The Production of Words with the Morpheme ED by Brazilian Speakers of English as a Foreign Language

Maria Lucia de Castro Gomes

Grupo Educacional Uninter, Brazil
malucastrogomes@terra.com.br

1. Introduction

Research in the area of English as a Second Language reveals that transfer is one of the main factors that prevent learners from having a native-like pronunciation. Observing Brazilian learners of English, we can indeed recognize interference of Portuguese segment features and syllable structure in the production of English words. Although research results have confirmed that, in the area of phonology, transfer is really one of the main sources of errors in L2 production and perception, other factors such as markedness and phonological environment have also been shown to be important constraints. Investigation into the similarity between first and second language acquisition have led researchers to the conclusion that L1 and L2 acquisition have a lot in common (Major, 1996; White, 2003; see Eckman, 2004 for a review) and that L2 learners' interlanguage is not only influenced by their native language. However, it happens that, regarding the focus of this particular research, languages are different in their syllable constitution and it is important to understand what happens to interlanguage syllables.

2. The acquisition of L2 syllables

Because languages have different syllable structures as well as different sound inventories, resyllabification of words is a common strategy for second language learners. L1 representation of syllables may generate a perceptive filter, which may lead the L2 learner to develop syllable simplification strategies, similar to those created by children during L1 acquisition, where there is also a preference for CV syllables (Young-Scholten & Archibald, 2000). There is some controversy about the reason for the preference for CV syllables by L2 learners: does it happen because of L1 transfer or because of universal principles? (see Carlisle, 2001 for a discussion). Carlisle suggests that learners will produce CV syllables independently of language transfer and that they may produce CVC as a strategy to simplify a difficult CVCC syllable even when in their language they have only CV syllables (Carlisle, 2001).

In Portuguese the canonic CV syllable is the most common (Cavaliere, 2005), while in English there is a preference for CVC syllables. As stated by Shockey (2003), "English is known to be a language with a potential for very heavy syllables when compared with other languages of the world. A CCCVCCC syllable is not unusual in English ('scrimped, splints')". In Portuguese the most complex structure is CCVCC or CCVV'CC, where the diphthong is interpreted as a sequence of two vowels (Silva, 2003; Mattoso Câmara, 1970). Furthermore there are severe restrictions for consonants in coda position. In Portuguese most varieties permit only two consonants in that position, the /r/ and the /s/, both with different dialectal possibilities of realization. In English, on the contrary, most consonants may occur in coda position.

Resuming the discussion about language transfer and language universals in L2 acquisition, a great deal of work has been done to investigate the influence of L1, of

markedness and of strength relations across syllables in the realization of epenthesis as a strategy to simplify syllables by L2 learners. Major (1996, 1997), mentioning his Ontogeny Model (OM), claims that "transfer processes decrease over time while universal developmental processes at first increase and then later decrease". Another model reviewed by Major (1997), the Similar Differential Rate Hypothesis (SDRH), "claims that similar phenomena present more difficulty than dissimilar phenomena and that markedness slows rate". Grounded on the basic premises of both models, Major (1997) proposes a third one, the Ontogeny Phylogeny Model (OPM), including a language change dimension, arguing that in this way it can account for both individuals and groups of speakers over generations. Hancin-Bhatt and Bhatt (1997) agree that transfer and developmental effects interact in the pronunciation of a second language but, according to them, transfer overrides development effects. They propose an interpretation of data via Optimality Theory. Baptista and Silva Filho (1997) examined the production of English single consonant codas by Brazilian learners of English, in relation to relative markedness of the target segment, and in relation to the environment. Results of that study, according to these researchers, "provide evidence for the need for perfecting the concept of consonantal strength or sonority" (Baptista & Silva Filho, 1997). Carlisle (1991) suggests that the degree of sonority of the previous environment influences the frequency of epenthesis. Results of Abrahamsson's study (2003), on the other hand, "suggest that sonority is a less influential factor in interlanguage development than other markedness factors, such as onset and coda length" and that "properties of L1 and L2 typically override principles of sonority". Another factor of investigation in L2 acquisition of syllable structure is the input, which will be discussed below.

