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PRODUCTION OF FINAL ALVEOLAR STOPS IN BRAZILIAN PORTUGUESE/ENGLISH INTERPHONOLOGY

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To my family:

Brígida

Onevio

Vanessa

Fernando

and

especially

Natalie.

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ABSTRACT

PRODUCTION OF FINAL ALVEOLAR STOPS IN BRAZILIAN PORTUGUESE/ENGLISH INTERPHONOLOGY

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UNIVERSIDADE FEDERAL DE SANTA CATARINA
2005

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This research focuses on the production of final alveolar stops by Brazilian learners of English. In order to investigate that thirty learners from the pre-intermediate level of an English course read a sentence list in English, containing several environment combinations, and a sentence list in BP, containing word-final *te* and *de*. Alveolar stops are subject to allophonic processes in BP and serve as a dialect marker. Considering L1 transfer, it is expected that the production of English final alveolar stops is problematic. This production was examined according to three research questions and five hypotheses. The first research question concerned main types of production of final alveolar stops and it was hypothesized that BP learners would produce targetlike, aspirated, palatalized, and epenthesized forms, as well as forms aspirated with vowel epenthesis and palatalized with vowel epenthesis. Even though other types of production were found, the most frequent types of production were the ones predicted by the hypothesis. The second research question dealt with voicing of the target sound, and the hypothesis predicted that the voiced target would be mispronounced more often than its voiceless counterpart. It was found that voicing influence varied according to type of error. The third research question aimed at investigating effects of phonological environment and three hypotheses were formulated. Concerning preceding environment, it was hypothesized that vowel height would carry over to the target facilitating the process of palatalization. The hypothesis was confirmed. Then, following Koerich (2002), it was hypothesized that errors would increase from vowels to consonants, and then to pause in the following environment. This hypothesis was partially confirmed. The last hypothesis concerned sonority relations across syllables and the results pointed to tendencies. To sum up, markedness, phonological environment, and transfer seemed to interact, shaping the production of final alveolar stops in Brazilian Portuguese/English interphonology.

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RESUMO

PRODUÇÃO DE PLOSIVAS ALVEOLARES EM FÍNAL DE SÍLABA NA INTERFONOLOGIA DO PORTUGUÊS DO BRASIL/INGLÊS

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Esta pesquisa focaliza a produção de plosivas alveolares em final de sílaba por estudantes brasileiros de inglês. No PB, plosivas alveolares são sujeitas a vários processos alofônicos e servem como um marcador dialetal. Portanto, sua produção em inglês pode tornar-se problemática. Trinta estudantes do nível pré-intermediário de um curso de inglês leram uma lista de sentenças em inglês contendo várias combinações de contexto fonológico e uma lista de sentenças em PB contendo palavras com sílabas finais *te* e *de*. A produção de plosivas alveolares finais foi examinada objetivando responder a três questões de pesquisa e investigar cinco hipóteses. (1) A primeira questão tratava dos principais tipos de produção de plosivas alveolares finais e a hipótese era que os participantes produziriam /t, d/ corretos, aspirados, palatalizados, epentetizados, aspirados com epêntese e palatalizados com epêntese. Embora outros tipos de produção foram encontrados, as mais freqüentes foram as previstas pela hipótese. (2) A Segunda questão lidava com vozeamento do som alvo e a hipótese previa que a consoante vozeada seria modificada com maior freqüência. Os resultados mostraram que influência de vozeamento varia conforme o tipo de erro. (3) A terceira questão tinha por objetivo investigar efeitos do ambiente fonológico e foram formuladas três hipóteses: (a) em relação ao ambiente anterior, foi suposto que altura da vogal afetaria altura do alvo promovendo palatalização, a hipótese foi confirmada; (b) seguindo Koerich (2002) foi suposto que erros aumentariam de vogais para consoantes para silêncio no ambiente seguinte ao alvo, a hipótese foi parcialmente confirmada; (c) a última hipótese investigava relações de sonoridade entre sons em diferentes palavras e os resultados apontaram apenas para tendências. Concluindo, marcação, ambiente fonológico e transferência parecem interagir modelando a produção de plosivas alveolares finais na interfonologia do Português do Brasil/Inglês.

102 páginas (excluindo anexos)
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CHAPTER 1

INTRODUCTION

1.1 Background to the study

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 (e.g. Tarone, 1980/1987; Baptista, 1987; Xavier, 1989; Baptista & Silva Filho, 1997; Fernandes, 1997; Rebello, 1997; Watkins, 2001; Koerich, 2002; Rauber, 2002; Kluge, 2004; and Silveira, 2004). Some of these researchers have focused on final consonants concerning the process of vowel epenthesis. For instance, Tarone (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, and Silveira (2004) investigated the role of instruction in the perception and production of final consonants. Vowel epenthesis production has been studied with special interest because it happens in learners' production of English as well as in loanwords such as *Internet*, which is pronounced by Brazilians as [✈● ● ■● ● ∗● ■], [✈● ● ■● ● ∗● ✲] or [✈● ● ■● ● ∗● 9✲] according to dialect. It might happen 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.

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.

In the same way, 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), for instance, states that BP "has a palatalization process affecting /t, d/ before front high vowels" (p. 54). So, BP speakers may say [❁♀● 9✈● ●] for *gatinho* - 'kitten', but [❁♀● ●] for *gato* - 'cat'. Going back to the word *Internet*, it may be pronounced as [✈● ● ▮● ● ✱● 9✈] or [✈● ● ▮● ● ✱● 9❄], but not as [✈● ● ▮● ● ✱● 9▮].

In order to identify the causes of vowel epenthesis, Baptista and Silva Filho (1997) and Koerich (2002) examined the interaction of markedness in terms of syllabic structure as well as voicing of the target sounds and phonological environment, dealing with differences in sonority between the target sound and the following environment as an epenthesis motivator. Both studies found that these factors may interact with L1 transfer contributing to epenthesis production.

Concerning markedness relations, closed syllables are less frequently found in the world's languages than open syllables, therefore, they are more marked and more difficult to be acquired. Also, every language which contains a voiced obstruent has its voiceless counterpart; thus, voiced consonants are more marked as well. Therefore, in the present study, it was expected that BP learners of English would convert CVC syllables into CV.CV sequences more frequently when the target was final /d/ than /t/. Besides markedness, phonological environment was an important variable in the present study. The reason for this was twofold. First, previous studies have shown that the rate of vowel epenthesis also depends on type of following environment – vowels, consonants, and silence – and its interaction with markedness. Second, the process of palatalization which alveolar stops undergo in most BP dialects is conditioned by the phonological environment.

1.2 Statement of purpose

Despite their markedness, syllables ending in final alveolar stops are common in English. Since BP phonotactics does not allow this structure, BP learners of English tend to add an epenthetic vowel to final obstruents in the foreign language. Furthermore, palatalization in BP may be transferred to Brazilian Portuguese/English interphonology resulting in intelligibility problems. Both of these errors may affect segmental and suprasegmental levels hindering communication. One way of helping learners to overcome their difficulty in producing final obstruents is to investigate under what conditions and to what extent errors are produced.

In order to investigate the possible causes for 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. The data obtained was analyzed concerning vowel epenthesis, palatalization, and aspiration processes. The main variables investigated were (a) voicing of the target consonant; (b) phonological environments; and (c) sonority relations across syllables. Through the examination of these variables, the present study aimed at (a) describing learners' production of final alveolar stops in monosyllabic English words; (b) testing the variables mentioned above concerning non-targetlike production, vowel epenthesis, palatalization, and aspiration; and (c) examining the relationship between BP idiolect and palatalization in Brazilian Portuguese/English interphonology.

1.3 Significance of the study

Learners of a foreign language may retain an accent even after long exposure to a native variety. Flege (1988) states that the "degree of perceived foreign accent increases along with the number . . . of segmental misarticulations" (p. 70). Studies on IL phonology can offer valuable insights on ways to reduce accent, thereby, improving communication. The results of this type of investigation can contribute to the elaboration of instructional materials and methods to help learners overcome speech production and comprehension difficulties.

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, environment combinations, lessons can be planned and the target sounds practiced in a productive way.

1.4 Organization of the thesis

This thesis consists of seven chapters. Chapters 2, 3, and 4 present an overview of the literature on the main areas of concern to the present study.

Chapter 2 presents the concept of the syllable, Hooper's (1976) Syllable Structure Condition (SSC) and Murray and Vennemann's (1983) Syllable Contact Law (SCL). Then, it describes and contrasts Goldsmith's (1990) Sonority Hierarchy and Hooper's (1976) Universal Strength Hierarchy, and describes the phonotactics of BP and English syllables with special attention to codas.

Chapter 3 discusses the allophonic processes undergone by alveolar stops in BP, word-final alveolar stops in English, and word-final alveolar stops in Brazilian Portuguese/English interphonology. It also briefly reviews important studies in interphonology dealing with the preceding and following phonological environment as a variable affecting the production of word-final consonants in Brazilian Portuguese/English interphonology.

Chapter 4 presents the Markedness Differential Hypothesis (MDH) and the Structural Conformity Hypothesis (SCH) proposed by Eckman (1977/1987; 1991). It also reviews the most relevant works in Brazilian Portuguese/English interphonology dealing with MDH, SCH, Syllable Contact Law (SCL), and phonological environment.

Chapter 5 describes the method used for carrying out the present study. It states the research questions and hypotheses, and describes the participants, the material, the procedures adopted for collecting, analyzing and classifying data on the production of final /t/ and /d/, and the statistical treatment employed.

Chapter 6 consists of a report of the results of the statistical analysis carried out to analyze the data gathered as well as of a discussion based on the literature and on the hypotheses previously stated.

Chapter 7 summarizes the main findings of the study and discusses the limitations and suggestions for further research, as well as e pedagogical implications.

CHAPTER 2

THE SYLLABLE

2.1 Introduction

The purpose of this chapter is to review the literature on the phonological concept of the syllable and to introduce Hooper's (1976) Syllable Structure Condition and Murray and Vennemann's (1983) Syllable Contact Law, which are crucial for the present study. Moreover, Goldsmith's (1990) Sonority Hierarchy is contrasted with Hooper's (1976) Universal Strength Hierarchy in order to set the ground for Hypothesis 3.3. This chapter also aims at describing the phonotactics of BP and English syllables with special attention to codas.

2.2 The syllable

Phonological systems as well as phonological generalizations are organized in terms of the syllable (Katamba, 1989; Giegerich, 1992). In general, any speaker of a language, even children, can easily identify the number of syllables in a given word in their own language (Giegerich, 1992; Laver, 1994). The syllable is defined both phonetically and phonologically in the literature; however, it has been remarked that defining the syllable is not as easy as having intuitions about it.

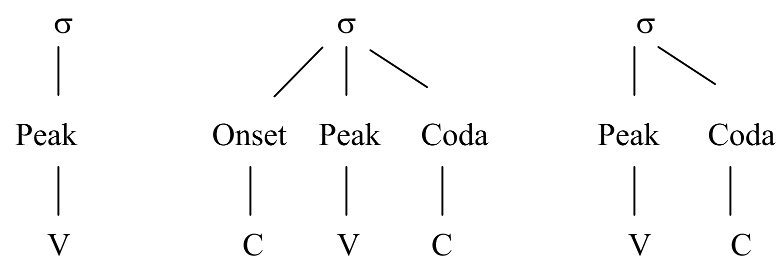
Phonetically, the syllable can be defined as 'a peak in the flow rate of pulmonic air' (Giegerich, 1992, p. 132). Phonologically, it is generally defined as a complex unit, composed of an onset and a rhyme. The syllable is considered complex for several reasons. One of them is that there are language specific internal rules which determine how segments may combine to form syllables. The onset comprises any consonant (C) preceding the rhyme and the rhyme is made up of a peak or nucleus, which is usually occupied by a vowel (V) followed by a coda, occupied by a (C). In order to belong to the same syllable, segments must belong to the same syllable node, or in other words, to the same sonority peak. Syllables with no segment in coda position are called open syllables whereas syllables with at least one consonant in the coda position are called closed syllables.

Katamba (1989) claims that it was only after the works of Hooper (1972) and Vennemann (1972) that the syllable was given the importance it actually deserves. Previous works assumed that “segments, boundaries and rules stating permissible combinations of segments in morphemes and words were sufficient to describe the sound systems of languages” (p. 164). The author adds that the syllable has a safe and central role as the basic phonotactic unit and as the domain of phonological rules because it is responsible for the regulation of how segments can combine and it conditions how and when phonological rules, internal to a language, will be applied.

2.3 Syllable structure and syllable contact

The universally least marked syllable structure is the CV syllable (Hooper, 1976; Roca, 1994). Clements and Keyser (1983) say that there are four types of languages, according to the syllable structures they comprise: (a) CV languages, like Senufo; (b) CV, V languages, like Maori; (c) CV, CVC languages, like Klamath; and (d) CV, V, CVC, VC languages, like English. When a language contains $C_xV_yC_z$ syllables, ‘x’, ‘y’, and ‘z’ being the number of segments in the onset, peak, and coda position respectively, it necessarily contains CV syllables as well.

Therefore, all the following syllables, although simple, are more marked than the CV syllable:



It is not the number of segments alone that conditions the existence of types of syllables. Phonotactic constraints, that is, relations among segments, are even more important in accounting for the existence of different types of syllables. These constraints are mostly based on differences in sonority among neighboring segments. In Goldsmith’s (1990) words sonority is “a ranking on a scale that reflects the degree of openness of the vocal apparatus during production, or the relative amount of energy produced during the sound – or perhaps it is a ranking that is motivated by, but distinct from, these notions” (p.110-111). Phonotactic rules operate in the Sonority Sequencing Principle (SSP) built according to the proposal that speech segments are ranked along a sonority scale (Clements, 1990). Roca (1994) establishes that “the sonority profile of the syllable must slope outwards from the peak” (p.153). Therefore, the peak can only be occupied by vowels and syllabic consonants which are highly sonorant.

Despite the research efforts made up to the present, it has been impossible to establish a universal sonority hierarchy. For instance, Hooper (1976) claims that sonority or strength relations are assumed to be universal but not absolute because some relations may be language specific. As Clements (1990) posits, the variations among the different scales proposed are due in part to "lack of agreement among phonologists as to exactly what the universal sonority hierarchy consists of" (p. 290).

Two of the most influential scales are Hooper's (1976) Universal Consonantal Strength Hierarchy and Goldsmith's (1990) Sonority Scale. Hooper (1976) prefers to treat sonority in terms of consonantal strength relations, considering the most sonorant sounds as the weakest ones and the least sonorant sounds as the ones with the greatest strength. She proposes the following intrinsic structure of the syllable:

MARGIN	NUCLEUS	MARGIN
obstruents nasals liquids glides	vowels	glides liquids nasals obstruents
Least vowel-like	Most vowel-like	Less vowel-like
STRONG	WEAK	WEAK

(p. 199)

By analyzing this structure, it can be concluded that consonantal strength is important also when differentiating onset and coda. Hooper states that the fact that voiceless stops are aspirated in initial position and often unreleased or subject to assimilation in final position serves as an argument for the greater strength of onsets. The author justifies her hierarchy of consonantal strength citing Foley's (1970) support on historical sound changes and Vennemann's (1972) and Hankamer and Aissen's (1974) assimilation rules. Hooper, as previously mentioned, claims that her consonantal strength hierarchy is universal but not absolute, varying across languages. The universal strength hierarchy she devised is the following:

glides	liquids	nasals	Vd continuants	Vl continuants Vd stops	Vl stops
1	2	3	4	5	6

(p. 206)

Even though it was not included in Hooper’s universal strength hierarchy scale, Baptista and Silva Filho (1997) and Koerich (2002) attributed the value seven (7) to affricates. They based this inclusion on Hooper’s suggestion that, in some languages, strengthening processes turn stops into affricates due to their articulatory complexity, and that the voiceless affricates constitute the strongest consonants.

The Sonority Hierarchy proposed by Goldsmith (1990) assigns value 5 to affricates. The author considers affricates as being intermediate to fricatives and stops as in the following scale:

Low – mid – high vowels	glides	liquids	nasals	fricatives	affricates	stops

(based on Goldsmith, p.111)

It seems that the reason for affricates being so controversial is twofold: (1) affricates are marked; thus, absent from many languages; and (2) affricates are sometimes seen as the joining of two phonemes.

The inclusion of affricates and the lack of acknowledgement of voicing contrasts are the main differences between Goldsmith's and Hooper's scales. Goldsmith does not consider voicing as an important feature concerning sonority; therefore, he does not attribute different values to voiced sounds and their voiceless counterparts. On the other hand, he attributes different values to the vowels according to relative height.

The author points out a few flaws in his scale and these can be extended to Hooper's. For instance, he mentions words such as *skin* and *tiks*, which are possible syllables in English even though they are in violation of the SSP, since /s/ is more sonorant than /k/. Clements (1990) also discusses SSP violations. He states that clusters conforming to the SSP are the most frequent; however, they are not the only possibilities. Moreover, Clements says that violations are restricted to the edges of the syllable because in the underlying representation of these syllables, the edges may be extrasyllabic and an epenthetic vowel may be represented.

Based on her universal consonantal strength scale, Hooper (1976) suggests a universal condition on the preferred syllable structure, stated in the rule she called Syllable Structure Condition (SSC), as follows:

P (C): $\$C_mC_nC_pC_qVC_rC_sC_t\$$

Where $m > n > p > q$

$r > s > t$ [sic][1]

$m > t$

$m \neq Ø$ (p. 229)

[1] Rebello (1997) observes that the arrows in this line should point in the opposite direction.

Following the SSC, cross-syllabic contacts in Spanish are described in the formula:

If $XVC_r\$C_mV$, and there is no pause between C_r and $C_{m,}$ then $m > r$.

(Hooper, 1976, p. 220)

Hooper's SSC is later revised by Murray and Vennemann (1983). Three changes are made:

(1) $m > r$ is turned into $m \geq r$, so that geminate consonants in syllable boundaries can be covered by the formula;

(2) $VC_r\$C_mV$ is turned into $C_r\$C_{m,}$, so that longer clusters can be addressed; and,

(3) SSC is turned into the Syllable Contact Law (SCL) as stated below:

> The preference for a syllabic structure $A^{\$}B$, where *A* and *B* are marginal segments and *a* and *b* are the Consonantal Strength values of *A* and *B* respectively, increases with the value of *b* minus *a*.
>
> Corollary: The tendency for a syllabic structure $A^{\$}B$ to change, where *A* and *B* are marginal segments and *a* and *b* are the Consonantal Strength values of *A* and *B* respectively, increases with the value of *a* minus *b*. (p. 520)

Baptista and Silva Filho (1997) as well as Koerich (2002), use Hooper's scale and Murray and Vennemann's (1983) SCL in order to verify if the latter is efficient in predicting which word-final consonants and following environment combinations trigger more vowel epenthesis in Brazilian Portuguese/English interphonology. Even though they found a tendency in favor of the scale, they corroborate Hooper's claim for a universal but not absolute scale. The present study re-examined the SCL concerning word-final alveolar stops.

2.4 The syllable structure in Brazilian Portuguese and in English

According to Cristófaro Silva (2002), BP syllable structure can be described as (C)(C)V(V')(C)(C), where V' is a semi-vowel. The peak is obligatory whereas the onset and the coda are optional. The following consonants can occupy the onset position in BP: /[illegible], [illegible] R, [illegible]/, but [8] only occupies single onset position when between vowels, and /[illegible]/ and /[illegible]/ appear in a very limited number of words and not word-initial.

The following consonant clusters can occupy the onset position in BP: /[illegible]/ but /[illegible]/ and /[illegible]/ never occupy the word initial onset slot and /[illegible]/ only appears in loan words.

The coda position in the BP syllable can be occupied by the archiphonemes /S, R, N/ which vary according to environment as well as dialect (Cristófaro Silva, 2002) and by /l/. Considering the BP syllable structure as $C_1C_2VV'C_3C_4$, C_4 can only be occupied by /S/ (Cristófaro Silva, 2002).

The English syllable, on the other hand, is much more complex than the BP. This complexity is shown in that (a) the clusters permitted are more varied and longer in both onset and coda positions; (b) there are syllabic consonants which can fill the peak position being, therefore, the nucleus of the syllable; and (c) a considerable number of words in the language are formed by clusters violating the SSC (Giegerich, 1992, p.139).

The syllabic consonants which can occupy the peak slot are /[illegible]/ and /[illegible]/ which originate from the elision of a reduced vowel (Jackson, 1980). The onset position of

English syllables can be occupied by any consonant phoneme except /4/, and /☛/ occurs in a very limited number of French loanwords. The following two-consonant and three-consonant clusters can occupy the onset position in English syllables: /● ● , ● ● , ● ● , ● ✤, ● ● , ● ⚲, ⍀● , ⌗● , ● ● , ⍀● , ⌗● , ● ● , ✤● , ✤● , ✤● , ● ● , ⚲● , †● , ❁● , ● ● , ⚲● , †● , ❁● , 9● , ● ● , ● ● , †★, ⚲★, ● ★, ● ★, ⍀★, ✤★, ● j, ● j, ● j, ⌣j/ (Jackson, 1980; Prator & Robinett, 1985), and /● ● ● , ● ● ● , ● ⚲● , ● ● ● , ● ✤● , ● ✤● , ● ● ★, ● ● ★, ● ✤★, ● ✤● /. Some of these clusters are very rare, such as /● ⚲● / which occurs only in the word *sphragistics* (Avery & Erlich, 1992; Jackson, 1980; Prator & Robinnet, 1985).

Any consonantal phoneme in English can occupy a singleton coda except /⌣/. Based on Kreidler (1989) and Jensen (1993), Koerich (2002) described two-consonant codas as follows:

> (a) SS clusters (stop + stop) - /● ● , ✤● , †⍀, ❁⍀/;
> (b) SF clusters (stop + fricative) - /● ⌗, ● ⌗, ⍀⌗, ● ● , ✤● , †● , ⍀● , ❁● /;
> (c) FS clusters (fricative + stop) - /● ● , ⚲● , ⌗● , ● ● , 9● , ● ⍀, ✱⍀, ● ⍀, ☛⍀, ● ✤/;
> (d) FF clusters (fricative + fricative) – ⚲⌗, ⚲● , ⌗● , ● ● , ✱● /;
> (e) NC clusters (nasal + C) - /● ● , ● ● , ● ⚲, ● ● , ● ● , ● ⍀, ● ● 9, ● ⍀☛, ● ⌗, ● ● , ● ⚲, ● ● , 4⍀, 4✤, 4⌗, 4● /;
> (f) -lC – where C can be /● , †, ● , ⍀, ✤, ● 9, ⍀☛, ⚲, ● , ⌗, ● , ● , 9, ● , ● /; and – rC clusters – where C can be /● , †, ● , ⍀, ✤, ❁, ● 9, ⍀☛, ⚲, ● , ⌗, ● , ● , 9, ● , ● , ● /.
>
> (p.28)

For three and four-consonant clusters in final position, Jackson (1980) designed a syllable-final combination chart, as follows, acknowledging that it does not express the restrictions with complete precision but is the most approximate possible and serves as illustration that “the fewer are the permissible combinations, the larger the clusters become” (p.44).

