in the production of word-final consonants analyzed. These findings provide no support for previous studies that found a close relationship between age of arrival in the L2 country and the acquisition of certain aspects of the L2 (JOHNSON & NEWPORT, 1988; MOYER, 1999), as the participants who arrived in the US at a younger age did not necessarily display lower rates of phonological process use. Furthermore, the fact that the participants who displayed high levels of L1 literacy (as measured by years of education in Brazil) still resorted to phonological processes may be regarded as possible evidence that high L1 literacy levels may make it hard for learners to suppress the transfer of their entrenched L1 sound-spelling correspondence knowledge. This assumption is corroborated by Young-Scholten and Archibald (2000).

Based on the results discussed in the previous paragraphs, a tentative answer to the second research question is that there is indeed a relationship between the learner profiles and the extent to which the participants resorted to phonological processes that result from transferring L1 sound-spelling correspondence into the production of L2 word-final consonants. The rate of phonological process use drops dramatically as proficiency level increases (MAJOR, 1986; ZIMMER, 2004).

In fact, when partial correlations[5] were run controlling for the proficiency variable, no other variable is significantly correlated, which confirms the strong relationship between target-like production of L2 word-final consonants and proficiency. Thus, although two other variables (attendance to EFL courses and use of English with native speakers) also interact with the use of phonological processes stemming from transfer of L1 sound-spelling correspondence (see Table 6), proficiency is the most important one. Most likely, the first two variables should be seen as essential factors to improve L2 proficiency, but it is the development of L2 proficiency that ultimately seems to lead to target-like production of English word-final consonants.

FINAL CONSIDERATIONS

The present study set out to investigate the effects of transfer of L1 sound-spelling correspondence on the production of English word-final consonants by Brazilian learners with diverse profiles and with extensive exposure to the L2 in the target country, showing that even in an L2 context, this type of transfer is frequent. It was also found that the presence of a final silent *–e* grapheme might have a facilitative effect in some contexts, in the sense that it tends to inhibit the production of certain phonological processes (Vocalization of Nasal and Delateralization), thus leading to a more target-like production of these word-final consonants. However, the silent *–e* condition might also delay target-like production of some word-final consonants, as it led the participants to resort more often to Vowel Paragoge, a phonological process that was scarcely ever used by the participants with words ending in a consonant grapheme.

The findings also reveal that extensive exposure to rich L2 input leads to the development of proficiency and improves production of L2 word-final consonants. Rich L2 input is more likely to be obtained if learners arrive in the L2 country with a certain level of L2 knowledge to cope with the extensive amount of L2 input, and if they are constantly using the L2 to communicate and monitor/refine their production of the L2 sounds. Despite its important role, the development of L2 proficiency does not eliminate L1 sound-spelling transfer, as phonological processes such as Delateralization remained recurrent in the interphonology of the Brazilian participants. This corroborates Koda's (2007) claim that L1 transfer (in

5. Partial correlations are used to show relationship between two or more variables while holding another variable constant. They are helpful to detect confounding variables.

this case, negative transfer) is resilient and cannot be easily suppressed, even by learners who are highly proficient.

In conclusion, the role of orthography should not be overlooked by interphonology studies, as the results reported here highlight the fact that the orthography variable can provide alternative explanations to findings that have been exclusively attributed to factors such as markedness, phonological environment or inability to perceive L2 sounds. Finally, the results indicate that even participants really immersed in a rich L2 input environment continue to resort to L1 sound-spelling transfer. This fact underscores the need for providing learners with pronunciation instruction that includes some sort of orthography component to raise their awareness of the different sound-spelling correspondences in English and their L1. The benefits of explicit pronunciation instruction have already been demonstrated in Author (2004), but the results reported here can be used to improve the design of pronunciation materials for Brazilian learners, taking into account the orthography factor.

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Appendix. Carrier Words

man	bone	file	bill	ice-cream	game
sun	phone	while	cell	room	same
coin	wine	whale	ball	dream	home
green	line	male	doll	ham	flame
moon	pine	pale	roll	mom	Time

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