3. The nature of the input

According to Gregg (2003), "input is the major factor in SLA". To acquire a second language, it is necessary to hear or to read that language so that a mental representation of the language, based on that input, is created by the learner. It happens that the input may be, and it usually is, provided by non-native teachers. On the other hand, even when the adult learner has the chance to hear native speakers often, the stability of the L1 phonological system might prevent the person from perceiving some sounds of the language being acquired. Complete second language acquisition involves the establishment of new categories for sounds and there is "a tendency to maintain sets of phones around phonemic target that have been set in childhood" (Pennington, 1997). According to Flege, MacKay and Meador (1999), corroborating predictions of Flege's Speech Learning Model (SLM), "the later L2 learning begins, the less likely L2 learners are to establish new categories for vowels in the L2". In other words, the second language learner perceives the sounds of the new language according to the phonetic categories of the system established during L1 acquisition. Piske, Flege and MacKay (1997) draw attention to the influence of continued use of L1 by bilinguals. They assume that, regardless of L2 input, bilinguals who continue to use their L1 frequently have a stronger foreign accent than those who use their L1 infrequently.

Young-Scholten (1995, 1997) argues that orthographic input influences the route of acquisition of syllable structure of English as a second language. Comparing the L1 and L2 acquisition processes, she claims that adult L2 learners prefer epenthesis over deletion as a strategy for syllable restructure, while the child prefers deletion in L1 acquisition, because of "access to written representation of words from the start" (Young-Scholten, 1995). Dziubalska-Kolaczyk (1997), in her beats-and-binding (B&B) model of phonology, claims that syllabification "proceeds on the one hand under the influence of morphological segmentation and complex orthography and, on the other, in accordance with the universal phonotactic preferences".

Young-Scholten and Archibald (2000) provide an overview of a number of studies in first and second language syllable acquisition and propose the existence of an interface between the segmental features and syllable structure. In their view, both universal principles of prosodic structure and the structure of the L1 influence the acquisition of L2 syllables. They believe that "L1 representational structure is very difficult to overcome". Archibald (1997) argues in favor of an abstract mental representation for an interlanguage grammar. He proposes, in the light of feature geometry, that the acquisition of a new syllabic structure is the projection of a new segmental contrast. He argues that "learners who have only a single liquid in their L1 will have to acquire a second liquid (i.e., an [l/r] contrast) before they will be able to reliably produce a range of onset clusters that include liquids".

Considering the morpheme ED, the interface between morphology and phonology and historical facts of English spelling may thus be interesting issues to investigate.

4. ED morpheme – orthography and its interface with morphology and phonology

Writing systems do not correspond to the sound system of languages in general. Orthographic systems usually have frequent occurrence of one-to-many correspondences between sound and spelling, such as *she, see, sea, Pete, key, quay, people, amoeba, machine* for the sound /i:/; as well as frequent occurrence of many-to- one correspondence, as the sound for the grapheme "o" in *love, move* and *stove*. (Giegerich, 1999).

In English, orthography interacts with morphology as there are graphemes that represent morphemes. As examples we can mention the morphemes for the plural nouns, the "s", and that for the regular past tense, the "ed". The invariable addition of the morpheme "ed" to the base form of the verb has an alteration only when the base ends in "e" or "y" (liked, hurried). On the other hand the plural noun morpheme (or that for the 3rd person of the present tense for regular verbs), "es" is added only for the allomorph /ɪz/, while the other two allomorphs, /s/ and /z/, are represented by the grapheme "s" (except for words ending in "y" or "o" (babies, potatoes). Despite those irregularities, there is consistency in the system and the rules are the same for the pronunciation of both morphemes. The underlying form is /d/ for the past tense, and /z/ for the plural, but two phonological processes may occur depending on the previous environment. When preceded by a voiceless consonant, progressive voicelessness is assimilated by the morpheme, yielding a voiceless /t/ and /s/. When the base form ends in a coronal stop before the addition of the /d/ for the regular past tense, or in a sibilant fricative before the /z/ for the plural noun or the 3rd person singular of present tense in verbs, an epenthetic vowel will be inserted between the two identical adjacent segments, to conform to OCP (Obligatory Contour Principle).

According to Pinker (2000), the system was not always like that. Before reorganization in the seventeenth century, both morphemes "ed" and "s" were pronounced with the vowel in every case. Concentration of stress on the first syllables, however, made speakers reduce the final syllables, eliminating some vowels or suffixes in many words. Writers like Shakespeare used to record the way the words were pronounced with an apostrophe: "Call me but love, and I'll be new *baptiz'd*; Henceforth I never will be Romeo". Because of orthographic reorganization, the old spelling was recovered. It is not clear, however, why that did not happen with the plural morpheme, where the "e" is only inserted when the stem ends in a sibilant fricative (Pinker, 2000), like in *wish – wishes*, for example.