Position A	*Position B*	*Position C*	*Position D*
● ● ● 4 ● ✤	Any consonant Except ⊖ ● ● ★	■ ● ✎ ● ●	● ●

The author says that

> The 48 permissible three-consonant syllable final combinations are either Position A + Position B + Position C, or Position B + Position C + Position D. The seven permissible four consonant combinations are as follows: /● ✤● ● /, /● ● ● ● /, /● ● ● ● /, /✤● ● ● /, /● ✞■● /, /✤● ■● /, /● ● ■● / as in *mulcts*, *glimpsed*, *tempts*, *texts*, *twelfths*, *sixths*, *thousandths*. Obviously, these sound clusters are likely to be reduced under the pressures of connected speech. (p. 44)

This description of the BP and English syllables shows that the former are more restricted both in terms of number and of combinations of segments in the coda and onset. According to markedness relations (see Chapter 4) and the English syllable being more marked, it is expected to be more difficult for BP speakers to learn the syllabic structure of English than the other way around.

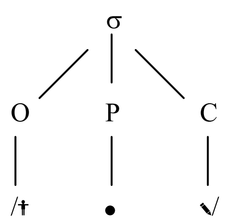
2.5 Syllable simplification strategies in Brazilian Portuguese/English interphonology

Simplification strategies may be applied to a CVC syllable obtaining a CV or CV.CV sequence, or to a CCV syllable, obtaining a VC.CV sequence. BP speakers tend to simplify BP consonant codas, in the rare cases when they are occupied by obstruents, adding a vowel (Tarone, 1987; Baptista & Silva Filho, 1997; Koerich, 2002; Rauber, 2002). For instance, the word *advogado*, 'lawyer' is usually produced as [♀✎✈● ● ❂♀✎●],

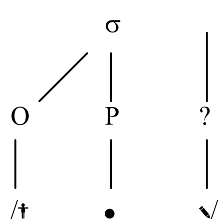
[ʔ\■● ● ❁ʔ\●] or [ʔ\↩✈● ● ❁ʔ\●]. This process towards the development of a new syllable happens even in the pronunciation of very educated people (Câmara Júnior, 1977).

The lack of final consonant codas in BP may lead BP learners to interpret an English final stop as an extrasyllabic consonant. Thus, they tend to turn a monosyllabic word into a two-syllable word by adding an extra vowel to resyllabify the stop. The autosegmental representations below illustrate the production of epenthesis in extrasyllabic final stops for the word 'bud':

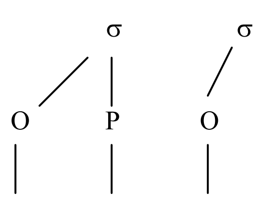
(1) CVC is a common structure in English:



(2) BP CVC syllable rarely ends in stops; thus, for BP learners /\/ cannot belong to the same syllable node as /†● /:

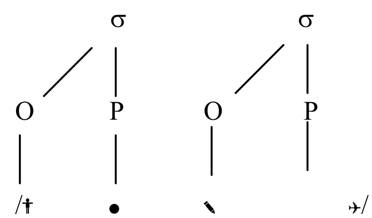


(3) Therefore, /d/ is considered as being the onset of an extra syllable:



/ɫ • ɴ/

(4) However, there are no syllables in BP or English without a peak. Thus, an extra vowel is added to fill up the peak slot:



Therefore, vowel epenthesis is an expected strategy explained in relation to transfer as well as to universal markedness owing to BP phonotactics and markedness of CVC syllables.

2.6 Conclusion

According to Souza (1998) BP allows nine types of syllables from V to CCVCC, and English permits twenty-four types from V to CCCVCCCCC. The CV syllable is the most frequent pattern in BP, and stops do not appear in word final position. This difference in structure might be one of the main motivators of errors in English, especially epenthesis.

Major (1997) states that vowel epenthesis is expected to decrease as learners become more proficient. In the studies of Baptista and Silva Filho (1997), with intermediate students, and Koerich (2002), with beginners, the overall rates of epenthesis were 15.2% and 44.45%, respectively, demonstrating that, at least at an early stage of acquisition, learners frequently turn CVC syllables into CV.CV.

The results obtained in Koerich, the study on which the present study was based, show that the alveolar stops were epenthesized 44.41% of the times they were produced. The present study expected a lower rate of epenthesis since the participants have a higher overall proficiency in English.

CHAPTER 3

PHONOLOGICAL ENVIRONMENT AND ALLOPHONIC PROCESSES

3.1 Introduction

This chapter discusses the allophonic processes undergone by alveolar stops in BP, word-final alveolar stops in English, and word-final alveolar stops in Brazilian Portuguese/English interphonology. Since the present study does not deal with clusters, the alveolar stops of the English *-ed* inflectional ending on regular past tense and regular past participle are not considered. In addition, this chapter presents a brief overview of the main interphonology studies dealing with phonological environment as a variable affecting the production of word-final consonants in Brazilian Portuguese/English interphonology.

3.2 Alveolar stops and allophonic processes

3.2.1 Alveolar stops and allophonic processes in Brazilian Portuguese

The commonest allophonic process involving alveolar stops in BP is palatalization. In BP alveolar stops are in complimentary distribution with affricates [● 9.■✎☛]; 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 c*arioca*[2] dialect according to linear phonology and of Hora (1993), analyzing it in the dialect of *baianos*[3] according to autosegmental phonology. Independent 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 [✈] and [✽] or the glide [j], the alveolar stops are palatalized in different parts of the country. Câmara Júnior (1977) states that /▮/ is replaced by an allophonic variant [✈] 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 c*ariocas* of all ages produce the allophonic affricate variants; whereas p*aulistanos*[4] 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’ [● ▮● ▮] (ALERS, 2002).

According to the data in the Linguistic and Ethnographic Atlas of the South Region of Brazil (ALERS, 2002) and personal observation, it seems reasonable to say that considering palatalization of alveolar stops there are three main groups of dialects in the state of Santa Catarina (one of the three states in the South): (a) as a marked characteristic of dialect, people belonging to older generations in Florianópolis, the capital of the state, do not palatalize alveolar stops in initial and medial syllables or in final syllables. In their

---

[2] People from Rio de Janeiro.
[3] People from Bahia, a Northeastern state.
[4] People born in Sâo Paulo.

dialect, *ditado* ‘dictation’ and *chocolate* ‘chocolate’ are pronounced as [␂✈● ♀␂▭] and [9● ✤● ● ♀● ✻]; (b) people in the southern parts of Santa Catarina palatalize alveolar stops in any position before a high front vowel. They say: [␂✒✈● ♀␂▭] and [9● ✤● ● ♀● 9✻]; and finally, (c) people from the midwest and north of the state palatalize alveolar stops in initial and medial syllables but not in final syllables, since they produce /▮/ in unstressed position. In their dialect, the two words are pronounced as [␂✒✈● ♀␂●] and [9● ✤● ● ♀● ▮].

3.2.2 Alveolar stops and allophonic processes in English

Unlike BP, English phonotactics permits alveolar stops in word-final position. In connected speech these alveolar stops undergo a considerable variety of allophonic processes.

Based on Jackson (1980), Kenworthy (1987), Temperley (1987), Avery and Ehrlich (1992), Giegerich (1992), Underhill (1994), and Celce-Murcia, Brinton & Goodwin (1996), the commonest processes are (a) elision, when alveolar stops appear between two consonants as in *old man* [● ▭● ● 7●]; (b) gemination when two identical consonants come together as in *hot tea* ✓✏✑● ● ● ✈● ☑; (c) palatalization when they appear before /★/ as in *would you* [● ▭␂✒● ● ●], and in its reduced alternative [● ▭␂✒● ●]; (d) unreleasing[5] when they appears “before other oral stops or at the end of an utterance”, as in *good bye* [❁▭␂● †♀✻] and *cat* [✤7● ●] (Giegerich, 1992, p. 217) or before an affricate as in *meet John* [● ✈✿ ● ␂✒✑✿ ☑; (e) glottalization, which is restricted to voiceless alveolar stops as in *put* [● ✻▭▭●]; (f) aspiration (a puff of air), which is restricted to voiceless stops

[5] Giegerich (1992) claims that the amount of release is related to speech style. Full release is more likely to happen in slow careful speech than in casual or fast speech, and it is also related to idiolect.

in the onset and is very likely to occur in the coda[6] in connected speech when they are followed by a stressed vowel[7]; and finally (g) flapping, when the voiceless alveolar stop is followed by a vowel in the onset position as in *got out* [☼▫✢9♀▭● ● ☑. This allophone is present in most AE dialects, especially in fast speech (Eckman & Iverson, 1997).

With respect to palatalization, it is important to remember that even though [● 9] and [✎☛] occur in English as allophones of /t/ and /d/, differently from BP, in English they are also phonemes.

3.2.3 Alveolar stops and allophonic processes 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. In terms of palatalization this difficulty can be put in the following way:

BP	English	BP	English
	/● /		/✎/
/● / - [● , ● 9]		/✎/ - [✎, ✎☛]	
	/● 9/		/✎☛/

[6] The resyllabification turns the coda into an onset.
[7] At the end of utterances and when the speaker is emphasizing the word which contains the final alveolar stop, aspiration is common in the speech of some native speakers.

To my knowledge there are no studies focusing on palatalization of final alveolar stops in Brazilian Portuguese/English interphonology; despite its frequent occurrence. 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 (/✈/) 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.

3.3 Phonological environment

3.3.1 The influence of phonological environment

Phonologists and phoneticians agree that a universal principle of sound systems is that sound units are influenced by their adjacent elements, assuming different phonetic values, according to processes such as assimilation, elision, liaison, and epenthesis (Jackson, 1980; Wolfram & Johnson, 1982; Laver, 1994). Bearing in mind the claim that interlanguages undergo the same phonological processes as of natural languages (Eckman, 1991), the above statement seems to be true for interlanguages as well.

L2 studies investigating the role of the phonological environment on pronunciation have proposed hypotheses in terms of sonority relations among speech sounds established in hierarchies or scales such as Goldsmith's (1990) and Hooper's (1976). The studies of Carlisle (1991, 1994), Rebello (1997) and Rauber (2002), for example, examined the effects of the preceding environment of /s/-clusters in terms of sonority relations. Baptista and Silva Filho (1997) and Koerich (2002) examined the effects of the following environment on the production of final consonants, based on Hooper's universal consonantal strength scale and on Murray and Vennemann's (1983) SCL (see Section 2.3). In these studies, Syllable Contact Numbers (SCN) were assigned to the consonants in cross-syllabic contacts. SCNs were obtained by the formula (*a-b*), where *a* is the value assigned to the target, and *b* to the environment sounds. The assumption was that the higher the SCN, the more problematic the segment. Although no significant effect of strength relations across syllables was found, both studies showed a tendency for the greater the difference, the more epenthesis, and the deviant consonants coincided in the two studies.

Fewer studies have tested the effects of the preceding environment on the production of codas. Yavas (1994), for instance, found that preceding high vowels favored voicing of final stops, and Hansen (2001) found that while diphthongs and /● / strongly disfavored targetlike production of final codas, a preceding monophthong other than /● / slightly favored it.

Allophonic processes of final alveolar stops in Brazilian Portuguese/English interphonology need to be studied with special concern to speech rate. With the objective of addressing the occurrence of an allophone as being the effect of a certain phonological environment, it is necessary to set a specific time span between the production of the target phone and the environmental phone. Zsiga (2000) claims that in order to have coarticulation, the silence span between the two sounds being studied must last less than 0.35s.

3.3.2 Carryover effect

Carryover and anticipatory effects, resulting from the coarticulation of neighboring sounds, have been investigated in L1 VCV sequences (e.g., Recasens, 1987; Farnetani & Recasens 1993; Marchal & Hardcastle, 1993; Modarresi, Sussman, Lindblom, & Burlingame, 2004).

A carryover effect comprises the effect the articulation of a sound has on the following sound, while an anticipatory effect is the effect the articulation of a sound has on its preceding sound. In a V_1CV_2 sequence a "variety of transitional phenomena" can be observed: (a) vowel to vowel effects, (b) vowel to consonant effects, and (c) consonant to vowel effects (March & Hardcastle, 1993, p. 139).

Modarresi et al. (2004) investigated the production of V.CV and VC.V syllables by five speakers of English and found that whereas in open syllables carryover effects predominated in alveolar environments, in closed syllables carryover effects exceeded anticipatory effects for all the stops tested. In summary, the authors say that (a) consonants are more sensitive to vowel coarticulation (tongue dorsum displacement) in syllable-final position than in syllable-initial position (e.g. /t/ is more affected in the word *net* than in the word *ten*); (b) carryover effects tend to be greater than anticipatory effects when the target is a final stop (e.g. in the phrase *meat offer*, /t/ is more affected by the preceding vowel than by the following vowel) ; and (3) closed syllables "strongly favor" carryover effects (e.g. in the word *feet*, the effects from /💡/ to /✈/ to /● / are greater than the effects from /● / to /✈/ to /💡/) (p. 298).

Concerning palatals, the fricatives are considered high consonants (Giegerich 1992), and palatographic configurations have shown that affricates are even higher than fricatives

(Recasens, 1990). Having this body of research and assumptions in mind, it is expected that learners who produce palatalization when aiming at the production of a final alveolar stop may do so more often when the alveolar stop is preceded by a high vowel because the height of the vowel will carry over raising the consonant so as to approximate it to the palate.

To my knowledge, there are no studies investigating the effect of the preceding environment on final oral stops in Brazilian Portuguese/English interphonology. Considering that the constraints which hold for natural languages hold also for interlanguages, the present study aims at investigating carryover effects (preceding environment effects) regarding palatalization of the final alveolar stops in Brazilian Portuguese/English interphonology.

3.4 Conclusion

As Carlisle (1994) states, it should be considered serious negligence on the part of the researcher who studies syllable simplification strategies not to take into account the role performed by the phonological environment. Studies such as Baptista and Silva Filho (1997), Rebello (1997), Rauber (2002), and Koerich (2002) carefully investigated the effect of the following phonological environment in terms of vowels, consonants, and silence, as well as the effect of the interaction of markedness and phonological environment in cross-syllabic contacts. As stated above, allophonic processes are intrinsically dependent on the environment of the target sound.

The present study investigated the influence of the phonological environment taking into account the effects of (1) the following environment in terms of vowels, consonants, and silence, and in terms of the Syllable Contact Law (SCL); and (2) the preceding environment in terms of a carryover process. In order to assure that coarticulation could have happened, data in which the time span between the target sound and the following environment was superior to 0.35s was discarded (Zsiga, 2000).

CHAPTER 4

UNIVERSAL MARKEDNESS RELATIONS AND BRAZILIAN PORTUGUESE/ENGLISH INTERPHONOLOGY STUDIES

4.1 Introduction

This chapter presents the Markedness Differential Hypothesis (MDH) and the Structural Conformity Hypothesis (SCH) proposed by Eckman (1977/1987; 1991). It also reviews the most relevant works in Brazilian Portuguese/English interphonology dealing with MDH, SCH, Syllable Contact Law (SCL), and phonological environment.

4.2 The Markedness Differential Hypothesis and the Structural Conformity Hypothesis

It has been long believed that language transfer plays a role in the process of acquisition of a second or foreign language (Tarone, 1980/1987; Major, 1987, 1998; Carlisle, 1991, 1992, 1994, 1997, 2001; Best, 1995; Flege, 1995; Gass, 1996; Leather & James, 1996; Baptista & Silva Filho, 1997; Keys, 2002; Koerich, 2002; Rauber, 2002; among many others). However, the extent to which other factors such as language markedness interact with transfer needs to be investigated in order to form a more accurate view of what actually happens in this process.

Accounting for the importance of markedness relations in L2 acquisition, Eckman (1977/1987) proposed the Markedness Differential Hypothesis (MDH), based on the principles of the Contrastive Analysis Hypotheses (CAH). The MDH was later developed into the Structure Conformity Hypothesis (SCH), which according to the author (1991), is a superior version of the MDH.

The CAH, formulated by Lado, was based on the belief that L2 elements that are similar to a learner's native language will be more easily acquired than the elements which differ from it (Lado, 1957, cited in Ellis, 1994). The strong version of the CAH was formulated in terms of predictions about errors that would be produced by L2 learners. Its weak version, developed by Wardhaugh (1970, as cited in Ellis 1994), proposed that the hypothesis could be used to explain errors after they are observed. However, research soon showed that, even though the CAH could actually explain some errors, when analyzing data from a large group of learners, it had several drawbacks, one of them being its lack of power to account for either the degree or the directionality of the difficulties.

With the aim of incorporating these factors into the study of L2 acquisition, Eckman (1977/1987) proposed the MDH, which makes claims based on the notions of implicational markedness and typological markedness. The notion of implicational markedness reads:

> A phenomenon A in some language is more marked than B if the presence of A in a language implies the presence of B; but the presence of B does not imply the presence of A. (p.60)

According to typological markedness, degrees of difficulties between an L1 and an L2 correspond directly to degrees of markedness.

Bearing these assumptions in mind, Eckman (1977/1987) proposes the MDH as stated below:

> The areas of difficulty that a language learner will have can be predicted on the basis of a systematic comparison of the grammars of the native language, the target language and the markedness relations stated in universal grammar, such that,
> (a) Those areas of the target language which differ from the native language and are more marked than the native language will be difficult.
> (b) The relative degree of difficulty of the areas of the target language which are more marked than the native language will correspond to the relative degree of markedness.
> (c) Those areas of the target language which are different from the native language, but are not more marked than the native language will not be difficult. (p. 61)

Acknowledging that the MDH failed to predict difficulty in areas which L1 and L2 do not differ, Eckman (1991) proposed the Structural Conformity Hypothesis (SCH). The SCH states that "the universal generalizations that hold for the primary languages hold also for interlanguages" (p.24). A theoretical advance in relation to the MDH is that the SCH can be more easily falsified. Eckman (1991) tested two phonological implicational universals proposed by Greenberg (1978, cited in Eckman, 1991, p. 24):

> a. Fricative-Stop Principle: if a language has at least one final consonant sequence consisting of stop + stop, it also has at least one final sequence consisting of fricative + stop.
> b. Resolvability Principle: if a language has a consonantal sequence of length *m* in either initial or final position, it also has at least one continuous subsequence of length *m-1* in this same position.

Eckman's data consisted of word-initial and word-final clusters produced by Korean, Japanese, and Chinese learners of English. The generalizations presented above appeared 97.5% of the time supporting the SCH. However, according to Barbara Baptista (personal communication, 2004), the importance and usefulness of the MDH rely on its power to make predictions based on L1 and L2 differences, which is not possible using the SCH alone. Therefore, both the MDH and the SCH have their own space in interphonology research.

4.3 The Markedness Differential Hypothesis, the Syllable Contact Law and Brazilian Portuguese/English interphonology

A growing body of studies has been carried out in order to investigate Brazilian Portuguese/English interphonology. Tarone (1980/1987) investigated how Korean, Cantonese, and BP speakers deal with consonant clusters narrating a story in English, and which strategies they use in order to simplify more marked syllable structures. Her study involved two speakers of each language and showed that, even though the preference for a less marked CV structure seemed independent of transfer, L1 influenced the choice of strategies, with BP speakers favoring the use of vowel epenthesis and both Korean and Cantonese learners favoring final consonant deletion.

Major (1986, 1987, 1992, 1994, 1996, 2000) investigated how transfer interacts with developmental stages in Brazilian Portuguese/English interphonology in relation to degree of foreign accent. Major (1987) set out to investigate the Ontogeny Model and stated that the choice of a specific epenthetic vowel, in the case of final consonants, seems to be related to the learner's stage of acquisition. Beginners tend to add the vowel [✈] as a simplification strategy and as a result of a transfer process, gradually replacing it by [●], reflecting a developmental process found in the L1 acquisition. His participants were two groups of six speakers, a beginner and an advanced group. They read a word list and a sentence list twice – first, at normal pace and then as fast as they could, and then a text. The results showed that stage of development, length of clusters, as well as text style influenced the production of epenthesis in the following ways: (a) as the style becomes more formal, transfer decreases and developmental processes increase; (b) as learners become more proficient, transfer decreases and developmental processes increase; and (c) as clusters become longer, errors increase. Moreover, as learners become more proficient, devoicing processes become more frequent whereas vowel epenthesis almost disappears.

Baptista and Silva Filho (1997) investigated the production of vowel epenthesis in singleton codas by Brazilians learners of English. The hypotheses tested were based on markedness, phonological environment, and sonority relations across syllables. Even though the six participants were all enrolled at a *Letras* course, they differed in level of proficiency. In line with Carlisle's (1994) study, participants were recorded reading a list of sentences in which the following environment was controlled in a way to test the target sounds and environment combinations selected for the study. Baptista and Silva Filho acknowledged the small scope of their research, but pointed to important results in regard to SCH and SCL. For instance: (1) relative markedness in regard to voicing of the target sound contributed to a higher frequency of vowel epenthesis when the target was a voiced consonant rather than when it was its voiceless counterpart; (2) transfer interacted with markedness considering manner of articulation but not considering place of articulation among voiced syllable-final stops; (3) regarding sonority of the target sound even though transfer seemed to have 'tempered' the effects of markedness, the MDH was partially met; and finally, (4) the sonority relations across syllables pointed to a tendency towards the postulates of the SCL.

In the line of Baptista and Silva Filho's study, Koerich (2002) investigated the effect of the linguistic variables of markedness of the target consonant, phonological environment, and sonority relations across syllables on the perception and production of word-final consonants by Brazilian learners of English. The participants of her study were 20 false-beginner learners (approximately 54 hours of instruction), and the results showed no significant effect of markedness or phonological environment both on the production and perception of word-final consonants, that is, the students produced epenthesis indiscriminately (the overall rate of epenthesis production was 44.45%), probably owing to the low level of proficiency in English. The results of Koerich corroborated those of Baptista and Silva Filho in terms of (1) a differential production of labial consonants demonstrating the interaction between transfer and markedness and the necessity of caution in regard to the MDH considering final consonants, and (2) the same tendencies towards effects of sonority relations across syllables conforming to the postulates of the SCL.

Following Koerich (2002), Silveira (2004) set out to investigate accented production and perception in terms of discrimination between CVC and CVCV syllables by 22 EFL students at beginning level. The author focused her investigation on effects of instruction on perception and production of final consonants. Her participants also showed difficulties as predicted by the MDH in that they had trouble discriminating between perfect minimal pairs whose differences were restricted to an additional final /✈/ as in the pair ‘fog’ [❢● ❁] and ‘foggy’ [❢● ❁✈]. The author also tested the following variables concerning markedness: (1) sonority; (2) voicing; and (3) place of articulation. Silveira found that the effect of (1) sonority of the target might vary for perception and production; (2) voicing seems not to affect perception and production of word-final consonants; and (3) there is a tendency for velars being more difficult to produce than alveolars and bilabials.

4.4 Conclusion

Eckman’s (1977/1987) Markedness Differential Hypothesis (MDH) accounts for the interaction between L1 transfer and language universals. The flexibility of the MDH allows it to predict and help to explain results obtained in studies concerning the transformation of

CVC syllables into CVCV syllables by Brazilians learners of English. Although results have not been conclusive up to the present moment, the body of research on the production and perception of final consonants in BP/E interphonology relating the issue to the effect of markedness relations has been putting together a considerable set of unique data which has potential to revitalize the discussion.

In the same way, investigations of the effect of phonological environment on the production of final consonants considering cross-syllabic relations have found tendencies towards the postulates of Murray and Vennemann's (1983) Syllable Contact Law (SCL).

With the intent to contribute to the scarce body of research on BP/E interphonology studies, the present study investigated the variation in the production of alveolar stops as being affected by the linguistic constraints posited by universal markedness relations and phonological environment, with specific reference to the MDH and to the SCL and their interaction with L1 transfer.