Nowadays the syllabic morpheme still exists in some adjectives: *aged, beloved, blessed, crooked, dogged, learned, naked, wicked,* and others, where the morpheme "ed" is pronounced /ɪd/, adding an extra syllable. Some adverbs also maintain the pronunciation of the vowel: *advisedly, deservedly, assuredly, fixedly.*

Processes of language change as well as the relationship between morphology and phonology might be interesting for the study in the area of English pronunciation by foreign learners. There are certainly many relevant facts to be investigated and research in this area is very recent.

5. Research on morpheme ED production by Brazilians

It is well known that a common feature of a Brazilian accent in English is the pronunciation of the morpheme ED, with the production of a vowel in every context. Some researchers have conducted projects to try to understand the phenomenon. Delatorre (2006) analyzed the influence of markedness, phonological context, orthography and task in the production of verbs in the regular past tense by 26 Brazilian adult learners of English. Frese (2007) investigated the relationship between perception and production of words ending in the morpheme ED by 32 Brazilian advanced learners of English. Alves (2004) studied the effect of explicit instruction to seven Brazilian university students in the acquisition of the ED morpheme. All three researchers report results that go beyond the mere influence of the native language. Factors such as markedness, instruction, the relationship between perception and production, orthographic representation, and task were also considered to play important roles in the pronunciation of verbs with the past tense morpheme.

Alves (2004) conducted a longitudinal research with seven Brazilian university students to analyze the influence of explicit instruction on L2 acquisition. Based on OT for the analysis, the objectives of the research were to determine the constraint hierarchies before, during and after instruction, compare variability during the process, and point out the effects of pedagogical intervention. The author concluded that instruction resulted not only in the reranking of constraints, but also in a new underlying structure, characterized by the final consonant cluster, which led the learners to the production of the target form. Instruction made it possible for the learner to notice some aspects of the input that had not been perceived before. Revisiting data and results of that study, Bonilha and Alves (2005) proposed a new analysis using a Connectionist Optimality Theory. As this new version of OT does not consider the phoneme as a mental representation, therefore nonexistent as an underlying form, the authors intended to verify the adequacy of a Connectionist OT for a second analysis of the data. Applying the Gradual Learning Algorithm and using some restrictions not considered by Alves (2004), the authors were able to propose a different ranking, considering both the learner's interlanguage and native language.

Delatorre (2006) analyzed data collected from 26 upper-intermediate students of English, focusing on four possible factors of influence on non-target production of ED endings: markedness, phonological environment, orthography, and nature of task. The nine hypotheses raised by Delatorre (based on sonority hierarchy, consonantal strength, typological universals, language processing, and data collection) predicted that Brazilian learners of English would produce an epenthetic medial vowel in monosyllabic words ending in codas formed by the addition of ED, to a greater or lesser degree, depending on the above-mentioned theoretical situations. Results of the analysis confirmed some predictions but contradicted others. In Table 2 below you can see a comparison of Delatorre's results with the preliminary results of the research presented here.

Considering production and perception, Frese (2006) analyzed data from 32 Brazilian advanced learners of English reading sentences and identifying an odd item during a listening test. Results of that study showed a positive correlation between production and perception, with the latter overriding the former. Comparing perception of the three allomorphs, statistical results showed a significantly higher rate of perception of /ɪd/ over /d/ or /t/. When these last two were compared, /t/ had a higher score. As for production, results followed perception

and confirmed the hypotheses raised by the researcher: there was a better production of verbs that had the allomorph /ɪd/, followed by /t/, and then /d/. Table 3 shows a comparison between Frese's results and some results from the present research.

Despite differences in research methodology, in objects of analysis, or in theoretical stances, one fact emerges consistently from research results in SLA: there is variability in learner language.