CHAPTER 5

METHOD

5.1 Introduction

This Chapter describes the method of the empirical investigation carried out in order to address the research questions and hypotheses stated below. The data was gathered in the second semester of 2004, in the foreign language laboratory of the Federal University of Santa Catarina, and treated and rated by the researcher using Praat, a program for speech analysis and synthesis. The Chapter describes the participants, the data collection instruments, the procedures adopted for analyzing and classifying the production of final /t/ and /d/, and the statistical treatment employed.

5.2 Research questions and hypotheses

The present study aimed at describing the types of mispronunciation of the alveolar stops in syllable-final position in the interphonology of BP learners of English. The following research questions and hypotheses seek to provide data on which a better understanding of the issue might be built. These research questions and hypotheses were based on observation of the performance of Brazilian learners of English during more than five years of teaching experience as well as on the literature cited in the review of literature (Chapters 2, 3, and 4). Nevertheless, the literature on the specific processes investigated here (palatalization, aspiration, and vowel epenthesis of alveolar stops) is extremely scarce, which on the one hand makes the task more difficult, but on the other adds value to the present research. The questions and corresponding hypotheses are the following:

Question 1: What sounds do BP learners of English produce when the target is word-final /t/ or /d/?

Hypothesis 1: When the target is a word-final /t/ or /d/, besides targetlike production, BP learners of English may produce vowel epenthesis, palatalization or aspiration in phonological environments where these processes are not allowed by the phonotactic rules of the language. Vowel epenthesis may be combined with either palatalization or aspiration.

Question 2: Does markedness in terms of voicing of the target consonant influence the production of word-final alveolar stops?

Hypothesis 2: The voiced alveolar stop causes more mispronunciations than the voiceless one.

Question 3: Does phonological environment in terms of the preceding and the following sounds influence the occurrence of different types of mispronunciation of the final alveolar stops?

Hypothesis 3.1: High vowels and closing diphthongs in the preceding environment tend to cause more palatalization than mid and low vowels.

Hypothesis 3.2: Vowels in the following environment tend to cause more mispronunciations than pauses and the latter more mispronunciations than consonants.

Hypothesis 3.3: The greater the difference in consonantal strength (or sonority) between /t/ or /d/ and the sound in the following environment, the greater will be the frequency of mispronunciations.

5.3 Participants

The participants were thirty pre-intermediate students of English (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 students were classified according to palatalization in BP in order to establish a relationship between idiolect and palatalization in Brazilian Portuguese/English interphonology. The table below shows the frequency of palatalization in BP per participant out of 13 potential tokens (see Section 5.4.3 for details).

Table 5.1

Frequencies and rates of palatalization in Brazilian Portuguese

	Nº of productions	Nº of palatalizations	% of palatalizations
P1	13	11	84
P2	13	12	92
P3	13	13	100
P4	13	1	7
P5	13	13	100
P6	13	11	84
P7	13	12	92
P8	13	13	100

P9	13	1	7
P10	13	13	100
P11	13	12	92
P12	13	12	92
P13	13	1	7
P14	13	12	92
P15	13	12	92
P16	13	11	84
P17	13	0	0
P18	13	1	7
P19	13	12	92
P20	13	3	23
P21	13	3	23
P22	13	13	100
P23	13	1	7
P24	13	12	92
P25	13	10	77
P26	13	13	100
P27	13	11	84
P28	13	12	92
P29	13	13	100
P30	13	13	100
TOTAL	390	277	71

5.4 Materials

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.

5.4.1 Questionnaire

The participant profile questionnaire designed by Koerich (2002) was applied here to assess biographical information as well as information on factors which are relevant to phonological research, such as amount of instruction and the use of language learning strategies outside the classroom (Appendix B).

5.4.2 Sentence reading test in English

Participants' production of final alveolar stops in English was assessed by a sentence reading test (Appendix C). The test consisted of a list of 240 topically unconnected short sentences containing monosyllabic words ending in /t/ or /d/ in different preceding and following phonological environment combinations. The preceding environments tested were /✈▪ ✶▪ ✉/● ▪ ♀✲▪ ● ▪ ● ● /■ The vowels /✲▪ ▭▪ 7▪ ● / were not included to limit the number of tokens as well as to have the same number of (a) high and mid-high (/✈▪♀✲▪● ● /) , and (b) mid-low and low vowels (/✶▪ ✉/● ▪ ● /). The diphthong /■✲/ was not included because the great majority of monosyllabic words containing /■✲/ are spelled with a final 'e', and since the data gathering instrument – a reading test – involved orthographic input, the inclusion of C'e' words was avoided. Consonants were not included as preceding environments in order to limit the study to singleton codas.

The following environments tested consisted of the vowels /✈▪ ✶▪ ● /, the consonants

/● ▪ †▪ ● ▪ ⬊▪ ✤▪ ❁▪ ⚲▪ ● ▪ ● ▪ ● ▪ ● 9▪ ⬊▪ ▬▪ ● ▪ ● ▪ ● /, 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, /∗/ and /● / were included in order to provide both a front and a back vowel as following environment. The interdental fricatives /■▪ ∗/ and the glides /★▪ ● / were not included because they are frequently mispronounced by BP EFL learners. Also, /9/ was not tested because its voiced counterpart /☛/ appears in the onset in only a very limited number of loan words such as ‘genre’. The total of tokens of word-final /t/ and /d/ included in this test was 240. Sentences were randomized for presentation so that each participant read them in a different order, thus ensuring the absence of ordering effects.

5.4.3 Sentence reading test in Brazilian Portuguese

The test consisted of 16 short unconnected sentences in BP designed to classify participants’ idiolects according to amount of palatalization in their native language speech. The target words in these sentences were words containing the graphically represented syllables ‘te’ and ‘de’ at the end of words (e.g. *interessante* [✲● ● ▪8▪● ⚲● ● ✲] – ‘interesting’ and *de* [⬊✲] – ‘of’) (Appendix D).

5.5 Procedures

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.

5.5.1 Questionnaire

As participants arrived at the laboratory they were given the questionnaire and instructed to sit down where an envelope had been placed. They answered the questionnaire and handed it in to the researcher. This procedure took approximately ten minutes.

5.5.2 Sentence reading test in English

Following the procedures adopted in Koerich (2002), each student received an envelope containing written instructions in BP for the test (Appendix E), two blocks containing the typewritten sentences, and a card. The envelopes and tapes were placed on the consoles beforehand in order to lead participants to sit as far from each other as possible, avoiding background noise in the recordings. Each block consisted of 8 sheets containing 120 typewritten sentences (Appendix I). Participants opened the envelopes on the researcher's command, and the researcher read the instructions aloud, clarifying doubts. Then, the researcher trained the participants in the recording procedures, which consisted of recording each sentence once using the card to slide down the page.

5.5.3 Sentence reading test in Brazilian Portuguese

After all participants finished the English test they were instructed to record the BP sentences. After finishing they put the tape away in the envelope and handed in all the material to the researcher.

5.6 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. Among other advantages, the software allowed isolation of the target and measurement of pause duration between target and following sounds. Thus, auditory and visual cues were employed to obtain the most accurate transcription of the data possible. The productions where the preceding or the following environment was mispronounced by the participants (e.g. [● ● ✎ ● ♀✼4] for 'road sign'), and in which there was a pause longer than 0.35s between the target and following sound were discarded (see Section 3.4).

The judgement procedures involved four main steps. First, the production was classified into six categories in order to answer the first research question: (1) targetlike productions of /t/ or /d/; (2) palatalization of /t/ or /d/ ([● 9, ✎☛]); (3) /t/ or /d/ followed by an epenthetic vowel ([● ✈■ ✎✈]); (4) /t/ or /d/ aspirated ([● ✼■ ✎✼]); (5) /t/ or /d/ palatalized and followed by vowel epenthesis ([● 9✈■ ✎☛✈]); and (6) /t/ or /d/ aspirated and followed by vowel epenthesis ([● ✼✈■ ✎✼✈✓/).

Then, the aspiration category (category 4, above) was divided into three subcategories according to duration, in order to have a better description of its occurrence – (a) aspiration with duration smaller than .1 second; (b) aspiration with time span between .1 and .2 seconds; and (c) aspiration with time span greater than .2 seconds. The limit was set at .2 seconds because very few productions contained aspiration longer than .2 seconds. The decision of creating subcategories for aspiration was made taking into consideration that shorter aspiration (less than .1 second) did not seem to be as serious as longer aspiration (more than .2 seconds) since they are not likely to interfere with intelligibility to the same extent. Palatalization, on the other hand, regardless of its duration, may interfere with intelligibility since it is infrequent on English native speech and results in a new phoneme. Furthermore, an additional subcategory was created for the tokens where the aspiration was voiced since it constituted a different error.

Other categories of error were found (e.g. velarization, devoicing, among others) but at a very low frequency (Appendix F). Therefore all productions which did not fit into the six initial categories were classified into a single seventh category. Finally, after all recordings were judged the seven categories analyzed were (1) targetlike; (2) palatalized; (3) vowel epenthesized; (4) aspirated; (5) palatalized and vowel epenthesized; (6) aspirated and vowel epenthesized; and (7) others.

As mentioned above, besides classifying the production of the target phonemes, the immediately preceding and following environments were also analyzed. Along with long pauses[8], all tokens where the preceding and/or 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.

5.7 Data analysis

5.7.1 Speech production data

[8]Silence span greater than 0.35s (Zsiga, 2000), which invalidates the effect the following environment might have on the production of the target sound (See section 3.4)

The data resulting from the categorization was arranged for statistical treatment according to the variables addressed in each hypothesis (see Section 5.2). The data was tabulated computing (a) the rate of tokens produced by subject for each error as well as for targetlike production to investigate Hypothesis 1; (b) the rate of tokens produced by subject for each of the six categories of error as well as overall errors to investigate Hypothesis 2; (c) the rate of palatalization produced by subject for each preceding environment to investigate Hypothesis 3.1; (d) the rates of overall mispronunciations and vowel epenthesis by subject for the following vowels, consonants and pauses to investigate Hypothesis 3.2; (e) the rates of mispronunciations by subject for each SCN based on Hooper's (1976) universal consonantal strength scale, and the rates of mispronunciations by subject for each SCN based on Goldsmith's (1990) sonority scale, to investigate Hypothesis 3.3; and (6) the rates of mispronunciations by preceding and following environment, to provide a more complete answer to Question 3.

As explained in section 3.3, the SCN corresponds to $a - b$, where a is the value of the target sound and b is the value of the following environment. The first a and b values assigned correspond to consonantal strength values proposed by Hooper (1976), and the second a and b values correspond to the sonority values proposed by Goldsmith (1990).

5.7.2 Statistical analysis

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.

CHAPTER 6

RESULTS AND DISCUSSION

6.1 Introduction

This chapter reports the results of the statistical tests run in order to examine the hypotheses and answers the research questions presented in Section 5.2. It also discusses these results in light of the pertinent theories and studies reviewed in Chapters 2, 3, and 4.

Each of the three hypotheses of this study establishes a main section of the present chapter. Even though the statistical tests were run by subject, the individual differences which can be identified in the profile questionnaire (Section 5.4.1) are considered of minor relevance, since this study aimed at finding patterns which may trigger pedagogical measures for the normally heterogeneously formed EFL classrooms in Brazil. In an attempt to have the most homogeneous group possible, for example, participants who had spent more than a month abroad were not included in the study, and idiolect regarding palatalization of word final 'te' and 'de' in BP was considered in terms of its effect on the production of final alveolar stops in Brazilian Portuguese/English interphonology.

In the analysis of Hypotheses 1 and 2, the four most frequent interlanguage processes – targetlike production, aspiration, palatalization, and vowel epenthesis – are discussed. Although Hypothesis 3.1 considered only palatalization, the effects of the preceding context are also discussed for aspiration, vowel epenthesis, and non-targetlike production. Hypothesis 3.2 is discussed concerning non-targetlike production in general and vowel epenthesis. In order to better answer Question 3, the effects of each following context are discussed for non-targetlike production, aspiration, palatalization, and vowel epenthesis. Hypothesis 3.3 considers only non-targetlike production in general and examines both Hooper's and Goldsmith's scales (see Section 2.3).

6.2 Brazilian Portuguese/English interphonology processes – Hypothesis 1

This study was motivated by the observation that final alveolar stops are a production difficulty in Brazilian Portuguese/English interphonology. Thus, in general terms, Hypothesis 1 predicted that participants would present targetlike and non-targetlike realizations of alveolar stops in final position. Table 6.1 presents these rates:

Table 6.1

Overall rates of targetlike and non-targetlike productions

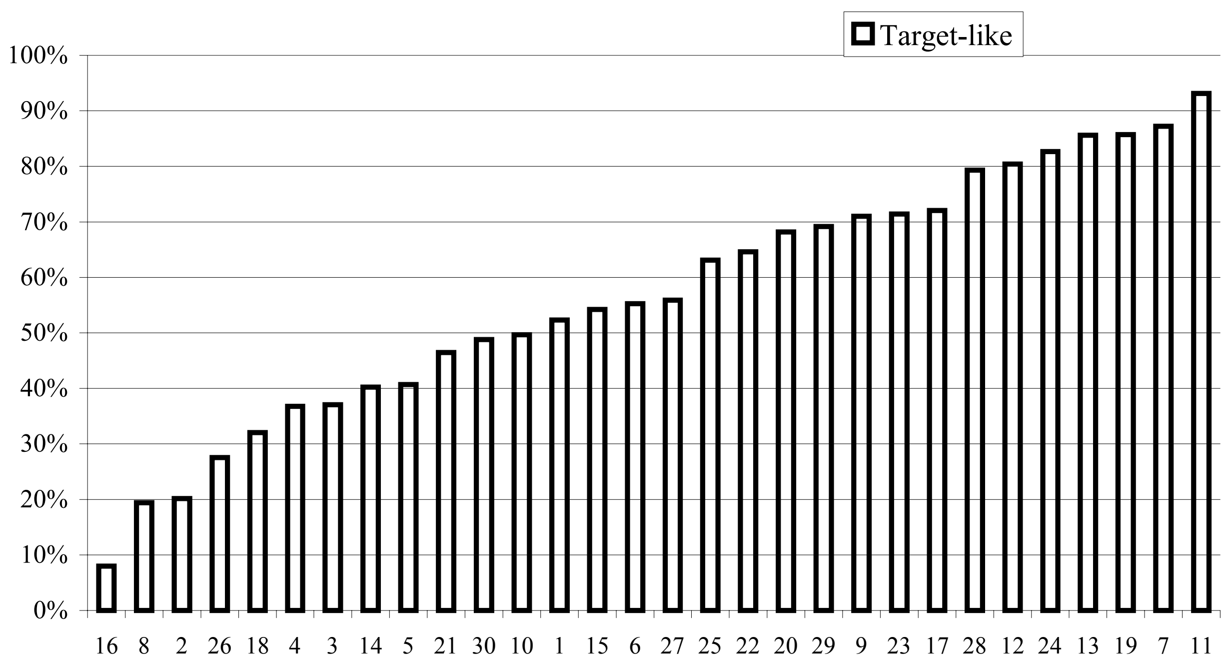
	Nº productions	Rate
Targetlike	3,255	57.9%
Non-targetlike	2,363	42.1%
Total	5,618	100%

Paired-sample *t*-tests showed no statistically significant difference in the rates of targetlike and non-targetlike productions computed by subjects, $t(29) = 1.60$, $p > .05$.

This lack of statistical significance seems to be due to the wide individual variation in the rates among the participants (M = 56.6%, range = 8 - 93 %, SD = .23), as Figure 6.1 shows, and indicates that, as predicted, final alveolar stops present difficulties for pre-intermediate students of English with approximately 150 hours of previous instruction.

Figure 6.1

Variability of targetlike production by participant



Specifically, Hypothesis 1 predicted that when the target is a syllable-final /t/ or /d/, besides targetlike production, BP learners of English may produce vowel epenthesis, palatalization or aspiration in phonological environments where these processes are not allowed by the phonotactic rules of the language, and that vowel epenthesis may be combined with either palatalization or aspiration. In fact, over 20 different sounds and sequences of sounds were identified in the participants' productions (Appendix F). Out of these 20 realizations, six main categories of error were analyzed in the study. Table 6.2 presents the frequency of occurrences for targetlike production and for these six categories of error:

Table 6.2

Main processes in the production of Brazilian Portuguese/English final alveolar stops

Type of Production	Nº Productions	Rate	SD
Targetlike[9]	3,255	57.9%	.23[10]
Aspiration	1,060	18.9%	.11
Palatalization	604	10.7%	.15
Vowel epenthesis	374	6.6%	.08
Aspiration with vowel epenthesis	109	2.0%	.03
Palatalization with vowel epenthesis	107	1.9%	.04
Others	109	2.0%	.01
Total	5,618	100%	–

Paired-sample *t*-tests showed that aspiration was significantly ($p<.05$) more frequently produced than any of the other errors: (1) aspiration and palatalization $t(29) = 2.21$; (2) aspiration and vowel epenthesis $t(29) = 4.90$, (3) aspiration and aspiration with

[9]Targetlike production corresponds to unreleased alveolar stops, glottal stops, deletion, flaps, and aspiration where the phonotactics of English allows these processes. Aspiration corresponds to both voiced and voiceless aspiration where it is not considered a common process (see Section 3.2.2). Palatalization corresponds to both voiced and voiceless palatalization. Others correspond to all other processes which were found in lower frequencies; for instance, there were 27 occurrences of devoicing and 20 occurrences of voicing.

[10] A SD value of .23 is equivalente to 23%.

vowel epenthesis $t(29) = 9.49$; and (4) aspiration and palatalization with vowel epenthesis $t(29) = 7.84$. There were no statistically significant ($p>.05$) differences between palatalization and vowel epenthesis.

The significant differences between aspiration and the other types of errors can be analyzed as evidence of difficulty to unrelease final /● / and /\/. It can indicate that there may be ‘awareness’ that these consonants are not fully released but at the same time difficulty to hold them in a native-like fashion. Full release of /● / and /\/ without connection to a following environment might lead to palatalization or vowel epenthesis, or to aspiration or palatalization with vowel epenthesis. Therefore, aspiration can be interpreted as lying between targetlike production and more auditorily salient mispronunciations – palatalization or vowel epenthesis.

The lack of a significant difference between palatalization and vowel epenthesis shows that, at least at the intermediate stage of EFL acquisition, these errors are equally common in Brazilian Portuguese/English interphonology. The basic difference between them is with respect to voicing of the target sound, discussed in Section 6.4.

An interesting piece of data seems to deserve closer attention – the fact that vowel epenthesis, aspiration and palatalization alone were significantly more frequent ($p<.001$) than their productions in association: (1) aspiration and aspiration with vowel epenthesis $t(29) = 9.49$; (2) palatalization and palatalization with vowel epenthesis $t(29) = 4.19$; (3) vowel epenthesis and aspiration with vowel epenthesis $t(29) = 4.06$; and (4) vowel epenthesis and palatalization with vowel epenthesis $t(29) = 3.19$.

The low frequency of the combinations may be also due to voicing of the target since palatalization and aspiration were more frequent when the target was the voiceless alveolar stop and vowel epenthesis was more frequent when the target was the voiced alveolar stop (see Section 6.4). In the case of palatalization with vowel epenthesis, its low frequency seems to indicate that if palatalization of /● / and /✎/ is triggered by vowel epenthesis, the epenthetic vowel tends to be omitted in the production process.

Targetlike production

As can be observed in Table 6.1, targetlike production comprised more than half of the data gathered in this study. Table 6.3 below displays the rates of the categories that correspond to targetlike production in this study:

Table 6.3

Frequencies and rates of realizations of targetlike alveolar stops

DESCRIPTION	N	Nº productions	Rate
Unreleased + Glottal Stops + Gemination + Released into the following sound	5,618	3,117	55.5%
Aspiration of the voiceless target before silence or in resyllabification with vowels	565	112	19.8%
Flap	394	22	5.6%
Total	–	3,255	–

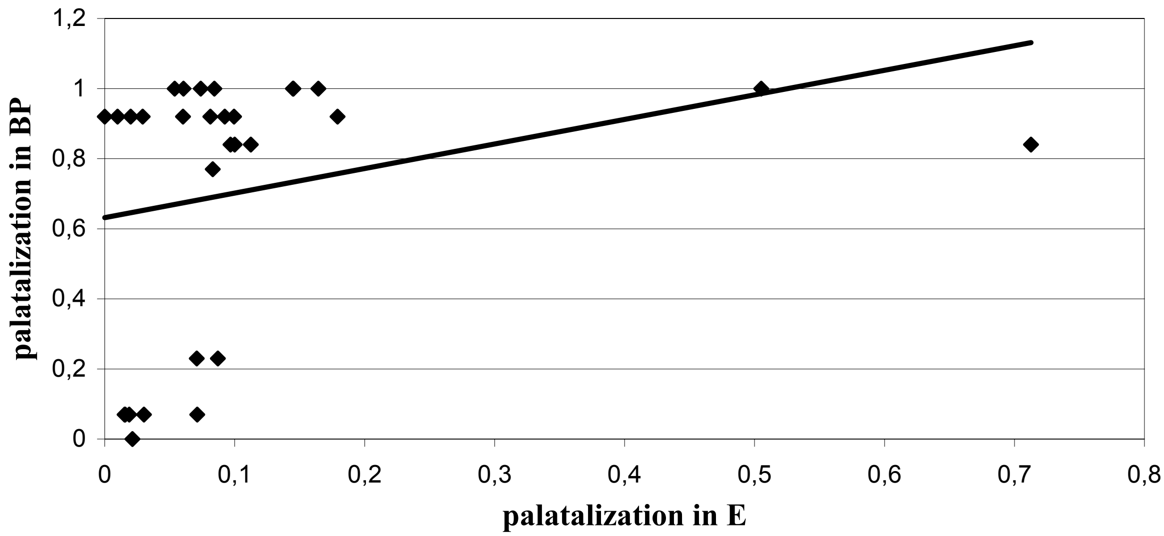
Since the participants of the present study had more exposure to American English, it was expected that flapping would occur more frequently than it did. One possible explanation for the under usage of flapping and for the low production of aspiration as a sign of resyllabification before vowels is that learners tend to segment their speech avoiding allophones and other features of connected speech which are characteristic of fast fluent speech.

6.3 Palatalization in Brazilian Portuguese and palatalization in Brazilian Portuguese/English interphonology

Palatalization is a common process in the production of alveolar stops and alveolar fricatives in Brazil (see Section 3.2.1). Therefore, it was expected that it would be frequent in the present study. As shown in Table 6.2, in fact, it appeared as a frequent misproduction of English final alveolar stops, by itself and accompanied by vowel epenthesis.

As mentioned in Section 3.2.3, 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 (see Sections 5.3 and 5.4.3 for further details). Figure 6.2 below shows the expected positive relationship between palatalization in BP and palatalization in Brazilian Portuguese/English interphonology:

Figure 6.2
Relationship between palatalization in Brazilian P ortuguese 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. Since Spearman's correlations are less affected by the presence of outliers, it was concluded that the presence of some outliers may have been responsible for the lack of significance in the Pearson's test. It must be noted that palatalization and palatalization with vowel epenthesis were the only processes which yielded positive correlations with palatalization in BP with both Pearson's and Spearman's tests. The correlation coefficients for palatalization with vowel epenthesis and palatalization in BP were *r* (30) = .255, and *rho* (30) = .241, non-significant at .05 level.