6. Variability

Something that is important to consider in the processes of L2 acquisition is the variability of learners' languages. Watkins' (2001) investigation of variability in the production of reduced vowels in English by Brazilian speakers showed that variability may be influenced by psycholinguistic factors that interact with those of linguistic nature such as phonological environment. One question that has been asked about variability in SLA is: Is it systematic (Gatbonton, 1978, Trofimovich, Gatbonton & Segalowitz, 2007)? Those researchers, using a dynamic approach investigated "whether L2 phonological learning can be characterized as a gradual and systematically patterned replacement of nonnative segments by native segments in learners' speech, conforming to a two-stage implicational scale" (Trofimovich et al., 2007). Based on Gatbonton's gradual diffusion framework, results confirmed that phonological learning progresses gradually and correct variants are acquired and incorrect ones are replaced. In 1978, Gatbonton used the gradual diffusion framework to examine three phonological variables in the speech of French Canadian university students: /ð/, as in *brother*, *the* and *soothe*; /θ/ as in *teeth*, *think* and *ether*, and /h/ as in *behind* and *he*. Starting from a dynamic paradigm to language change, a two-stage system is proposed – an acquisition stage and a replacement stage. In the acquisition phase, the L2 segment occurs in the learner's speech and coexists with incorrect ones in every context. In the second phase, incorrect segments are gradually replaced by the target segment in every context of use. This learning-driven diffusion model is determined by the context immediately preceding the L2 segment according to Clements' sonority hierarchy – contexts ordered from heaviest (most vowel-like) to lightest (most consonant-like). Results suggest that "phonetic variability in second-language speech is patterned, not random, and that the source of this variability and systematicity is the process by which the learner masters new elements of the target language" (Gatbonton, 1978). The dynamic model used in that research was able to capture three dimensions in the implicational system: time, phonological context difficulty and phonetic variability.

Recognizing the importance of Gatbonton's findings, Trofimovich, Gatbonton and Segalowitz present two important research gaps to be filled – the need for more applications of the dynamic model to L2 phonological acquisition and the challenge to offer psycholinguistic (processing) descriptions to the development of SLA (Trofimovich, Gatbonton & Segalowitz, 2007). The object of this new research was firstly to apply the dynamic approach to describe the phonology of L2 learners and test Gatbonton's framework, this time with a larger database. Secondly a psycholinguistic dimension would be added to the model, considering two factors: linguistic similarity, or distance between L1 and L2, and lexical frequency. The 40 French Canadian informants at different levels of proficiency were recorded while reading a text, and their level of accent was judged by 10 native speakers of English. The researchers analyzed the data in two different ways.

In analysis 1, two different variables were taken into consideration: the overall production accuracy of the English segment /ð/, and an implicational scaling of participants' utterances of /ð/ according to the same sonority hierarchy used in the previous work by Gatbonton (1978). The first variable had the previous phonetic contexts ordered on a

continuum between the easiest to most difficult: sentence-initial, voiced fricative, vowel, voiceless stop, nasal, liquid, voiceless fricative, and voiced stop. For the second variable, three discrete values were applied to describe the acquisition development – 1 for consistently right pronunciation; 01 for variable production and 0 for consistently wrong pronunciation. Data were then subjected to implicational scaling, with phonetic contexts ordered according the sonority hierarchy used by Gatbonton (1978). Results revealed a great variability in the informants' production. Sixteen of the forty participants fit the matrix previously prepared for the implicational scale. Although the results presented a clear and systematic patterning of variability, the researchers realized that the pattern obtained was not perfect and concluded that other factors could affect the degree of accuracy predicted by the framework used. The predominantly linguistic criterion was not sufficient to account for the results. The researchers decided then to add a psycholinguistic, processing-based criterion to try to obtain a better scaling solution for the data.

In analysis 2, data from 17 participants in a cross-language identification and similarity rating task were rated by the 40 participants and, with the results, the phonetic contexts were reordered and informants' data were again submitted to an implicational scale based on cross-linguistic similarity. This time the order was: voiced fricative, liquid, initial, voiceless fricative, vowel, voiceless stop, nasal, and voiced stop. The difficulty was determined according to the degree of similarity perceived with sounds of the first language. But again the scaling solution was not perfect, and only 40% of the informants fitted the gradual diffusion scale predicted. Trofimovich et al. hypothesized then that a new psycholinguistic dimension might help refine the criterion for context difficulty definition. Lexical frequency was then considered to help refine the similarity-based criterion for contextual difficulty for the segment under analysis, English /ð/. Estimates of lexical frequency were obtained from the British National Corpus (BNC) for spoken English. This time results were improved considerably as 25 of the 40 participants fitted into the matrix, although this time they had to leave the liquid out of the phonetic contexts because it presented a high percentage of discrepancies. Only seven contexts were considered now, and this time they were ordered as follows: voiced fricative, initial, vowel, voiceless stop, voiceless fricative, nasal and voiced stop.