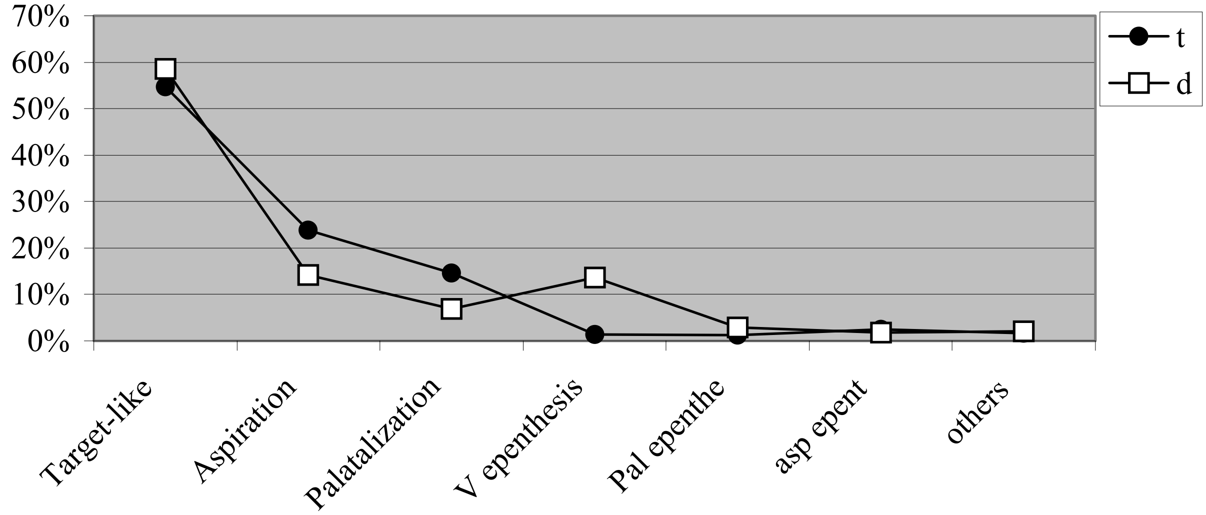
These results seem to indicate that L1 idiolect alone cannot account for palatalization in English. On the other hand, Figure 6.2 shows that the participants who did not palatalize in BP did not palatalize or palatalized very little in English, which might be seen as an indication that the absence of palatalization in BP may be a predictor of its absence in Brazilian Portuguese/English interphonology. This tendency was confirmed by Pearson Correlation tests run only for the participants who palatalized in BP less than 25% of the time. These tests 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, $r(8) = .707$, $p = .050$.

6.4 Voicing of the target sound – Hypothesis 2

Based on universal markedness relations, Hypothesis 2 predicted that the voiced alveolar stop would cause a higher rate of errors than the voiceless alveolar stop. Figure 6.3 depicts the data for the voiceless and voiced alveolar stops concerning targetlike production, aspiration, palatalization, vowel epenthesis, palatalization with vowel epenthesis, aspiration with vowel epenthesis, and other errors:

Figure 6.3

Rates of the main types of production by voiced and voiceless alveolar stops



As can be seen in the graph, contrary to the hypothesis, the voiceless alveolar stop caused more errors concerning both palatalization and aspiration, which were the most frequent misproductions. The only tendency according to the hypothesis was for vowel epenthesis, since, for aspiration with vowel epenthesis, palatalization with vowel epenthesis, and other types of misproductions, the rates were extremely close. Table 6.4 shows the rates of targetlike and the three main types of mispronunciation of the voiced and voiceless alveolar stops:

Table 6.4

Rates of main types of production by voicing of the target

	Targetlike	Aspiration	Palatalization	Vowel Epenthesis
N [-vd]	2,801	2,801	2,801	2,801
N° Prod [-vd]	1,614	685	431	35
Rate	**57.6%**	**24.4%**	**15.4%**	**1.25%**
SD	.20	.12	.16	.02
N [+vd]	2,817	2,817	2,817	2,817
N° Prod [+vd]	1,641	375	173	369
Rate	**58.2%**	**13.3%**	**6.15%**	**13%**
SD	.26	.10	.13	.15
Total N	5,618	5,618	5,618	5,618
Total N° Prod	3,255	1060	604	374
Total %	**57.8%**	**18.9%**	**10.7%**	**6.7%**

For targetlike production, a paired-sample *t*-test yielded the following result: t (29) = -2.01, p = .054. This result, very close to statistical significance, suggests that, considering all possible errors, there is a considerable tendency for learners to have more difficulty in the production of the final voiceless alveolar stop, against Hypothesis 2. This lack of support for the hypothesis is reinforced by the results for the two most frequent mispronunciations. For both aspiration and palatalization, the *t*-tests on the differences of the rates by voicing yielded highly significant results: t (29) = 8.24, $p < .001$, and, t (29) = 7.71, $p < .001$.

Vowel epenthesis presented the only pronounced difference according to the hypothesis. Paired-sample *t*-test yielded the following result: t (29) = -5.18, $p < .001$. Higher rates of vowel epenthesis for the voiced alveolar stop were found by Baptista and Silva Filho (1997) and Koerich (2002) as well. Table 6.5 shows the data of the three studies:

Table 6.5

Rates of vowel epenthesis by voicing of the target

Alveolar stop	This study		Koerich (2002)		Baptista & Silva Filho (1997)	
	N	V EPENT	N	V EPENT	N	V EPENT
[-vd]	2,801	1.25%	400	43.75%	156	10.3%
[+vd]	2,817	13 %	424	45.04%	162	16.7%
total	5,618	–	824	–	318	–

Baptista and Silva Filho did not run statistical tests, and a paired-sample *t*-test showed that the difference found in Koerich's study was not statistically significant (t (19) =-.55, p >.05), so the set of data on the misproduction has to be seen in terms of a tendency. It must be noted that both Baptista and Silva Filho and the present study dealt with intermediate students whereas Koerich dealt with beginners, which might explain the strikingly higher rates of epenthesis in the latter study. Likewise, the lack of a significant difference in the rates of alveolar stops (as well as in any other voicing pair) was attributed to the participants' low level. As Koerich observes, it seems that at this stage of learning, students have a strong tendency to epenthesize final obstruents in general.

6.5 Phonological environment – Research Question 3

The variable phonological environment comprised three hypotheses. Hypothesis 3.1 investigated the effects of the preceding environment on palatalization, Hypothesis 3.2 investigated the effect of the following environment in terms of vowels, consonants, and silence, and Hypotheses 3.3 investigated syllabic contact making use of both Hooper's (1976) Universal Strength Scale and Goldsmith's (1990) Sonority Scale.

6.5.1 Preceding environment

Few studies have investigated the effects of the preceding environment on the production of final codas; thus, the difficulty in formulating hypotheses concerning this variable is great. Coarticulation studies on first language have found evidence of carryover effects from vowels to consonants in closed syllables (see Section 3.3).

Hypothesis 3.1 focused on palatalization but for exploratory purposes and aiming at better answering Q3, data on the effect of the preceding environment is reported below for non-targetlike production, vowel epenthesis, and aspiration as well.

6.5.1.1 High vowels and palatalization – Hypothesis 3.1

High vowels are articulated closer to the palate than non-high vowels; thus, palatalization of the consonant would be more frequent when this consonant is preceded by a high than by a non-high vowel. The present study tested three 'high' vowels (one high, one mid-high, and one low-high diphthong) – /✈▪ ● ▭▪ ♀✲/, and three non-high vowels – /▭▪ ✱▪ ● /, before each target-following environment combination. Even though /♀✲/ and /● / are not considered high vowels, at the end of their articulation the tongue is high, therefore, for the purposes of the present study they were treated as high vowels. The following table presents the descriptive statistics for high and non-high vowels:

Table 6.6

Rates of palatalization by preceding environment (high x non-high vowels)

Environment	N	Palatalized	Rate	SD
high	2,902	404	14%	.16
non-high	2,716	200	7.36%	.14
Total	5,618	604	10.75%	–

A paired-sample *t*-test on the rates of palatalization computed by subjects for high and non-high preceding vowels showed a highly significant difference ($p < .001$): $t(29) = 6.26$. This result supported the hypothesis formulated in this study that high vowels and closing diphthongs in the preceding environment would cause more palatalization than mid and low vowels.

The data for each vowel is shown in the following table:

Table 6.7

Rates of palatalization by preceding environment

Environment	N	Palatalized	Rate	SD
♀✽	978	115	11.7%	.13
✈	1067	138	12.9%	.15
● 🗀	857	154	18%	.23
∗	959	60	6.2%	.14
⇨/●	878	63	7.1%	.01
●	879	74	8.4%	.18
Total	5,618	604	10.7%	-

Paired-sample *t*-tests showed that palatalization was significantly more frequent when word-final alveolar stops were preceded by /● 🗀/. The results for the pairs /● 🗀/ and the other high vowels are the following: For /● 🗀/-/✈/, t (29) = 2.33, p = .027, and for /● 🗀/-/♀✽/, t(29) = 2.58, p = .015. The results for the *t*-tests for /● 🗀/ and the non-high vowels were all statistically significant (p < .001) as well. Among the low vowels there was no significant difference. Therefore the following hierarchy of palatalization promoters may be proposed in relation to preceding environment:

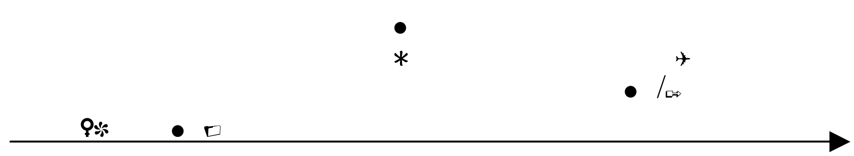


Figure 6.4

Approximate hierarchy of palatalization promoters for environments preceding final alveolar stops

Laver (1994) states that rounding of the vowel /● / requires either horizontal contraction of the lips alone, or horizontal contraction with vertical contraction of the lips triggering a change in the area and shape of the interlabial space. Also, rounding adds strength to the vowel (Hooper, 1976). It can be speculated that besides tongue position, lip rounding is also carried over to the following [t, d] in a way that the compressed air produced at the medial phase of the articulation of [t, d] may be released with more friction, inducing more to palatalization than either /♀✻/ or /✈/. This assumption needs to be more thorougly investigated, though. The statistical difference among high vowels needs to be studied in more detail since the literature says that in the case of alveolopalatals, coarticulation favors effects from vowels regarding height rather than fronting, probably because of tongue positioning (Recasens, Farnetani, Fontdevilla & Pallarès, 1993).

6.5.1.2 Effects of preceding environment on other types of production

Similar analyses were carried out for the data on overall errors, vowel epenthesis and aspiration to verify the effect of the preceding environment on their production as well. Table 6.8 shows this data:

Table 6.8

Rates of non-targetlike, epenthesized, and aspirated realizations by preceding environment

Environment	N	Non-targetlike		Vowel Epenthesis		Aspiration	
		Nº Prod	Rate	Nº Prod	Rate	Nº Prod	Rate
♀✼	978	392	40%	57	5.8%	154	15.7%
✈	1067	528	49%	109	10.2%	202	18.9%
● ▭	857	417	48.6%	53	6.2%	175	20.4%
∗	959	364	38%	63	6.6%	181	18.9%
● /✎	878	309	32%	32	3.6%	173	19.7%
●	879	353	40%	60	6.8%	175	19.9%
Total	5,618	2,363	–	374	–	1060	–

Paired-sample *t*-tests yielded the following highly significant results ($p <. 01$) for the differences between the members of the following pairs concerning (a) overall errors: (1) /♀✼/-/✈/, t (29) = -3.56; (2) /♀✼/-/● ▭/, t (29) = -3.76; (3) /✈/-/∗/, t (29) = 3.87; (4) /✈/-/● /✎/, t (29) = 4.54; (5) /✈/-/● /, t (29) = 3.61; (6) /● ▭/-/∗/, t (29) = 3.11; (7) /● /-/● /✎/, t (29) = 3.77; and (8) /● ▭/-/● /, t (29) = 2.81. All other paired-sample *t*-tests yielded no significance ($p > .05$). Figure 6.5 illustrates the results:

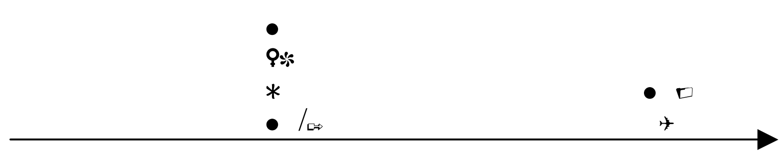


Figure 6.5

Approximate hierarchy of non-targetlike promoters for environments preceding final alveolar stops

For vowel epenthesis, paired-sample *t*-tests yielded two significant results at the .01 level: (1) /✈/-/● /☞/, *t* (29) = 4.81; and (2) /♀✲/-/✈/, *t* (29) = -2.87; and three results significant at the .05 level: (1) /✈/-/● ▭/, *t* (29) = 2.41; (2) /✈/-/● /, *t* (29) = 2.71; and (3) /● /-/● /☞/, *t* (29) = 2.46. All the other paired-sample *t*-tests yielded non-significant results (*p* > .05).

Hooper (1976) claims that vowel strength varies from language to language and that in English, the weakest vowel is /● / whereas in BP the weakest vowel is /✈/. Since interphonologies are dynamic continuums, vowel strength values may vary till the target language value is reached or till the vowel fossilizes somewhere between native and target values. The vowel /✈/ preceding alveolar stops significantly triggered more vowel epenthesis than the other vowels tested in the present study. This result indicates that the relationship between strength of preceding vowel and vowel epenthesis deserves future research and analysis. The following hierarchy of diffculty was designed based on the statistical results yielded in this study:

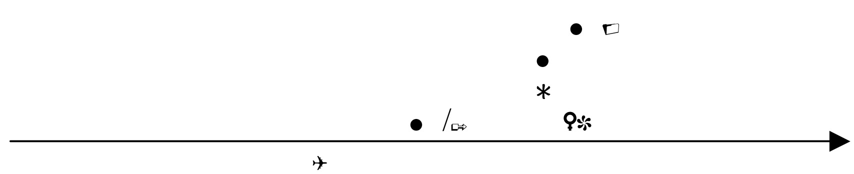


Figure 6.6

Approximate hierarchy of difficulty concerning vowel epenthesis by environments preceding alveolar stops

Concerning aspiration, paired-sample *t*-tests yielded significant and close to significant results only for the pairs containing /⚲✻/: (1) /⚲✻/-/● /▪ t (29) = -2.84, p = .008; (2) /⚲✻/-/● / ▪ t (29) = -2.90, p = .007; (3) /⚲✻/-/∗/▪ t (29) = -2.91, p = .007; (4) /⚲✻/-/● /⇨/▪ t (29) = -1.97, p = .059; and (5) /⚲✻/-/✈/▪ t (29) = -2.80, p = .009. It seems reasonable that this result may be attributed to the length of /⚲✻/ - the longest vowel tested in the preceding environment (Peng & Ann, 2000) – and to the fact that longer vowels cause shorter lags reducing the probability of aspiration. Based on these results, the following hierarchy of difficulty for aspiration can be proposed:

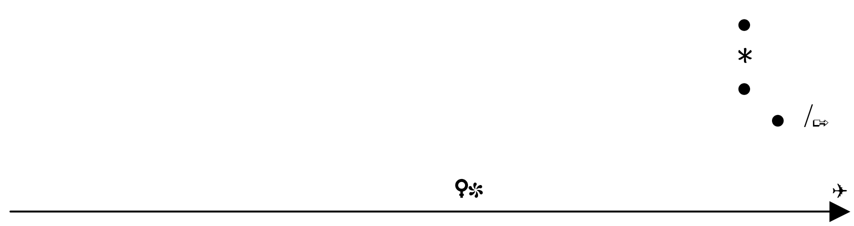


Figure 6.7

Approximate hierarchy of difficulty concerning aspiration by environments preceding alveolar stops

6.5.2 Following environment

6.5.2.1 Vowels, Consonants, and Silence – Hypothesis 3.2

Hypothesis 3.2 was based on the medians of vowel epenthesis found in Koerich (2002). It stated that vowels in the following environment of final alveolar stops would cause more errors than consonants and consonants more errors than silence. First, the results for non-targetlike production are presented and discussed and then the results concerning vowel epenthesis are reported and discussed in relation to the results obtained by Koerich and other relevant previous studies.

6.5.2.1.1 Non-targetlike production

The table below shows the rates for vowels, consonants, and silence as following environments of word-final alveolar stops in the production of overall errors:

Table 6.9

Rates of non-targetlike production by following environment

Environment	N	Nº Produced	Rate	SD
Vowel	799	405	50.6%	.25
Consonant	4,490	1,819	40.5%	.22
Silence	329	139	42.24%	.25
Total	5,618	2,363	–	–

Paired-sample *t*-tests yielded the following results: (1) for the pair vowel-consonant, t (29) = 6.84, $p < .001$; (2) for the pair vowel-silence, t (29) = 3.22, $p < .01$; and (3) for the pair consonant-silence, t (29) = -.01, $p = .995$. Thus, vowels in the following environment significantly triggered more errors than consonants and silence whereas the difference between consonants and silence was not significant. Therefore, the hypothesis was only partially supported.

6.5.2.1.2 Vowel epenthesis

Since previous studies have analyzed the effect of the following environment concerning the process of vowel epenthesis, the same analysis carried out for non-target production is carried out in this section for vowel epenthesis. The table below shows the rates of vowel epenthesis according to the following environment:

Table 6.10

Rates of vowel epenthesis by following environment

Environment	N	Nº Produced	Rate	SD
Vowel	799	100	12.5%	.16
Consonant	4,490	273	6.8%	.07
Silence	329	1	0.003%	.02
Total	5,618	374	–	–

Paired-sample *t*-tests yielded high significance ($p < .001$) for all pairs: vowel-consonant, $t\ (29) = 3.92$; vowel-silence, $t\ (29) = 5.01$; and consonant-silence, $t\ (29) = 4.63$.

Therefore, for alveolar stops, vowels tend to cause more epenthesis than consonants and consonants more epenthesis than silence. Koerich's (2002) results showed the same tendency concerning overall final consonant targets; however, her results did not yield statistical significance. In Baptista and Silva Filho's (1997) study, consonants caused more epenthesis than vowels and vowels more epenthesis than silence. Neither study carried out an analysis for the alveolar stops independently, so it is not possible to establish a straightforward correspondence between the previous results and the ones of the present study. A third study, Tarone (1980/1987), found a different order, with vowel epenthesis increasing from vowels to consonants, and then silence.

6.5.2.2 Types of production by following environment

This section aims at better answering Question 3 by investigating the effects of following environment in different processes mainly in terms of voicing, manner of articulation, and place of articulation (see Section 5. 2).

6.5.2.2.1 Vowels

The present study did not aim at investigating the effects of vowel quality in the following environment. Therefore, three vowels were selected to stand for the whole group.

The table below shows the descriptive statistics for the vowels in the following environment:

Table 6.11

Rates of mispronunciations by vowels in the following environment

Cont	N	Non-targetlike			Aspiration			Palatalization			Vowel Epenthesis		
		N° Prod	Rate %	SD	N° Prod	Rate %	SD	N° Prod	Rate %	SD	N° Prod	Rate %	SD
✈	206	105	51	.28	46	22	.22	16	7.8	.23	32	15.5	.27
∗	268	130	48.5	.26	51	19	.18	19	7.1	.11	33	12.3	.15
●	287	170	59.2	.29	62	21	.17	40	13.9	.19	35	12.2	.17
Total	799	405	50.6	.25	159	22.2	-	75	9.4	-	100	12.5	.16

Concerning non-targetlike production, paired-sample *t*-tests yielded a significant difference only for the pair /∗/-/● /, t (29) = -2.95, $p < .01$. Due to the small variety of vowels in the data, it is not possible to state the cause of this difference. Since /∗/ is the only lax vowel among the three vowels tested, it can be speculated that this feature has some effect on the production of final alveolar stops. For aspiration and for vowel epenthesis, paired-sample *t*-tests yielded non-significant ($p > .05$) results for all pairs of vowels.

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 /✈/ was not a palatalization motivator. As in the case of non-targetlike production, the lax vowel seemed to be less problematic as a following environment: For the pair /∗/-/● /, t (29) = -3.14, $p < .01$.

In spite of the lack of significance in the difference between front vowels and between the pair /✈/-/● /, 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 Brazilian Portuguese/English interphonology, as discussed in Section 6.2.1, 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 Brazilian Portuguese/English interphonology.

6.5.2.2.2 Consonants and silence

The following table presents the results for the errors by following consonant:

Table 6.12

Rates of mispronunciations by consonants and silence in the following environment

Cont	N	Non-targetlike			Aspiration			Palatalization			Vowel Epenthesis		
		Nº Prod	Rate %	SD	Nº Prod	Rate %	SD	Nº Prod	Rate %	SD	Nº Prod	Rate %	SD
●	293	125	42.7	.31	62	21.0	.21	44	15.0	.23	21	7.2	.12
†	293	111	38.0	.30	64	21.8	.19	23	7.8	.19	22	7.5	.12
●	272	93	34.2	.26	50	18.3	.16	24	8.8	.18	11	4.0	.09
ˎ	303	108	35.6	.29	41	13.5	.17	23	7.6	.14	18	6.0	.11
♣	258	152	58.9	.31	85	32.9	.26	42	16.0	.24	17	6.6	.16
❂	283	158	55.8	.30	68	24.0	.19	39	13.8	.18	28	9.9	.14
♀	283	153	54.0	.33	58	20.0	.15	57	20.0	.24	20	7.0	.11

•	273	183	67.0	.27	80	29.3	.21	42	15.4	.16	30	11.0	.14
•	294	43	14.6	.16	21	7.1	.10	7	2.4	.08	8	2.7	.05
•	293	74	25.3	.25	33	11.2	.13	9	3.0	.09	16	5.4	.10
• 9	266	62	23.3	.26	20	7.5	.12	19	7.1	.12	10	3.8	.07
•	287	74	25.8	.28	20	6.9	.10	30	10.4	.14	9	3.1	.05
h	260	159	61.0	.29	61	23.4	.16	32	12.3	.14	33	12.7	.18
•	251	85	33.9	.28	49	19.5	.20	29	11.6	.16	6	2.4	.05
•	297	127	42.8	.28	53	17.8	.16	37	12.4	.21	8	2.7	.10
•	284	112	39.4	.24	60	21.1	.18	21	7.4	.13	16	5.6	.01
Silen.	329	139	42.2	.25	76	48.1[11]	.24	51	15.5	.24	1	0.0	.01
Total	4,818	1,958	40.6	-	901	18.7	-	529	10.9	-	274	5.7	-

For non-targetlike production in general, voicing of the following environment is significant only in terms of fricatives. Paired-sample *t*-tests run on each voicing pair yielded the following results, significant at the level .01: (1) /•/-/v/, *t*(29) = .-3.45; and (2) /• /-/• /, *t*(29) = .-3.31. Thus, both voiced fricatives are more problematic as following environment than their voiceless counterparts considering non-targetlike production. For vowel epenthesis, voiced sounds in the following environment caused more vowel epenthesis than their voiceless counterparts. It seems that markedness of the following environment added diffculty for targetlike production.

However, there was a significant difference ($p<.05$) only for the labiodental fricatives, *t*(29) = -2.59. Voicing does not seem to play an important role concerning the following environment for palatalization and aspiration, although an opposite tendency to the one found for vowel epenthesis can be noticed, that is, voiceless sounds caused more palatalization and aspiration. However, the bilabial stops were the only pair to present statistical significance ($p<.01$) for palatalization. The voiceless bilabial stop significantly

[11] For aspiration, N = 158 – only when the target was the voiced alveolar stop.

triggered more palatalization than its voiced counterpart, $t(29) = 3.34$, which explains the voiceless bilabial stop superiority in the difficulty hierarchy proposed for non-targetlike production. For aspiration, the only significant difference ($p<.05$) was for the velars, $t(29) = 2.51$; conversely, the fricatives point towards the opposite direction: voiced fricatives induced more aspiration than their voiceless counterparts. The labiodentals yielded a significant difference at the .05 level, $t(29) = -2.39$.

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 as shown by paired sample *t*-tests (1) alveolars-bilabials, $t(29) = -2.20$, $p <.05$; (2) alveolars-velars, $t(29) = -5.07$, $p<.001$. Between bilabials and velars, velars tend to be more problematic, $t(29) = -3.96$, $p<.001$. Among fricatives, labiodentals and the glottal fricative yielded highly significant ($p<.001$) differences considering non-targetlike production when compared to alveolar fricatives: (1) labiodentals-alveolar fricatives, $t(29) = 9.52$; and (2) glottal fricative-alveolar fricatives, $t(29) = 8.78$. Between the glottal fricative and labiodentals the difference was not significant. ($p>.05$), $t(29) = .21$. The alveolar fricatives seemed to facilitate targetlike production. Major (1986) states that BP learners of English borrow the sequence final stop plus [•] as [C•]. This effect is opposite to the other fricatives which are amongst the most problematic following environments, therefore, manner of articulation seems not to influence production as much as place of articulation. However, a paired-sample *t*-test run for the pair stops-fricatives yielded a significant result ($p<.01$), $t(29) = 3.04$, showing that even though labiodentals and the glottal are problematic, the alveolar fricatives neutralized their effect. The alveolar fricatives were the only sounds which yielded no significant differences when compared to affricates. As for alveolar fricatives, affricates seem to have facilitated alveolar production, in this case, probably due to gemination. Between the nasal stops, paired-sample *t*-tests indicate that the bilabial nasal significantly ($p=.01$) caused fewer problems than the alveolar nasal, $t(29) = -2.76$. The alveolar liquid, which was the only other sonorant consonant tested, yielded no significant differences from either nasals. Moreover, the difference between /l/ and /m/ and between /l/ and /n/ is practically the same, placing /l/ between the two nasals in a hierarchy of difficulty. A paired-sample *t*-test between sonorants and obstruents yielded the following result $t(29) = 3.70$, $p<.01$.

Comparing the results obtained for the sonorants with those for the obstruents, only the affricates, the alveolar fricatives, and the alveolar stops caused less difficulty than the sonorants. This is probably due to place of articulation and gemination. For the alveolar fricatives the lack of difficulty seems to be also linked to transfer. Eight out of the eleven least problematic environments were alveolars, indicating that there is an important relationship between place of articulation of the target and the environment sounds. Paired-sample *t*-tests yielded no significance for the difference concerning place of articulation of stop sounds for vowel epenthesis. 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. Unlike vowel epenthesis, palatalization seems to depend on the markedness of the following environment regarding place of articulation. Fricatives once more 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, $t(29) = -2.132$. As happened for palatalization, in the case of aspiration, velars were significantly ($p<.01$) more aspirated than alveolars, $t(29) = 4.24$, and bilabials, $t(29) = 2.784$. Among fricatives, labiodentals induced significantly ($p<.001$) more aspirated than the alveolar fricatives, $t(29) = 6.40$. The glottal fricative present no differences from labiodentals and significantly ($p<.01$) triggered more aspiration than the alveolar fricatives, $t(29) = 3.59$. When the following environment was silence, the voiced alveolar stop was aspirated 48% of the time. Silence was a problematic environment concerning palatalization and the most problematic one in regard to aspiration.

Accounting for the significant and non-significant results of the paired-sample *t*-tests run for all possible following environment pairs, Figures 6.8 to 6.11 propose the following hierarchies of difficulty by type of production when the target sound is an alveolar stop:

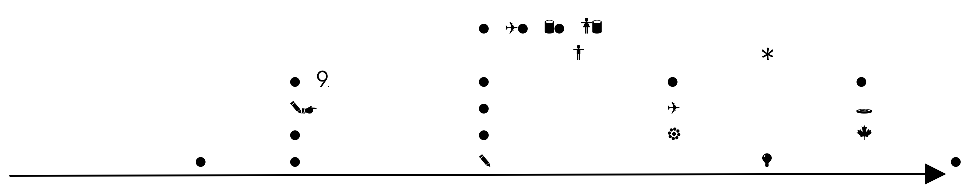


Figure 6.8

Approximate hierarchy of non-targetlike promoters for environments following final alveolar stops

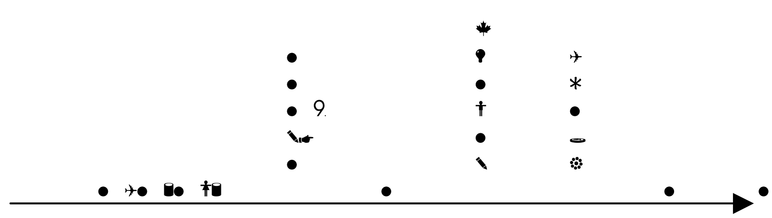


Figure 6.9

Approximate hierarchy of difficulty concerning vowel epenthesis by following environment

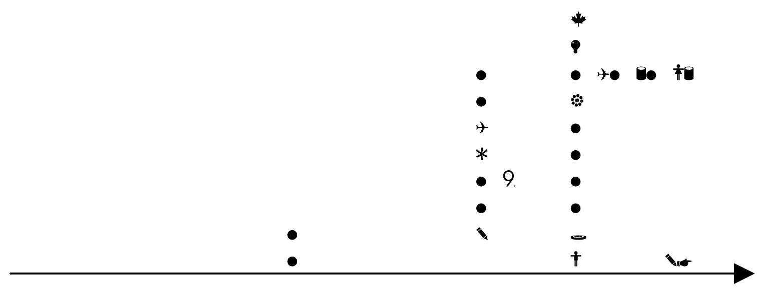


Figure 6.10

Approximate hierarchy of difficulty concerning palatalization by following environment

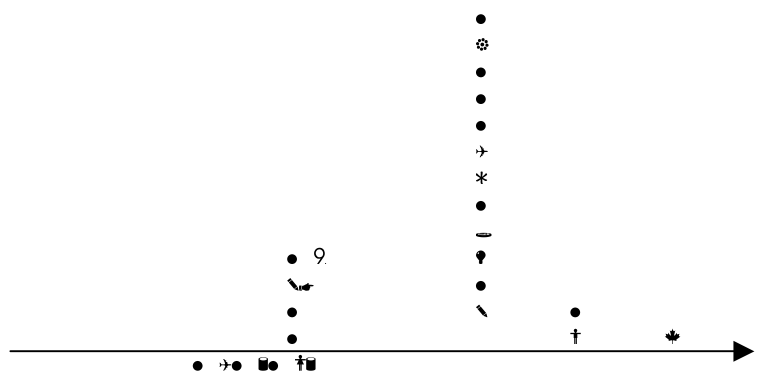


Figure 6.11

Approximate hierarchy of difficulty concerning aspiration by following environment

6.5.2.3 Combinations of preceding and following environments

The results of the statistical tests seem to indicate the influence of the preceding and following environment on the production of final alveolar stops not only in quantitative terms, but also in terms of the types of errors. In order to verify the effects of combinations of preceding and following environments, the data for palatalization[12] was organized as in Table 6.13 and frequencies of palatalization were calculated for each instance. The table comprises the combinations: (1) the most problematic preceding and following environments; (2) the most problematic preceding and least problematic following environment; (3) the least problematic preceding and most problematic following environment; and finally, (4) the least problematic preceding and least problematic following environment.

Table 6.13

Rates of palatalization by combination of preceding and following environments according to difficulty

Environment	Target	N	Palatalized	Rate	Token
(1) /● /-/💡/	●	25	10	40%	boat fever
(1) /● /-/💡/	✎	23	7	30%	road forks
(2) /● /-/● /	●	24	1	4%	boat sank
(2) /● /-/● /	✎	24	1	4%	road sign
(3) /∗/-/💡/	●	24	1	4%	bet fifteen
(3) /∗/-/💡/	✎	28	3	10%	red feathers
(4) /∗/-/● /	●	29	0	0%	pet sings
(4) /∗/-/● /	✎	26	0	0%	red socks

Besides confirming that problematic environments in combination may trigger more palatalization than problematic environments combined with non-problematic environments, the table also shows that palatalization is not word specific. Thus, familiarity and frequency of use had less influence on word production, at least concerning

[12] Palatalization was chosen because even though it was the second most frequent error, the first type of error – aspiration, is not considered so serious since it does not interfere as mcuh with intelligibility.

palatalization, than phonological environment. For example, the words ‘boat’, ‘road’, and ‘red’ 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 [💡] and only 4% of the time when followed by [●], ‘road’ – was palatalized 30% of the time when followed by[💡] and only 4% of the time when followed by [●], and ‘red’ – was palatalized 10% of the time when followed by [💡] and was not palatalized when followed by [●]. 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 phonological benvironment.

6.5.2.4 Syllable Contact Law (SCL) – Hypothesis 3.3

Hypothesis 3.3 investigated whether strength and sonority relations across syllables influenced error production. The syllable contact numbers[13] (SCN) generated using Hooper’s (1976) universal strength scale and Goldsmith’s (1990) sonority scale are analyzed according to the SCL.

6.5.2.4.1 Hooper’s (1976) Universal Consonantal Strength Hierarchy

Hooper’s (1976) universal consonantal strength scale (see Section 2.3) was used to generate syllable contact numbers (SCN) as explained in section 5.7.1. Table 6.14 shows the descriptive statistics for overall errors by SCN using Hooper’s scale:

[13] For the correspondence SCN – pair addressed see Appendix J.

Table 6.14

Rates of non-targetlike production by SCN with Hooper's scale

SCN	-2	-1	0	1	2	3	4	5	6
N	271	689	1184	1205	549	437	147	390	409
Non-targetlike	65	255	533	518	225	166	82	172	232
Rate (%)	24	37	45	43	41	38	56	44	57

The table below shows the results obtained by paired-sample *t*-tests on neighboring SCNs:

Table 6.15

Values of the differences for each neighboring SCNs with the Paired-sample *t*-tests for overall errors using Hooper's scale

	(-2) (-1)	(-1) (0)	(0) (1)	(1) (2)	(2) (3)	(3) (4)	(4) (5)	(5) (6)
t (29)	-3.340	-3.703	.723	.767	.786	-3.547	.858	-1.657
p	.002	.001	.475	.449	.438	.001	.398	.108

Following Baptista and Silva Filho (1997) and Koerich (2002), the affricates were attributed the value of 7 in Hooper's scale; therefore, for affricates in the environment, when the target are alveolar stops, the SCNs are –1 (-vd/affricate) and –2 (+vd/affricate). As seen in Section 6.7.2, affricates are amongst the least problematic following environments, yielding support to Hooper's universal strength scale since they received the lowest SCNs as well as the lowest rates of error; thus, they were placed on the scale right where they should have been placed as to obtain the expected results according to the SCL.

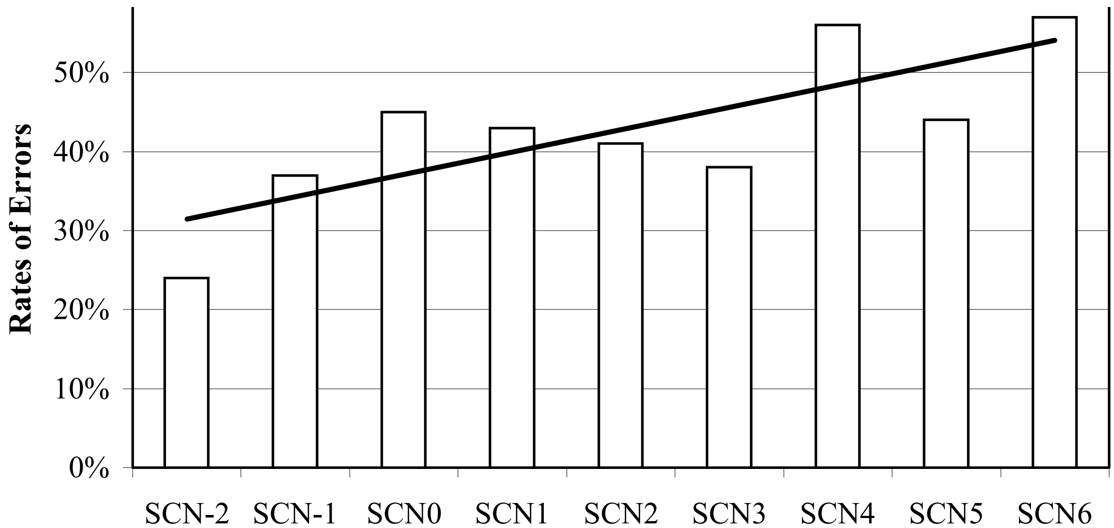
Moreover, vowels were shown to cause more problems in the following environment than consonants and silence. Vowels being the most sonorant sounds, the pairs bearing vowels in the environment received the SCNs 5 and 6 for voiced and voiceless stops, respectively. Although the difference between (5) and (6) was not significant and (4) triggered more errors than (5), the SCNs assigned to vowels placed the greatest amount of errors at the expected end of the scale.

The alveolar fricatives that were also among the least problematic environments are placed in the scale together with the glottal and labiodental fricatives, which are among the most problematic environments. Thus, they nearly neutralized the effects of each other.

Even though not exactly in the direction Hooper's strength scale, the sequence obtained shows a tendency in favor of the scale as the graph below demonstrates:

Figure 6.12

Error rates by Syllable Contact Number (SCN) generated with Hooper's scale



6.5.2.4.2 Goldsmith's (1990) Sonority Scale

Goldsmith's (1990) sonority scale (see Section 2.3) was used to generate syllable contact numbers[14] (SCN) as explained in section 5.7.1. The table below shows the descriptive statistics for overall errors by SCN:

Table 6.16

Rates of non-targetlike production by SCN with Goldsmith's scale

SCN	-2	-1	0	1	2	3	4	5	6
N	-	-	1702	544	1391	558	287	-	799
Non-target	-	-	772	136	612	212	112	-	404
Rate (%)	-	-	45	25	44	38	39	-	51

[14] For the corresponding SCN – pair addressed see Appendix k.

The table below shows the results obtained by paired-sample *t*-tests on neighboring SCNs:

Table 6.17

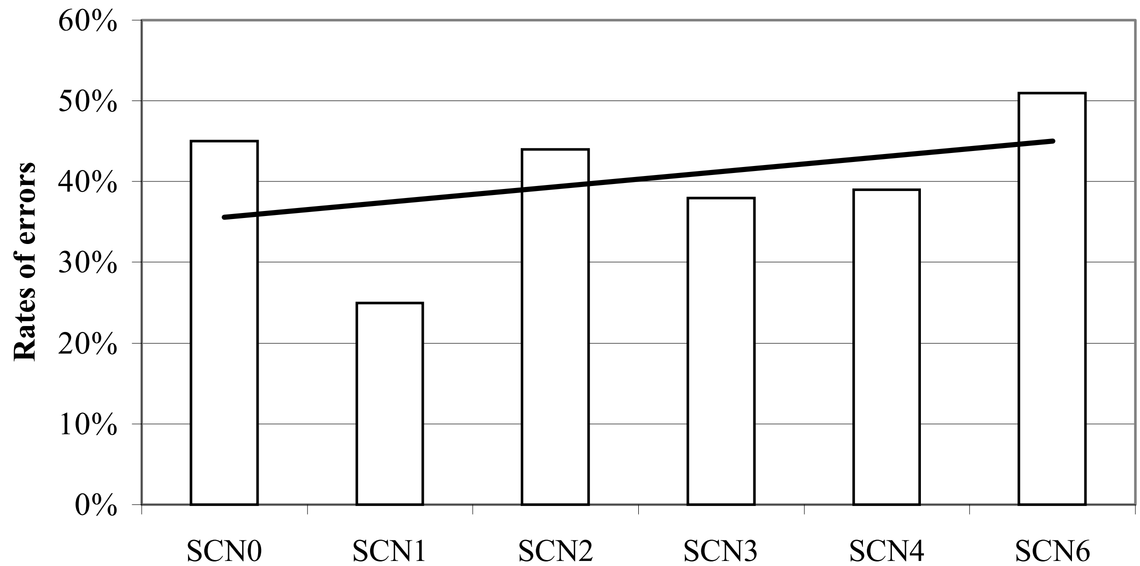
Values of the differences for each neighboring SCNs with the Paired-sample *t*-tests for overall errors using Goldsmith's scale

	(0) (1)	(1) (2)	(2) (3)	(3) (4)	(4) (6)
t (29)	7.102	-7.543	1.760	-.130	-4.963
p	.000	.000	.089	.897	.000

Goldsmith places the affricates between the stops and the fricatives on the sonority scale; hence, affricates were assigned SCN 1 while stops were assigned SCN 0. In the present study, stops caused far more errors than affricates as following environments. Probably for this reason, the results went in the direction of Hooper's scale especially because it deals with alveolar stops. As in Hooper's scale, fricatives are all placed together, neutralizing the extreme results concerning place of articulation, that is, alveolar fricatives as the least problematic following environments whereas labiodental and glottal fricatives as the most problematic following environments. Once more, vowels being the most sonorant sounds and having being responsible for most of the errors produced by the participants, were assigned the highest SCNs. No pair was assigned SCN '5', therefore it was not possible to evaluate the full range of values in the scale. The graph below illustrates the lack of support for H3.3 concerning the Sonority Scale proposed by Goldsmith (1990):

Figure 6.13

Error rates by Syllable Contact Number (SCN) generated with Goldsmith's (1990) Universal Consonantal Strength Hierarchy



6.6 Conclusion

The present study aimed at answering three research questions and testing five hypotheses. The variables investigated were (1) type of production; (2) voicing of the target sound; and (3) phonological environment.

Hypothesis 1 predicted that besides targetlike production BP learners of English would produce palatalization, aspiration, and vowel epenthesis as well as palatalization with vowel epenthesis or aspiration with vowel epenthesis. Even though other processes were found, the predicted ones were the most frequent. Therefore, the results supported this hypothesis. Aspiration was found to be the most frequent error. It is speculated that this frequency might indicate that the learners are aware that alveolar stops are often unreleased in final position but that they have difficulty in doing so, and end up producing aspiration. Moreover, the processes of palatalization in English and palatalization in BP were found to correlate to some extent. The absence of the latter serves as an indicator that the former may be also absent. Also regarding palatalization the fact that palatalization with vowel epenthesis was very infrequent seems to indicate that if palatalization of /● / and /✎/ is triggered by vowel epenthesis, the epenthetic vowel tends to be omitted in the production process.

Hypothesis 2 predicted that the voiced alveolar stop would cause more mispronunciations than its voiceless counterpart. Concerning change in the syllabic structure, that is, vowel epenthesis, the hypothesis found support in the data gathered in this study, which is in line with the tendencies shown in Baptista and Silva Filho (1997) and Koerich (2002). However, the processes of aspiration and palatalization were significantly more frequent when the target was the voiceless alveolar stop, showing a tendency for the voiceless sound to be a more problematic sound in coda position than the voiced one.

Hypothesis 3.1 concerned the effects the preceding environment may have on final alveolar stops in relation to palatalization. It was shown that high vowels favor its production. Besides being clearly present when palatalization occurred, preceding /● / and /✈/ were problematic concerning vowel epenthesis and aspiration as well. However, only palatalization showed a significant difference for a specific group of vowels (high x non-high).

Hypothesis 3.2 dealt with the following environment in terms of vowels, consonants, and silence. Koerich (2002) observed that vowels in the following environment would be expected to facilitate the production of final consonants through resyllabification. Since her results did not support this expectation, she acknowledged the possibility of her participants' low level of proficiency in the foreign language having caused random resyllabification. However, the participants of the present study had approximately 100 more hours of instruction in relation to Koerich's participants and even so, vowels were significantly more problematic in the context than consonants for them. There was a tendency for consonants to be more problematic than silence, but a paired sample *t*-test yielded no statistical significance. The higher rate of vowel epenthesis when vowels were following the final alveolar stops may have resulted from the wide variation in targetlike production among participants, which in turn might reflect the variation in individual proficiency concerning pronunciation – 70% of the participants produced vowel epenthesis in the environment of vowels whereas 97% of the participants produced vowel epenthesis in the environment of consonants. The participants who produced vowel epenthesis in the environment of vowels produced much more vowel epenthesis than those who produced more vowel epenthesis in the environment of a consonant, since vowels were found to trigger significantly more vowel epenthesis than consonants. In line with Koerich, this indicates that low proficiency learners tend to produce more errors in the environment of vowels than higher proficiency learners. On the other hand, in regard to non-targetlike production in general, vowels consistently triggered more errors than consonants.

Significant results showed the influence of the following environment on the production of the alveolar stops. Some processes are more affected by voicing, others by place of articulation. For instance, voiced sounds following alveolar stops triggered more vowel epenthesis than voiceless sounds, and velar stops triggered more palatalization than bilabial and alveolar stops (See Section 6.7.2). Markedness seems therefore to interact with transfer making interphonology dependent on the L1 and L2 as well as on universals.

The variable "silence" in the following environment had progressively more frequent effect in a hierarchy of difficulty considering vowel epenthesis, palatalization, and aspiration. Whereas (a) there was only one instance of production of vowel epenthesis in the environment of silence; (b) for palatalization, silence was among the ten most problematic sounds; and (c) concerning aspiration, silence was significantly more problematic than any other sound tested. Thus, reinforcing the influence the following environment has on misproductions and the similarity between palatalization and aspiration.

Affricates in the following environment do not seem to cause problems, probably because of gemination and deletion processes. The alveolar fricatives seem not only to be non-problematic, but also to facilitate the production of alveolar stops. The sonorants, disregarding the sonority distance, are not as problematic as labiodental and glottal fricatives or bilabial and velar stops.

Hypothesis 3.3 investigated the effects of the SCL on the production of final alveolar stops with SCN generated from Hooper's and Goldsmith's scales. As in Baptista and Silva Filho's (1997) and Koerich's (2002) studies, the present study showed a tendency in favor of Hooper's scale with some deviations. It must be noted that sonority scales are based on manner of articulation, which does not seem be very relevant to the present study. Comparing Hooper's and Goldsmith's scales, the results tend to go in the direction of the former. As previously observed, this tendency was strongly reinforced by the placement of affricates as the strongest sounds in the scale.

As Baptista and Silva Filho (1997) acknowledged, in order to determine whether or not a following environment class causes difficulty, the interaction between it and the target sound must be considered. Besides that, even though voicing has not been shown to play a consistent role, the fricatives have shown a very significant increase in difficulty for the voiced sounds. On the other hand, for the alveolar stops as the target, there was no difference in relation to voicing.

Markedness of following environment regarding place of articulation, which is not considered on the scale, played an effective role in the production of final alveolar stops. The results here seem to argue for the necessity to relate markedness, sonority, and transfer in order to have a better understanding of what happens in interphonology.

CHAPTER 7

CONCLUSION

7.1 Final Remarks

The main objectives of the present study were threefold: (1) to describe the production of final alveolar stops in Brazilian Portuguese/English interphonology; (2) to re-examine some of the findings of Koerich (2002) concerning production of final alveolar stops: (a) the influence of voicing of the target sound; (b) the effects of the following environment in terms of vowels, consonants, and silence; and (c) the effects of sonority relations across syllables; and (3) to investigate the effects of the preceding environment on final alveolar stop production by Brazilian learners of English.