The findings of this study suggest that L2 learning progresses gradually and the progress is influenced by the interaction of L1 and the nature of the L2 input. At least two psycholinguistic factors may determine the course of the progress: cross-language similarity and lexical frequency.

7. The current study

As mentioned previously, this is just the initial stage of a study that had 60 informants recorded reading paragraphs and telling short stories. Participants were all university students and teachers with different levels of proficiency in English. They took a placement test comprised of 120 questions of general English, two texts with 5 comprehension questions each, and 10 questions for a listening evaluation. They were all classified according to the Common European Framework of Reference criteria – A1, A2, B1, B2, C1, C2.

For this preliminary analysis and piloting of the implicational scale, there was a selection of data from 24 of the informants – 40 tokens out of the 150 produced in the reading task by each one of them. Of the 24 informants, 15 female and 9 male (mean age: 29.54; range: 17-54), only 6 had had some experience abroad and all of them had at least started their English learning in a classroom environment. Actually most of them had only had *that* kind of real contact with English – not to mention contact with music, film, Internet, and all the written English in the globalized environment.

The tokens selected for these preliminary analyses were 40 regular verbs: 14 with the allomorph /t/, 14 with /d/ and 12 with /ɪd/, with at least one exemplar of each segment possible, selected from the various texts recorded, with the purpose of providing different previous phonological contexts: vowel, liquid, nasal, voiced fricative, voiceless fricative, voiced stop, voiceless stop, and consonant cluster. The sounds of the words selected were cut with the help of the software Sound Forge 6.0, and then analyzed first impressionistically by the researcher and her advisor, who is a native speaker of English, and then analyzed acoustically with the program Praat version for Windows Vista.

The percentage of epenthesis production by all the speakers for verbs with the allomorphs /t/ and /d/ was calculated and it presented the following ascending order, according to the segment that preceded the morpheme ED in the word: vowel – 30.21; nasal – 33.33; liquid – 41.67; voiceless fricative – 52.08; voiceless stop – 58.33; voiceless cluster – 63.54; voiced fricative – 64.58; voiceless affricate – 66.67; voiced stop – 70.83; voiced affricate – 75 (see Figure 1).

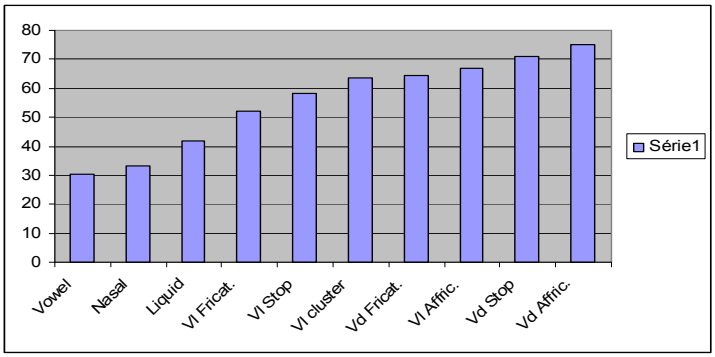

Figure 1. Informants' production of epenthesis in regular verbs in the past tense, as a function of phonological environment preceding the ED

Notwithstanding the reduced number of tokens analyzed, these results were then compared with those of Delatorre (2006) and then with those of Frese (2006), this time including the percentage of epenthesis in verbs with the allomorph /ɪd/, where there must really be a vowel in a targetlike production (see Tables 1 and 2).

Table 1. Comparison with results of Delatorre (2006) in terms of previous phonological environments that cause more epenthesis. The segments to the left cause more epenthesis than the segments to the right.The rightmost column shows the results that confirmed (Y) or did not confirm (N) Delatorre's results.