The main findings of this investigation with BP students of English at the intermediate level are summarized below.

<u>Finding 1</u>: When aiming at the production of final alveolar stops, BP learners of English produce, besides targetlike production, aspiration, palatalization, vowel epenthesis, and vowel epenthesis with either palatalization or aspiration, in this hierarchical order, even when the phonotactics of English do not allow these processes.

<u>Finding 2:</u> Aspiration was the most frequent error. This result can be interpreted as indicating that whereas learners have some awareness that final alveolar stops are not fully released, they fail to hold them in a native-like fashion.

<u>Finding 3</u>: Contrary to Yavas' (1994) findings, devoicing was rarely produced.

<u>Finding 4</u>: BP learners who usually do not palatalize word-final ‘te’ and ‘de’ in BP, do not tend to palatalize final alveolar stops in English.

<u>Finding 5</u>: The rate of production of aspiration with vowel epenthesis and palatalization with vowel epenthesis was around 2%. In the case of palatalization with vowel epenthesis, this low frequency seems to indicate that if palatalization of /● / and /✎/ is triggered by vowel epenthesis, the epenthetic vowel tends to be omitted in the production process.

<u>Finding 6</u>: The voiceless alveolar stop caused slightly more difficulty than its voiced counterpart.

<u>Finding 7</u>: The final voiced alveolar stop is significantly more susceptible to vowel epenthesis than its voiceless counterpart. This finding is in tandem with the tendency acknowledged by Baptista and Silva Filho (1997) and Koerich (2002) and reasonings based on universal markedness relations and syllable simplification strategies.

<u>Finding 8</u>: The final voiceless alveolar stop is significantly more susceptible to palatalization and aspiration than its voiced counterpart.

<u>Finding 9</u>: High, mid-high vowels, and closing diphthongs in the preceding environment of final alveolar stops cause more palatalization than mid-low and low vowels.

<u>Finding 10</u>: The front high tense vowel in the preceding environment of final alveolar stops causes more vowel epenthesis than the other five vowels tested, probably due to carryover effects.

<u>Finding 11</u>: The true diphthong /♀✻/ in the preceding environment of final alveolar stops cause significantly less aspiration than the other vowels tested, probably because of its greater length in comparison to the other vowels tested, since longer vowels tend to cause shorter lag.

Finding 12: Vowels in the following environment of final alveolar stops cause more errors than consonants and pause showing that learners tend to segment their speech.

Finding 13: Vowels, labiodental fricatives, velar stops, the glottal fricative, and the voiceless bilabial stop are amongst the most problematic following environments for final alveolar stops.

Finding 14: Alveolar fricatives, affricates, and the bilabial nasal stop are amongst the least problematic following environments for final alveolar stops, probably due to L1 transfer and place of articulation.

Finding 15: Voiced sounds in the following environment of final alveolar stops tend to cause more vowel epenthesis than their voiceless counterparts.

Finding 16: 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 both aspiration and palatalization showing that markedness of following environment concerning place of articulation might have influenced learners' production.

Finding 17: Silence causes significantly more aspiration than any other following environment tested probably because neither gemination nor resyllabification are possible without the addition of an epenthetic sound.

Finding 18: Preceding and following problematic environments in combination trigger more errors than preceding and following problematic environments in combination with environments which are not problematic.

Finding 19: Palatalization seems not to be word specific but probably environment specific.

Finding 20: In order to study final alveolar stops, placing the affricates after stops in a sonority scale (as in Hooper, 1976) yields more satisfactory results than placing the affricates between fricatives and stops (as in Goldsmith, 1990).

The findings having shown that patterns can be drawn from interphonology by analyzing variables of markedness, transfer, and phonological environment, the research questions were answered and the hypotheses investigated. Thus, the objectives of the present research were fulfilled since an opportunity for a better understanding of the production of final alveolar stops in Brazilian Portuguese/English interphonology was provided.

7.2 Pedagogical implications

Learners differ greatly from each other in many ways. One of them is dialect. The present 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.

When this is not possible, teachers should be at least aware of the possible errors their students are likely to produce and provide help either to prevent or correct them when they are already present. As this study demonstrated, final alveolar stops are susceptible to many types of errors. It has also been shown that the type of error depends on learner' idiolect as well as phonological environment.

Palatalization was one of the most serious errors found and it is scarcely addressed in the literature. In most pronunciation 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 /• / is not problematic as a preceding environment concerning palatalization, neither is /s/ as a following environment; thus, when teaching negatives, teachers could explore these least problematic environments (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.

Vowel epenthesis was another frequent error found in the present study. A reduced number of materials provide learners with instruction on the syllable structure. This knowledge would be very useful in order to avoid vowel epenthesis after final consonants as well as before initial consonant clusters. The awareness that final stops may generate closed syllables tends to promote learners' self-monitoring. Also, learners' should be explicitly taught how to hold final stops in order to avoid excessive aspiration. Still, the present study showed that words containing the high front vowel should not be used to illustrate the concept of the syllable since it is a very problematic environment. Care should be taken in the choice of words as well as environments when preparing classes and designing instructional material.

Another way to avoid errors is by promoting opportunities of practice of appropriate linking and deletion. This way, the final /t/ and /d/ can be resyllabified with the first sound of the following word instead of with an epenthetic vowel. The results of the present study, in tandem with Koerich's (2002), have shown that learners tend to segment their speech since the environment where vowel epenthesis was more frequent was found to be vowels. Thus, by instructing learners to link words and training them on this process, much of vowel epenthesis instances could be avoided. Besides word intelligibility, rhythm and intonation also benefit from the avoidance of vowel epenthesis, since the insertion of an epenthetic vowel icreases the number of syllables.

Teaching words in connected speech rather than in isolation, besides being more authentic, is more beneficial for production as well as perception. The results of the present study have also indicated that gemination of alveolar stops is not a strategy that needs to be explicitly taught because it was often amongst all participants in the environments of alveolar stops and unreleased before affricates.

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.

7.3 Limitations and suggestions for further research

The first important limitation of this research was triggered by the 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 sounds chosen for preceding environments. 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, a larger variety of preceding environments should have been present on the research; however, the data gathering would have been too exhaustive for the participants and the transcription sections would have been be too long. Also, as a suggestion for further research, consonants as preceding environments could be studied.

A third important limitation was the absence of statistical tests on the combinations of preceding and following environments. A suggestion to surpass this limitation would be to run statistical tests using VARBRUL since it accounts for variability.

Vowel epenthesis being the third most frequent error, the quality of the epenthetic vowel could have been determined. Major (1987) for instance, found that transfer and developmental factors influence the quality of the vowel.

Also, many errors found in the present study seem to be conditioned by specific environments. Independent research could be conducted on the remaining data. The minor processes such as devoicing, as well as the subcategories of aspiration and palatalization could be studied in terms of phonological environment. Furthermore, concerning aspiration, degrees of intensity could be studied and the relationship with palatalization could be thoroughly analyzed and discussed.

Moreover, 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.

Finally, a new fruitful area has recently been set on the research of perception of an L2 as a condition for its production. The relationship between perception and production could be studied concerning markedness of the target sounds and the processes of vowel epenthesis and palatalization using the Categorial Discrimination Test (CDT) following the adaptations applied in Koerich (2002) as well as identification tasks.

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APPENDICES

Appendix A

	SEX	AGE	Q10	Q19	Q24	Q25	Q26	Q27	Q28	Q29	Q30/32	Q33	PAL BP
P1	M	19	Y	N	N	N	N	Y	N	N	SPA FRE	CURITIBA	+
P2	F	21	N	N	N	N	N	Y	N	N	N	FLORIANÓPOLIS	+
P3	M	19	Y	N	N	N	Y	Y	Y	Y	N	FLORIANÓPOLIS	+
P4	M	22	N	N	N	N	Y	Y	Y	N	SPA	CAMPOS NOVOS	-
P5	F	19	Y	N	Y	N	Y	Y	Y	N	N	USRUSSANGA	+
P6	F	21	N	N	N	N	Y	N	N	N	N	ARARANGUÁ	+
P7	M	20	Y	N	N	N	Y	Y	Y	N	SPA	FLORIANÓPOLIS	+
P8	F	17	Y	N	N	N	N	Y	N	N	N	LAGES	+
P9	F	20	Y	N	N	N	N	Y	Y	Y	ITA	JOINVILLE / MAFRA	-
P10	F	26	Y	N	-	-	N	Y	N	N	N	FLORIANÓPOLIS	+
P11	M	18	N	N	N	N	Y	Y	Y	Y	SPA	FLORIANÓPOLIS	+
P12	F	15	N	N	N	N	N	Y	Y	Y	N	FLORIANÓPOLIS	+
P13	M	47	Y	N	N	N	Y	Y	N	N	FRE	FLORIANÓPOLIS	-
P14	M	22	Y	N	N	N	Y	Y	Y	N	FRE	APUCARANA	+
P15	F	18	Y	N	N	N	N	Y	Y	N	SPA	PRESIDENTE GETÚLIO	+
P16	F	26	N	N	N	N	N	N	N	N	N	IMARUÍ	+
P17	M	21	N	N	N	N	N	Y	N	N	SPA	JOAÇABA	-
P18	M	23	Y	N	N	N	N	N	N	N	GER	JOINVILLE / MAFRA	-
P19	M	22	N	N	N	N	Y	Y	Y	N	SPA	BRUSQUE	+
P20	F	22	N	N	N	N	N	N	N	Y	ITA	CAITÚ	-
P21	F	21	N	N	N	N	Y	Y	N	N	SPA	CONCÓRDIA	-
P22	M	22	N	N	N	N	Y	Y	N	N	N	GOIANIA	+
P23	M	18	Y	N	Y	N	N	Y	Y	N	SPA	UNIÃO DA VITÓRIA	-
P24	M	18	Y	N	N	N	N	Y	Y	Y	N	GOIANIA	+
P25	M	19	Y	N	N	N	N	Y	Y	Y	N	BARRA BONITA	+
P26	F	20	Y	N	N	N	N	Y	N	N	SPA	SÃO JOSÉ	+
P27	M	24	Y	N	N	N	Y	Y	N	Y	-	GOIÁS	+
P28	F	18	Y	N	N	N	N	Y	Y	N	SPA	BELO HORIZONTE	+
P29	F	24	N	N	N	N	N	Y	N	Y	JAP	CASTRO	+
P30	F	20	N	N	N	N	N	Y	Y	Y	SPA	FLORIANÓPOLIS	+

SPA – SPANISH
GER – GERMAN
FRE – FRENCH
ITA – ITALIAN
JAP – JAPANESE

PALATALIZATION IN BP

(-) LESS THAN 25%
(+) MORE THAN 75%

Appendix B

Universidade Federal de Santa Catarina
Curso de Pós-Graduação em Inglês e Literaturas Correspondentes
Aluna: Profª Melissa Bettoni-Techio
Orientadora: Profª Drª Rosana Denise Koerich

IN:

QUESTIONÁRIO SOBRE PARTICIPANTES DE PESQUISA DE CAMPO

Por favor, responda às perguntas abaixo. Este questionário visa somente obter informações que serão utilizadas para direcionar a análise dos dados da pesquisa conduzida pela aluna acima citada. Em nenhuma hipótese os nomes dos participantes serão divulgados, pois se trata de uma pesquisa quantitativa. Solicito informar nome e telefone somente para, no caso de necessitar alguma informação adicional, poder entrar em contato com você posteriormente.

1. NOME: ________________________________ 2. DATA: __________

3. IDADE: ______________ 4. SEXO: FEM / MASC 5. TEL: __________

Responda às perguntas abaixo tendo em mente que o objetivo é traçar um perfil de seu contato com o inglês. Tente ser o mais específico/a possível. Faça qualquer tipo de comentário que julgar interessante para dar uma visão fiel deste contato.

6. Fez inglês no colégio? SIM / NÃO
7. Desde que série? ________________________________
8. Qual sua idade na época? ________________________________
9. As aulas exploravam comunicação escrita e oral?

____

10. Fez curso de inglês? SIM / NÃO
11. Qual curso/escola?

____

12. Em que ano começou? ________________________________
13. Em que ano terminou/parou? ________________________________
14. Quantas horas por semana tinha o curso em média? ____________________
15. Qual o curso de inglês que freqüenta no momento?____________________

16. Qual nível/semestre/fase que freqüenta no momento? __________________________

17. Quantas horas semanais têm este curso? ______________________________________

18. Quantas horas por semana, além do curso, você dedica ao estudo da língua inglesa / a atividades para aperfeiçoar seu inglês?

    ____

19. Tem vivência em país de língua inglesa? (mais de 1 mês) SIM / NÃO

20. Por quanto tempo? __________________ 21. Qual sua idade na época? _________

22. Freqüentou escola naquele país? SIM / NÃO

23. Que tipo de escola/ curso?

    ____

24. Conversa com freqüência em inglês com outros brasileiros? SIM / NÃO

25. Conversa com freqüência em inglês com falantes nativos? SIM / NÃO

26. Assiste filmes sem dublagem com freqüência? SIM / NÃO

27. Ouve música em inglês com freqüência? SIM / NÃO 28. Canta? SIM / NÃO

29. Transcreve (tira) letras de músicas? SIM / NÃO

30. Estuda, estudou, ou tem contato com outra língua estrangeira? SIM / NÃO

31. Em que contexto? (escola, na família...) ______________________________________

32. Qual língua? ____

33. Em que cidade foi criado/a? ____

34. Qual seu sotaque no português? (por exemplo: norte/ nordeste/sul do país, do estado)

    ____

35. Acrescente qualquer informação que julgar interessante

    ____

    ____

Universidade Federal de Santa Catarina
Curso de Pós-Graduação em Inglês e Literaturas Correspondentes
Researcher: Profª Melissa Bettoni-Techio
Adviser: Profª Drª Rosana Denise Koerich

IN:

QUESTIONNAIRE ABOUT RESEARCH PARTICIPANTS

Please answer the questions below.

This questionnaire aims only at gathering information that will help in the analysis of the research data. Under no circumstances will the names of the participants be revealed, as this research is strictly quantitative. I request your name and phone number only for the purpose of contacting you later in case more information is needed.

1. NAME: ________________________ 2. DATE: __________

3. AGE: ________ 4. SEX: FEM / MASC 5. PHONE: __________

Please, answer the questions below, bearing in mind that they will help to characterize your contact with English. Be as specific as possible. Add any comment that may be important to give a complete and accurate view of this contact.

6. Did you study English in high school? YES / NO

7. When did you start? ________________________

8. How old were you at the time? ________________________

9. Did the classes develop both written and oral expression?

____

10. Have you taken a language course? YES / NO

11. What course?

____

12. When did you start? ________________________

13. When did you finish/stop? ________________________

14. How many classes a week, on the average were devoted to the course? __________

15. What English course are you presently taking?

____

16. What level ? ______________________________

17. How many class hours a week are devoted to the course? ____________

18. How many hours a week, besides the course hours, do you dedicate to the study of English/to activities to improve your English?

____

19. Have you lived in an English speaking country? (longer than 1 m) YES / NO

20. For how long? ____________ 21. How old were you at the time? ______

22. Did you go to school there? YES / NO

23. What kind of school/ course was it?

____

24. Do you often speak English with other Brazilians? YES / NO

25. Do you often speak English with native speakers? YES / NO

26. Do you often watch films without dubbing? YES / NO

27. Do you often listen to music in English? YES / NO

28. Do you sing? YES / NO

29. Do you try to write the lyrics to the songs you hear? YES / NO

30. Do you study/have you studied/do you have contact with any other FL? YES / NO

31. In what context? (school, family...) ____________________

32. What language? ______________________________

33. Where did you grow up? ________________________

34. What is your regional accent? (in Portuguese)

____

35. Add any information about your contact with English you consider important.

Appendix C

SENTENCE READING TEST

Preceding environment: /✈▪ ✱▪ ⌐/● ▪ ● ▪ ⚲✲▪ ● /
Following environment:
/✈▪ ✱▪ ● ▪ ● ▪ ☨▪ ● ▪ ↘▪ ✤▪ ❂▪ ● ▪ ● ▪ ⚲▪ ● ▪ ⌐▪ ● 9▪ ↘☛▪ ● ▪ ● ▪
● ▪ 5/

●	d
✈ ● He has to eat more.	✈ ● They need my help.
✈ ✈ They never greet each other.	✈ ✈ I read easy books.
✈ ✱ They eat eggs.	✈ ✱ They need eggs.
✈ ● The meat offer is low.	✈ ● We need oranges.
✈ ● They eat peaches.	✈ ● They need pencils.
✈ ☨ Monkeys eat bananas.	✈ ☨ They need better houses.
✈ ✤ Bunnies eat carrots.	✈ ✤ Children need cooperation.
✈ ❂ This street garage is empty.	✈ ❂ My parents breed garlic.
✈ ↘ I eat delicious food.	✈ ↘ High speed destroyed her car.
✈ ● I eat turkey.	✈ ● They need total coverage.
✈ ● We eat soup in winter.	✈ ● I have to read several books.
✈ ● I'll meet zoo guards.	✈ ● We need zoo tickets.
✈ ● 9 I can eat chocolate.	✈ ● 9 I need chocolate every day.
✈ ↘☛ I meet John every Sunday.	✈ ↘☛ We need jobs.
✈ 5 I have sore feet.	✈ 5 He drives in high speed.
✈ ⚲ I eat four times a day.	✈ ⚲ We read fables.
✈ ● I'll meet Violet there.	✈ ● We need vacations.
✈ ● We have sweet lemonade.	✈ ● I read love stories.
✈ ●	✈ ●

We meet Nick there.	We need novelties.
✈ ▬ Home, sweet home.	✈ ▬ We feed horses.
∗ ✈ My pet eats a lot.	∗ ✈ The red eagle came back.
∗ ∗ I get eggs on Easter Day.	∗ ∗ The red egg is mine.
∗ ● I bet all I have.	∗ ● He’s fed all the animals.
∗ ● If you get tired, go home.	∗ ● The red tractor is faster.
∗ ✎ I let Dave drive.	∗ ✎ The red door is open.
∗ ♣ I met Ken on Monday.	∗ ♣ She has a red coat.
∗ ❁ You have to let go.	∗ ❁ The bread got cold.
∗ ● I let Peter win.	∗ ● My red pants are missing.
∗ † This net belongs to Sue.	∗ † The red bag is smaller.
∗ ● Her pet sings.	∗ ● My red socks are dirty.
∗ ● They let zebras free.	∗ ● The red zone is forbidden.
∗ ● 9 He let children in.	∗ ● 9 The red chair is on sale.
∗ ✎☛ They let John go.	∗ ✎☛ I have a red jacket.
∗ ● She met my sister.	∗ ● The dead mice are there.
∗ 5 I have a new pet.	∗ 5 I fell from my bed.
∗ 💡 I bet fifteen dollars on him.	∗ 💡 It has red feathers.
∗ ● He met Vanessa here.	∗ ● The red van was stolen.
∗ ● I let Luke in.	∗ ● Those red leaves are beautiful.
∗ ● We’ll get nowhere.	∗ ● Give me red napkins.
∗ ▬ This vet has a dog.	∗ ▬ I have a red house.
☞ 💡 She’s not famous.	☞ 💡 She has an odd father.
☞ ● He’s not very happy.	☞ ● This is an odd video.
☞ ● I got lucky.	● ● The tree has broad leaves.

She's got nothing.	He has an odd name.
I'm not hungry.	They nod happily.
It's a hot evening.	This is an odd e-mail.
What else do you see?	The fish's swollen the rod end.
There is hot oil in the pan.	They nod all the time.
This is the hot tap.	This cod tastes delicious.
Give me a hot dog.	The odd doctor is back.
I like hot caramel.	Even a clod can do it.
I'm not going with you.	Rod gained the game.
This is not possible.	It has an odd perfection.
He got bald.	RES is an odd bar.
I'm not sorry.	God save the queen.
She is not Zen.	This is a broad zoo.
I like hot chocolate.	I know Rod chose Ann.
He's not John.	This is an odd joke.
There's a lot more.	They play odd music.
This is too hot.	I know it's odd.
We fight for money.	She has tried four pies.
The light varies a little.	I'll have fried violets for lunch.
She's a bright lawyer.	She tried less than the others.
The light never ceases.	They fried nothing at all.
The right hill is higher.	They tried hurrying up.
This is a bright evening.	He tried each pie.
The night echoes are frightening.	He fried eggs for lunch.

This is the right order.	She tried all brands.
♀✻ ● She might take it again.	♀✻ ● They tried tomatoes and lettuce.
♀✻ ✎ The right door was open.	♀✻ ✎ She tried during one hour.
♀✻ ✤ The right cable is new.	♀✻ ✤ I like fried carrots.
♀✻ ❁ This is the right game.	♀✻ ❁ She tried getting up earlier.
♀✻ ● This is the right part.	♀✻ ● She fried potatoes.
♀✻ † He’s the right boy.	♀✻ † He tried both pies.
♀✻ ● He’s the right singer.	♀✻ ● He tried several doctors.
♀✻ ● You might zap the pizza.	♀✻ ● They tried zillions of times.
♀✻ ● 9 We have bright children.	♀✻ ● 9 I’ve tried chicken soup.
♀✻ ✎☛ This is the right job.	♀✻ ✎☛ She tied John’s hands.
♀✻ ● May is the right month.	♀✻ ● They tied monkeys.
♀✻ 5 He is very bright.	♀✻ 5 I’m sure she tried.
● ✈ The goat eats too much.	● ✈ The load equality is amazing.
● ∗ They coat eggs with chocolate.	● ∗ The road emptiness was amazing.
● ● I’ll take the coat or the blouse.	● ● They load oranges onto the trucks.
● ● There’s a boat to the island.	● ● The road tax is high.
● ✎ This goat dances.	● ✎ There’s a road deviation up ahead.
● ✤ This coat costs a fortune.	● ✤ This road can lead you home.
● ❁ This boat goes to the park.	● ❁ The toad got stuck.
● ● It’s in the coat pocket.	● ● She is a road police.
● † The coat buttons are loose.	● † There’s a toad behind you.
● ● The boat sank here.	● ● Turn at the road sign.
● ● The coat zipper is broken.	● ● This road zigzags.
● ● 9 This boat changed my life.	● ● 9 The road challenge is today.

● The goat joined the others.	● The toad jumped home.
● ● The boat moved away.	● ● I load meat onto the trucks.
● 5 This is my new coat.	● 5 Take the other road.
● This is a boat fever.	● This road forks near my house.
● ● The boat vanished away.	● ● They load various trucks.
● ● The boat leaves tomorrow.	● ● I load lemons onto the trains.
● ● His boat never arrives on time.	● ● This road never ends.
● This coat has to be mine.	● This road has many flowers.
● ✈ The doors shut easily.	● ✈ The stud eats grass.
● ∗ I like all stones but emeralds.	● ∗ It will bud every summer.
● ● Everyone is coming but Oliver.	● ● It can be a bud or a rose.
● ● I cut tomatoes for your salad.	● ● I gave a rose bud to Ann.
● He'll nut Dennis.	● Mud damaged the car.
● I cut carrots.	● Mud carried it away.
● The cut got bad.	● The mud goes to the sea.
● ● I cut pies for everybody.	● ● There's a mud puddle here.
● † I cut bananas.	● † There's mud behind the door.
● ● The cut swelled.	● ● It'll bud soon.
● ● This is a nut zebra.	● ● I have spud zillion times a day.
● ● 9 I cut chocolate for you.	● ● 9 Mud changed the garden.
● She can cut jelly.	● The mud joined the river.
● ● I will shut my mouth.	● ● The spud mom made is great.
● 5 We have a beach hut.	● 5 This is a marvelous bud.
● I have a gut feeling about it.	● I'll cook a spud for you.
● ●	● ●

I like all flowers but violets.	The bud violated the picture.
● ● I'll cut lemons.	● ● I'll have spud later.
● ● Dana is my nut niece.	● ● There's a pink bud now.
● She shut herself off.	● They threw mud here.

Appendix D

SENTENCE READING TEST

BRAZILIAN PORTUGUESE

1. Choveu a noi**te** toda.
2. Meu filho faz administração à noi**te**.
3. Eu **te** admiro muito.

4. Não me sinto apto para es**te** trabalho.
5. Para dor **de** garganta é bom lei**te** quen**te** com mel.
6. Ela é uma pessoa bastan**te** interessan**te**.
7. Eu considero matemática uma disciplina interessan**te**.
8. Experimen**te** o bolo **de** chocola**te** da minha mãe.

DISTRACTERS

9. Esta bolsa é nova.
10. Azul é a minha cor favorita.
11. Nós fomos ao cinema juntos.
12. Eu nunca tomo café da manhã.
13. Tenho muitos amigos, mas não os vejo com freqüência.
14. Gosto da atmosfera daqui.
15. Deixe-se levar pelo ritmo da música.
16. Eu não sei qual é a diferença entre advérbio e adjetivo.
17. Você tem que acessar a Internet.

Appendix E

SENTENCE READING TEST

Instructions

Este envelope contém o seguinte material para o teste:

2 blocos para leitura
1 folha cartão

1. Escreva seu nome legível no envelope.
2. Retire a fita do aparelho, escreva seu nome na etiqueta e devolva afita ao aparelho (ATENÇÃO PARA A POSIÇÃO DE ROLAGEM)
3. Não pressione nenhuma tecla.
4. Retire do envelope a folha cartão e o bloco preso com clips <u>VERDE</u>.
5. Deixe o bloco virado para baixo a sua frente.
6. Coloque o envelope no chão.
7. Você vai gravar sua leitura das sentenças contidas no bloco com clips VERDE de acordo com os seguintes passos:

- RETIRE O CLIPS DO BLOCO
- CUBRA AS SENTENÇAS COM O CARTÃO E VÁ CORRENDO O MESMO A MEDIDA QUE FOR LENDO CADA SENTENÇA
- LEIA CADA SENTENÇA UMA VEZ.
- HÁ PALAVRAS DESCONHECIDAS, NÃO É ESPERADA PERFEIÇÃO, LEIA COMO ACHAR QUE DEVE SER.

8. Após colocar o fone confortavelmente, ao comando da pesquisadora, pressione a tecla <DRILL> e proceda a gravação da sua leitura das sentenças.
9. Ao terminar sua leitura, pressione <STOP> e

COM O MÍNIMO BARULHO POSSÍVEL

10. Recoloque o clips no bloco que acabou de ler (não precisa organizar, é só juntar as folhas) e devolva o bloco ao envelope.
11. Pegue o bloco de clips VERMELHO e proceda da mesma forma, com o cartão, etc.

LEMBRE DE PRESSIONAR <DRILL>.

Grata pela colaboração.

SENTENCE READING TEST

Instructions

This envelope contains the following material for the test:

2 blocks for the reading test
1 card

1. Write your name on the envelope.
2. Remove the tape from the tape recorder, write your name on the tag of the tape and insert it in the tape recorder (ATTENTION TO THE POSITION OF THE TAPE)
3. Do not press any button.
4. Remove the card and the block with the GREEN clips from the envelope.
5. Leave the block with the backside up in front of you
6. Put the envelope on the floor.
7. You are going to record your reading of the sentences in the block with the GREEN clips. Follow these steps:

- REMOVE THE CLIPS
- COVER THE SENTENCES WITH THE CARD AND CONTINUE SLIDING THE CARD DOWN AS YOU PROCEED WITH EACH SENTENCE.
- READ EACH SENTENCE ONLY ONCE. YOU MAY REPEAT THE READING OF WORDS BUT DO NOT REPEAT ANY SENTENCE.
- THERE ARE SOME UNFAMILIAR WORDS. YOU ARE NOT EXPECTED TO READ PERFECTLY. READ THE WAY YOU BELIEVE TO BE CORRECT.

8. Set the earphone comfortably and, at the command of the researcher, press <DRILL> and start your recording of the sentences.
9. When you finish the reading, press <STOP> and

AS QUIETLY AS POSSIBLE

10. Put the clips back (it's not necessary to organize the sheets; just put them together). Put the block back in the envelope.
11. Take out the block with the RED clips and proceed as you did with the previous block using the card, etc.

REMEMBER TO PRESS <DRILL>

Thank you for your cooperation.

Appendix F

CODE	PROCESS
0	release no asp. + glottal stops
1	palatalization [● 9☑ or [✎☛☑
2	Vowel epenthesis
3	palatalization with vowel epenthesis
R4	Aspiration 4 (/t/ before pause)
4	aspiration <0.1s
R5	Aspiration 5 (/t/ before pause)
5	aspiration >0.1 and <0.2s
R6	Aspiration 6 (/t/ before pause)
6	aspiration >0.2s
7	aspiration + vowel epenthesis
8	voiced aspiration
9	voiceless palatalization for d [✎9]
10	deletion and gemination
11	flap between vowels
12	/● / into [✎☛☑ or /✎/ into [● 9☑
13	[🍁■ ❁■ 4[
14	[ts] or [ds]
15	[tz] or [dz]
16	devoicing
17	voicing
18	flap with epenthesis
19	[r]
20	voiceless interdental
21	Voicing with vowel epenthesis
22	Devoiving with vowel epenthesis
23	[●]
24	[💡]

Appendix G

Correspondence between SCN and pair of sounds

SCN (Hooper, 1976)	PAIRS
-2	(✎-● 9) (✎-✎☛)
-1	(● -● 9) (● -✎☛) (✎-●) (✎-●) (✎-✤)
0	(● -●) (● -●) (● -✤) (✎-†) (✎-✎) (✎-❁) (✎-❢) (d-⌓) (✎-●)
1	(✎-●) (✎-●) (● -†) (● -✎) (● -❁) (● -❢) (t-⌓) (● -●)
2	(✎-●) (✎-●) (● -●) (● -●)
3	(● -●) (● -●) (✎-●)
4	(● -●)
5	(✎-✈) (✎-✱) (✎-●)
6	(● -✈) (● -✱) (● -●)

SCN (Goldsmith, 1990)	PAIRS
-2	-
-1	-
0	(● -●) (● -●) (● -✤) (● -†) (● -✎) (● -❁) (✎-●) (✎-●) (✎-✤) (✎-†) (✎-✎) (✎-❁)
1	(✎-● 9) (✎-✎☛) (● -● 9) (● -✎☛)
2	(✎-❢) (d-⌓) (✎-●) (✎-●) (✎-●) (● -❢) (t-⌓) (● -●) (● -●) (● -●)
3	(✎-●) (✎-●) (● -●) (● -●)
4	(✎-●) (● -●)
5	-
6	(✎-✈) (✎-✱) (✎-●) (● -✈) (● -✱) (● -●)

Appendix H

Production per participant and phonological environment

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
	0	1	X	X	X	4	0	7	5	X	0	0	X	X	3
	5	13 4	1	X	X	X	X	X	5	7	X	X	X	1	X
	X	1	1	0	7	4	1	7	R4	6	0	0	5	1	1
	10	0	10	10	X	10	10	10	X	10	10	10	10	1	10
	3	3	0	10	0	0	10	3	10	10	10	10	10	7	10
	0	5	1	5	X	14	0	5	0	5	0	0	4	4	0
	5	5	1	5	5	X	0	5	0	1	0	10	0	2	0
	0	1	0	10	1	X	0	1	0	4	10	0	0	0	0
	0	5	1	0	5	X	0	7	0	1	X	0	5	0	0
	4	1	1	0	1	0	0	5	0	X	0	0	1	1	5
	5	1	3	X	1	1	4	7	4	X	0	0	1	1	1
	0	0	0	0	4	0	0	0	0	0	0	0	0	0	5
	0	13	0	0	15	5	4	1	X	X	0	0	0	5	5
9	10	5	0	7	10	10	10	X	10	X	10	14	10	2	1
	1	1	10	10	1	X	10	X	10	0	10	10	X	10	X
	X	5	1	X	1	13	4	7	X	5	0	0	X	2	2
	0	6	1	X	4	5	0	5	5	X	0	0	0	13 4	0
	0	1	1	5	1	0	0	1	0	4	0	0	X	4	0
	0	7	1	5	0	10	0	7	0	X	0	0	0	5	0
5	0	6	6	10	6	6	5	6	5	13	5	4	5	1	1
	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26	P27	P28	P29	P30
	1	X	X	4	X	X	X	2	1	X	5	1	X	0	0
	X	4	X	X	X	X	X	X	1	X	X	X	X	X	4
	1	0	X	11	2	3	1	7	4	5	1	5	5	4	5
	1	X	X	10	10	X	10	10	10	10	7	10	10	10	13
	1	10	10	10	10	1	10	7	1	10	X	10	10	10	1
	1	0	X	0	X	5	5	5	1	0	1	4	4	0	X
	1	X	5	0	0	6	0	4	1	0	5	0	0	0	1
	1	1	X	0	0	1	0	1	1	0	1	0	0	0	1
	1	0	0	0	0	X	4	4	0	0	5	0	0	0	1
	1	1	X	0	1	3	0	4	0	0	1	X	0	0	X
	3	5	X	5	3	4	1	1	1	5	1	1	1	3	1

	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
	0	5	X	0	0	6	0	0	X	0	0	0	X	0	0
	X	10	X	10	10	0	X	10	10	10	5	X	10	10	1
	0	10	10	10	5	1	10	10	10	10	10	0	10	10	4
	X	5	2	4	1	7	0	5	0	0	6	7	0	X	4
	3	0	X	4	13	5	X	4	0	13	5	1	X	0	1
	1	0	0	0	5	1	5	0	0	0	5	0	0	4	1
	1	0	X	0	X	3	5	0	1	6	1	0	1	0	0
5	1	6	X	0	5	6	X	6	1	5	6	4	5	0	1

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
	0	1	1	X	X	X	4	X	0	X	0	0	0	X	2
	X	0	1	X	0	1	4	4	0	6	0	X	0	X	5
	X	7	0	0	5	0	0	6	X	X	0	0	0	2	2
	0	4	X	10	X	10	10	X	10	5	10	10	X	10	10
	0	5	0	10	X	1	10	X	10	5	10	5	0	5	10
	5	5	X	X	X	1	4	X	0	5	0	4	0	0	5
	2	X	X	6	X	X	4	6	0	X	0	0	0	7	0
	0	4	X	10	X	0	0	X	0	X	X	0	0	0	0
	0	5	0	0	X	0	0	X	0	X	X	5	0	5	0
	5	X	X	X	12	17	0	1	12	X	0	X	0	1	1
	0	5	0	5	5	18	4	7	X	5	5	4	0	0	4
	0	X	1	X	X	X	0	X	X	X	0	0	14	0	0
	4	5	1	7	0	X	0	5	0	6	0	0	0	5	5
	10	0	X	10	X	10	10	X	10	X	10	10	X	1	X

• 9															
• •	0	0	X	10	X	X	10	12	10	X	10	X	0	10	X
•	0	0	1	X	5	X	0	5	0	0	0	0	0	21	5
• •	0	X	0	0	X	0	0	3	1	0	0	0	17	0	5
• •	0	5	X	X	X	0	0	0	0	X	X	0	0	0	0
• •	0	5	X	0	X	0	0	5	0	6	17	0	0	1	1
• 5	5	1	1	10	5	6	0	X	1	6	0	1	6	5	1
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
•	X	0	X	0	X	X	X	0	X	5	5	0	X	4	5
•	1	5	5	X	X	X	X	X	4	6	5	4	0	0	5
• •	1	5	7	0	0	X	X	0	0	5	3	4	0	0	4
• •	X	X	10	X	10	5	10	X	10	10	5	10	10	10	0
•	1	10	10	0	0	10	1	X	6	10	6	4	10	4	4
•	1	0	5	0	0	0	X	X	0	5	1	X	4	X	0
•	1	5	X	0	0	5	X	5	0	5	5	X	X	X	4
• •	1	5	5	X	0	0	5	X	0	0	4	0	X	0	1
•	1	0	0	X	0	4	X	X	0	4	5	0	0	0	0
•	1	5	X	0	X	0	X	X	0	0	1	5	0	1	X
• •	1	5	4	0	X	5	1	0	0	4	5	X	5	0	5
• •	1	6	0	X	0	0	X	X	0	X	0	0	X	X	0
• •	1	4	X	0	0	0	X	0	0	0	0	10	0	0	0
• • 9	X	10	X	X	10	10	X	0	10	10	10	10	10	10	10

• ✎	1	5	X	X	10	X	X	10	10	1	1	10	4	10	0
•	X	X	X	0	0	0	X	0	0	0	5	4	5	0	0
• •	X	0	6	X	0	5	5	17	1	4	6	0	0	X	0
• •	1	X	X	X	0	0	X	X	0	0	6	0	X	0	0
• •	1	0	5	0	0	5	X	0	0	5	5	1	4	1	5
• 5	1	6	X	0	X	4	0	6	6	1	1	5	4	6	1

•	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
✈ ✈	0	X	1	2	X	1	0	X	5	X	0	X	0	5	5
✈ ✱	2	5	0	0	0	1	0	5	0	X	0	6	0	7	2
✈ •	7	5	1	2	5	2	1	5	5	7	0	0	0	1	4
✈ •	5	6	1	X	14	10	5	6	4	X	10	10	10	10	10
✈ ✎	0	0	1	7	5	10	10	7	5	1	10	X	4	10	7
✈ 🍁	5	5	1	2	X	1	0	1	0	X	10	1	0	1	5
✈ ❁	0	5	3	5	0	1	0	3	0	5	0	1	X	0	0
✈ •	1	1	1	6	1	1	0	7	0	X	0	5	X	5	1
✈ †	0	5	4	2	0	5	0	2	X	5	0	6	0	0	0
✈ •	1	1	1	4	1	1	0	5	0	0	5	1	0	1	1
✈ •	5	5	1	5	X	5	0	5	5	5	4	1	5	4	4
✈ •	4	X	0	X	0	0	0	X	0	X	0	0	6	0	0
✈ •	0	5	0	5	X	6	0	X	6	6	0	5	6	5	7
✈ • 9	1	X	10	5	X	X	10	X	10	X	X	10	X	10	10
✈ ✎	1	1	0	X	1	10	10	3	10	10	0	10	10	X	10
✈	1	1	5	7	0	0	0	4	0	1	0	5	0	1	0
✈ •	0	1	0	X	0	0	0	7	4	6	0	4	X	0	0
✈ •	5	1	0	1	5	0	0	1	0	X	0	1	0	4	1
✈ •	1	1	1	X	X	6	0	0	1	5	0	1	X	4	5
✈ 5	6	6	1	10	6	6	5	6	6	6	6	6	5	5	6
•	**P16**	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
✈ ✈	1	X	6	6	4	X	X	4	0	6	5	0	X	X	5
✈ ✱	3	6	7	7	0	6	0	6	1	5	3	0	0	5	4
✈ •	1	0	7	0	21	7	X	0	1	1	1	1	4	4	4
✈ •	X	5	X	10	10	10	10	10	10	6	5	5	4	5	1
✈ ✎	3	0	10	10	10	10	10	10	10	5	1	0	10	10	4
✈ 🍁	X	0	1	0	1	X	6	5	0	1	1	4	0	4	4
✈ ❁	1	0	1	0	0	4	4	0	0	1	1	5	0	0	0
✈ •	X	0	2	X	5	0	2	4	1	X	5	4	0	1	5

✈ †	1	4	6	0	5	4	6	0	0	1	5	5	0	0	0
✈ 💡	1	0	X	0	X	P	X	1	0	1	1	0	0	4	4
✈ ●	1	X	7	6	1	4	6	5	1	0	X	X	5	X	4
✈ ●	1	0	7	0	X	7	5	0	0	0	0	0	0	4	6
✈ ●	1	6	X	0	0	0	0	0	X	0	0	3	0	0	0
✈ ● 9	1	10	7	10	10	10	10	10	X	10	X	0	10	X	4
✈ ✎	1	10	6	10	10	10	10	10	10	10	10	1	10	10	7
✈ ⬭	1	0	6	0	1	1	0	4	0	1	1	0	0	5	0
✈ ●	1	1	X	0	0	X	X	0	0	5	5	0	0	2	1
✈ ●	1	0	X	0	0	5	0	0	0	4	1	0	5	1	0
✈ ●	1	6	X	5	1	5	X	5	X	5	1	4	5	1	6
✈ 5	1	6	0	6	6	6	6	6	4	6	5	5	4	X	0

●	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
∗ ✈	0	X	1	X	X	5	0	7	5	0	0	0	0	X	5
∗ ∗	X	X	5	7	0	11	0	6	0	6	0	11	11	16	5
∗ ●	X	5	X	20	4	11	4	X	0	17	0	5	11	0	13 🍁
∗ ●	0	0	10	5	X	X	10	X	1	10	10	10	10	10	10
∗ ✎	0	6	0	5	6	17	10	10	10	5	10	0	X	10	10
∗ 🍁	0	X	X	X	0	X	0	X	X	X	0	X	X	X	0
∗ ❁	1	4	1	4	5	0	X	7	X	5	18	11	1	0	21
∗ ●	0	5	0	X	5	4	0	X	0	5	0	0	0	4	0
∗ †	0	0	5	5	X	4	0	0	0	0	10	0	0	2	0
∗ 💡	0	5	X	0	0	4	0	X	0	0	4	0	X	4	0
∗ ●	X	X	X	X	6	X	X	X	X	X	0	X	X	X	4
∗ ●	0	0	0	0	0	0	0	0	0	X	0	0	0	0	0
∗ ●	0	X	0	0	0	5	0	0	7	X	0	0	0	0	0
∗ ● 9	1	5	10	4	10	0	X	0	X	10	10	10	10	10	10
∗ ✎	0	5	0	0	5	10	10	7	10	10	10	10	10	2	10
∗ ⬭	0	5	3	7	X	0	0	1	X	X	0	0	6	X	6
∗ ●	5	5	0	X	5	X	0	5	0	5	17	0	0	0	4
∗ ●	X	X	X	X	X	X	0	X	X	X	17	X	X	X	0
∗ ●	0	5	1	7	X	0	0	6	0	0	0	0	X	4	0
∗ 5	6	6	1	6	6	6	X	5	1	6	0	6	6	5	0
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
∗ ✈	1	14	X	5	2	X	X	0	0	5	5	0	0	0	X
∗ ∗	1	0	0	0	0	X	X	0	0	X	5	5	0	0	0
∗	1	5	2	0	0	7	X	5	0	11	5	11	0	4	4

•															
* •	1	X	X	10	X	10	X	X	10	0	10	10	10	X	1
*	1	6	10	10	0	X	6	X	0	17	5	10	10	4	5
*	1	X	5	X	4	X	X	X	0	5	X	X	X	X	X
*	1	0	0	1	1	0	0	4	0	X	5	X	0	0	4
* •	1	5	5	X	0	5	X	4	0	0	5	4	0	4	5
* †	1	X	5	0	0	X	X	0	0	0	X	5	0	0	4
*	3	X	5	5	1	0	0	X	0	4	5	0	X	0	0
* •	1	X	2	X	6	5	X	X	0	6	5	0	0	X	X
* •	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
* •	0	0	0	17	0	0	0	0	0	0	0	0	0	0	4
* • 9	10	X	10	10	5	10	10	10	10	10	10	4	10	10	4
*	7	5	10	10	10	10	6	10	10	10	5	1	10	10	10
*	1	5	0	0	X	5	X	4	X	4	1	5	X	X	0
* •	1	0	5	0	0	5	5	X	0	6	5	4	5	5	5
* •	X	X	5	X	5	X	X	X	X	5	6	X	X	X	X
* •	1	0	X	17	0	5	X	0	0	21	5	0	0	0	14
* 5	1	X	7	6	0	6	6	4	0	5	5	5	5	5	6

•	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
•	7	5	1	X	0	0	0	5	5	X	0	0	X	X	0
• *	X	7	1	2	0	11	11	X	11	0	11	11	0	11	0
• •	3	X	1	5	7	11	4	7	5	X	0	5	0	3	6
• •	0	1	1	X	10	10	10	0	1	10	10	10	10	10	0
•	1	0	1	0	5	0	10	10	10	10	10	X	0	10	10
•	1	4	0	X	4	1	4	5	1	X	0	5	X	18	0
•	1	5	1	6	5	4	0	X	0	4	0	0	0	0	0
• •	0	5	1	4	X	4	0	1	0	0	10	0	0	0	0
• †	0	5	5	4	7	4	4	5	0	0	0	0	0	0	0
•	0	4	1	0	5	4	0	X	0	0	0	0	4	4	5
• •	5	5	3	X	X	0	4	1	5	0	0	0	4	1	0
• •	0	0	0	0	0	0	0	0	X	0	0	0	0	0	0
• •	4	0	X	5	14	5	0	0	0	0	0	0	X	0	0
• • 9	X	0	0	5	10	0	10	X	10	X	10	10	X	X	X
•	10	6	1	5	10	0	10	5	10	10	10	10	10	10	10

•	0	5	1	5	X	3	0	5	6	7	0	0	X	X	X
• •	0	4	1	6	7	0	0	6	1	X	0	0	0	0	4
• •	0	0	0	0	0	X	0	4	0	0	X	0	0	17	X
• •	0	5	1	0	5	0	0	1	0	X	0	0	0	0	0
• 5.	6	6	1	6	6	6	5	6	1	6	10	6	5	6	0
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
• ✈	1	5	X	X	0	X	X	X	0	X	5	0	5	7	0
• *	19	0	0	X	0	19	5	11	0	11	1	X	11	11	0
• •	1	4	X	0	0	X	5	0	4	1	5	0	0	7	4
• •	1	10	5	10	10	5	X	5	10	10	5	4	10	10	1
•	1	10	10	10	0	1	10	10	10	10	5	10	10	10	4
•	X	0	X	0	4	4	X	5	4	5	5	4	0	5	4
•	1	0	7	0	4	4	0	2	4	0	5	0	0	0	4
• •	1	1	5	0	0	0	0	0	0	0	5	0	0	0	0
• †	1	0	0	0	0	4	0	5	0	0	4	17	4	0	4
•	1	0	0	0	1	4	0	0	0	0	1	0	0	0	0
• •	1	5	7	0	5	5	1	0	0	0	5	1	0	0	0
• •	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
• •	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0
• • 9.	X	10	10	10	10	X	10	10	10	10	X	10	10	10	X
•	1	0	5	10	0	5	10	10	10	10	10	10	10	10	0
•	X	0	6	0	X	5	0	5	1	5	X	1	0	0	X
• •	5	0	0	X	4	5	0	0	0	17	X	17	0	0	0
• •	0	X	4	0	0	5	6	0	0	0	5	0	0	0	4
• •	0	0	17	0	X	X	X	0	0	17	0	0	0	0	4
• 5.	1	6	1	5	0	4	4	0	0	1	6	0	4	14	6

•	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
• ✈	5	X	X	X	X	X	X	1	X	X	10	6	17	X	X
• *	7	1	3	X	1	5	X	X	0	6	10	0	2	2	0
• •	1	5	1	X	1	X	X	6	5	1	0	1	0	1	1
• •	X	X	1	X	X	6	X	1	1	10	10	1	10	X	10
•	X	17	X	X	X	0	X	3	10	X	10	0	10	3	1
•	1	X	1	X	X	0	X	1	0	0	0	5	0	0	X
•	1	1	X	2	3	1	0	X	0	1	0	0	7	7	X