Delatorre		**This research**		**Confirmed**
+	-	%	%	
Consonants	Vowels	58.45	30.21	Y
Obstruents	Sonorants	64.43	37.50	Y
Sonorants	Vowels	37.50	30.21	Y
Vd Obstr.	Sonorants	67.71	37.50	Y
Stops	Fricatives	64.58	58.33	Y
Nasals	Liquids	33.33	41.67	N
Bilabials	Velar	61.67	64.58	N
/p/	/b/	61.46	62.50	N
/k/	/g/	59.72	79.17	N
/s/	/z/	58.33	45.83	Y
/tʃ/	/dʒ/	66.67	72.92	N
/oʊ/	/eɪ/	54.17	25.00	Y
/eɪ/	/aɪ/	25.00	25.00	N

Table 2. Comparison with results in Frese (2006) in terms of epenthesis produced in the three allomorphs for the morpheme ED

Production of epenthesis according to the rule		**Frese**	**This research**	**Confirmed**
Voiceless Alveolar	/t/	42.63	58.04	Y
Voiced Alveolar	/d/	21.13	47.62	Y
	/ɪd/	93.63	82.99	Y

Results were then submitted to Trofimovich et al's framework (2007), which was based on Gatbonton (1978), who sequenced the five columns "according to the proportion of correct and incorrect variants when the speech of all the informants was combined". Trofimovich et al (2007) presented data in the same sonority hierarchy used by Gatbonton, with three extra columns, one for sentence-initial and two others for liquids and nasals, which had been collapsed by Gatbonton. The matrix presented in Table 3 is sequenced according to the percentage of epenthesis produced in verbs with the allomorphs /t/ and /d/. The first column was for vowels that caused less epenthesis and the last for voiced affricate that caused most epenthesis. In this matrix there are ten columns for phonological environment. In Table 4, which shows the results, there is an extra column that indicates the level of the participant as determined by the placement test.

Table 3. Data matrix used in the implicational scaling analysis

Subject	1 Vowel	2 nasal	3 liquid	4 Vl fric	5 Vl stop	6 Vl cluster	7 Vd fric	8 Vl affric	9 Vd stop	10 Vd affric	Stage	Level
	0	0	0	0	0	0	0	0	0	0	1	
	01	0	0	0	0	0	0	0	0	0	2	
	01	01	0	0	0	0	0	0	0	0	3	
	01	01	01	0	0	0	0	0	0	0	4	
	01	01	01	01	0	0	0	0	0	0	5	
	01	01	01	01	01	0	0	0	0	0	6	
	01	01	01	01	01	01	0	0	0	0	7	
	01	01	01	01	01	01	01	0	0	0	8	
	01	01	01	01	01	01	01	01	0	0	9	
	01	01	01	01	01	01	01	01	01	0	10	
	01	01	01	01	01	01	01	01	01	01	11	
	1	01	01	01	01	01	01	01	01	01	12	
	1	1	01	01	01	01	01	01	01	01	13	
	1	1	1	01	01	01	01	01	01	01	14	
	1	1	1	1	01	01	01	01	01	01	15	
	1	1	1	1	1	01	01	01	01	01	16	
	1	1	1	1	1	1	01	01	01	01	17	
	1	1	1	1	1	1	1	01	01	01	18	
	1	1	1	1	1	1	1	1	01	01	19	
	1	1	1	1	1	1	1	1	1	01	20	
	1	1	1	1	1	1	1	1	1	1	21	

Table 4. Implicational scaling of production of the morpheme ED with the allomorphs /t/ and /d/ sequenced in a sonority hierarchy based on the informants' production. The numbers in parentheses correspond to the quantity of verbs with that preceding context produced by each speaker.