❁															
• •	4	1	X	4	X	X	X	1	0	1	10	1	0	2	1
• †	1	X	1	X	1	X	0	1	0	1	X	4	X	7	X
• ♀	X	1	1	X	6	1	0	1	0	4	0	X	0	4	1
• •	5	5	X	X	5	X	X	3	5	1	0	0	6	X	1
• •	0	5	X	X	X	0	X	X	X	0	0	0	0	0	0
• •	X	4	X	7	0	X	X	X	0	1	0	0	0	0	X
• • 9	X	1	X	X	1	10	10	1	X	10	5	10	10	1	10
•	X	1	X	X	X	3	X	1	0	X	0	10	10	10	X
•	0	1	X	X	X	4	0	1	1	1	0	0	5	1	5
• •	0	5	X	X	0	X	X	5	X	5	0	5	5	0	5
• •	5	1	X	X	5	X	4	1	X	5	0	1	0	4	5
• •	1	1	X	X	5	10	X	5	0	0	0	0	0	4	0
• 5	6	6	1	X	1	1	X	6	6	1	6	6	6	5	1
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
• ✈	X	0	X	X	X	2	X	0	X	X	5	X	0	X	4
• *	1	X	X	0	5	7	X	0	0	X	1	4	X	1	R4
• •	1	X	X	1	5	X	X	0	0	1	1	1	6	1	5
• •	X	6	X	1	X	X	X	X	10	X	3	X	5	1	5
•	X	10	X	10	10	5	X	5	10	10	X	X	X	0	4
•	1	X	X	0	1	5	X	0	0	X	X	1	5	0	4
• ❁	1	5	X	0	1	0	1	6	4	1	4	5	0	0	5
• •	1	X	5	0	0	0	X	5	1	X	5	5	0	0	4
• †	1	X	X	0	5	5	X	4	0	2	5	X	0	X	4
• ♀	1	5	X	0	1	1	X	0	1	5	0	1	0	0	4
• •	X	5	X	X	1	X	X	5	0	X	1	X	4	X	0
• •	1	6	X	0	0	0	0	0	0	4	0	0	4	0	0
• •	1	0	X	17	0	0	X	X	0	0	0	0	0	X	0
• • 9	1	5	X	10	X	X	10	10	10	10	10	10	10	10	5

	1	X	X	1	10	7	X	10	1	X	4	X	10	10	5
	1	X	X	0	5	5	X	0	4	7	6	0	0	X	0
	1	0	X	7	0	5	X	5	0	X	5	X	4	0	2
	1	0	X	0	0	f	5	5	0	1	5	X	4	0	4
	1	5	X	0	0	3	1	5	4	1	5	4	0	0	0
5	1	6	5	6	5	1	X	5	0	1	6	1	5	1	5

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
	6	5	X	2	X	2	0	X	X	X	0	0	0	16h	0
	2	0	X	2	4	X	0	X	0	X	0	0	0	0	2
	0	2	1	X	3	0	0	4	2	0	X	0	0	0	0
	2	0	0	10	10	0	10	2	X	10	10	X	2	2	10
	7	2	10	10	10	X	10	X	10	X	10	10	10	X	10
	2	4	X	14	X	X	0	9	X	X	0	0	0	2	4
	2	5	1	4	0	2	0	2	0	0	134	0	0	0	134
	4	0	1	2	X	X	0	2	0	0	0	0	X	0	0
	5	8	0	X	X	2	0	X	4	X	10	4	0	0	0
	2	4	1	4	3	1	0	3	0	X	0	0	0	0	2
	X	8	1	X	X	X	0	2	0	X	0	0	X	8	0
	0	4	0	0	0	0	2	X	0	0	0	0	0	0	0
	2	X	0	X	0	0	0	7	0	X	0	0	0	0	2
9	6	2	0	8	X	0	10	4	10	X	10	10	0	0	10
	10	1	X	1	10	0	10	0	0	X	10	10	10	10	10
	2	7	10	2	X	X	X	2	X	X	0	0	X	X	2
	2	0	0	0	0	X	0	0	0	0	10	0	0	0	0
	X	4	X	4	7	0	0	3	0	X	10	0	X	X	0
	X	0	10	2	X	X	0	X	0	X	0	0	X	2	0
5	6	4	1	X	X	X	0	7	0	6	0	0	0	0	0
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
	X	0	X	0	0	X	X	0	0	0	5	0	X	0	0
	1	X	X	0	X	X	0	0	0	0	X	4	X	X	5
	3	0	X	0	0	0	X	0	4	0	7	0	0	0	0
	3	X	X	0	2	10	5	10	10	10	10	10	5	10	10

♀☼ ✎	3	2	X	10	10	10	0	10	10	10	7	10	X	10	4
♀☼ 🍁	X	0	X	0	0	X	X	0	X	9	X	X	0	0	X
♀☼ ❁	3	0	X	2	X	5	0	134	0	0	0	0	0	0	0
♀☼ ●	9	0	X	0	0	5	4	0	0	0	X	0	5	0	0
♀☼ †	9	0	X	0	0	0	4	0	0	0	5	0	0	0	X
♀☼ 💡	2	0	X	0	2	0	0	5	0	0	0	4	0	0	X
♀☼ ●	3	4	X	2	9	X	X	0	0	0	5	4	0	0	X
♀☼ ●	3	0	2	0	0	0	0	0	0	0	X	0	0	0	0
♀☼ ●	2	0	X	0	0	5	X	0	0	0	0	0	2	0	14
♀☼ ● 9	10	0	X	10	10	10	X	10	10	10	X	10	10	10	4
♀☼✎	3	X	X	10	10	0	10	10	10	4	10	10	10	10	10
♀☼ ⬭	3	5	X	2	X	7	X	5	2	2	2	2	2	0	0
♀☼ ●	9	0	0	0	2	0	0	5	0	0	0	0	0	0	0
♀☼ ●	1	X	X	0	0	1	X	0	X	0	0	X	4	0	X
♀☼ ●	X	0	X	0	0	9	0	X	X	X	0	2	2	0	4
♀☼ 5	9	X	5	0	0	0	5	0	0	0	5	0	5	0	4

✎	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
* ✈	2	X	X	2	X	X	0	7	X	X	0	0	0	2	2
* *	0	3	3	0	7	0	0	2	0	2	4	0	2	0	0
* ●	0	X	X	X	X	2	0	X	X	X	0	0	0	X	X
* ●	2	8	1	8	1	4	0	9	10	X	0	0	0	2	10
* ✎	2	3	3	X	2	10	10	2	10	X	10	10	10	2	10
* 🍁	2	4	1	2	0	0	0	9	5	X	0	0	0	4	0
* ❁	2	5	3	X	X	2	0	2	X	X	0	0	0	2	0
* ●	0	4	0	0	0	0	0	5	0	0	0	0	0	2	0
* †	0	2	0	X	5	0	0	0	0	X	0	0	0	2	0
* 💡	0	4	1	5	7	2	0	2	0	0	0	0	0	2	4
* ●	5	7	0	8	0	2	0	7	0	X	0	0	0	2	0
* ●	0	4	0	0	5	0	0	6	X	0	0	0	0	X	0
* ●	0	4	0	0	0	0	0	X	2	0	0	0	0	2	0
* ● 9	0	1	0	7	9	1	10	9	10	X	10	10	X	2	X
* ✎ ☛	0	1	3	2	10	10	10	9	10	0	10	10	10	X	10
* ⬭	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
* ●	0	0	1	6	0	0	0	0	0	0	0	0	0	0	X

* ●	X	X	X	14	2	X	0	X	X	X	0	0	0	2	0
* ●	2	4	1	6	7	0	0	0	V	0	0	0	0	16h	0
* 5	4	6	1	6	0	5	0	5	5	6	0	6	0	5	0

	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
* ✈	X	0	X	16	0	X	X	X	0	0	7	0	0	2	4
* *	9	5	2	0	0	0	0	2	0	0	7	0	0	0	0
* ●	9	X	2	0	X	X	X	X	X	2	14	0	X	X	0
* ●	1	10	2	0	0	X	0	0	10	10	5	8	10	10	4
* ✎	1	10	10	10	10	10	10	0	10	10	3	2	10	10	0
* 🍁	9	0	7	0	6	4	4	4	0	1	4	0	0	0	5
* ❁	3	0	0	0	7	0	X	0	0	0	9	X	0	4	5
* ●	1	0	0	0	0	4	X	2	0	0	4	0	0	0	0
* †	9	0	2	0	0	X	0	0	0	0	2	0	0	0	0
* 💡	1	0	2	0	X	9	X	0	4	2	5	2	0	0	2
* ●	3	5	X	0	4	0	0	0	0	0	5	2	0	0	2
* ●	2	0	0	0	0	X	X	0	0	0	0	0	5	0	0
* ●	3	0	X	0	0	2	0	0	0	0	0	2	0	0	0
* ● 9	X	10	0	10	2	10	10	10	10	10	10	9	10	10	10
* ✎	3	10	10	X	10	X	10	10	10	10	9	1	10	10	0
* ⊖	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
* ●	1	0	X	0	0	0	5	X	0	0	8	0	0	0	0
* ●	X	0	X	X	X	X	0	0	0	0	X	X	0	X	X
* ●	9	0	2	0	0	0	X	4	0	0	7	0	0	2	0
* 5	9	6	6	5	0	0	4	5	0	6	5	0	4	6	0

✎	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
✈ ✈	0	X	X	2	5	0	0	2	2	2	0	0	0	X	2
✈ *	2	16	0	2	2	2	0	4	2	2	0	0	0	2	0
✈ ●	2	4	3	2	7	2	0	2	2	2	0	0	0	2	2
✈ ●	0	7	1	8	X	0	10	7	10	4	10	9	10	2	10
✈ ✎	X	X	13❁	2	5	X	0	3	13🍁	X	10	10	5	12	10
✈ 🍁	2	3	1	2	5	4	0	2	3	14	0	5	0	X	2
✈ ❁	0	3	3	X	9	X	0	2	0	2	0	0	X	10	2
✈	4	7	1	2	9	3	0	2	0	X	0	0	2	2	4

●															
✈ †	4	3	0	10	2	3	0	2	0	0	0	0	0	1	8
✈ ♀	8	5	1	7	7	2	0	3	0	X	4	0	X	2	X
✈ ●	0	4	1	2	2	2	X	3	9	4	0	0	0	2	2
✈ ●	2	X	0	2	X	0	0	7	0	16	0	0	X	2	0
✈ ●	0	1	0	0	0	X	0	2	0	0	0	0	0	0	2
✈ ● 9	3	0	0	10	10	3	0	X	10	X	0	10	10	10	9
✈ ✎	2	14	X	10	1	0	10	10	10	2	10	10	10	1	10
✈ ⬭	0	14	0	2	3	0	2	5	1	0	0	0	0	X	2
✈ ●	2	2	1	10	0	0	0	0	0	0	0	0	0	0	0
✈ ●	0	8	0	0	X	0	0	0	0	2	0	0	0	0	0
✈ ●	5	4	1	2	3	0	0	2	0	5	0	0	X	2	2
✈ 5.	0	1	1	10	6	1	0	5	5	134	0	4	0	5	0
✎	**P16**	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
✈ ✈	X	X	2	X	0	2	X	0	0	0	8	5	0	2	2
✈ *	3	0	2	0	5	2	X	0	2	0	5	X	15	2	0
✈ ●	3	0	2	2	0	2	5	2	0	0	9	2	0	9	0
✈ ●	X	0	10	10	10	10	6	10	10	10	3	10	10	10	4
✈ ✎	9	10	X	10	0	4	0	10	10	10	5	0	0	2	0
✈ 🍁	3	0	7	X	X	0	4	0	4	0	5	0	0	4	0
✈ ❁	9	X	X	X	4	0	X	2	0	0	3	X	5	2	2
✈ ●	1	0	2	0	0	0	16	0	0	0	5	0	14	4	8
✈ †	9	0	2	0	5	4	0	0	0	0	3	2	0	0	0
✈ ♀	1	0	X	X	X	0	6	X	16	0	7	X	0	4	X
✈ ●	3	5	2	0	9	2	0	1	0	2	3	0	0	2	2
✈ ●	1	X	X	0	0	5	X	0	0	0	0	0	0	0	0
✈ ●	12	0	2	0	0	0	0	0	0	0	0	2	0	0	0
✈ ● 9	X	10	X	0	2	10	10	10	10	10	0	10	10	10	0
✈ ✎	X	10	10	10	10	10	10	10	10	10	14	10	10	10	2
✈ ⬭	3	0	2	4	2	2	0	4	0	0	9	2	0	2	2
✈ ●	9	0	X	X	0	0	5	0	0	0	9	X	0	0	0
✈ ●	9	X	X	0	0	0	0	0	0	0	0	0	0	0	0
✈ ●	3	0	2	X	3	3	X	X	0	0	9	2	0	2	0
✈ 5.	9	0	9	0	0	0	X	0	0	0	5	0	0	5	9

✎	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15
• ✈	2	X	0	2	X	2	0	X	0	X	7	X	X	X	X
• *	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0
• •	0	2	X	0	5	X	4	X	X	X	0	4	0	X	X
• •	X	X	X	X	0	X	0	X	9	X	0	X	X	5	X
• ✎	2	0	X	10	X	X	10	X	10	X	0	X	10	X	X
• ✤	X	X	X	X	X	2	X	X	X	X	0	X	X	X	X
• ❁	8	X	3	2	X	X	0	3	X	X	4	0	0	2	2
• •	0	X	0	X	X	2	X	X	0	X	0	X	0	2	X
• †	0	0	0	X	X	0	0	X	0	X	0	X	0	0	X
• ♀	4	X	X	X	X	2	0	X	0	X	X	X	0	2	X
• •	4	0	X	2	X	X	2	X	7	X	0	X	0	X	X
• •	0	X	X	0	0	X	0	X	X	X	0	0	0	0	0
• •	X	X	0	0	X	X	0	X	X	X	X	X	0	X	0
• • 9	0	X	X	8	16	X	X	X	0	10	X	X	X	5	0
• ✎☛	10	5	X	2	X	X	10	X	0	10	10	X	10	7	X
• ⌒	0	4	0	2	6	16	5	X	0	X	0	0	0	X	4
• •	0	X	X	2	X	X	0	X	16	X	X	X	6	X	0
• •	1	4	X	X	X	0	0	X	X	0	0	X	0	4	0
• •	0	X	X	0	X	0	0	X	0	X	0	X	0	0	X
• 5	6	4	X	6	6	6	X	X	5	X	0	X	X	X	0
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
• ✈	9	X	X	X	X	X	5	0	X	X	X	0	0	2	4
• *	X	X	0	0	0	X	0	X	0	0	X	0	X	X	0
• •	0	X	2	0	X	X	X	X	0	0	5	0	0	X	5
• •	X	0	X	X	X	X	X	X	10	10	X	4	0	0	8
• ✎	1	10	6	10	10	10	10	10	10	1	3	10	10	10	8

• 🍁	X	X	X	X	0	X	X	0	X	0	X	4	X	0	X
• ✿	9	0	2	0	4	X	X	X	0	0	5	X	X	0	0
• •	1	0	2	0	X	12	X	0	0	X	4	3	X	X	0
• †	1	0	6	0	X	X	0	X	X	X	5	2	0	0	0
• 💡	9	5	5	X	5	5	0	0	0	X	5	X	0	4	0
• •	3	0	5	0	9	7	X	0	0	0	7	X	0	0	2
• •	X	0	X	0	X	X	0	X	0	0	0	0	X	0	0
• •	1	X	14	X	0	0	0	0	0	0	X	X	X	0	0
• • 9	X	X	2	0	X	X	X	0	10	X	X	2	10	10	2
• ✎	10	10	6	X	10	10	0	0	10	10	2	1	X	10	10
•	3	X	2	X	X	X	0	0	0	2	4	0	16	X	16
• •	0	5	X	0	0	X	X	X	X	0	X	X	X	X	X
• •	9	0	X	0	5	0	X	0	0	0	5	0	0	0	0
• •	0	0	2	0	0	4	X	X	0	0	X	0	X	2	0
• 5	X	5	X	X	0	X	5	6	0	6	5	0	4	6	4

✎	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
• ✈	0	X	1	2	X	X	X	X	X	X	X	X	X	X	0
• ∗	X	0	1	X	X	X	0	3	0	2	0	X	0	2	4
• •	X	4	X	X	X	3	0	X	0	6	0	0	0	2	0
• •	0	4	X	10	5	X	0	X	10	5	0	0	10	2	10
• ✎	0	0	1	X	X	10	0	2	5	0	10	10	2	2	10
• 🍁	2	1	1	2	0	X	0	9	0	4	4	4	0	X	4
• ✿	X	4	X	X	X	X	X	X	X	9	0	4	X	0	0
• •	X	1	1	X	5	X	X	9	0	0	0	0	X	4	4
• †	2	4	X	X	9	X	0	X	X	16	0	0	0	2	2
• 💡	8	1	1	X	9	2	X	4	5	0	10	1	0	2	9
• •	X	4	2	X	X	2	0	X	X	0	2	0	0	0	9
•	0	0	X	0	0	X	0	0	0	0	0	0	0	0	0

•															
• •	0	4	0	X	0	0	0	3	2	0	0	0	0	0	2
• • 9	0	3	X	X	X	0	X	X	X	X	0	10	X	1	X
•	X	X	X	X	10	X	X	X	X	10	10	10	10	10	10
•	2	1	1	9	3	2	0	X	7	0	0	0	0	X	2
• •	X	7	X	8	0	0	0	X	X	0	0	10	0	0	0
• •	1	4	X	X	0	2	0	X	0	5	0	X	0	4	X
• •	3	3	1	X	0	X	0	0	0	2	0	0	X	4	0
• 5	6	X	1	6	9	9	4	9	5	16h	X	5	0	6	0
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
•	X	X	X	0	1	X	X	X	X	X	X	X	X	X	0
•	3	4	X	2	X	3	X	4	0	0	4	1	0	2	2
• •	X	0	2	0	2	2	0	0	0	8	7	1	X	0	2
• •	1	10	X	10	10	10	10	10	0	10	5	4	10	0	8
•	9	X	X	10	X	X	X	10	10	4	7	10	10	4	2
•	1	0	X	0	4	4	4	4	0	2	5	2	0	0	0
•	10	0	X	X	0	X	X	0	0	2	16	0	5	X	4
• •	9	0	X	0	X	0	4	0	0	0	X	2	0	0	4
• †	1	X	2	0	0	X	X	0	0	0	4	2	0	X	4
•	1	5	X	0	9	4	5	0	0	0	0	2	2	9	5
• •	9	5	X	0	4	0	X	7	0	0	7	X	X	2	X
• •	9	X	X	0	X	X	0	0	0	0	0	0	0	0	0
• •	1	0	X	X	8	0	0	0	0	0	0	2	0	0	0
• • 9	X	10	X	10	X	10	X	10	10	10	X	1	10	10	2
•	X	10	X	0	10	X	X	10	10	X	X	4	10	X	5
•	3	4	X	0	4	X	0	0	0	2	0	2	0	2	2
• •	9	0	0	0	X	0	0	0	0	0	X	0	0	0	0
• •	9	0	2	0	0	X	0	0	0	0	0	0	0	X	0
• •	1	0	X	0	0	X	0	0	0	0	4	•	0	0	0
•	9	0	X	5	0	4	0	6	0	4	6	4	5	6	5

5															

✎	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**	**P15**
• ✈	0	X	X	2	X	0	0	2	0	X	0	0	2	5	X
• *	2	4	3	0	22	2	0	2	16	4	0	0	16	2	0
• •	2	X	X	X	16	X	4	X	0	X	0	0	X	2	2
• •	0	0	10	X	X	X	10	5	X	X	X	0	X	16	10
• ✎	2	0	0	X	X	0	0	2	10	X	10	10	0	2	0
• ♣	2	4	1	2	X	1	0	X	0	0	0	4	0	2	5
• ❁	2	5	1	2	X	2	4	X	5	X	0	0	X	2	0
• •	0	2	1	2	X	X	0	2	5	X	0	0	✎•	2	X
• †	0	8	X	2	X	0	0	2	0	X	0	0	0	0	0
• •	X	X	X	2	X	X	0	X	0	X	0	X	X	X	4
• •	2	4	1	2	5	X	0	2	0	0	X	0	0	X	2
• •	0	X	X	2	X	0	0	2	0	0	0	0	0	2	0
• •	0	0	X	2	X	X	0	X	0	X	X	0	0	0	0
• • 9	1	5	X	8	X	X	10	0	10	0	0	0	10	2	10
• ✎	0	X	X	X	X	0	10	9	X	X	10	10	10	2	10
•	0	7	X	2	X	X	0	0	X	14	0	0	X	2	4
• •	0	0	X	12	X	X	0	X	0	X	0	0	0	0	X
• •	0	X	X	2	5	0	0	X	0	X	X	0	X	2	0
• •	0	0	X	0	X	0	0	0	0	X	0	0	0	0	0
• 5	2	6	1	0	5	5	X	6	5	6	0	6	0	16	4
	P16	**P17**	**P18**	**P19**	**P20**	**P21**	**P22**	**P23**	**P24**	**P25**	**P26**	**P27**	**P28**	**P29**	**P30**
• ✈	X	0	X	X	2	X	X	X	0	0	X	2	X	X	2
• *	9	0	16	11	0	0	X	4	0	X	4	16	0	0	16
• •	3	0	X	2	0	22	X	0	0	2	9	0	0	0	4
• •	X	0	16	10	X	X	X	X	X	2	5	10	0	5	0

•	9	0	2	10	X	X	10	0	10	10	5	X	X	6	0
•	9	0	X	0	4	5	X	0	9	10	5	1	0	4	4
•	X	0	X	X	4	9	X	X	4	X	9	9	X	0	2
• •	X	0	X	0	0	5	X	0	0	0	5	2	X	1	X
• †	1	X	X	0	0	2	X	0	0	0	0	X	0	X	0
•	X	0	X	X	0	X	X	0	X	0	0	0	0	X	0
• •	9	4	22	5	X	2	X	X	16	2	3	3	X	X	0
• •	0	0	4	X	0	X	0	0	0	0	0	0	0	0	0
• •	X	0	X	0	0	0	X	X	X	0	0	0	0	0	0
• • 9	2	0	10	10	10	X	10	10	10	10	3	10	10	0	4
•	X	10	X	0	10	10	X	10	10	10	5	10	0	X	2
•	3	0	X	0	5	2	X	0	4	0	7	X	0	0	5
• •	9	0	7	0	0	5	X	X	0	0	X	0	X	X	4
• •	X	0	2	X	0	5	X	X	4	0	X	0	X	X	9
• •	1	0	X	0	0	0	0	0	0	0	4	5	0	0	0
• 5.	9	0	6	0	0	0	5	0	0	4	6	16	4	6	5

Appendix I

She is not Zen.

I let Peter win.

They tried hurrying up.

They load various trucks.

I’m sure she tried.

The boat leaves tomorrow.

We need zoo tickets.

I’ll meet Violet there.

We meet Nick there.

I read love stories.

I’ve tried chicken soup.

She met my sister.

He’s the right singer.

Take the other road.

God save the queen.

This is not possible.

He tried both pies.

He tried each pie.

She shut herself off.

I know it’s odd.

Give me red napkins.