Subject	**1**(4) Vowel	**2**(2) Nasal	**3**(2) Liquid	**4** (4) Vl fric	**5**(4) Vl stop	**6**(4) Vl clust	**7**(2) Vd fric	**8**(2) Vl affric	**9**(2) Vd stop	**10**(2) Vd affric	**St**	**Level**
1	0	0	0	0	0	0	0	0	0	0	1	A1
26	01	0	0	0	0	0	0	0	0	0	2	A1
21	01	0	0	01*	0	0	0	0	0	0	2	A1
48	01	0	0	01*	01*	0	0	0	0	0	2	A1
2	01	01	01	0	01*	0	0	0	0	0	4	A1
18	01	01	01	01	01	0	0	0	0	0	6	B1
20	01	01	01	01	01	01	0	1*	0	0	7	**A1**
6	01	1*	01	0*	01	01	0	0	0	0	7	**B2**
10	01	01	01	0*	01	01	01	0	0	01*	8	B1
19	01	01	0*	01	01	01	01	0	01*	0	8	B1
24	01	01	01	0*	01	0*	01	0	01*	0	8	B1
11	01	1*	01	01	01	01	01	0	0	01*	8	B1
3	01	01	01	01	01	0*	01	01	0	0	9	**B2**
12	01	1*	01	01	01	01	01	1*	01	0	10	B1
7	01	01	01	01	01	01	01	01	01	01	11	B1
49	1	01	1*	01	01	01	0*	1*	0*	0*	12	**B2+**
8	1	1	1	01	01	01	0*	0*	0*	0*	14	B1+
9	1	1	1	01	01	01	0*	0*	01	0*	14	B2
16	01*	1	1	1	01	01	01	01	0*	01	15	B2
4	1	1	1	1	01	01	1*	1*	01	1*	15	**B1**
14	1	1	1	1	1	1	01	0*	1*	0*	17	C1
15	1	1	1	1	01*	1	1	0*	1	0*	18	C1
5	1	1	1	1	1	1	1	1	1	1	21	C1
17	1	1	1	1	1	1	1	1	1	1	21	C1+

*NOTE: Asterisks indicate cells that do not confirm to the implicational patterns.

8. Discussion

Observing Table 1, it can be seen that almost half the results from this small set of data do not conform to Delatorre's results. She did not have all of her hypotheses confirmed. Other studies on epenthesis production by Brazilians learners of English have also shown different results from those predicted by theories related to markedness – phonological environment relation, sonority hierarchy, syllable contact and others (Baptista & Silva Filho, 1997; Rebello, 1997; Delatorre, 2007). At first glance, the sonority hierarchy seems to fit the order of difficulty, as in larger groups the results tend to coincide more easily: consonants cause more epenthesis than vowels, obstruents cause more than sonorants, sonorants more than vowels and so on. But when one compares segments or features more specifically with one another, it is more difficult to predict the results. That is probably why it was not difficult to predict and obtain results which coincided with those of Frese (2007) – Table 2. First because the pronunciation of the allomorph /ɪd/ is really easier than the other two for Brazilian Portuguese speakers to produce, since the orthographic vowel is pronounced. Second because only obstruents trigger the production of the voiceless allomorph /t/, due to voicelessness assimilation. And for the production of /d/, besides voiced obstruents, there are also verbs ending in vowels and sonorants, which trigger less epenthesis.

Table 4 shows participants' production of epenthesis sequenced by overall result according to preceding phonological context. Observing the column for the levels, it can be seen that, despite five participants (in bold) who did not follow the pattern, there is a consistent order of development with epenthesis decreasing as language levels become higher. But if the scale is analyzed as a whole, it can be seen that very few informants (only the six in bold in the leftmost column) fit the matrix, producing many incompatible data cells (the ones with asterisks). Trofimovich et al's results showed that Gatbonton's original data are replicable, but many more cells not fitting the matrix emerged in their scale. The researchers begin with some obvious reasons for the discrepancies: Gatbonton's informants were mostly beginners, while Trofimovich et al's were in a wider range of proficiency levels. Gatbonton analyzed the segment /ð/ in five phonetic contexts with unequal numbers of tokens, while Trofimovich and colleagues used eight phonetic context and ten tokens for each context. The researchers go even beyond to investigate why the patterning was not perfect. From that imperfection they suggest that factors other than purely phonetic context determine the ease or difficulty with which accuracy is developed. They decided then to utilize a psycholinguistic, processing-based criterion to define phonetic context difficulty. Using that new criterion within the implicational scaling, they verified the possibility of a better solution for the gradual diffusion framework, giving it an explanatory as well as descriptive dimension.

At first they decided to add a processing dimension of perceived cross-language similarity to help define context difficulty. They hypothesized that "if cross-language similarity determines how accurately L2 sounds are perceived and produced, this processing dimension can be used to develop principled, perception-based criteria for defining the degree of a segment's contextual difficulty" (Trofimovich et al., 2007). Results were pretty much similar to those obtained in the first scale where only the sonority hierarchy was considered. Although this solution was successful in determining instances of difficulty with the target segment, "it ostensibly failed to distinguish fine-grained differences in context difficulty", as stated by the authors. They then tried to refine the criterion for defining context difficulty with a new psycholinguistic dimension – lexical frequency.

Before subjecting the data collected in this research to those other two implicational scalings, many questions need to be taken into consideration, and if it is not possible to answer them, the issues involved need at least to be better investigated.

9. Cross-language similarity

In our research, unlike Gatbonton's and Trofimovich et al's, which focuses on the pronunciation of a difficult-to-pronounce phoneme, we considered instead a morpheme, involving syllable structure. Cross-language similarity should not be considered just in terms of the identification, and consequent production, of an L2 sound as similar to one of the sounds of the L1. What will count here is the difference in syllable structure between the two languages and how that difference is perceived and dealt with by the learner. If Brazilian-accented English is characterized by the presence of an epenthetic vowel to break a difficult consonant cluster in a word, what might the learner's representation of that word be? What interpretation might the learners make of what they hear? We cannot forget that, at least for most informants in this research, those at the lower levels, much of the input they receive is 'teacher talk', characterized by a slow rate of speech, and very frequently with a non-nativelike accent. Another question is: what interpretation might the learners make of what they see? Many studies have been conducted concerning the role of orthography in epenthesis production (Young-Scholten, 1995, 1997; Silveira, 2004; Alves, 2004; Delatorre, 2006), and they consistently suggest that orthography does influence the occurrence of epenthesis. Coleman (2002) discusses the nature of syllable representation in the mental lexicon, giving as examples the epenthetic vowels that are systematically produced in some dialect pronunciations of monosyllabic words. He questions whether the pronunciation of 'milk' and 'film' as [mɪləkˈ] and [fɪləmˈ] by these speakers means that their lexical representation for such words are of lexical disyllables or disyllabic pronunciations of lexical monosyllables. With our L2 learner informants we are quite certain that, in the early stages of learning, they systematically add an extra syllable to the verb in the regular past tense (informant 1, for example). But what happens with those advanced speakers, some of them teachers who know the metalinguistic rules for production of the morpheme, who persist in producing some verbs with the extra syllable (informants 14 and 15, for example)?

10. Lexical frequency

If frequency really influences accuracy in a second language, as claimed by Trofimovich et al. (2007), and this line of thought prevails in this research, it will probably be necessary to take a new epistemological stance for this inquiry, outside classical generative linguistics. There is a new line of investigation of the phenomena that is emerging in SLA which, instead of trying to explain the nature of the cognitive states of an L2 learner, attempts to explain the causal processes that effect changes in those states (Gregg, 2003). As stated by Pierrehumbert (2001), "this line of research has established that the cognitive representation of sound structure is probabilistic, with frequencies playing a crucial role in the acquisition of phonological and phonetic competence, in speech production and perception, and in long-term mental representations". Some of the theoretical tracks that follow this line of thought, presented by Pierrehumbert (2001, 2003) are: lexical networks, stochastic grammars, statistical modes and exemplar theory. They are all theoretical constructs that consider language experience and frequency of input as being central to language acquisition. According to Bybee (2003), "the frequency with which individual words are used and the frequency with which certain patterns recur in a language affects the nature of mental representation and in some cases the actual phonetic shape of words". Gregg (2003) questions the relation between input and acquisition, asking: "How often does input of X need to be provided in order for X to be acquired?" and further improves the question to: "In order to create representation R, how often does input that […] 'contains' R need to be presented to the learner?" The first thing to be done, in our case, in order to deal with frequency, is to try

to determine what the nature of the input is for a second language learner. How can frequency be determined? A native spoken corpus is not likely to be sufficient, firstly because the frequency of words presented in textbooks may not always replicate the frequency of use by native speakers. Only recently have corpus-based textbooks begun to be written (McCarthy, McCarten & Santiford, 2005; Saslow & Ascher, 2006). Secondly, storage of words in the lexicon and the relation between L1 and L2 may influence the frequency with which words are produced by the second language learner, especially if, as claimed by De Bot (1992), "lexical elements in different languages are stored together". In other words, it may be hypothesized that even though a word is not frequent in native speech, it may be more frequently used by a non-native if it is a cognate to a word in the L1. With regard to this, Silveira (2004) proposes that frequently-used cognate words trigger epenthesis. Thirdly, a learner of English may have much more contact with written than spoken English, at least in the case of the informants who took part in this research. A corpus of written language should therefore also be considered. Lastly, it may be helpful to go beyond mere word frequency and investigate syllable statistics in English and Portuguese.

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